www.zcyphygeodesy.com

Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China

The basic principles, main formulas and important methods of geodesy on the deforming Earth have been included in ETideLoad4.5 to improve higher education environment.

Program examples for Earth Tide, Load Effect and Monitoring Computation

- Analytically compatible geodetic and geodynamic algorithm package using the numerical standards unified and geophysical models coordinated
- Compatible with and improved the IERS conventions, some geodetic concepts clarified, all the algorithms derivated and verificated completely
- Uniform computation of solid tidal, load tidal, polar shift and mass centric variation effects on all-element geodetic variations in whole Earth space
- Analytical computation of surface load effects on all-element geodetic variations and collaborative monitoring of time-varying Earth gravity field
- Geodetic monitoring of the surface hydrological environment and ground stability variations and prediction of their spatio-temporal evolution

Classroom Teaching Self-Exercise Science Research Engineer Computing

Earth Tide, Load Effect and Deformation Monitoring Computation

ETideLoad4.5

Chinese Academy of Surveying & mapping
October 2024, Beijing, China

Computation of various tidal and polar shift effects on all-element geodetic variations

- Computation of solid tidal effects on various geodetic variations outside solid Earth
- Spherical harmonic synthesis on ocean tidal load effects outside solid Earth
- Spherical harmonic synthesis on atmosphere tidal load effects outside solid Earth
- Computation of Earth's rotation polar shift effects on geodetic variations and tidal effects on EPR
- Computation of the permanent tidal and Earth's mass centric variation effects on geodetic variations
- Computation of solid Earth and load tidal effects on geodetic networks
- The regional approach of load tidal effects by load Green's Integral
- Forecast of various tidal effects on surface all-element geodetic variations

Processing and analysis on non-tidal geodetic variation time series

- Separation and processing of gross errors in geodetic variation time series
- Low-pass filtering and signal reconstructing for irregular time series
- Weighted operation, difference, integral and interpolation on time series
- Normalized extraction from batch time series of geodetic monitoring network
- Processing and analysis on batch time series of geodetic monitoring network
- Construction and analysis on record time series from geodetic network
- Processing and analysis on variation (vector) grid time series
- Multi-form spatiotemporal interpolation from grid time series

Load deformation field approach and monitoring from heterogeneous variations

- Spherical harmonic analysis on global surface load time series
- Spherical analysis on tidal harmonic cons-tants and construction of tidal load model
- Computation of the load model value using spherical harmonic synthesis
- Computation of load deformation field using spherical harmonic synthesis
- Regional refinement of load deformation field by Green's Integral
- Regional approach of load deformation field using SRBFs
- Load deformation field monitoring from heterogeneous variations with Green's integral constraints
- Load deformation field monitoring from heterogeneous variations using spherical radial basis functions
- Geodynamic calculation on geodetic field grid time series
- Surface load and load deformation field monitoring computation processes

CORS/InSAR collab-orative monitoring and ground stability estimation

- Pseudo-stable adjustment of record time series for geodetic network variations
- Gross error detection and spatial de-formation analysis on InSAR variations
- Collaborative monitoring and process-ing of InSAR with CORS network
- Deep fusion and time series analysis on multi-source InSAR variations
- Computation of ground stability vari-ation based on vertical deformation
- Computation of ground stability vari-ation based on gravity variations
- Computation of ground stability vari-ation based on variation vectors
- Statistical synthesis and prediction of ground stability variations

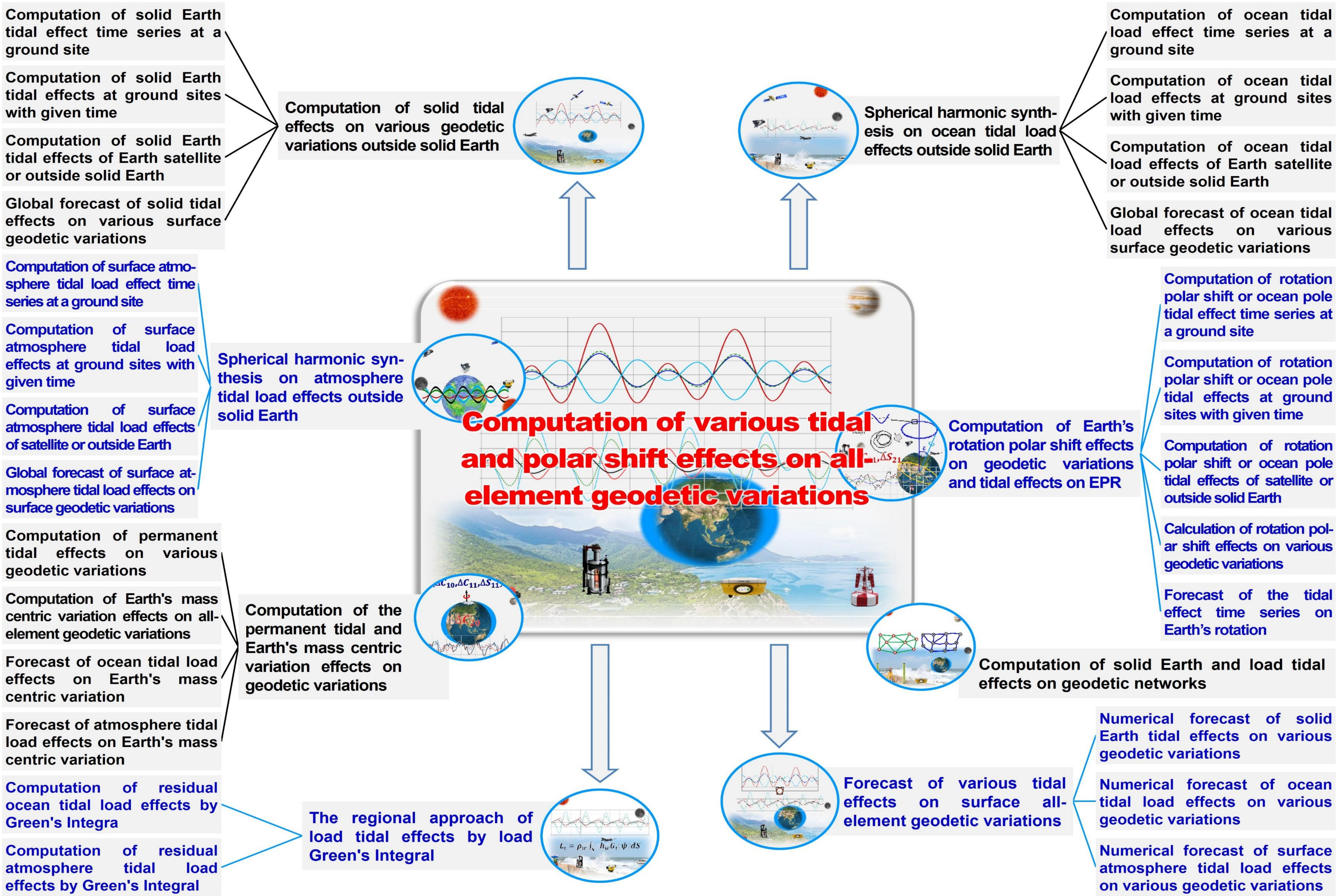
ETideLoad4.5 Summary, Setting and visualization

- ETideLoad4.5 Goals, Features and strengths
- Dominant concepts and ideas in ETideLoad4.5
- Geophysical models and numerical standards
- Visualization for multi-attributes in ground variation time series
- Visualization for variation record time series on geodetic network
- Visualization for specified attribute in discrete point file
- Visualization for geodetic grid and variation grid time series file
- Visualization for geodetic vector grid file

Editing and calcul-ation tools for geodetic data files

- Conversion of general ASCII data into ETideLoad format
- Data interpolation, extracting and land-sea area separation
- Simple and direct calculation on geodetic data files
- Operations on variation time series with same specifications
- Generating and constructing of regional geodetic grid
- Constructing and transforming of vector grid file
- Statistical analysis on various geodetic data files
- Gross error detection and weighted basis function gridding

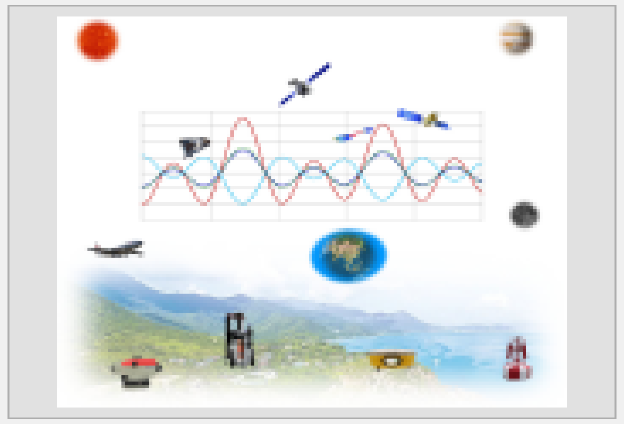
Chuanyin Zhang, Beijing, China October 2024 www.zcyphygeodesy.com



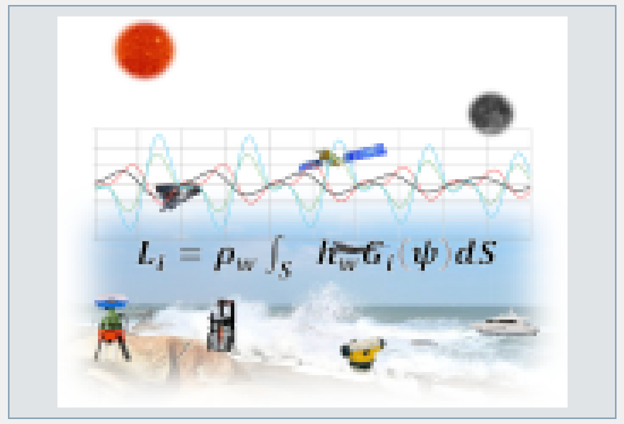
Compatible with and improved all the geodetic algorithms in Chapters 6, 7, and 8 of the IERS conventions (2010).

Computation of various tidal effects on various geodetic variations

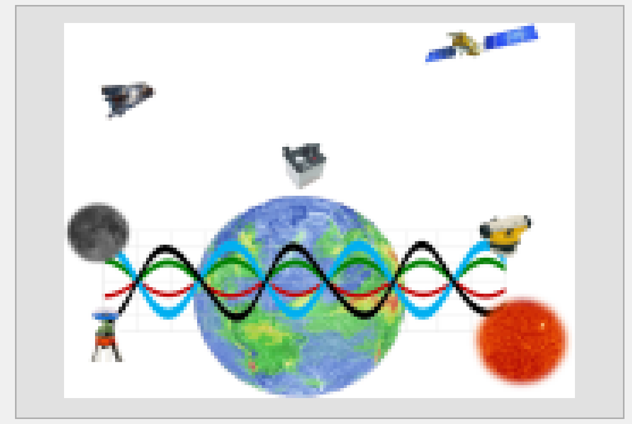
Computation of various tidal and polar shift effects on all-element geodetic variations



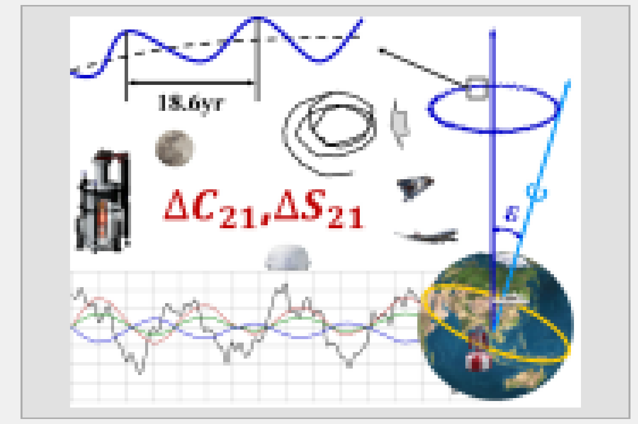
Computation of solid tidal effects on various geodetic variations outside solid Earth



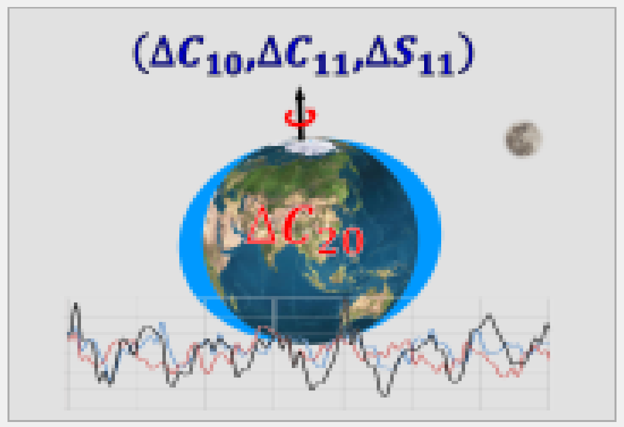
Spherical harmonic synthesis on ocean tidal load effects outside solid Earth



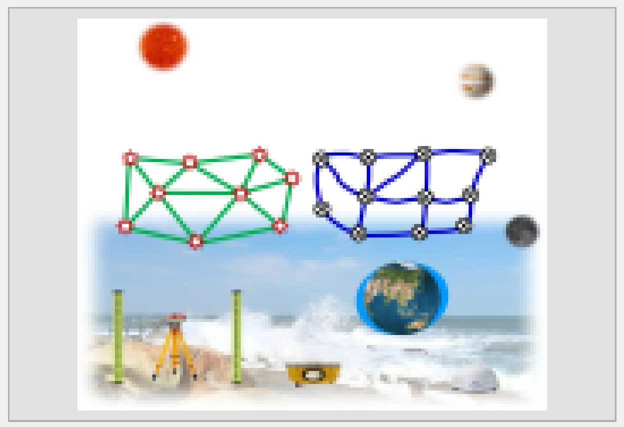
Spherical harmonic synthesis on atmosphere tidal load effects outside solid Earth



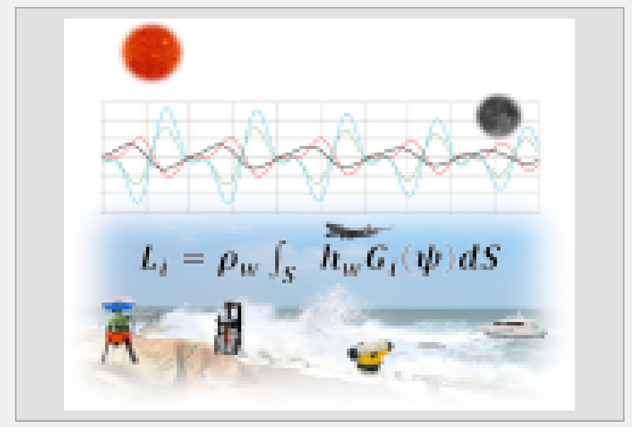
Computation of rotation polar shift effects on geodetic variations and tidal effects on EPR



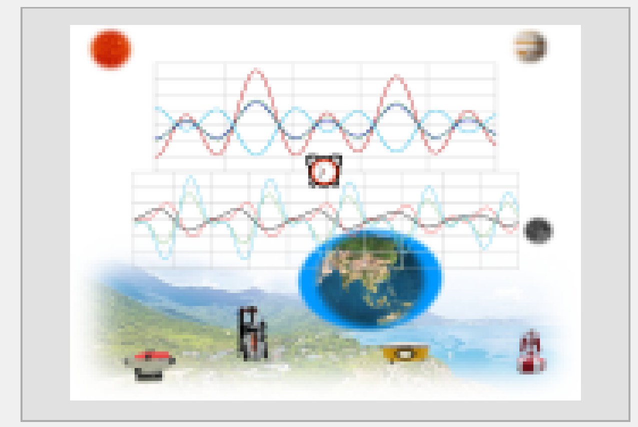
Computation of the permanent tidal and Earth's mass centric variation effects on geodetic variations



Computation of solid Earth and load tidal effects on geodetic networks



The regional approach of load tidal effects by load Green's Integral



Forecast of various tidal effects on surface all-element geodetic variations

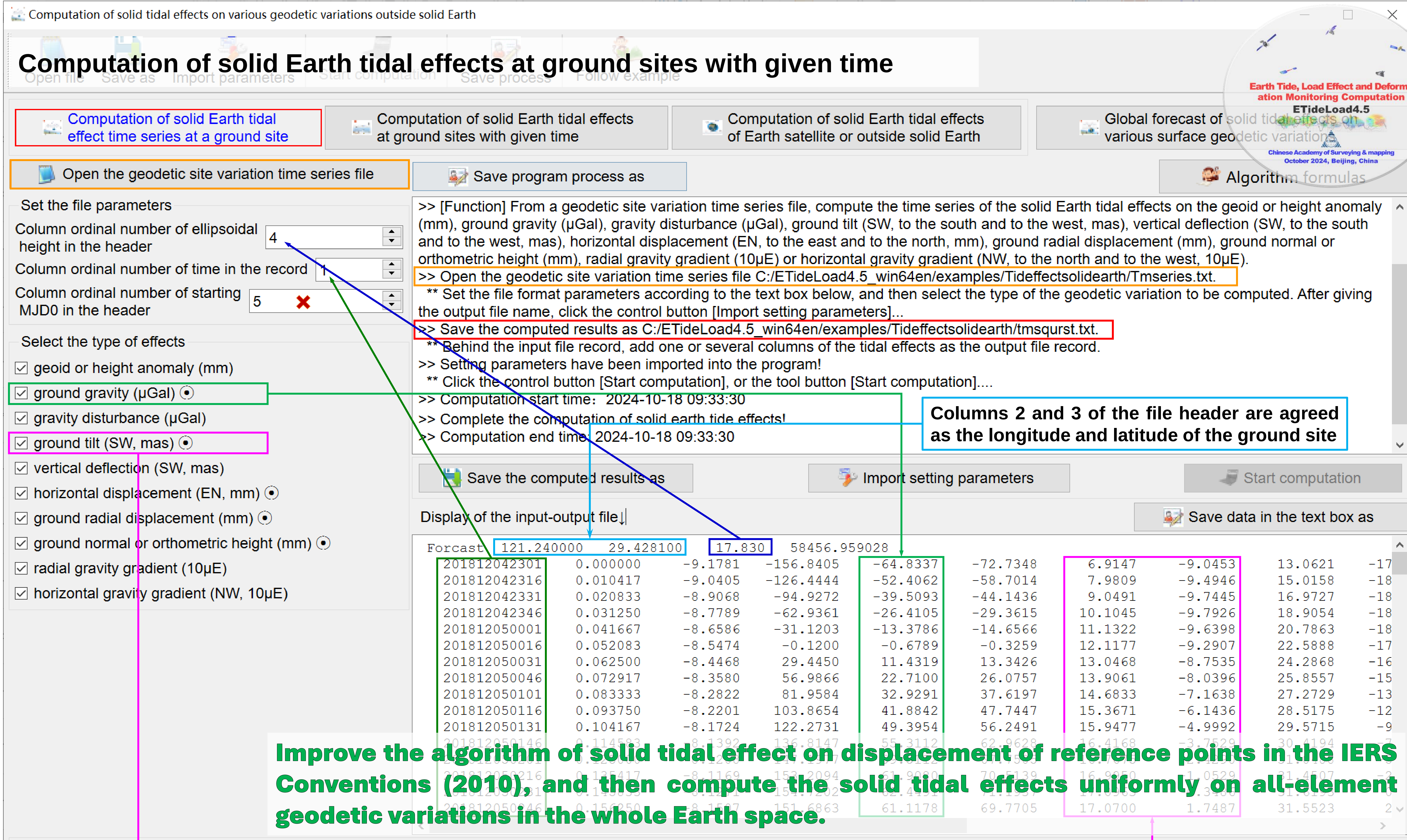
- **Analytically compatible geodetic and geodynamic algorithm package using the numerical standards unified and geophysical models coordinated**
- **Compatible with and improved the IERS conventions, some geodetic concepts clarified, all the algorithms derivated and verificated completely**
- **Uniform computation of solid tidal, load tidal, polar shift and mass centric variation effects on all-element geodetic variations in whole Earth space**

Functional architecture of the subsystem

The files format of 5 kinds of geodetic variation time series

These programs are suitable for various geodetic variations on the ground or outside the solid Earth. A point outside the solid Earth generally refers to the space point that is not fixed to the solid Earth in ocean space, near-Earth space, or satellite altitude. The geodetic variations marked with ⊙ in the following program interface are valid only when the site is fixed with the solid Earth.

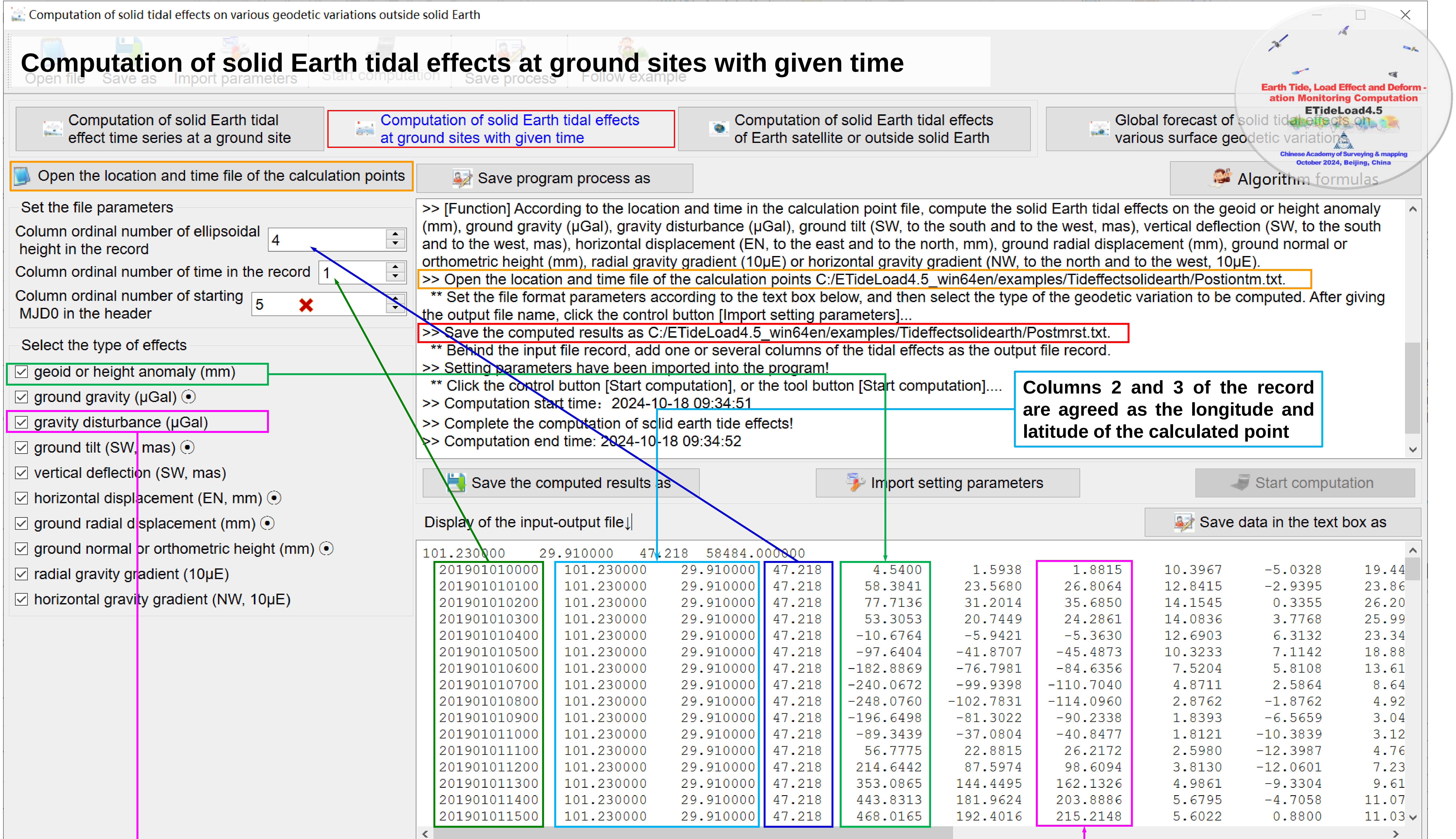
Time (date and epoch) are agreed to adopt Greenwich Time (zero time zone), which is expressed in modified Julian Date (MJD, in GPS time, and Julian Date 2000.0 = MJD 51544.5) or a long integer agreed by ETideLoad, e.g., 2018122412.



The program adopts the same numerical standards and analytical algorithms of the solid Earth tidal effects on geopotential and and geodetic site displacement that are compatible with the IERS Conventions (2010), and compute uniformly the solid Earth tidal effects on all-element geodetic variations considering the latitude and frequency dependence of the Love numbers, so as to maintain rigorously the analytical relationships between the solid Earth tidal effects on various geodetic variations.

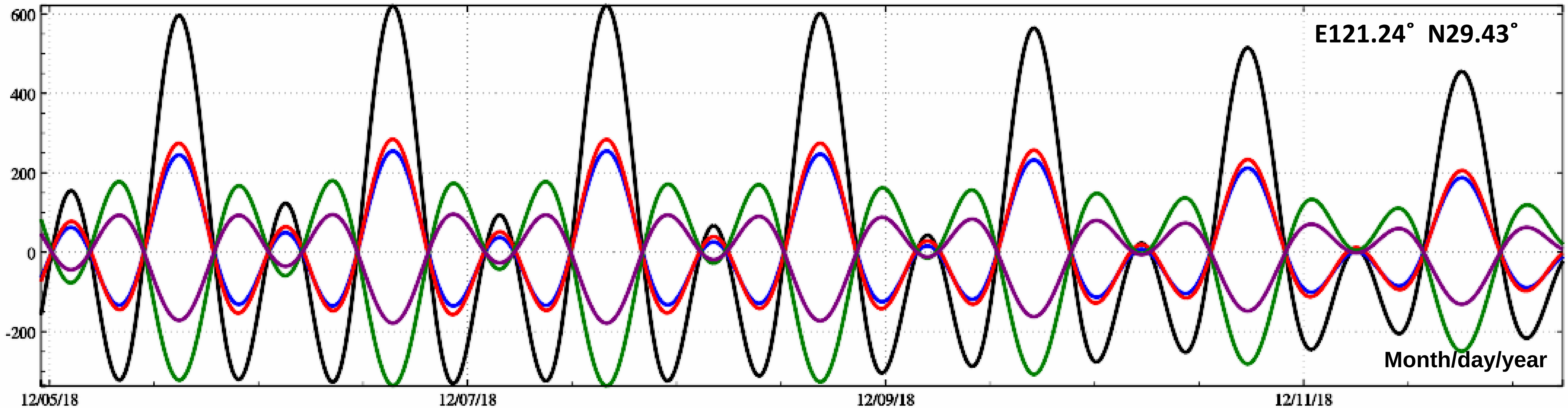
The Earth's tide generating potential (TGP) from the moon is calculated from 2nd to 6th degree, that from the sun from 2nd to 3rd degree, and that from other planets at the 2nd degree.

The solid tidal effect on normal height (approximately 300mm) is out of phase with the effect on the ellipsoidal height or geoid (approximately 600mm, namely the sign is opposite). The east-west component of the site displacement, tilt or horizontal gradient effect is generally much greater than the north-south component.



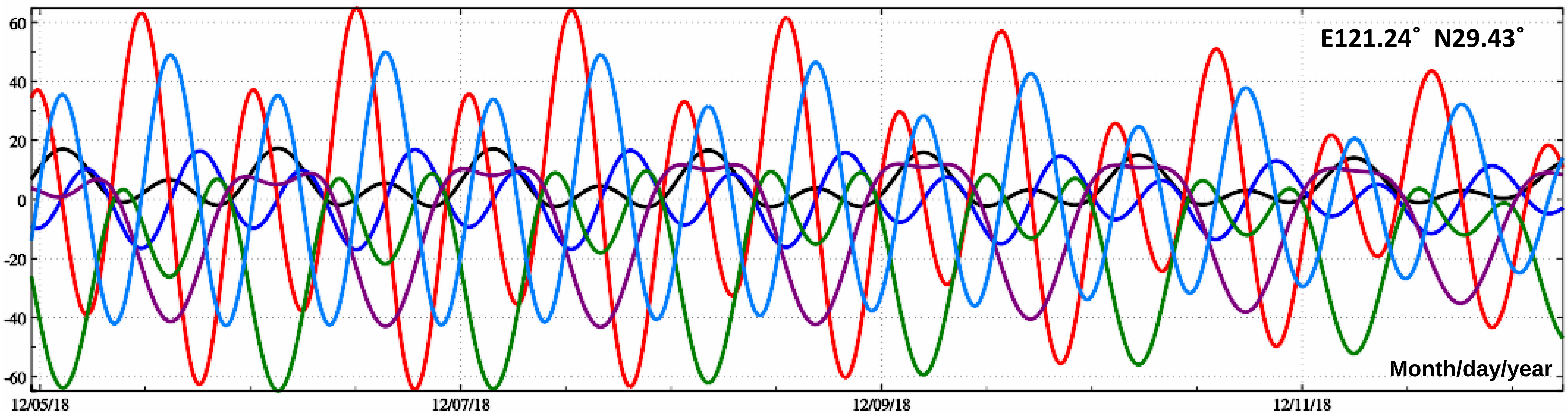
201901010000	101.230000	29.910000	47.218	4.5400	1.5938	1.8815	10.3967	-5.0328	19.44
201901010100	101.230000	29.910000	47.218	58.3841	23.5680	26.8064	12.8415	-2.9395	23.86
201901010200	101.230000	29.910000	47.218	77.7136	31.2014	35.6850	14.1545	0.3355	26.20
201901010300	101.230000	29.910000	47.218	53.3053	20.7449	24.2861	14.0836	3.7768	25.99
201901010400	101.230000	29.910000	47.218	-10.6764	-5.9421	-5.3630	12.6903	6.3132	23.34
201901010500	101.230000	29.910000	47.218	-97.6404	-41.8707	-45.4873	10.3233	7.1142	18.88
201901010600	101.230000	29.910000	47.218	-182.8869	-76.7981	-84.6356	7.5204	5.8108	13.61
201901010700	101.230000	29.910000	47.218	-240.0672	-99.9398	-110.7040	4.8711	2.5864	8.64
201901010800	101.230000	29.910000	47.218	-248.0760	-102.7831	-114.0960	2.8762	-1.8762	4.92
201901010900	101.230000	29.910000	47.218	-196.6498	-81.3022	-90.2338	1.8393	-6.5659	3.04
201901011000	101.230000	29.910000	47.218	-89.3439	-37.0804	-40.8477	1.8121	-10.3839	3.12
201901011100	101.230000	29.910000	47.218	56.7775	22.8815	26.2172	2.5980	-12.3987	4.76
201901011200	101.230000	29.910000	47.218	214.6442	87.5974	98.6094	3.8130	-12.0601	7.23
201901011300	101.230000	29.910000	47.218	353.0865	144.4495	162.1326	4.9861	-9.3304	9.61
201901011400	101.230000	29.910000	47.218	443.8313	181.9624	203.8886	5.6795	-4.7058	11.07
201901011500	101.230000	29.910000	47.218	468.0165	192.4016	215.2148	5.6022	0.8800	11.03

- The program adopts the same numerical standards and analytical algorithms of the solid Earth tidal effects on geopotential and and geodetic site displacement that are compatible with the IERS Conventions (2010), and compute uniformly the solid Earth tidal effects on all-element geodetic variations considering the latitude and frequency dependence of the Love numbers, so as to maintain rigorously the analytical relationships between the solid Earth tidal effects on various geodetic variations.
- The Earth's tide generating potential (TGP) from the moon is calculated from 2nd to 6th degree, that from the sun from 2nd to 3rd degree, and that from other planets at the 2nd degree.
- The solid tidal effect on normal height (approximately 300mm) is out of phase with the effect on the ellipsoidal height or geoid (approximately 600mm, namely the sign is opposite). The east-west component of the site displacement, tilt or horizontal gradient effect is generally much greater than the north-south component.

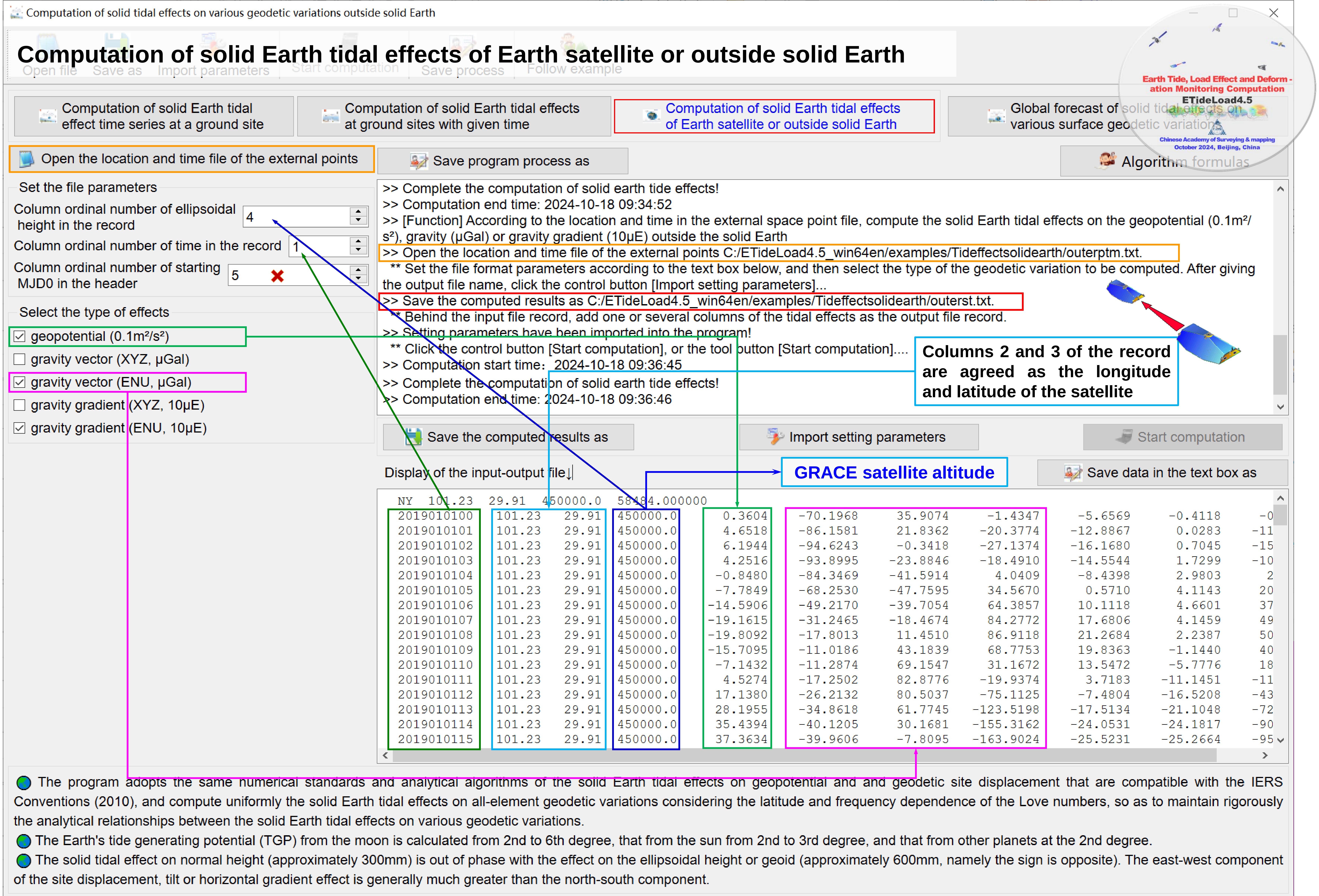


Solid tidal effects : geoid or height anomaly (mm) ground gravity (μGal) radial displacement (mm) normal or orthometric height (mm) radial gravity gradient (10μE)

The solid tidal effect on normal height (approximately 300mm) is out of phase with that on the ellipsoidal height or geoid (approximately 600mm, namely the sign is opposite).



Solid tidal effects : ground tilt (S, mas) tilt (W, mas) horizontal displacement (E, mm) horizontal displacement (N, mm) horizontal gradient (N, 10μE) horizontal gradient (W, 10μE)



Computation of solid tidal effects on various geodetic variations outside solid Earth
Computation of solid Earth tidal effects of Earth satellite or outside solid Earth
Open file
Save as
Import parameters
Start computation
Save process
Follow example
ETideLoad4.5
Earth Tide, Load Effect and Deformation Monitoring Computation
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of solid Earth tidal effect time series at a ground site
Computation of solid Earth tidal effects at ground sites with given time
Computation of solid Earth tidal effects of Earth satellite or outside solid Earth
Global forecast of solid tidal effects on various surface geodetic variations
Open the location and time file of the external points
Save program process as
Algorithm formulas
Set the file parameters
Column ordinal number of ellipsoidal height in the record
4
Column ordinal number of time in the record
1
Column ordinal number of starting MJD0 in the header
5
Select the type of effects
geopotential (0.1m²/s²)
gravity vector (XYZ, μGal)
gravity vector (ENU, μGal)
gravity gradient (XYZ, 10μE)
gravity gradient (ENU, 10μE)
>> Complete the computation of solid earth tide effects!
>> Computation end time: 2024-10-18 09:34:52
>> [Function] According to the location and time in the external space point file, compute the solid Earth tidal effects on the geopotential (0.1m²/s²), gravity (μGal) or gravity gradient (10μE) outside the solid Earth
>> Open the location and time file of the external points C:/ETideLoad4.5_win64en/examples/Tideffectsolidearth/outerptm.txt.
** Set the file format parameters according to the text box below, and then select the type of the geodetic variation to be computed. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Tideffectsolidearth/outerst.txt.
** Behind the input file record, add one or several columns of the tidal effects as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 09:36:45
>> Complete the computation of solid earth tide effects!
>> Computation end time: 2024-10-18 09:36:46
Columns 2 and 3 of the record are agreed as the longitude and latitude of the satellite
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file
GRACE satellite altitude
Save data in the text box as
NY 101.23 29.91 450000.0 58484.000000
2019010100 101.23 29.91 450000.0 0.3604 -70.1968 35.9074 -1.4347 -5.6569 -0.4118 -0
2019010101 101.23 29.91 450000.0 4.6518 -86.1581 21.8362 -20.3774 -12.8867 0.0283 -11
2019010102 101.23 29.91 450000.0 6.1944 -94.6243 -0.3418 -27.1374 -16.1680 0.7045 -15
2019010103 101.23 29.91 450000.0 4.2516 -93.8995 -23.8846 -18.4910 -14.5544 1.7299 -10
2019010104 101.23 29.91 450000.0 -0.8480 -84.3469 -41.5914 4.0409 -8.4398 2.9803 2
2019010105 101.23 29.91 450000.0 -7.7849 -68.2530 -47.7595 34.5670 0.5710 4.1143 20
2019010106 101.23 29.91 450000.0 -14.5906 -49.2170 -39.7054 64.3857 10.1118 4.6601 37
2019010107 101.23 29.91 450000.0 -19.1615 -31.2465 -18.4674 84.2772 17.6806 4.1459 49
2019010108 101.23 29.91 450000.0 -19.8092 -17.8013 11.4510 86.9118 21.2684 2.2387 50
2019010109 101.23 29.91 450000.0 -15.7095 -11.0186 43.1839 68.7753 19.8363 -1.1440 40
2019010110 101.23 29.91 450000.0 -7.1432 -11.2874 69.1547 31.1672 13.5472 -5.7776 18
2019010111 101.23 29.91 450000.0 4.5274 -17.2502 82.8776 -19.9374 3.7183 -11.1451 -11
2019010112 101.23 29.91 450000.0 17.1380 -26.2132 80.5037 -75.1125 -7.4804 -16.5208 -43
2019010113 101.23 29.91 450000.0 28.1955 -34.8618 61.7745 -123.5198 -17.5134 -21.1048 -72
2019010114 101.23 29.91 450000.0 35.4394 -40.1205 30.1681 -155.3162 -24.0531 -24.1817 -90
2019010115 101.23 29.91 450000.0 37.3634 -39.9606 -7.8095 -163.9024 -25.5231 -25.2664 -95
The program adopts the same numerical standards and analytical algorithms of the solid Earth tidal effects on geopotential and and geodetic site displacement that are compatible with the IERS Conventions (2010), and compute uniformly the solid Earth tidal effects on all-element geodetic variations considering the latitude and frequency dependence of the Love numbers, so as to maintain rigorously the analytical relationships between the solid Earth tidal effects on various geodetic variations.
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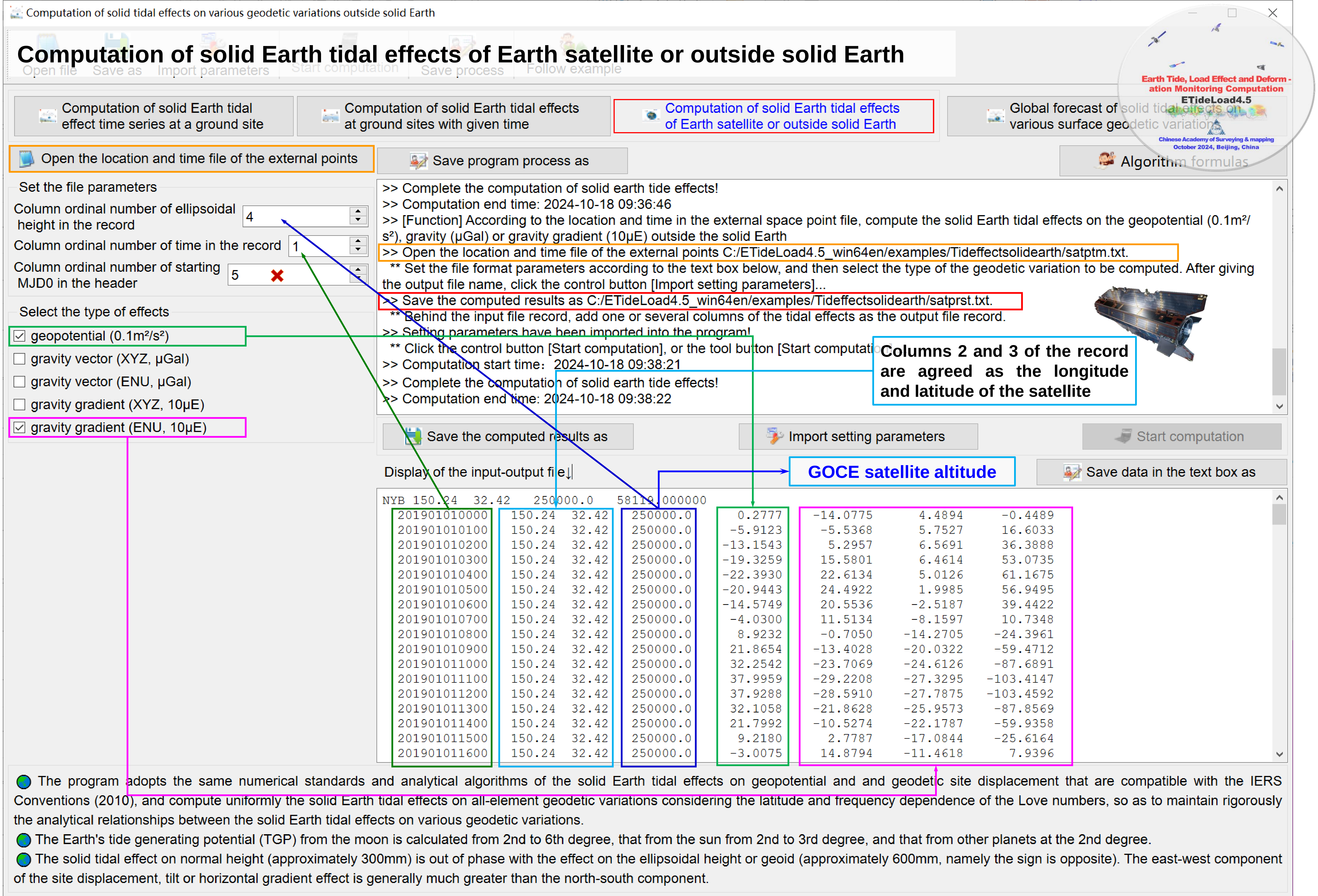
Computation of solid tidal effects on various geodetic variations outside solid Earth
Computation of solid Earth tidal effects of Earth satellite or outside solid Earth
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of solid Earth tidal effect time series at a ground site
Computation of solid Earth tidal effects at ground sites with given time
Computation of solid Earth tidal effects of Earth satellite or outside solid Earth
Global forecast of solid tidal effects on various surface geodetic variations
Open the location and time file of the external points
Save program process as
Algorithm formulas
Set the file parameters
Column ordinal number of ellipsoidal height in the record
4
Column ordinal number of time in the record
1
Column ordinal number of starting MJD0 in the header
5
Select the type of effects
geopotential (0.1m²/s²)
gravity vector (XYZ, μGal)
gravity vector (ENU, μGal)
gravity gradient (XYZ, 10μE)
gravity gradient (ENU, 10μE)
>> Complete the computation of solid earth tide effects!
>> Computation end time: 2024-10-18 09:36:46
>> [Function] According to the location and time in the external space point file, compute the solid Earth tidal effects on the geopotential (0.1m²/s²), gravity (μGal) or gravity gradient (10μE) outside the solid Earth
>> Open the location and time file of the external points C:/ETideLoad4.5_win64en/examples/Tideffectsolidearth/satptm.txt.
** Set the file format parameters according to the text box below, and then select the type of the geodetic variation to be computed. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Tideffectsolidearth/satprst.txt.
** Behind the input file record, add one or several columns of the tidal effects as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computati
>> Computation start time: 2024-10-18 09:38:21
>> Complete the computation of solid earth tide effects!
>> Computation end time: 2024-10-18 09:38:22
Columns 2 and 3 of the record are agreed as the longitude and latitude of the satellite
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file
GOCE satellite altitude
Save data in the text box as
NYB 150.24 32.42 250000.0 58119.000000
201901010000 150.24 32.42 250000.0 0.2777 -14.0775 4.4894 -0.4489
201901010100 150.24 32.42 250000.0 -5.9123 -5.5368 5.7527 16.6033
201901010200 150.24 32.42 250000.0 -13.1543 5.2957 6.5691 36.3888
201901010300 150.24 32.42 250000.0 -19.3259 15.5801 6.4614 53.0735
201901010400 150.24 32.42 250000.0 -22.3930 22.6134 5.0126 61.1675
201901010500 150.24 32.42 250000.0 -20.9443 24.4922 1.9985 56.9495
201901010600 150.24 32.42 250000.0 -14.5749 20.5536 -2.5187 39.4422
201901010700 150.24 32.42 250000.0 -4.0300 11.5134 -8.1597 10.7348
201901010800 150.24 32.42 250000.0 8.9232 -0.7050 -14.2705 -24.3961
201901010900 150.24 32.42 250000.0 21.8654 -13.4028 -20.0322 -59.4712
201901011000 150.24 32.42 250000.0 32.2542 -23.7069 -24.6126 -87.6891
201901011100 150.24 32.42 250000.0 37.9959 -29.2208 -27.3295 -103.4147
201901011200 150.24 32.42 250000.0 37.9288 -28.5910 -27.7875 -103.4592
201901011300 150.24 32.42 250000.0 32.1058 -21.8628 -25.9573 -87.8569
201901011400 150.24 32.42 250000.0 21.7992 -10.5274 -22.1787 -59.9358
201901011500 150.24 32.42 250000.0 9.2180 2.7787 -17.0844 -25.6164
201901011600 150.24 32.42 250000.0 -3.0075 14.8794 -11.4618 7.9396
The program adopts the same numerical standards and analytical algorithms of the solid Earth tidal effects on geopotential and and geodetic site displacement that are compatible with the IERS Conventions (2010), and compute uniformly the solid Earth tidal effects on all-element geodetic variations considering the latitude and frequency dependence of the Love numbers, so as to maintain rigorously the analytical relationships between the solid Earth tidal effects on various geodetic variations.
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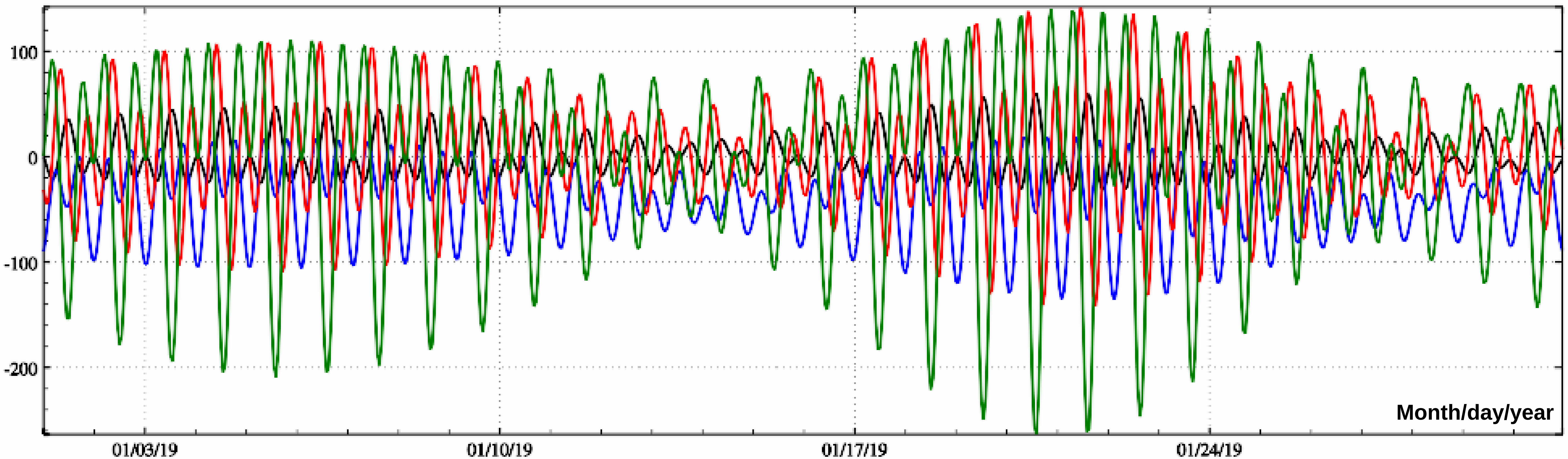
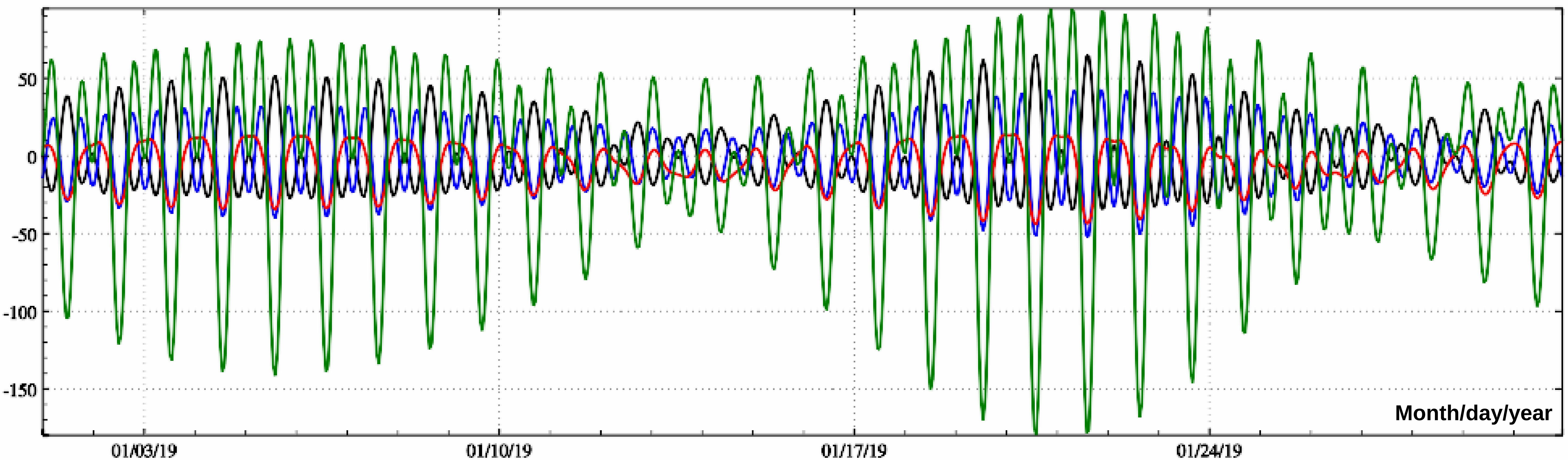
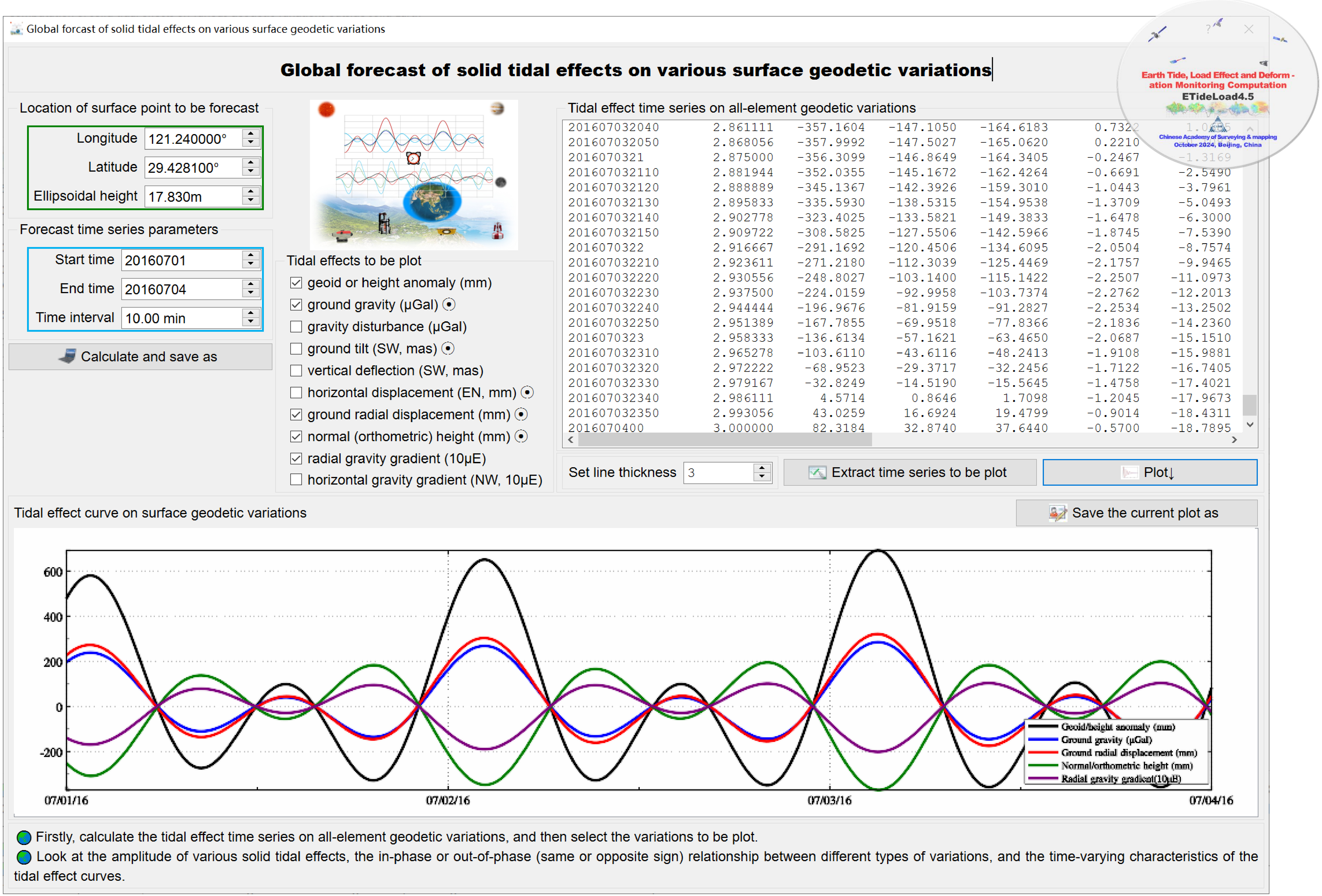
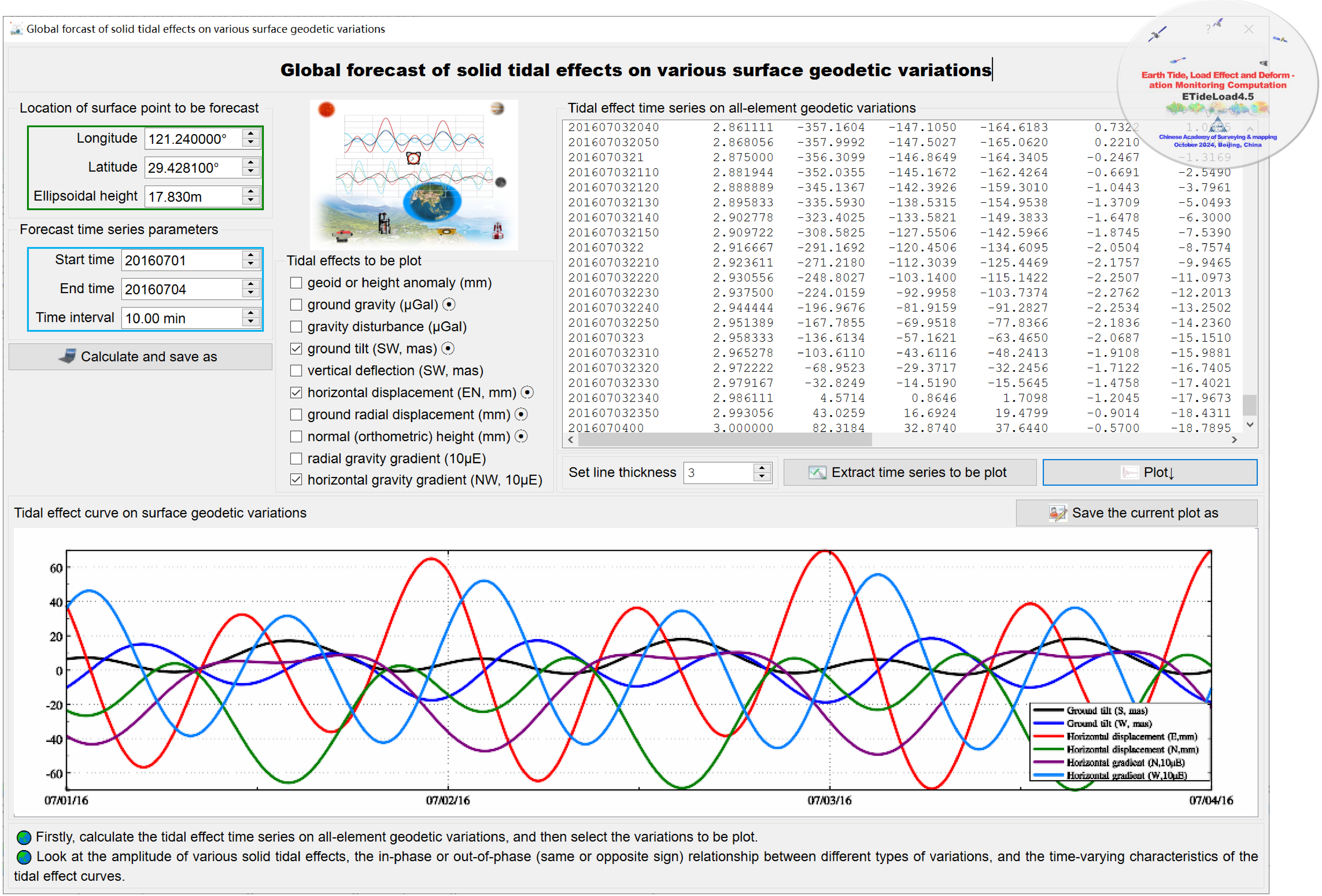


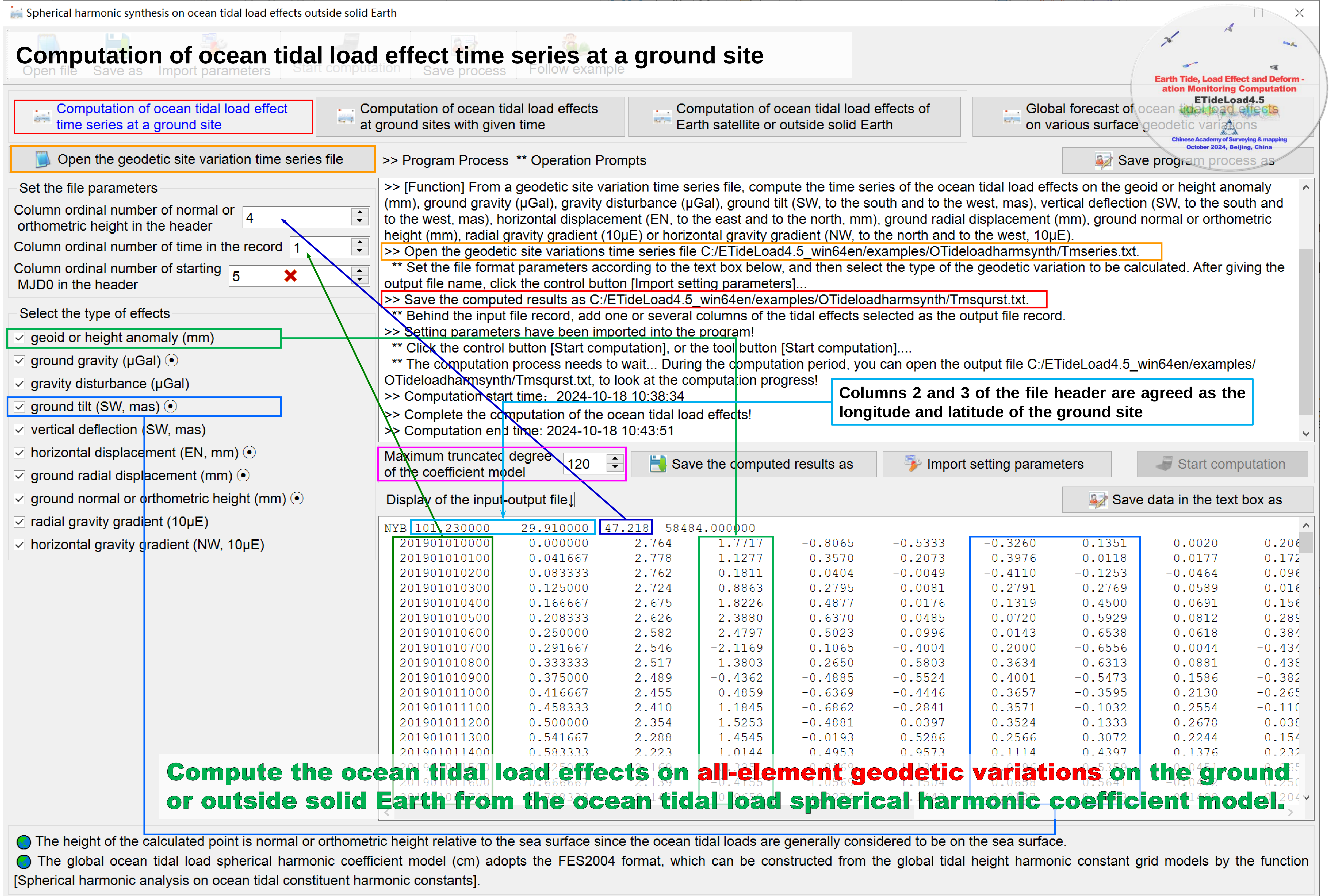
The solid tidal effects at 450km altitude： geopotential ($0.1m^2/s^2$), gravity vector (E, N: along the GRACE orbit/SST-II, U, μGal)

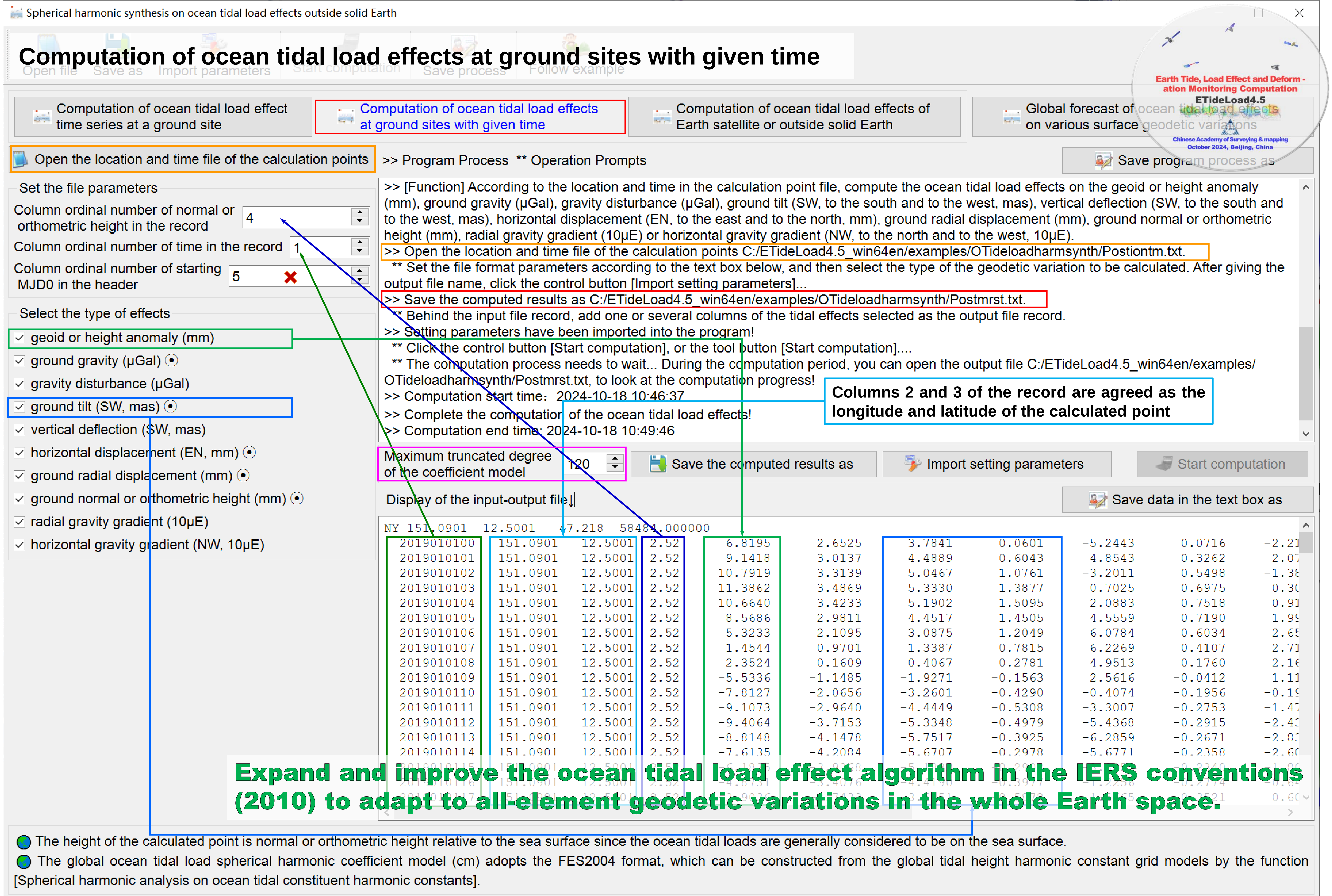


The solid tidal effects at 250km altitude： geopotential ($0.1m^2/s^2$), gravity gradient (E, N: along the GOCE orbit, U, 10μE)

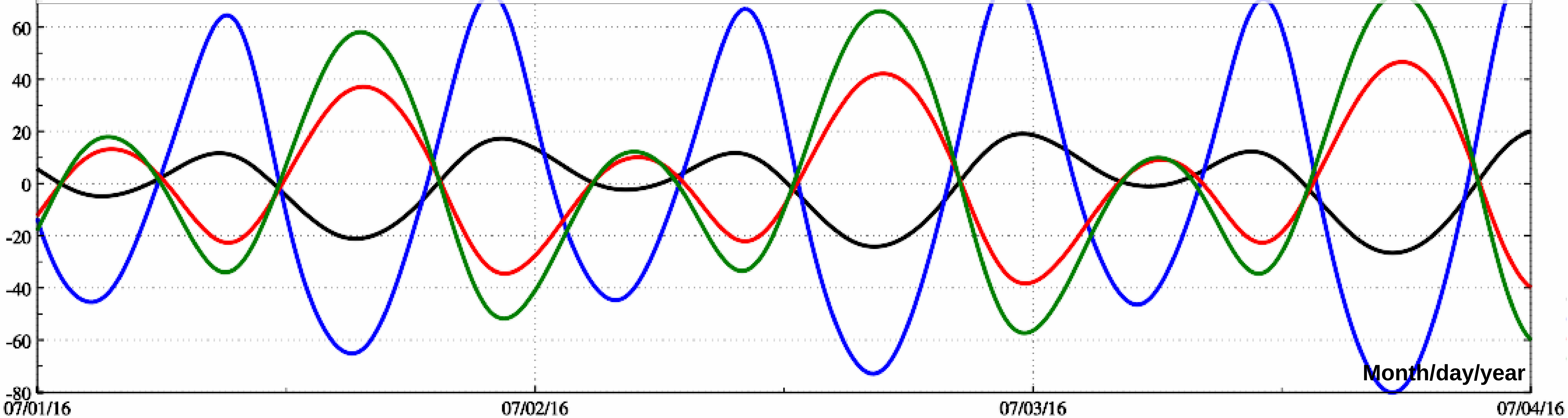

Global forcast of solid tidal effects on various surface geodetic variations
Global forecast of solid tidal effects on various surface geodetic variations
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Ellipsoidal height 17.830m
Forecast time series parameters
Start time 20160701
End time 20160704
Time interval 10.00 min
Calculate and save as
Tidal effects to be plot
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
normal (orthometric) height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
Tidal effect time series on all-element geodetic variations
201607032040 2.861111 -357.1604 -147.1050 -164.6183 0.7322
201607032050 2.868056 -357.9992 -147.5027 -165.0620 0.2210
2016070321 2.875000 -356.3099 -146.8649 -164.3405 -0.2467
201607032110 2.881944 -352.0355 -145.1672 -162.4264 -0.6691 -2.5490
201607032120 2.888889 -345.1367 -142.3926 -159.3010 -1.0443 -3.7961
201607032130 2.895833 -335.5930 -138.5315 -154.9538 -1.3709 -5.0493
201607032140 2.902778 -323.4025 -133.5821 -149.3833 -1.6478 -6.3000
201607032150 2.909722 -308.5825 -127.5506 -142.5966 -1.8745 -7.5390
2016070322 2.916667 -291.1692 -120.4506 -134.6095 -2.0504 -8.7574
201607032210 2.923611 -271.2180 -112.3039 -125.4469 -2.1757 -9.9465
201607032220 2.930556 -248.8027 -103.1400 -115.1422 -2.2507 -11.0973
201607032230 2.937500 -224.0159 -92.9958 -103.7374 -2.2762 -12.2013
201607032240 2.944444 -196.9676 -81.9159 -91.2827 -2.2534 -13.2502
201607032250 2.951389 -167.7855 -69.9518 -77.8366 -2.1836 -14.2360
2016070323 2.958333 -136.6134 -57.1621 -63.4650 -2.0687 -15.1510
201607032310 2.965278 -103.6110 -43.6116 -48.2413 -1.9108 -15.9881
201607032320 2.972222 -68.9523 -29.3717 -32.2456 -1.7122 -16.7405
201607032330 2.979167 -32.8249 -14.5190 -15.5645 -1.4758 -17.4021
201607032340 2.986111 4.5714 0.8646 1.7098 -1.2045 -17.9673
201607032350 2.993056 43.0259 16.6924 19.4799 -0.9014 -18.4311
2016070400 3.000000 82.3184 32.8740 37.6440 -0.5700 -18.7895
Set line thickness 3
Extract time series to be plot
Plot↓
Tidal effect curve on surface geodetic variations
Save the current plot as
600
400
200
0
-200
07/01/16
07/02/16
07/03/16
07/04/16
Geoid/height anomaly (mm)
Ground gravity (μGal)
Ground radial displacement (mm)
Normal/orthometric height (mm)
Radial gravity gradient(10μE)
Firstly, calculate the tidal effect time series on all-element geodetic variations, and then select the variations to be plot.
Look at the amplitude of various solid tidal effects, the in-phase or out-of-phase (same or opposite sign) relationship between different types of variations, and the time-varying characteristics of the tidal effect curves.


Global forcast of solid tidal effects on various surface geodetic variations
Global forecast of solid tidal effects on various surface geodetic variations
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Ellipsoidal height 17.830m
Forecast time series parameters
Start time 20160701
End time 20160704
Time interval 10.00 min
Calculate and save as
Tidal effects to be plot
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
normal (orthometric) height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
Tidal effect time series on all-element geodetic variations
201607032040 2.861111 -357.1604 -147.1050 -164.6183 0.7322
201607032050 2.868056 -357.9992 -147.5027 -165.0620 0.2210
2016070321 2.875000 -356.3099 -146.8649 -164.3405 -0.2467 -1.3169
201607032110 2.881944 -352.0355 -145.1672 -162.4264 -0.6691 -2.5490
201607032120 2.888889 -345.1367 -142.3926 -159.3010 -1.0443 -3.7961
201607032130 2.895833 -335.5930 -138.5315 -154.9538 -1.3709 -5.0493
201607032140 2.902778 -323.4025 -133.5821 -149.3833 -1.6478 -6.3000
201607032150 2.909722 -308.5825 -127.5506 -142.5966 -1.8745 -7.5390
2016070322 2.916667 -291.1692 -120.4506 -134.6095 -2.0504 -8.7574
201607032210 2.923611 -271.2180 -112.3039 -125.4469 -2.1757 -9.9465
201607032220 2.930556 -248.8027 -103.1400 -115.1422 -2.2507 -11.0973
201607032230 2.937500 -224.0159 -92.9958 -103.7374 -2.2762 -12.2013
201607032240 2.944444 -196.9676 -81.9159 -91.2827 -2.2534 -13.2502
201607032250 2.951389 -167.7855 -69.9518 -77.8366 -2.1836 -14.2360
2016070323 2.958333 -136.6134 -57.1621 -63.4650 -2.0687 -15.1510
201607032310 2.965278 -103.6110 -43.6116 -48.2413 -1.9108 -15.9881
201607032320 2.972222 -68.9523 -29.3717 -32.2456 -1.7122 -16.7405
201607032330 2.979167 -32.8249 -14.5190 -15.5645 -1.4758 -17.4021
201607032340 2.986111 4.5714 0.8646 1.7098 -1.2045 -17.9673
201607032350 2.993056 43.0259 16.6924 19.4799 -0.9014 -18.4311
2016070400 3.000000 82.3184 32.8740 37.6440 -0.5700 -18.7895
Set line thickness 3
Extract time series to be plot
Plot↓
Tidal effect curve on surface geodetic variations
Save the current plot as
60
40
20
0
-20
-40
-60
07/01/16
07/02/16
07/03/16
07/04/16
Ground tilt (S, mas)
Ground tilt (W, mas)
Horizontal displacement (E,mm)
Horizontal displacement (N,mm)
Horizontal gradient (N,10μE)
Horizontal gradient (W,10μE)
Firstly, calculate the tidal effect time series on all-element geodetic variations, and then select the variations to be plot.
Look at the amplitude of various solid tidal effects, the in-phase or out-of-phase (same or opposite sign) relationship between different types of variations, and the time-varying characteristics of the tidal effect curves.

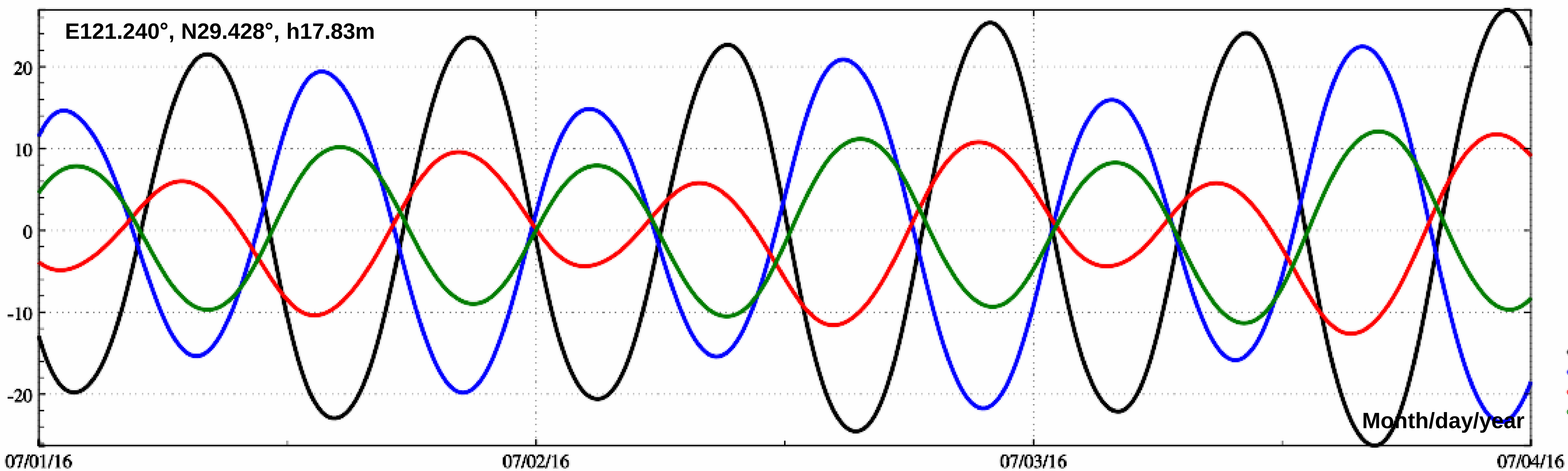

Spherical harmonic synthesis on ocean tidal load effects outside solid Earth
Computation of ocean tidal load effect time series at a ground site
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of ocean tidal load effect time series at a ground site
Computation of ocean tidal load effects at ground sites with given time
Computation of ocean tidal load effects of Earth satellite or outside solid Earth
Global forecast of ocean tidal load effects on various surface geodetic variations
Open the geodetic site variation time series file
>> Program Process ** Operation Prompts
Save program process as
Set the file parameters
Column ordinal number of normal or orthometric height in the header 4
Column ordinal number of time in the record 1
Column ordinal number of starting MJD0 in the header 5
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
>> [Function] From a geodetic site variation time series file, compute the time series of the ocean tidal load effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (10μE) or horizontal gravity gradient (NW, to the north and to the west, 10μE).
>> Open the geodetic site variations time series file C:/ETideLoad4.5_win64en/examples/OTideloadharmsynth/Tmseries.txt.
** Set the file format parameters according to the text box below, and then select the type of the geodetic variation to be calculated. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/OTideloadharmsynth/Tmsqurst.txt.
** Behind the input file record, add one or several columns of the tidal effects selected as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
** The computation process needs to wait... During the computation period, you can open the output file C:/ETideLoad4.5_win64en/examples/OTideloadharmsynth/Tmsqurst.txt, to look at the computation progress!
>> Computation start time: 2024-10-18 10:38:34
>> Complete the computation of the ocean tidal load effects!
>> Computation end time: 2024-10-18 10:43:51
Columns 2 and 3 of the file header are agreed as the longitude and latitude of the ground site
Maximum truncated degree of the coefficient model 120
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
Save data in the text box as
NYB 101.230000 29.910000 47.218 58484.000000
201901010000 0.000000 2.764 1.7717 -0.8065 -0.5333 -0.3260 0.1351 0.0020
201901010100 0.041667 2.778 1.1277 -0.3570 -0.2073 -0.3976 0.0118 -0.0177
201901010200 0.083333 2.762 0.1811 0.0404 -0.0049 -0.4110 -0.1253 -0.0464
201901010300 0.125000 2.724 -0.8863 0.2795 0.0081 -0.2791 -0.2769 -0.0589
201901010400 0.166667 2.675 -1.8226 0.4877 0.0176 -0.1319 -0.4500 -0.0691
201901010500 0.208333 2.626 -2.3880 0.6370 0.0485 -0.0720 -0.5929 -0.0812
201901010600 0.250000 2.582 -2.4797 0.5023 -0.0996 0.0143 -0.6538 -0.0618
201901010700 0.291667 2.546 -2.1169 0.1065 -0.4004 0.2000 -0.6556 0.0044
201901010800 0.333333 2.517 -1.3803 -0.2650 -0.5803 0.3634 -0.6313 0.0881
201901010900 0.375000 2.489 -0.4362 -0.4885 -0.5524 0.4001 -0.5473 0.1586
201901011000 0.416667 2.455 0.4859 -0.6369 -0.4446 0.3657 -0.3595 0.2130
201901011100 0.458333 2.410 1.1845 -0.6862 -0.2841 0.3571 -0.1032 0.2554
201901011200 0.500000 2.354 1.5253 -0.4881 0.0397 0.3524 0.1333 0.2678
201901011300 0.541667 2.288 1.4545 -0.0193 0.5286 0.2566 0.3072 0.2244
201901011400 0.583333 2.223 1.0144 0.4953 0.9573 0.1114 0.4397 0.1376
Compute the ocean tidal load effects on all-element geodetic variations on the ground or outside solid Earth from the ocean tidal load spherical harmonic coefficient model.
The height of the calculated point is normal or orthometric height relative to the sea surface since the ocean tidal loads are generally considered to be on the sea surface.
The global ocean tidal load spherical harmonic coefficient model (cm) adopts the FES2004 format, which can be constructed from the global tidal height harmonic constant grid models by the function [Spherical harmonic analysis on ocean tidal constituent harmonic constants].


Spherical harmonic synthesis on ocean tidal load effects outside solid Earth
Computation of ocean tidal load effects at ground sites with given time
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of ocean tidal load effect time series at a ground site
Computation of ocean tidal load effects at ground sites with given time
Computation of ocean tidal load effects of Earth satellite or outside solid Earth
Global forecast of ocean tidal load effects on various surface geodetic variations
Open the location and time file of the calculation points
>> Program Process ** Operation Prompts
Save program process as
Set the file parameters
Column ordinal number of normal or orthometric height in the record 4
Column ordinal number of time in the record 1
Column ordinal number of starting MJD0 in the header 5
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
>> [Function] According to the location and time in the calculation point file, compute the ocean tidal load effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (10μE) or horizontal gravity gradient (NW, to the north and to the west, 10μE).
>> Open the location and time file of the calculation points C:/ETideLoad4.5_win64en/examples/OTideloadharmsynth/Postiontm.txt.
** Set the file format parameters according to the text box below, and then select the type of the geodetic variation to be calculated. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/OTideloadharmsynth/Postmrst.txt.
** Behind the input file record, add one or several columns of the tidal effects selected as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
** The computation process needs to wait... During the computation period, you can open the output file C:/ETideLoad4.5_win64en/examples/OTideloadharmsynth/Postmrst.txt, to look at the computation progress!
>> Computation start time: 2024-10-18 10:46:37
>> Complete the computation of the ocean tidal load effects!
>> Computation end time: 2024-10-18 10:49:46
Columns 2 and 3 of the record are agreed as the longitude and latitude of the calculated point
Maximum truncated degree of the coefficient model 120
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
Save data in the text box as
NY 151.0901 12.5001 47.218 58484.000000
2019010100 151.0901 12.5001 2.52 6.8195 2.6525 3.7841 0.0601 -5.2443 0.0716
2019010101 151.0901 12.5001 2.52 9.1418 3.0137 4.4889 0.6043 -4.8543 0.3262
2019010102 151.0901 12.5001 2.52 10.7919 3.3139 5.0467 1.0761 -3.2011 0.5498
2019010103 151.0901 12.5001 2.52 11.3862 3.4869 5.3330 1.3877 -0.7025 0.6975
2019010104 151.0901 12.5001 2.52 10.6640 3.4233 5.1902 1.5095 2.0883 0.7518
2019010105 151.0901 12.5001 2.52 8.5686 2.9811 4.4517 1.4505 4.5559 0.7190
2019010106 151.0901 12.5001 2.52 5.3233 2.1095 3.0875 1.2049 6.0784 0.6034
2019010107 151.0901 12.5001 2.52 1.4544 0.9701 1.3387 0.7815 6.2269 0.4107
2019010108 151.0901 12.5001 2.52 -2.3524 -0.1609 -0.4067 0.2781 4.9513 0.1760
2019010109 151.0901 12.5001 2.52 -5.5336 -1.1485 -1.9271 -0.1563 2.5616 -0.0412
2019010110 151.0901 12.5001 2.52 -7.8127 -2.0656 -3.2601 -0.4290 -0.4074 -0.1956
2019010111 151.0901 12.5001 2.52 -9.1073 -2.9640 -4.4449 -0.5308 -3.3007 -0.2753
2019010112 151.0901 12.5001 2.52 -9.4064 -3.7153 -5.3348 -0.4979 -5.4368 -0.2915
2019010113 151.0901 12.5001 2.52 -8.8148 -4.1478 -5.7517 -0.3925 -6.2859 -0.2671
2019010114 151.0901 12.5001 2.52 -7.6135 -4.2084 -5.6707 -0.2978 -5.6771 -0.2358
Expand and improve the ocean tidal load effect algorithm in the IERS conventions (2010) to adapt to all-element geodetic variations in the whole Earth space.
The height of the calculated point is normal or orthometric height relative to the sea surface since the ocean tidal loads are generally considered to be on the sea surface.
The global ocean tidal load spherical harmonic coefficient model (cm) adopts the FES2004 format, which can be constructed from the global tidal height harmonic constant grid models by the function [Spherical harmonic analysis on ocean tidal constituent harmonic constants].

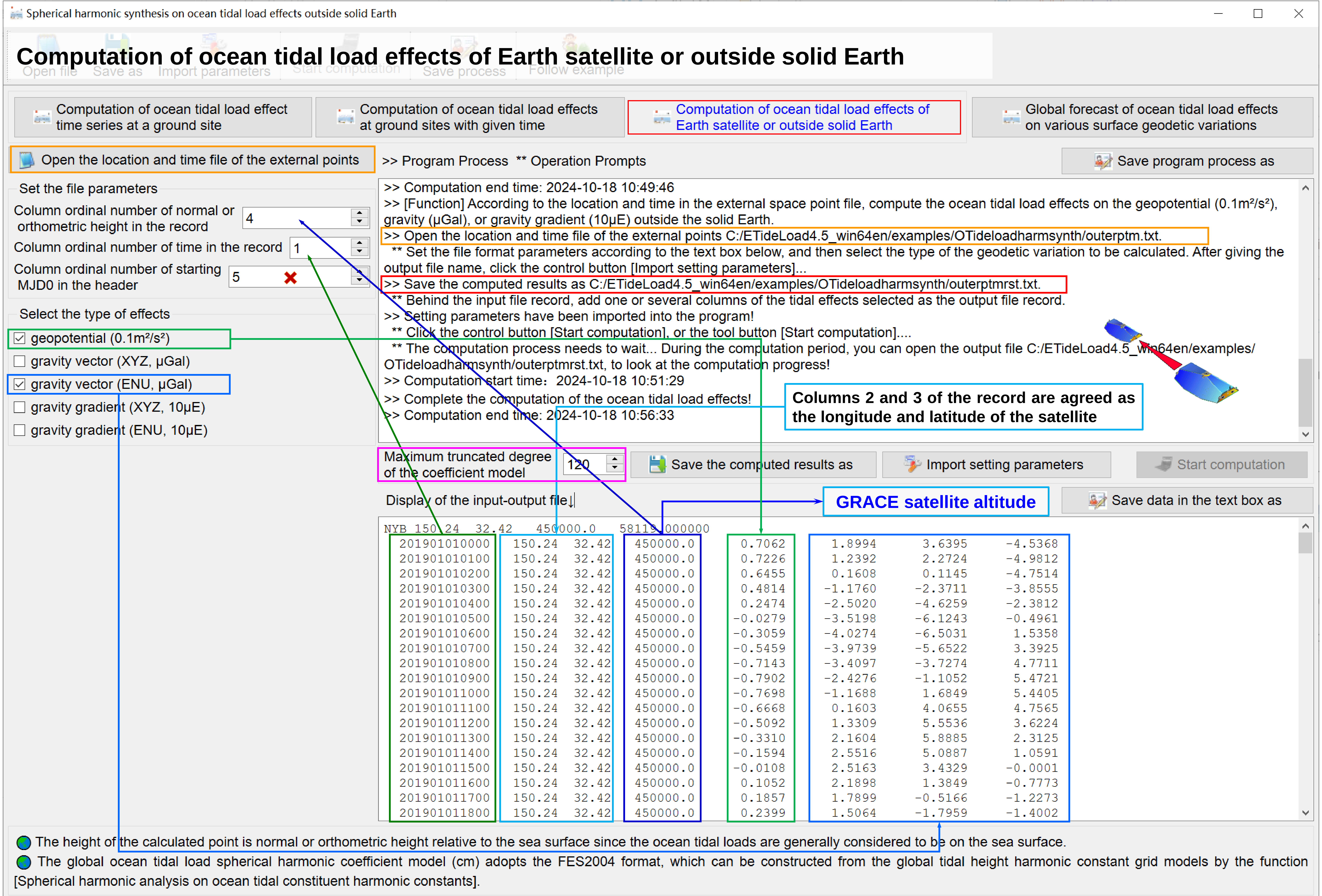
Different from the effect of the solid Earth's tide, the load effect on normal height is in the same phase as that on ellipsoidal height, and the magnitude of the tidal load effect on normal height is about 1.75 times that on ellipsoidal height.

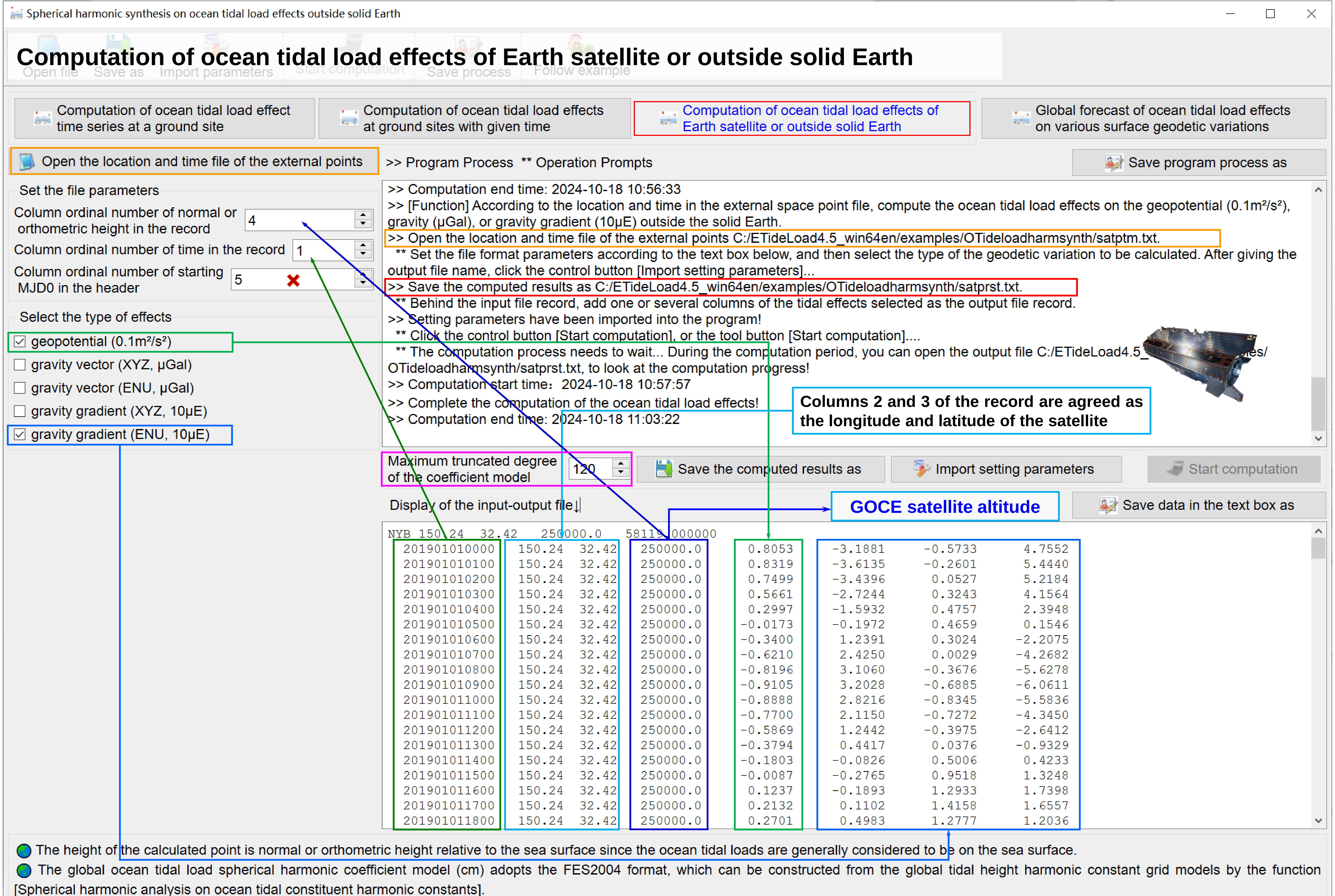


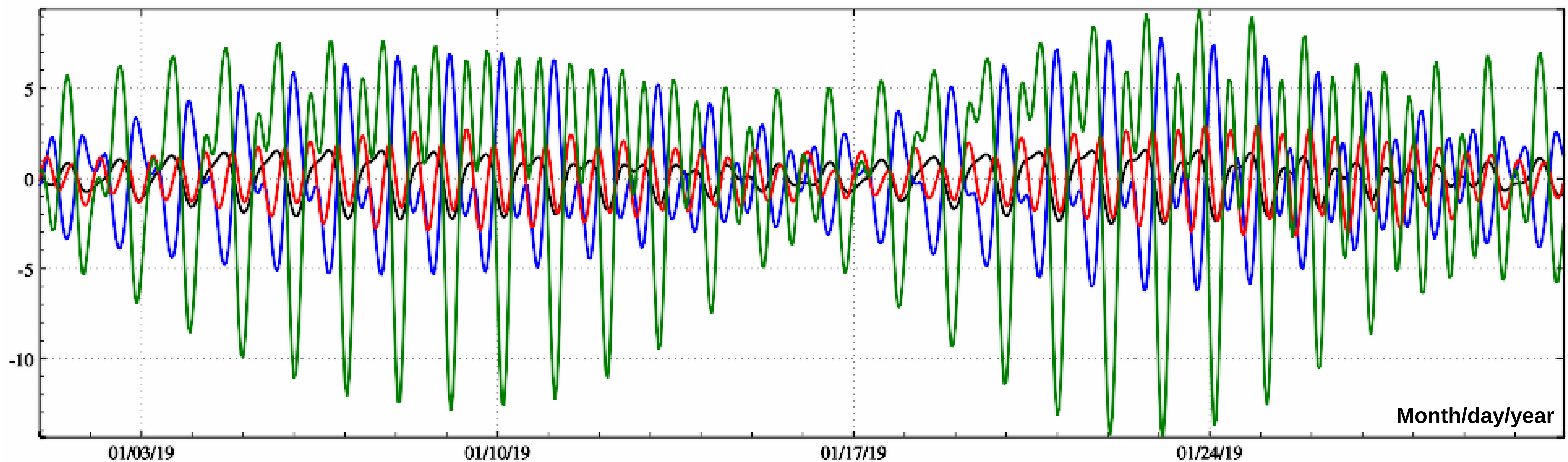
The ocean tidal load effects (360-degree) : height anomaly (mm) ground gravity (μGal) radial displacement (mm) orthometric height (mm)



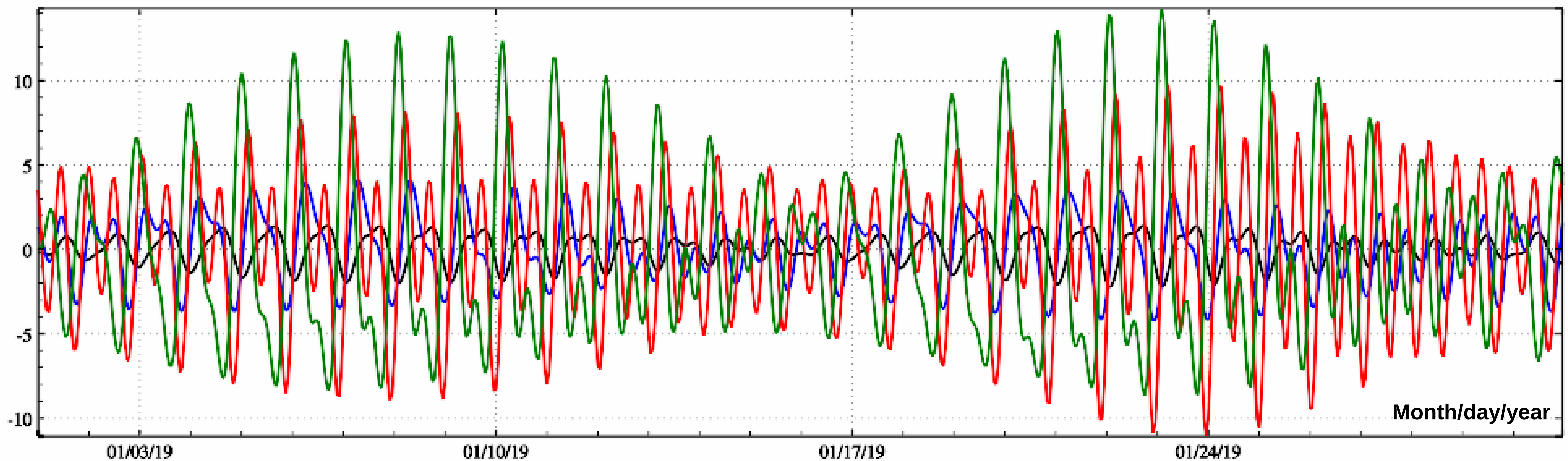
The ocean tidal load effects (360-degree) : ground tilt (S, mas) tilt (W, mas) horizontal displacement (E, mm) horizontal displacement (N, mm)


Spherical harmonic synthesis on ocean tidal load effects outside solid Earth
Computation of ocean tidal load effects of Earth satellite or outside solid Earth
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Computation of ocean tidal load effect time series at a ground site
Computation of ocean tidal load effects at ground sites with given time
Computation of ocean tidal load effects of Earth satellite or outside solid Earth
Global forecast of ocean tidal load effects on various surface geodetic variations
Open the location and time file of the external points
>> Program Process ** Operation Prompts
Save program process as
Set the file parameters
Column ordinal number of normal or orthometric height in the record
4
Column ordinal number of time in the record
1
Column ordinal number of starting MJD0 in the header
5
Select the type of effects
geopotential (0.1m²/s²)
gravity vector (XYZ, μGal)
gravity vector (ENU, μGal)
gravity gradient (XYZ, 10μE)
gravity gradient (ENU, 10μE)
>> Computation end time: 2024-10-18 10:49:46
>> [Function] According to the location and time in the external space point file, compute the ocean tidal load effects on the geopotential (0.1m²/s²), gravity (μGal), or gravity gradient (10μE) outside the solid Earth.
>> Open the location and time file of the external points C:/ETideLoad4.5_win64en/examples/OTideloadharmsynth/outerptm.txt.
** Set the file format parameters according to the text box below, and then select the type of the geodetic variation to be calculated. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/OTideloadharmsynth/outerptmrst.txt.
** Behind the input file record, add one or several columns of the tidal effects selected as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
** The computation process needs to wait... During the computation period, you can open the output file C:/ETideLoad4.5_win64en/examples/OTideloadharmsynth/outerptmrst.txt, to look at the computation progress!
>> Computation start time: 2024-10-18 10:51:29
>> Complete the computation of the ocean tidal load effects!
>> Computation end time: 2024-10-18 10:56:33
Columns 2 and 3 of the record are agreed as the longitude and latitude of the satellite
Maximum truncated degree of the coefficient model
120
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
GRACE satellite altitude
Save data in the text box as
NYB 150.24 32.42 450000.0 58119.000000
201901010000 150.24 32.42 450000.0 0.7062 1.8994 3.6395 -4.5368
201901010100 150.24 32.42 450000.0 0.7226 1.2392 2.2724 -4.9812
201901010200 150.24 32.42 450000.0 0.6455 0.1608 0.1145 -4.7514
201901010300 150.24 32.42 450000.0 0.4814 -1.1760 -2.3711 -3.8555
201901010400 150.24 32.42 450000.0 0.2474 -2.5020 -4.6259 -2.3812
201901010500 150.24 32.42 450000.0 -0.0279 -3.5198 -6.1243 -0.4961
201901010600 150.24 32.42 450000.0 -0.3059 -4.0274 -6.5031 1.5358
201901010700 150.24 32.42 450000.0 -0.5459 -3.9739 -5.6522 3.3925
201901010800 150.24 32.42 450000.0 -0.7143 -3.4097 -3.7274 4.7711
201901010900 150.24 32.42 450000.0 -0.7902 -2.4276 -1.1052 5.4721
201901011000 150.24 32.42 450000.0 -0.7698 -1.1688 1.6849 5.4405
201901011100 150.24 32.42 450000.0 -0.6668 0.1603 4.0655 4.7565
201901011200 150.24 32.42 450000.0 -0.5092 1.3309 5.5536 3.6224
201901011300 150.24 32.42 450000.0 -0.3310 2.1604 5.8885 2.3125
201901011400 150.24 32.42 450000.0 -0.1594 2.5516 5.0887 1.0591
201901011500 150.24 32.42 450000.0 -0.0108 2.5163 3.4329 -0.0001
201901011600 150.24 32.42 450000.0 0.1052 2.1898 1.3849 -0.7773
201901011700 150.24 32.42 450000.0 0.1857 1.7899 -0.5166 -1.2273
201901011800 150.24 32.42 450000.0 0.2399 1.5064 -1.7959 -1.4002
The height of the calculated point is normal or orthometric height relative to the sea surface since the ocean tidal loads are generally considered to be on the sea surface.
The global ocean tidal load spherical harmonic coefficient model (cm) adopts the FES2004 format, which can be constructed from the global tidal height harmonic constant grid models by the function [Spherical harmonic analysis on ocean tidal constituent harmonic constants].

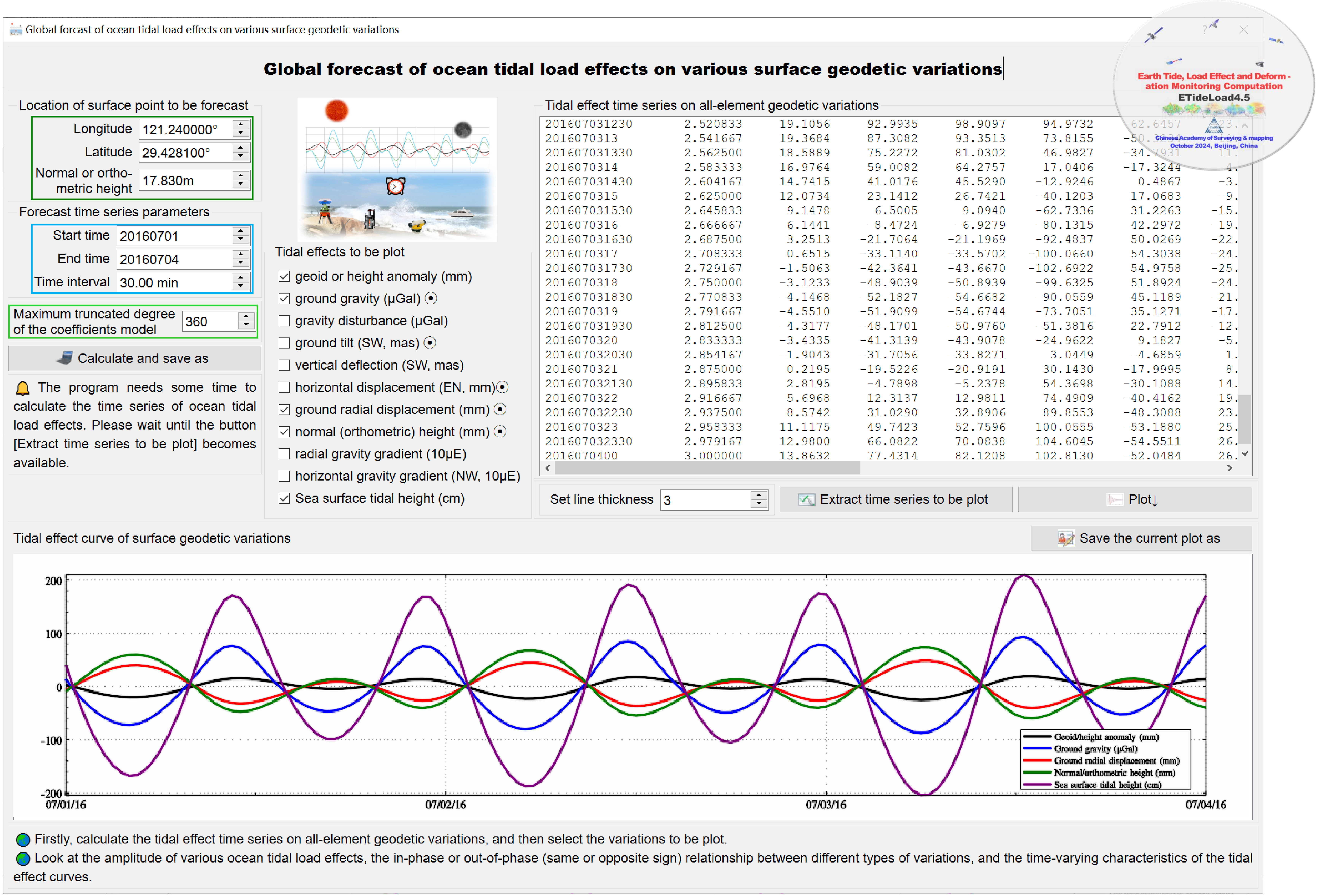

Spherical harmonic synthesis on ocean tidal load effects outside solid Earth
Computation of ocean tidal load effects of Earth satellite or outside solid Earth
Open file Save as Import parameters Start computation Save process Follow example
Computation of ocean tidal load effect time series at a ground site
Computation of ocean tidal load effects at ground sites with given time
Computation of ocean tidal load effects of Earth satellite or outside solid Earth
Global forecast of ocean tidal load effects on various surface geodetic variations
Open the location and time file of the external points
>> Program Process ** Operation Prompts
Save program process as
Set the file parameters
Column ordinal number of normal or orthometric height in the record 4
Column ordinal number of time in the record 1
Column ordinal number of starting MJD0 in the header 5
Select the type of effects
geopotential (0.1m²/s²)
gravity vector (XYZ, μGal)
gravity vector (ENU, μGal)
gravity gradient (XYZ, 10μE)
gravity gradient (ENU, 10μE)
>> Computation end time: 2024-10-18 10:56:33
>> [Function] According to the location and time in the external space point file, compute the ocean tidal load effects on the geopotential (0.1m²/s²), gravity (μGal), or gravity gradient (10μE) outside the solid Earth.
>> Open the location and time file of the external points C:/ETideLoad4.5_win64en/examples/OTideloadharmsynth/satptm.txt.
** Set the file format parameters according to the text box below, and then select the type of the geodetic variation to be calculated. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/OTideloadharmsynth/satprst.txt.
** Behind the input file record, add one or several columns of the tidal effects selected as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
** The computation process needs to wait... During the computation period, you can open the output file C:/ETideLoad4.5_...es/OTideloadharmsynth/satprst.txt, to look at the computation progress!
>> Computation start time: 2024-10-18 10:57:57
>> Complete the computation of the ocean tidal load effects!
>> Computation end time: 2024-10-18 11:03:22
Columns 2 and 3 of the record are agreed as the longitude and latitude of the satellite
Maximum truncated degree of the coefficient model 120
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
GOCE satellite altitude
Save data in the text box as
NYB 150.24 32.42 250000.0 58119.000000
201901010000 150.24 32.42 250000.0 0.8053 -3.1881 -0.5733 4.7552
201901010100 150.24 32.42 250000.0 0.8319 -3.6135 -0.2601 5.4440
201901010200 150.24 32.42 250000.0 0.7499 -3.4396 0.0527 5.2184
201901010300 150.24 32.42 250000.0 0.5661 -2.7244 0.3243 4.1564
201901010400 150.24 32.42 250000.0 0.2997 -1.5932 0.4757 2.3948
201901010500 150.24 32.42 250000.0 -0.0173 -0.1972 0.4659 0.1546
201901010600 150.24 32.42 250000.0 -0.3400 1.2391 0.3024 -2.2075
201901010700 150.24 32.42 250000.0 -0.6210 2.4250 0.0029 -4.2682
201901010800 150.24 32.42 250000.0 -0.8196 3.1060 -0.3676 -5.6278
201901010900 150.24 32.42 250000.0 -0.9105 3.2028 -0.6885 -6.0611
201901011000 150.24 32.42 250000.0 -0.8888 2.8216 -0.8345 -5.5836
201901011100 150.24 32.42 250000.0 -0.7700 2.1150 -0.7272 -4.3450
201901011200 150.24 32.42 250000.0 -0.5869 1.2442 -0.3975 -2.6412
201901011300 150.24 32.42 250000.0 -0.3794 0.4417 0.0376 -0.9329
201901011400 150.24 32.42 250000.0 -0.1803 -0.0826 0.5006 0.4233
201901011500 150.24 32.42 250000.0 -0.0087 -0.2765 0.9518 1.3248
201901011600 150.24 32.42 250000.0 0.1237 -0.1893 1.2933 1.7398
201901011700 150.24 32.42 250000.0 0.2132 0.1102 1.4158 1.6557
201901011800 150.24 32.42 250000.0 0.2701 0.4983 1.2777 1.2036
The height of the calculated point is normal or orthometric height relative to the sea surface since the ocean tidal loads are generally considered to be on the sea surface.
The global ocean tidal load spherical harmonic coefficient model (cm) adopts the FES2004 format, which can be constructed from the global tidal height harmonic constant grid models by the function [Spherical harmonic analysis on ocean tidal constituent harmonic constants].



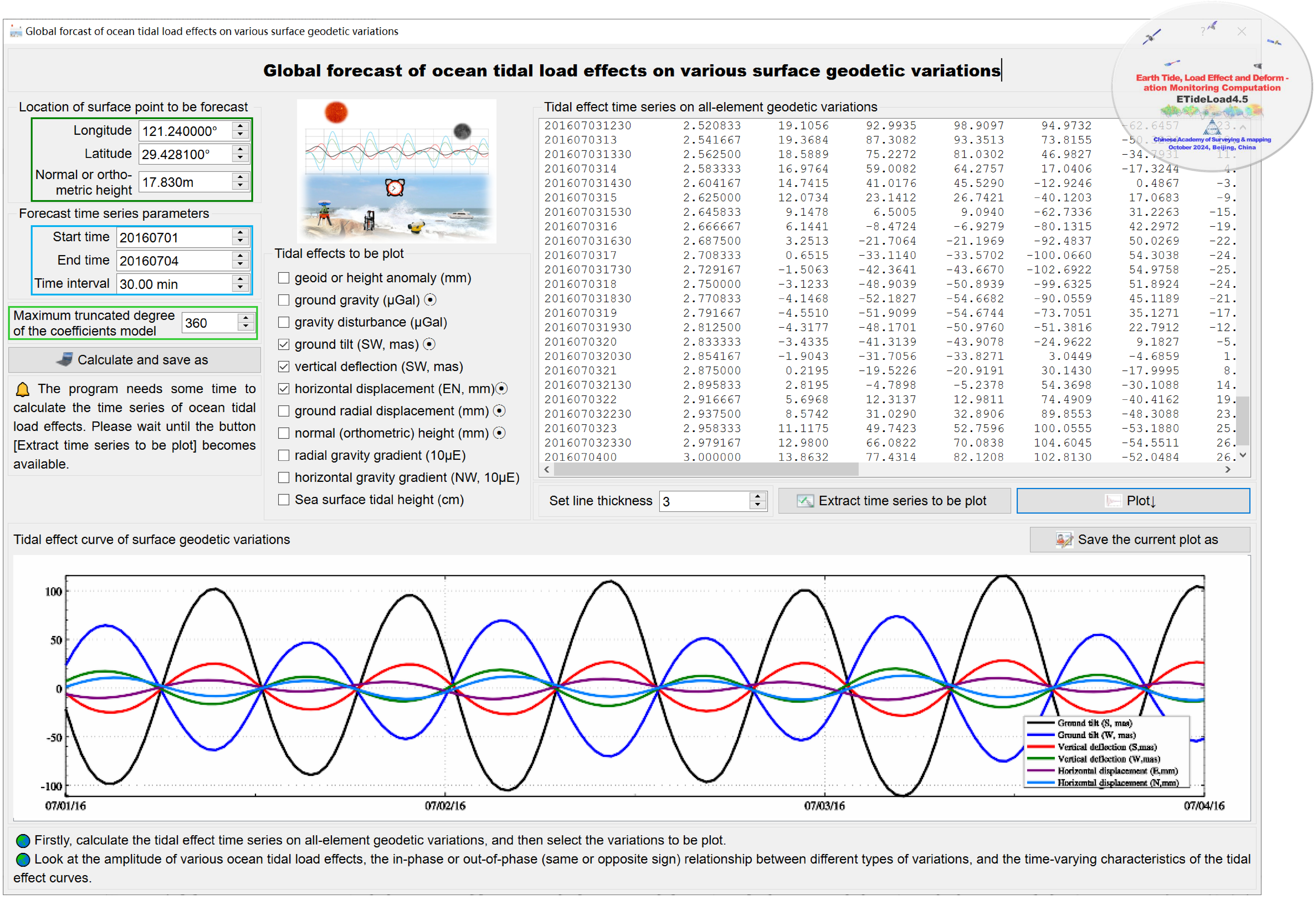
The ocean tidal load effects at 450km altitude： geopotential (0.1m²/s²), gravity vector (E, N: along the GRACE orbit/SST-ll, U, μGal)



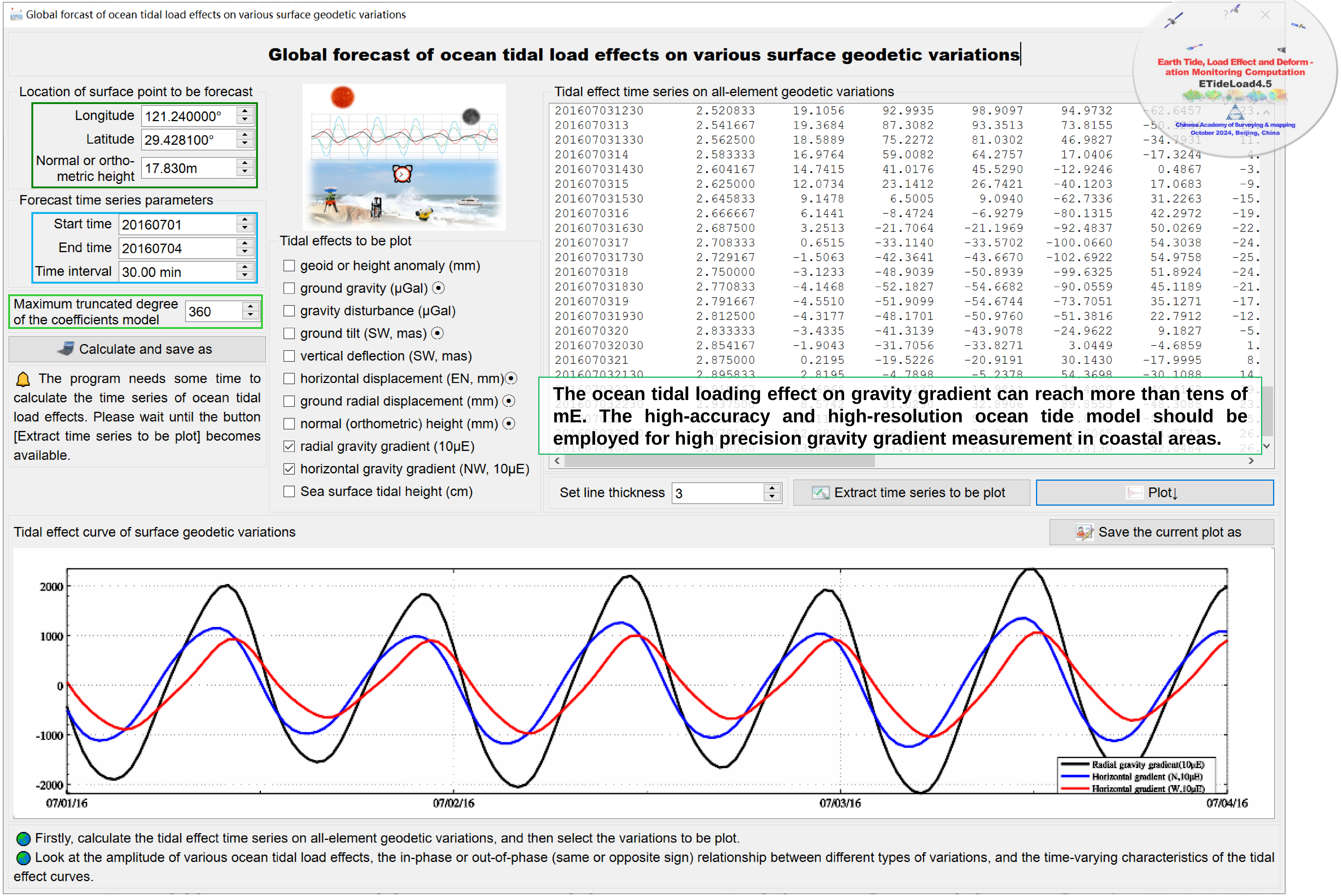
The ocean tidal load effects at 250km altitude： geopotential (0.1m²/s²), gravity gradient (E, N: along the GOCE orbit, U, 10μE)

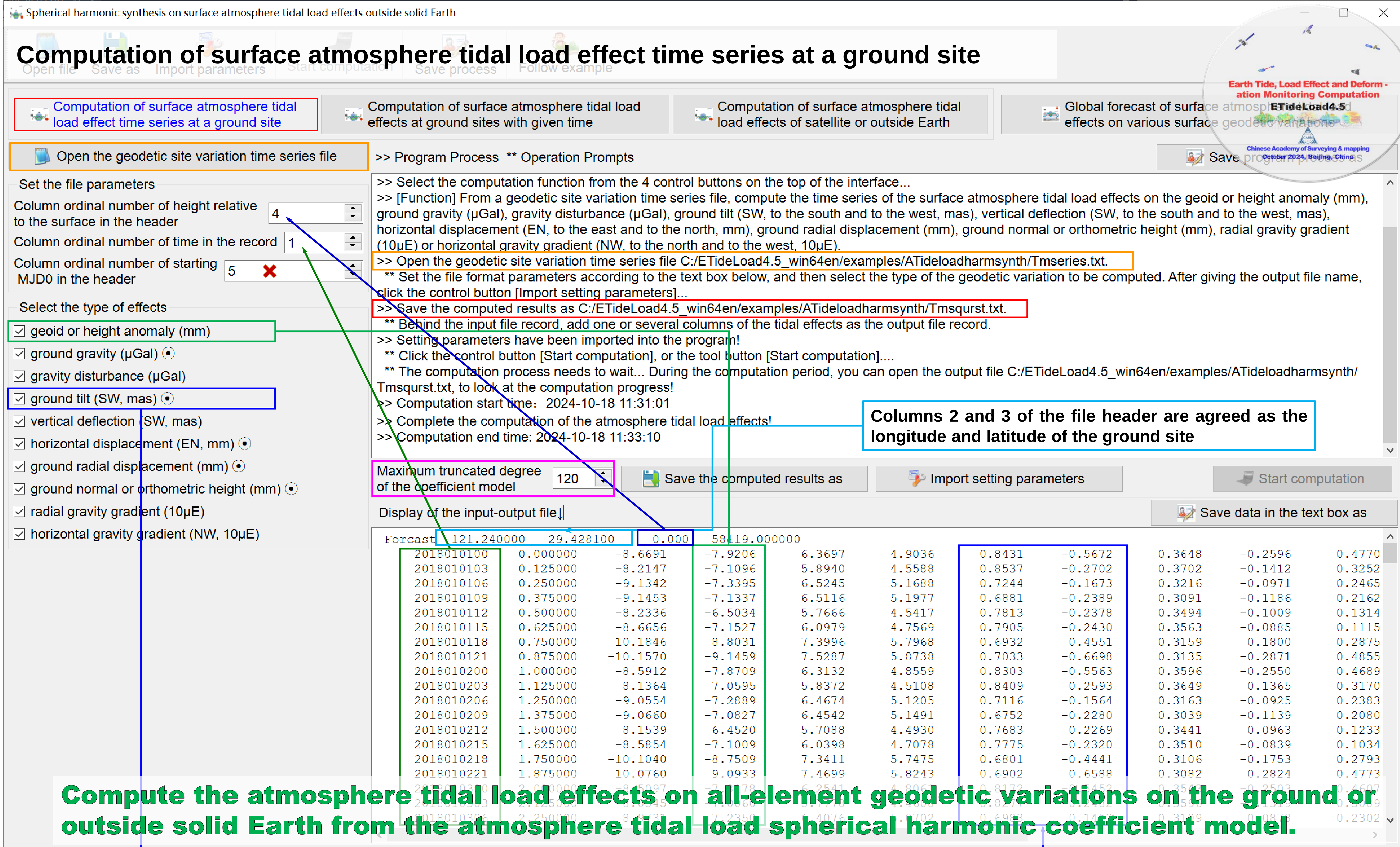


Global forcast of ocean tidal load effects on various surface geodetic variations
Global forecast of ocean tidal load effects on various surface geodetic variations
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Normal or orthometric height 17.830m
Forecast time series parameters
Start time 20160701
End time 20160704
Time interval 30.00 min
Maximum truncated degree of the coefficients model 360
Calculate and save as
The program needs some time to calculate the time series of ocean tidal load effects. Please wait until the button [Extract time series to be plot] becomes available.
Tidal effects to be plot
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
normal (orthometric) height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
Sea surface tidal height (cm)
Tidal effect time series on all-element geodetic variations
201607031230 2.520833 19.1056 92.9935 98.9097 94.9732 -62.6457
201607031300 2.541667 19.3684 87.3082 93.3513 73.8155
201607031330 2.562500 18.5889 75.2272 81.0302 46.9827
201607031400 2.583333 16.9764 59.0082 64.2757 17.0406 -17.3244
201607031430 2.604167 14.7415 41.0176 45.5290 -12.9246 0.4867
201607031500 2.625000 12.0734 23.1412 26.7421 -40.1203 17.0683
201607031530 2.645833 9.1478 6.5005 9.0940 -62.7336 31.2263
201607031600 2.666667 6.1441 -8.4724 -6.9279 -80.1315 42.2972
201607031630 2.687500 3.2513 -21.7064 -21.1969 -92.4837 50.0269
201607031700 2.708333 0.6515 -33.1140 -33.5702 -100.0660 54.3038
201607031730 2.729167 -1.5063 -42.3641 -43.6670 -102.6922 54.9758
201607031800 2.750000 -3.1233 -48.9039 -50.8939 -99.6325 51.8924
201607031830 2.770833 -4.1468 -52.1827 -54.6682 -90.0559 45.1189
201607031900 2.791667 -4.5510 -51.9099 -54.6744 -73.7051 35.1271
201607031930 2.812500 -4.3177 -48.1701 -50.9760 -51.3816 22.7912
201607032000 2.833333 -3.4335 -41.3139 -43.9078 -24.9622 9.1827
201607032030 2.854167 -1.9043 -31.7056 -33.8271 3.0449 -4.6859
201607032100 2.875000 0.2195 -19.5226 -20.9191 30.1430 -17.9995
201607032130 2.895833 2.8195 -4.7898 -5.2378 54.3698 -30.1088
201607032200 2.916667 5.6968 12.3137 12.9811 74.4909 -40.4162
201607032230 2.937500 8.5742 31.0290 32.8906 89.8553 -48.3088
201607032300 2.958333 11.1175 49.7423 52.7596 100.0555 -53.1880
201607032330 2.979167 12.9800 66.0822 70.0838 104.6045 -54.5511
201607040000 3.000000 13.8632 77.4314 82.1208 102.8130 -52.0484
Set line thickness 3
Extract time series to be plot
Plot
Tidal effect curve of surface geodetic variations
Save the current plot as
200
100
0
-100
-200
07/01/16
07/02/16
07/03/16
07/04/16
Geoid/height anomaly (mm)
Ground gravity (μGal)
Ground radial displacement (mm)
Normal/orthometric height (mm)
Sea surface tidal height (cm)
Firstly, calculate the tidal effect time series on all-element geodetic variations, and then select the variations to be plot.
Look at the amplitude of various ocean tidal load effects, the in-phase or out-of-phase (same or opposite sign) relationship between different types of variations, and the time-varying characteristics of the tidal effect curves.



Global forcast of ocean tidal load effects on various surface geodetic variations
Global forecast of ocean tidal load effects on various surface geodetic variations
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Normal or ortho-metric height 17.830m
Forecast time series parameters
Start time 20160701
End time 20160704
Time interval 30.00 min
Maximum truncated degree of the coefficients model 360
Calculate and save as
The program needs some time to calculate the time series of ocean tidal load effects. Please wait until the button [Extract time series to be plot] becomes available.
Tidal effects to be plot
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
normal (orthometric) height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
Sea surface tidal height (cm)
Tidal effect time series on all-element geodetic variations
201607031230 2.520833 19.1056 92.9935 98.9097 94.9732 -62.6457
201607031 3 2.541667 19.3684 87.3082 93.3513 73.8155
201607031330 2.562500 18.5889 75.2272 81.0302 46.9827
201607031 4 2.583333 16.9764 59.0082 64.2757 17.0406 -17.3244
201607031430 2.604167 14.7415 41.0176 45.5290 -12.9246 0.4867 -3.
201607031 5 2.625000 12.0734 23.1412 26.7421 -40.1203 17.0683 -9.
201607031530 2.645833 9.1478 6.5005 9.0940 -62.7336 31.2263 -15.
201607031 6 2.666667 6.1441 -8.4724 -6.9279 -80.1315 42.2972 -19.
201607031630 2.687500 3.2513 -21.7064 -21.1969 -92.4837 50.0269 -22.
201607031 7 2.708333 0.6515 -33.1140 -33.5702 -100.0660 54.3038 -24.
201607031730 2.729167 -1.5063 -42.3641 -43.6670 -102.6922 54.9758 -25.
201607031 8 2.750000 -3.1233 -48.9039 -50.8939 -99.6325 51.8924 -24.
201607031830 2.770833 -4.1468 -52.1827 -54.6682 -90.0559 45.1189 -21.
201607031 9 2.791667 -4.5510 -51.9099 -54.6744 -73.7051 35.1271 -17.
201607031930 2.812500 -4.3177 -48.1701 -50.9760 -51.3816 22.7912 -12.
201607032 0 2.833333 -3.4335 -41.3139 -43.9078 -24.9622 9.1827 -5.
201607032030 2.854167 -1.9043 -31.7056 -33.8271 3.0449 -4.6859 1.
201607032 1 2.875000 0.2195 -19.5226 -20.9191 30.1430 -17.9995 8.
201607032130 2.895833 2.8195 -4.7898 -5.2378 54.3698 -30.1088 14.
201607032 2 2.916667 5.6968 12.3137 12.9811 74.4909 -40.4162 19.
201607032230 2.937500 8.5742 31.0290 32.8906 89.8553 -48.3088 23.
201607032 3 2.958333 11.1175 49.7423 52.7596 100.0555 -53.1880 25.
201607032330 2.979167 12.9800 66.0822 70.0838 104.6045 -54.5511 26.
201607040 0 3.000000 13.8632 77.4314 82.1208 102.8130 -52.0484 26.
Set line thickness 3
Extract time series to be plot
Plot↓
Tidal effect curve of surface geodetic variations
Save the current plot as
100
50
0
-50
-100
07/01/16
07/02/16
07/03/16
07/04/16
Ground tilt (S, mas)
Ground tilt (W, mas)
Vertical deflection (S,mas)
Vertical deflection (W,mas)
Horizontal displacement (E,mm)
Horizontal displacement (N,mm)
Firstly, calculate the tidal effect time series on all-element geodetic variations, and then select the variations to be plot.
Look at the amplitude of various ocean tidal load effects, the in-phase or out-of-phase (same or opposite sign) relationship between different types of variations, and the time-varying characteristics of the tidal effect curves.


Global forcast of ocean tidal load effects on various surface geodetic variations
Global forecast of ocean tidal load effects on various surface geodetic variations
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Normal or ortho-metric height 17.830m
Forecast time series parameters
Start time 20160701
End time 20160704
Time interval 30.00 min
Maximum truncated degree of the coefficients model 360
Calculate and save as
The program needs some time to calculate the time series of ocean tidal load effects. Please wait until the button [Extract time series to be plot] becomes available.
Tidal effects to be plot
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
normal (orthometric) height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
Sea surface tidal height (cm)
Tidal effect time series on all-element geodetic variations
201607031230 2.520833 19.1056 92.9935 98.9097 94.9732
2016070313 2.541667 19.3684 87.3082 93.3513 73.8155
201607031330 2.562500 18.5889 75.2272 81.0302 46.9827
2016070314 2.583333 16.9764 59.0082 64.2757 17.0406 -17.3244
201607031430 2.604167 14.7415 41.0176 45.5290 -12.9246 0.4867
2016070315 2.625000 12.0734 23.1412 26.7421 -40.1203 17.0683
201607031530 2.645833 9.1478 6.5005 9.0940 -62.7336 31.2263
2016070316 2.666667 6.1441 -8.4724 -6.9279 -80.1315 42.2972
201607031630 2.687500 3.2513 -21.7064 -21.1969 -92.4837 50.0269
2016070317 2.708333 0.6515 -33.1140 -33.5702 -100.0660 54.3038
201607031730 2.729167 -1.5063 -42.3641 -43.6670 -102.6922 54.9758
2016070318 2.750000 -3.1233 -48.9039 -50.8939 -99.6325 51.8924
201607031830 2.770833 -4.1468 -52.1827 -54.6682 -90.0559 45.1189
2016070319 2.791667 -4.5510 -51.9099 -54.6744 -73.7051 35.1271
201607031930 2.812500 -4.3177 -48.1701 -50.9760 -51.3816 22.7912
2016070320 2.833333 -3.4335 -41.3139 -43.9078 -24.9622 9.1827
201607032030 2.854167 -1.9043 -31.7056 -33.8271 3.0449 -4.6859
2016070321 2.875000 0.2195 -19.5226 -20.9191 30.1430 -17.9995
The ocean tidal loading effect on gravity gradient can reach more than tens of mE. The high-accuracy and high-resolution ocean tide model should be employed for high precision gravity gradient measurement in coastal areas.
Set line thickness 3
Extract time series to be plot
Plot
Tidal effect curve of surface geodetic variations
Save the current plot as
2000
1000
0
-1000
-2000
07/01/16
07/02/16
07/03/16
07/04/16
Radial gravity gradient(10μE)
Horizontal gradient (N,10μE)
Horizontal gradient (W,10μE)
Firstly, calculate the tidal effect time series on all-element geodetic variations, and then select the variations to be plot.
Look at the amplitude of various ocean tidal load effects, the in-phase or out-of-phase (same or opposite sign) relationship between different types of variations, and the time-varying characteristics of the tidal effect curves.

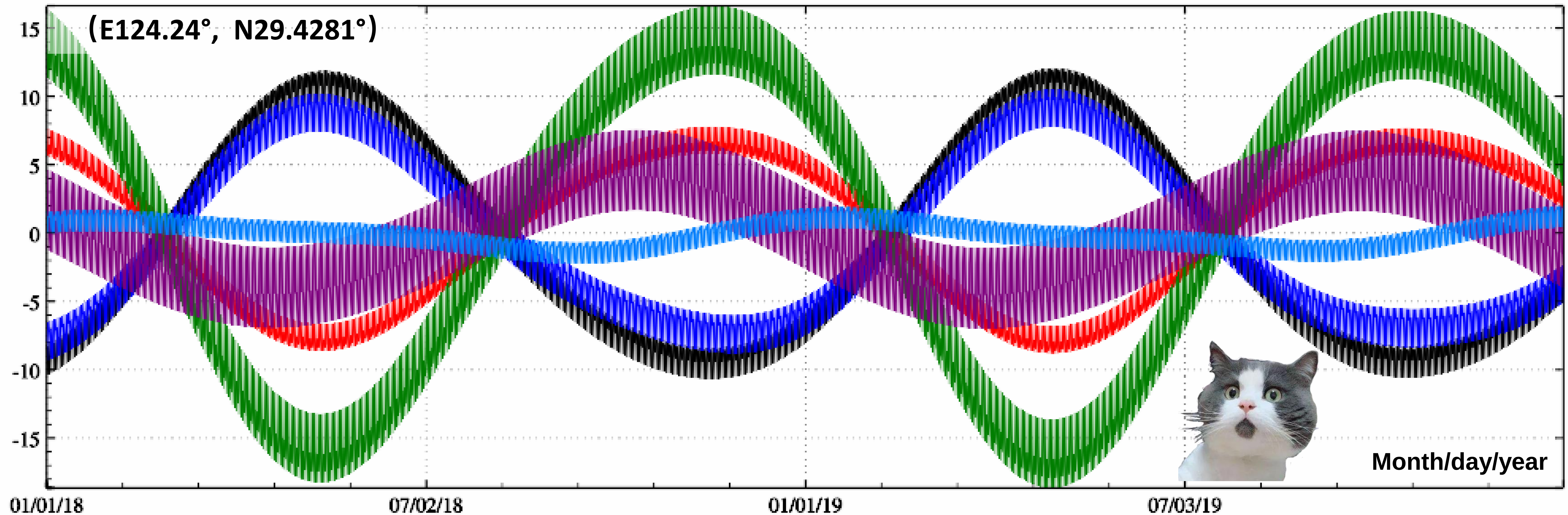


When calculating the indirect influences of surface atmosphere tidal load, the program assumes that the atmosphere loads are concentrated on the Earth's surface, and the height h of the calculation point is the height of the point relative to the surface. When calculating the direct influences of surface atmosphere tidal load to the gravity or gravity gradient, it is assumed that there is a proportional relationship between atmosphere P_h at height h and surface atmosphere P_0, namely $P_h=P_0\,(1-h/44330)^{5225}$.

The annual periodic amplitude of the surface atmosphere tide is more than 10 times the diurnal periodic amplitude. In the land area, the surface atmosphere is high in winter and low in summer, so that the ground decline in winter and uplift in summer, resulting in annual and semi-annual periodic ground vertical deformations, which should be considered in centimeter-level geodesy.

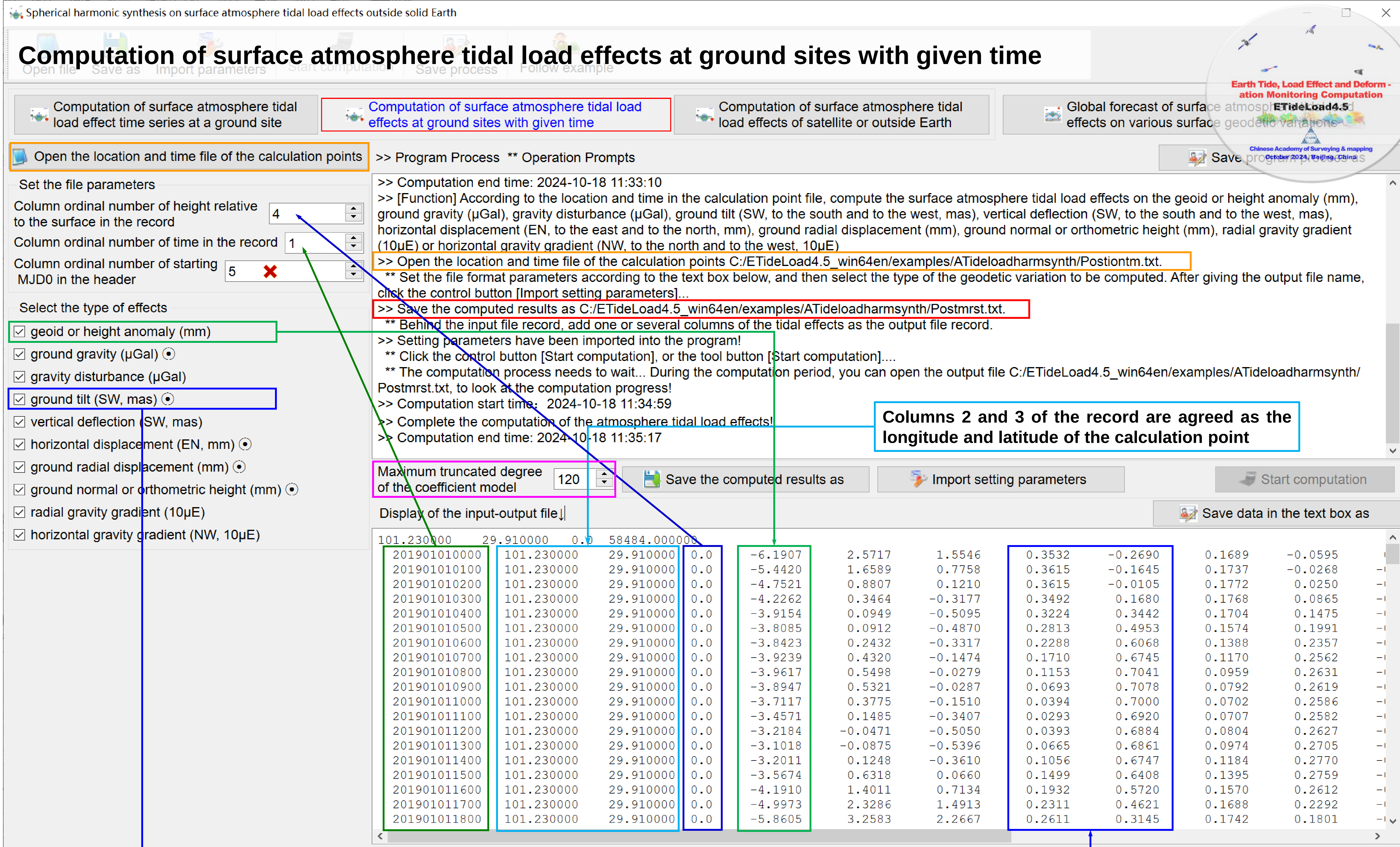
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China

Expand and improve surface atmosphere tidal load effect algorithm in the IERS conventions (2010) to adapt to all-element geodetic variations in the whole Earth space.



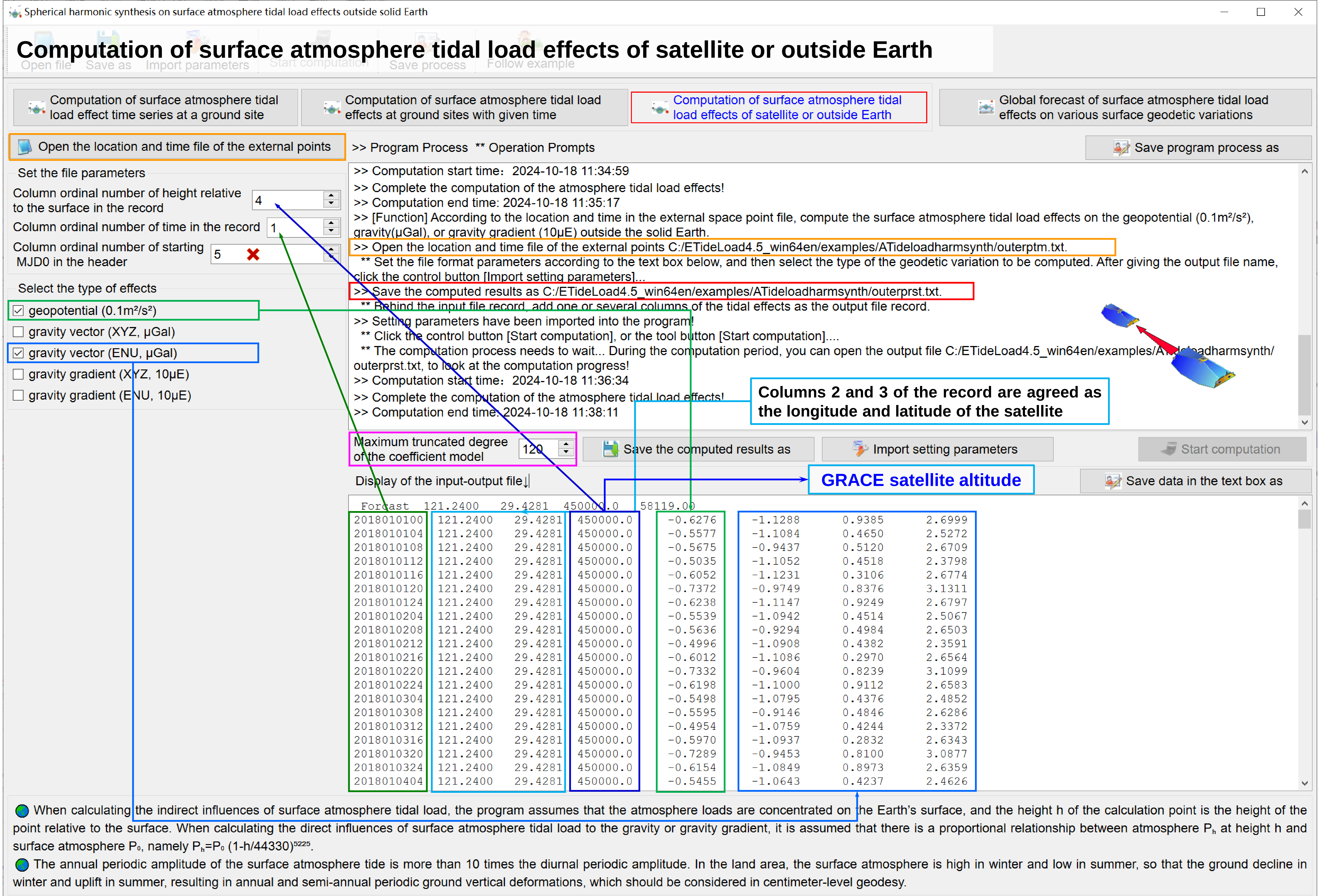
The Surface atmosphere tidal load effects (360-degree) : surface atmosphere(hPa/mbar) height anomaly (mm) ground gravity (μGal) orthometric height (mm) radial gravity gradient (10μE) horizontal displacement (N, 10μE)

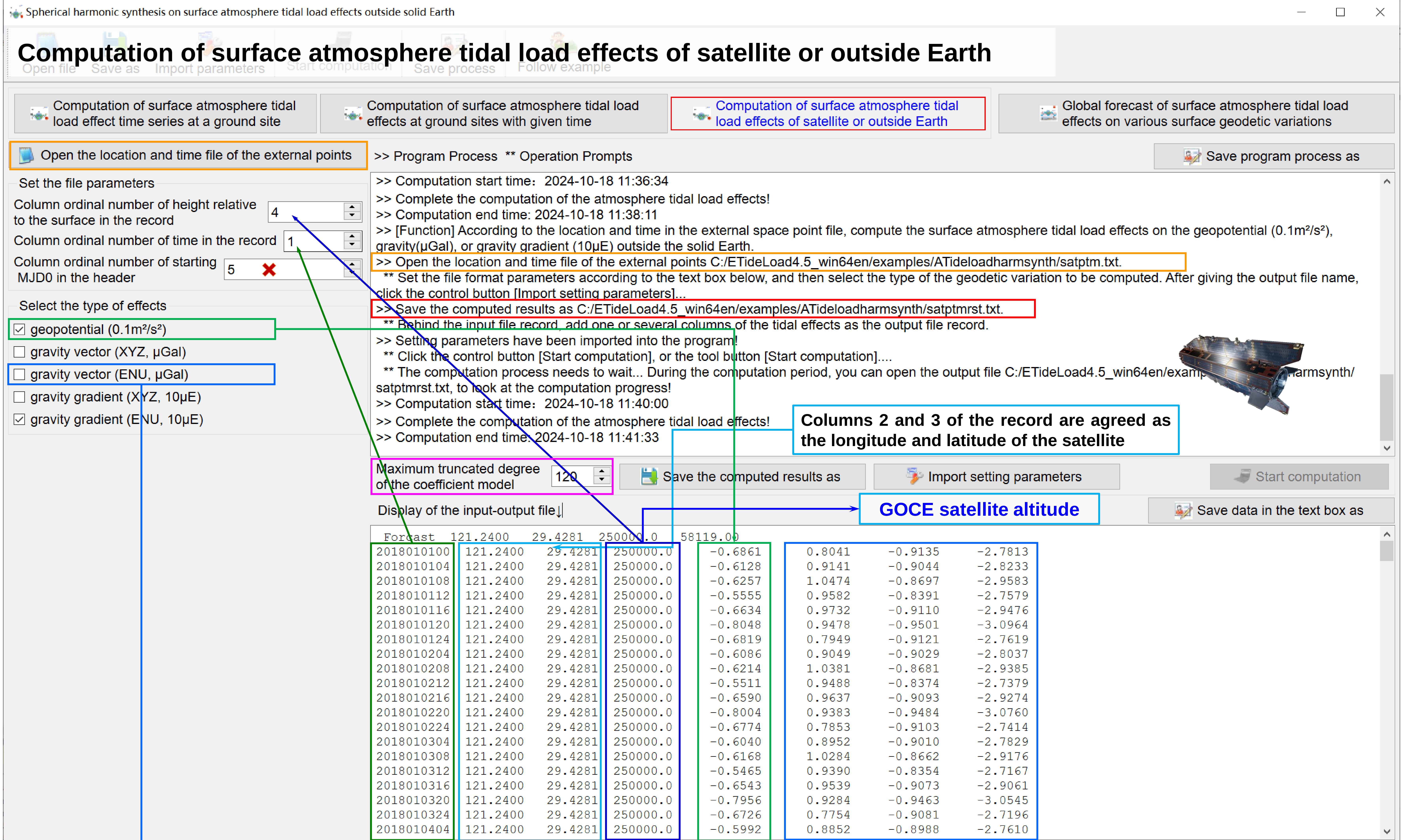
The annual periodic amplitude of the surface atmosphere tide is more than 10 times the diurnal periodic amplitude. In the land area, the surface atmosphere is high in winter and low in summer, so that the ground decline in winter and uplift in summer, resulting in annual and semi-annual periodic ground vertical deformations, which should be considered in centimeter-level geodesy.



When calculating the indirect influences of surface atmosphere tidal load, the program assumes that the atmosphere loads are concentrated on the Earth's surface, and the height h of the calculation point is the height of the point relative to the surface. When calculating the direct influences of surface atmosphere tidal load to the gravity or gravity gradient, it is assumed that there is a proportional relationship between atmosphere P_h at height h and surface atmosphere P_0, namely $P_h=P_0\,(1-h/44330)^{5225}$.

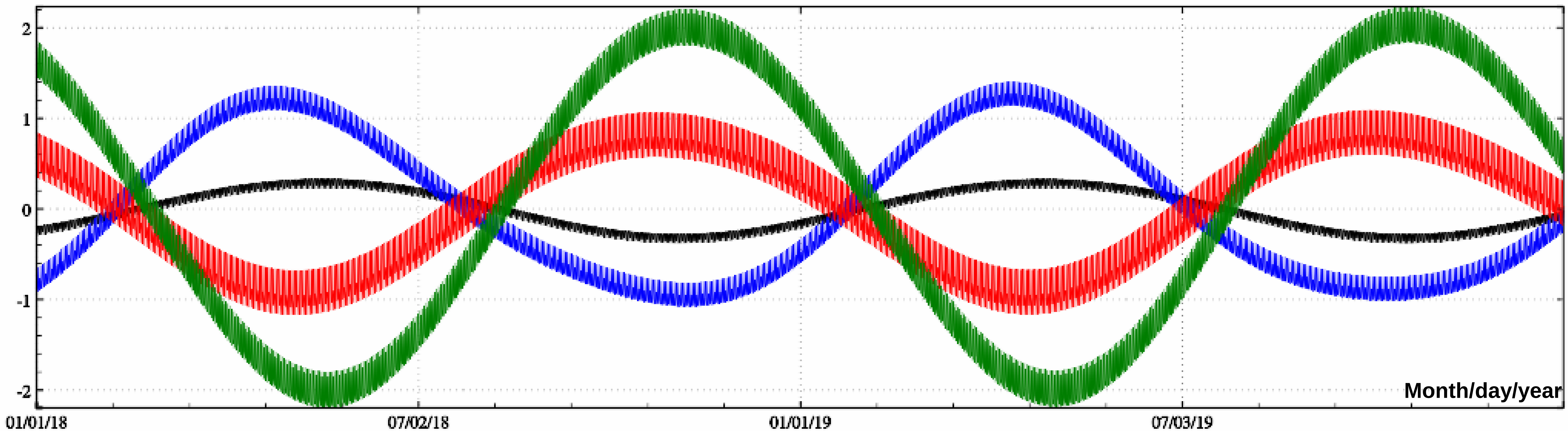
The annual periodic amplitude of the surface atmosphere tide is more than 10 times the diurnal periodic amplitude. In the land area, the surface atmosphere is high in winter and low in summer, so that the ground decline in winter and uplift in summer, resulting in annual and semi-annual periodic ground vertical deformations, which should be considered in centimeter-level geodesy.


Spherical harmonic synthesis on surface atmosphere tidal load effects outside solid Earth
Computation of surface atmosphere tidal load effects of satellite or outside Earth
Open file Save as Import parameters Start computation Save process Follow example
Computation of surface atmosphere tidal load effect time series at a ground site
Computation of surface atmosphere tidal load effects at ground sites with given time
Computation of surface atmosphere tidal load effects of satellite or outside Earth
Global forecast of surface atmosphere tidal load effects on various surface geodetic variations
Open the location and time file of the external points
>> Program Process ** Operation Prompts
Save program process as
Set the file parameters
Column ordinal number of height relative to the surface in the record 4
Column ordinal number of time in the record 1
Column ordinal number of starting MJD0 in the header 5
Select the type of effects
geopotential (0.1m²/s²)
gravity vector (XYZ, μGal)
gravity vector (ENU, μGal)
gravity gradient (XYZ, 10μE)
gravity gradient (ENU, 10μE)
>> Computation start time: 2024-10-18 11:34:59
>> Complete the computation of the atmosphere tidal load effects!
>> Computation end time: 2024-10-18 11:35:17
>> [Function] According to the location and time in the external space point file, compute the surface atmosphere tidal load effects on the geopotential (0.1m²/s²), gravity(μGal), or gravity gradient (10μE) outside the solid Earth.
>> Open the location and time file of the external points C:/ETideLoad4.5_win64en/examples/ATideloadharmsynth/outerptm.txt.
** Set the file format parameters according to the text box below, and then select the type of the geodetic variation to be computed. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/ATideloadharmsynth/outerprst.txt.
** Behind the input file record, add one or several columns of the tidal effects as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
** The computation process needs to wait... During the computation period, you can open the output file C:/ETideLoad4.5_win64en/examples/ATideloadharmsynth/outerprst.txt, to look at the computation progress!
>> Computation start time: 2024-10-18 11:36:34
>> Complete the computation of the atmosphere tidal load effects!
>> Computation end time: 2024-10-18 11:38:11
Columns 2 and 3 of the record are agreed as the longitude and latitude of the satellite
Maximum truncated degree of the coefficient model 120
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
GRACE satellite altitude
Save data in the text box as
Forcast 121.2400 29.4281 450000.0 58119.00
2018010100 121.2400 29.4281 450000.0 -0.6276 -1.1288 0.9385 2.6999
2018010104 121.2400 29.4281 450000.0 -0.5577 -1.1084 0.4650 2.5272
2018010108 121.2400 29.4281 450000.0 -0.5675 -0.9437 0.5120 2.6709
2018010112 121.2400 29.4281 450000.0 -0.5035 -1.1052 0.4518 2.3798
2018010116 121.2400 29.4281 450000.0 -0.6052 -1.1231 0.3106 2.6774
2018010120 121.2400 29.4281 450000.0 -0.7372 -0.9749 0.8376 3.1311
2018010124 121.2400 29.4281 450000.0 -0.6238 -1.1147 0.9249 2.6797
2018010204 121.2400 29.4281 450000.0 -0.5539 -1.0942 0.4514 2.5067
2018010208 121.2400 29.4281 450000.0 -0.5636 -0.9294 0.4984 2.6503
2018010212 121.2400 29.4281 450000.0 -0.4996 -1.0908 0.4382 2.3591
2018010216 121.2400 29.4281 450000.0 -0.6012 -1.1086 0.2970 2.6564
2018010220 121.2400 29.4281 450000.0 -0.7332 -0.9604 0.8239 3.1099
2018010224 121.2400 29.4281 450000.0 -0.6198 -1.1000 0.9112 2.6583
2018010304 121.2400 29.4281 450000.0 -0.5498 -1.0795 0.4376 2.4852
2018010308 121.2400 29.4281 450000.0 -0.5595 -0.9146 0.4846 2.6286
2018010312 121.2400 29.4281 450000.0 -0.4954 -1.0759 0.4244 2.3372
2018010316 121.2400 29.4281 450000.0 -0.5970 -1.0937 0.2832 2.6343
2018010320 121.2400 29.4281 450000.0 -0.7289 -0.9453 0.8100 3.0877
2018010324 121.2400 29.4281 450000.0 -0.6154 -1.0849 0.8973 2.6359
2018010404 121.2400 29.4281 450000.0 -0.5455 -1.0643 0.4237 2.4626
When calculating the indirect influences of surface atmosphere tidal load, the program assumes that the atmosphere loads are concentrated on the Earth's surface, and the height h of the calculation point is the height of the point relative to the surface. When calculating the direct influences of surface atmosphere tidal load to the gravity or gravity gradient, it is assumed that there is a proportional relationship between atmosphere Pₕ at height h and surface atmosphere P₀, namely Pₕ=P₀ (1-h/44330)⁵²²⁵.
The annual periodic amplitude of the surface atmosphere tide is more than 10 times the diurnal periodic amplitude. In the land area, the surface atmosphere is high in winter and low in summer, so that the ground decline in winter and uplift in summer, resulting in annual and semi-annual periodic ground vertical deformations, which should be considered in centimeter-level geodesy.

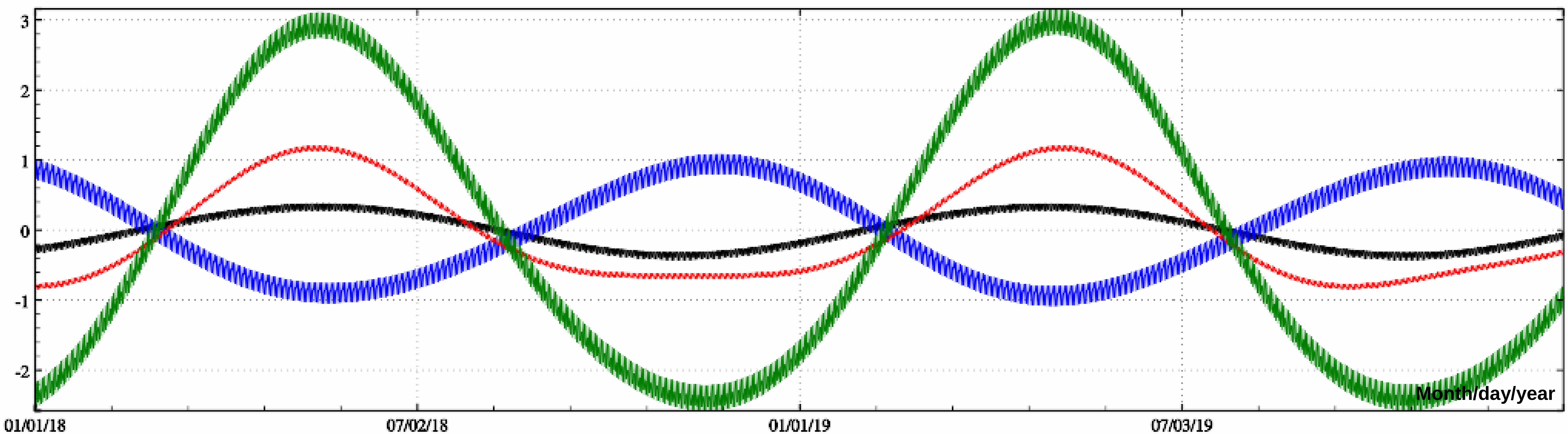


When calculating the indirect influences of surface atmosphere tidal load, the program assumes that the atmosphere loads are concentrated on the Earth's surface, and the height h of the calculation point is the height of the point relative to the surface. When calculating the direct influences of surface atmosphere tidal load to the gravity or gravity gradient, it is assumed that there is a proportional relationship between atmosphere P_h at height h and surface atmosphere P_0, namely $P_h=P_0\,(1-h/44330)^{5225}$.

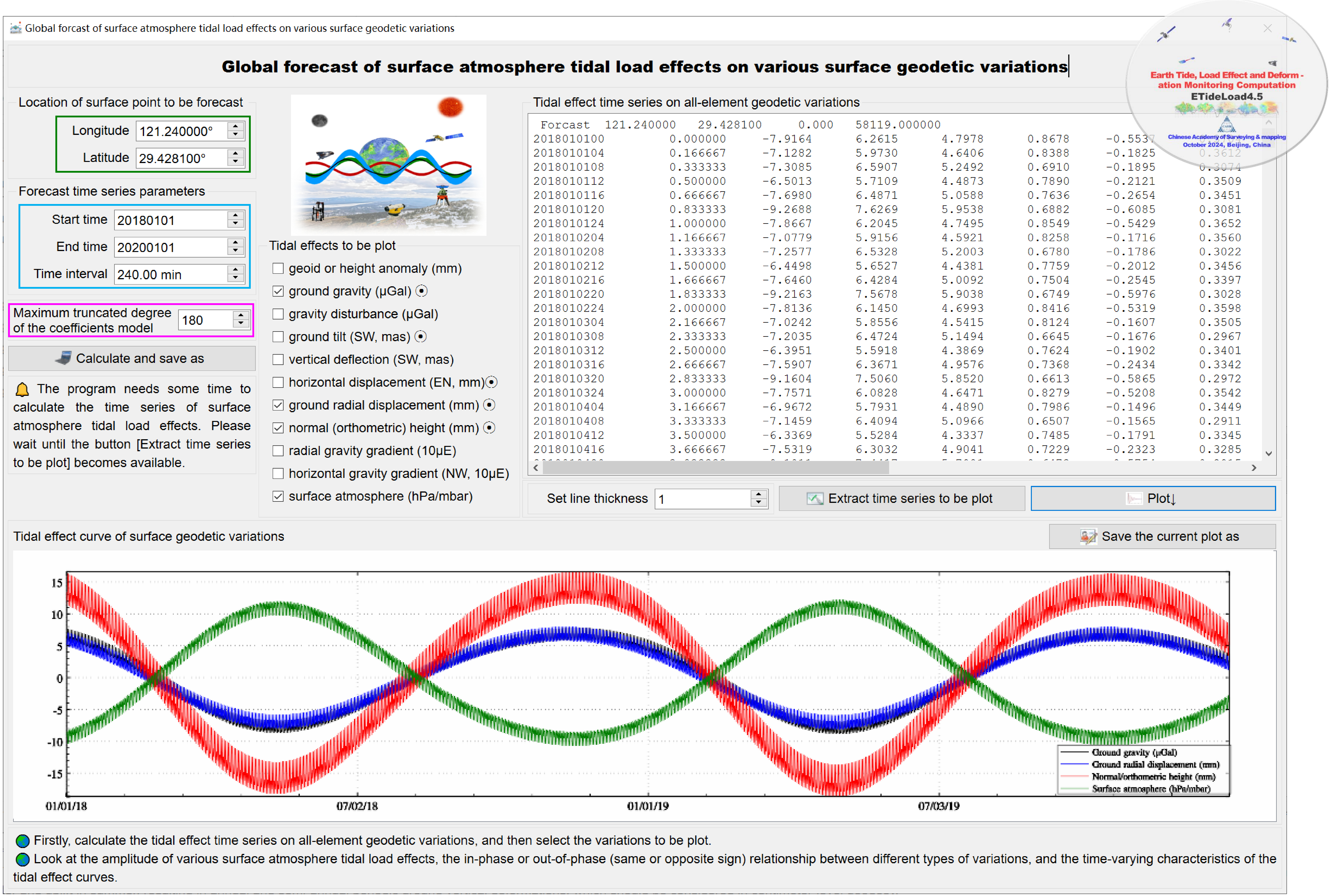
The annual periodic amplitude of the surface atmosphere tide is more than 10 times the diurnal periodic amplitude. In the land area, the surface atmosphere is high in winter and low in summer, so that the ground decline in winter and uplift in summer, resulting in annual and semi-annual periodic ground vertical deformations, which should be considered in centimeter-level geodesy.

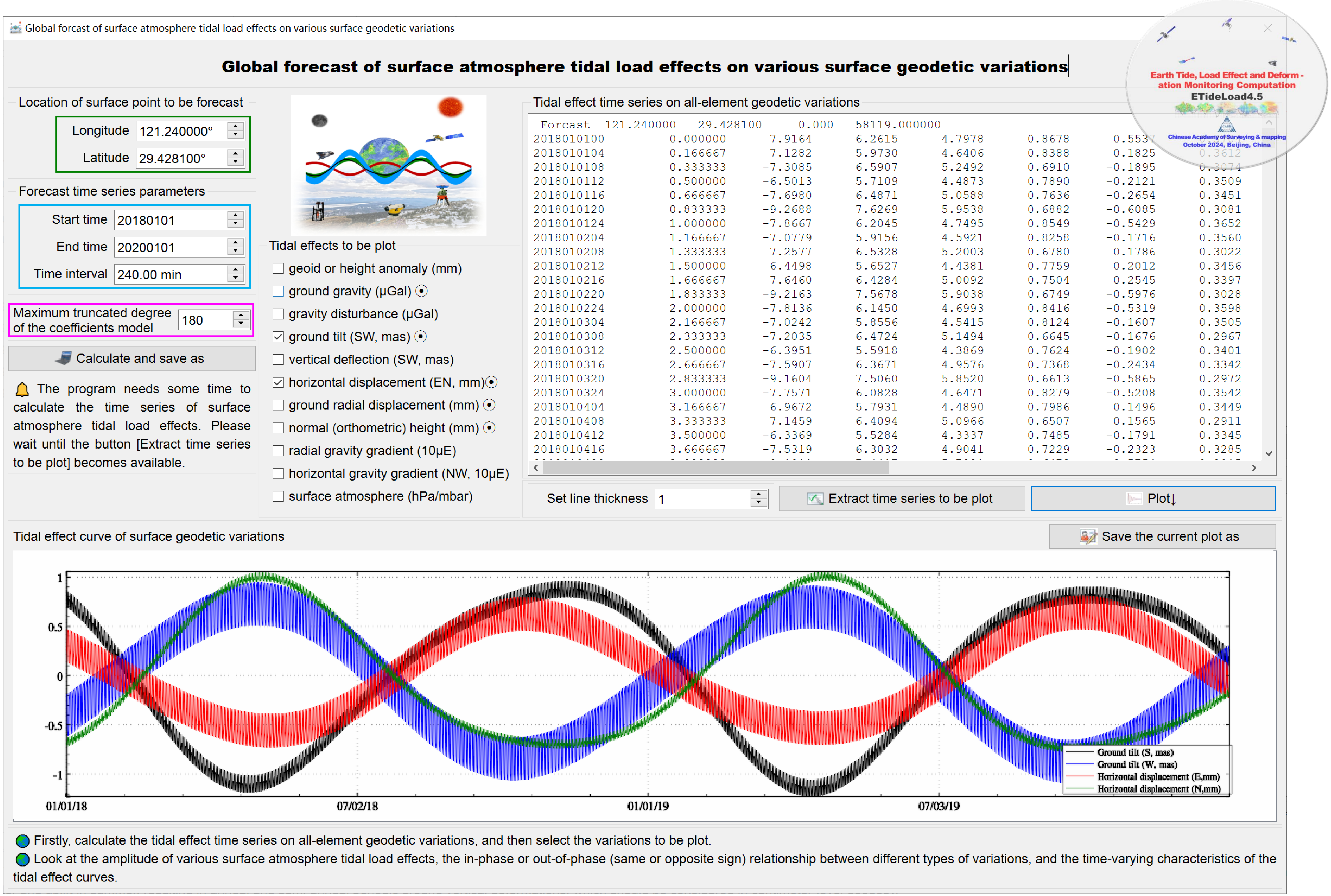


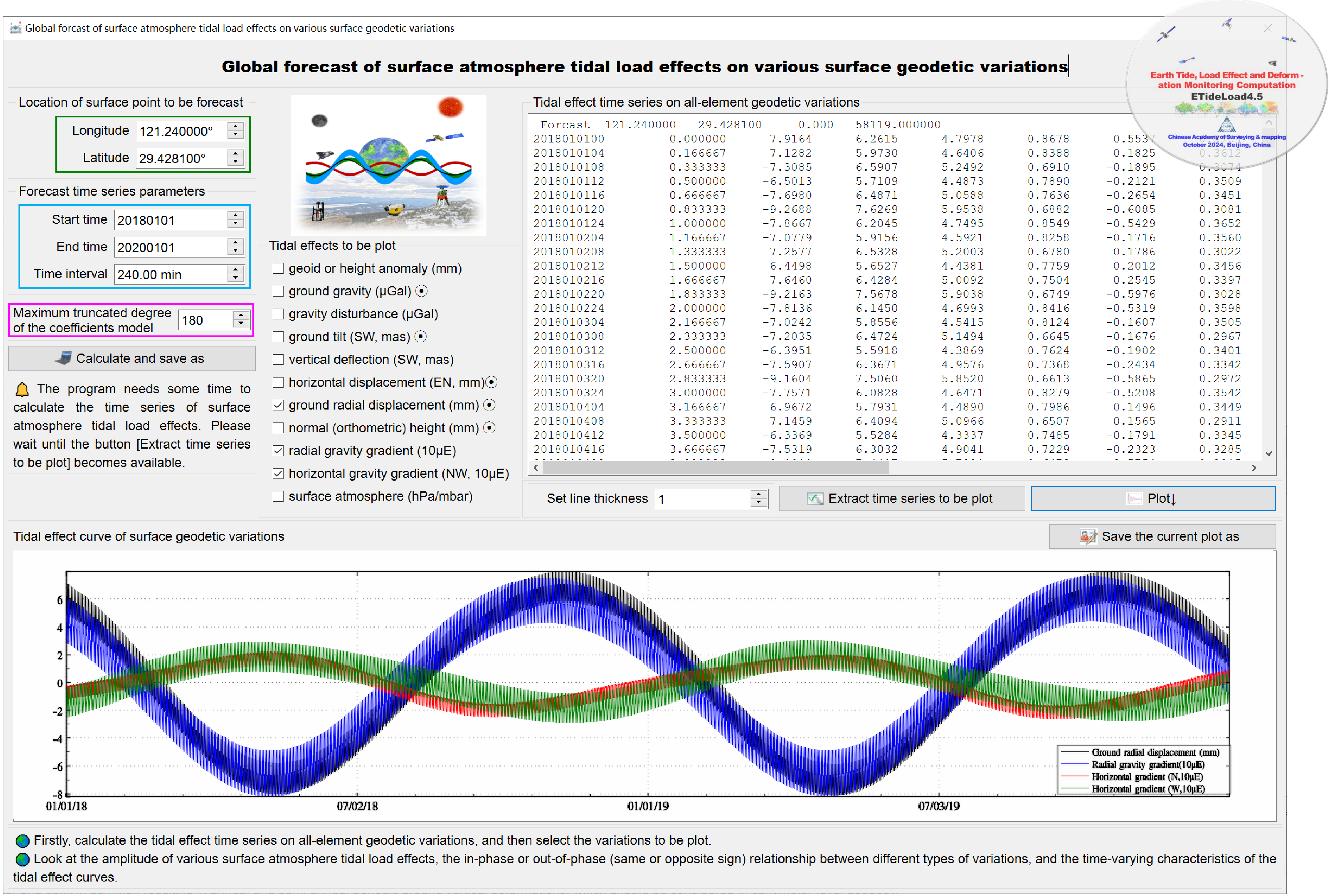
Surface atmosphere tidal effects at 450km altitude: geopotential (0.1m²/s²), gravity vector (E, N: along the GRACE orbit/SST-II, U, μGal)

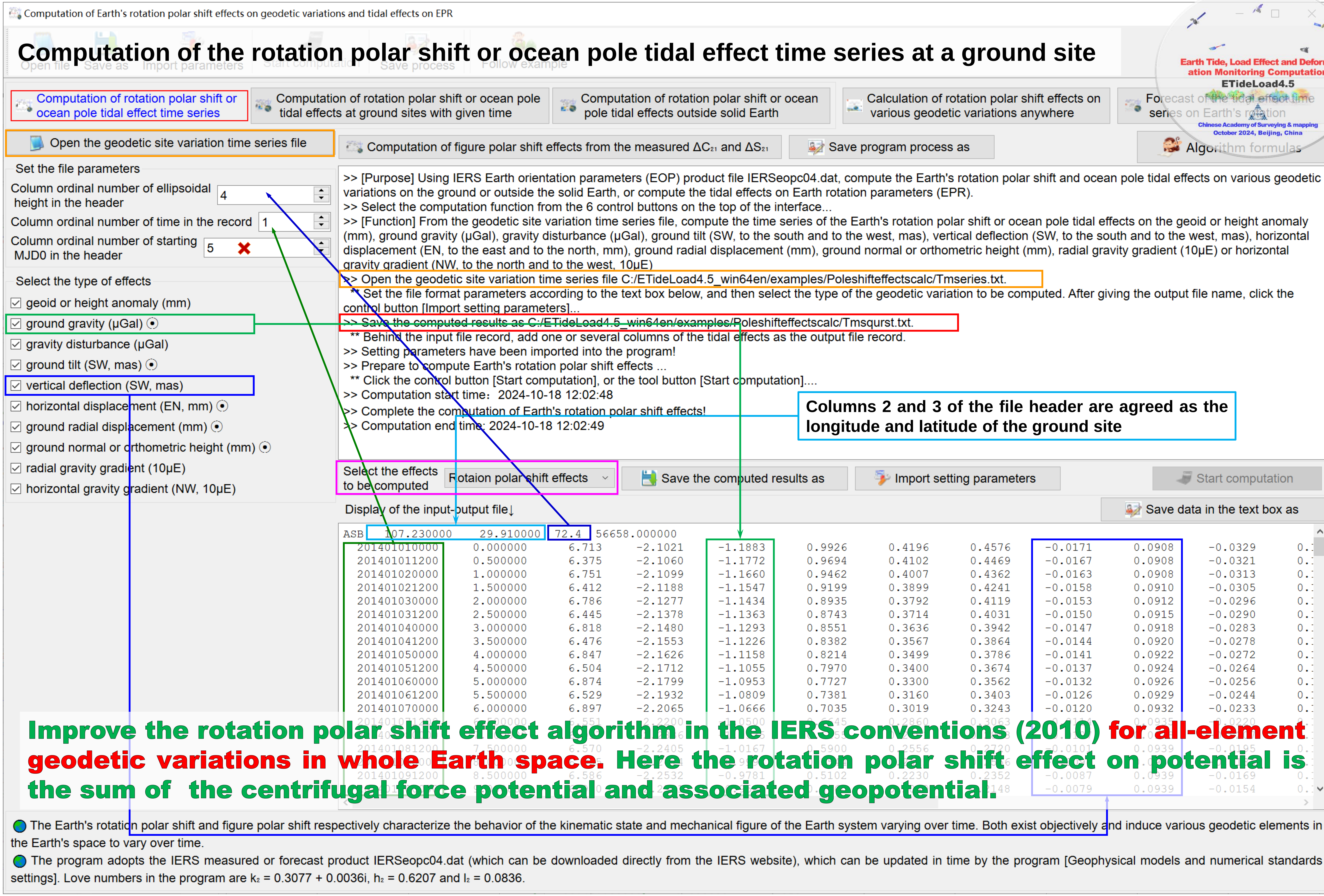


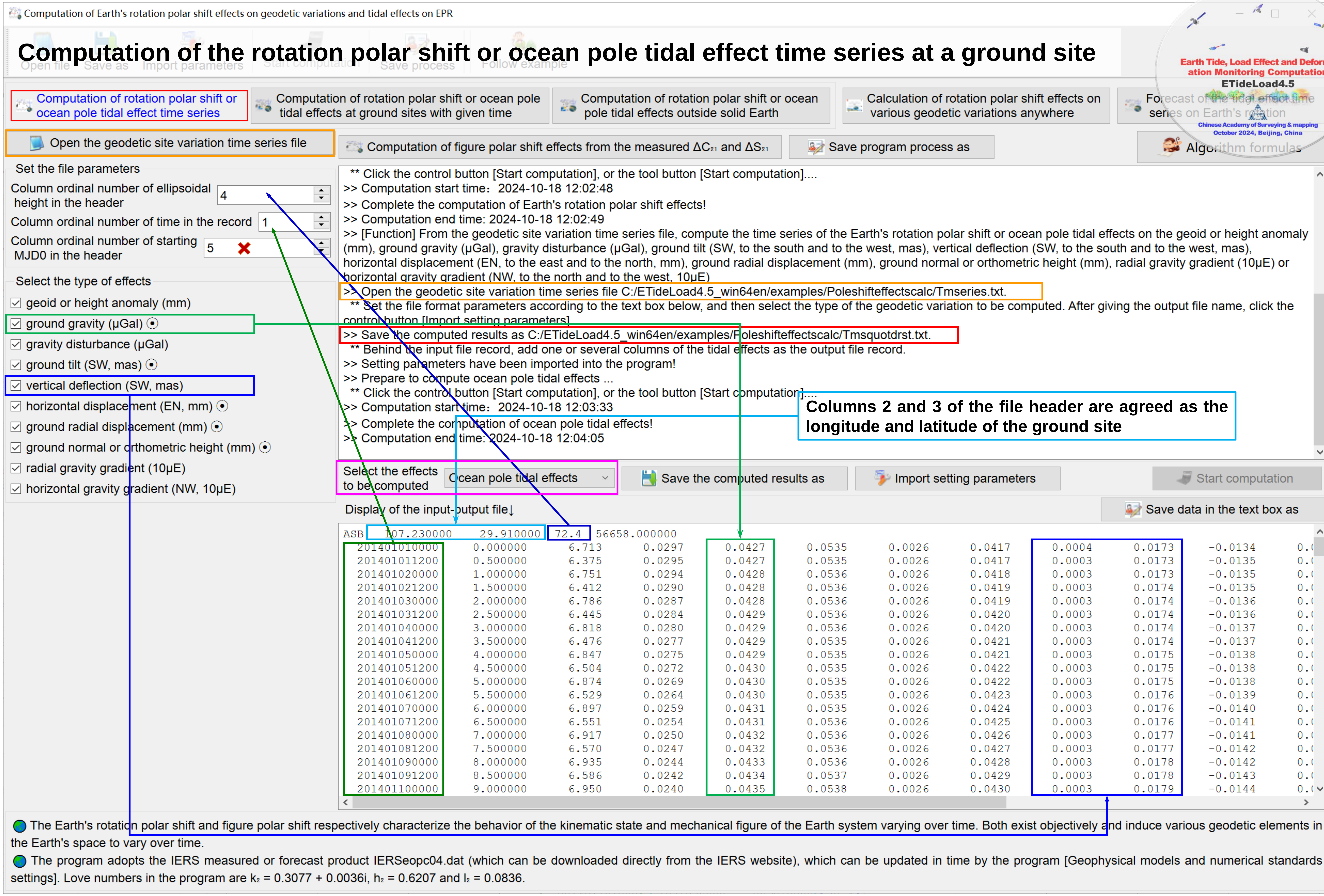
Surface atmosphere tidal effects at 250km altitude: geopotential (0.1m²/s²), gravity gradient (E, N: along the GOCE orbit, U, 10μE)

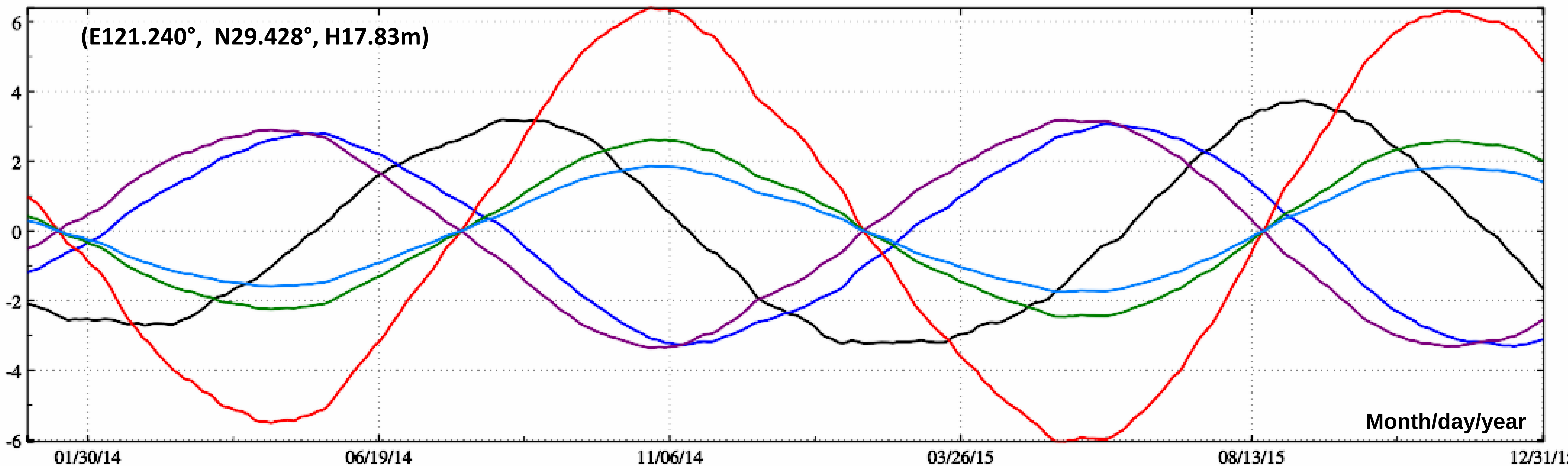

Global forcast of surface atmosphere tidal load effects on various surface geodetic variations
Global forecast of surface atmosphere tidal load effects on various surface geodetic variations
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Forecast time series parameters
Start time 20180101
End time 20200101
Time interval 240.00 min
Maximum truncated degree of the coefficients model 180
Calculate and save as
The program needs some time to calculate the time series of surface atmosphere tidal load effects. Please wait until the button [Extract time series to be plot] becomes available.
Tidal effects to be plot
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
normal (orthometric) height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
surface atmosphere (hPa/mbar)
Tidal effect time series on all-element geodetic variations
Forcast 121.240000 29.428100 0.000 58119.000000
2018010100 0.000000 -7.9164 6.2615 4.7978 0.8678 -0.5537
2018010104 0.166667 -7.1282 5.9730 4.6406 0.8388 -0.1825 0.3612
2018010108 0.333333 -7.3085 6.5907 5.2492 0.6910 -0.1895 0.3074
2018010112 0.500000 -6.5013 5.7109 4.4873 0.7890 -0.2121 0.3509
2018010116 0.666667 -7.6980 6.4871 5.0588 0.7636 -0.2654 0.3451
2018010120 0.833333 -9.2688 7.6269 5.9538 0.6882 -0.6085 0.3081
2018010124 1.000000 -7.8667 6.2045 4.7495 0.8549 -0.5429 0.3652
2018010204 1.166667 -7.0779 5.9156 4.5921 0.8258 -0.1716 0.3560
2018010208 1.333333 -7.2577 6.5328 5.2003 0.6780 -0.1786 0.3022
2018010212 1.500000 -6.4498 5.6527 4.4381 0.7759 -0.2012 0.3456
2018010216 1.666667 -7.6460 6.4284 5.0092 0.7504 -0.2545 0.3397
2018010220 1.833333 -9.2163 7.5678 5.9038 0.6749 -0.5976 0.3028
2018010224 2.000000 -7.8136 6.1450 4.6993 0.8416 -0.5319 0.3598
2018010304 2.166667 -7.0242 5.8556 4.5415 0.8124 -0.1607 0.3505
2018010308 2.333333 -7.2035 6.4724 5.1494 0.6645 -0.1676 0.2967
2018010312 2.500000 -6.3951 5.5918 4.3869 0.7624 -0.1902 0.3401
2018010316 2.666667 -7.5907 6.3671 4.9576 0.7368 -0.2434 0.3342
2018010320 2.833333 -9.1604 7.5060 5.8520 0.6613 -0.5865 0.2972
2018010324 3.000000 -7.7571 6.0828 4.6471 0.8279 -0.5208 0.3542
2018010404 3.166667 -6.9672 5.7931 4.4890 0.7986 -0.1496 0.3449
2018010408 3.333333 -7.1459 6.4094 5.0966 0.6507 -0.1565 0.2911
2018010412 3.500000 -6.3369 5.5284 4.3337 0.7485 -0.1791 0.3345
2018010416 3.666667 -7.5319 6.3032 4.9041 0.7229 -0.2323 0.3285
Set line thickness 1
Extract time series to be plot
Plot
Tidal effect curve of surface geodetic variations
Save the current plot as
15
10
5
0
-5
-10
-15
01/01/18
07/02/18
01/01/19
07/03/19
Ground gravity (μGal)
Ground radial displacement (mm)
Normal/orthometric height (mm)
Surface atmosphere (hPa/mbar)
Firstly, calculate the tidal effect time series on all-element geodetic variations, and then select the variations to be plot.
Look at the amplitude of various surface atmosphere tidal load effects, the in-phase or out-of-phase (same or opposite sign) relationship between different types of variations, and the time-varying characteristics of the tidal effect curves.


Global forcast of surface atmosphere tidal load effects on various surface geodetic variations
Global forecast of surface atmosphere tidal load effects on various surface geodetic variations
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Forecast time series parameters
Start time 20180101
End time 20200101
Time interval 240.00 min
Maximum truncated degree of the coefficients model 180
Calculate and save as
The program needs some time to calculate the time series of surface atmosphere tidal load effects. Please wait until the button [Extract time series to be plot] becomes available.
Tidal effects to be plot
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
normal (orthometric) height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
surface atmosphere (hPa/mbar)
Tidal effect time series on all-element geodetic variations
Forcast 121.240000 29.428100 0.000 58119.000000
2018010100 0.000000 -7.9164 6.2615 4.7978 0.8678 -0.5537
2018010104 0.166667 -7.1282 5.9730 4.6406 0.8388 -0.1825 0.3612
2018010108 0.333333 -7.3085 6.5907 5.2492 0.6910 -0.1895 0.3074
2018010112 0.500000 -6.5013 5.7109 4.4873 0.7890 -0.2121 0.3509
2018010116 0.666667 -7.6980 6.4871 5.0588 0.7636 -0.2654 0.3451
2018010120 0.833333 -9.2688 7.6269 5.9538 0.6882 -0.6085 0.3081
2018010124 1.000000 -7.8667 6.2045 4.7495 0.8549 -0.5429 0.3652
2018010204 1.166667 -7.0779 5.9156 4.5921 0.8258 -0.1716 0.3560
2018010208 1.333333 -7.2577 6.5328 5.2003 0.6780 -0.1786 0.3022
2018010212 1.500000 -6.4498 5.6527 4.4381 0.7759 -0.2012 0.3456
2018010216 1.666667 -7.6460 6.4284 5.0092 0.7504 -0.2545 0.3397
2018010220 1.833333 -9.2163 7.5678 5.9038 0.6749 -0.5976 0.3028
2018010224 2.000000 -7.8136 6.1450 4.6993 0.8416 -0.5319 0.3598
2018010304 2.166667 -7.0242 5.8556 4.5415 0.8124 -0.1607 0.3505
2018010308 2.333333 -7.2035 6.4724 5.1494 0.6645 -0.1676 0.2967
2018010312 2.500000 -6.3951 5.5918 4.3869 0.7624 -0.1902 0.3401
2018010316 2.666667 -7.5907 6.3671 4.9576 0.7368 -0.2434 0.3342
2018010320 2.833333 -9.1604 7.5060 5.8520 0.6613 -0.5865 0.2972
2018010324 3.000000 -7.7571 6.0828 4.6471 0.8279 -0.5208 0.3542
2018010404 3.166667 -6.9672 5.7931 4.4890 0.7986 -0.1496 0.3449
2018010408 3.333333 -7.1459 6.4094 5.0966 0.6507 -0.1565 0.2911
2018010412 3.500000 -6.3369 5.5284 4.3337 0.7485 -0.1791 0.3345
2018010416 3.666667 -7.5319 6.3032 4.9041 0.7229 -0.2323 0.3285
Set line thickness 1
Extract time series to be plot
Plot↓
Tidal effect curve of surface geodetic variations
Save the current plot as
1
0.5
0
-0.5
-1
01/01/18
07/02/18
01/01/19
07/03/19
Ground tilt (S, mas)
Ground tilt (W, mas)
Horizontal displacement (E,mm)
Horizontal displacement (N,mm)
Firstly, calculate the tidal effect time series on all-element geodetic variations, and then select the variations to be plot.
Look at the amplitude of various surface atmosphere tidal load effects, the in-phase or out-of-phase (same or opposite sign) relationship between different types of variations, and the time-varying characteristics of the tidal effect curves.

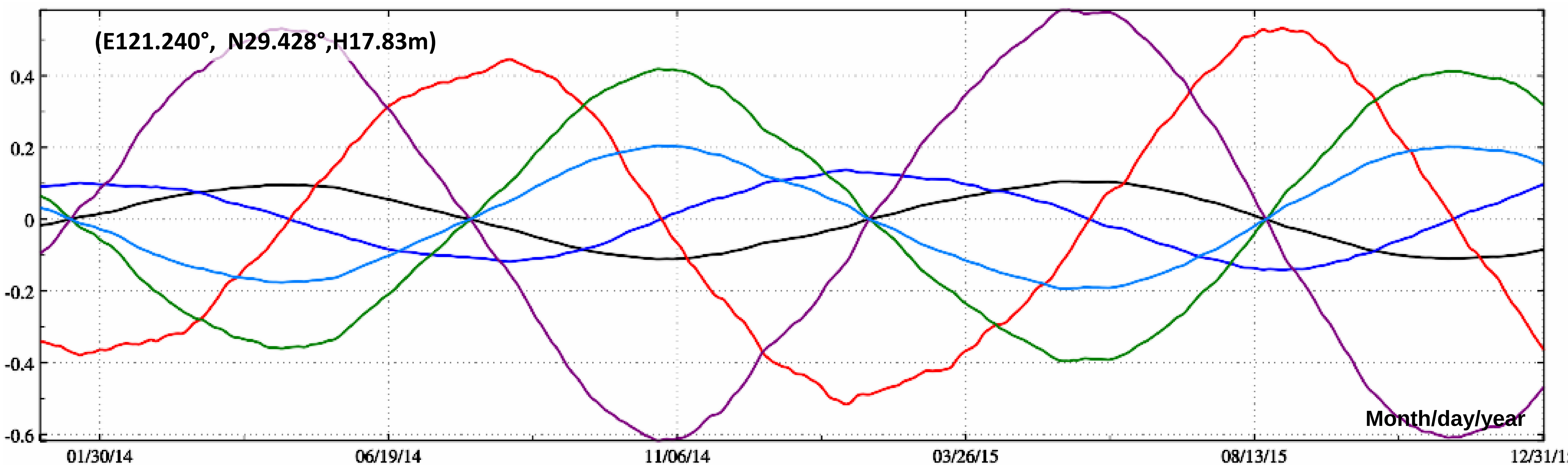

Global forcast of surface atmosphere tidal load effects on various surface geodetic variations
Global forecast of surface atmosphere tidal load effects on various surface geodetic variations
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Forecast time series parameters
Start time 20180101
End time 20200101
Time interval 240.00 min
Maximum truncated degree of the coefficients model 180
Calculate and save as
The program needs some time to calculate the time series of surface atmosphere tidal load effects. Please wait until the button [Extract time series to be plot] becomes available.
Tidal effects to be plot
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
normal (orthometric) height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
surface atmosphere (hPa/mbar)
Tidal effect time series on all-element geodetic variations
Forcast 121.240000 29.428100 0.000 58119.000000
2018010100 0.000000 -7.9164 6.2615 4.7978 0.8678 -0.5537
2018010104 0.166667 -7.1282 5.9730 4.6406 0.8388 -0.1825 0.3612
2018010108 0.333333 -7.3085 6.5907 5.2492 0.6910 -0.1895 0.3074
2018010112 0.500000 -6.5013 5.7109 4.4873 0.7890 -0.2121 0.3509
2018010116 0.666667 -7.6980 6.4871 5.0588 0.7636 -0.2654 0.3451
2018010120 0.833333 -9.2688 7.6269 5.9538 0.6882 -0.6085 0.3081
2018010124 1.000000 -7.8667 6.2045 4.7495 0.8549 -0.5429 0.3652
2018010204 1.166667 -7.0779 5.9156 4.5921 0.8258 -0.1716 0.3560
2018010208 1.333333 -7.2577 6.5328 5.2003 0.6780 -0.1786 0.3022
2018010212 1.500000 -6.4498 5.6527 4.4381 0.7759 -0.2012 0.3456
2018010216 1.666667 -7.6460 6.4284 5.0092 0.7504 -0.2545 0.3397
2018010220 1.833333 -9.2163 7.5678 5.9038 0.6749 -0.5976 0.3028
2018010224 2.000000 -7.8136 6.1450 4.6993 0.8416 -0.5319 0.3598
2018010304 2.166667 -7.0242 5.8556 4.5415 0.8124 -0.1607 0.3505
2018010308 2.333333 -7.2035 6.4724 5.1494 0.6645 -0.1676 0.2967
2018010312 2.500000 -6.3951 5.5918 4.3869 0.7624 -0.1902 0.3401
2018010316 2.666667 -7.5907 6.3671 4.9576 0.7368 -0.2434 0.3342
2018010320 2.833333 -9.1604 7.5060 5.8520 0.6613 -0.5865 0.2972
2018010324 3.000000 -7.7571 6.0828 4.6471 0.8279 -0.5208 0.3542
2018010404 3.166667 -6.9672 5.7931 4.4890 0.7986 -0.1496 0.3449
2018010408 3.333333 -7.1459 6.4094 5.0966 0.6507 -0.1565 0.2911
2018010412 3.500000 -6.3369 5.5284 4.3337 0.7485 -0.1791 0.3345
2018010416 3.666667 -7.5319 6.3032 4.9041 0.7229 -0.2323 0.3285
Set line thickness 1
Extract time series to be plot
Plot↓
Tidal effect curve of surface geodetic variations
Save the current plot as
6
4
2
0
-2
-4
-6
-8
01/01/18
07/02/18
01/01/19
07/03/19
Ground radial displacement (mm)
Radial gravity gradient(10μE)
Horizontal gradient (N,10μE)
Horizontal gradient (W,10μE)
Firstly, calculate the tidal effect time series on all-element geodetic variations, and then select the variations to be plot.
Look at the amplitude of various surface atmosphere tidal load effects, the in-phase or out-of-phase (same or opposite sign) relationship between different types of variations, and the time-varying characteristics of the tidal effect curves.


Computation of Earth's rotation polar shift effects on geodetic variations and tidal effects on EPR
Computation of the rotation polar shift or ocean pole tidal effect time series at a ground site
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of rotation polar shift or ocean pole tidal effect time series
Computation of rotation polar shift or ocean pole tidal effects at ground sites with given time
Computation of rotation polar shift or ocean pole tidal effects outside solid Earth
Calculation of rotation polar shift effects on various geodetic variations anywhere
Forecast of the tidal effect time series on Earth's rotation
Open the geodetic site variation time series file
Computation of figure polar shift effects from the measured ΔC21 and ΔS21
Save program process as
Algorithm formulas
Set the file parameters
Column ordinal number of ellipsoidal height in the header
4
Column ordinal number of time in the record
1
Column ordinal number of starting MJD0 in the header
5
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
>> [Purpose] Using IERS Earth orientation parameters (EOP) product file IERSeopc04.dat, compute the Earth's rotation polar shift and ocean pole tidal effects on various geodetic variations on the ground or outside the solid Earth, or compute the tidal effects on Earth rotation parameters (EPR).
>> Select the computation function from the 6 control buttons on the top of the interface...
>> [Function] From the geodetic site variation time series file, compute the time series of the Earth's rotation polar shift or ocean pole tidal effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (10μE) or horizontal gravity gradient (NW, to the north and to the west, 10μE)
>> Open the geodetic site variation time series file C:/ETideLoad4.5_win64en/examples/Poleshifteffectscalc/Tmseries.txt.
** Set the file format parameters according to the text box below, and then select the type of the geodetic variation to be computed. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Poleshifteffectscalc/Tmsqurst.txt.
** Behind the input file record, add one or several columns of the tidal effects as the output file record.
>> Setting parameters have been imported into the program!
>> Prepare to compute Earth's rotation polar shift effects ...
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 12:02:48
>> Complete the computation of Earth's rotation polar shift effects!
>> Computation end time: 2024-10-18 12:02:49
Columns 2 and 3 of the file header are agreed as the longitude and latitude of the ground site
Select the effects to be computed
Rotaion polar shift effects
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
Save data in the text box as
ASB 107.230000 29.910000 72.4 56658.000000
201401010000 0.000000 6.713 -2.1021 -1.1883 0.9926 0.4196 0.4576 -0.0171 0.0908 -0.0329
201401011200 0.500000 6.375 -2.1060 -1.1772 0.9694 0.4102 0.4469 -0.0167 0.0908 -0.0321
201401020000 1.000000 6.751 -2.1099 -1.1660 0.9462 0.4007 0.4362 -0.0163 0.0908 -0.0313
201401021200 1.500000 6.412 -2.1188 -1.1547 0.9199 0.3899 0.4241 -0.0158 0.0910 -0.0305
201401030000 2.000000 6.786 -2.1277 -1.1434 0.8935 0.3792 0.4119 -0.0153 0.0912 -0.0296
201401031200 2.500000 6.445 -2.1378 -1.1363 0.8743 0.3714 0.4031 -0.0150 0.0915 -0.0290
201401040000 3.000000 6.818 -2.1480 -1.1293 0.8551 0.3636 0.3942 -0.0147 0.0918 -0.0283
201401041200 3.500000 6.476 -2.1553 -1.1226 0.8382 0.3567 0.3864 -0.0144 0.0920 -0.0278
201401050000 4.000000 6.847 -2.1626 -1.1158 0.8214 0.3499 0.3786 -0.0141 0.0922 -0.0272
201401051200 4.500000 6.504 -2.1712 -1.1055 0.7970 0.3400 0.3674 -0.0137 0.0924 -0.0264
201401060000 5.000000 6.874 -2.1799 -1.0953 0.7727 0.3300 0.3562 -0.0132 0.0926 -0.0256
201401061200 5.500000 6.529 -2.1932 -1.0809 0.7381 0.3160 0.3403 -0.0126 0.0929 -0.0244
201401070000 6.000000 6.897 -2.2065 -1.0666 0.7035 0.3019 0.3243 -0.0120 0.0932 -0.0233
Improve the rotation polar shift effect algorithm in the IERS conventions (2010) for all-element geodetic variations in whole Earth space. Here the rotation polar shift effect on potential is the sum of the centrifugal force potential and associated geopotential.
The Earth's rotation polar shift and figure polar shift respectively characterize the behavior of the kinematic state and mechanical figure of the Earth system varying over time. Both exist objectively and induce various geodetic elements in the Earth's space to vary over time.
The program adopts the IERS measured or forecast product IERSeopc04.dat (which can be downloaded directly from the IERS website), which can be updated in time by the program [Geophysical models and numerical standards settings]. Love numbers in the program are k₂ = 0.3077 + 0.0036i, h₂ = 0.6207 and l₂ = 0.0836.

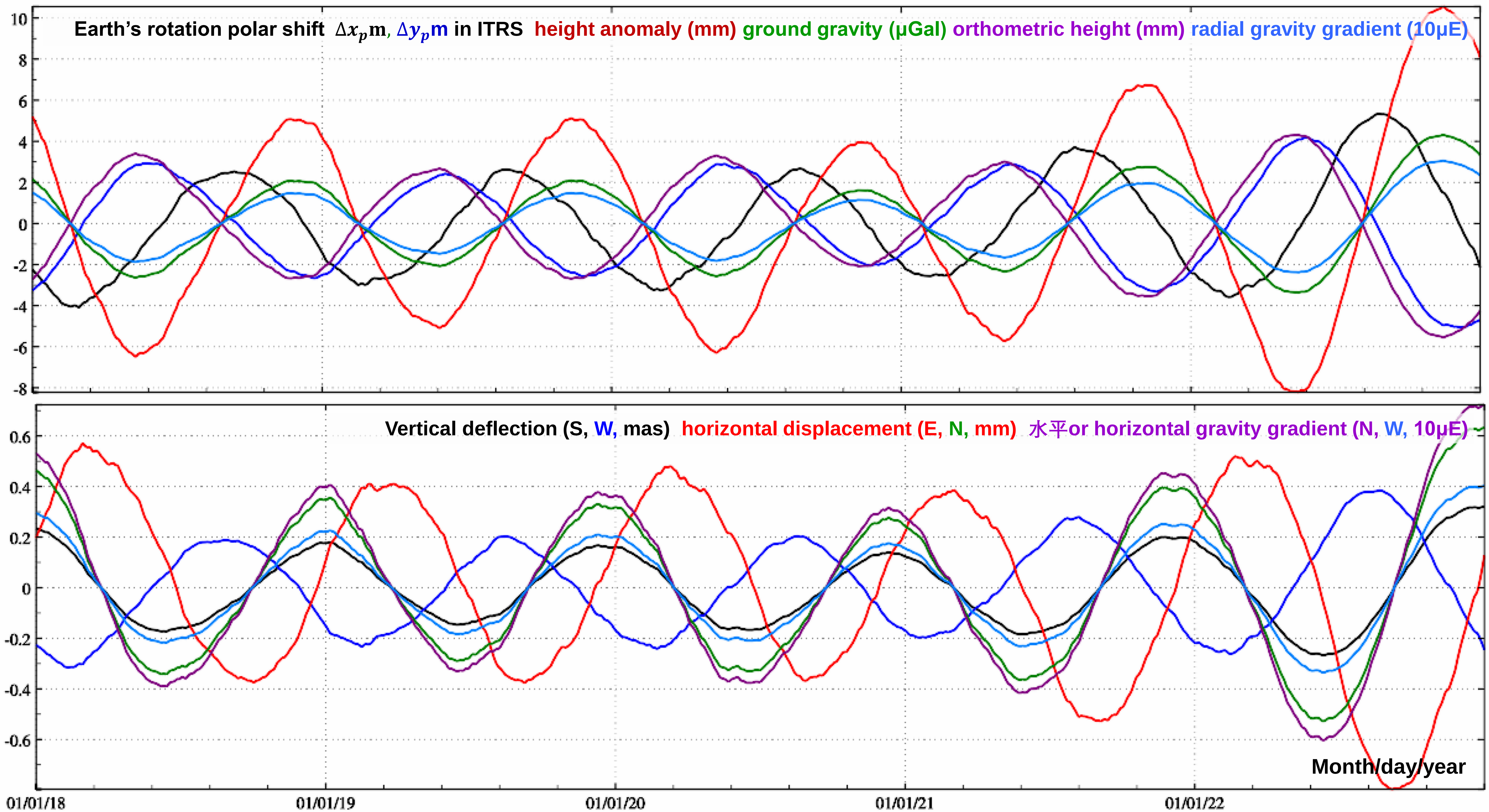

Computation of Earth's rotation polar shift effects on geodetic variations and tidal effects on EPR
Computation of the rotation polar shift or ocean pole tidal effect time series at a ground site
Open file Save as Import parameters Start computation Save process Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of rotation polar shift or ocean pole tidal effect time series
Computation of rotation polar shift or ocean pole tidal effects at ground sites with given time
Computation of rotation polar shift or ocean pole tidal effects outside solid Earth
Calculation of rotation polar shift effects on various geodetic variations anywhere
Forecast of the tidal effect time series on Earth's rotation
Open the geodetic site variation time series file
Computation of figure polar shift effects from the measured ΔC21 and ΔS21
Save program process as
Algorithm formulas
Set the file parameters
Column ordinal number of ellipsoidal height in the header 4
Column ordinal number of time in the record 1
Column ordinal number of starting MJD0 in the header 5
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 12:02:48
>> Complete the computation of Earth's rotation polar shift effects!
>> Computation end time: 2024-10-18 12:02:49
>> [Function] From the geodetic site variation time series file, compute the time series of the Earth's rotation polar shift or ocean pole tidal effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (10μE) or horizontal gravity gradient (NW, to the north and to the west, 10μE)
>> Open the geodetic site variation time series file C:/ETideLoad4.5_win64en/examples/Poleshifteffectscalc/Tmseries.txt.
** Set the file format parameters according to the text box below, and then select the type of the geodetic variation to be computed. After giving the output file name, click the control button [Import setting parameters]
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Poleshifteffectscalc/Tmsquotdrst.txt.
** Behind the input file record, add one or several columns of the tidal effects as the output file record.
>> Setting parameters have been imported into the program!
>> Prepare to compute ocean pole tidal effects ...
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 12:03:33
>> Complete the computation of ocean pole tidal effects!
>> Computation end time: 2024-10-18 12:04:05
Columns 2 and 3 of the file header are agreed as the longitude and latitude of the ground site
Select the effects to be computed
Ocean pole tidal effects
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
Save data in the text box as
ASB 107.230000 29.910000 72.4 56658.000000
201401010000 0.000000 6.713 0.0297 0.0427 0.0535 0.0026 0.0417 0.0004 0.0173 -0.0134
201401011200 0.500000 6.375 0.0295 0.0427 0.0535 0.0026 0.0417 0.0003 0.0173 -0.0135
201401020000 1.000000 6.751 0.0294 0.0428 0.0536 0.0026 0.0418 0.0003 0.0173 -0.0135
201401021200 1.500000 6.412 0.0290 0.0428 0.0536 0.0026 0.0419 0.0003 0.0174 -0.0135
201401030000 2.000000 6.786 0.0287 0.0428 0.0536 0.0026 0.0419 0.0003 0.0174 -0.0136
201401031200 2.500000 6.445 0.0284 0.0429 0.0536 0.0026 0.0420 0.0003 0.0174 -0.0136
201401040000 3.000000 6.818 0.0280 0.0429 0.0536 0.0026 0.0420 0.0003 0.0174 -0.0137
201401041200 3.500000 6.476 0.0277 0.0429 0.0535 0.0026 0.0421 0.0003 0.0174 -0.0137
201401050000 4.000000 6.847 0.0275 0.0429 0.0535 0.0026 0.0421 0.0003 0.0175 -0.0138
201401051200 4.500000 6.504 0.0272 0.0430 0.0535 0.0026 0.0422 0.0003 0.0175 -0.0138
201401060000 5.000000 6.874 0.0269 0.0430 0.0535 0.0026 0.0422 0.0003 0.0175 -0.0138
201401061200 5.500000 6.529 0.0264 0.0430 0.0535 0.0026 0.0423 0.0003 0.0176 -0.0139
201401070000 6.000000 6.897 0.0259 0.0431 0.0535 0.0026 0.0424 0.0003 0.0176 -0.0140
201401071200 6.500000 6.551 0.0254 0.0431 0.0536 0.0026 0.0425 0.0003 0.0176 -0.0141
201401080000 7.000000 6.917 0.0250 0.0432 0.0536 0.0026 0.0426 0.0003 0.0177 -0.0141
201401081200 7.500000 6.570 0.0247 0.0432 0.0536 0.0026 0.0427 0.0003 0.0177 -0.0142
201401090000 8.000000 6.935 0.0244 0.0433 0.0536 0.0026 0.0428 0.0003 0.0178 -0.0142
201401091200 8.500000 6.586 0.0242 0.0434 0.0537 0.0026 0.0429 0.0003 0.0178 -0.0143
201401100000 9.000000 6.950 0.0240 0.0435 0.0538 0.0026 0.0430 0.0003 0.0179 -0.0144
The Earth's rotation polar shift and figure polar shift respectively characterize the behavior of the kinematic state and mechanical figure of the Earth system varying over time. Both exist objectively and induce various geodetic elements in the Earth's space to vary over time.
The program adopts the IERS measured or forecast product IERSeopc04.dat (which can be downloaded directly from the IERS website), which can be updated in time by the program [Geophysical models and numerical standards settings]. Love numbers in the program are k2 = 0.3077 + 0.0036i, h2 = 0.6207 and l2 = 0.0836.



Earth's rotation polar shift (Δx_pm, Δy_pm in ITRS) effects: height anomaly (mm) ground gravity (μGal) orthometric height (mm) radial gravity gradient (10μE)

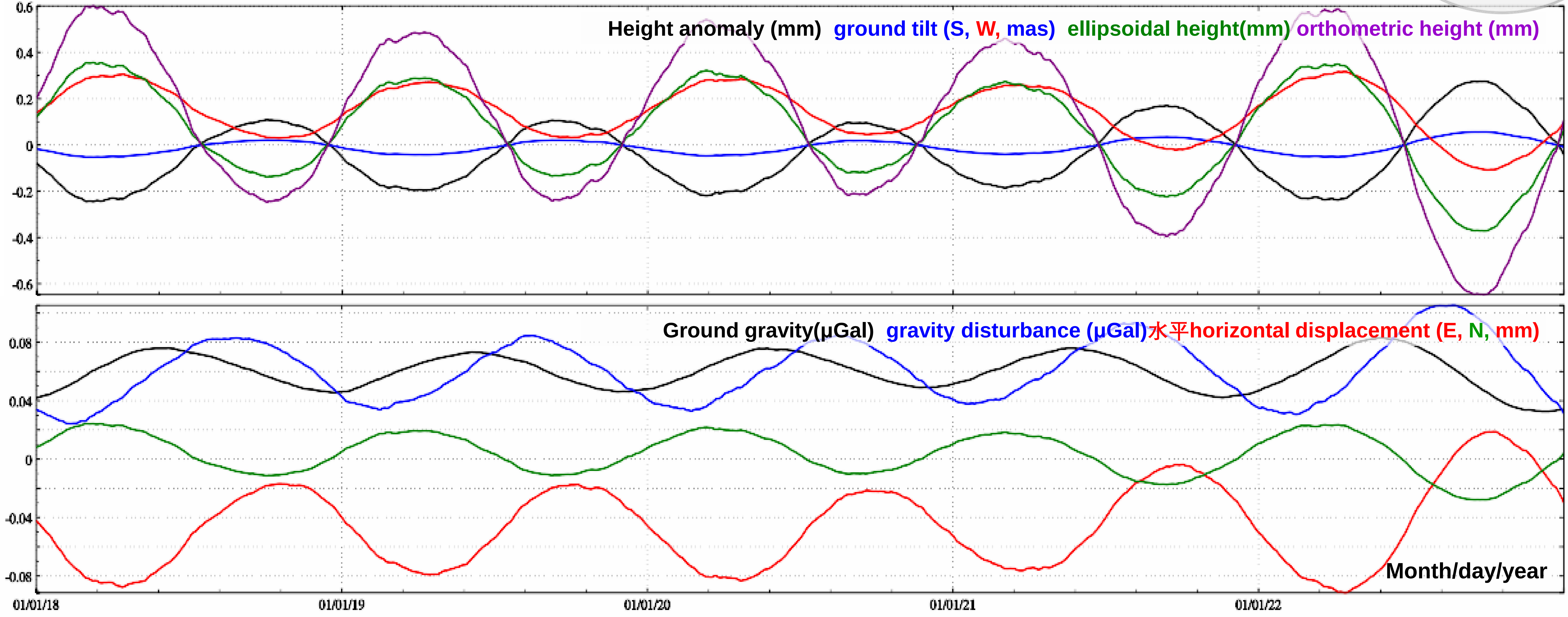


Earth's rotation polar shift effects: ground tilt (S, W, mas) horizontal displacement (E, N, mm) horizontal gravity gradient (N, W, 10μE)



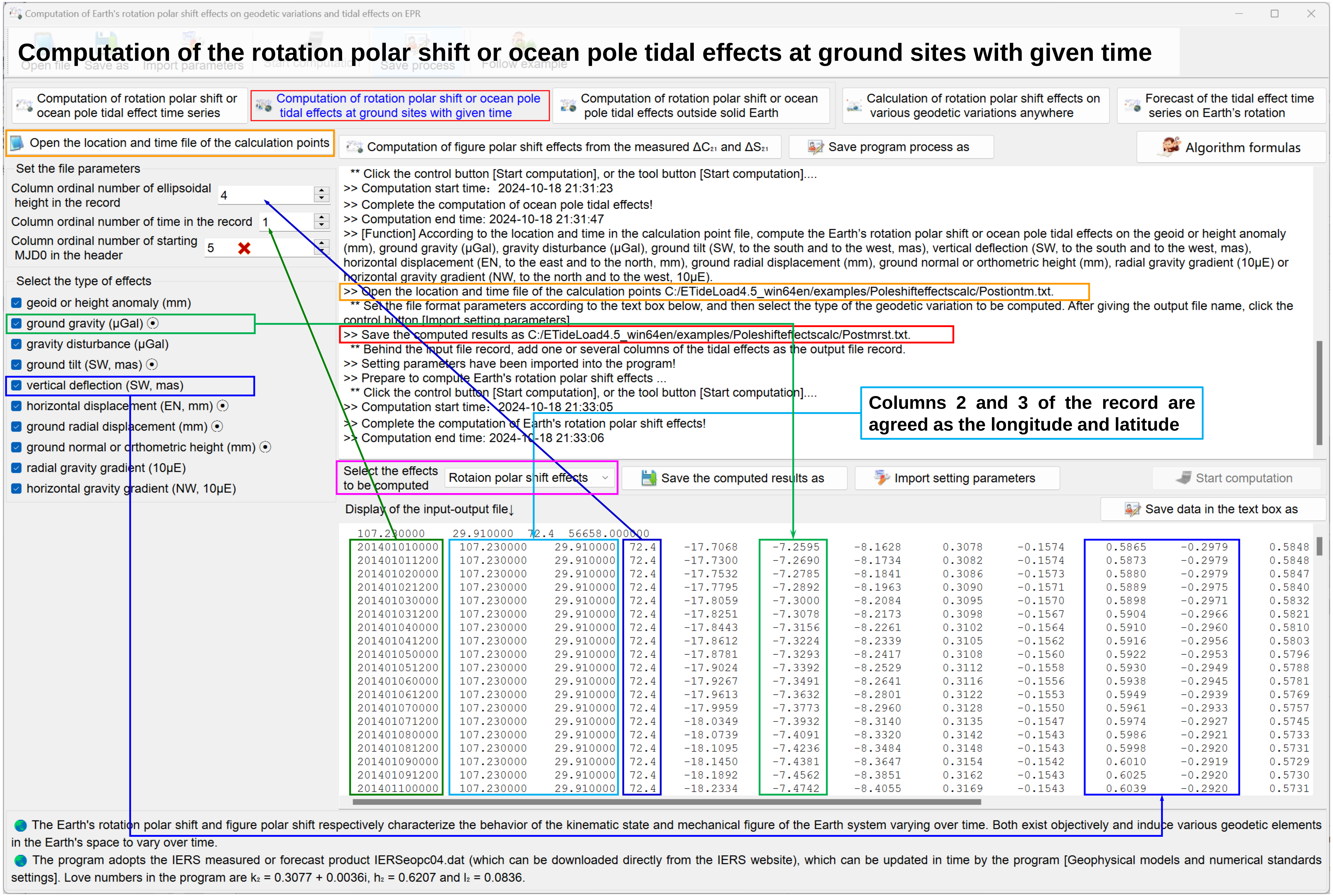
Earth's rotation polar shift effect time series on various geodetic variation

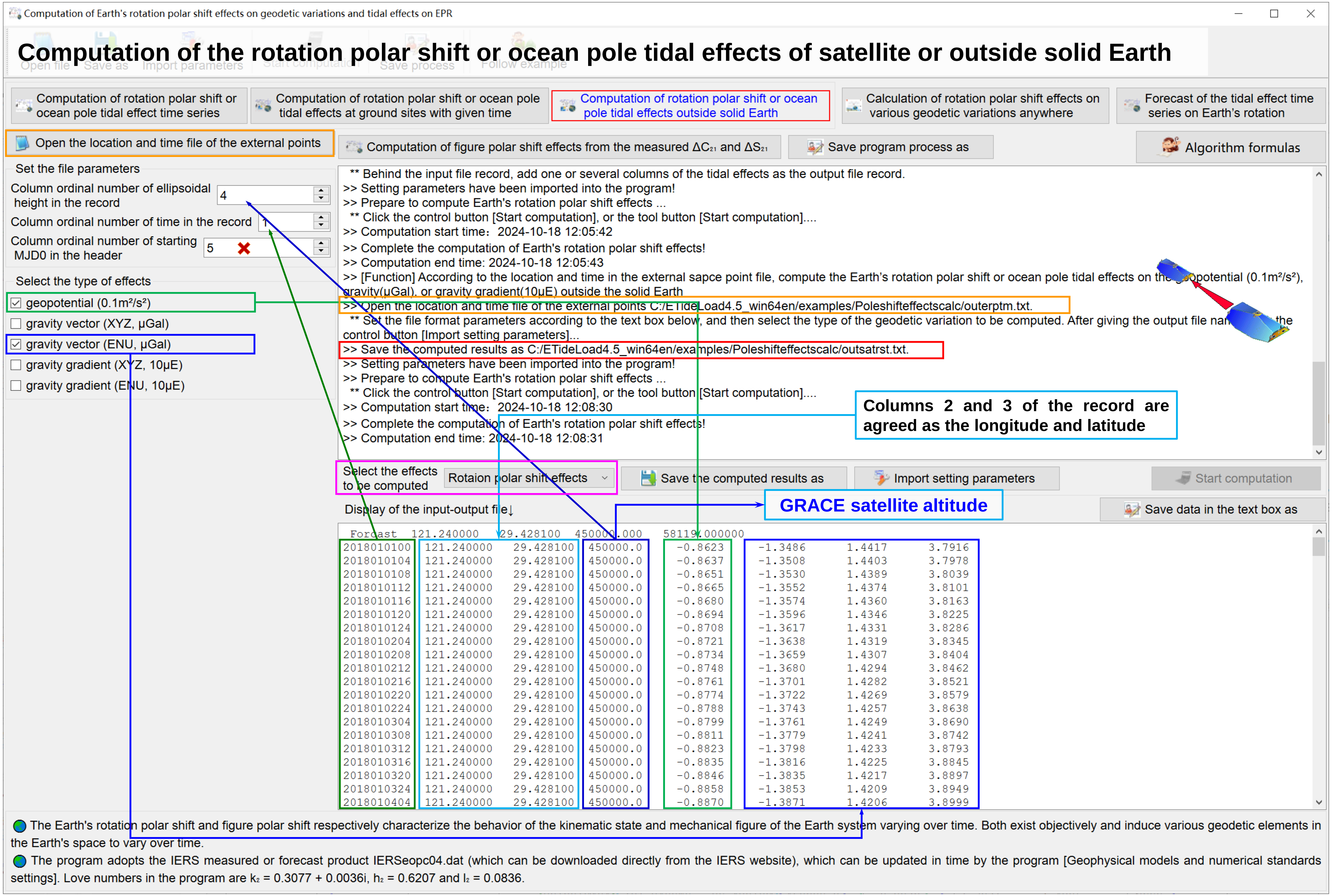
Although the Earth's rotation polar shift itself can reach the meter level, the resulting effect on geoid or ground normal height is only in mm level, that on ground gravity is μGal level, that on radial gravity gradient is 10μE level, that on horizontal geodetic elements are small and can be generally ignored.

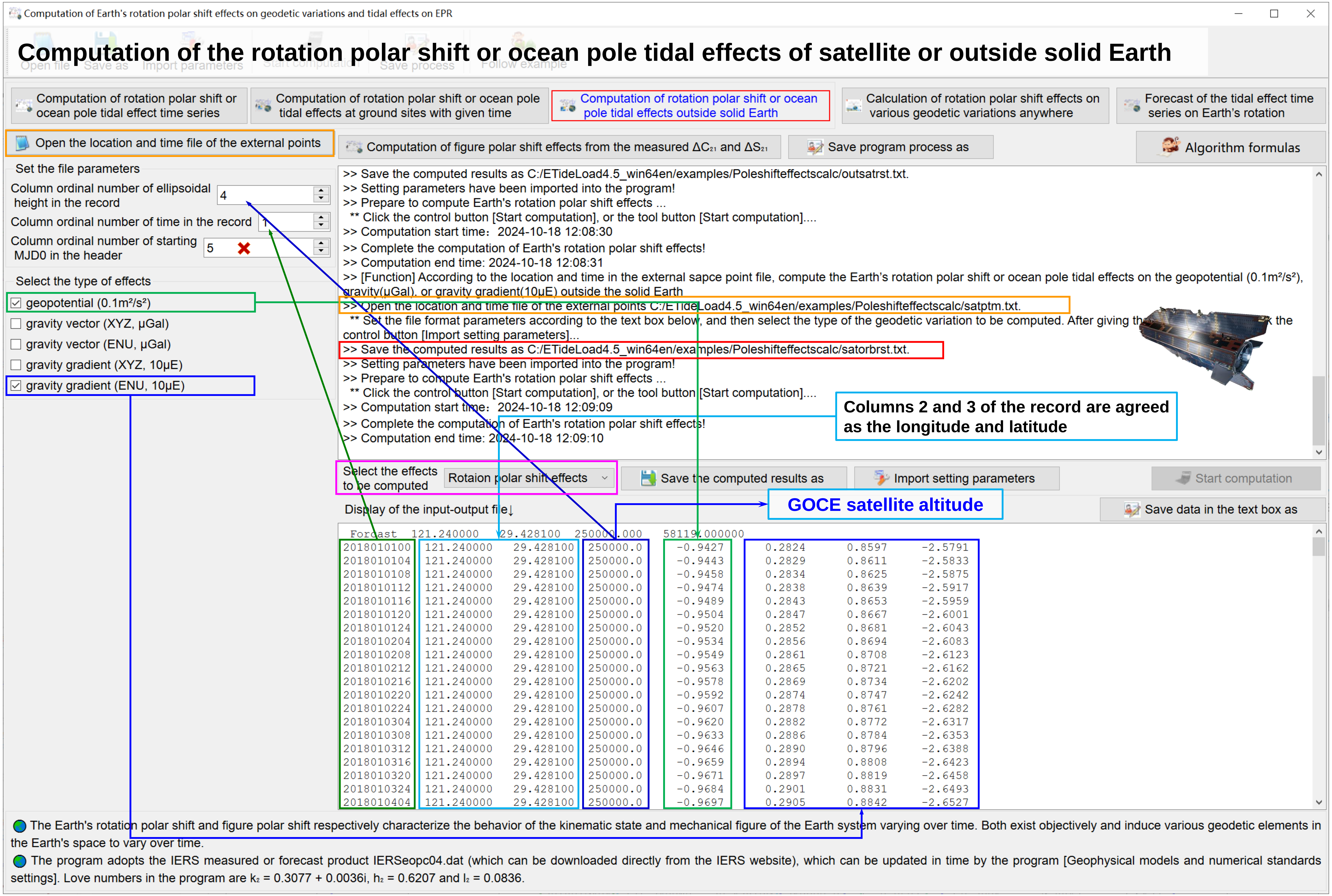


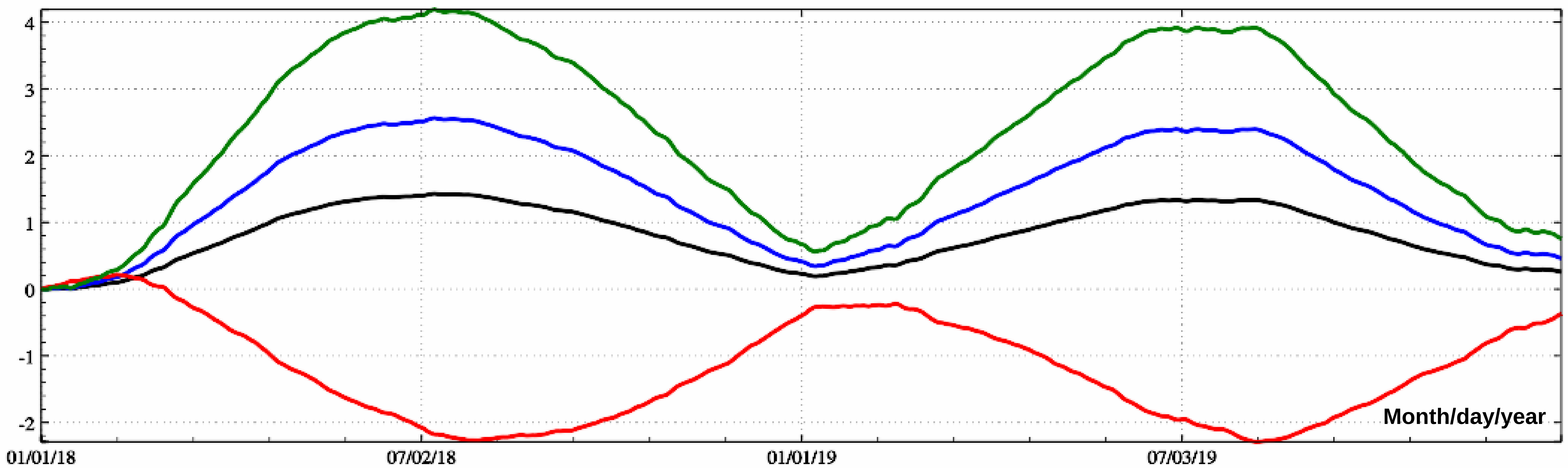
Ocean polar tide effect time series on geodetic variations at the point P in the coastal zone area

The ocean polar tide effects on geodetic variations are small, which can be ignored in general geodetic cases.

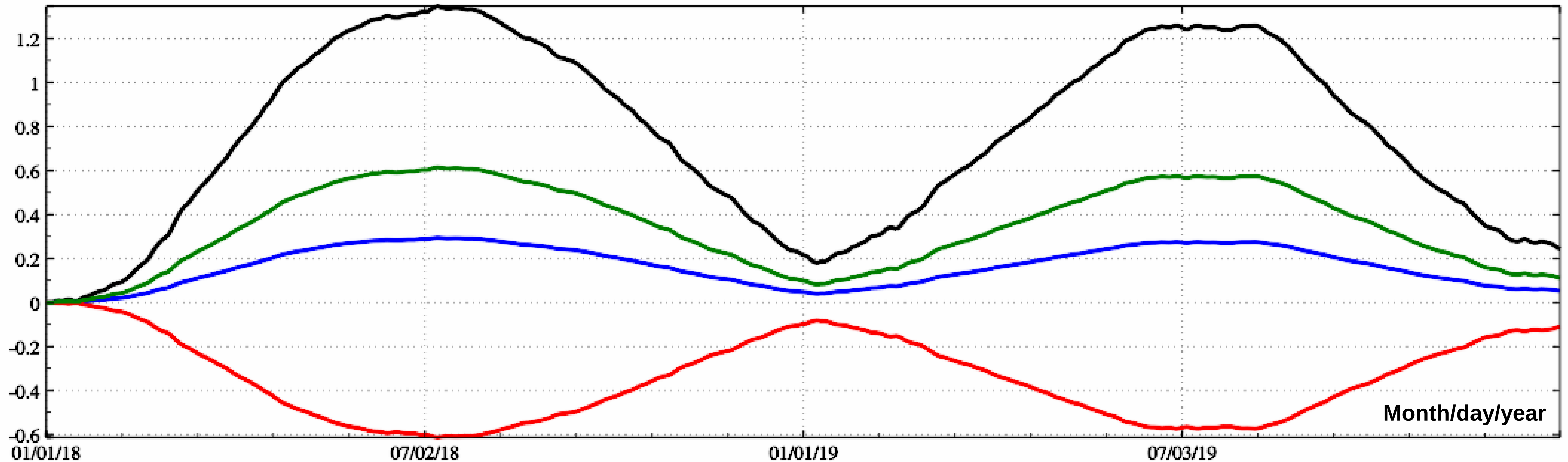

Computation of Earth's rotation polar shift effects on geodetic variations and tidal effects on EPR
Computation of the rotation polar shift or ocean pole tidal effects at ground sites with given time
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Computation of rotation polar shift or ocean pole tidal effect time series
Computation of rotation polar shift or ocean pole tidal effects at ground sites with given time
Computation of rotation polar shift or ocean pole tidal effects outside solid Earth
Calculation of rotation polar shift effects on various geodetic variations anywhere
Forecast of the tidal effect time series on Earth's rotation
Open the location and time file of the calculation points
Computation of figure polar shift effects from the measured ΔC21 and ΔS21
Save program process as
Algorithm formulas
Set the file parameters
Column ordinal number of ellipsoidal height in the record 4
Column ordinal number of time in the record 1
Column ordinal number of starting MJD0 in the header 5
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 21:31:23
>> Complete the computation of ocean pole tidal effects!
>> Computation end time: 2024-10-18 21:31:47
>> [Function] According to the location and time in the calculation point file, compute the Earth's rotation polar shift or ocean pole tidal effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (10μE) or horizontal gravity gradient (NW, to the north and to the west, 10μE).
>> Open the location and time file of the calculation points C:/ETideLoad4.5_win64en/examples/Poleshifteffectscalc/Postiontm.txt.
** Set the file format parameters according to the text box below, and then select the type of the geodetic variation to be computed. After giving the output file name, click the control button [Import setting parameters]
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Poleshifteffectscalc/Postmrst.txt.
** Behind the input file record, add one or several columns of the tidal effects as the output file record.
>> Setting parameters have been imported into the program!
>> Prepare to compute Earth's rotation polar shift effects ...
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 21:33:05
>> Complete the computation of Earth's rotation polar shift effects!
>> Computation end time: 2024-10-18 21:33:06
Columns 2 and 3 of the record are agreed as the longitude and latitude
Select the effects to be computed
Rotaion polar shift effects
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
Save data in the text box as
107.230000 29.910000 72.4 56658.000000
201401010000 107.230000 29.910000 72.4 -17.7068 -7.2595 -8.1628 0.3078 -0.1574 0.5865 -0.2979 0.5848
201401011200 107.230000 29.910000 72.4 -17.7300 -7.2690 -8.1734 0.3082 -0.1574 0.5873 -0.2979 0.5848
201401020000 107.230000 29.910000 72.4 -17.7532 -7.2785 -8.1841 0.3086 -0.1573 0.5880 -0.2979 0.5847
201401021200 107.230000 29.910000 72.4 -17.7795 -7.2892 -8.1963 0.3090 -0.1571 0.5889 -0.2975 0.5840
201401030000 107.230000 29.910000 72.4 -17.8059 -7.3000 -8.2084 0.3095 -0.1570 0.5898 -0.2971 0.5832
201401031200 107.230000 29.910000 72.4 -17.8251 -7.3078 -8.2173 0.3098 -0.1567 0.5904 -0.2966 0.5821
201401040000 107.230000 29.910000 72.4 -17.8443 -7.3156 -8.2261 0.3102 -0.1564 0.5910 -0.2960 0.5810
201401041200 107.230000 29.910000 72.4 -17.8612 -7.3224 -8.2339 0.3105 -0.1562 0.5916 -0.2956 0.5803
201401050000 107.230000 29.910000 72.4 -17.8781 -7.3293 -8.2417 0.3108 -0.1560 0.5922 -0.2953 0.5796
201401051200 107.230000 29.910000 72.4 -17.9024 -7.3392 -8.2529 0.3112 -0.1558 0.5930 -0.2949 0.5788
201401060000 107.230000 29.910000 72.4 -17.9267 -7.3491 -8.2641 0.3116 -0.1556 0.5938 -0.2945 0.5781
201401061200 107.230000 29.910000 72.4 -17.9613 -7.3632 -8.2801 0.3122 -0.1553 0.5949 -0.2939 0.5769
201401070000 107.230000 29.910000 72.4 -17.9959 -7.3773 -8.2960 0.3128 -0.1550 0.5961 -0.2933 0.5757
201401071200 107.230000 29.910000 72.4 -18.0349 -7.3932 -8.3140 0.3135 -0.1547 0.5974 -0.2927 0.5745
201401080000 107.230000 29.910000 72.4 -18.0739 -7.4091 -8.3320 0.3142 -0.1543 0.5986 -0.2921 0.5733
201401081200 107.230000 29.910000 72.4 -18.1095 -7.4236 -8.3484 0.3148 -0.1543 0.5998 -0.2920 0.5731
201401090000 107.230000 29.910000 72.4 -18.1450 -7.4381 -8.3647 0.3154 -0.1542 0.6010 -0.2919 0.5729
201401091200 107.230000 29.910000 72.4 -18.1892 -7.4562 -8.3851 0.3162 -0.1543 0.6025 -0.2920 0.5730
201401100000 107.230000 29.910000 72.4 -18.2334 -7.4742 -8.4055 0.3169 -0.1543 0.6039 -0.2920 0.5731
The Earth's rotation polar shift and figure polar shift respectively characterize the behavior of the kinematic state and mechanical figure of the Earth system varying over time. Both exist objectively and induce various geodetic elements in the Earth's space to vary over time.
The program adopts the IERS measured or forecast product IERSeopc04.dat (which can be downloaded directly from the IERS website), which can be updated in time by the program [Geophysical models and numerical standards settings]. Love numbers in the program are k2 = 0.3077 + 0.0036i, h2 = 0.6207 and l2 = 0.0836.


Computation of Earth's rotation polar shift effects on geodetic variations and tidal effects on EPR
Computation of the rotation polar shift or ocean pole tidal effects of satellite or outside solid Earth
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Computation of rotation polar shift or ocean pole tidal effect time series
Computation of rotation polar shift or ocean pole tidal effects at ground sites with given time
Computation of rotation polar shift or ocean pole tidal effects outside solid Earth
Calculation of rotation polar shift effects on various geodetic variations anywhere
Forecast of the tidal effect time series on Earth's rotation
Open the location and time file of the external points
Computation of figure polar shift effects from the measured ΔC21 and ΔS21
Save program process as
Algorithm formulas
Set the file parameters
Column ordinal number of ellipsoidal height in the record
4
Column ordinal number of time in the record
1
Column ordinal number of starting MJD0 in the header
5
Select the type of effects
geopotential (0.1m²/s²)
gravity vector (XYZ, μGal)
gravity vector (ENU, μGal)
gravity gradient (XYZ, 10μE)
gravity gradient (ENU, 10μE)
** Behind the input file record, add one or several columns of the tidal effects as the output file record.
>> Setting parameters have been imported into the program!
>> Prepare to compute Earth's rotation polar shift effects ...
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 12:05:42
>> Complete the computation of Earth's rotation polar shift effects!
>> Computation end time: 2024-10-18 12:05:43
>> [Function] According to the location and time in the external sapce point file, compute the Earth's rotation polar shift or ocean pole tidal effects on the geopotential (0.1m²/s²), gravity(μGal), or gravity gradient(10μE) outside the solid Earth
>> Open the location and time file of the external points C:/ETideLoad4.5_win64en/examples/Poleshifteffectscalc/outerptm.txt.
** Set the file format parameters according to the text box below, and then select the type of the geodetic variation to be computed. After giving the output file name, the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Poleshifteffectscalc/outsatrst.txt.
>> Setting parameters have been imported into the program!
>> Prepare to compute Earth's rotation polar shift effects ...
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 12:08:30
>> Complete the computation of Earth's rotation polar shift effects!
>> Computation end time: 2024-10-18 12:08:31
Columns 2 and 3 of the record are agreed as the longitude and latitude
Select the effects to be computed
Rotaion polar shift effects
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
GRACE satellite altitude
Save data in the text box as
Forcast 121.240000 29.428100 450000.000 58119.000000
2018010100 121.240000 29.428100 450000.0 -0.8623 -1.3486 1.4417 3.7916
2018010104 121.240000 29.428100 450000.0 -0.8637 -1.3508 1.4403 3.7978
2018010108 121.240000 29.428100 450000.0 -0.8651 -1.3530 1.4389 3.8039
2018010112 121.240000 29.428100 450000.0 -0.8665 -1.3552 1.4374 3.8101
2018010116 121.240000 29.428100 450000.0 -0.8680 -1.3574 1.4360 3.8163
2018010120 121.240000 29.428100 450000.0 -0.8694 -1.3596 1.4346 3.8225
2018010124 121.240000 29.428100 450000.0 -0.8708 -1.3617 1.4331 3.8286
2018010204 121.240000 29.428100 450000.0 -0.8721 -1.3638 1.4319 3.8345
2018010208 121.240000 29.428100 450000.0 -0.8734 -1.3659 1.4307 3.8404
2018010212 121.240000 29.428100 450000.0 -0.8748 -1.3680 1.4294 3.8462
2018010216 121.240000 29.428100 450000.0 -0.8761 -1.3701 1.4282 3.8521
2018010220 121.240000 29.428100 450000.0 -0.8774 -1.3722 1.4269 3.8579
2018010224 121.240000 29.428100 450000.0 -0.8788 -1.3743 1.4257 3.8638
2018010304 121.240000 29.428100 450000.0 -0.8799 -1.3761 1.4249 3.8690
2018010308 121.240000 29.428100 450000.0 -0.8811 -1.3779 1.4241 3.8742
2018010312 121.240000 29.428100 450000.0 -0.8823 -1.3798 1.4233 3.8793
2018010316 121.240000 29.428100 450000.0 -0.8835 -1.3816 1.4225 3.8845
2018010320 121.240000 29.428100 450000.0 -0.8846 -1.3835 1.4217 3.8897
2018010324 121.240000 29.428100 450000.0 -0.8858 -1.3853 1.4209 3.8949
2018010404 121.240000 29.428100 450000.0 -0.8870 -1.3871 1.4206 3.8999
The Earth's rotation polar shift and figure polar shift respectively characterize the behavior of the kinematic state and mechanical figure of the Earth system varying over time. Both exist objectively and induce various geodetic elements in the Earth's space to vary over time.
The program adopts the IERS measured or forecast product IERSeopc04.dat (which can be downloaded directly from the IERS website), which can be updated in time by the program [Geophysical models and numerical standards settings]. Love numbers in the program are k₂ = 0.3077 + 0.0036i, h₂ = 0.6207 and l₂ = 0.0836.

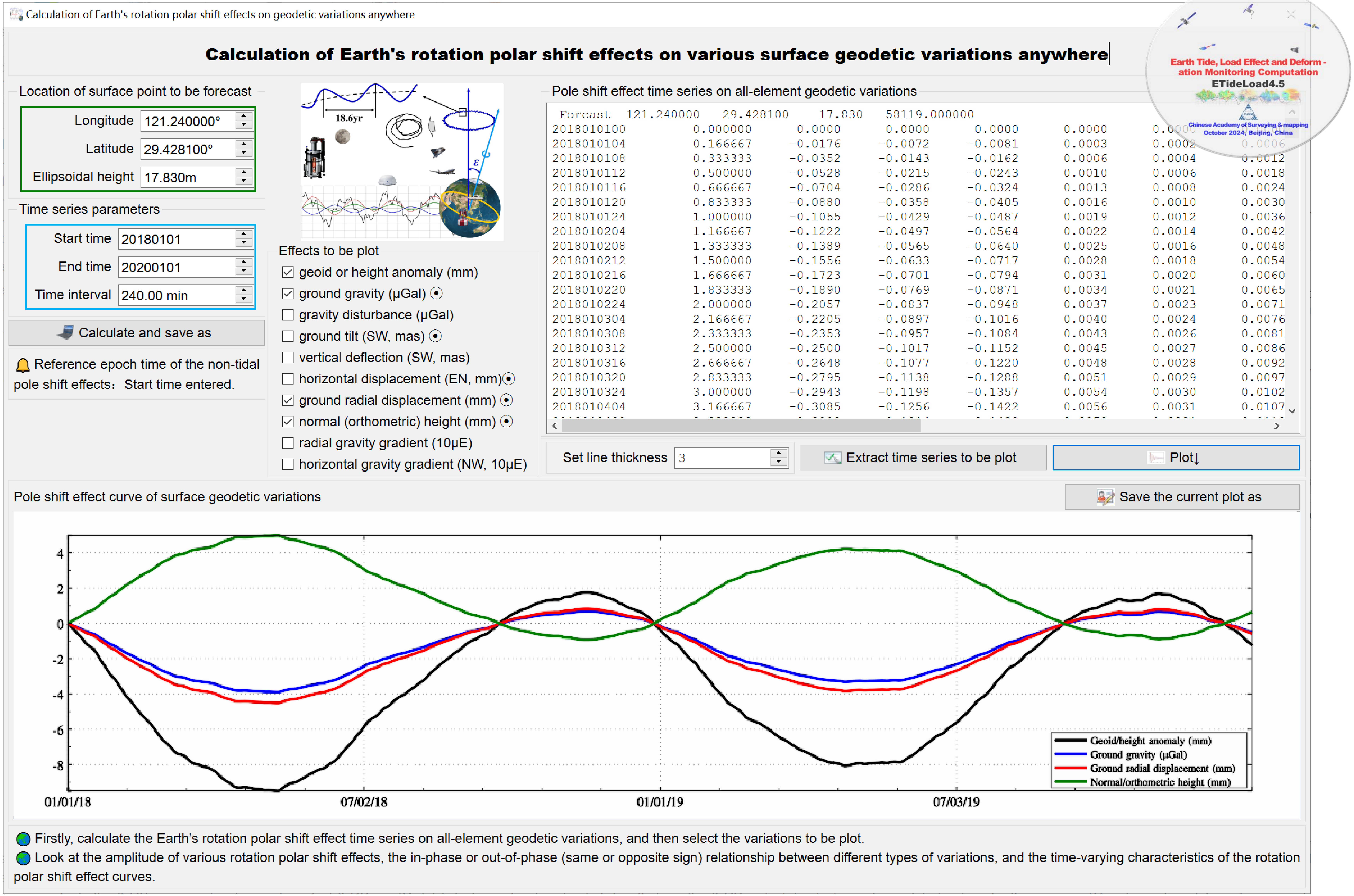

Computation of Earth's rotation polar shift effects on geodetic variations and tidal effects on EPR
Computation of the rotation polar shift or ocean pole tidal effects of satellite or outside solid Earth
Computation of rotation polar shift or ocean pole tidal effect time series
Computation of rotation polar shift or ocean pole tidal effects at ground sites with given time
Computation of rotation polar shift or ocean pole tidal effects outside solid Earth
Calculation of rotation polar shift effects on various geodetic variations anywhere
Forecast of the tidal effect time series on Earth's rotation
Open the location and time file of the external points
Computation of figure polar shift effects from the measured ΔC21 and ΔS21
Save program process as
Algorithm formulas
Set the file parameters
Column ordinal number of ellipsoidal height in the record
4
Column ordinal number of time in the record
1
Column ordinal number of starting MJD0 in the header
5
Select the type of effects
geopotential (0.1m²/s²)
gravity vector (XYZ, μGal)
gravity vector (ENU, μGal)
gravity gradient (XYZ, 10μE)
gravity gradient (ENU, 10μE)
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Poleshifteffectscalc/outsatrst.txt.
>> Setting parameters have been imported into the program!
>> Prepare to compute Earth's rotation polar shift effects ...
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 12:08:30
>> Complete the computation of Earth's rotation polar shift effects!
>> Computation end time: 2024-10-18 12:08:31
>> [Function] According to the location and time in the external sapce point file, compute the Earth's rotation polar shift or ocean pole tidal effects on the geopotential (0.1m²/s²), gravity(μGal), or gravity gradient(10μE) outside the solid Earth
>> Open the location and time file of the external points C:/ETideLoad4.5_win64en/examples/Poleshifteffectscalc/satptm.txt.
** Set the file format parameters according to the text box below, and then select the type of the geodetic variation to be computed. After giving th… the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Poleshifteffectscalc/satorbrst.txt.
>> Setting parameters have been imported into the program!
>> Prepare to compute Earth's rotation polar shift effects ...
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 12:09:09
>> Complete the computation of Earth's rotation polar shift effects!
>> Computation end time: 2024-10-18 12:09:10
Columns 2 and 3 of the record are agreed as the longitude and latitude
Select the effects to be computed
Rotaion polar shift effects
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
GOCE satellite altitude
Save data in the text box as
Forcast 121.240000 29.428100 250000.000 58119.000000
2018010100 121.240000 29.428100 250000.0 -0.9427 0.2824 0.8597 -2.5791
2018010104 121.240000 29.428100 250000.0 -0.9443 0.2829 0.8611 -2.5833
2018010108 121.240000 29.428100 250000.0 -0.9458 0.2834 0.8625 -2.5875
2018010112 121.240000 29.428100 250000.0 -0.9474 0.2838 0.8639 -2.5917
2018010116 121.240000 29.428100 250000.0 -0.9489 0.2843 0.8653 -2.5959
2018010120 121.240000 29.428100 250000.0 -0.9504 0.2847 0.8667 -2.6001
2018010124 121.240000 29.428100 250000.0 -0.9520 0.2852 0.8681 -2.6043
2018010204 121.240000 29.428100 250000.0 -0.9534 0.2856 0.8694 -2.6083
2018010208 121.240000 29.428100 250000.0 -0.9549 0.2861 0.8708 -2.6123
2018010212 121.240000 29.428100 250000.0 -0.9563 0.2865 0.8721 -2.6162
2018010216 121.240000 29.428100 250000.0 -0.9578 0.2869 0.8734 -2.6202
2018010220 121.240000 29.428100 250000.0 -0.9592 0.2874 0.8747 -2.6242
2018010224 121.240000 29.428100 250000.0 -0.9607 0.2878 0.8761 -2.6282
2018010304 121.240000 29.428100 250000.0 -0.9620 0.2882 0.8772 -2.6317
2018010308 121.240000 29.428100 250000.0 -0.9633 0.2886 0.8784 -2.6353
2018010312 121.240000 29.428100 250000.0 -0.9646 0.2890 0.8796 -2.6388
2018010316 121.240000 29.428100 250000.0 -0.9659 0.2894 0.8808 -2.6423
2018010320 121.240000 29.428100 250000.0 -0.9671 0.2897 0.8819 -2.6458
2018010324 121.240000 29.428100 250000.0 -0.9684 0.2901 0.8831 -2.6493
2018010404 121.240000 29.428100 250000.0 -0.9697 0.2905 0.8842 -2.6527
The Earth's rotation polar shift and figure polar shift respectively characterize the behavior of the kinematic state and mechanical figure of the Earth system varying over time. Both exist objectively and induce various geodetic elements in the Earth's space to vary over time.
The program adopts the IERS measured or forecast product IERSeopc04.dat (which can be downloaded directly from the IERS website), which can be updated in time by the program [Geophysical models and numerical standards settings]. Love numbers in the program are k₂ = 0.3077 + 0.0036i, h₂ = 0.6207 and l₂ = 0.0836.



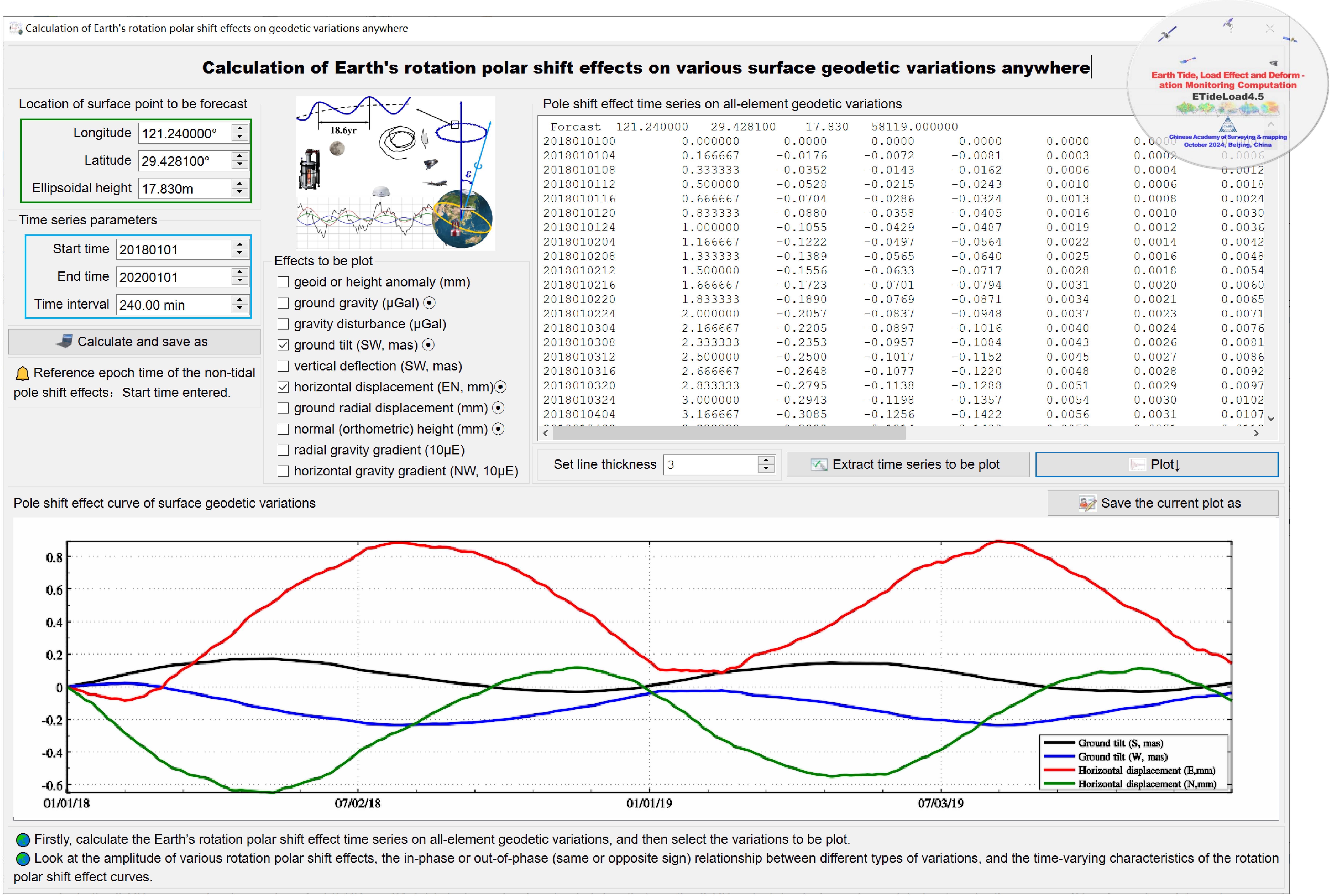
Earth's rotation polar shift effects at 450km altitude: geopotential (0.1m²/s²), gravity vector (E, N: along the GRACE orbit/SST-ll, U, μGal)

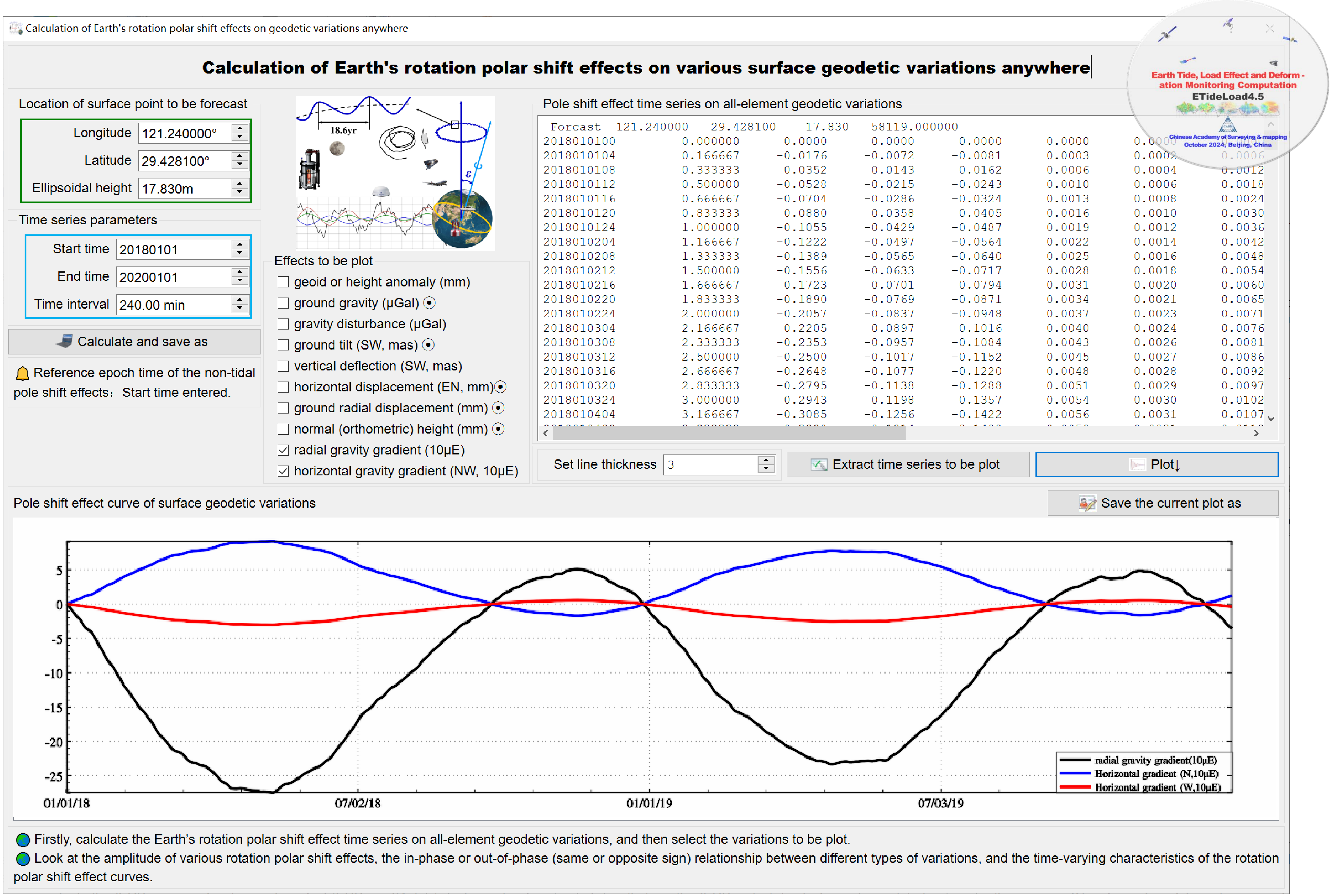


Earth's rotation polar shift effects at 250km altitude: geopotential (0.1m²/s²), gravity gradient (E, N: along the GOCE orbit, U, 10μE)



Calculation of Earth's rotation polar shift effects on geodetic variations anywhere
Calculation of Earth's rotation polar shift effects on various surface geodetic variations anywhere
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Ellipsoidal height 17.830m
Time series parameters
Start time 20180101
End time 20200101
Time interval 240.00 min
Calculate and save as
Reference epoch time of the non-tidal pole shift effects: Start time entered.
18.6yr
Effects to be plot
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
normal (orthometric) height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
Pole shift effect time series on all-element geodetic variations
Forcast 121.240000 29.428100 17.830 58119.000000
2018010100 0.000000 0.0000 0.0000 0.0000 0.0000 0.0000
2018010104 0.166667 -0.0176 -0.0072 -0.0081 0.0003 0.0002 0.0006
2018010108 0.333333 -0.0352 -0.0143 -0.0162 0.0006 0.0004 0.0012
2018010112 0.500000 -0.0528 -0.0215 -0.0243 0.0010 0.0006 0.0018
2018010116 0.666667 -0.0704 -0.0286 -0.0324 0.0013 0.0008 0.0024
2018010120 0.833333 -0.0880 -0.0358 -0.0405 0.0016 0.0010 0.0030
2018010124 1.000000 -0.1055 -0.0429 -0.0487 0.0019 0.0012 0.0036
2018010204 1.166667 -0.1222 -0.0497 -0.0564 0.0022 0.0014 0.0042
2018010208 1.333333 -0.1389 -0.0565 -0.0640 0.0025 0.0016 0.0048
2018010212 1.500000 -0.1556 -0.0633 -0.0717 0.0028 0.0018 0.0054
2018010216 1.666667 -0.1723 -0.0701 -0.0794 0.0031 0.0020 0.0060
2018010220 1.833333 -0.1890 -0.0769 -0.0871 0.0034 0.0021 0.0065
2018010224 2.000000 -0.2057 -0.0837 -0.0948 0.0037 0.0023 0.0071
2018010304 2.166667 -0.2205 -0.0897 -0.1016 0.0040 0.0024 0.0076
2018010308 2.333333 -0.2353 -0.0957 -0.1084 0.0043 0.0026 0.0081
2018010312 2.500000 -0.2500 -0.1017 -0.1152 0.0045 0.0027 0.0086
2018010316 2.666667 -0.2648 -0.1077 -0.1220 0.0048 0.0028 0.0092
2018010320 2.833333 -0.2795 -0.1138 -0.1288 0.0051 0.0029 0.0097
2018010324 3.000000 -0.2943 -0.1198 -0.1357 0.0054 0.0030 0.0102
2018010404 3.166667 -0.3085 -0.1256 -0.1422 0.0056 0.0031 0.0107
Set line thickness 3
Extract time series to be plot
Plot↓
Pole shift effect curve of surface geodetic variations
Save the current plot as
4
2
0
-2
-4
-6
-8
01/01/18
07/02/18
01/01/19
07/03/19
Geoid/height anomaly (mm)
Ground gravity (μGal)
Ground radial displacement (mm)
Normal/orthometric height (mm)
Firstly, calculate the Earth's rotation polar shift effect time series on all-element geodetic variations, and then select the variations to be plot.
Look at the amplitude of various rotation polar shift effects, the in-phase or out-of-phase (same or opposite sign) relationship between different types of variations, and the time-varying characteristics of the rotation polar shift effect curves.

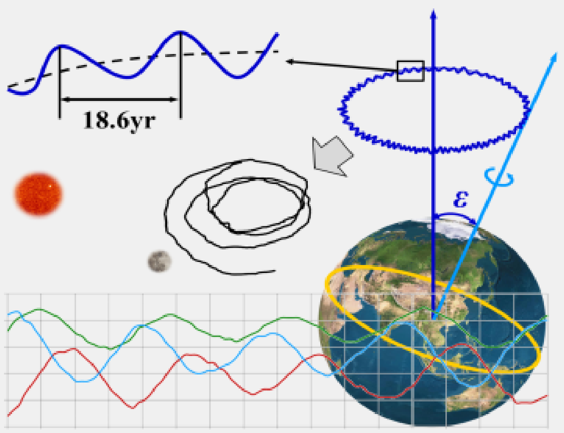

Calculation of Earth's rotation polar shift effects on geodetic variations anywhere
Calculation of Earth's rotation polar shift effects on various surface geodetic variations anywhere
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Ellipsoidal height 17.830m
Time series parameters
Start time 20180101
End time 20200101
Time interval 240.00 min
Calculate and save as
Reference epoch time of the non-tidal pole shift effects: Start time entered.
18.6yr
Effects to be plot
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
normal (orthometric) height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
Pole shift effect time series on all-element geodetic variations
Forcast 121.240000 29.428100 17.830 58119.000000
2018010100 0.000000 0.0000 0.0000 0.0000 0.0000 0.0000
2018010104 0.166667 -0.0176 -0.0072 -0.0081 0.0003 0.0002 0.0006
2018010108 0.333333 -0.0352 -0.0143 -0.0162 0.0006 0.0004 0.0012
2018010112 0.500000 -0.0528 -0.0215 -0.0243 0.0010 0.0006 0.0018
2018010116 0.666667 -0.0704 -0.0286 -0.0324 0.0013 0.0008 0.0024
2018010120 0.833333 -0.0880 -0.0358 -0.0405 0.0016 0.0010 0.0030
2018010124 1.000000 -0.1055 -0.0429 -0.0487 0.0019 0.0012 0.0036
2018010204 1.166667 -0.1222 -0.0497 -0.0564 0.0022 0.0014 0.0042
2018010208 1.333333 -0.1389 -0.0565 -0.0640 0.0025 0.0016 0.0048
2018010212 1.500000 -0.1556 -0.0633 -0.0717 0.0028 0.0018 0.0054
2018010216 1.666667 -0.1723 -0.0701 -0.0794 0.0031 0.0020 0.0060
2018010220 1.833333 -0.1890 -0.0769 -0.0871 0.0034 0.0021 0.0065
2018010224 2.000000 -0.2057 -0.0837 -0.0948 0.0037 0.0023 0.0071
2018010304 2.166667 -0.2205 -0.0897 -0.1016 0.0040 0.0024 0.0076
2018010308 2.333333 -0.2353 -0.0957 -0.1084 0.0043 0.0026 0.0081
2018010312 2.500000 -0.2500 -0.1017 -0.1152 0.0045 0.0027 0.0086
2018010316 2.666667 -0.2648 -0.1077 -0.1220 0.0048 0.0028 0.0092
2018010320 2.833333 -0.2795 -0.1138 -0.1288 0.0051 0.0029 0.0097
2018010324 3.000000 -0.2943 -0.1198 -0.1357 0.0054 0.0030 0.0102
2018010404 3.166667 -0.3085 -0.1256 -0.1422 0.0056 0.0031 0.0107
Set line thickness 3
Extract time series to be plot
Plot↓
Pole shift effect curve of surface geodetic variations
Save the current plot as
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
01/01/18
07/02/18
01/01/19
07/03/19
Ground tilt (S, mas)
Ground tilt (W, mas)
Horizontal displacement (E,mm)
Horizontal displacement (N,mm)
Firstly, calculate the Earth's rotation polar shift effect time series on all-element geodetic variations, and then select the variations to be plot.
Look at the amplitude of various rotation polar shift effects, the in-phase or out-of-phase (same or opposite sign) relationship between different types of variations, and the time-varying characteristics of the rotation polar shift effect curves.


Calculation of Earth's rotation polar shift effects on geodetic variations anywhere
Calculation of Earth's rotation polar shift effects on various surface geodetic variations anywhere
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Ellipsoidal height 17.830m
Time series parameters
Start time 20180101
End time 20200101
Time interval 240.00 min
Calculate and save as
Reference epoch time of the non-tidal pole shift effects: Start time entered.
18.6yr
Effects to be plot
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
normal (orthometric) height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
Pole shift effect time series on all-element geodetic variations
Forcast 121.240000 29.428100 17.830 58119.000000
2018010100 0.000000 0.0000 0.0000 0.0000 0.0000 0.0000
2018010104 0.166667 -0.0176 -0.0072 -0.0081 0.0003 0.0002 0.0006
2018010108 0.333333 -0.0352 -0.0143 -0.0162 0.0006 0.0004 0.0012
2018010112 0.500000 -0.0528 -0.0215 -0.0243 0.0010 0.0006 0.0018
2018010116 0.666667 -0.0704 -0.0286 -0.0324 0.0013 0.0008 0.0024
2018010120 0.833333 -0.0880 -0.0358 -0.0405 0.0016 0.0010 0.0030
2018010124 1.000000 -0.1055 -0.0429 -0.0487 0.0019 0.0012 0.0036
2018010204 1.166667 -0.1222 -0.0497 -0.0564 0.0022 0.0014 0.0042
2018010208 1.333333 -0.1389 -0.0565 -0.0640 0.0025 0.0016 0.0048
2018010212 1.500000 -0.1556 -0.0633 -0.0717 0.0028 0.0018 0.0054
2018010216 1.666667 -0.1723 -0.0701 -0.0794 0.0031 0.0020 0.0060
2018010220 1.833333 -0.1890 -0.0769 -0.0871 0.0034 0.0021 0.0065
2018010224 2.000000 -0.2057 -0.0837 -0.0948 0.0037 0.0023 0.0071
2018010304 2.166667 -0.2205 -0.0897 -0.1016 0.0040 0.0024 0.0076
2018010308 2.333333 -0.2353 -0.0957 -0.1084 0.0043 0.0026 0.0081
2018010312 2.500000 -0.2500 -0.1017 -0.1152 0.0045 0.0027 0.0086
2018010316 2.666667 -0.2648 -0.1077 -0.1220 0.0048 0.0028 0.0092
2018010320 2.833333 -0.2795 -0.1138 -0.1288 0.0051 0.0029 0.0097
2018010324 3.000000 -0.2943 -0.1198 -0.1357 0.0054 0.0030 0.0102
2018010404 3.166667 -0.3085 -0.1256 -0.1422 0.0056 0.0031 0.0107
Set line thickness 3
Extract time series to be plot
Plot↓
Pole shift effect curve of surface geodetic variations
Save the current plot as
5
0
-5
-10
-15
-20
-25
01/01/18
07/02/18
01/01/19
07/03/19
radial gravity gradient(10μE)
Horizontal gradient (N,10μE)
Horizontal gradient (W,10μE)
Firstly, calculate the Earth's rotation polar shift effect time series on all-element geodetic variations, and then select the variations to be plot.
Look at the amplitude of various rotation polar shift effects, the in-phase or out-of-phase (same or opposite sign) relationship between different types of variations, and the time-varying characteristics of the rotation polar shift effect curves.

The 1mas polar shift corresponds to the surface displacement of 3cm.

Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China

Forecast of the tidal effect time series on Earth's rotation (EPR)



Forecast time series parameters

Start time 20180101

End time 20200101

Time interval 240.00 min

select the type of tidal effect: Long period tidal effect

Calculate and save as

The tidal effect time series on Earth's rotation (EPR)

date	day	m1	m2 (uas)	dLOD (us/day)	dUT1 (ms)	dX1 (mas)	dX2 (mas)	dw (e-14rad/s)
2018010100	0.000000	176.3364	-80.0140	-16.4154	-109.4040	-0.8817	-0.5187	1.3851
2018010104	0.166667	178.0185	-77.2652	-28.0124	-109.4003	-1.0389	-0.7073	2.3639
2018010108	0.333333	180.1408	-74.1469	-37.8732	-109.3948	-1.1843	-0.8874	3.1961
2018010112	0.500000	182.6795	-70.6880	-45.8797	-109.3878	-1.3166	-1.0572	3.8719
2018010116	0.666667	185.6071	-66.9207	-51.9376	-109.3796	-1.4347	-1.2152	4.3832
2018010120	0.833333	188.8922	-62.8798	-55.9783	-109.3706	-1.5373	-1.3598	4.7242
2018010124	1.000000	192.5001	-58.6028	-57.9595	-109.3611	-1.6237	-1.4898	4.8915
2018010204	1.166667	196.3932	-54.1291	-57.8657	-109.3514	-1.6930	-1.6038	4.8836
2018010208	1.333333	200.5310	-49.5001	-55.7085	-109.3419	-1.7446	-1.7007	4.7015
2018010212	1.500000	204.8709	-44.7585	-51.5258	-109.3330	-1.7781	-1.7798	4.3485
2018010216	1.666667	209.3681	-39.9480	-45.3814	-109.3249	-1.7931	-1.8402	3.8300
2018010220	1.833333	213.9766	-35.1127	-37.3636	-109.3179	-1.7897	-1.8813	3.1533
2018010224	2.000000	218.6491	-30.2972	-27.5838	-109.3125	-1.7677	-1.9027	2.3279
2018010304	2.166667	223.3377	-25.5457	-16.1743	-109.3088	-1.7275	-1.9043	1.3650
2018010308	2.333333	227.9944	-20.9017	-3.2863	-109.3072	-1.6695	-1.8860	0.2773
2018010312	2.500000	232.5713	-16.4077	10.9126	-109.3078	-1.5942	-1.8479	-0.9211
2018010316	2.666667	237.0211	-12.1049	26.2411	-109.3109	-1.5022	-1.7903	-2.2148
2018010320	2.833333	241.2979	-8.0327	42.5072	-109.3166	-1.3945	-1.7137	-3.5876
2018010324	3.000000	245.3568	-4.2284	59.5107	-109.3251	-1.2720	-1.6188	-5.0227

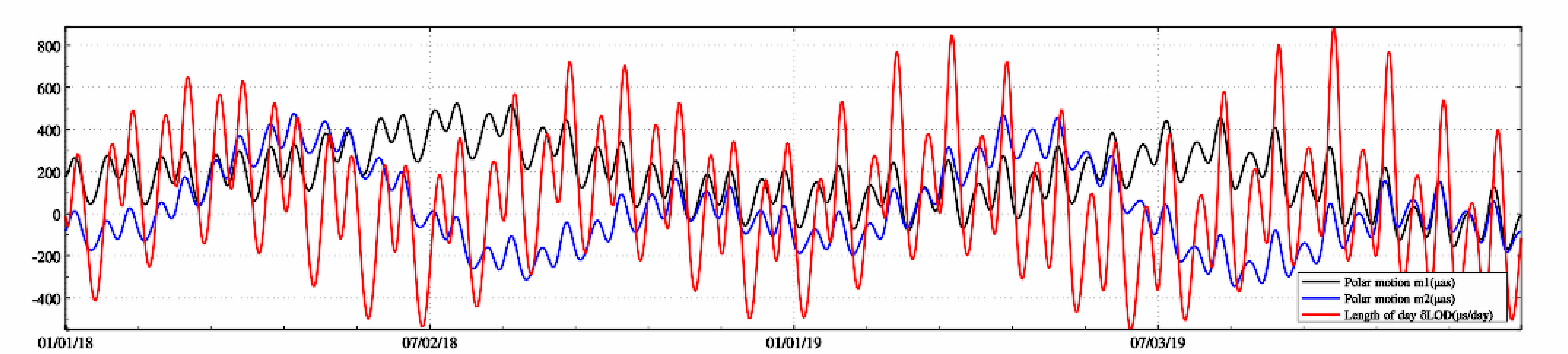
Set line thickness 2

Extract time series to be plot

Plot↓

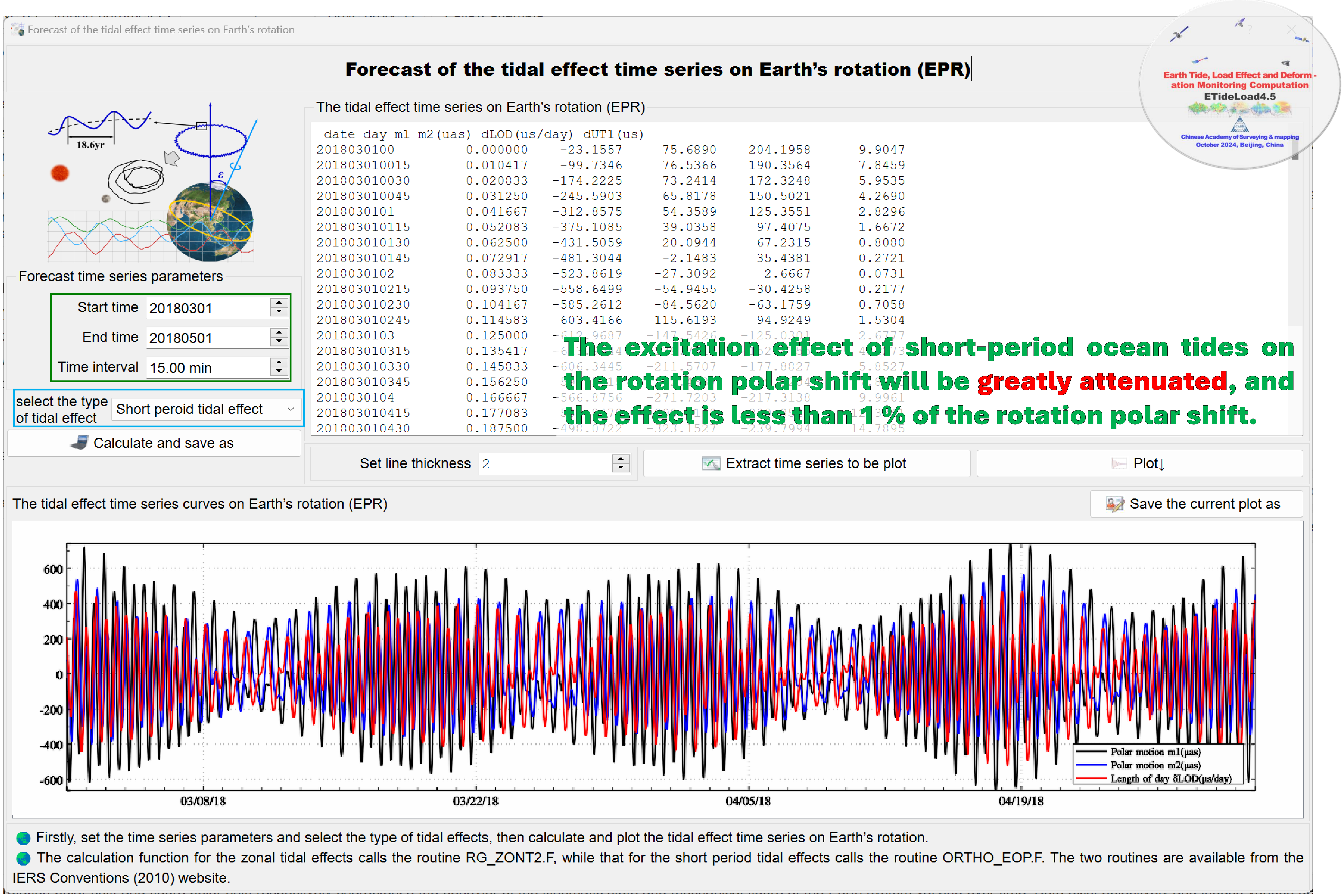
The tidal effect time series curves on Earth's rotation (EPR)

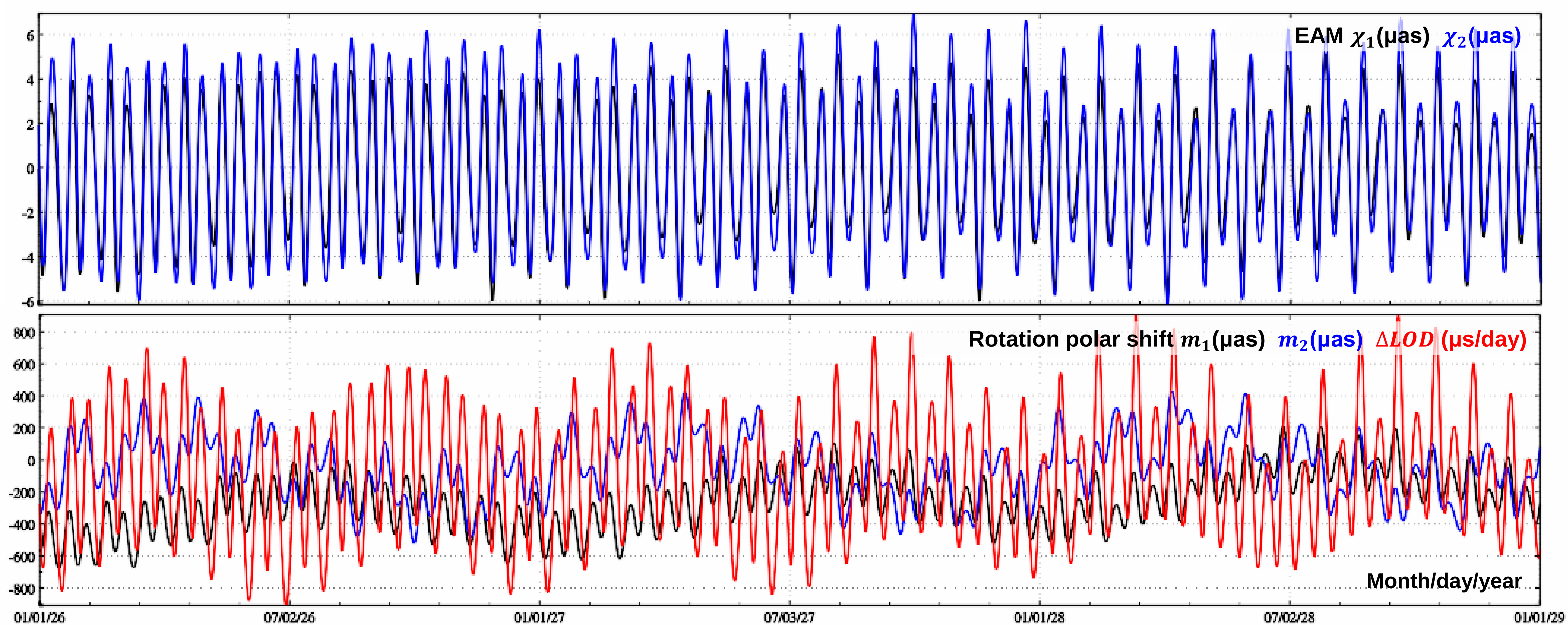
Save the current plot as



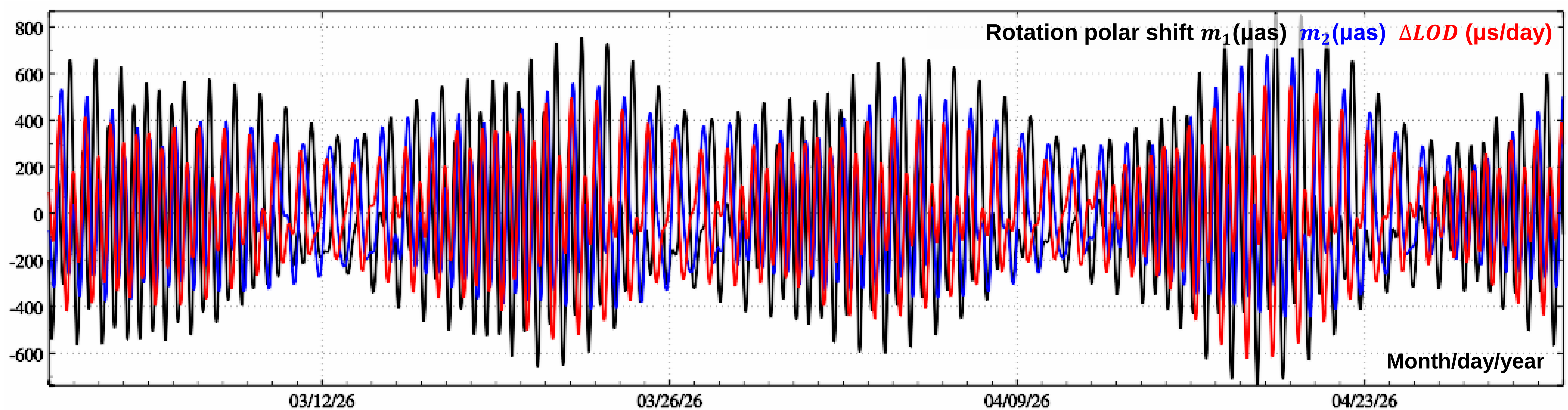
Firstly, set the time series parameters and select the type of tidal effects, then calculate and plot the tidal effect time series on Earth's rotation.

The calculation function for the zonal tidal effects calls the routine RG_ZONT2.F, while that for the short period tidal effects calls the routine ORTHO_EOP.F. The two routines are available from the IERS Conventions (2010) website.

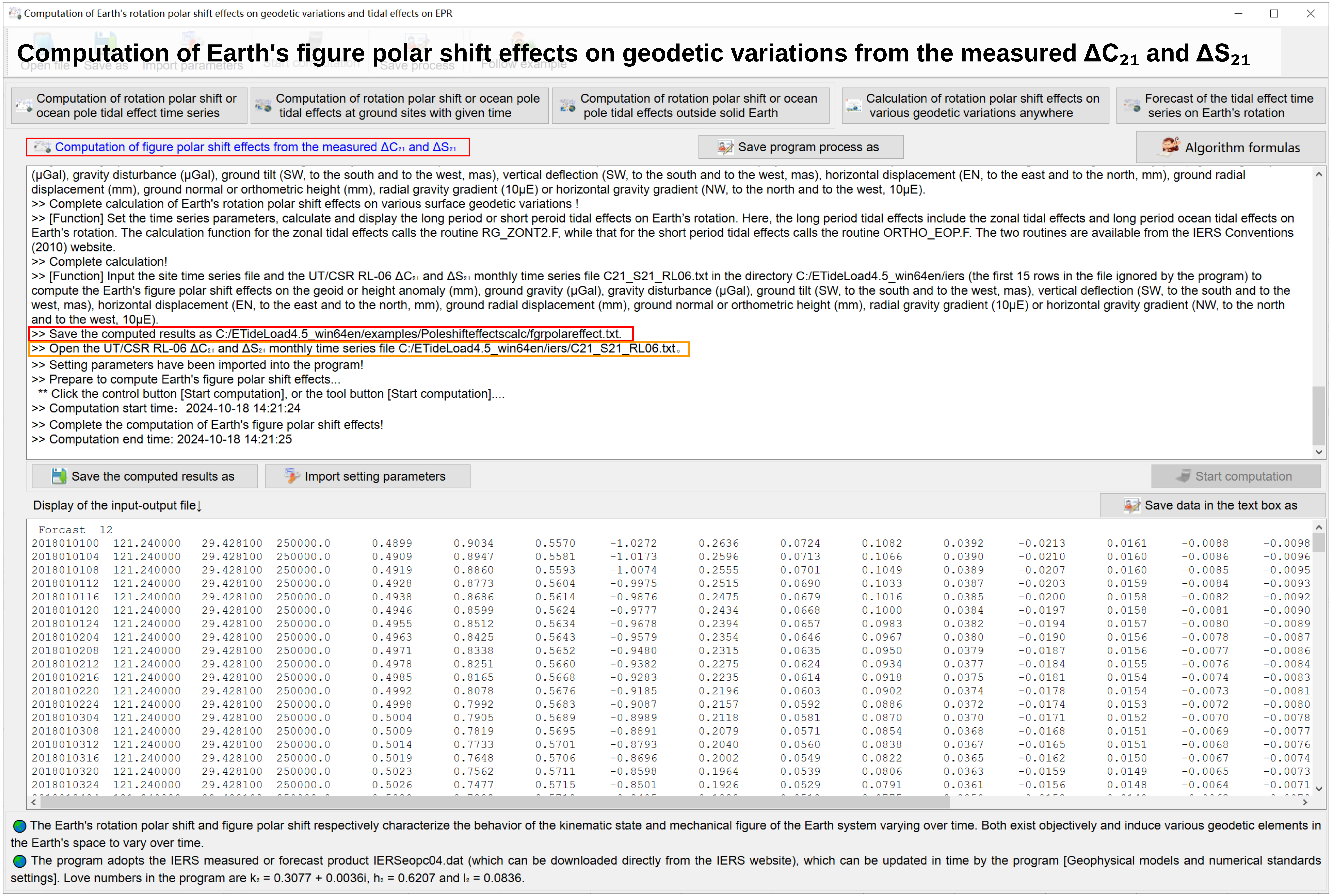

Forecast of the tidal effect time series on Earth's rotation
Forecast of the tidal effect time series on Earth's rotation (EPR)
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
18.6yr
Forecast time series parameters
Start time 20180301
End time 20180501
Time interval 15.00 min
select the type of tidal effect
Short peroid tidal effect
Calculate and save as
The tidal effect time series on Earth's rotation (EPR)
date day m1 m2(uas) dLOD(us/day) dUT1(us)
2018030100 0.000000 -23.1557 75.6890 204.1958 9.9047
201803010015 0.010417 -99.7346 76.5366 190.3564 7.8459
201803010030 0.020833 -174.2225 73.2414 172.3248 5.9535
201803010045 0.031250 -245.5903 65.8178 150.5021 4.2690
2018030101 0.041667 -312.8575 54.3589 125.3551 2.8296
201803010115 0.052083 -375.1085 39.0358 97.4075 1.6672
201803010130 0.062500 -431.5059 20.0944 67.2315 0.8080
201803010145 0.072917 -481.3044 -2.1483 35.4381 0.2721
2018030102 0.083333 -523.8619 -27.3092 2.6667 0.0731
201803010215 0.093750 -558.6499 -54.9455 -30.4258 0.2177
201803010230 0.104167 -585.2612 -84.5620 -63.1759 0.7058
201803010245 0.114583 -603.4166 -115.6193 -94.9249 1.5304
2018030103 0.125000 -612.9687 -147.5426 -125.0301 2.6777
201803010315 0.135417
201803010330 0.145833 -606.3445 -211.5707 -177.8827 5.8527
201803010345 0.156250
2018030104 0.166667 -566.8756 -271.7203 -217.3138 9.9961
201803010415 0.177083
201803010430 0.187500 -498.0722 -323.1527 -239.7994 14.7895
The excitation effect of short-period ocean tides on the rotation polar shift will be greatly attenuated, and the effect is less than 1 % of the rotation polar shift.
Set line thickness 2
Extract time series to be plot
Plot↓
The tidal effect time series curves on Earth's rotation (EPR)
Save the current plot as
600
400
200
0
-200
-400
-600
03/08/18
03/22/18
04/05/18
04/19/18
Polar motion m1(μas)
Polar motion m2(μas)
Length of day δLOD(μs/day)
Firstly, set the time series parameters and select the type of tidal effects, then calculate and plot the tidal effect time series on Earth's rotation.
The calculation function for the zonal tidal effects calls the routine RG_ZONT2.F, while that for the short period tidal effects calls the routine ORTHO_EOP.F. The two routines are available from the IERS Conventions (2010) website.



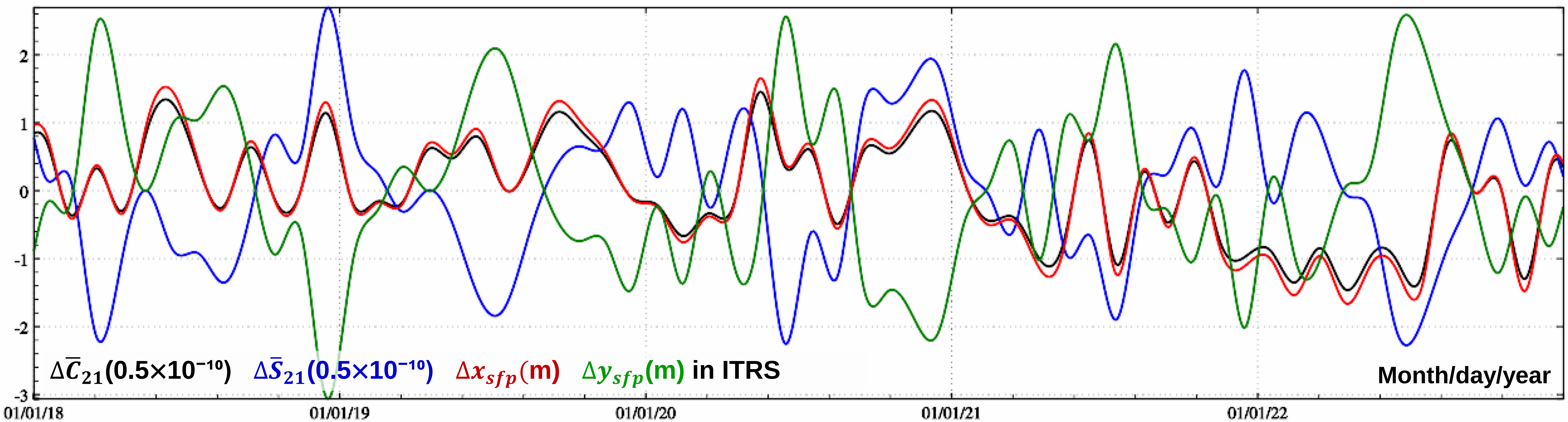
Long-period tidal effect time series for the Earth's rotation motion



The time series of diurnal and semi-diurnal tidal effects on ERP

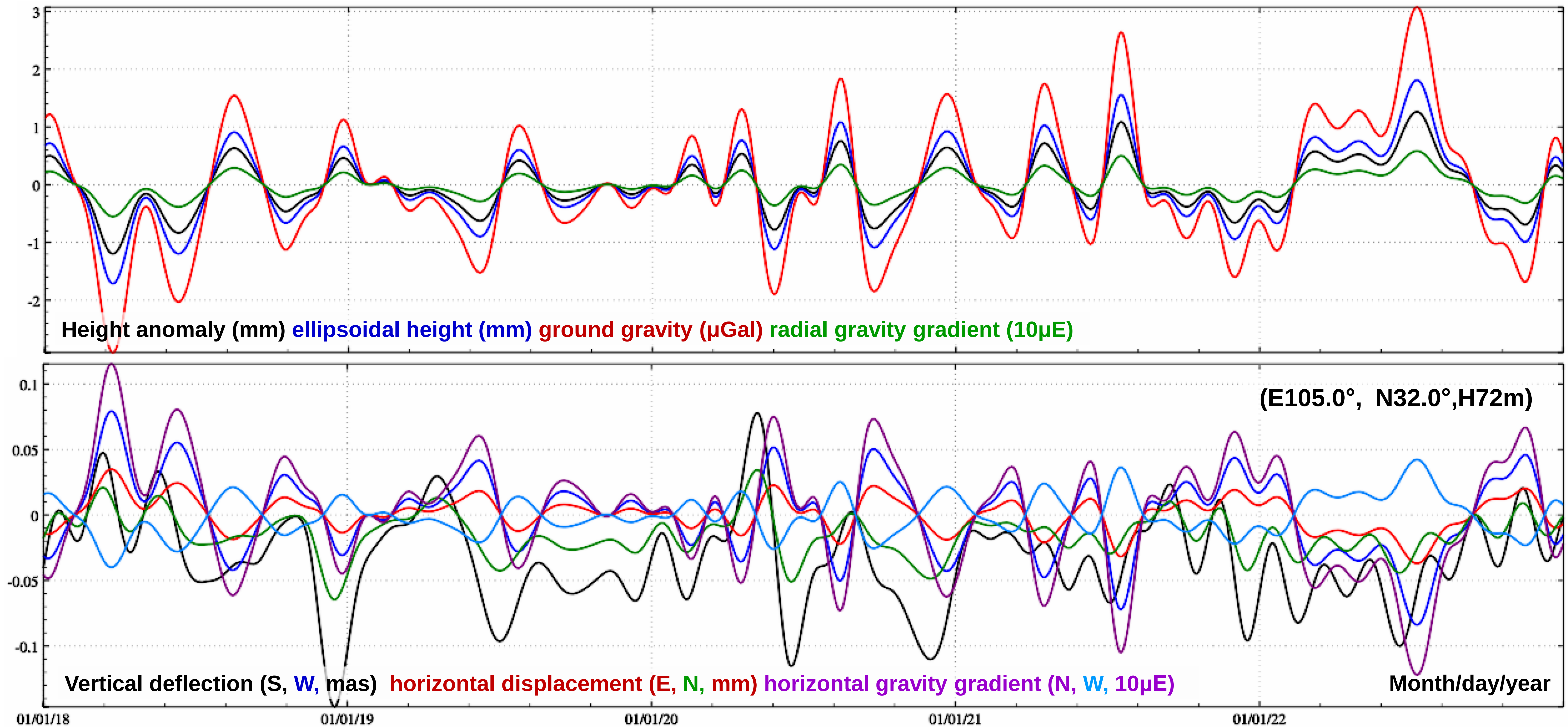

Computation of Earth's rotation polar shift effects on geodetic variations and tidal effects on EPR
Computation of Earth's figure polar shift effects on geodetic variations from the measured ΔC21 and ΔS21
Computation of rotation polar shift or ocean pole tidal effect time series
Computation of rotation polar shift or ocean pole tidal effects at ground sites with given time
Computation of rotation polar shift or ocean pole tidal effects outside solid Earth
Calculation of rotation polar shift effects on various geodetic variations anywhere
Forecast of the tidal effect time series on Earth's rotation
Computation of figure polar shift effects from the measured ΔC21 and ΔS21
Save program process as
Algorithm formulas
(μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (10μE) or horizontal gravity gradient (NW, to the north and to the west, 10μE).
>> Complete calculation of Earth's rotation polar shift effects on various surface geodetic variations !
>> [Function] Set the time series parameters, calculate and display the long period or short peroid tidal effects on Earth's rotation. Here, the long period tidal effects include the zonal tidal effects and long period ocean tidal effects on Earth's rotation. The calculation function for the zonal tidal effects calls the routine RG_ZONT2.F, while that for the short period tidal effects calls the routine ORTHO_EOP.F. The two routines are available from the IERS Conventions (2010) website.
>> Complete calculation!
>> [Function] Input the site time series file and the UT/CSR RL-06 ΔC21 and ΔS21 monthly time series file C21_S21_RL06.txt in the directory C:/ETideLoad4.5_win64en/iers (the first 15 rows in the file ignored by the program) to compute the Earth's figure polar shift effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (10μE) or horizontal gravity gradient (NW, to the north and to the west, 10μE).
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Poleshifteffectscalc/fgrpolareffect.txt.
>> Open the UT/CSR RL-06 ΔC21 and ΔS21 monthly time series file C:/ETideLoad4.5_win64en/iers/C21_S21_RL06.txt。
>> Setting parameters have been imported into the program!
>> Prepare to compute Earth's figure polar shift effects...
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time：2024-10-18 14:21:24
>> Complete the computation of Earth's figure polar shift effects!
>> Computation end time: 2024-10-18 14:21:25
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
Save data in the text box as
Forcast 12
2018010100 121.240000 29.428100 250000.0 0.4899 0.9034 0.5570 -1.0272 0.2636 0.0724 0.1082 0.0392 -0.0213 0.0161 -0.0088 -0.0098
2018010104 121.240000 29.428100 250000.0 0.4909 0.8947 0.5581 -1.0173 0.2596 0.0713 0.1066 0.0390 -0.0210 0.0160 -0.0086 -0.0096
2018010108 121.240000 29.428100 250000.0 0.4919 0.8860 0.5593 -1.0074 0.2555 0.0701 0.1049 0.0389 -0.0207 0.0160 -0.0085 -0.0095
2018010112 121.240000 29.428100 250000.0 0.4928 0.8773 0.5604 -0.9975 0.2515 0.0690 0.1033 0.0387 -0.0203 0.0159 -0.0084 -0.0093
2018010116 121.240000 29.428100 250000.0 0.4938 0.8686 0.5614 -0.9876 0.2475 0.0679 0.1016 0.0385 -0.0200 0.0158 -0.0082 -0.0092
2018010120 121.240000 29.428100 250000.0 0.4946 0.8599 0.5624 -0.9777 0.2434 0.0668 0.1000 0.0384 -0.0197 0.0158 -0.0081 -0.0090
2018010124 121.240000 29.428100 250000.0 0.4955 0.8512 0.5634 -0.9678 0.2394 0.0657 0.0983 0.0382 -0.0194 0.0157 -0.0080 -0.0089
2018010204 121.240000 29.428100 250000.0 0.4963 0.8425 0.5643 -0.9579 0.2354 0.0646 0.0967 0.0380 -0.0190 0.0156 -0.0078 -0.0087
2018010208 121.240000 29.428100 250000.0 0.4971 0.8338 0.5652 -0.9480 0.2315 0.0635 0.0950 0.0379 -0.0187 0.0156 -0.0077 -0.0086
2018010212 121.240000 29.428100 250000.0 0.4978 0.8251 0.5660 -0.9382 0.2275 0.0624 0.0934 0.0377 -0.0184 0.0155 -0.0076 -0.0084
2018010216 121.240000 29.428100 250000.0 0.4985 0.8165 0.5668 -0.9283 0.2235 0.0614 0.0918 0.0375 -0.0181 0.0154 -0.0074 -0.0083
2018010220 121.240000 29.428100 250000.0 0.4992 0.8078 0.5676 -0.9185 0.2196 0.0603 0.0902 0.0374 -0.0178 0.0154 -0.0073 -0.0081
2018010224 121.240000 29.428100 250000.0 0.4998 0.7992 0.5683 -0.9087 0.2157 0.0592 0.0886 0.0372 -0.0174 0.0153 -0.0072 -0.0080
2018010304 121.240000 29.428100 250000.0 0.5004 0.7905 0.5689 -0.8989 0.2118 0.0581 0.0870 0.0370 -0.0171 0.0152 -0.0070 -0.0078
2018010308 121.240000 29.428100 250000.0 0.5009 0.7819 0.5695 -0.8891 0.2079 0.0571 0.0854 0.0368 -0.0168 0.0151 -0.0069 -0.0077
2018010312 121.240000 29.428100 250000.0 0.5014 0.7733 0.5701 -0.8793 0.2040 0.0560 0.0838 0.0367 -0.0165 0.0151 -0.0068 -0.0076
2018010316 121.240000 29.428100 250000.0 0.5019 0.7648 0.5706 -0.8696 0.2002 0.0549 0.0822 0.0365 -0.0162 0.0150 -0.0067 -0.0074
2018010320 121.240000 29.428100 250000.0 0.5023 0.7562 0.5711 -0.8598 0.1964 0.0539 0.0806 0.0363 -0.0159 0.0149 -0.0065 -0.0073
2018010324 121.240000 29.428100 250000.0 0.5026 0.7477 0.5715 -0.8501 0.1926 0.0529 0.0791 0.0361 -0.0156 0.0148 -0.0064 -0.0071
The Earth's rotation polar shift and figure polar shift respectively characterize the behavior of the kinematic state and mechanical figure of the Earth system varying over time. Both exist objectively and induce various geodetic elements in the Earth's space to vary over time.
The program adopts the IERS measured or forecast product IERSeopc04.dat (which can be downloaded directly from the IERS website), which can be updated in time by the program [Geophysical models and numerical standards settings]. Love numbers in the program are k2 = 0.3077 + 0.0036i, h2 = 0.6207 and l2 = 0.0836.

In the Earth-fixed coordinate system with arbitrary positioning and orientation, the mechanical figure polar coordinates of the deforming Earth can be uniquely determined by the degree-2 tesseral harmonic geopotential coefficients $(\bar{C}_{21}, \bar{S}_{21})$. Therefore, the various tidal and non-tidal effects on figure pole can be accurately obtained in geodesy.



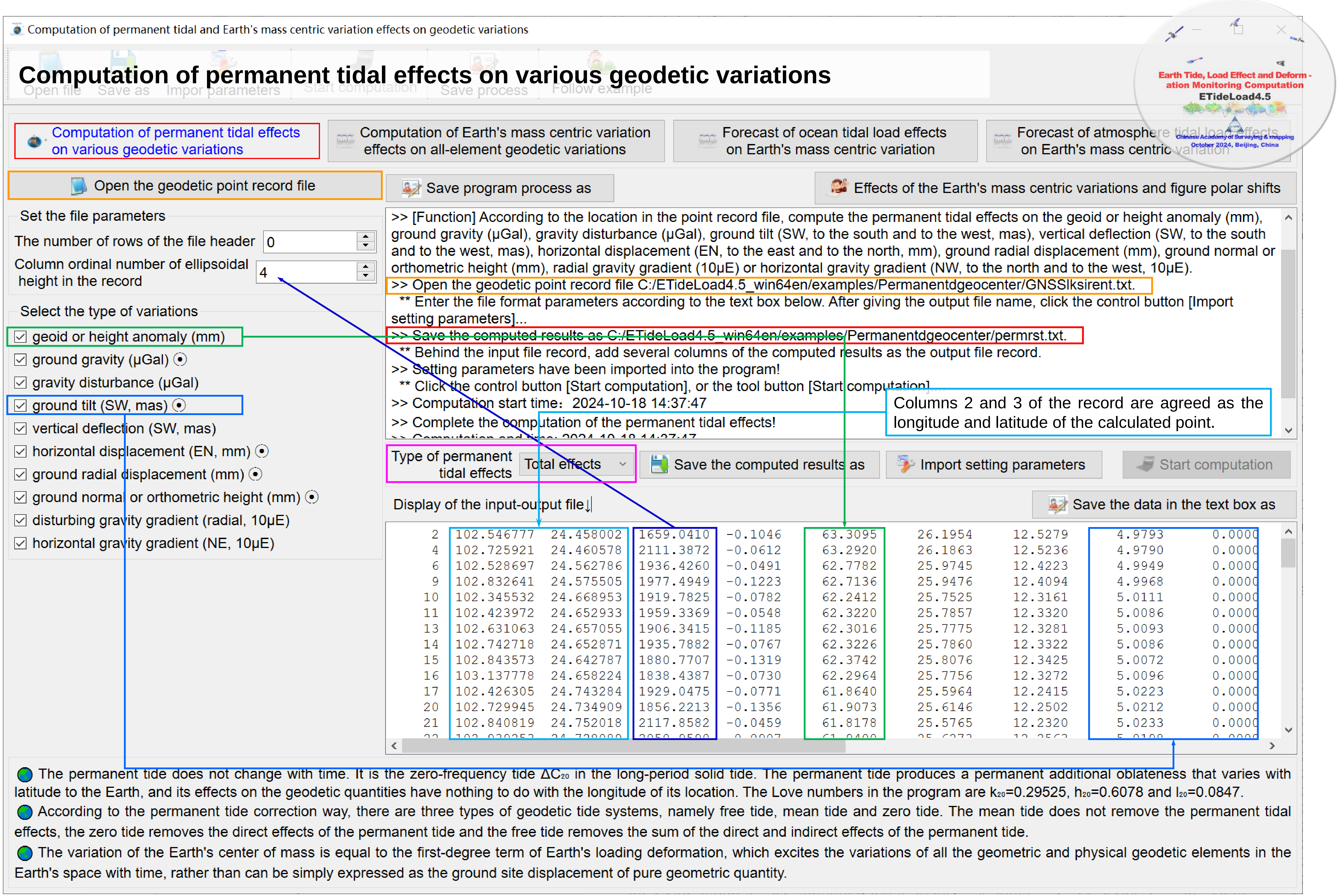
Degree-2 tesseral sector harmonic geopotential coefficient and Earth's figure polar shift time series measured by SLR from UT/CSR

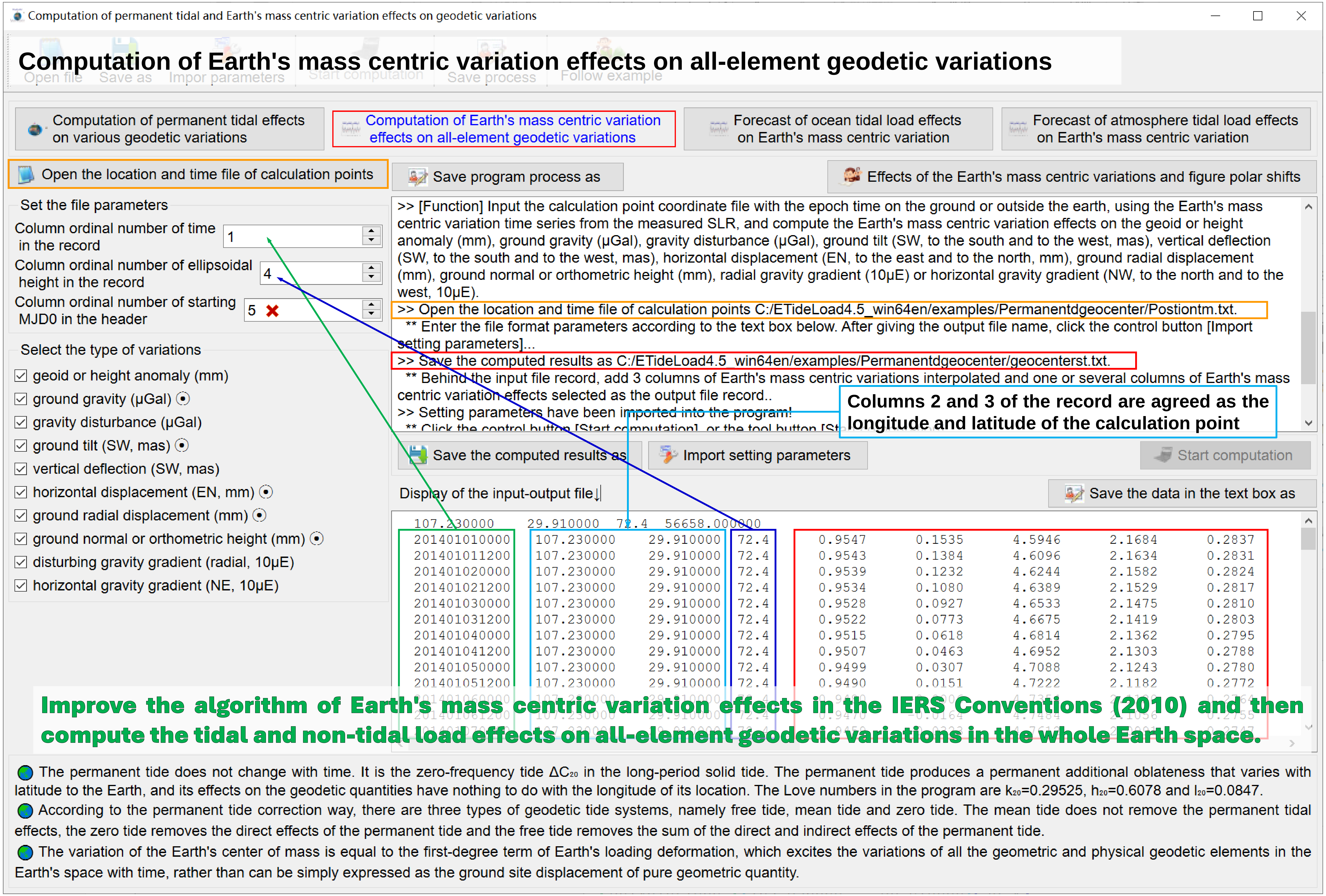
Although the Earth's figure polar shift itself can reach the meter level, the resulting effect on geoid is not greater than 2mm. The Earth's figure polar shift effects on horizontal geodetic elements such as ground horizontal displacement, vertical deviation or horizontal gravity gradient are small and can be generally ignored.

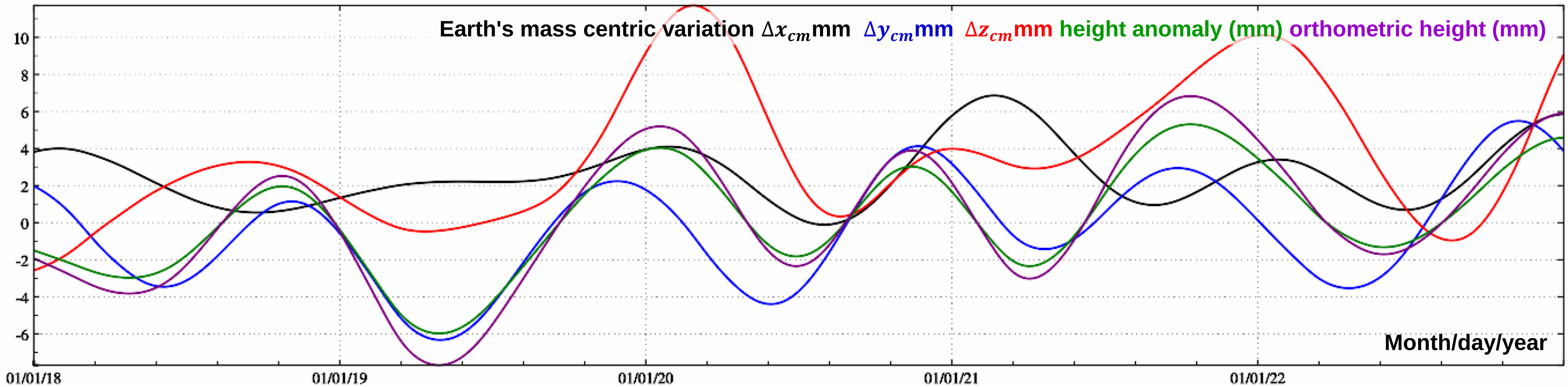


Earth's figure polar shift effect time series on geodetic variations

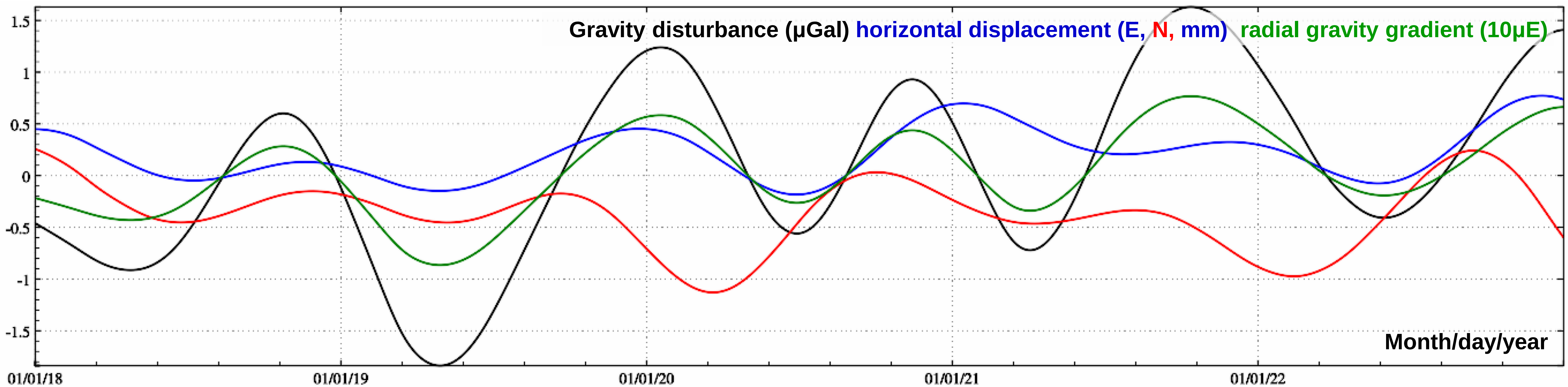
The Earth's rotation polar shift and Earth's figure polar shift respectively represent the kinematic state of the whole Earth system and the characteristics of Earth's mechanical shape changing with time, which are both natural objective behaviors. Both of them will cause various geodetic elements in Earth's space to change with time.


Computation of permanent tidal and Earth's mass centric variation effects on geodetic variations
Computation of permanent tidal effects on various geodetic variations
Open file
Save as
Impor parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of permanent tidal effects on various geodetic variations
Computation of Earth's mass centric variation effects on all-element geodetic variations
Forecast of ocean tidal load effects on Earth's mass centric variation
Forecast of atmosphere tidal load effects on Earth's mass centric variation
Open the geodetic point record file
Save program process as
Effects of the Earth's mass centric variations and figure polar shifts
Set the file parameters
The number of rows of the file header 0
Column ordinal number of ellipsoidal height in the record 4
Select the type of variations
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
disturbing gravity gradient (radial, 10μE)
horizontal gravity gradient (NE, 10μE)
>> [Function] According to the location in the point record file, compute the permanent tidal effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (10μE) or horizontal gravity gradient (NW, to the north and to the west, 10μE).
>> Open the geodetic point record file C:/ETideLoad4.5_win64en/examples/Permanentdgeocenter/GNSSlksirent.txt.
** Enter the file format parameters according to the text box below. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Permanentdgeocenter/permrst.txt.
** Behind the input file record, add several columns of the computed results as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]...
>> Computation start time: 2024-10-18 14:37:47
>> Complete the computation of the permanent tidal effects!
Columns 2 and 3 of the record are agreed as the longitude and latitude of the calculated point.
Type of permanent tidal effects
Total effects
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
Save the data in the text box as
2 102.546777 24.458002 1659.0410 -0.1046 63.3095 26.1954 12.5279 4.9793 0.0000
4 102.725921 24.460578 2111.3872 -0.0612 63.2920 26.1863 12.5236 4.9790 0.0000
6 102.528697 24.562786 1936.4260 -0.0491 62.7782 25.9745 12.4223 4.9949 0.0000
9 102.832641 24.575505 1977.4949 -0.1223 62.7136 25.9476 12.4094 4.9968 0.0000
10 102.345532 24.668953 1919.7825 -0.0782 62.2412 25.7525 12.3161 5.0111 0.0000
11 102.423972 24.652933 1959.3369 -0.0548 62.3220 25.7857 12.3320 5.0086 0.0000
13 102.631063 24.657055 1906.3415 -0.1185 62.3016 25.7775 12.3281 5.0093 0.0000
14 102.742718 24.652871 1935.7882 -0.0767 62.3226 25.7860 12.3322 5.0086 0.0000
15 102.843573 24.642787 1880.7707 -0.1319 62.3742 25.8076 12.3425 5.0072 0.0000
16 103.137778 24.658224 1838.4387 -0.0730 62.2964 25.7756 12.3272 5.0096 0.0000
17 102.426305 24.743284 1929.0475 -0.0771 61.8640 25.5964 12.2415 5.0223 0.0000
20 102.729945 24.734909 1856.2213 -0.1356 61.9073 25.6146 12.2502 5.0212 0.0000
21 102.840819 24.752018 2117.8582 -0.0459 61.8178 25.5765 12.2320 5.0233 0.0000
The permanent tide does not change with time. It is the zero-frequency tide ΔC₂₀ in the long-period solid tide. The permanent tide produces a permanent additional oblateness that varies with latitude to the Earth, and its effects on the geodetic quantities have nothing to do with the longitude of its location. The Love numbers in the program are k₂₀=0.29525, h₂₀=0.6078 and l₂₀=0.0847.
According to the permanent tide correction way, there are three types of geodetic tide systems, namely free tide, mean tide and zero tide. The mean tide does not remove the permanent tidal effects, the zero tide removes the direct effects of the permanent tide and the free tide removes the sum of the direct and indirect effects of the permanent tide.
The variation of the Earth's center of mass is equal to the first-degree term of Earth's loading deformation, which excites the variations of all the geometric and physical geodetic elements in the Earth's space with time, rather than can be simply expressed as the ground site displacement of pure geometric quantity.


Computation of permanent tidal and Earth's mass centric variation effects on geodetic variations
Computation of Earth's mass centric variation effects on all-element geodetic variations
Computation of permanent tidal effects on various geodetic variations
Computation of Earth's mass centric variation effects on all-element geodetic variations
Forecast of ocean tidal load effects on Earth's mass centric variation
Forecast of atmosphere tidal load effects on Earth's mass centric variation
Open the location and time file of calculation points
Save program process as
Effects of the Earth's mass centric variations and figure polar shifts
Set the file parameters
Column ordinal number of time in the record
1
Column ordinal number of ellipsoidal height in the record
4
Column ordinal number of starting MJD0 in the header
5
Select the type of variations
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
disturbing gravity gradient (radial, 10μE)
horizontal gravity gradient (NE, 10μE)
>> [Function] Input the calculation point coordinate file with the epoch time on the ground or outside the earth, using the Earth's mass centric variation time series from the measured SLR, and compute the Earth's mass centric variation effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (10μE) or horizontal gravity gradient (NW, to the north and to the west, 10μE).
>> Open the location and time file of calculation points C:/ETideLoad4.5_win64en/examples/Permanentdgeocenter/Postiontm.txt.
** Enter the file format parameters according to the text box below. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Permanentdgeocenter/geocenterst.txt.
** Behind the input file record, add 3 columns of Earth's mass centric variations interpolated and one or several columns of Earth's mass centric variation effects selected as the output file record..
>> Setting parameters have been imported into the program!
Columns 2 and 3 of the record are agreed as the longitude and latitude of the calculation point
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
Save the data in the text box as
107.230000 29.910000 72.4 56658.000000
201401010000 107.230000 29.910000 72.4 0.9547 0.1535 4.5946 2.1684 0.2837
201401011200 107.230000 29.910000 72.4 0.9543 0.1384 4.6096 2.1634 0.2831
201401020000 107.230000 29.910000 72.4 0.9539 0.1232 4.6244 2.1582 0.2824
201401021200 107.230000 29.910000 72.4 0.9534 0.1080 4.6389 2.1529 0.2817
201401030000 107.230000 29.910000 72.4 0.9528 0.0927 4.6533 2.1475 0.2810
201401031200 107.230000 29.910000 72.4 0.9522 0.0773 4.6675 2.1419 0.2803
201401040000 107.230000 29.910000 72.4 0.9515 0.0618 4.6814 2.1362 0.2795
201401041200 107.230000 29.910000 72.4 0.9507 0.0463 4.6952 2.1303 0.2788
201401050000 107.230000 29.910000 72.4 0.9499 0.0307 4.7088 2.1243 0.2780
201401051200 107.230000 29.910000 72.4 0.9490 0.0151 4.7222 2.1182 0.2772
Improve the algorithm of Earth's mass centric variation effects in the IERS Conventions (2010) and then compute the tidal and non-tidal load effects on all-element geodetic variations in the whole Earth space.
The permanent tide does not change with time. It is the zero-frequency tide ΔC20 in the long-period solid tide. The permanent tide produces a permanent additional oblateness that varies with latitude to the Earth, and its effects on the geodetic quantities have nothing to do with the longitude of its location. The Love numbers in the program are k20=0.29525, h20=0.6078 and l20=0.0847.
According to the permanent tide correction way, there are three types of geodetic tide systems, namely free tide, mean tide and zero tide. The mean tide does not remove the permanent tidal effects, the zero tide removes the direct effects of the permanent tide and the free tide removes the sum of the direct and indirect effects of the permanent tide.
The variation of the Earth's center of mass is equal to the first-degree term of Earth's loading deformation, which excites the variations of all the geometric and physical geodetic elements in the Earth's space with time, rather than can be simply expressed as the ground site displacement of pure geometric quantity.

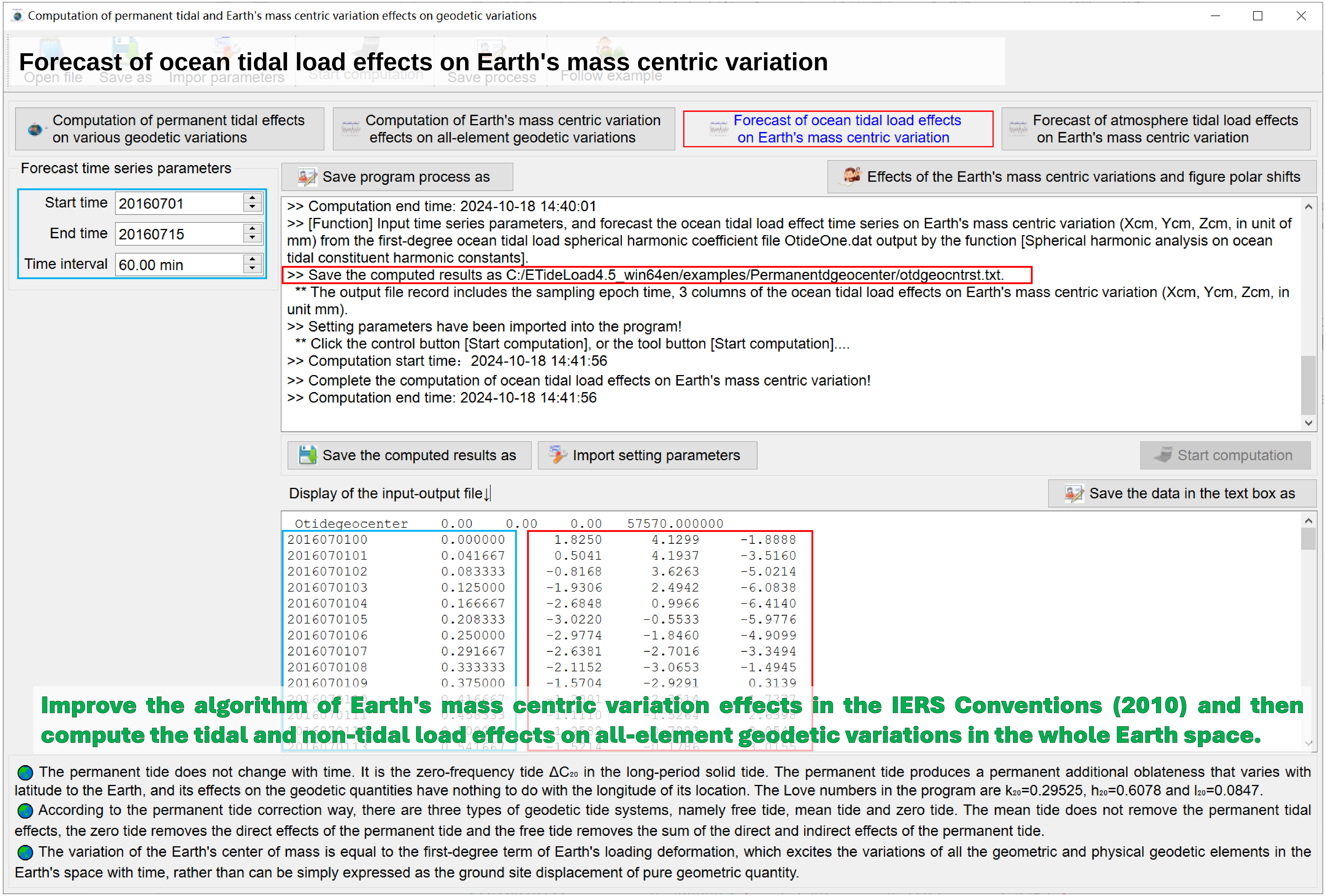


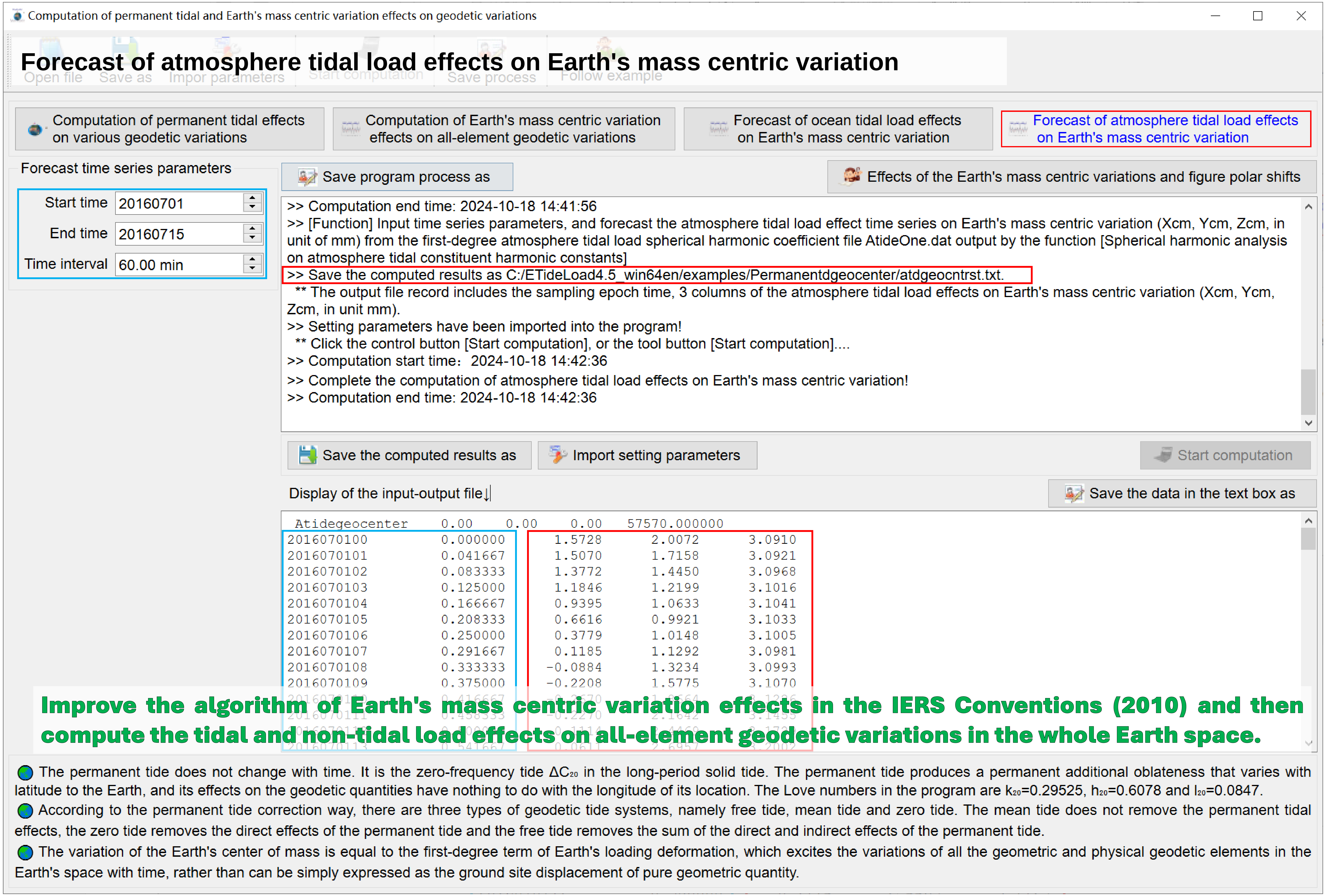
Earth's mass centric variation and their effects on the height anomaly geoid and orthometric height

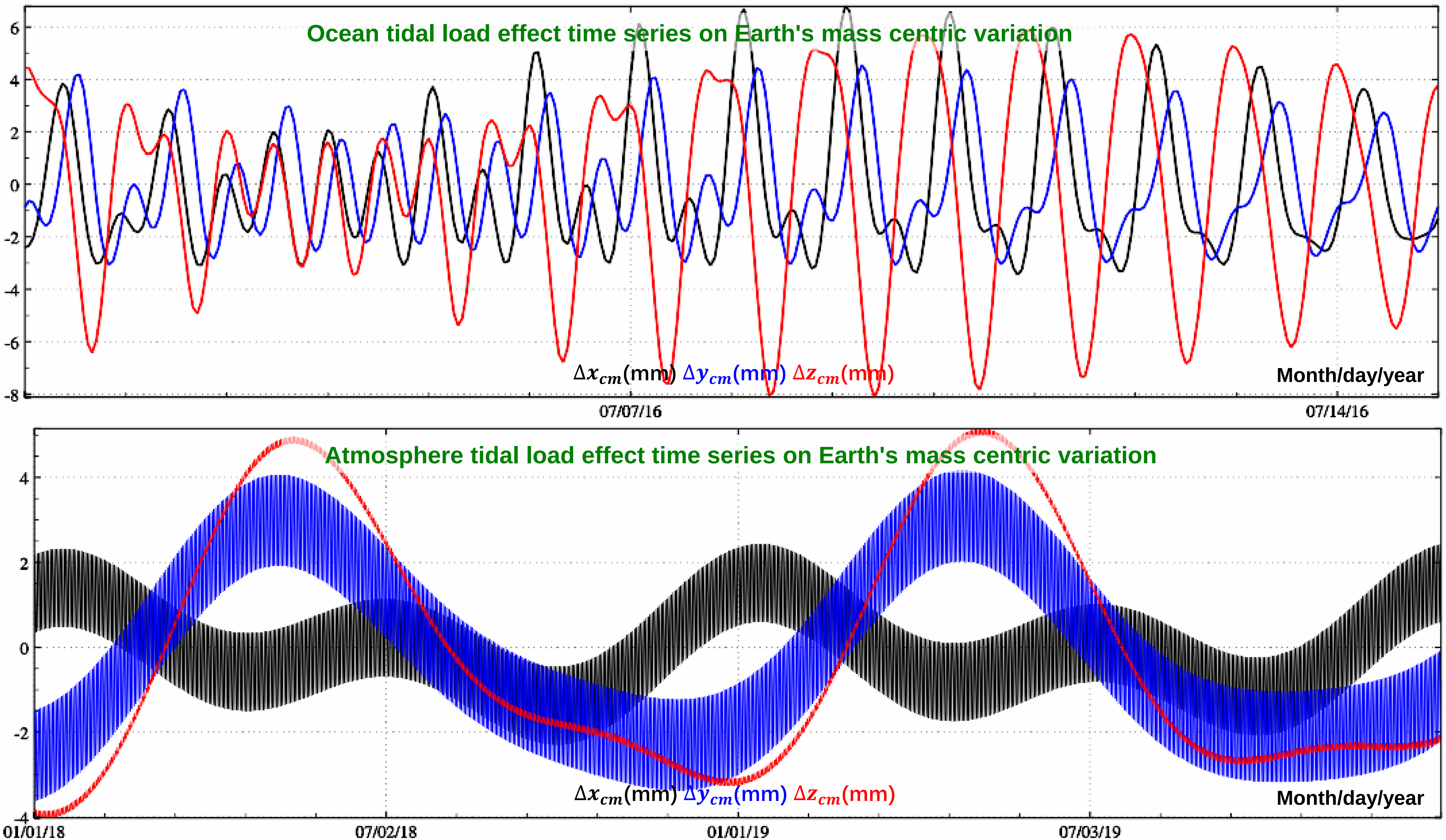


Earth's mass centric variation effect time series on various geodetic variations

The variations of the Earth's center of mass measured by the SLR generally represent the deformation of whole Earth system excited by the non-tidal load variations, thus affecting various geometric and physical geodetic elements in the Earth space, rather than simply showing the ground site displacement of pure geometric elements.

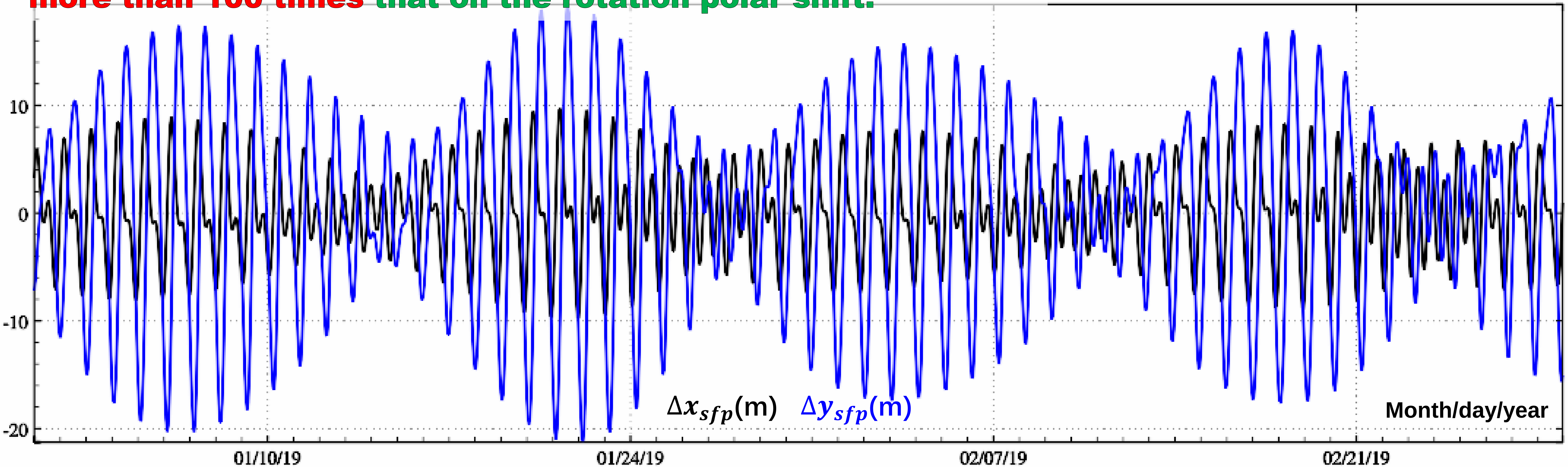

Computation of permanent tidal and Earth's mass centric variation effects on geodetic variations
Forecast of ocean tidal load effects on Earth's mass centric variation
Open file
Save as
Impor parameters
Start computation
Save process
Follow example
Computation of permanent tidal effects on various geodetic variations
Computation of Earth's mass centric variation effects on all-element geodetic variations
Forecast of ocean tidal load effects on Earth's mass centric variation
Forecast of atmosphere tidal load effects on Earth's mass centric variation
Forecast time series parameters
Start time 20160701
End time 20160715
Time interval 60.00 min
Save program process as
Effects of the Earth's mass centric variations and figure polar shifts
>> Computation end time: 2024-10-18 14:40:01
>> [Function] Input time series parameters, and forecast the ocean tidal load effect time series on Earth's mass centric variation (Xcm, Ycm, Zcm, in unit of mm) from the first-degree ocean tidal load spherical harmonic coefficient file OtideOne.dat output by the function [Spherical harmonic analysis on ocean tidal constituent harmonic constants].
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Permanentdgeocenter/otdgeocntrst.txt.
** The output file record includes the sampling epoch time, 3 columns of the ocean tidal load effects on Earth's mass centric variation (Xcm, Ycm, Zcm, in unit mm).
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 14:41:56
>> Complete the computation of ocean tidal load effects on Earth's mass centric variation!
>> Computation end time: 2024-10-18 14:41:56
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
Save the data in the text box as
Otidegeocenter 0.00 0.00 0.00 57570.000000
2016070100 0.000000 1.8250 4.1299 -1.8888
2016070101 0.041667 0.5041 4.1937 -3.5160
2016070102 0.083333 -0.8168 3.6263 -5.0214
2016070103 0.125000 -1.9306 2.4942 -6.0838
2016070104 0.166667 -2.6848 0.9966 -6.4140
2016070105 0.208333 -3.0220 -0.5533 -5.9776
2016070106 0.250000 -2.9774 -1.8460 -4.9099
2016070107 0.291667 -2.6381 -2.7016 -3.3494
2016070108 0.333333 -2.1152 -3.0653 -1.4945
2016070109 0.375000 -1.5704 -2.9291 0.3139
Improve the algorithm of Earth's mass centric variation effects in the IERS Conventions (2010) and then compute the tidal and non-tidal load effects on all-element geodetic variations in the whole Earth space.
The permanent tide does not change with time. It is the zero-frequency tide ΔC20 in the long-period solid tide. The permanent tide produces a permanent additional oblateness that varies with latitude to the Earth, and its effects on the geodetic quantities have nothing to do with the longitude of its location. The Love numbers in the program are k20=0.29525, h20=0.6078 and l20=0.0847.
According to the permanent tide correction way, there are three types of geodetic tide systems, namely free tide, mean tide and zero tide. The mean tide does not remove the permanent tidal effects, the zero tide removes the direct effects of the permanent tide and the free tide removes the sum of the direct and indirect effects of the permanent tide.
The variation of the Earth's center of mass is equal to the first-degree term of Earth's loading deformation, which excites the variations of all the geometric and physical geodetic elements in the Earth's space with time, rather than can be simply expressed as the ground site displacement of pure geometric quantity.


Computation of permanent tidal and Earth's mass centric variation effects on geodetic variations
Forecast of atmosphere tidal load effects on Earth's mass centric variation
Open file
Save as
Impor parameters
Start computation
Save process
Follow example
Computation of permanent tidal effects on various geodetic variations
Computation of Earth's mass centric variation effects on all-element geodetic variations
Forecast of ocean tidal load effects on Earth's mass centric variation
Forecast of atmosphere tidal load effects on Earth's mass centric variation
Forecast time series parameters
Start time 20160701
End time 20160715
Time interval 60.00 min
Save program process as
Effects of the Earth's mass centric variations and figure polar shifts
>> Computation end time: 2024-10-18 14:41:56
>> [Function] Input time series parameters, and forecast the atmosphere tidal load effect time series on Earth's mass centric variation (Xcm, Ycm, Zcm, in unit of mm) from the first-degree atmosphere tidal load spherical harmonic coefficient file AtideOne.dat output by the function [Spherical harmonic analysis on atmosphere tidal constituent harmonic constants]
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Permanentdgeocenter/atdgeocntrst.txt.
** The output file record includes the sampling epoch time, 3 columns of the atmosphere tidal load effects on Earth's mass centric variation (Xcm, Ycm, Zcm, in unit mm).
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 14:42:36
>> Complete the computation of atmosphere tidal load effects on Earth's mass centric variation!
>> Computation end time: 2024-10-18 14:42:36
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
Save the data in the text box as
Atidegeocenter 0.00 0.00 0.00 57570.000000
2016070100 0.000000 1.5728 2.0072 3.0910
2016070101 0.041667 1.5070 1.7158 3.0921
2016070102 0.083333 1.3772 1.4450 3.0968
2016070103 0.125000 1.1846 1.2199 3.1016
2016070104 0.166667 0.9395 1.0633 3.1041
2016070105 0.208333 0.6616 0.9921 3.1033
2016070106 0.250000 0.3779 1.0148 3.1005
2016070107 0.291667 0.1185 1.1292 3.0981
2016070108 0.333333 -0.0884 1.3234 3.0993
2016070109 0.375000 -0.2208 1.5775 3.1070
Improve the algorithm of Earth's mass centric variation effects in the IERS Conventions (2010) and then compute the tidal and non-tidal load effects on all-element geodetic variations in the whole Earth space.
The permanent tide does not change with time. It is the zero-frequency tide ΔC₂₀ in the long-period solid tide. The permanent tide produces a permanent additional oblateness that varies with latitude to the Earth, and its effects on the geodetic quantities have nothing to do with the longitude of its location. The Love numbers in the program are k₂₀=0.29525, h₂₀=0.6078 and l₂₀=0.0847.
According to the permanent tide correction way, there are three types of geodetic tide systems, namely free tide, mean tide and zero tide. The mean tide does not remove the permanent tidal effects, the zero tide removes the direct effects of the permanent tide and the free tide removes the sum of the direct and indirect effects of the permanent tide.
The variation of the Earth's center of mass is equal to the first-degree term of Earth's loading deformation, which excites the variations of all the geometric and physical geodetic elements in the Earth's space with time, rather than can be simply expressed as the ground site displacement of pure geometric quantity.

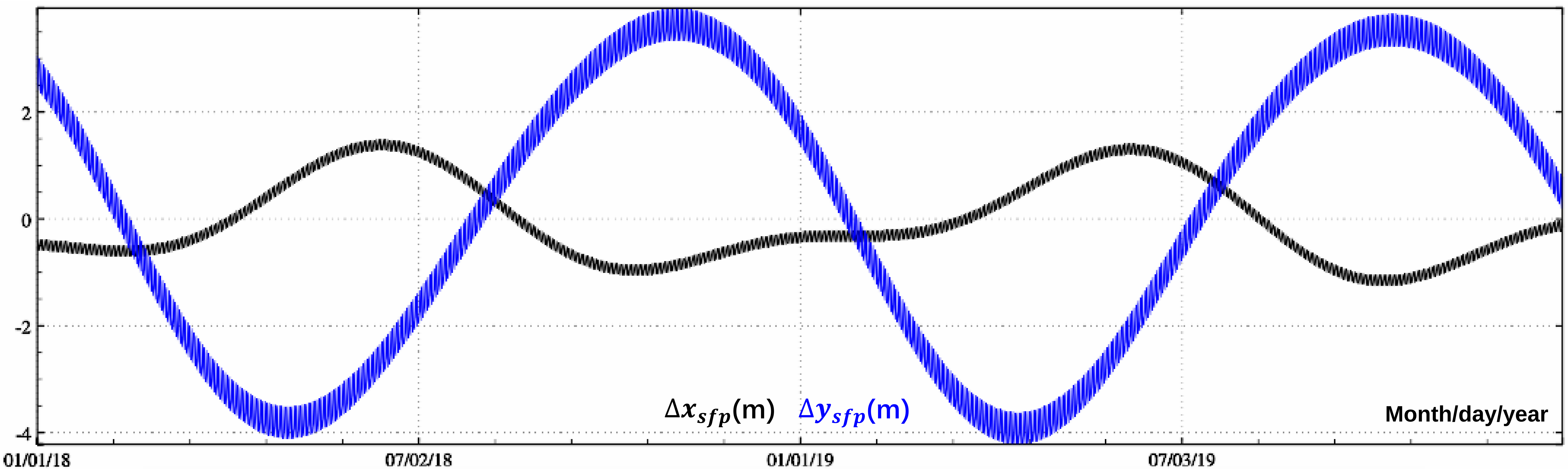


The Earth's tidal force from the celestial body at the Earth's center of mass is always equal to zero, so geodesy does not specifically study the solid tidal effect on the Earth's center of mass. Ocean tides and surface atmosphere tides lead to the redistribution of surface mass, causing periodic variations of Earth's center of mass.

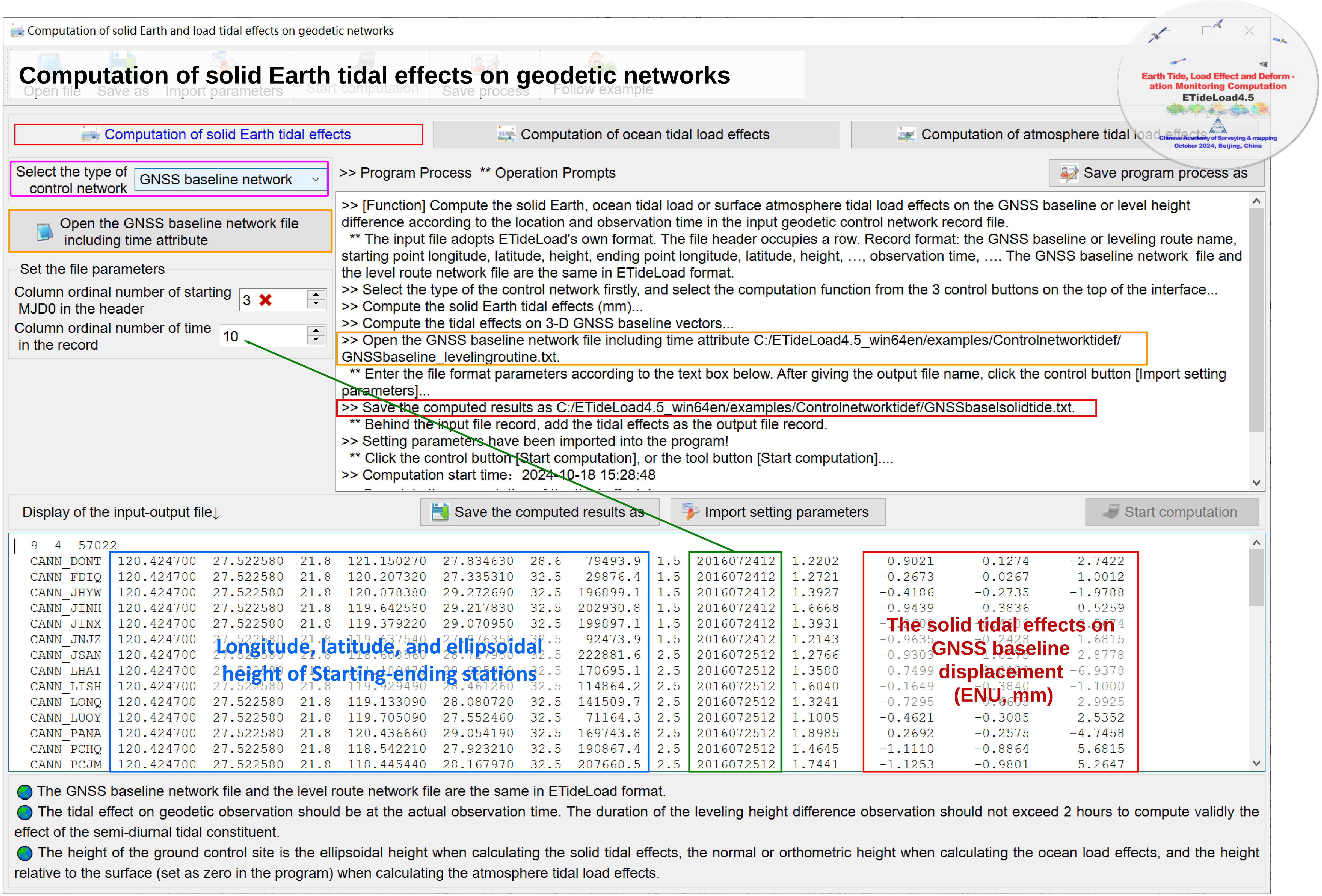
The ocean tidal load effect on the Earth's figure polar shift is more than 100 times that on the rotation polar shift.



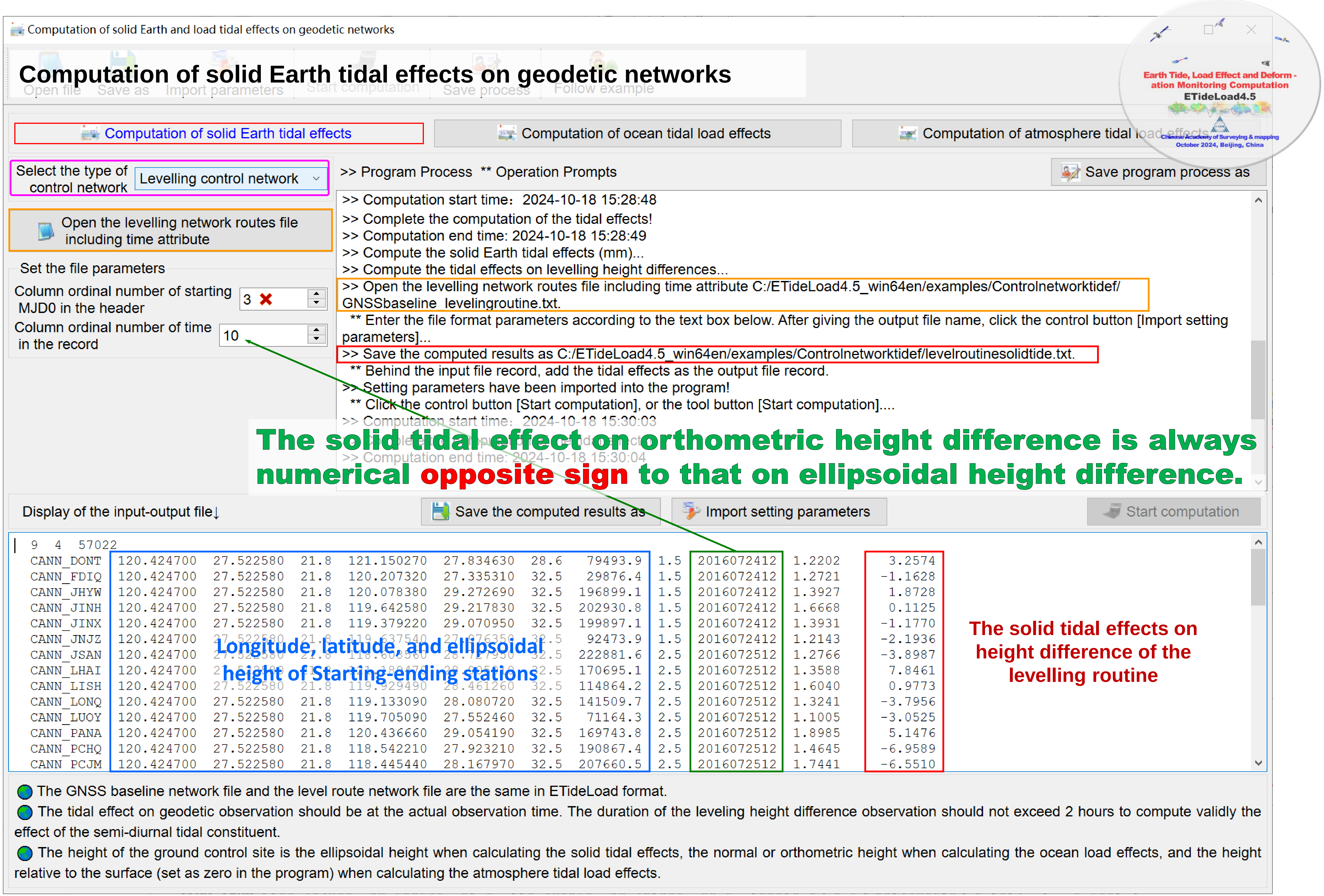
The ocean tidal load effect time series (m) on Earth's figure polar shifts in ITRS

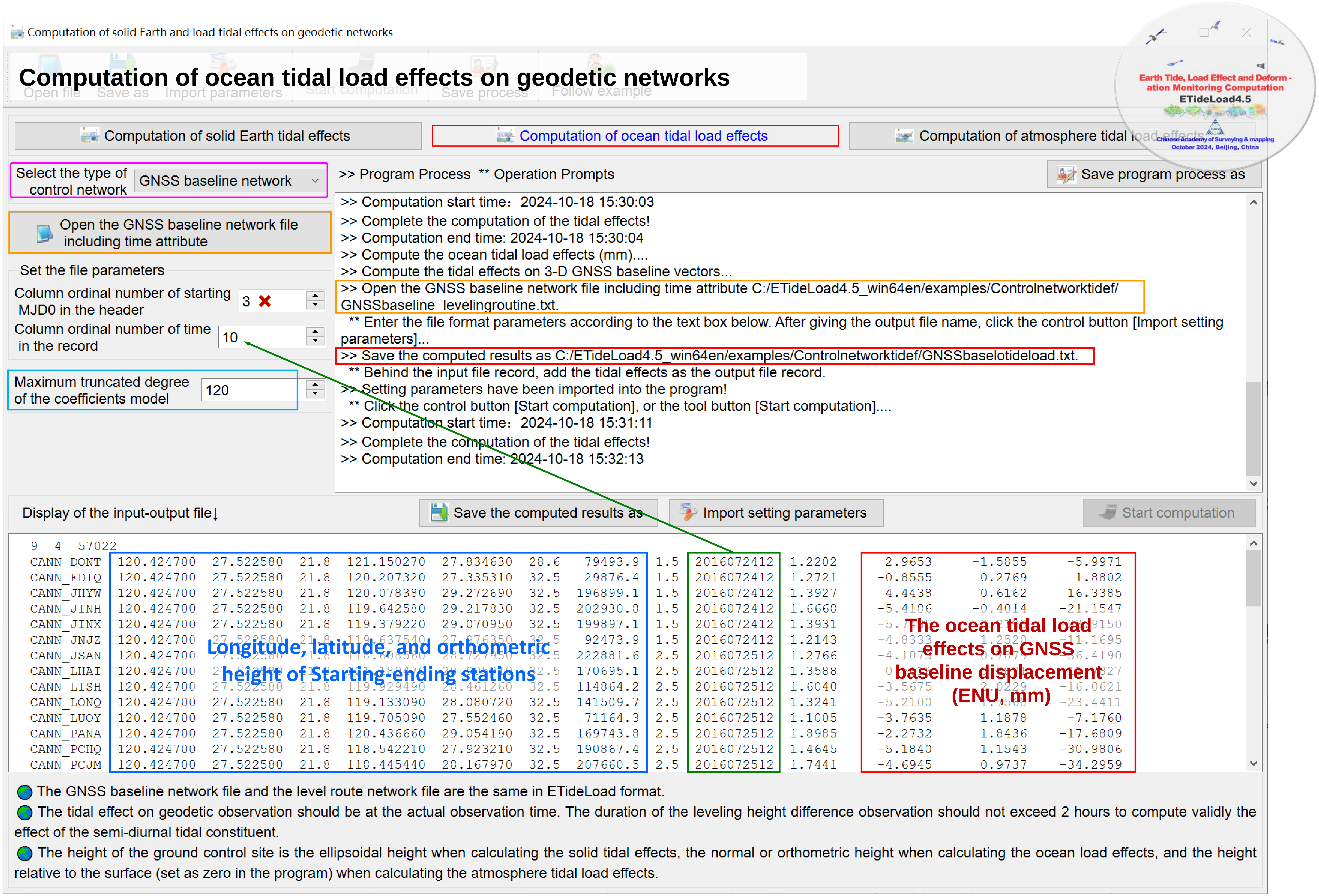


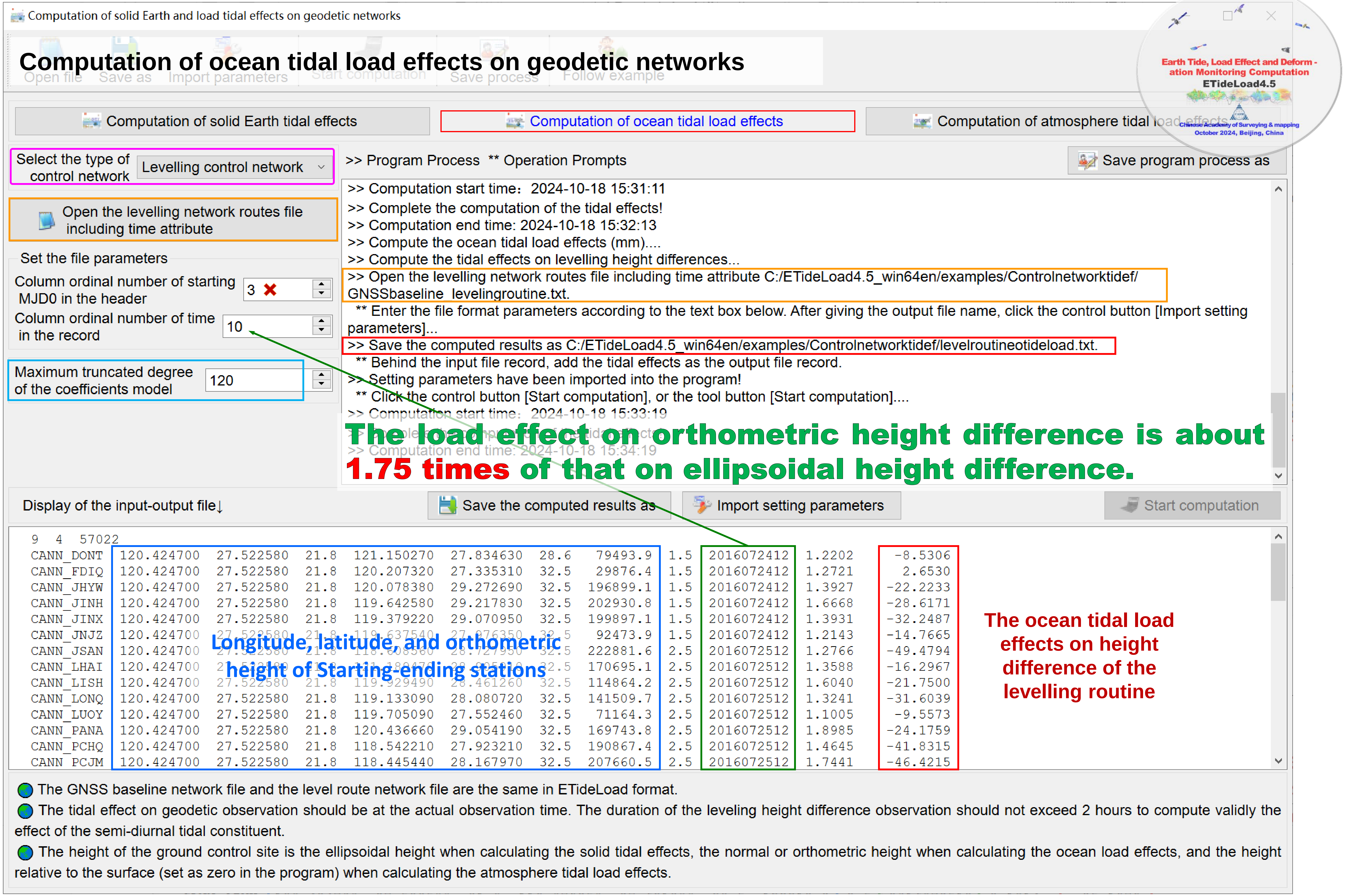
The surface atmosphere tidal load effect time series (m) on Earth's figure polar shifts in ITRS

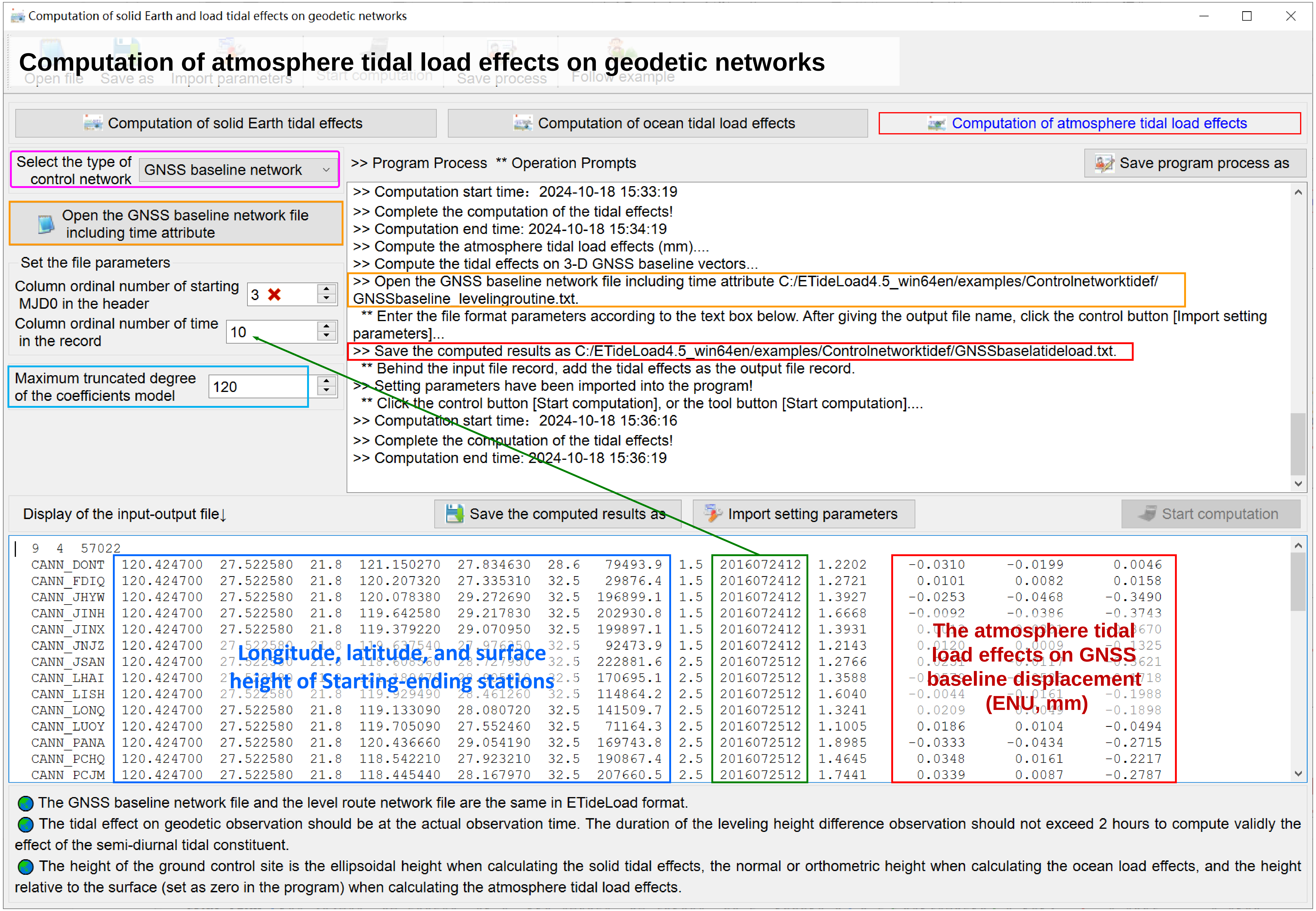


Computation of solid Earth and load tidal effects on geodetic networks
Computation of solid Earth tidal effects on geodetic networks
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of solid Earth tidal effects
Computation of ocean tidal load effects
Computation of atmosphere tidal load effects
Select the type of control network
GNSS baseline network
Open the GNSS baseline network file including time attribute
Set the file parameters
Column ordinal number of starting MJD0 in the header
3
Column ordinal number of time in the record
10
>> Program Process ** Operation Prompts
Save program process as
>> [Function] Compute the solid Earth, ocean tidal load or surface atmosphere tidal load effects on the GNSS baseline or level height difference according to the location and observation time in the input geodetic control network record file.
** The input file adopts ETideLoad's own format. The file header occupies a row. Record format: the GNSS baseline or leveling route name, starting point longitude, latitude, height, ending point longitude, latitude, height, …, observation time, …. The GNSS baseline network file and the level route network file are the same in ETideLoad format.
>> Select the type of the control network firstly, and select the computation function from the 3 control buttons on the top of the interface...
>> Compute the solid Earth tidal effects (mm)...
>> Compute the tidal effects on 3-D GNSS baseline vectors...
>> Open the GNSS baseline network file including time attribute C:/ETideLoad4.5_win64en/examples/Controlnetworktidef/GNSSbaseline_levelingroutine.txt.
** Enter the file format parameters according to the text box below. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Controlnetworktidef/GNSSbaselsolidtide.txt.
** Behind the input file record, add the tidal effects as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 15:28:48
Display of the input-output file↓
Save the computed results as
Import setting parameters
Start computation
9 4 57022
CANN_DONT 120.424700 27.522580 21.8 121.150270 27.834630 28.6 79493.9 1.5 2016072412 1.2202 0.9021 0.1274 -2.7422
CANN_FDIQ 120.424700 27.522580 21.8 120.207320 27.335310 32.5 29876.4 1.5 2016072412 1.2721 -0.2673 -0.0267 1.0012
CANN_JHYW 120.424700 27.522580 21.8 120.078380 29.272690 32.5 196899.1 1.5 2016072412 1.3927 -0.4186 -0.2735 -1.9788
CANN_JINH 120.424700 27.522580 21.8 119.642580 29.217830 32.5 202930.8 1.5 2016072412 1.6668 -0.9439 -0.3836 -0.5259
CANN_JINX 120.424700 27.522580 21.8 119.379220 29.070950 32.5 199897.1 1.5 2016072412 1.3931
CANN_JNJZ 120.424700 92473.9 1.5 2016072412 1.2143 -0.9635 1.6815
CANN_JSAN 120.424700 222881.6 2.5 2016072512 1.2766 -0.9303 2.8778
CANN_LHAI 120.424700 170695.1 2.5 2016072512 1.3588 0.7499 -6.9378
CANN_LISH 120.424700 27.522580 21.8 119.929490 28.461260 32.5 114864.2 2.5 2016072512 1.6040 -0.1649 -0.3840 -1.1000
CANN_LONQ 120.424700 27.522580 21.8 119.133090 28.080720 32.5 141509.7 2.5 2016072512 1.3241 -0.7295 2.9925
CANN_LUOY 120.424700 27.522580 21.8 119.705090 27.552460 32.5 71164.3 2.5 2016072512 1.1005 -0.4621 -0.3085 2.5352
CANN_PANA 120.424700 27.522580 21.8 120.436660 29.054190 32.5 169743.8 2.5 2016072512 1.8985 0.2692 -0.2575 -4.7458
CANN_PCHQ 120.424700 27.522580 21.8 118.542210 27.923210 32.5 190867.4 2.5 2016072512 1.4645 -1.1110 -0.8864 5.6815
CANN_PCJM 120.424700 27.522580 21.8 118.445440 28.167970 32.5 207660.5 2.5 2016072512 1.7441 -1.1253 -0.9801 5.2647
Longitude, latitude, and ellipsoidal height of Starting-ending stations
The solid tidal effects on GNSS baseline displacement (ENU, mm)
The GNSS baseline network file and the level route network file are the same in ETideLoad format.
The tidal effect on geodetic observation should be at the actual observation time. The duration of the leveling height difference observation should not exceed 2 hours to compute validly the effect of the semi-diurnal tidal constituent.
The height of the ground control site is the ellipsoidal height when calculating the solid tidal effects, the normal or orthometric height when calculating the ocean load effects, and the height relative to the surface (set as zero in the program) when calculating the atmosphere tidal load effects.

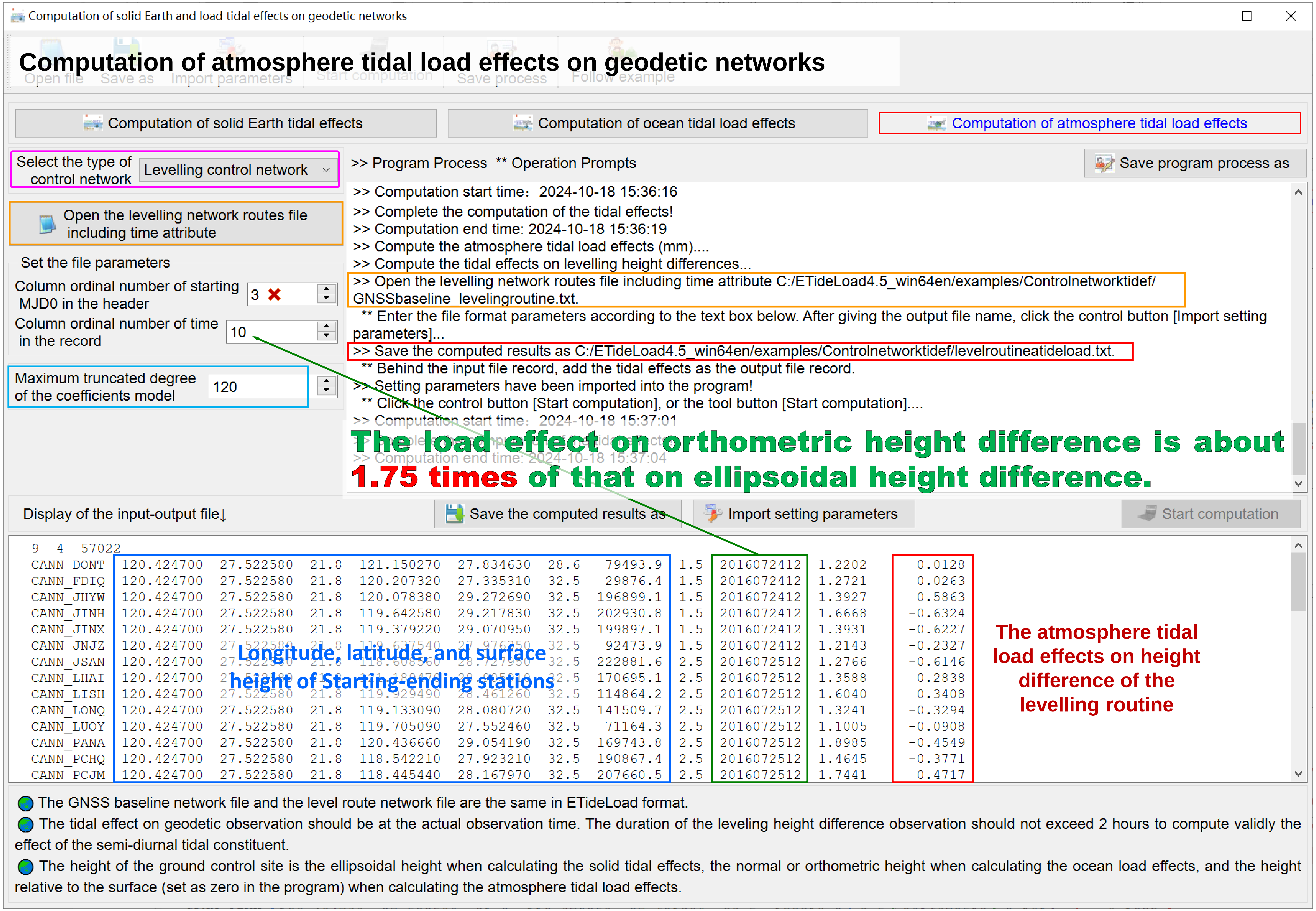

Computation of solid Earth and load tidal effects on geodetic networks
Computation of solid Earth tidal effects on geodetic networks
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of solid Earth tidal effects
Computation of ocean tidal load effects
Computation of atmosphere tidal load effects
Select the type of control network
Levelling control network
Open the levelling network routes file including time attribute
Set the file parameters
Column ordinal number of starting MJD0 in the header
3
Column ordinal number of time in the record
10
>> Program Process ** Operation Prompts
Save program process as
>> Computation start time: 2024-10-18 15:28:48
>> Complete the computation of the tidal effects!
>> Computation end time: 2024-10-18 15:28:49
>> Compute the solid Earth tidal effects (mm)...
>> Compute the tidal effects on levelling height differences...
>> Open the levelling network routes file including time attribute C:/ETideLoad4.5_win64en/examples/Controlnetworktidef/GNSSbaseline_levelingroutine.txt.
** Enter the file format parameters according to the text box below. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Controlnetworktidef/levelroutinesolidtide.txt.
** Behind the input file record, add the tidal effects as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 15:30:03
>> Computation end time: 2024-10-18 15:30:04
The solid tidal effect on orthometric height difference is always numerical opposite sign to that on ellipsoidal height difference.
Display of the input-output file↓
Save the computed results as
Import setting parameters
Start computation
9 4 57022
CANN_DONT 120.424700 27.522580 21.8 121.150270 27.834630 28.6 79493.9 1.5 2016072412 1.2202 3.2574
CANN_FDIQ 120.424700 27.522580 21.8 120.207320 27.335310 32.5 29876.4 1.5 2016072412 1.2721 -1.1628
CANN_JHYW 120.424700 27.522580 21.8 120.078380 29.272690 32.5 196899.1 1.5 2016072412 1.3927 1.8728
CANN_JINH 120.424700 27.522580 21.8 119.642580 29.217830 32.5 202930.8 1.5 2016072412 1.6668 0.1125
CANN_JINX 120.424700 27.522580 21.8 119.379220 29.070950 32.5 199897.1 1.5 2016072412 1.3931 -1.1770
CANN_JNJZ 120.424700 27.522580 21.8 119.637540 27.976350 32.5 92473.9 1.5 2016072412 1.2143 -2.1936
CANN_JSAN 120.424700 222881.6 2.5 2016072512 1.2766 -3.8987
CANN_LHAI 120.424700 170695.1 2.5 2016072512 1.3588 7.8461
CANN_LISH 120.424700 27.522580 21.8 119.929490 28.461260 32.5 114864.2 2.5 2016072512 1.6040 0.9773
CANN_LONQ 120.424700 27.522580 21.8 119.133090 28.080720 32.5 141509.7 2.5 2016072512 1.3241 -3.7956
CANN_LUOY 120.424700 27.522580 21.8 119.705090 27.552460 32.5 71164.3 2.5 2016072512 1.1005 -3.0525
CANN_PANA 120.424700 27.522580 21.8 120.436660 29.054190 32.5 169743.8 2.5 2016072512 1.8985 5.1476
CANN_PCHQ 120.424700 27.522580 21.8 118.542210 27.923210 32.5 190867.4 2.5 2016072512 1.4645 -6.9589
CANN_PCJM 120.424700 27.522580 21.8 118.445440 28.167970 32.5 207660.5 2.5 2016072512 1.7441 -6.5510
Longitude, latitude, and ellipsoidal height of Starting-ending stations
The solid tidal effects on height difference of the levelling routine
The GNSS baseline network file and the level route network file are the same in ETideLoad format.
The tidal effect on geodetic observation should be at the actual observation time. The duration of the leveling height difference observation should not exceed 2 hours to compute validly the effect of the semi-diurnal tidal constituent.
The height of the ground control site is the ellipsoidal height when calculating the solid tidal effects, the normal or orthometric height when calculating the ocean load effects, and the height relative to the surface (set as zero in the program) when calculating the atmosphere tidal load effects.

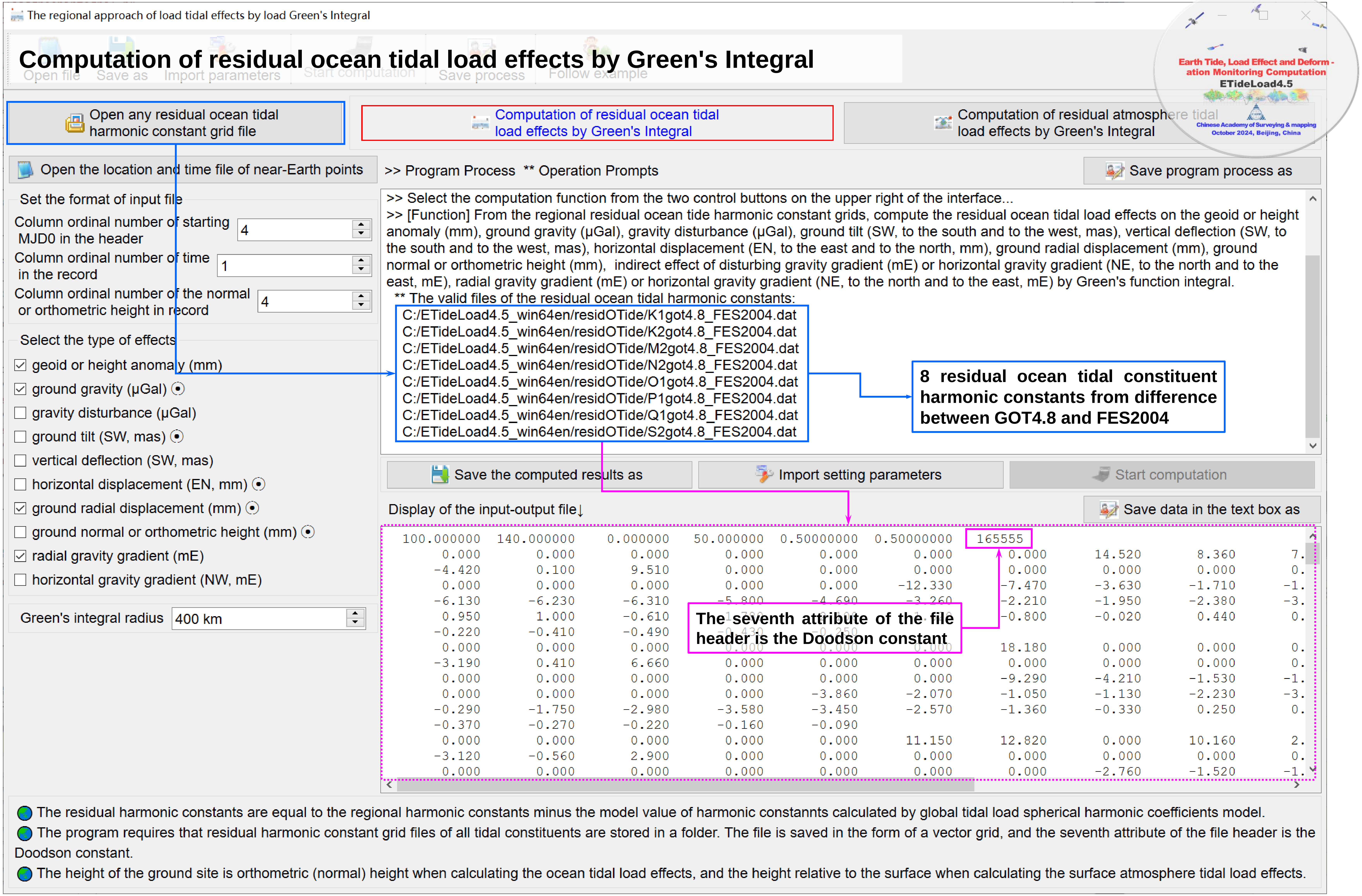

Computation of solid Earth and load tidal effects on geodetic networks
Computation of ocean tidal load effects on geodetic networks
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of solid Earth tidal effects
Computation of ocean tidal load effects
Computation of atmosphere tidal load effects
Select the type of control network
GNSS baseline network
Open the GNSS baseline network file including time attribute
Set the file parameters
Column ordinal number of starting MJD0 in the header
3
Column ordinal number of time in the record
10
Maximum truncated degree of the coefficients model
120
>> Program Process ** Operation Prompts
Save program process as
>> Computation start time: 2024-10-18 15:30:03
>> Complete the computation of the tidal effects!
>> Computation end time: 2024-10-18 15:30:04
>> Compute the ocean tidal load effects (mm)....
>> Compute the tidal effects on 3-D GNSS baseline vectors...
>> Open the GNSS baseline network file including time attribute C:/ETideLoad4.5_win64en/examples/Controlnetworktidef/GNSSbaseline_levelingroutine.txt.
** Enter the file format parameters according to the text box below. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Controlnetworktidef/GNSSbaselotideload.txt.
** Behind the input file record, add the tidal effects as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 15:31:11
>> Complete the computation of the tidal effects!
>> Computation end time: 2024-10-18 15:32:13
Display of the input-output file↓
Save the computed results as
Import setting parameters
Start computation
9 4 57022
CANN_DONT 120.424700 27.522580 21.8 121.150270 27.834630 28.6 79493.9 1.5 2016072412 1.2202 2.9653 -1.5855 -5.9971
CANN_FDIQ 120.424700 27.522580 21.8 120.207320 27.335310 32.5 29876.4 1.5 2016072412 1.2721 -0.8555 0.2769 1.8802
CANN_JHYW 120.424700 27.522580 21.8 120.078380 29.272690 32.5 196899.1 1.5 2016072412 1.3927 -4.4438 -0.6162 -16.3385
CANN_JINH 120.424700 27.522580 21.8 119.642580 29.217830 32.5 202930.8 1.5 2016072412 1.6668 -5.4186 -0.4014 -21.1547
CANN_JINX 120.424700 27.522580 21.8 119.379220 29.070950 32.5 199897.1 1.5 2016072412 1.3931
CANN_JNJZ 120.424700 92473.9 1.5 2016072412 1.2143
CANN_JSAN 120.424700 222881.6 2.5 2016072512 1.2766
CANN_LHAI 120.424700 170695.1 2.5 2016072512 1.3588
CANN_LISH 120.424700 114864.2 2.5 2016072512 1.6040 -3.5675 -16.0621
CANN_LONQ 120.424700 27.522580 21.8 119.133090 28.080720 32.5 141509.7 2.5 2016072512 1.3241 -5.2100 -23.4411
CANN_LUOY 120.424700 27.522580 21.8 119.705090 27.552460 32.5 71164.3 2.5 2016072512 1.1005 -3.7635 1.1878 -7.1760
CANN_PANA 120.424700 27.522580 21.8 120.436660 29.054190 32.5 169743.8 2.5 2016072512 1.8985 -2.2732 1.8436 -17.6809
CANN_PCHQ 120.424700 27.522580 21.8 118.542210 27.923210 32.5 190867.4 2.5 2016072512 1.4645 -5.1840 1.1543 -30.9806
CANN_PCJM 120.424700 27.522580 21.8 118.445440 28.167970 32.5 207660.5 2.5 2016072512 1.7441 -4.6945 0.9737 -34.2959
Longitude, latitude, and orthometric height of Starting-ending stations
The ocean tidal load effects on GNSS baseline displacement (ENU, mm)
The GNSS baseline network file and the level route network file are the same in ETideLoad format.
The tidal effect on geodetic observation should be at the actual observation time. The duration of the leveling height difference observation should not exceed 2 hours to compute validly the effect of the semi-diurnal tidal constituent.
The height of the ground control site is the ellipsoidal height when calculating the solid tidal effects, the normal or orthometric height when calculating the ocean load effects, and the height relative to the surface (set as zero in the program) when calculating the atmosphere tidal load effects.


Computation of solid Earth and load tidal effects on geodetic networks
Computation of ocean tidal load effects on geodetic networks
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of solid Earth tidal effects
Computation of ocean tidal load effects
Computation of atmosphere tidal load effects
Select the type of control network
Levelling control network
Open the levelling network routes file including time attribute
Set the file parameters
Column ordinal number of starting MJD0 in the header
3
Column ordinal number of time in the record
10
Maximum truncated degree of the coefficients model
120
>> Program Process ** Operation Prompts
Save program process as
>> Computation start time: 2024-10-18 15:31:11
>> Complete the computation of the tidal effects!
>> Computation end time: 2024-10-18 15:32:13
>> Compute the ocean tidal load effects (mm)....
>> Compute the tidal effects on levelling height differences...
>> Open the levelling network routes file including time attribute C:/ETideLoad4.5_win64en/examples/Controlnetworktidef/GNSSbaseline_levelingroutine.txt.
** Enter the file format parameters according to the text box below. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Controlnetworktidef/levelroutineotideload.txt.
** Behind the input file record, add the tidal effects as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 15:33:19
>> Computation end time: 2024-10-18 15:34:19
The load effect on orthometric height difference is about 1.75 times of that on ellipsoidal height difference.
Display of the input-output file↓
Save the computed results as
Import setting parameters
Start computation
9 4 57022
CANN_DONT 120.424700 27.522580 21.8 121.150270 27.834630 28.6 79493.9 1.5 2016072412 1.2202 -8.5306
CANN_FDIQ 120.424700 27.522580 21.8 120.207320 27.335310 32.5 29876.4 1.5 2016072412 1.2721 2.6530
CANN_JHYW 120.424700 27.522580 21.8 120.078380 29.272690 32.5 196899.1 1.5 2016072412 1.3927 -22.2233
CANN_JINH 120.424700 27.522580 21.8 119.642580 29.217830 32.5 202930.8 1.5 2016072412 1.6668 -28.6171
CANN_JINX 120.424700 27.522580 21.8 119.379220 29.070950 32.5 199897.1 1.5 2016072412 1.3931 -32.2487
CANN_JNJZ 120.424700 27.522580 21.8 119.637540 27.976350 32.5 92473.9 1.5 2016072412 1.2143 -14.7665
CANN_JSAN 120.424700 27.522580 21.8 118.608560 28.727950 32.5 222881.6 2.5 2016072512 1.2766 -49.4794
CANN_LHAI 120.424700 [illegible] 32.5 170695.1 2.5 2016072512 1.3588 -16.2967
CANN_LISH 120.424700 27.522580 21.8 119.929490 28.461260 32.5 114864.2 2.5 2016072512 1.6040 -21.7500
CANN_LONQ 120.424700 27.522580 21.8 119.133090 28.080720 32.5 141509.7 2.5 2016072512 1.3241 -31.6039
CANN_LUOY 120.424700 27.522580 21.8 119.705090 27.552460 32.5 71164.3 2.5 2016072512 1.1005 -9.5573
CANN_PANA 120.424700 27.522580 21.8 120.436660 29.054190 32.5 169743.8 2.5 2016072512 1.8985 -24.1759
CANN_PCHQ 120.424700 27.522580 21.8 118.542210 27.923210 32.5 190867.4 2.5 2016072512 1.4645 -41.8315
CANN_PCJM 120.424700 27.522580 21.8 118.445440 28.167970 32.5 207660.5 2.5 2016072512 1.7441 -46.4215
Longitude, latitude, and orthometric height of Starting-ending stations
The ocean tidal load effects on height difference of the levelling routine
The GNSS baseline network file and the level route network file are the same in ETideLoad format.
The tidal effect on geodetic observation should be at the actual observation time. The duration of the leveling height difference observation should not exceed 2 hours to compute validly the effect of the semi-diurnal tidal constituent.
The height of the ground control site is the ellipsoidal height when calculating the solid tidal effects, the normal or orthometric height when calculating the ocean load effects, and the height relative to the surface (set as zero in the program) when calculating the atmosphere tidal load effects.

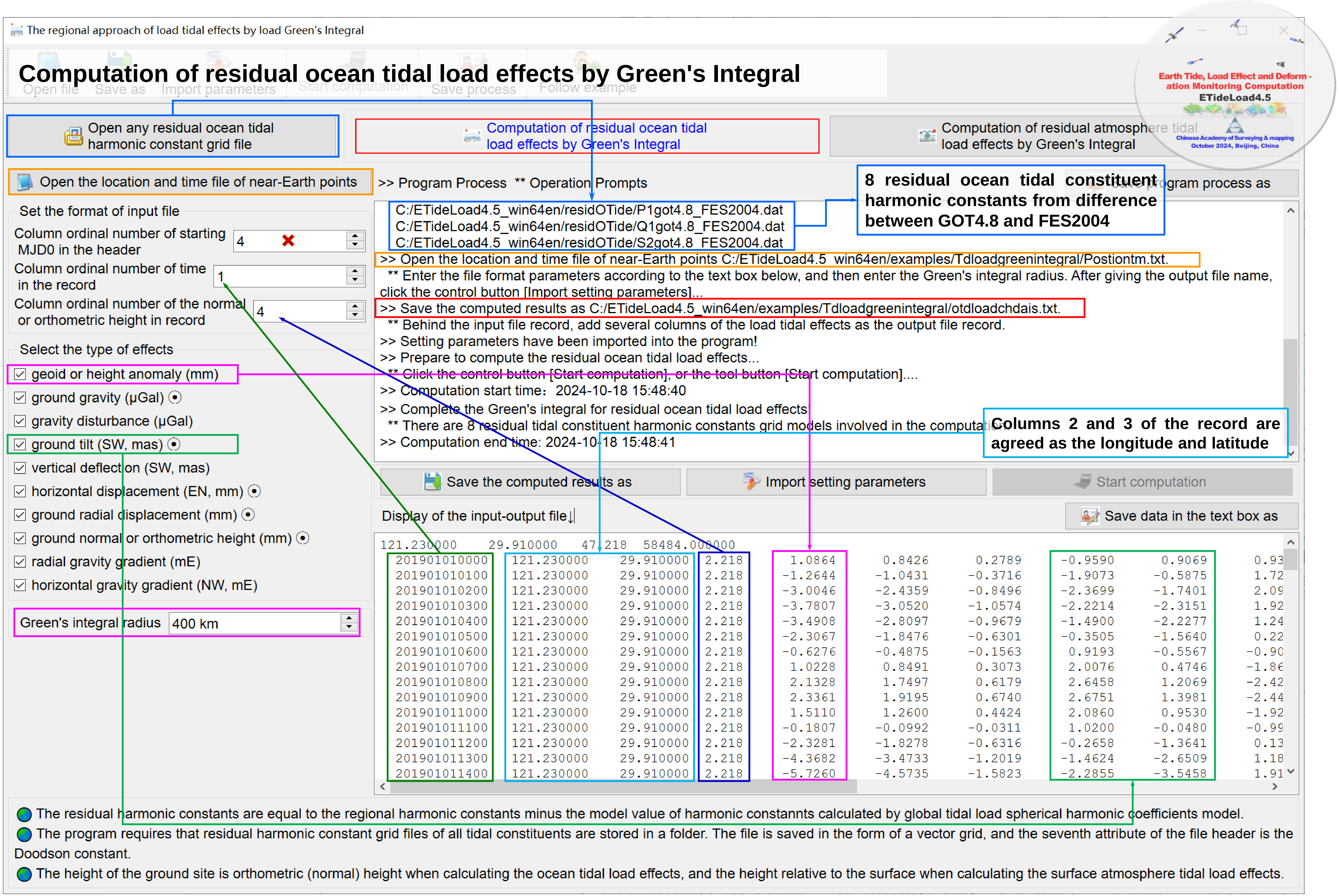


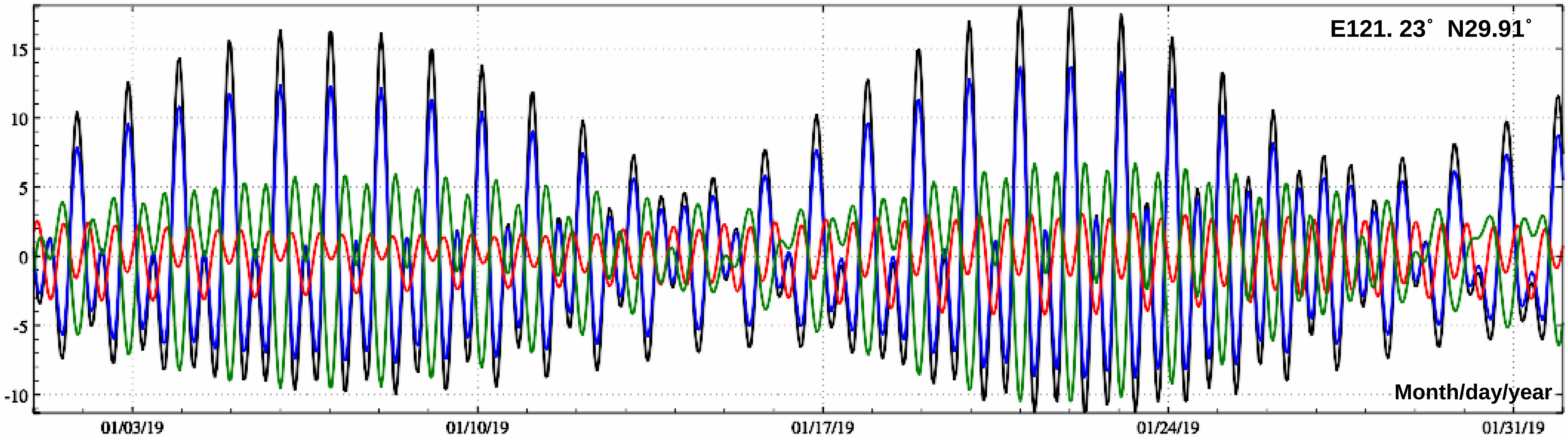
Computation of solid Earth and load tidal effects on geodetic networks
Computation of atmosphere tidal load effects on geodetic networks
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Computation of solid Earth tidal effects
Computation of ocean tidal load effects
Computation of atmosphere tidal load effects
Select the type of control network
GNSS baseline network
Open the GNSS baseline network file including time attribute
Set the file parameters
Column ordinal number of starting MJD0 in the header
3
Column ordinal number of time in the record
10
Maximum truncated degree of the coefficients model
120
>> Program Process ** Operation Prompts
Save program process as
>> Computation start time: 2024-10-18 15:33:19
>> Complete the computation of the tidal effects!
>> Computation end time: 2024-10-18 15:34:19
>> Compute the atmosphere tidal load effects (mm)....
>> Compute the tidal effects on 3-D GNSS baseline vectors...
>> Open the GNSS baseline network file including time attribute C:/ETideLoad4.5_win64en/examples/Controlnetworktidef/GNSSbaseline_levelingroutine.txt.
** Enter the file format parameters according to the text box below. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Controlnetworktidef/GNSSbaselatideload.txt.
** Behind the input file record, add the tidal effects as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 15:36:16
>> Complete the computation of the tidal effects!
>> Computation end time: 2024-10-18 15:36:19
Display of the input-output file↓
Save the computed results as
Import setting parameters
Start computation
9 4 57022
CANN_DONT 120.424700 27.522580 21.8 121.150270 27.834630 28.6 79493.9 1.5 2016072412 1.2202 -0.0310 -0.0199 0.0046
CANN_FDIQ 120.424700 27.522580 21.8 120.207320 27.335310 32.5 29876.4 1.5 2016072412 1.2721 0.0101 0.0082 0.0158
CANN_JHYW 120.424700 27.522580 21.8 120.078380 29.272690 32.5 196899.1 1.5 2016072412 1.3927 -0.0253 -0.0468 -0.3490
CANN_JINH 120.424700 27.522580 21.8 119.642580 29.217830 32.5 202930.8 1.5 2016072412 1.6668 -0.0092 -0.0386 -0.3743
CANN_JINX 120.424700 27.522580 21.8 119.379220 29.070950 32.5 199897.1 1.5 2016072412 1.3931
CANN_JNJZ 120.424700 32.5 92473.9 1.5 2016072412 1.2143
CANN_JSAN 120.424700 32.5 222881.6 2.5 2016072512 1.2766
CANN_LHAI 120.424700 170695.1 2.5 2016072512 1.3588
CANN_LISH 120.424700 32.5 114864.2 2.5 2016072512 1.6040 -0.0044 -0.1988
CANN_LONQ 120.424700 27.522580 21.8 119.133090 28.080720 32.5 141509.7 2.5 2016072512 1.3241 0.0209 -0.1898
CANN_LUOY 120.424700 27.522580 21.8 119.705090 27.552460 32.5 71164.3 2.5 2016072512 1.1005 0.0186 0.0104 -0.0494
CANN_PANA 120.424700 27.522580 21.8 120.436660 29.054190 32.5 169743.8 2.5 2016072512 1.8985 -0.0333 -0.0434 -0.2715
CANN_PCHQ 120.424700 27.522580 21.8 118.542210 27.923210 32.5 190867.4 2.5 2016072512 1.4645 0.0348 0.0161 -0.2217
CANN_PCJM 120.424700 27.522580 21.8 118.445440 28.167970 32.5 207660.5 2.5 2016072512 1.7441 0.0339 0.0087 -0.2787
Longitude, latitude, and surface height of Starting-ending stations
The atmosphere tidal load effects on GNSS baseline displacement (ENU, mm)
The GNSS baseline network file and the level route network file are the same in ETideLoad format.
The tidal effect on geodetic observation should be at the actual observation time. The duration of the leveling height difference observation should not exceed 2 hours to compute validly the effect of the semi-diurnal tidal constituent.
The height of the ground control site is the ellipsoidal height when calculating the solid tidal effects, the normal or orthometric height when calculating the ocean load effects, and the height relative to the surface (set as zero in the program) when calculating the atmosphere tidal load effects.


Computation of solid Earth and load tidal effects on geodetic networks
Computation of atmosphere tidal load effects on geodetic networks
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Computation of solid Earth tidal effects
Computation of ocean tidal load effects
Computation of atmosphere tidal load effects
Select the type of control network
Levelling control network
Open the levelling network routes file including time attribute
Set the file parameters
Column ordinal number of starting MJD0 in the header
3
Column ordinal number of time in the record
10
Maximum truncated degree of the coefficients model
120
>> Program Process ** Operation Prompts
Save program process as
>> Computation start time: 2024-10-18 15:36:16
>> Complete the computation of the tidal effects!
>> Computation end time: 2024-10-18 15:36:19
>> Compute the atmosphere tidal load effects (mm)....
>> Compute the tidal effects on levelling height differences...
>> Open the levelling network routes file including time attribute C:/ETideLoad4.5_win64en/examples/Controlnetworktidef/GNSSbaseline_levelingroutine.txt.
** Enter the file format parameters according to the text box below. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Controlnetworktidef/levelroutineatideload.txt.
** Behind the input file record, add the tidal effects as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 15:37:01
>> Computation end time: 2024-10-18 15:37:04
The load effect on orthometric height difference is about 1.75 times of that on ellipsoidal height difference.
Display of the input-output file↓
Save the computed results as
Import setting parameters
Start computation
9 4 57022
CANN_DONT 120.424700 27.522580 21.8 121.150270 27.834630 28.6 79493.9 1.5 2016072412 1.2202 0.0128
CANN_FDIQ 120.424700 27.522580 21.8 120.207320 27.335310 32.5 29876.4 1.5 2016072412 1.2721 0.0263
CANN_JHYW 120.424700 27.522580 21.8 120.078380 29.272690 32.5 196899.1 1.5 2016072412 1.3927 -0.5863
CANN_JINH 120.424700 27.522580 21.8 119.642580 29.217830 32.5 202930.8 1.5 2016072412 1.6668 -0.6324
CANN_JINX 120.424700 27.522580 21.8 119.379220 29.070950 32.5 199897.1 1.5 2016072412 1.3931 -0.6227
CANN_JNJZ 120.424700 32.5 92473.9 1.5 2016072412 1.2143 -0.2327
CANN_JSAN 120.424700 32.5 222881.6 2.5 2016072512 1.2766 -0.6146
CANN_LHAI 120.424700 170695.1 2.5 2016072512 1.3588 -0.2838
CANN_LISH 120.424700 32.5 114864.2 2.5 2016072512 1.6040 -0.3408
CANN_LONQ 120.424700 27.522580 21.8 119.133090 28.080720 32.5 141509.7 2.5 2016072512 1.3241 -0.3294
CANN_LUOY 120.424700 27.522580 21.8 119.705090 27.552460 32.5 71164.3 2.5 2016072512 1.1005 -0.0908
CANN_PANA 120.424700 27.522580 21.8 120.436660 29.054190 32.5 169743.8 2.5 2016072512 1.8985 -0.4549
CANN_PCHQ 120.424700 27.522580 21.8 118.542210 27.923210 32.5 190867.4 2.5 2016072512 1.4645 -0.3771
CANN_PCJM 120.424700 27.522580 21.8 118.445440 28.167970 32.5 207660.5 2.5 2016072512 1.7441 -0.4717
Longitude, latitude, and surface height of Starting-ending stations
The atmosphere tidal load effects on height difference of the levelling routine
The GNSS baseline network file and the level route network file are the same in ETideLoad format.
The tidal effect on geodetic observation should be at the actual observation time. The duration of the leveling height difference observation should not exceed 2 hours to compute validly the effect of the semi-diurnal tidal constituent.
The height of the ground control site is the ellipsoidal height when calculating the solid tidal effects, the normal or orthometric height when calculating the ocean load effects, and the height relative to the surface (set as zero in the program) when calculating the atmosphere tidal load effects.

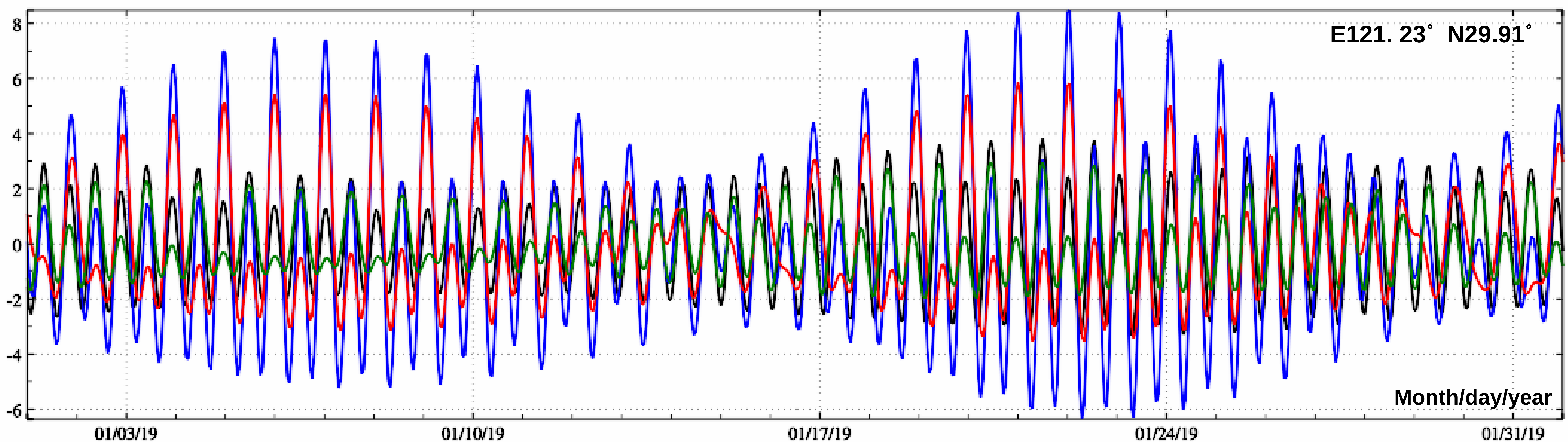


The regional approach of load tidal effects by load Green's Integral
Computation of residual ocean tidal load effects by Green's Integral
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Open any residual ocean tidal harmonic constant grid file
Computation of residual ocean tidal load effects by Green's Integral
Computation of residual atmosphere tidal load effects by Green's Integral
Open the location and time file of near-Earth points
>> Program Process ** Operation Prompts
Save program process as
Set the format of input file
Column ordinal number of starting MJD0 in the header 4
Column ordinal number of time in the record 1
Column ordinal number of the normal or orthometric height in record 4
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (mE)
horizontal gravity gradient (NW, mE)
Green's integral radius 400 km
>> Select the computation function from the two control buttons on the upper right of the interface...
>> [Function] From the regional residual ocean tide harmonic constant grids, compute the residual ocean tidal load effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), indirect effect of disturbing gravity gradient (mE) or horizontal gravity gradient (NE, to the north and to the east, mE), radial gravity gradient (mE) or horizontal gravity gradient (NE, to the north and to the east, mE) by Green's function integral.
** The valid files of the residual ocean tidal harmonic constants:
C:/ETideLoad4.5_win64en/residOTide/K1got4.8_FES2004.dat
C:/ETideLoad4.5_win64en/residOTide/K2got4.8_FES2004.dat
C:/ETideLoad4.5_win64en/residOTide/M2got4.8_FES2004.dat
C:/ETideLoad4.5_win64en/residOTide/N2got4.8_FES2004.dat
C:/ETideLoad4.5_win64en/residOTide/O1got4.8_FES2004.dat
C:/ETideLoad4.5_win64en/residOTide/P1got4.8_FES2004.dat
C:/ETideLoad4.5_win64en/residOTide/Q1got4.8_FES2004.dat
C:/ETideLoad4.5_win64en/residOTide/S2got4.8_FES2004.dat
8 residual ocean tidal constituent harmonic constants from difference between GOT4.8 and FES2004
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
Save data in the text box as
100.000000 140.000000 0.000000 50.000000 0.50000000 0.50000000 165555
The seventh attribute of the file header is the Doodson constant
The residual harmonic constants are equal to the regional harmonic constants minus the model value of harmonic constannts calculated by global tidal load spherical harmonic coefficients model.
The program requires that residual harmonic constant grid files of all tidal constituents are stored in a folder. The file is saved in the form of a vector grid, and the seventh attribute of the file header is the Doodson constant.
The height of the ground site is orthometric (normal) height when calculating the ocean tidal load effects, and the height relative to the surface when calculating the surface atmosphere tidal load effects.

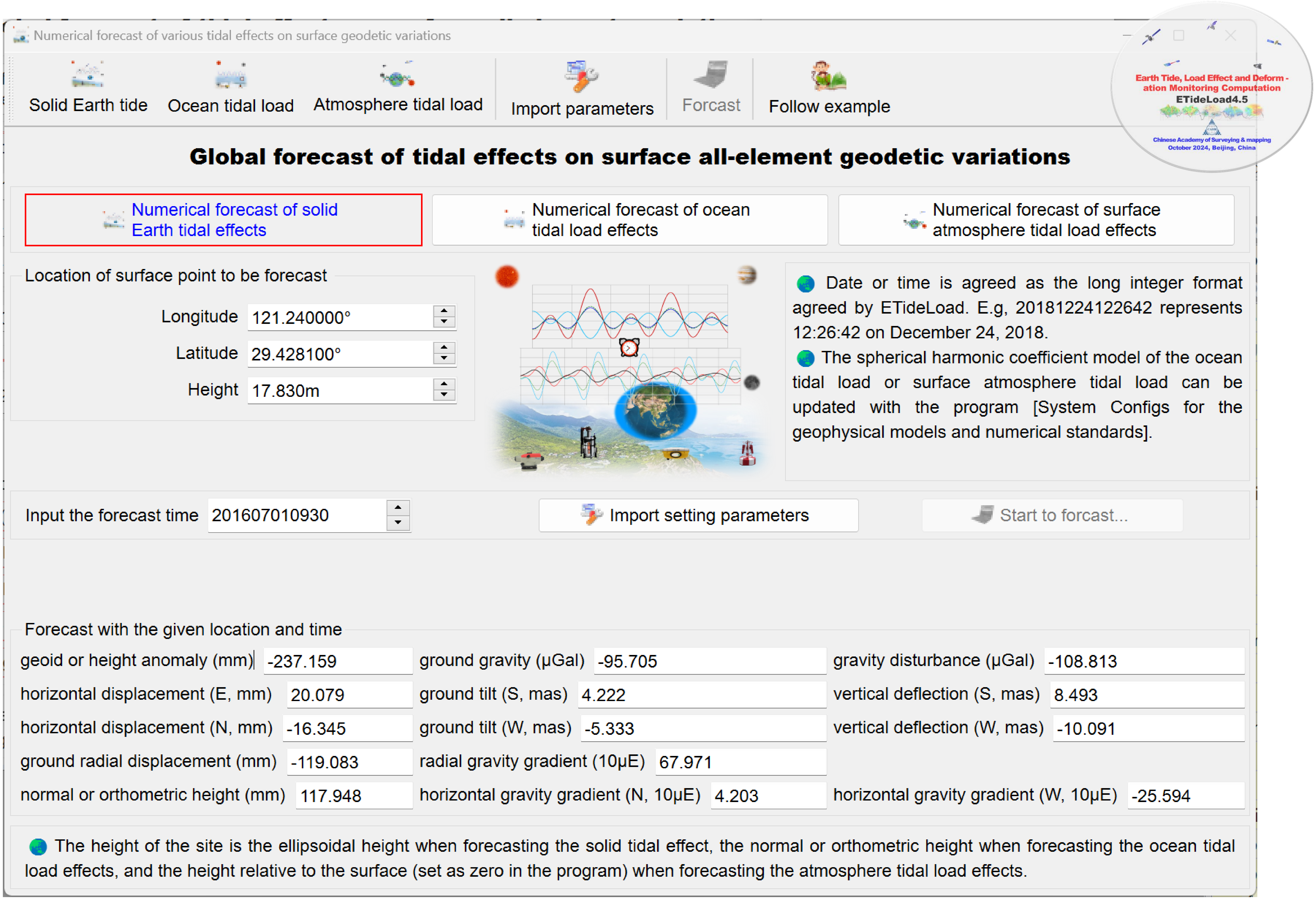

The regional approach of load tidal effects by load Green's Integral
Computation of residual ocean tidal load effects by Green's Integral
Open file Save as Import parameters Start computation Save process Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Open any residual ocean tidal harmonic constant grid file
Computation of residual ocean tidal load effects by Green's Integral
Computation of residual atmosphere tidal load effects by Green's Integral
Open the location and time file of near-Earth points
>> Program Process ** Operation Prompts
Save program process as
8 residual ocean tidal constituent harmonic constants from difference between GOT4.8 and FES2004
Set the format of input file
Column ordinal number of starting MJD0 in the header 4
Column ordinal number of time in the record 1
Column ordinal number of the normal or orthometric height in record 4
C:/ETideLoad4.5_win64en/residOTide/P1got4.8_FES2004.dat
C:/ETideLoad4.5_win64en/residOTide/Q1got4.8_FES2004.dat
C:/ETideLoad4.5_win64en/residOTide/S2got4.8_FES2004.dat
>> Open the location and time file of near-Earth points C:/ETideLoad4.5_win64en/examples/Tdloadgreenintegral/Postiontm.txt.
** Enter the file format parameters according to the text box below, and then enter the Green's integral radius. After giving the output file name, click the control button [Import setting parameters]...
>> Save the computed results as C:/ETideLoad4.5_win64en/examples/Tdloadgreenintegral/otdloadchdais.txt.
** Behind the input file record, add several columns of the load tidal effects as the output file record.
>> Setting parameters have been imported into the program!
>> Prepare to compute the residual ocean tidal load effects...
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-18 15:48:40
>> Complete the Green's integral for residual ocean tidal load effects
** There are 8 residual tidal constituent harmonic constants grid models involved in the computation
>> Computation end time: 2024-10-18 15:48:41
Columns 2 and 3 of the record are agreed as the longitude and latitude
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (mE)
horizontal gravity gradient (NW, mE)
Green's integral radius 400 km
Save the computed results as
Import setting parameters
Start computation
Display of the input-output file↓
Save data in the text box as
121.230000 29.910000 47.218 58484.000000
201901010000 121.230000 29.910000 2.218 1.0864 0.8426 0.2789 -0.9590 0.9069 0.93
201901010100 121.230000 29.910000 2.218 -1.2644 -1.0431 -0.3716 -1.9073 -0.5875 1.72
201901010200 121.230000 29.910000 2.218 -3.0046 -2.4359 -0.8496 -2.3699 -1.7401 2.09
201901010300 121.230000 29.910000 2.218 -3.7807 -3.0520 -1.0574 -2.2214 -2.3151 1.92
201901010400 121.230000 29.910000 2.218 -3.4908 -2.8097 -0.9679 -1.4900 -2.2277 1.24
201901010500 121.230000 29.910000 2.218 -2.3067 -1.8476 -0.6301 -0.3505 -1.5640 0.22
201901010600 121.230000 29.910000 2.218 -0.6276 -0.4875 -0.1563 0.9193 -0.5567 -0.90
201901010700 121.230000 29.910000 2.218 1.0228 0.8491 0.3073 2.0076 0.4746 -1.86
201901010800 121.230000 29.910000 2.218 2.1328 1.7497 0.6179 2.6458 1.2069 -2.42
201901010900 121.230000 29.910000 2.218 2.3361 1.9195 0.6740 2.6751 1.3981 -2.44
201901011000 121.230000 29.910000 2.218 1.5110 1.2600 0.4424 2.0860 0.9530 -1.92
201901011100 121.230000 29.910000 2.218 -0.1807 -0.0992 -0.0311 1.0200 -0.0480 -0.99
201901011200 121.230000 29.910000 2.218 -2.3281 -1.8278 -0.6316 -0.2658 -1.3641 0.13
201901011300 121.230000 29.910000 2.218 -4.3682 -3.4733 -1.2019 -1.4624 -2.6509 1.18
201901011400 121.230000 29.910000 2.218 -5.7260 -4.5735 -1.5823 -2.2855 -3.5458 1.91
The residual harmonic constants are equal to the regional harmonic constants minus the model value of harmonic constannts calculated by global tidal load spherical harmonic coefficients model.
The program requires that residual harmonic constant grid files of all tidal constituents are stored in a folder. The file is saved in the form of a vector grid, and the seventh attribute of the file header is the Doodson constant.
The height of the ground site is orthometric (normal) height when calculating the ocean tidal load effects, and the height relative to the surface when calculating the surface atmosphere tidal load effects.

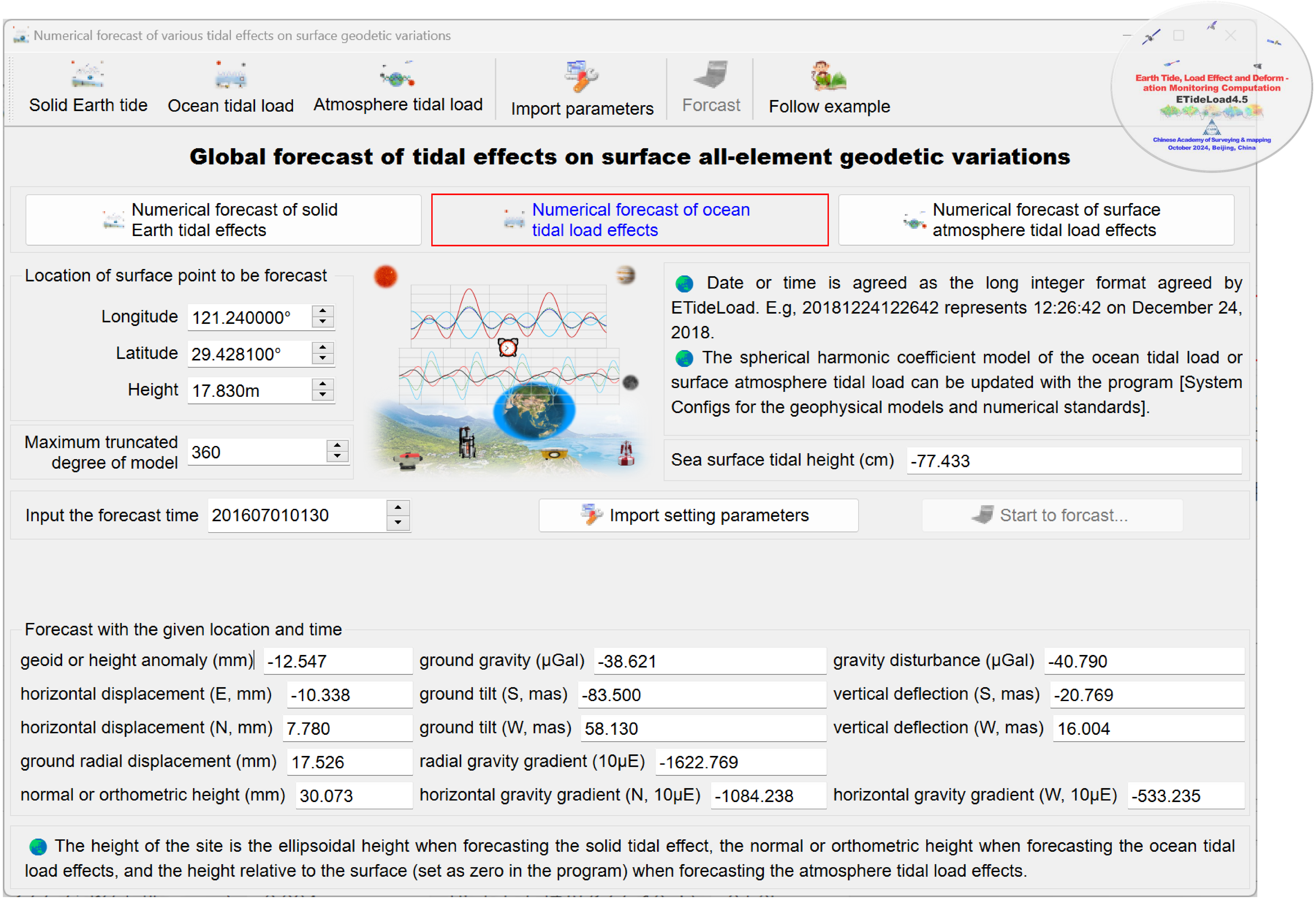


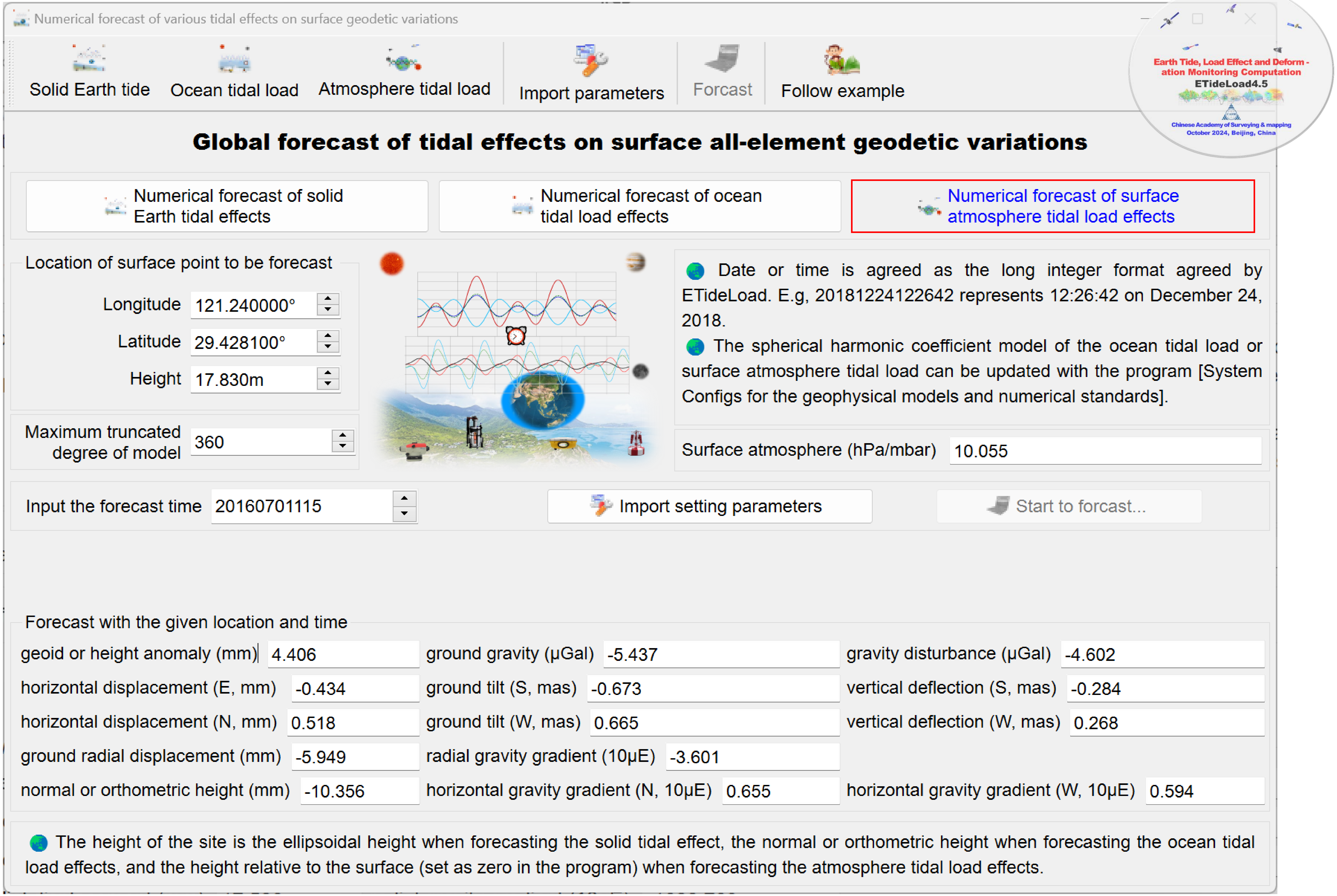
The residual ocean tidal load effects (GOT4.8-FES2004): height anomaly (mm), ground gravity (μGal), radial displacement (mm), orthometric height (mm)

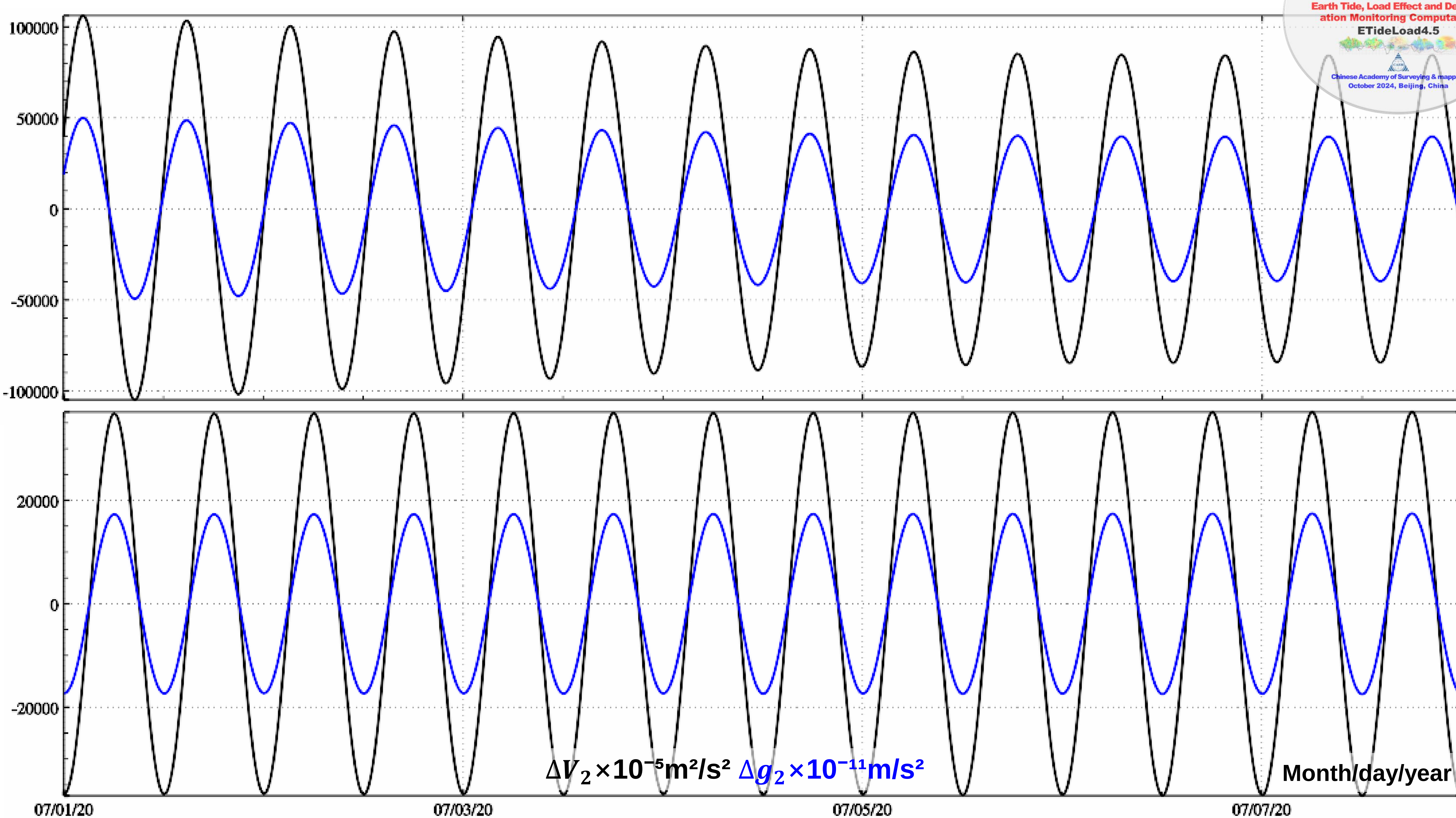


The residual ocean tidal load effects (GOT4.8-FES2004): ground tilt (S, mas), (W, mas), horizontal displacement (E, mm)), (N, mm)

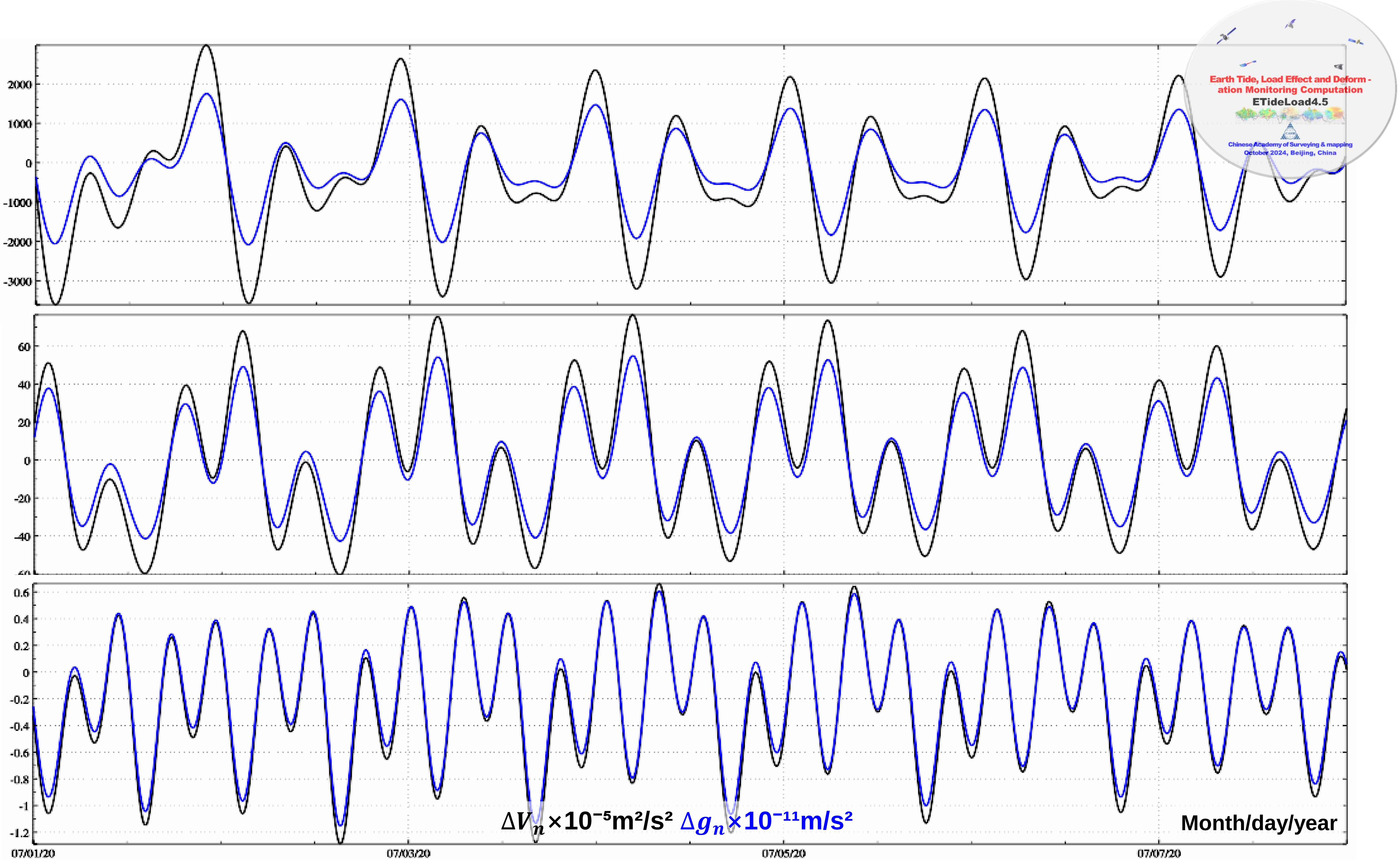

Numerical forecast of various tidal effects on surface geodetic variations
Solid Earth tide
Ocean tidal load
Atmosphere tidal load
Import parameters
Forcast
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Global forecast of tidal effects on surface all-element geodetic variations
Numerical forecast of solid Earth tidal effects
Numerical forecast of ocean tidal load effects
Numerical forecast of surface atmosphere tidal load effects
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Height 17.830m
Date or time is agreed as the long integer format agreed by ETideLoad. E.g, 20181224122642 represents 12:26:42 on December 24, 2018.
The spherical harmonic coefficient model of the ocean tidal load or surface atmosphere tidal load can be updated with the program [System Configs for the geophysical models and numerical standards].
Input the forecast time 201607010930
Import setting parameters
Start to forcast...
Forecast with the given location and time
geoid or height anomaly (mm) -237.159
ground gravity (μGal) -95.705
gravity disturbance (μGal) -108.813
horizontal displacement (E, mm) 20.079
ground tilt (S, mas) 4.222
vertical deflection (S, mas) 8.493
horizontal displacement (N, mm) -16.345
ground tilt (W, mas) -5.333
vertical deflection (W, mas) -10.091
ground radial displacement (mm) -119.083
radial gravity gradient (10μE) 67.971
normal or orthometric height (mm) 117.948
horizontal gravity gradient (N, 10μE) 4.203
horizontal gravity gradient (W, 10μE) -25.594
The height of the site is the ellipsoidal height when forecasting the solid tidal effect, the normal or orthometric height when forecasting the ocean tidal load effects, and the height relative to the surface (set as zero in the program) when forecasting the atmosphere tidal load effects.


Numerical forecast of various tidal effects on surface geodetic variations
Solid Earth tide
Ocean tidal load
Atmosphere tidal load
Import parameters
Forcast
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Global forecast of tidal effects on surface all-element geodetic variations
Numerical forecast of solid Earth tidal effects
Numerical forecast of ocean tidal load effects
Numerical forecast of surface atmosphere tidal load effects
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Height 17.830m
Maximum truncated degree of model 360
Date or time is agreed as the long integer format agreed by ETideLoad. E.g, 20181224122642 represents 12:26:42 on December 24, 2018.
The spherical harmonic coefficient model of the ocean tidal load or surface atmosphere tidal load can be updated with the program [System Configs for the geophysical models and numerical standards].
Sea surface tidal height (cm) -77.433
Input the forecast time 201607010130
Import setting parameters
Start to forcast...
Forecast with the given location and time
geoid or height anomaly (mm) -12.547
ground gravity (μGal) -38.621
gravity disturbance (μGal) -40.790
horizontal displacement (E, mm) -10.338
ground tilt (S, mas) -83.500
vertical deflection (S, mas) -20.769
horizontal displacement (N, mm) 7.780
ground tilt (W, mas) 58.130
vertical deflection (W, mas) 16.004
ground radial displacement (mm) 17.526
radial gravity gradient (10μE) -1622.769
normal or orthometric height (mm) 30.073
horizontal gravity gradient (N, 10μE) -1084.238
horizontal gravity gradient (W, 10μE) -533.235
The height of the site is the ellipsoidal height when forecasting the solid tidal effect, the normal or orthometric height when forecasting the ocean tidal load effects, and the height relative to the surface (set as zero in the program) when forecasting the atmosphere tidal load effects.

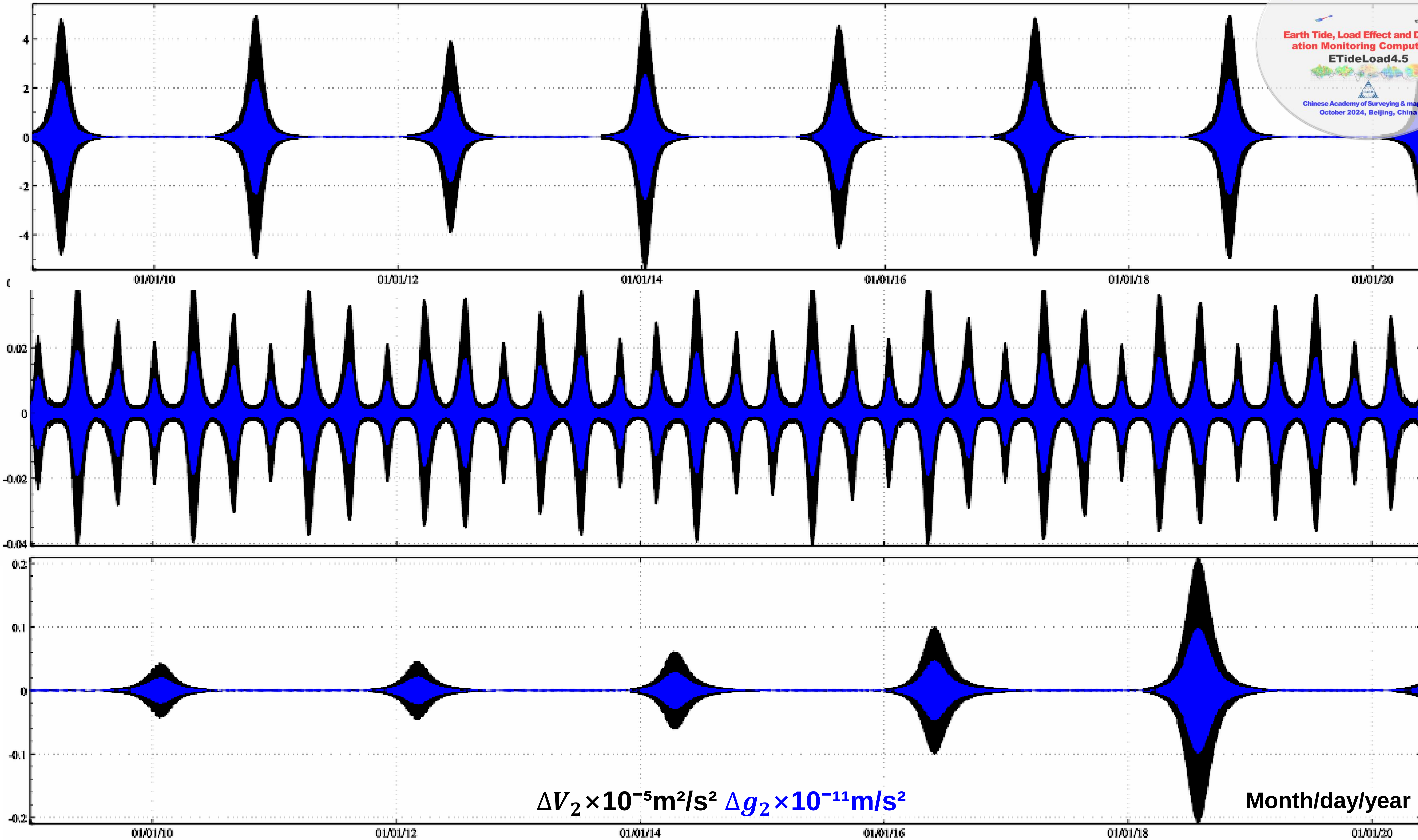

Numerical forecast of various tidal effects on surface geodetic variations
Solid Earth tide
Ocean tidal load
Atmosphere tidal load
Import parameters
Forcast
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Global forecast of tidal effects on surface all-element geodetic variations
Numerical forecast of solid Earth tidal effects
Numerical forecast of ocean tidal load effects
Numerical forecast of surface atmosphere tidal load effects
Location of surface point to be forecast
Longitude 121.240000°
Latitude 29.428100°
Height 17.830m
Maximum truncated degree of model 360
Date or time is agreed as the long integer format agreed by ETideLoad. E.g, 20181224122642 represents 12:26:42 on December 24, 2018.
The spherical harmonic coefficient model of the ocean tidal load or surface atmosphere tidal load can be updated with the program [System Configs for the geophysical models and numerical standards].
Surface atmosphere (hPa/mbar) 10.055
Input the forecast time 20160701115
Import setting parameters
Start to forcast...
Forecast with the given location and time
geoid or height anomaly (mm) 4.406
ground gravity (μGal) -5.437
gravity disturbance (μGal) -4.602
horizontal displacement (E, mm) -0.434
ground tilt (S, mas) -0.673
vertical deflection (S, mas) -0.284
horizontal displacement (N, mm) 0.518
ground tilt (W, mas) 0.665
vertical deflection (W, mas) 0.268
ground radial displacement (mm) -5.949
radial gravity gradient (10μE) -3.601
normal or orthometric height (mm) -10.356
horizontal gravity gradient (N, 10μE) 0.655
horizontal gravity gradient (W, 10μE) 0.594
The height of the site is the ellipsoidal height when forecasting the solid tidal effect, the normal or orthometric height when forecasting the ocean tidal load effects, and the height relative to the surface (set as zero in the program) when forecasting the atmosphere tidal load effects.



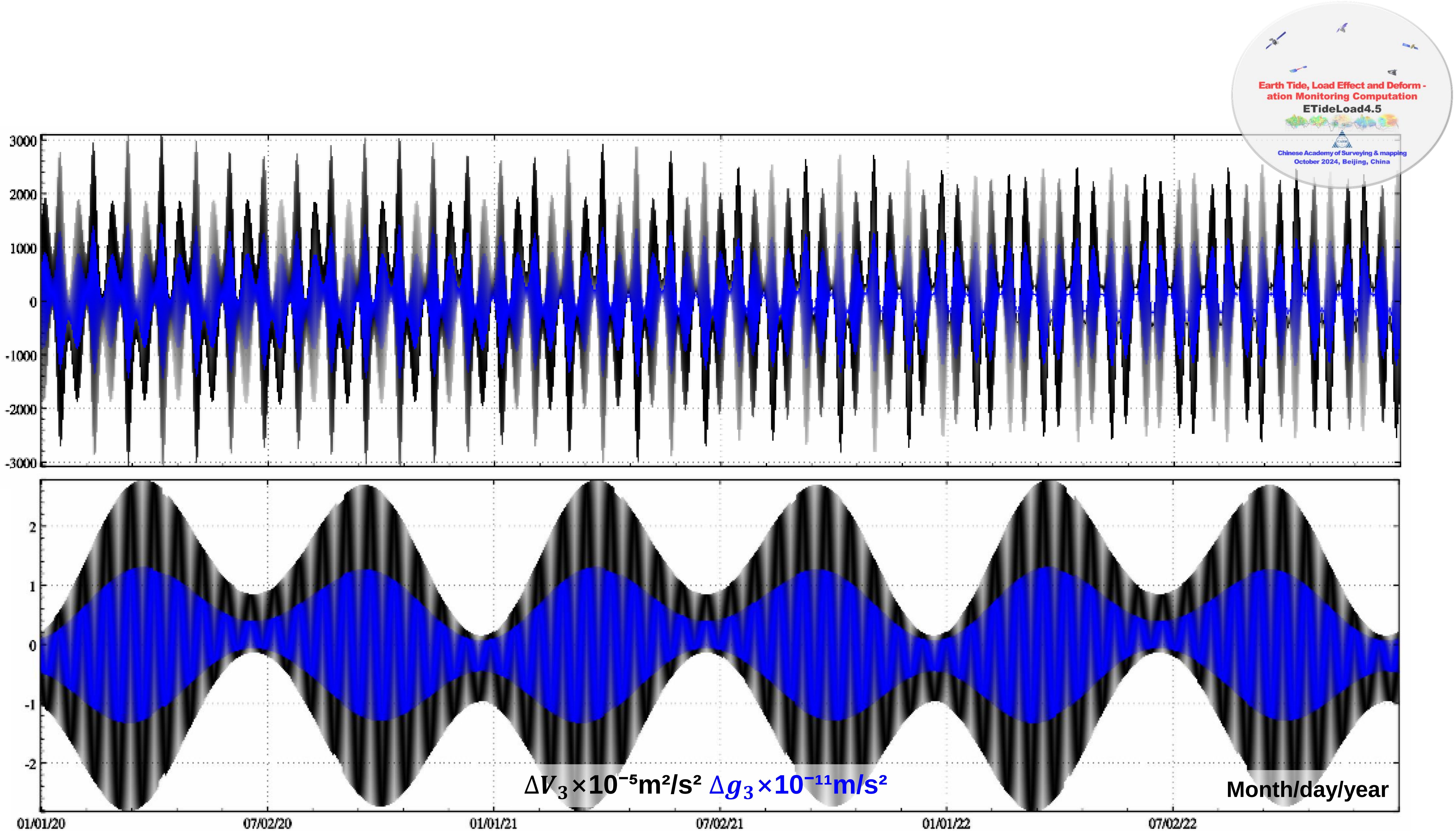
Degree-2 Earth’s tidal potential (force) time series from Moon and Sun (7 days)



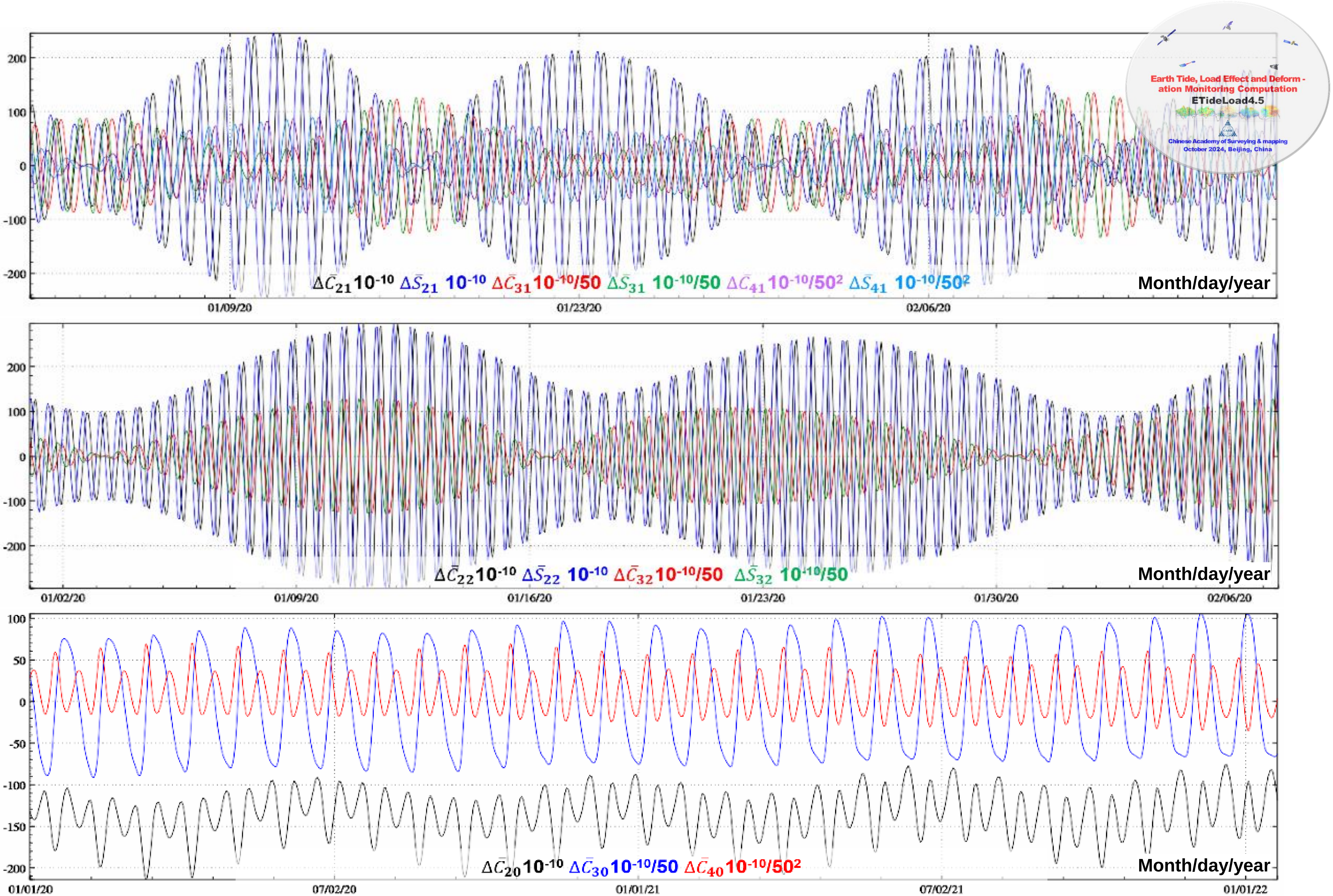
Degree 3, 4 and 5 Earth's tidal potential (force) time series from Moon (7 days)



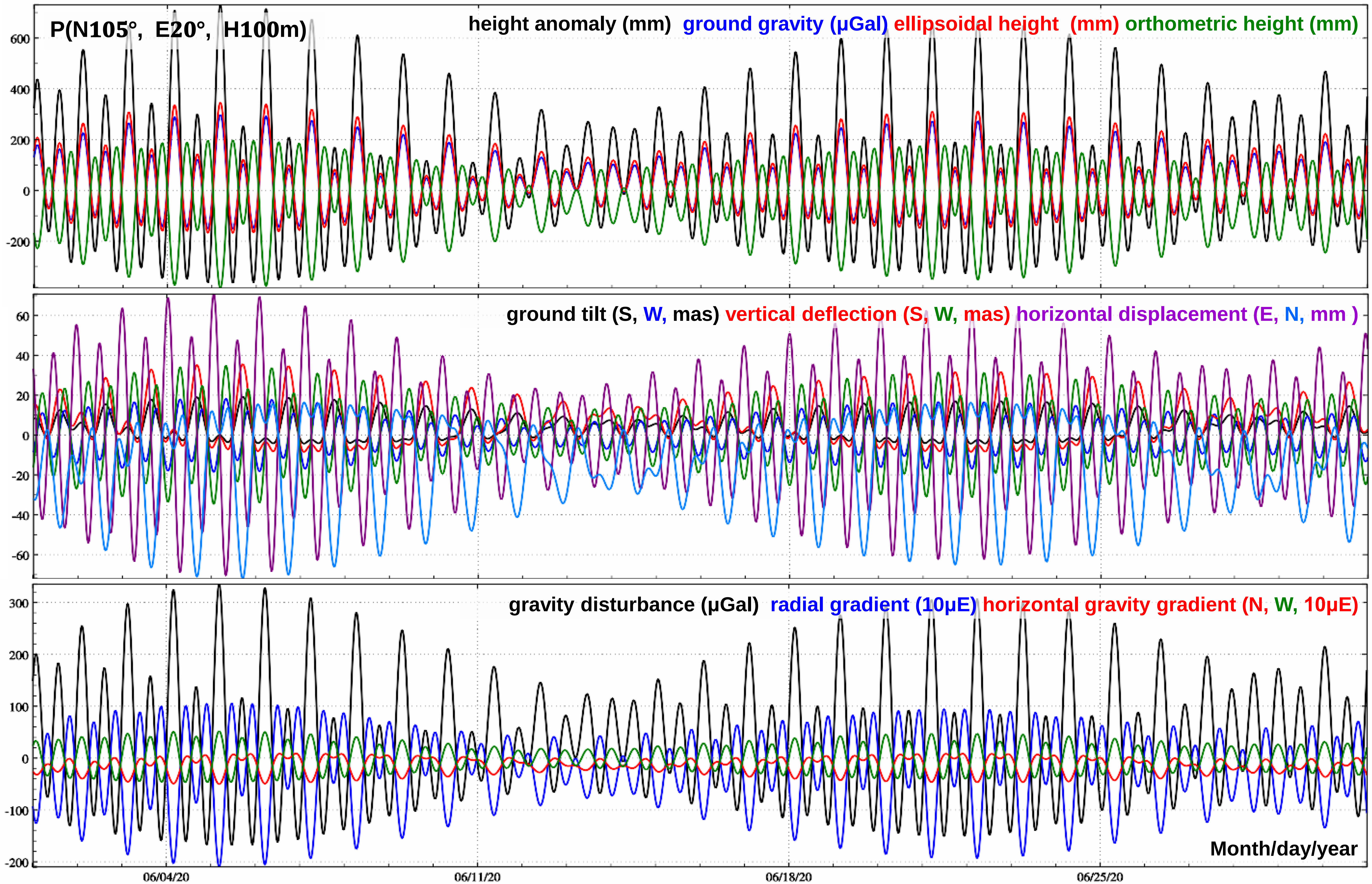
Degree-2 Earth's tidal potential (force) time series from Venus, Jupiter and Mars (12 years)



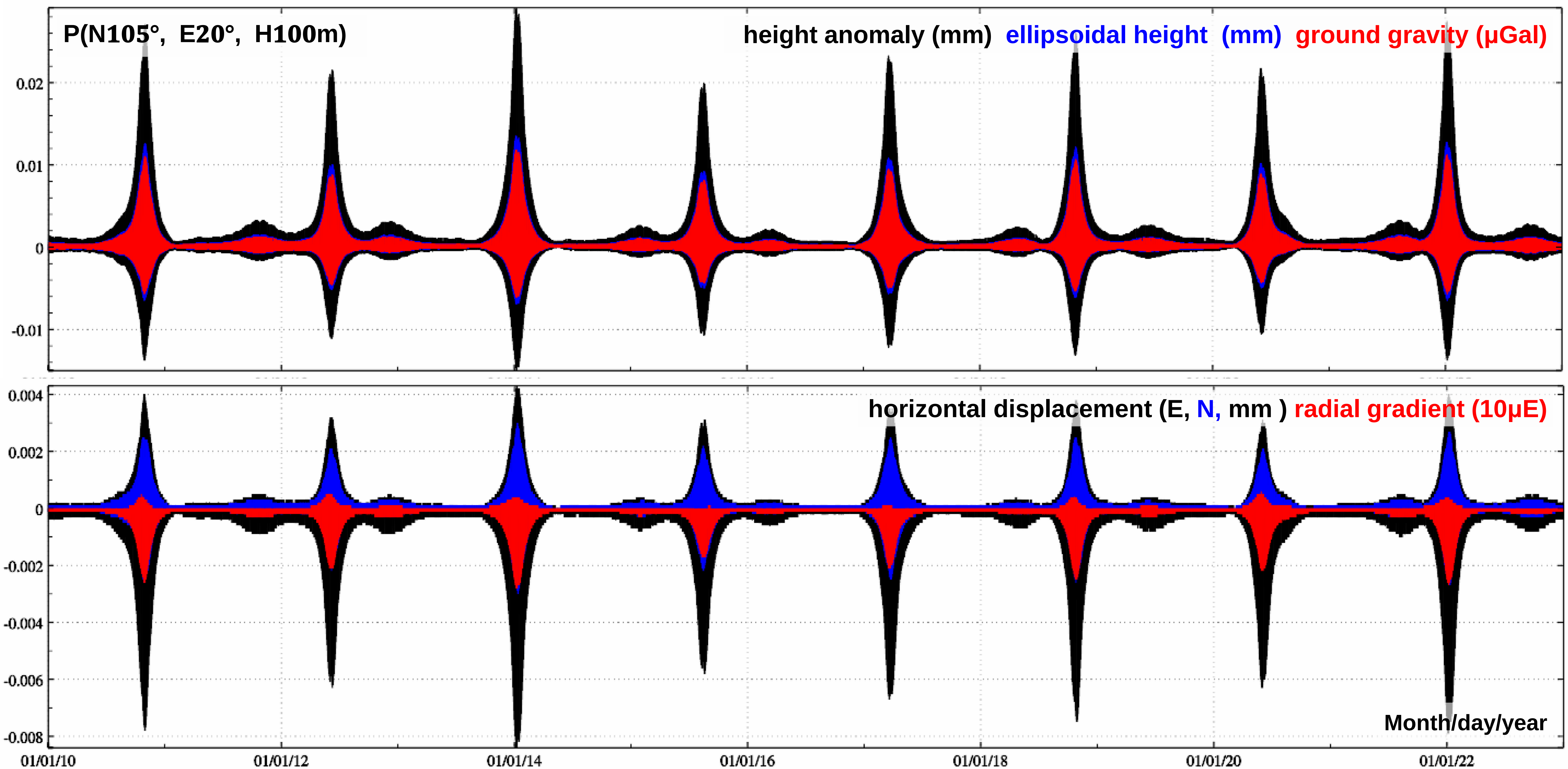
Degree 3 Earth's tidal potential (force) time series from Moon and Sun (2 years)



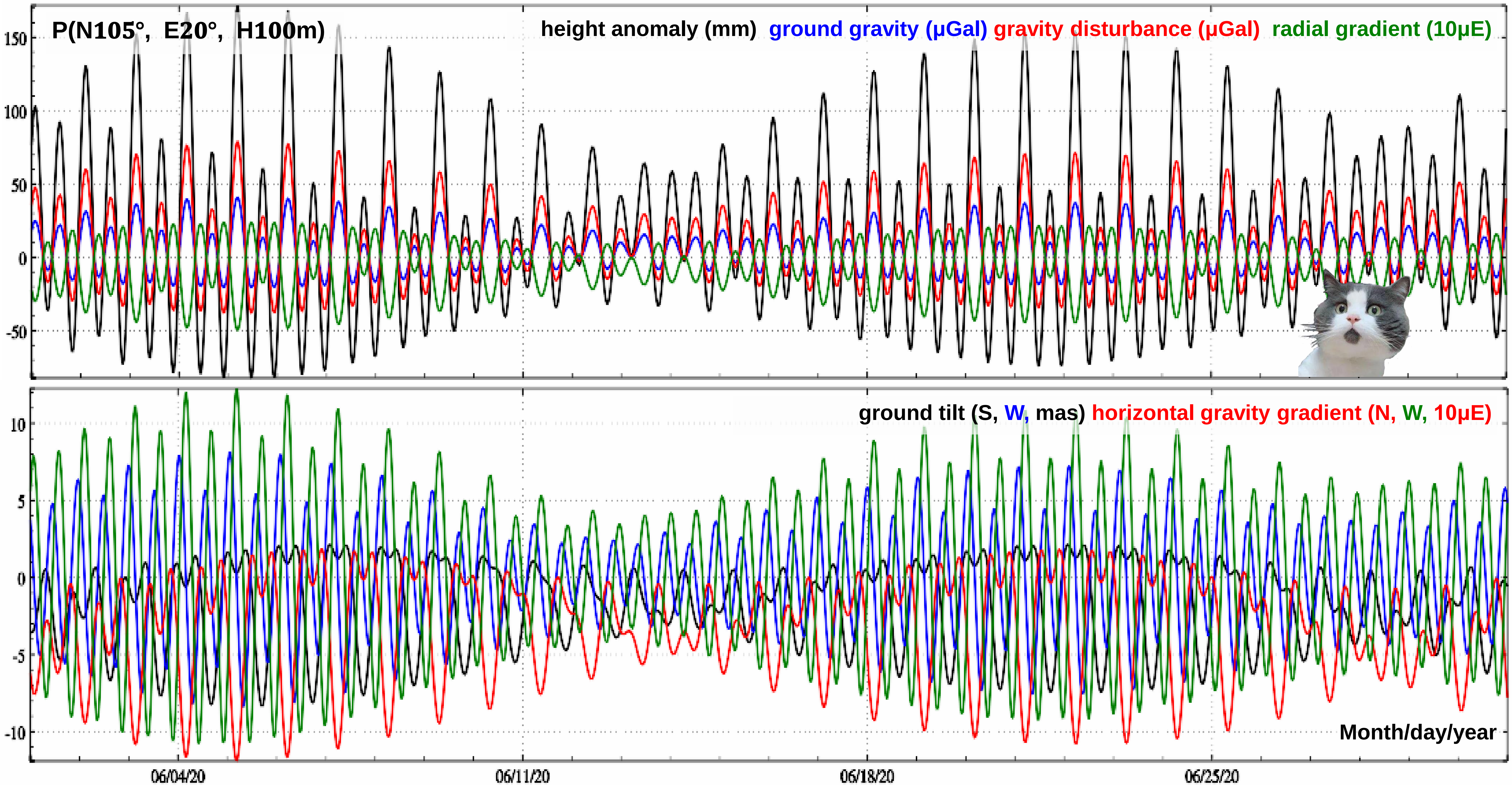
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
$\Delta\bar{C}_{21}$ 10^{-10} $\Delta\bar{S}_{21}$ 10^{-10} $\Delta\bar{C}_{31}$ $10^{-10}/50$ $\Delta\bar{S}_{31}$ $10^{-10}/50$ $\Delta\bar{C}_{41}$ $10^{-10}/50^2$ $\Delta\bar{S}_{41}$ $10^{-10}/50^2$
Month/day/year
01/09/20
01/23/20
02/06/20
$\Delta\bar{C}_{22}$ 10^{-10} $\Delta\bar{S}_{22}$ 10^{-10} $\Delta\bar{C}_{32}$ $10^{-10}/50$ $\Delta\bar{S}_{32}$ $10^{-10}/50$
Month/day/year
01/02/20
01/09/20
01/16/20
01/23/20
01/30/20
02/06/20
$\Delta\bar{C}_{20}$ 10^{-10} $\Delta\bar{C}_{30}$ $10^{-10}/50$ $\Delta\bar{C}_{40}$ $10^{-10}/50^2$
Month/day/year
01/01/20
07/02/20
01/01/21
07/02/21
01/01/22



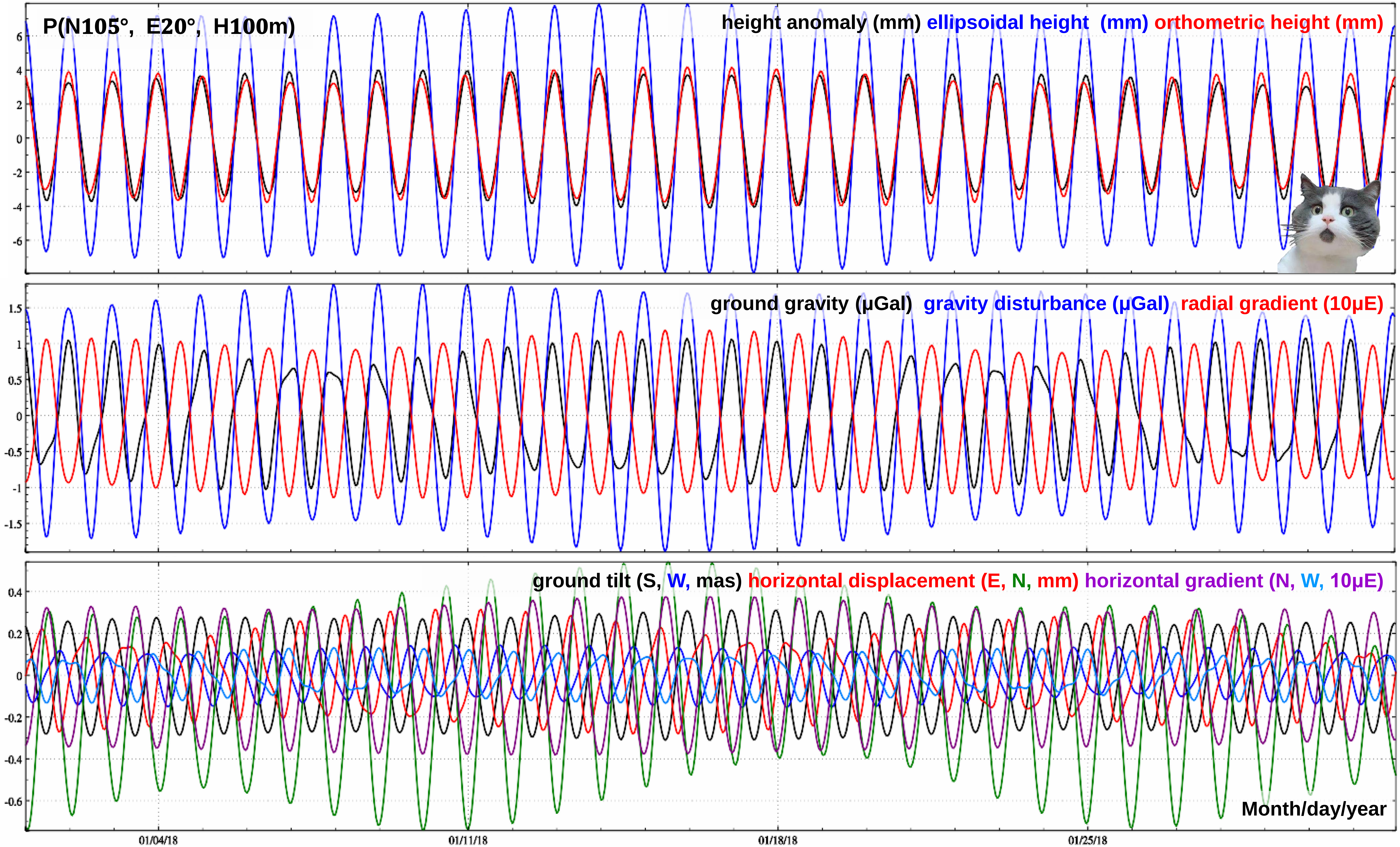
Solid Earth tidal effect time series on all-element geodetic variations



Solid tidal effect time series from the planets outside Earth



The indirect influence time series of tidal potential to geodetic variations



Contributions of potential Love number frequency dependent corrections airptideS1_cs.dat | proS1_.ini | Airtdloadcs.dat | Otideloadcs.dat

Ocean tidal height load normalized spherical harmonic coefficient model in cm.
Created by ETideLoad, ZHANG Chuanyin, Chinese Academy of Surveying and Mapping.

Doodson	name	n	m	Csin+	Ccos+	Csin-	Ccos-	C+	eps+	C-	eps-
247.455	2N2	1	0	0.00458562	0.00231038	0.00458562	0.00231038	0.005135	63.2596	0.005135	63.2596
247.455	2N2	1	1	-0.00773380	0.00473565	0.01063946	-0.00152991	0.009069	301.4805	0.010749	98.1828
247.455	2N2	2	0	0.01415077	-0.00470716	0.01415077	-0.00470716	0.014913	108.3994	0.014913	108.3994
247.455	2N2	2	1	-0.01749377	0.01964053	-0.02057617	0.01244109	0.026302	318.3086	0.024045	301.1587
247.455	2N2	2	2	-0.05076973	0.15409810	0.03408330	-0.00708020	0.162246	341.7648	0.034811	101.7353
247.455	2N2	3	0	-0.00345932	-0.05402235	-0.00345932	-0.05402235	0.054133	183.6639	0.054133	183.6639
247.455	2N2	3	1	0.00459468	0.02860553	0.08674509	0.04125120	0.028972	9.1250	0.096054	64.5668
247.455	2N2	3	2	-0.01359111	-0.04803085	0.00043095	0.01917460	0.049917	195.7997	0.019179	1.2875
247.455	2N2	3	3	0.11576000	0.04745531	0.10043379	-0.03897379	0.125109	67.7090	0.107731	111.2090
247.455	2N2	4	0	-0.04607076	0.02579335	-0.04607076	0.02579335	0.052800	299.2429	0.052800	299.2429
247.455	2N2	4	1	0.03322584	0.01467790	0.01394749	0.02945707	0.036324	66.1660	0.032592	25.3369
247.455	2N2	4	2	0.06616682	-0.16308472	0.08023800	0.03608357	0.175996	157.9166	0.087978	65.7862
247.455	2N2	4	3	-0.04323293	-0.08712246	-0.08031745	0.08908738	0.097259	206.3921	0.119948	317.9635
247.455	2N2	4	4	-0.07108370	0.11911427	-0.03283587	0.04029420	0.138712	329.1726	0.051979	320.8233
247.455	2N2	5	0	0.00423674	0.05025371	0.00423674	0.05025371	0.050432	4.8190	0.050432	4.8190

Ocean tidal load spherical harmonic coefficient model FES2014b720cs.dat

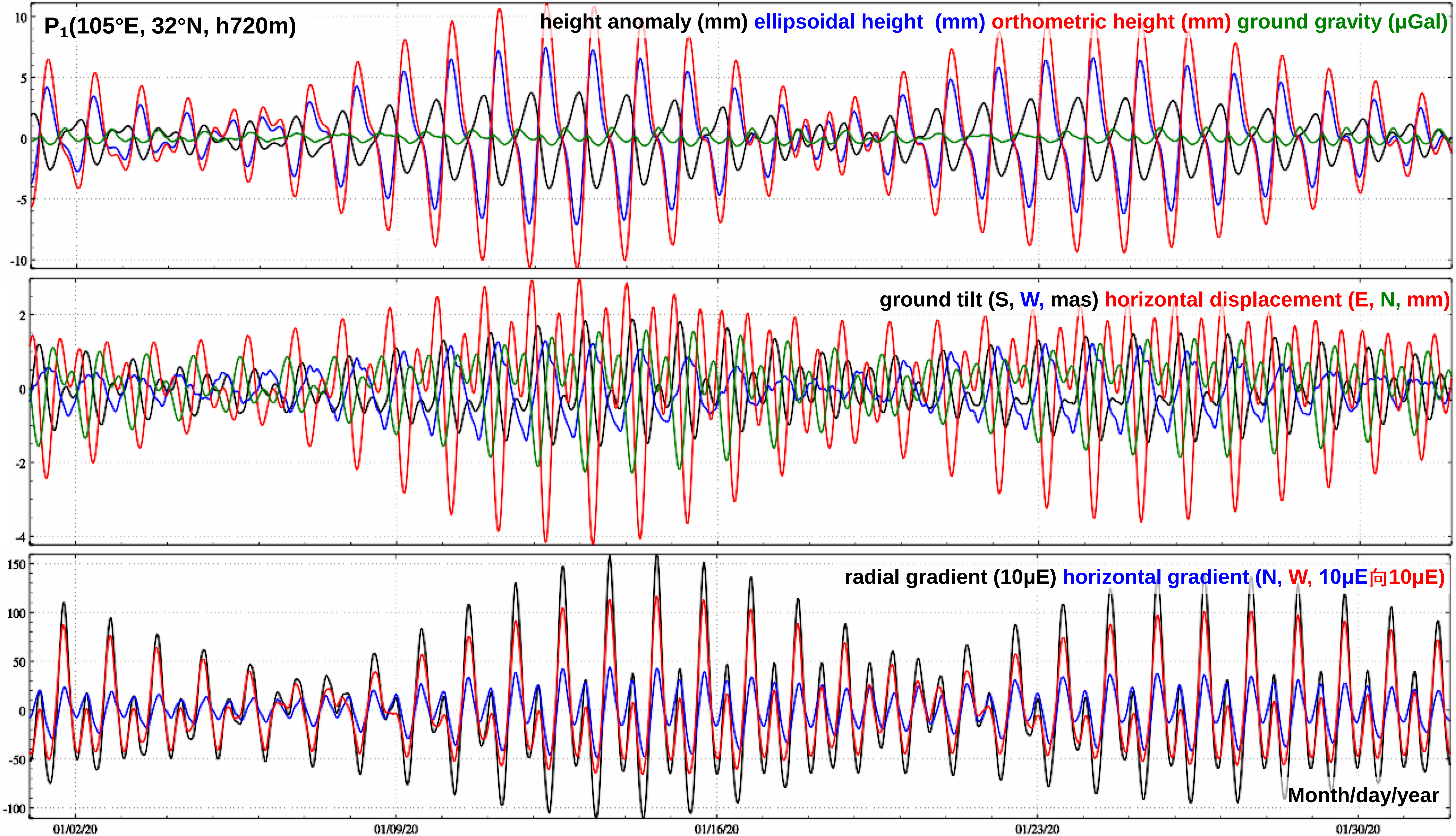
ECMWF2006.dat

Atmospheric tide normalized spherical harmonic coefficients model in hPa.
Created by ETideLoad4.0, ZHANG Chuanyin, Chinese academy of surveying and mapping.

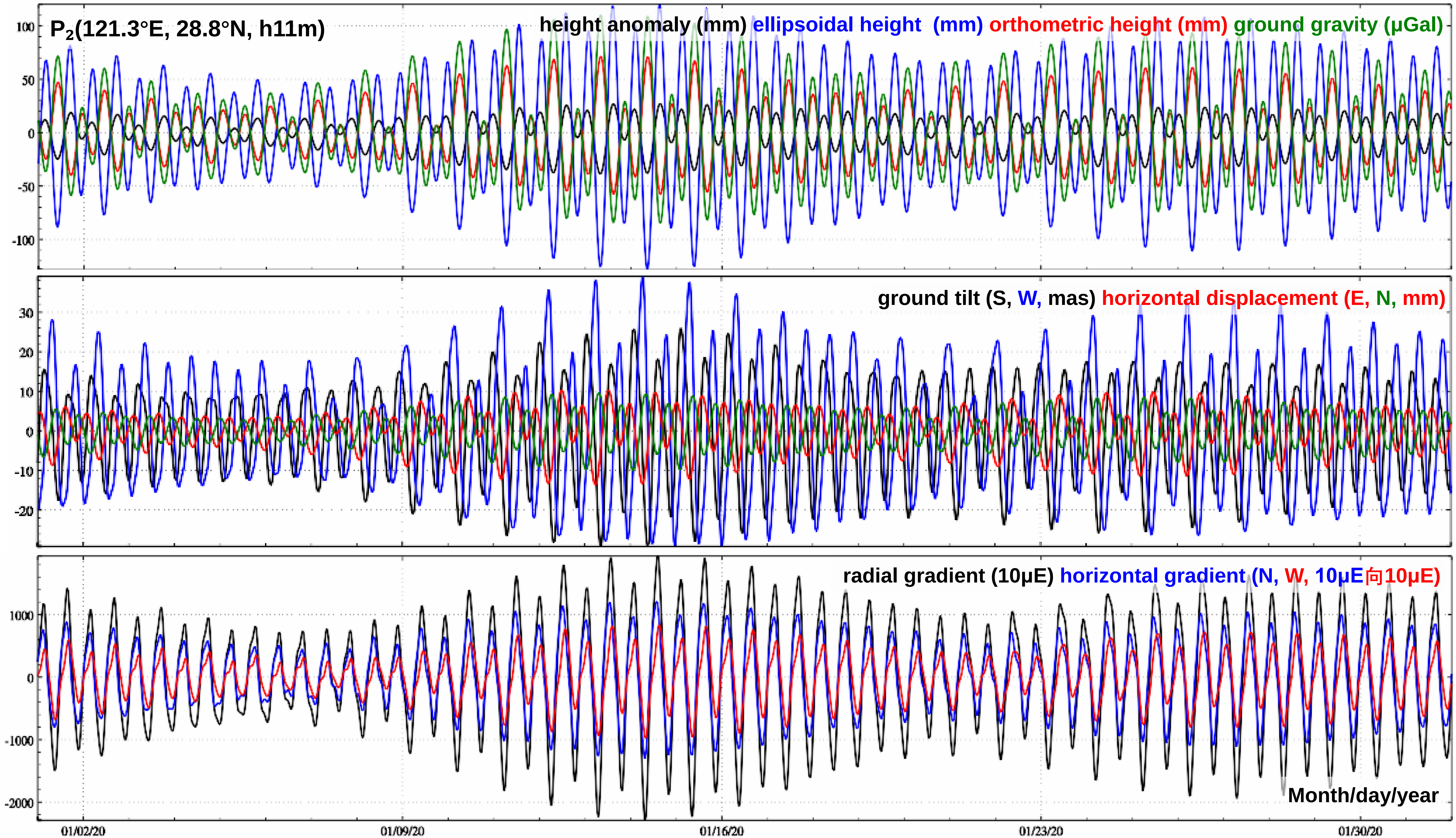
Doodson	name	n	m	Csin+	Ccos+	Csin-	Ccos-	C+	eps+	C-	eps-
164.556	S1	1	0	-0.01044031	0.00562801	-0.01044031	0.00562801	0.011861	298.3276	0.011861	298.3276
164.556	S1	1	1	-0.02015273	-0.30983977	-0.02700767	0.03081953	0.310494	183.7214	0.040979	318.7714
164.556	S1	2	0	-0.00879779	0.02710081	-0.00879779	0.02710081	0.028493	342.0149	0.028493	342.0149
164.556	S1	2	1	-0.00268684	-0.06100327	-0.02133604	0.03900132	0.061062	182.5219	0.044456	331.3187
164.556	S1	2	2	0.04746907	-0.07026009	-0.05105739	-0.01871012	0.084793	145.9563	0.054378	249.8745
164.556	S1	3	0	0.02425656	0.01222288	0.02425656	0.01222288	0.027162	63.2565	0.027162	63.2565
164.556	S1	3	1	-0.00066157	0.08663528	0.01518488	0.03226590	0.086638	359.5625	0.035660	25.2025
164.556	S1	3	2	0.05673625	-0.01538495	0.00624773	-0.04261815	0.058785	105.1718	0.043074	171.6600
164.556	S1	3	3	0.01548229	0.03548483	-0.06617883	0.00859431	0.038715	23.5720	0.066735	277.3993
164.556	S1	4	0	0.01955708	-0.01828613	0.01955708	-0.01828613	0.026774	133.0765	0.026774	133.0765
164.556	S1	4	1	-0.01459852	0.00147989	0.03554801	-0.00397062	0.014673	275.7885	0.035769	96.3734
164.556	S1	4	2	0.01936298	0.02790702	0.01483771	-0.01816466	0.033967	34.7544	0.023454	140.7565
164.556	S1	4	3	0.05871492	0.05584845	0.02091051	-0.06383148	0.081034	46.4333	0.067169	161.8618
164.556	S1	4	4	0.05072226	-0.00992714	-0.02941680	0.00989714	0.051685	101.0737	0.031037	288.5953
164.556	S1	5	0	0.00534727	-0.01557997	0.00534727	-0.01557997	0.016472	161.0570	0.016472	161.0570

Atmosphere tidal load spherical harmonic coefficient model ECMF2006cs360.dat

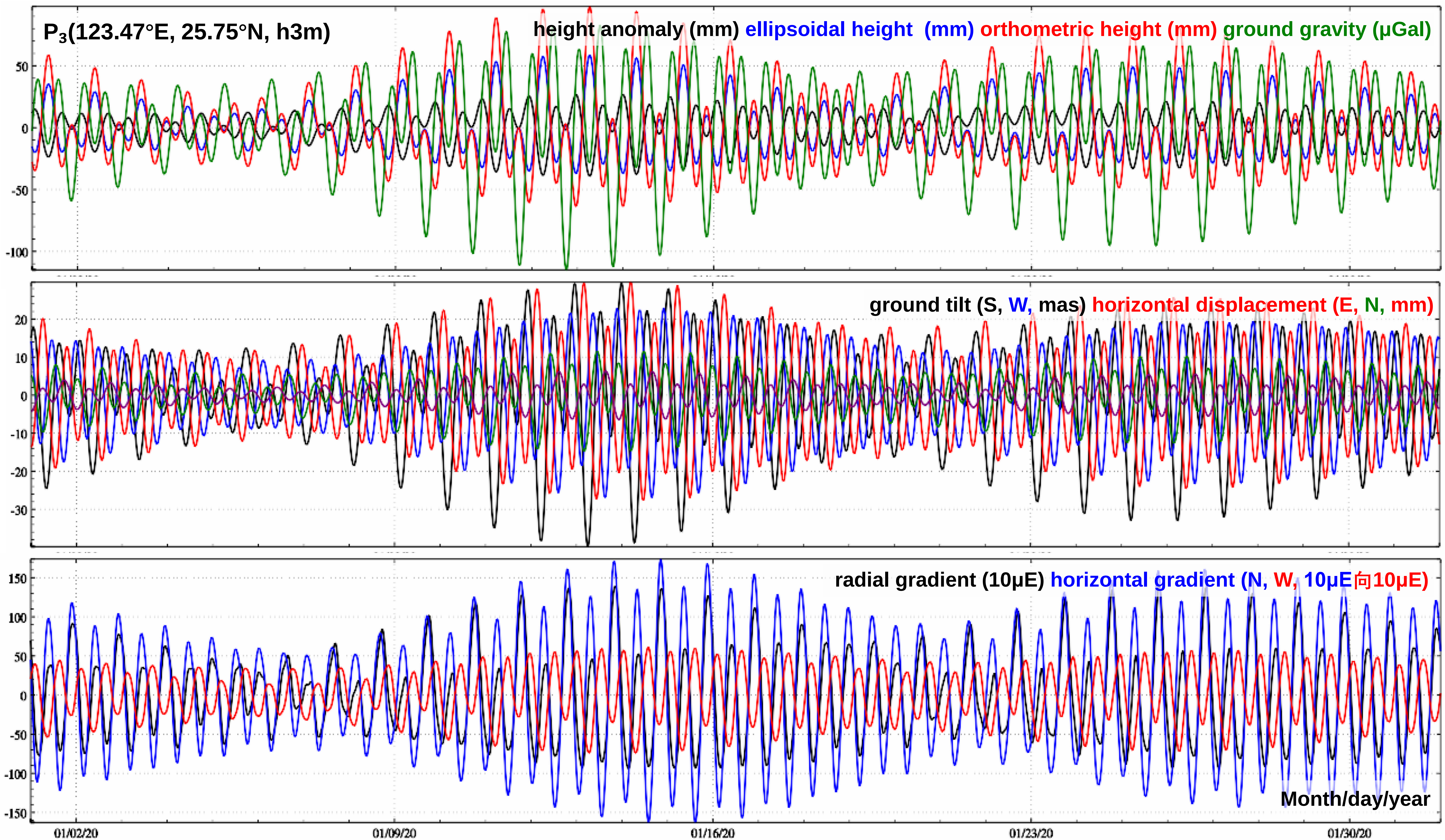
The ocean tidal load effects should be taken into account for the centimeter-level precision geodesy in inland areas.



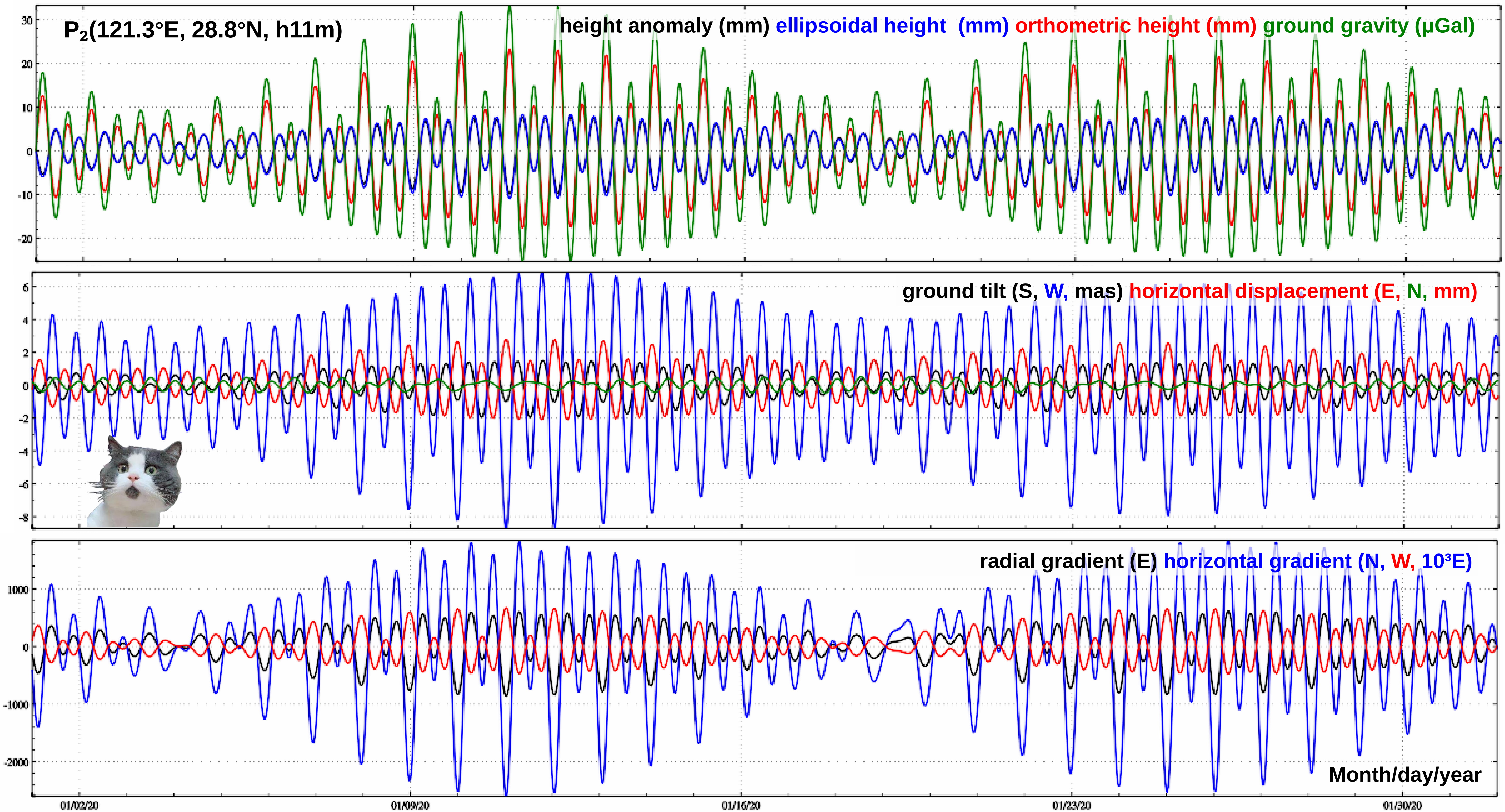
The ocean tidal load effect time series on geodetic variations at P_1 point in the inland area 400km away from the coastline



The ocean tidal load effect time series on geodetic variations at P_2 point on the coastal zone

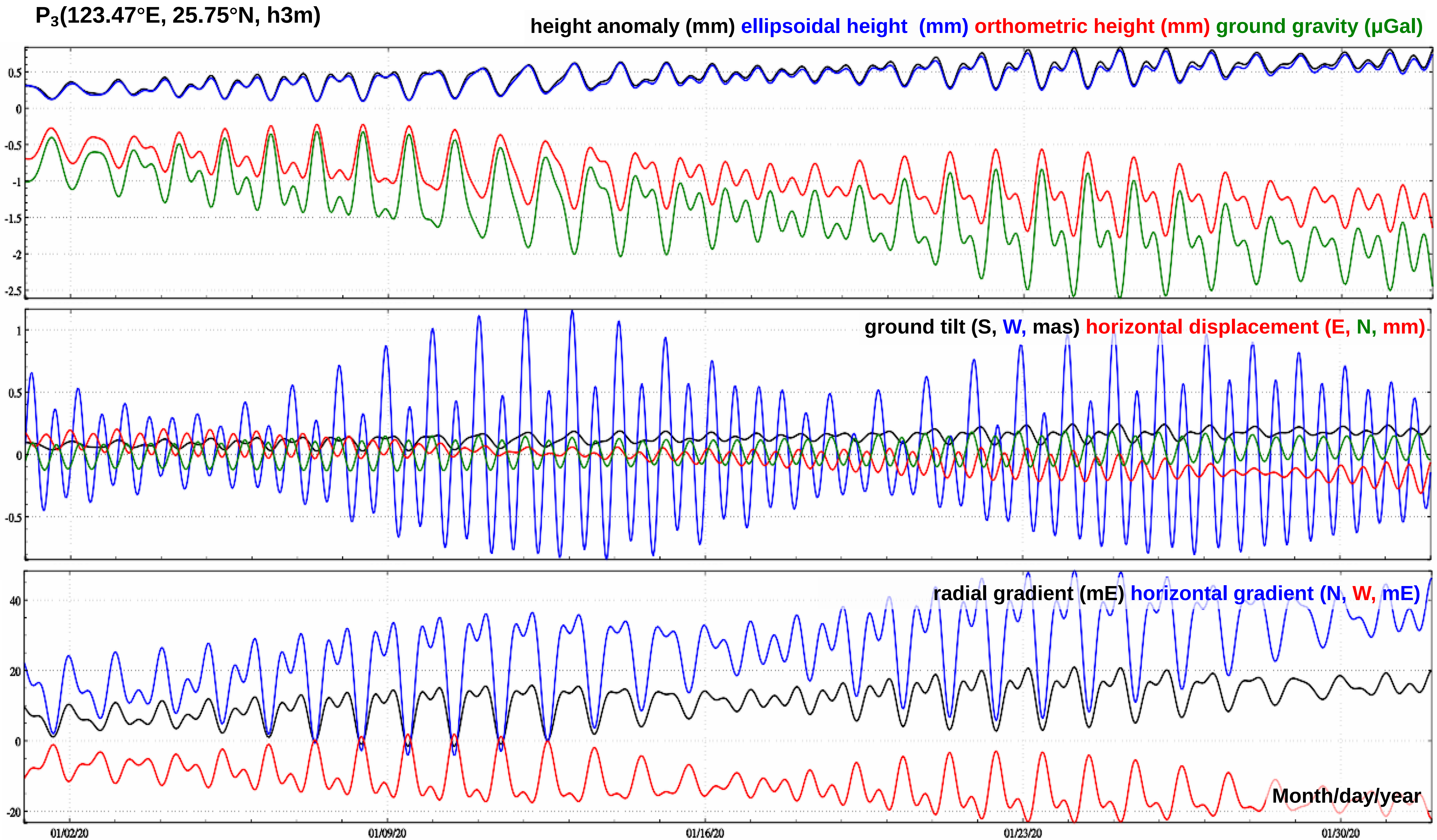


The ocean tidal load effect time series on geodetic variations at P_3 point on offshore island 200km away from the coastline

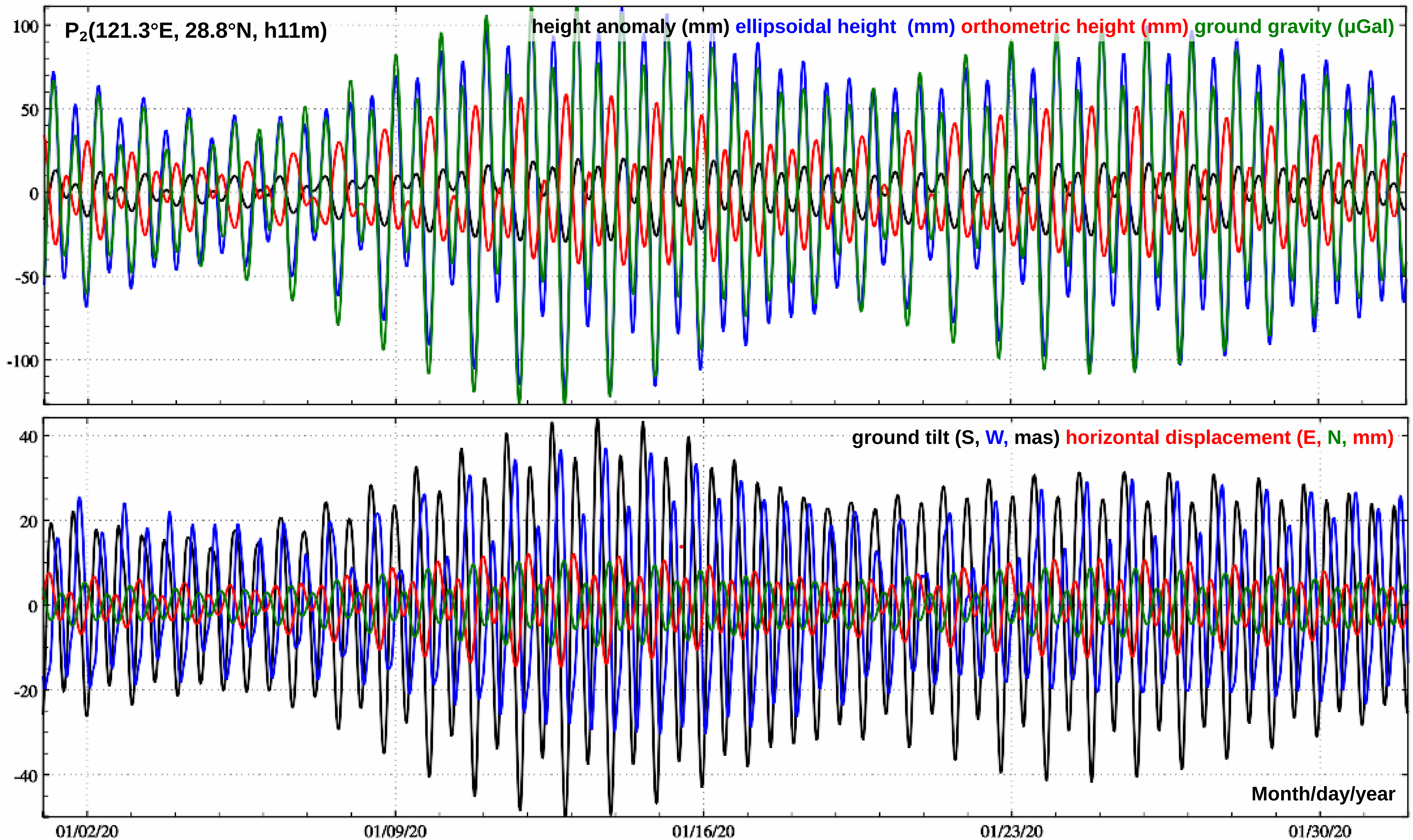


The residual time series of ocean tidal load effects (FES2014b720cs) on geodetic variations at the P_2 in the coastal zone

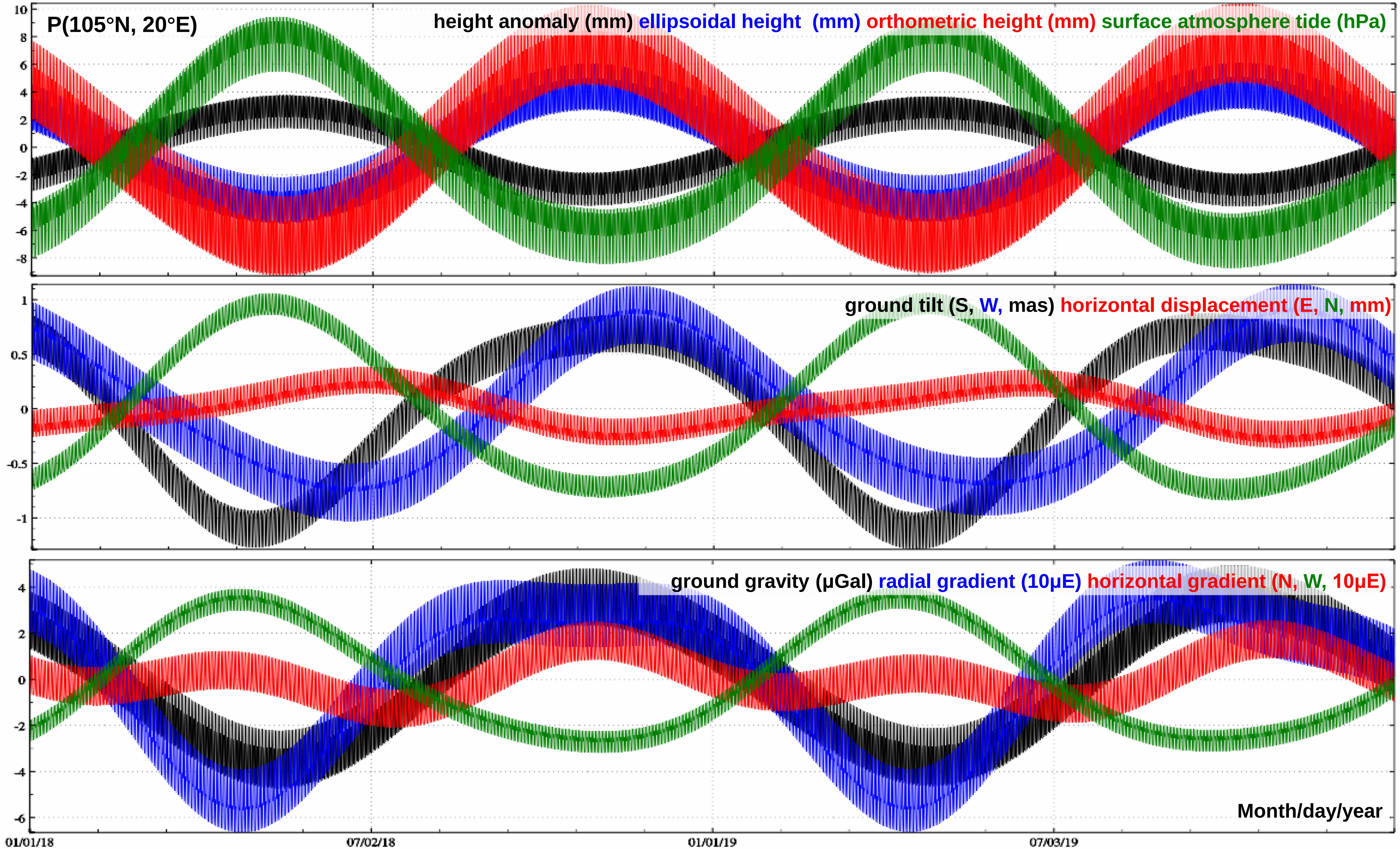
The ocean tidal load effects on gravity gradient are dominant in the ultrashort wave parts, and the high-degree ocean tidal load spherical harmonic coefficient model FES2014b720cs cannot contain these ultrashort wave signals in coastal areas. The calculation results of the residual load effects on gravity gradient are divergent and not available using load Green's function integral.



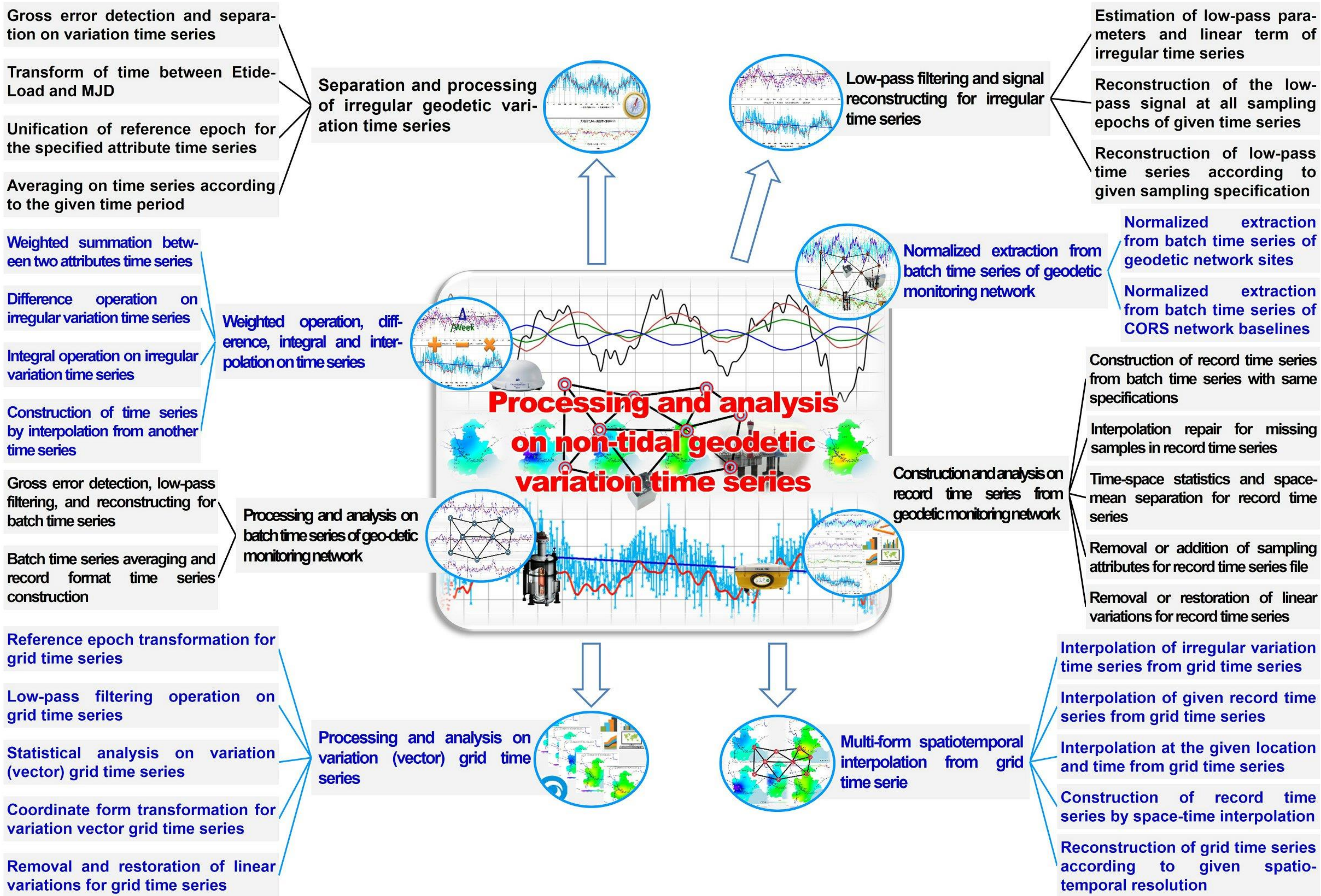
The residual time series of ocean tidal load effects (FES2014b720cs) on geodetic variations at the P_3 on the sea island 200km away from the coastline

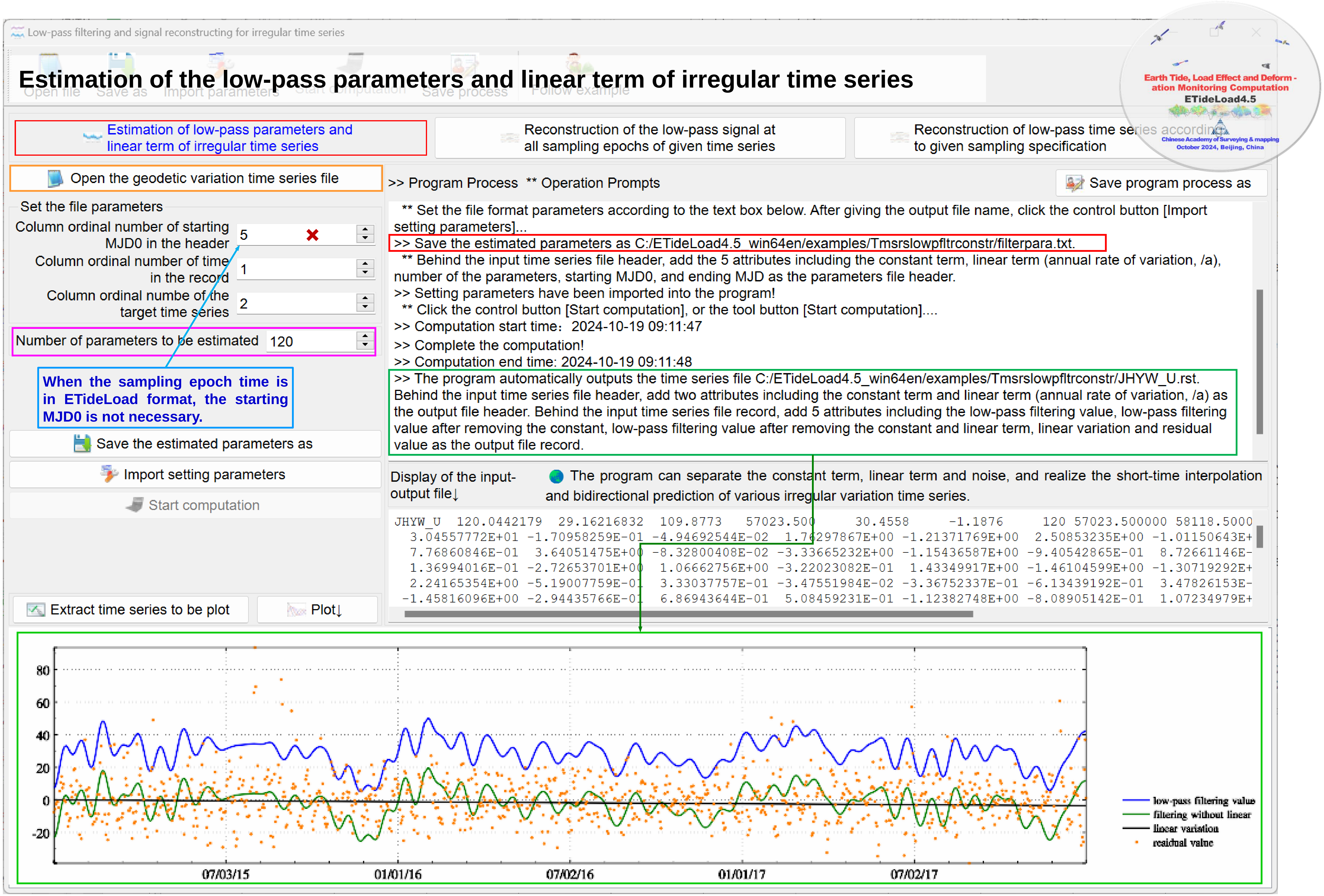


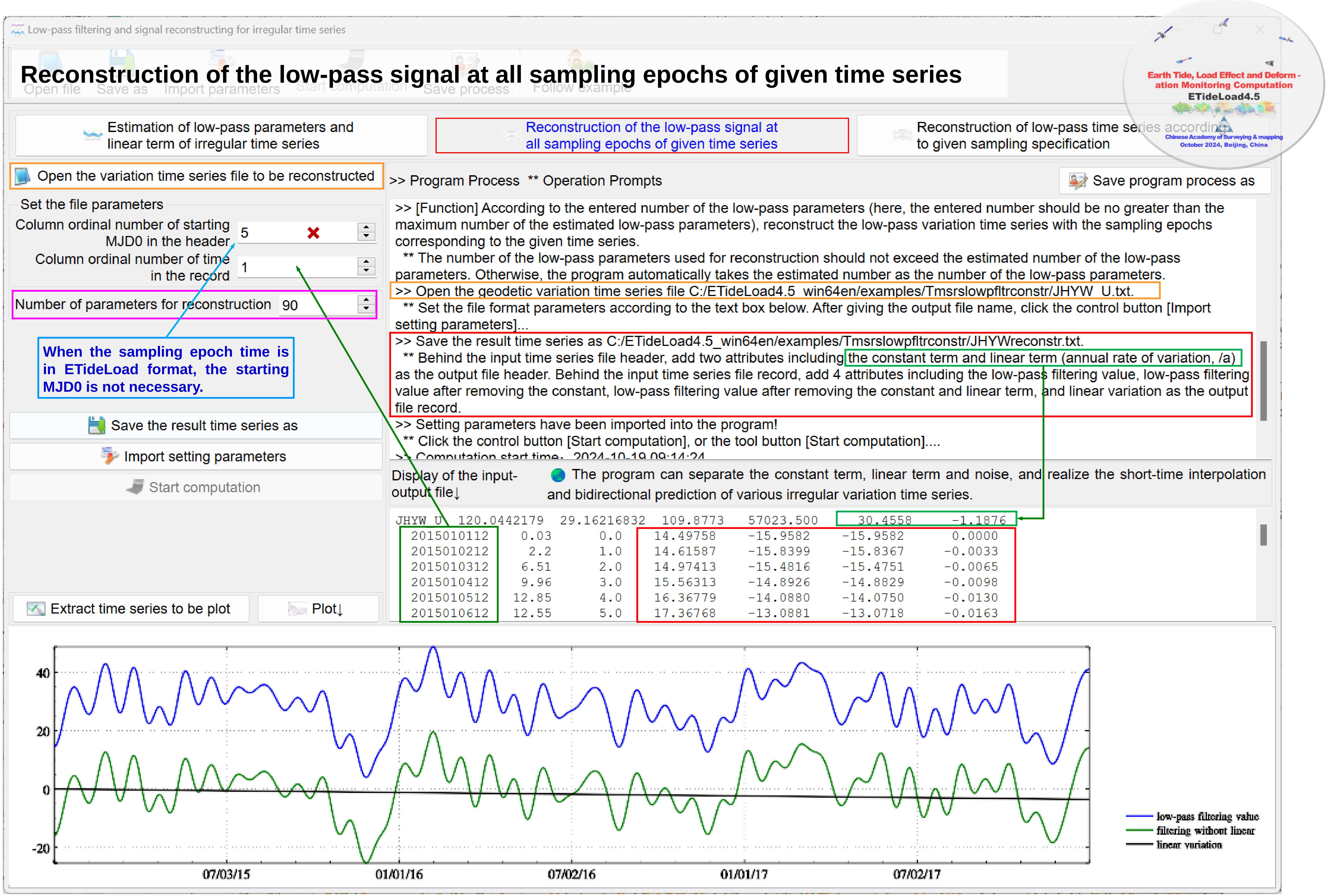
The refine value time series of ocean tidal load effects on geodetic variations at the P_2 in the coastal zone (FES2014b720cs model + load Green's integral of residual)



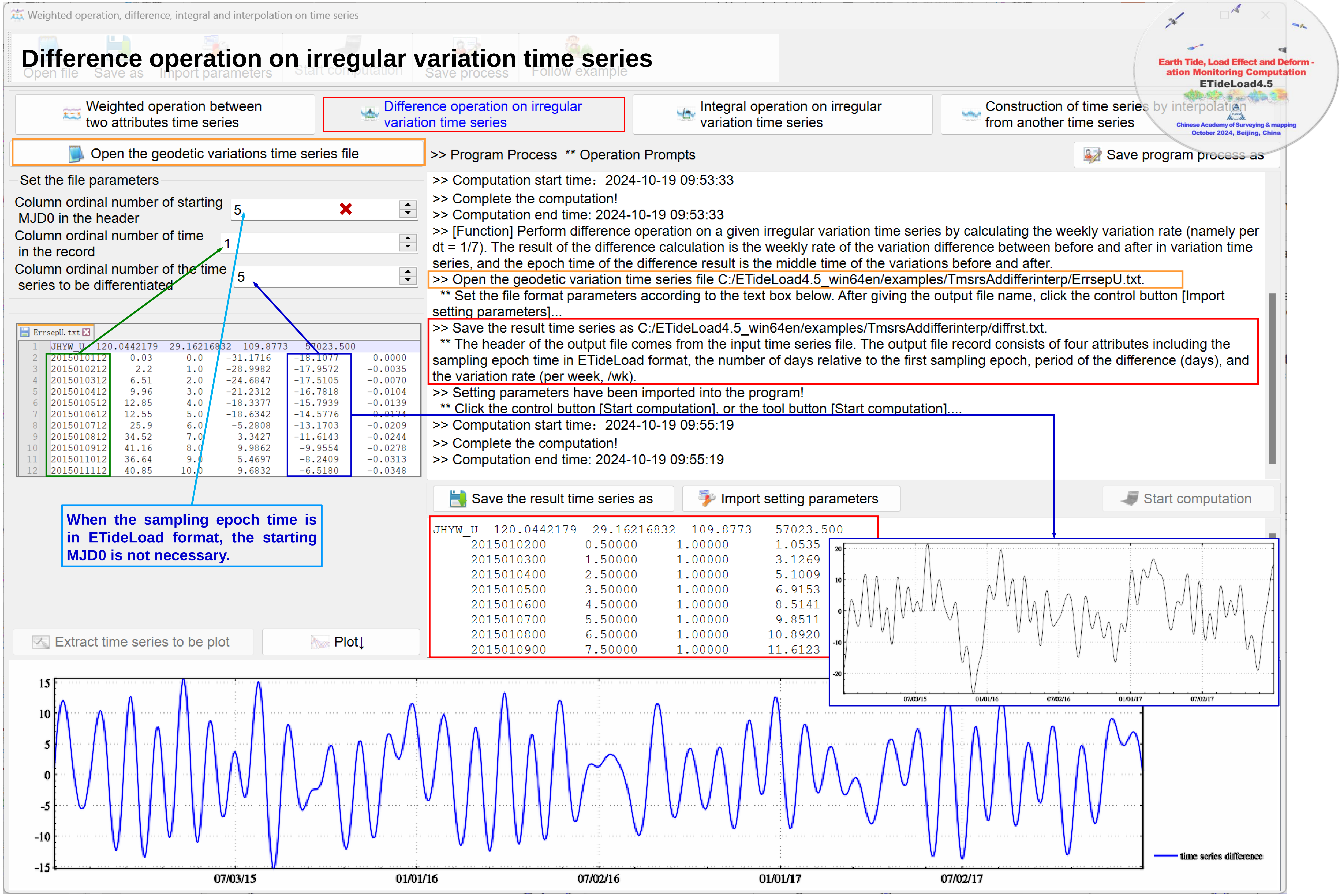
The surface atmosphere tidal load effect time series on geodetic variations


Gross error detection and separation on variation time series
Transform of time between Etide-Load and MJD
Unification of reference epoch for the specified attribute time series
Averaging on time series according to the given time period
Separation and processing of irregular geodetic variation time series
Low-pass filtering and signal reconstructing for irregular time series
Estimation of low-pass parameters and linear term of irregular time series
Reconstruction of the low-pass signal at all sampling epochs of given time series
Reconstruction of low-pass time series according to given sampling specification
Weighted summation between two attributes time series
Difference operation on irregular variation time series
Integral operation on irregular variation time series
Construction of time series by interpolation from another time series
Weighted operation, difference, integral and interpolation on time series
Normalized extraction from batch time series of geodetic monitoring network
Normalized extraction from batch time series of geodetic network sites
Normalized extraction from batch time series of CORS network baselines
Construction of record time series from batch time series with same specifications
Interpolation repair for missing samples in record time series
Time-space statistics and space-mean separation for record time series
Removal or addition of sampling attributes for record time series file
Removal or restoration of linear variations for record time series
Construction and analysis on record time series from geodetic monitoring network
Processing and analysis on non-tidal geodetic variation time series
Gross error detection, low-pass filtering, and reconstructing for batch time series
Batch time series averaging and record format time series construction
Processing and analysis on batch time series of geo-detic monitoring network
Reference epoch transformation for grid time series
Low-pass filtering operation on grid time series
Statistical analysis on variation (vector) grid time series
Coordinate form transformation for variation vector grid time series
Removal and restoration of linear variations for grid time series
Processing and analysis on variation (vector) grid time series
Multi-form spatiotemporal interpolation from grid time serie
Interpolation of irregular variation time series from grid time series
Interpolation of given record time series from grid time series
Interpolation at the given location and time from grid time series
Construction of record time series by space-time interpolation
Reconstruction of grid time series according to given spatio-temporal resolution

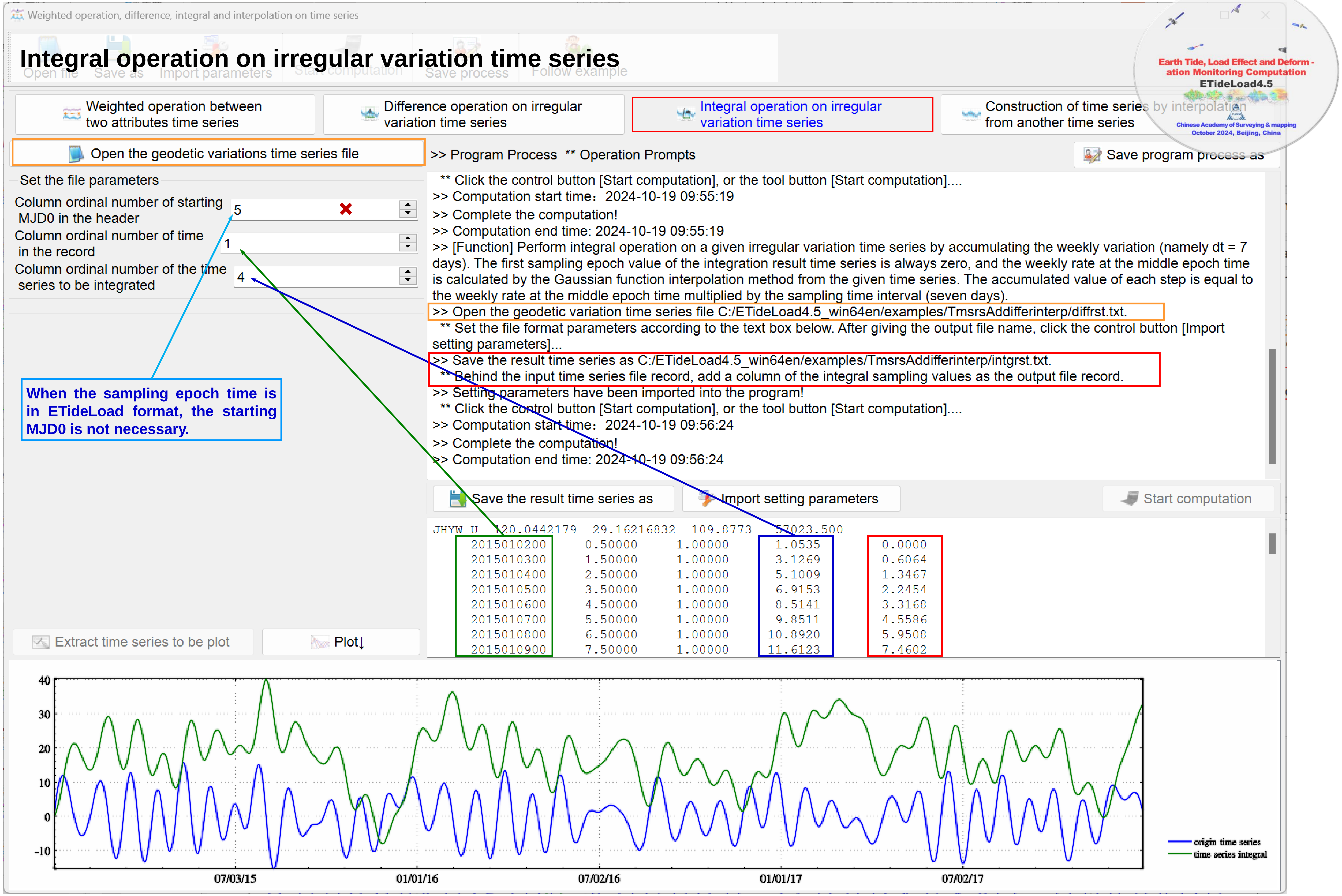

Low-pass filtering and signal reconstructing for irregular time series
Estimation of the low-pass parameters and linear term of irregular time series
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Estimation of low-pass parameters and linear term of irregular time series
Reconstruction of the low-pass signal at all sampling epochs of given time series
Reconstruction of low-pass time series according to given sampling specification
Open the geodetic variation time series file
Set the file parameters
Column ordinal number of starting MJD0 in the header
5
Column ordinal number of time in the record
1
Column ordinal numbe of the target time series
2
Number of parameters to be estimated
120
When the sampling epoch time is in ETideLoad format, the starting MJD0 is not necessary.
Save the estimated parameters as
Import setting parameters
Start computation
Extract time series to be plot
Plot↓
>> Program Process ** Operation Prompts
Save program process as
** Set the file format parameters according to the text box below. After giving the output file name, click the control button [Import setting parameters]...
>> Save the estimated parameters as C:/ETideLoad4.5_win64en/examples/Tmsrslowpfltrconstr/filterpara.txt.
** Behind the input time series file header, add the 5 attributes including the constant term, linear term (annual rate of variation, /a), number of the parameters, starting MJD0, and ending MJD as the parameters file header.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-19 09:11:47
>> Complete the computation!
>> Computation end time: 2024-10-19 09:11:48
>> The program automatically outputs the time series file C:/ETideLoad4.5_win64en/examples/Tmsrslowpfltrconstr/JHYW_U.rst. Behind the input time series file header, add two attributes including the constant term and linear term (annual rate of variation, /a) as the output file header. Behind the input time series file record, add 5 attributes including the low-pass filtering value, low-pass filtering value after removing the constant, low-pass filtering value after removing the constant and linear term, linear variation and residual value as the output file record.
Display of the input-output file↓
The program can separate the constant term, linear term and noise, and realize the short-time interpolation and bidirectional prediction of various irregular variation time series.
JHYW_U 120.0442179 29.16216832 109.8773 57023.500 30.4558 -1.1876 120 57023.500000 58118.5000
3.04557772E+01 -1.70958259E-01 -4.94692544E-02 1.76297867E+00 -1.21371769E+00 2.50853235E+00 -1.01150643E+
7.76860846E-01 3.64051475E+00 -8.32800408E-02 -3.33665232E+00 -1.15436587E+00 -9.40542865E-01 8.72661146E-
1.36994016E-01 -2.72653701E+00 1.06662756E+00 -3.22023082E-01 1.43349917E+00 -1.46104599E+00 -1.30719292E+
2.24165354E+00 -5.19007759E-01 3.33037757E-01 -3.47551984E-02 -3.36752337E-01 -6.13439192E-01 3.47826153E-
-1.45816096E+00 -2.94435766E-01 6.86943644E-01 5.08459231E-01 -1.12382748E+00 -8.08905142E-01 1.07234979E+
80
60
40
20
0
-20
07/03/15
01/01/16
07/02/16
01/01/17
07/02/17
low-pass filtering value
filtering without linear
linear variation
residual value

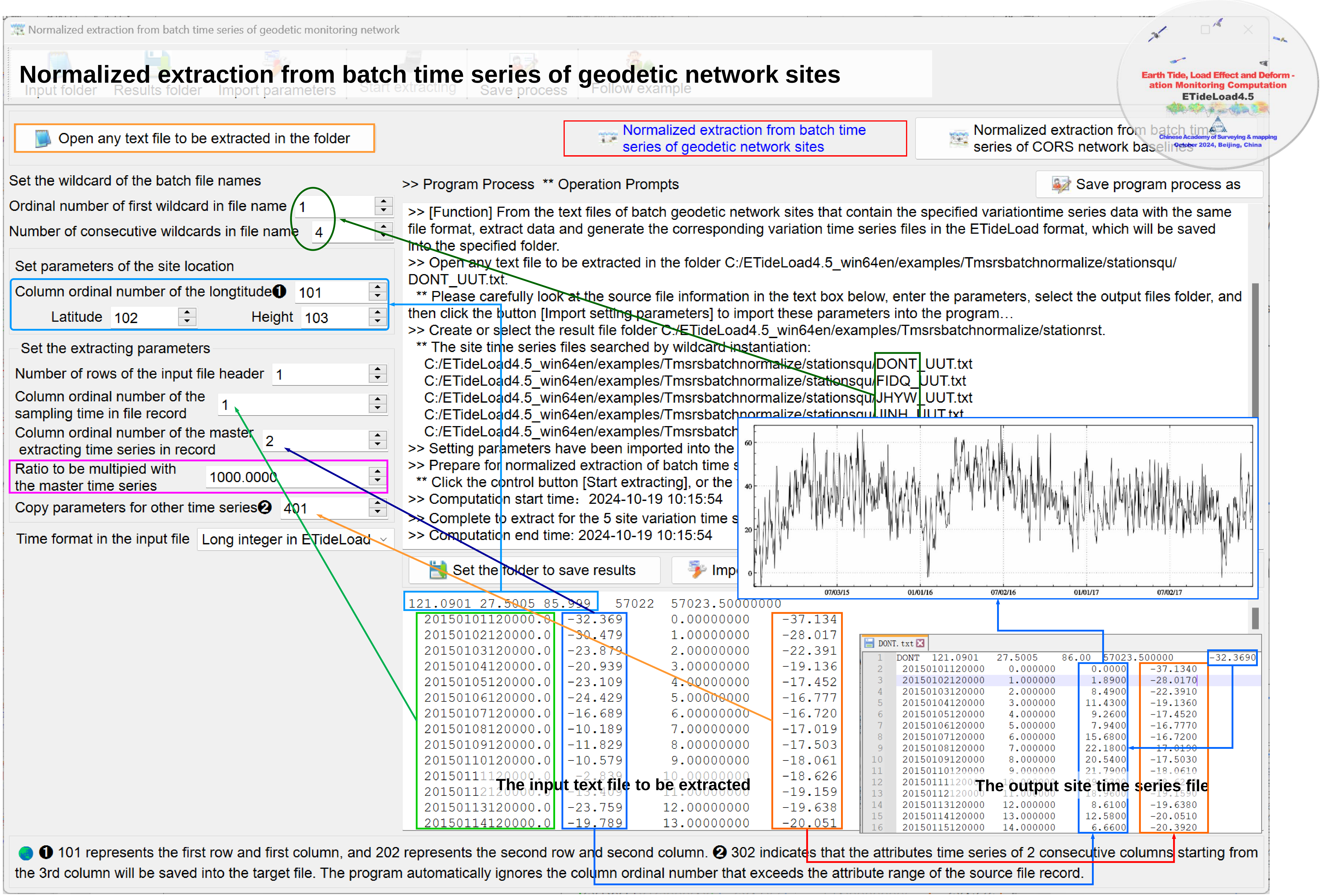

Low-pass filtering and signal reconstructing for irregular time series
Reconstruction of the low-pass signal at all sampling epochs of given time series
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Estimation of low-pass parameters and linear term of irregular time series
Reconstruction of the low-pass signal at all sampling epochs of given time series
Reconstruction of low-pass time series according to given sampling specification
Open the variation time series file to be reconstructed
Set the file parameters
Column ordinal number of starting MJD0 in the header
5
Column ordinal number of time in the record
1
Number of parameters for reconstruction
90
When the sampling epoch time is in ETideLoad format, the starting MJD0 is not necessary.
Save the result time series as
Import setting parameters
Start computation
Extract time series to be plot
Plot↓
>> Program Process ** Operation Prompts
Save program process as
>> [Function] According to the entered number of the low-pass parameters (here, the entered number should be no greater than the maximum number of the estimated low-pass parameters), reconstruct the low-pass variation time series with the sampling epochs corresponding to the given time series.
** The number of the low-pass parameters used for reconstruction should not exceed the estimated number of the low-pass parameters. Otherwise, the program automatically takes the estimated number as the number of the low-pass parameters.
>> Open the geodetic variation time series file C:/ETideLoad4.5_win64en/examples/Tmsrslowpfltrconstr/JHYW_U.txt.
** Set the file format parameters according to the text box below. After giving the output file name, click the control button [Import setting parameters]...
>> Save the result time series as C:/ETideLoad4.5_win64en/examples/Tmsrslowpfltrconstr/JHYWreconstr.txt.
** Behind the input time series file header, add two attributes including the constant term and linear term (annual rate of variation, /a) as the output file header. Behind the input time series file record, add 4 attributes including the low-pass filtering value, low-pass filtering value after removing the constant, low-pass filtering value after removing the constant and linear term, and linear variation as the output file record.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-19 09:14:24
Display of the input-output file↓
The program can separate the constant term, linear term and noise, and realize the short-time interpolation and bidirectional prediction of various irregular variation time series.
JHYW_U 120.0442179 29.16216832 109.8773 57023.500 30.4558 -1.1876
2015010112 0.03 0.0 14.49758 -15.9582 -15.9582 0.0000
2015010212 2.2 1.0 14.61587 -15.8399 -15.8367 -0.0033
2015010312 6.51 2.0 14.97413 -15.4816 -15.4751 -0.0065
2015010412 9.96 3.0 15.56313 -14.8926 -14.8829 -0.0098
2015010512 12.85 4.0 16.36779 -14.0880 -14.0750 -0.0130
2015010612 12.55 5.0 17.36768 -13.0881 -13.0718 -0.0163
40
20
0
-20
07/03/15
01/01/16
07/02/16
01/01/17
07/02/17
low-pass filtering value
filtering without linear
linear variation

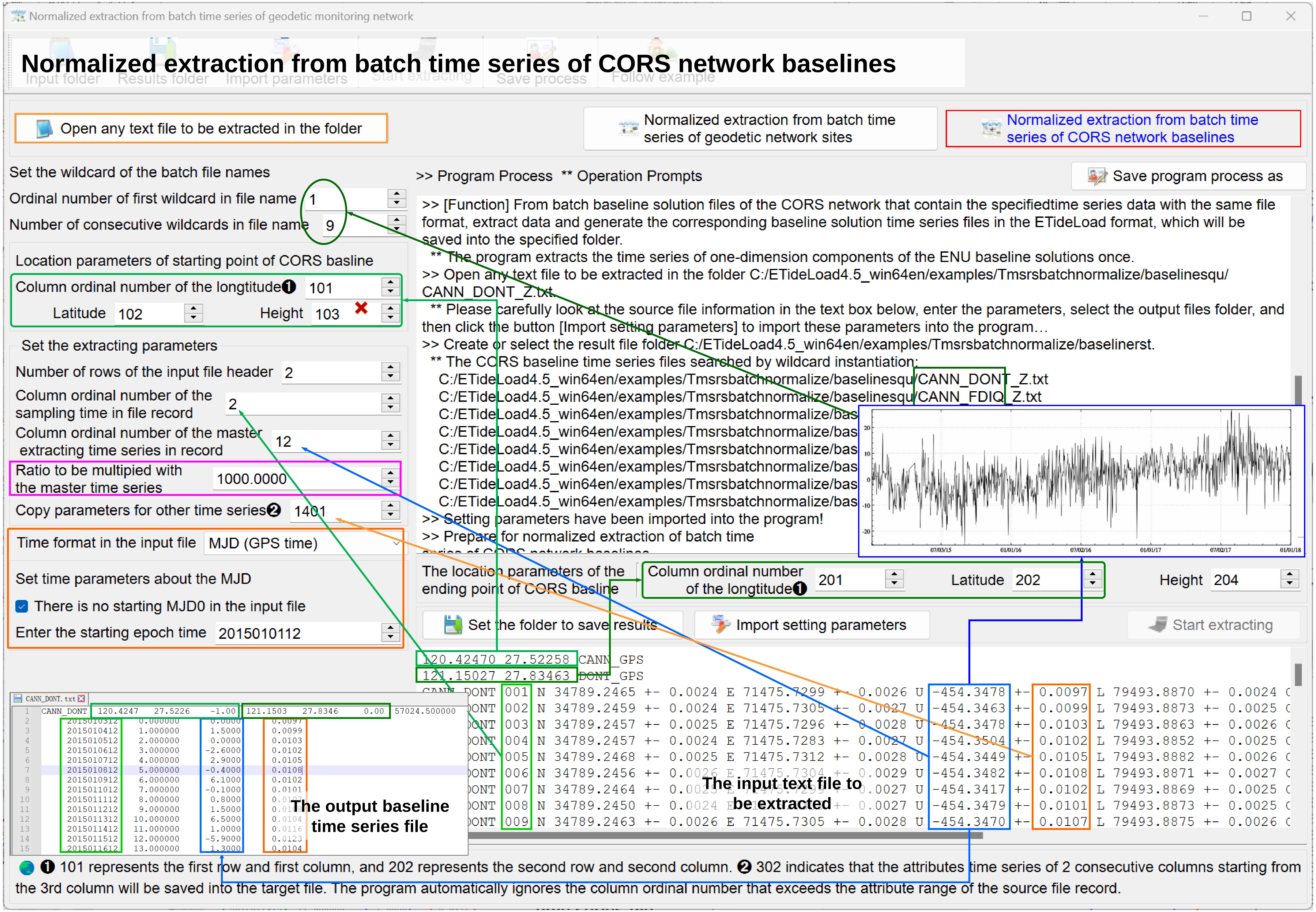
Difference operation on irregular variation time series

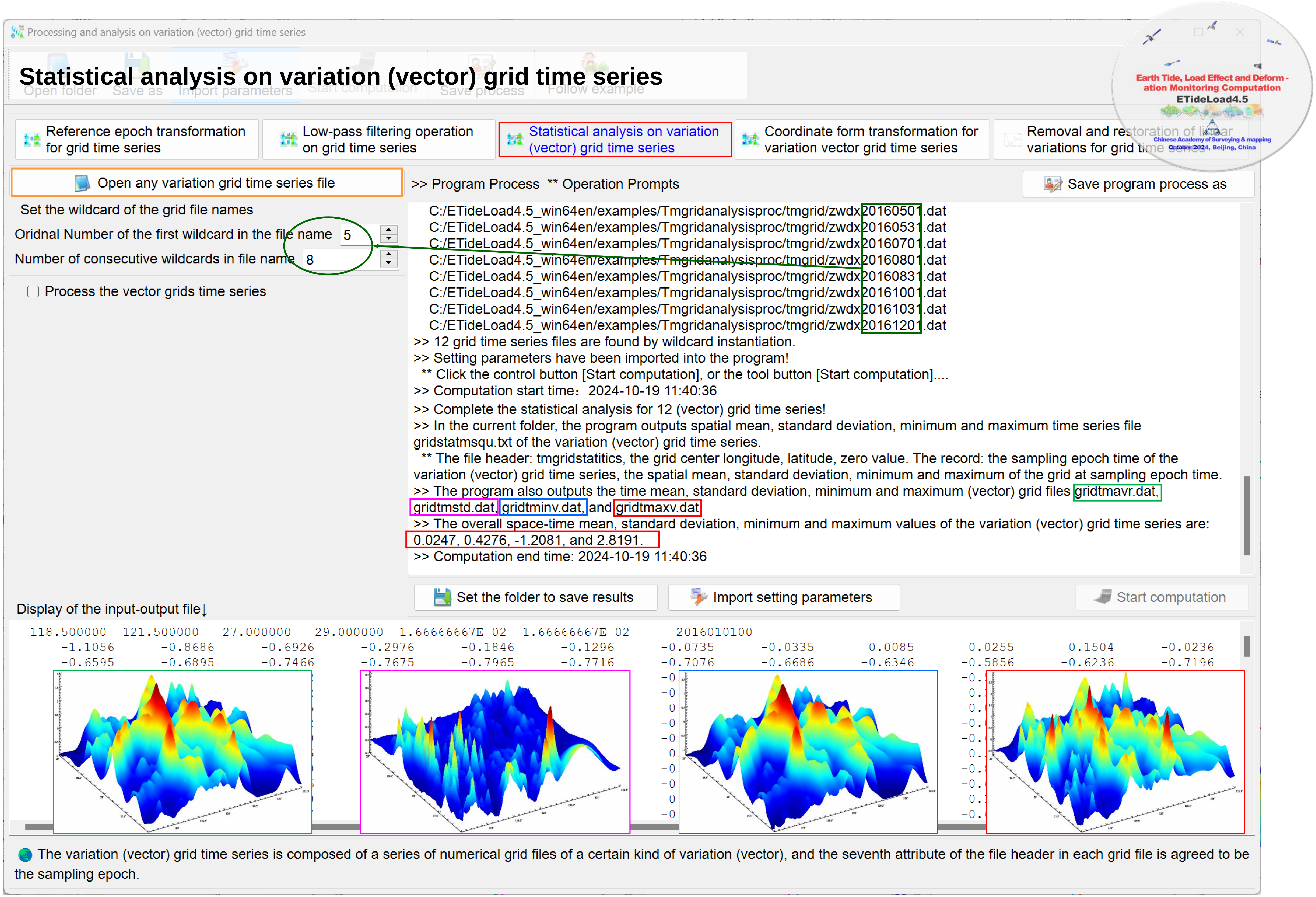


Integral operation on irregular variation time series



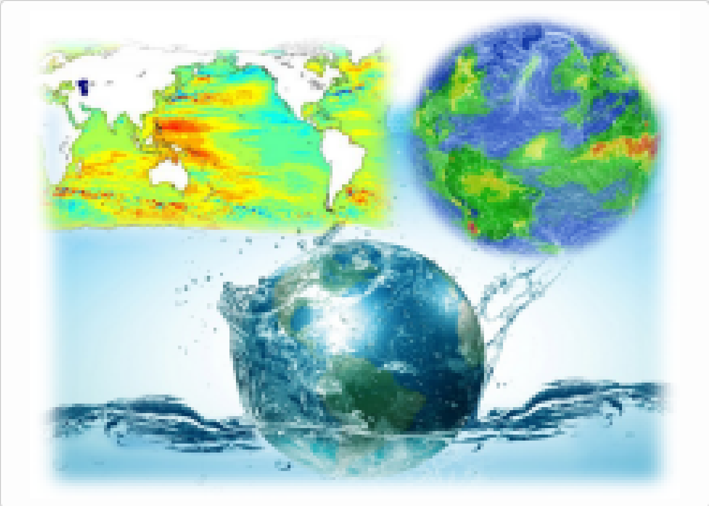

Normalized extraction from batch time series of geodetic monitoring network
Normalized extraction from batch time series of geodetic network sites
Input folder
Results folder
Import parameters
Start extracting
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Open any text file to be extracted in the folder
Normalized extraction from batch time series of geodetic network sites
Normalized extraction from batch time series of CORS network baselines
Set the wildcard of the batch file names
Ordinal number of first wildcard in file name 1
Number of consecutive wildcards in file name 4
Set parameters of the site location
Column ordinal number of the longtitude❶ 101
Latitude 102
Height 103
Set the extracting parameters
Number of rows of the input file header 1
Column ordinal number of the sampling time in file record 1
Column ordinal number of the master extracting time series in record 2
Ratio to be multiplied with the master time series 1000.0000
Copy parameters for other time series❷ 401
Time format in the input file Long integer in ETideLoad
>> Program Process ** Operation Prompts
Save program process as
>> [Function] From the text files of batch geodetic network sites that contain the specified variationtime series data with the same file format, extract data and generate the corresponding variation time series files in the ETideLoad format, which will be saved into the specified folder.
>> Open any text file to be extracted in the folder C:/ETideLoad4.5_win64en/examples/Tmsrsbatchnormalize/stationsqu/DONT_UUT.txt.
** Please carefully look at the source file information in the text box below, enter the parameters, select the output files folder, and then click the button [Import setting parameters] to import these parameters into the program…
>> Create or select the result file folder C:/ETideLoad4.5_win64en/examples/Tmsrsbatchnormalize/stationrst.
** The site time series files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/Tmsrsbatchnormalize/stationsqu/DONT_UUT.txt
C:/ETideLoad4.5_win64en/examples/Tmsrsbatchnormalize/stationsqu/FIDQ_UUT.txt
C:/ETideLoad4.5_win64en/examples/Tmsrsbatchnormalize/stationsqu/JHYW_UUT.txt
>> Setting parameters have been imported into the
>> Prepare for normalized extraction of batch time
** Click the control button [Start extracting], or the
>> Computation start time: 2024-10-19 10:15:54
>> Complete to extract for the 5 site variation time
>> Computation end time: 2024-10-19 10:15:54
Set the folder to save results
121.0901 27.5005 85.999 57022 57023.50000000
20150101120000.0 -32.369 0.00000000 -37.134
20150102120000.0 -30.479 1.00000000 -28.017
20150103120000.0 -23.879 2.00000000 -22.391
20150104120000.0 -20.939 3.00000000 -19.136
20150105120000.0 -23.109 4.00000000 -17.452
20150106120000.0 -24.429 5.00000000 -16.777
20150107120000.0 -16.689 6.00000000 -16.720
20150108120000.0 -10.189 7.00000000 -17.019
20150109120000.0 -11.829 8.00000000 -17.503
20150110120000.0 -10.579 9.00000000 -18.061
20150113120000.0 -23.759 12.00000000 -19.638
20150114120000.0 -19.789 13.00000000 -20.051
The input text file to be extracted
DONT.txt
DONT 121.0901 27.5005 86.00 57023.500000 -32.3690
20150101120000 0.000000 0.0000 -37.1340
20150102120000 1.000000 1.8900 -28.0170
20150103120000 2.000000 8.4900 -22.3910
20150104120000 3.000000 11.4300 -19.1360
20150105120000 4.000000 9.2600 -17.4520
20150106120000 5.000000 7.9400 -16.7770
20150107120000 6.000000 15.6800 -16.7200
20150108120000 7.000000 22.1800 -17.0190
20150109120000 8.000000 20.5400 -17.5030
20150113120000 12.000000 8.6100 -19.6380
20150114120000 13.000000 12.5800 -20.0510
20150115120000 14.000000 6.6600 -20.3920
The output site time series file
60
40
20
0
07/03/15
01/01/16
07/02/16
01/01/17
07/02/17
❶ 101 represents the first row and first column, and 202 represents the second row and second column. ❷ 302 indicates that the attributes time series of 2 consecutive columns starting from the 3rd column will be saved into the target file. The program automatically ignores the column ordinal number that exceeds the attribute range of the source file record.


Normalized extraction from batch time series of geodetic monitoring network
Normalized extraction from batch time series of CORS network baselines
Input folder
Results folder
Import parameters
Start extracting
Save process
Follow example
Open any text file to be extracted in the folder
Normalized extraction from batch time series of geodetic network sites
Normalized extraction from batch time series of CORS network baselines
Set the wildcard of the batch file names
Ordinal number of first wildcard in file name 1
Number of consecutive wildcards in file name 9
Location parameters of starting point of CORS basline
Column ordinal number of the longtitude❶ 101
Latitude 102
Height 103
Set the extracting parameters
Number of rows of the input file header 2
Column ordinal number of the sampling time in file record 2
Column ordinal number of the master extracting time series in record 12
Ratio to be multipied with the master time series 1000.0000
Copy parameters for other time series❷ 1401
Time format in the input file MJD (GPS time)
Set time parameters about the MJD
There is no starting MJD0 in the input file
Enter the starting epoch time 2015010112
>> Program Process ** Operation Prompts
Save program process as
>> [Function] From batch baseline solution files of the CORS network that contain the specifiedtime series data with the same file format, extract data and generate the corresponding baseline solution time series files in the ETideLoad format, which will be saved into the specified folder.
** The program extracts the time series of one-dimension components of the ENU baseline solutions once.
>> Open any text file to be extracted in the folder C:/ETideLoad4.5_win64en/examples/Tmsrsbatchnormalize/baselinesqu/CANN_DONT_Z.txt.
** Please carefully look at the source file information in the text box below, enter the parameters, select the output files folder, and then click the button [Import setting parameters] to import these parameters into the program…
>> Create or select the result file folder C:/ETideLoad4.5_win64en/examples/Tmsrsbatchnormalize/baselinerst.
** The CORS baseline time series files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/Tmsrsbatchnormalize/baselinesqu/CANN_DONT_Z.txt
C:/ETideLoad4.5_win64en/examples/Tmsrsbatchnormalize/baselinesqu/CANN_FDIQ_Z.txt
>> Setting parameters have been imported into the program!
>> Prepare for normalized extraction of batch time
The location parameters of the ending point of CORS basline
Column ordinal number of the longtitude❶ 201
Latitude 202
Height 204
Set the folder to save results
Import setting parameters
Start extracting
120.42470 27.52258 CANN_GPS
121.15027 27.83463 DONT_GPS
CANN_DONT 001 N 34789.2465 +- 0.0024 E 71475.7299 +- 0.0026 U -454.3478 +- 0.0097 L 79493.8870 +- 0.0024
002 N 34789.2459 +- 0.0024 E 71475.7305 +- 0.0027 U -454.3463 +- 0.0099 L 79493.8873 +- 0.0025
003 N 34789.2457 +- 0.0025 E 71475.7296 +- 0.0028 U -454.3478 +- 0.0103 L 79493.8863 +- 0.0026
004 N 34789.2457 +- 0.0024 E 71475.7283 +- 0.0027 U -454.3504 +- 0.0102 L 79493.8852 +- 0.0025
005 N 34789.2468 +- 0.0025 E 71475.7312 +- 0.0028 U -454.3449 +- 0.0105 L 79493.8882 +- 0.0026
006 N 34789.2456 +- 0.0026 E 71475.7304 +- 0.0029 U -454.3482 +- 0.0108 L 79493.8871 +- 0.0027
007 N 34789.2464 +- 0.0025 E 71475.7299 +- 0.0027 U -454.3417 +- 0.0102 L 79493.8869 +- 0.0025
008 N 34789.2450 +- 0.0024 E 71475.7299 +- 0.0027 U -454.3479 +- 0.0101 L 79493.8873 +- 0.0025
009 N 34789.2463 +- 0.0026 E 71475.7305 +- 0.0028 U -454.3470 +- 0.0107 L 79493.8875 +- 0.0026
The input text file to be extracted
CANN_DONT.txt
CANN_DONT 120.4247 27.5226 -1.00 121.1503 27.8346 0.00 57024.500000
2015010412 1.000000 1.5000 0.0099
2015010512 2.000000 0.0000 0.0103
2015010612 3.000000 -2.6000 0.0102
2015010712 4.000000 2.9000 0.0105
2015010812 5.000000 -0.4000 0.0108
2015010912 6.000000 1.1000 0.0102
2015011012 7.000000 -0.1000 0.0101
2015011112 8.000000 0.8000
2015011212 9.000000 1.5000
2015011312 10.000000 6.5000 0.0104
2015011412 11.000000 1.0000 0.0116
2015011512 12.000000 -5.9000 0.0123
2015011612 13.000000 1.3000 0.0104
The output baseline time series file
❶ 101 represents the first row and first column, and 202 represents the second row and second column. ❷ 302 indicates that the attributes time series of 2 consecutive columns starting from the 3rd column will be saved into the target file. The program automatically ignores the column ordinal number that exceeds the attribute range of the source file record.



Processing and analysis on variation (vector) grid time series
Statistical analysis on variation (vector) grid time series
Open folder
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Reference epoch transformation for grid time series
Low-pass filtering operation on grid time series
Statistical analysis on variation (vector) grid time series
Coordinate form transformation for variation vector grid time series
Removal and restoration of linear variations for grid time series
Open any variation grid time series file
Set the wildcard of the grid file names
Oridnal Number of the first wildcard in the file name 5
Number of consecutive wildcards in file name 8
Process the vector grids time series
>> Program Process ** Operation Prompts
Save program process as
C:/ETideLoad4.5_win64en/examples/Tmgridanalysisproc/tmgrid/zwdx20160501.dat
C:/ETideLoad4.5_win64en/examples/Tmgridanalysisproc/tmgrid/zwdx20160531.dat
C:/ETideLoad4.5_win64en/examples/Tmgridanalysisproc/tmgrid/zwdx20160701.dat
C:/ETideLoad4.5_win64en/examples/Tmgridanalysisproc/tmgrid/zwdx20160801.dat
C:/ETideLoad4.5_win64en/examples/Tmgridanalysisproc/tmgrid/zwdx20160831.dat
C:/ETideLoad4.5_win64en/examples/Tmgridanalysisproc/tmgrid/zwdx20161001.dat
C:/ETideLoad4.5_win64en/examples/Tmgridanalysisproc/tmgrid/zwdx20161031.dat
C:/ETideLoad4.5_win64en/examples/Tmgridanalysisproc/tmgrid/zwdx20161201.dat
>> 12 grid time series files are found by wildcard instantiation.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-19 11:40:36
>> Complete the statistical analysis for 12 (vector) grid time series!
>> In the current folder, the program outputs spatial mean, standard deviation, minimum and maximum time series file gridstatmsqu.txt of the variation (vector) grid time series.
** The file header: tmgridstatitics, the grid center longitude, latitude, zero value. The record: the sampling epoch time of the variation (vector) grid time series, the spatial mean, standard deviation, minimum and maximum of the grid at sampling epoch time.
>> The program also outputs the time mean, standard deviation, minimum and maximum (vector) grid files gridtmavr.dat, gridtmstd.dat, gridtminv.dat, and gridtmaxv.dat
>> The overall space-time mean, standard deviation, minimum and maximum values of the variation (vector) grid time series are: 0.0247, 0.4276, -1.2081, and 2.8191.
>> Computation end time: 2024-10-19 11:40:36
Set the folder to save results
Import setting parameters
Start computation
Display of the input-output file↓
118.500000 121.500000 27.000000 29.000000 1.66666667E-02 1.66666667E-02 2016010100
-1.1056 -0.8686 -0.6926 -0.2976 -0.1846 -0.1296 -0.0735 -0.0335 0.0085 0.0255 0.1504 -0.0236
-0.6595 -0.6895 -0.7466 -0.7675 -0.7965 -0.7716 -0.7076 -0.6686 -0.6346 -0.5856 -0.6236 -0.7196
The variation (vector) grid time series is composed of a series of numerical grid files of a certain kind of variation (vector), and the seventh attribute of the file header in each grid file is agreed to be the sampling epoch.

Load deformation field approach and monitoring from heterogeneous variations

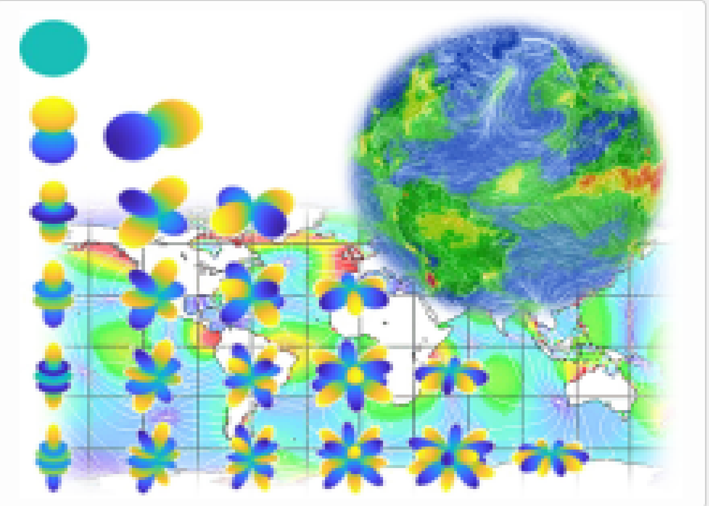


Spherical harmonic analysis on global surface load time series

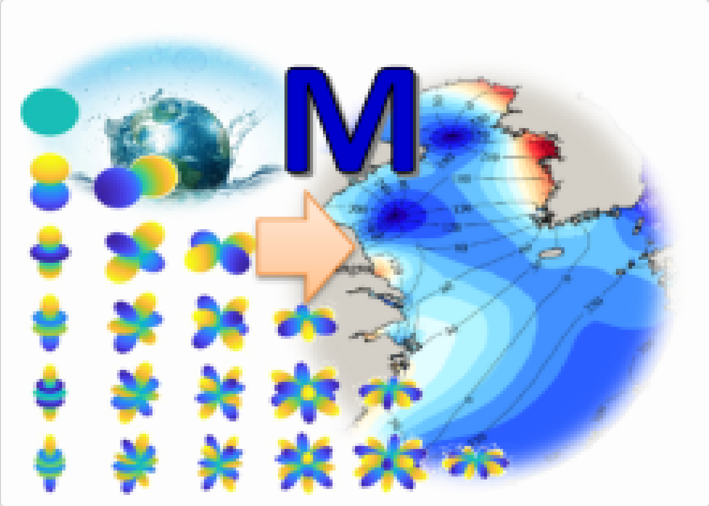
Load deformation field approach and monitoring from heterogeneous variations

The non-tidal load variations of atmosphere, sea level, soil water, groundwater, lakes and glaciers in the Earth's surface layer lead to geopotential variation, while can excite solid Earth deformation and then cause all-element geodetic variations with time, while these variations can also be captured by various geodetic technologies.

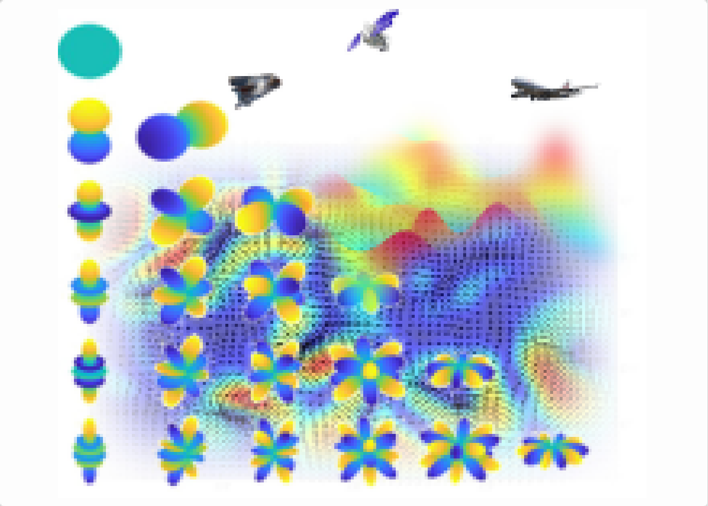
Functional architecture of the subsystem



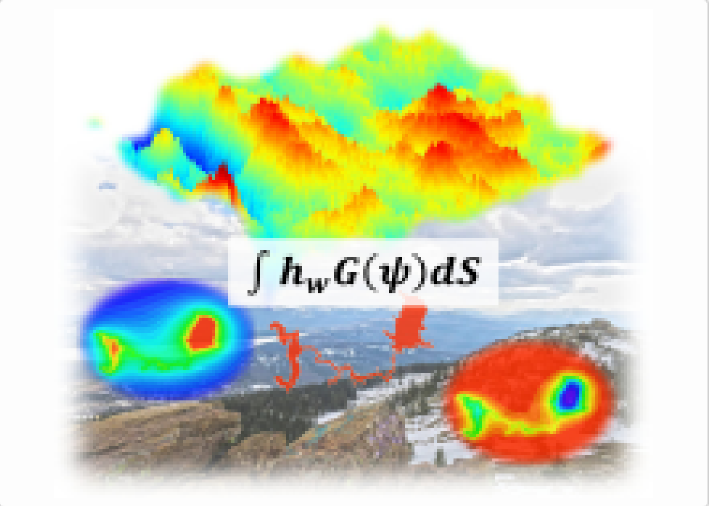
Spherical analysis on tide constants and construction of tidal load model



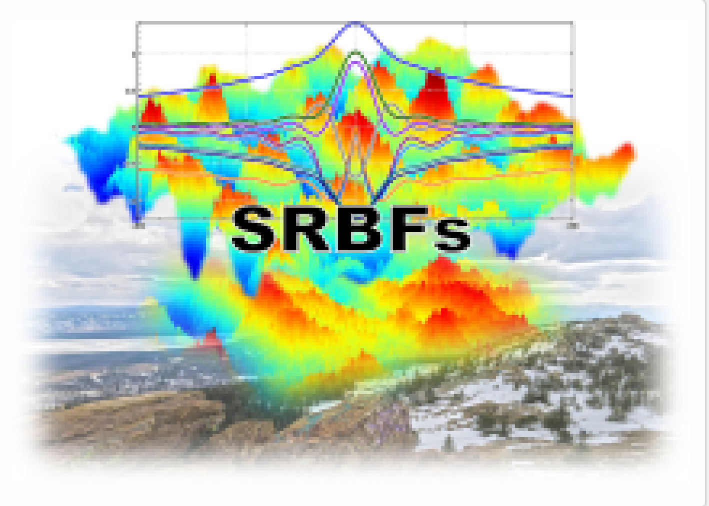
Computation of the load model value by spherical harmonic synthesis



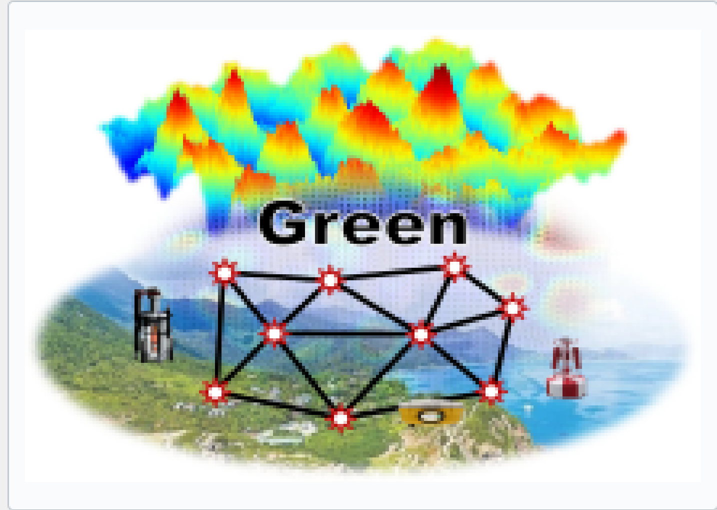
Computation of load deformation field by spherical harmonic synthesis



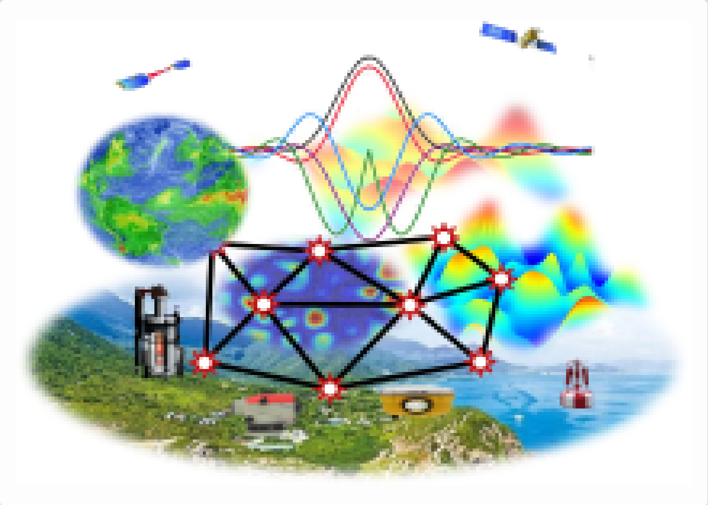
Regional refinement of load deformation field by Green's Integral



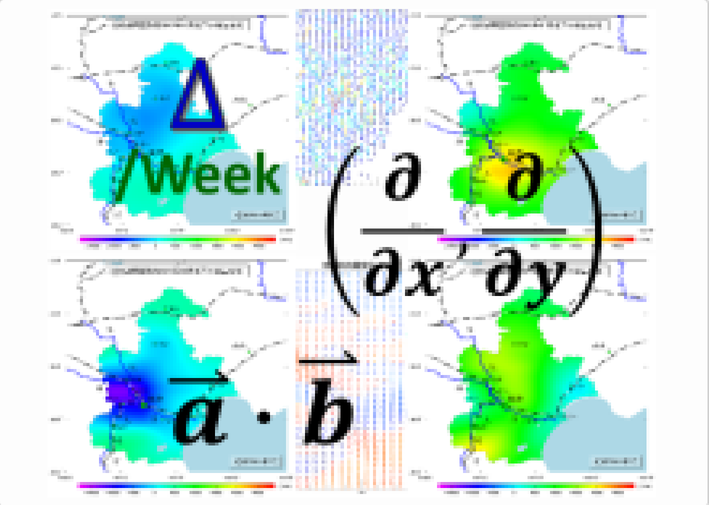
Regional approach of load deformation field using SRBFs



Load deformation field monitoring from heterogeneous variations with Green's integral constraints



Load deformation field monitoring from heterogeneous variations using spherical radial basis functions

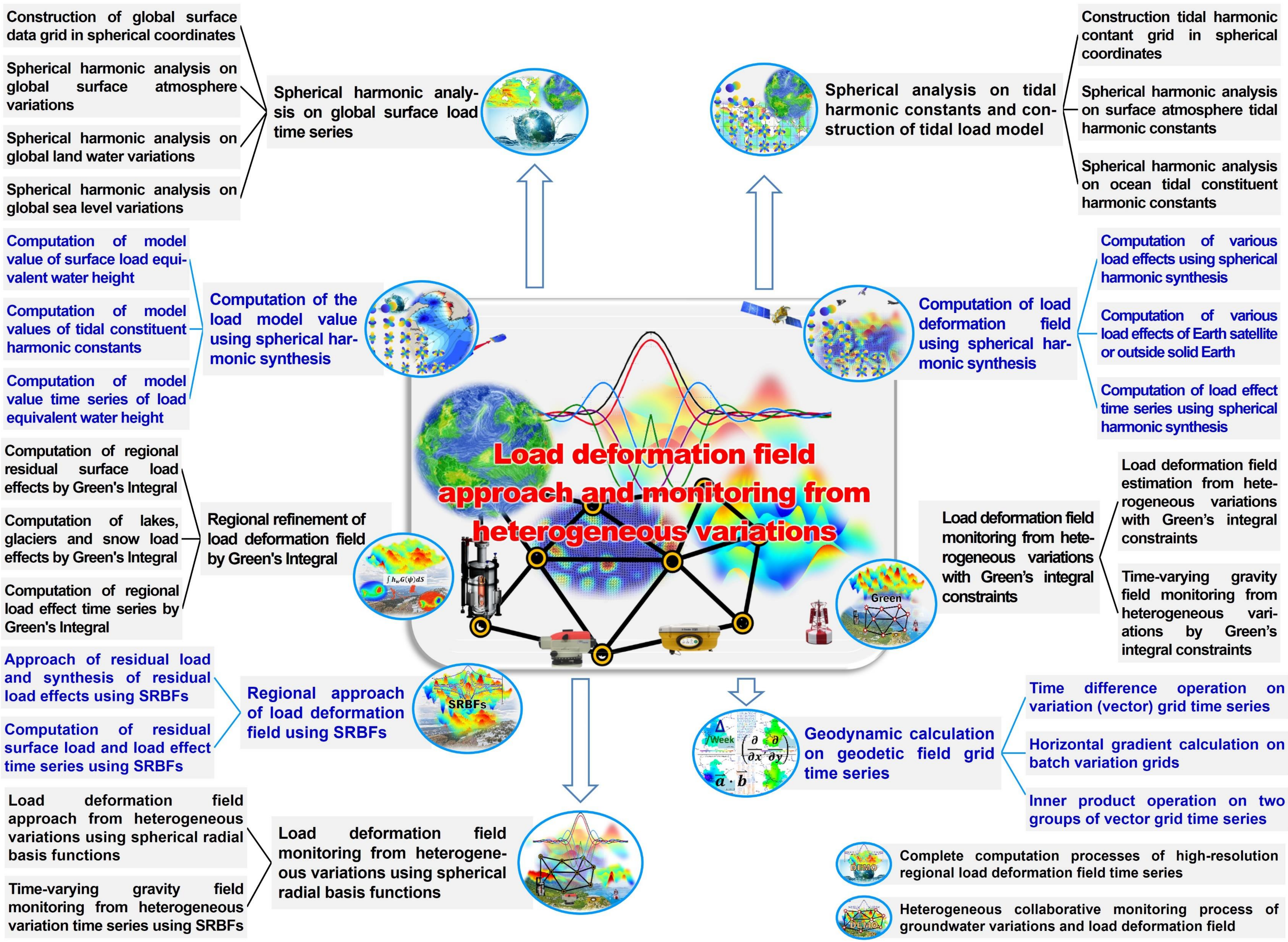


Geodynamic calculation on geodetic field grid time series

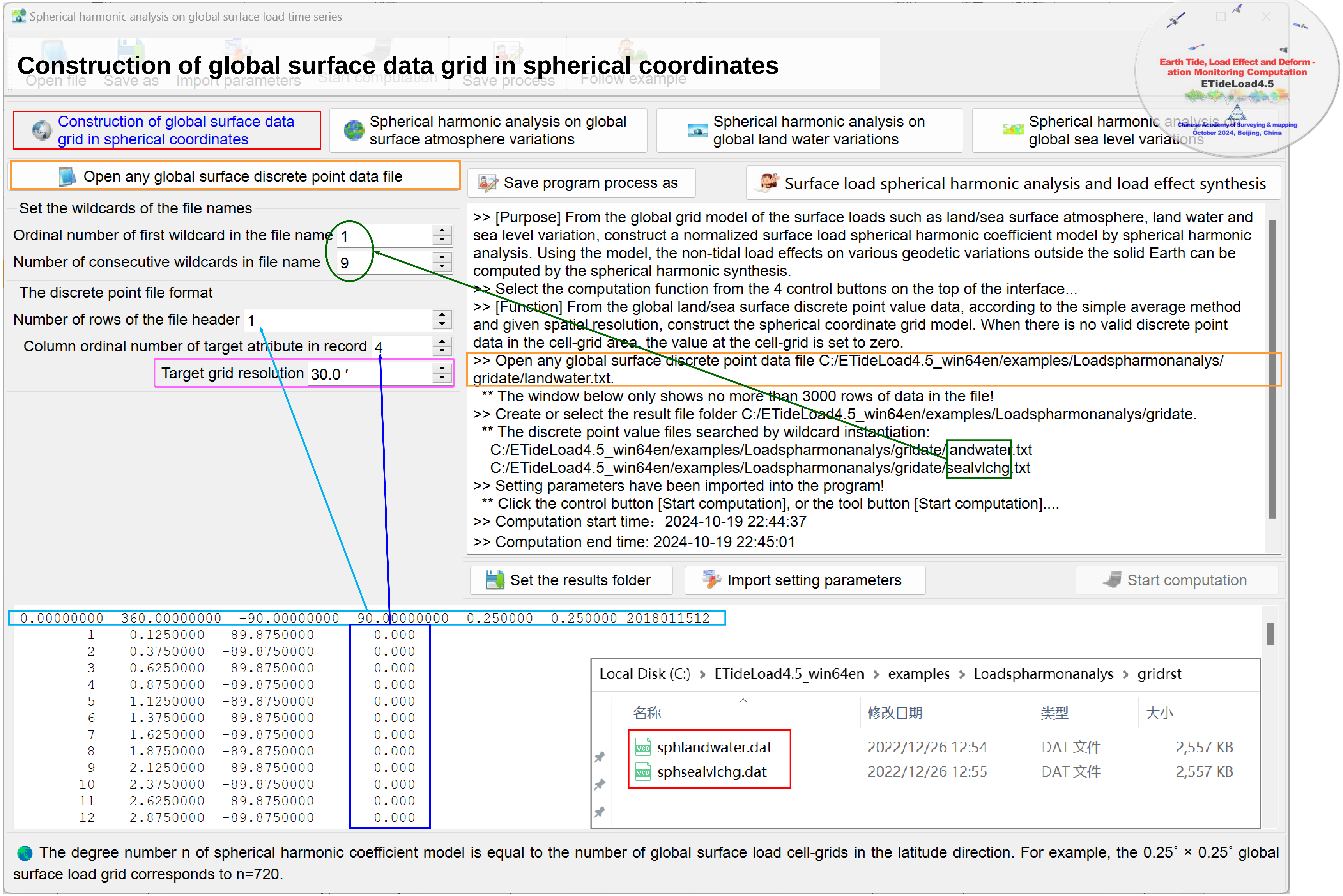
Complete computation processes of high-resolution regional load deformation field time series

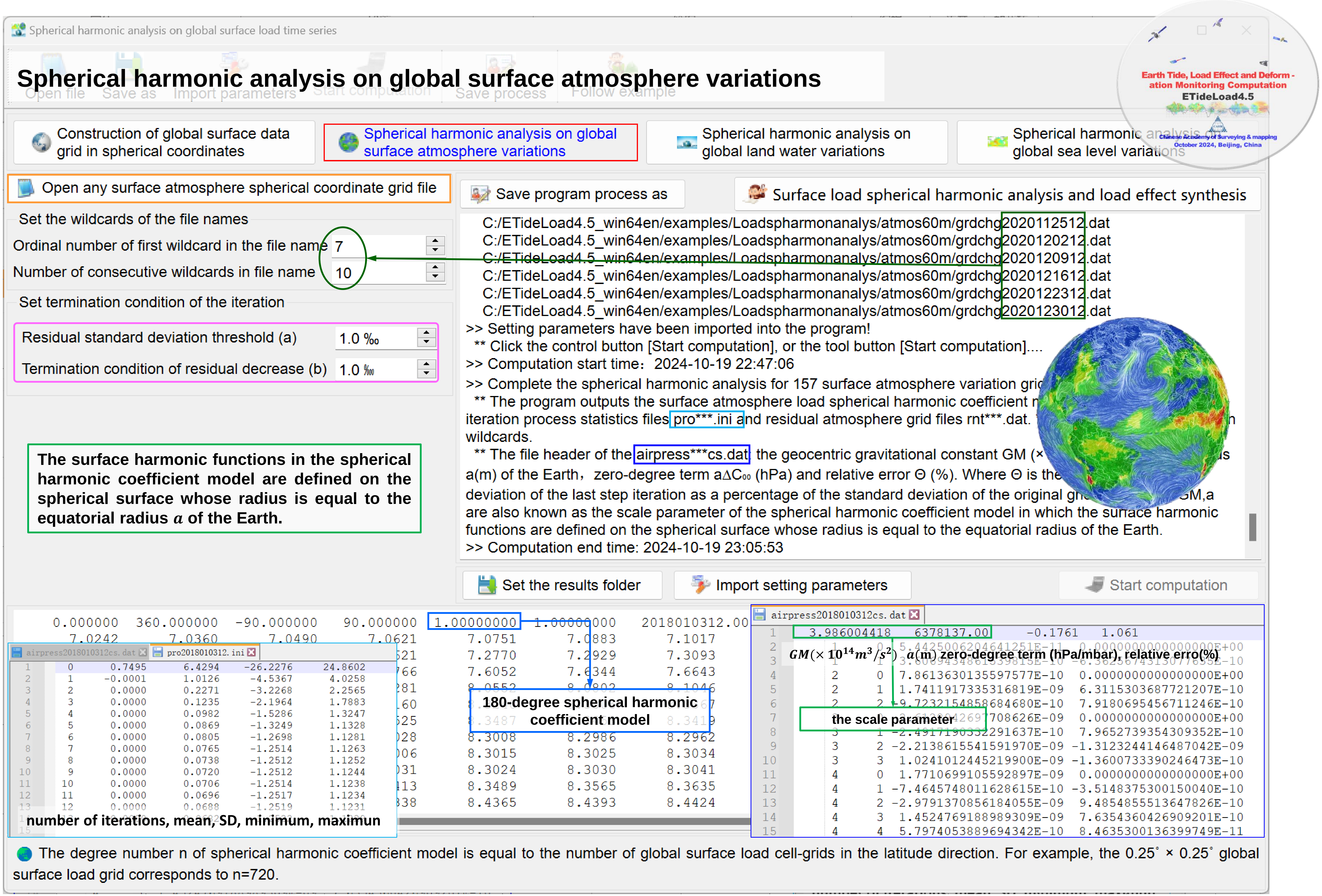
Collaborative monitoring process of groundwater variations and load deformation field

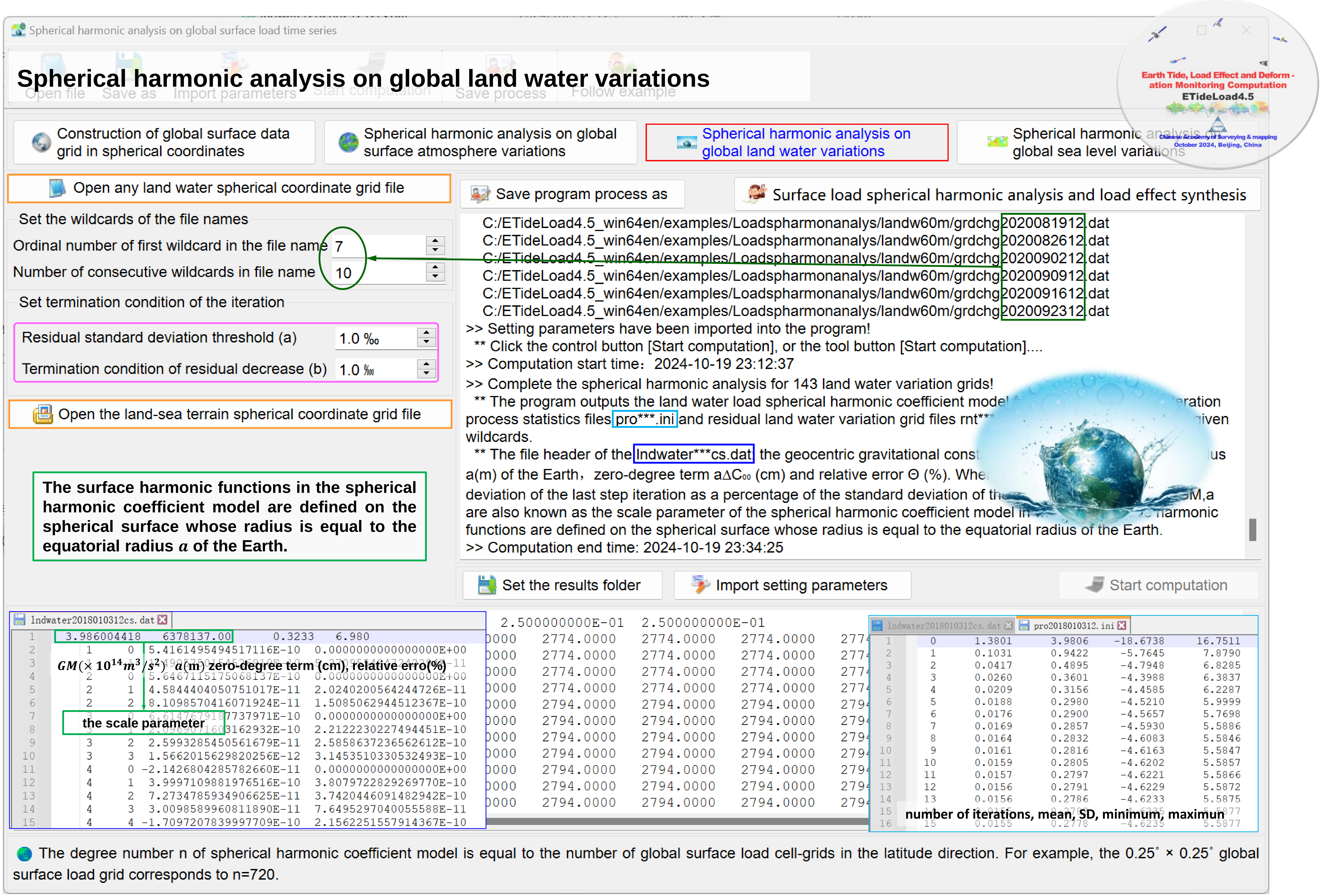
Surface load and load deformation field monitoring computation processes

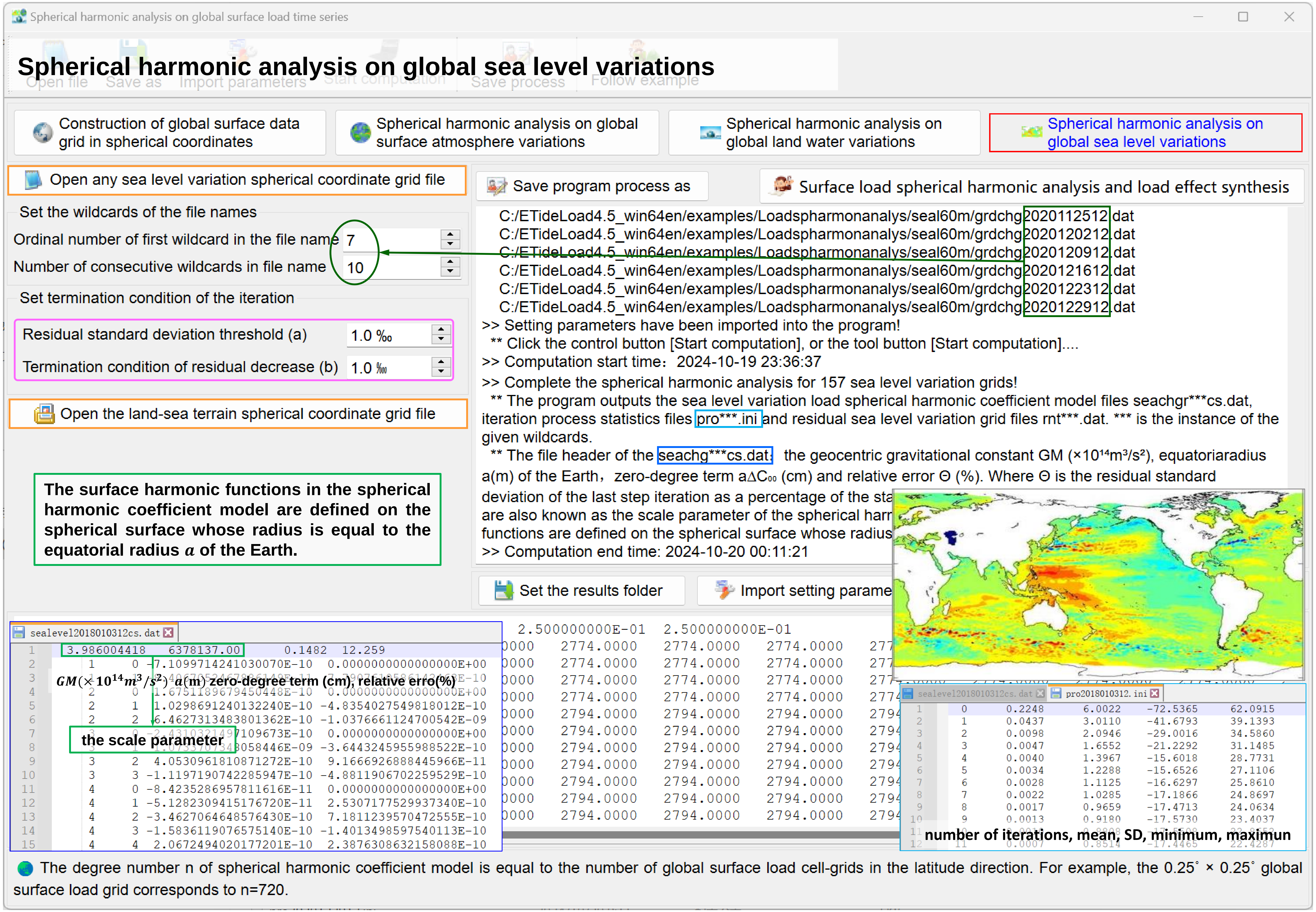

Construction of global surface data grid in spherical coordinates
Spherical harmonic analysis on global surface atmosphere variations
Spherical harmonic analysis on global land water variations
Spherical harmonic analysis on global sea level variations
Spherical harmonic analysis on global surface load time series
Spherical analysis on tidal harmonic constants and construction of tidal load model
Construction tidal harmonic contant grid in spherical coordinates
Spherical harmonic analysis on surface atmosphere tidal harmonic constants
Spherical harmonic analysis on ocean tidal constituent harmonic constants
Computation of model value of surface load equivalent water height
Computation of model values of tidal constituent harmonic constants
Computation of model value time series of load equivalent water height
Computation of the load model value using spherical harmonic synthesis
Computation of load deformation field using spherical harmonic synthesis
Computation of various load effects using spherical harmonic synthesis
Computation of various load effects of Earth satellite or outside solid Earth
Computation of load effect time series using spherical harmonic synthesis
Load deformation field approach and monitoring from heterogeneous variations
Computation of regional residual surface load effects by Green's Integral
Computation of lakes, glaciers and snow load effects by Green's Integral
Computation of regional load effect time series by Green's Integral
Regional refinement of load deformation field by Green's Integral
Load deformation field monitoring from heterogeneous variations with Green's integral constraints
Green
Load deformation field estimation from heterogeneous variations with Green's integral constraints
Time-varying gravity field monitoring from heterogeneous variations by Green's integral constraints
Approach of residual load and synthesis of residual load effects using SRBFs
Computation of residual surface load and load effect time series using SRBFs
Regional approach of load deformation field using SRBFs
SRBFs
Geodynamic calculation on geodetic field grid time series
Week
Time difference operation on variation (vector) grid time series
Horizontal gradient calculation on batch variation grids
Inner product operation on two groups of vector grid time series
Load deformation field approach from heterogeneous variations using spherical radial basis functions
Time-varying gravity field monitoring from heterogeneous variation time series using SRBFs
Load deformation field monitoring from heterogeneous variations using spherical radial basis functions
Complete computation processes of high-resolution regional load deformation field time series
Heterogeneous collaborative monitoring process of groundwater variations and load deformation field

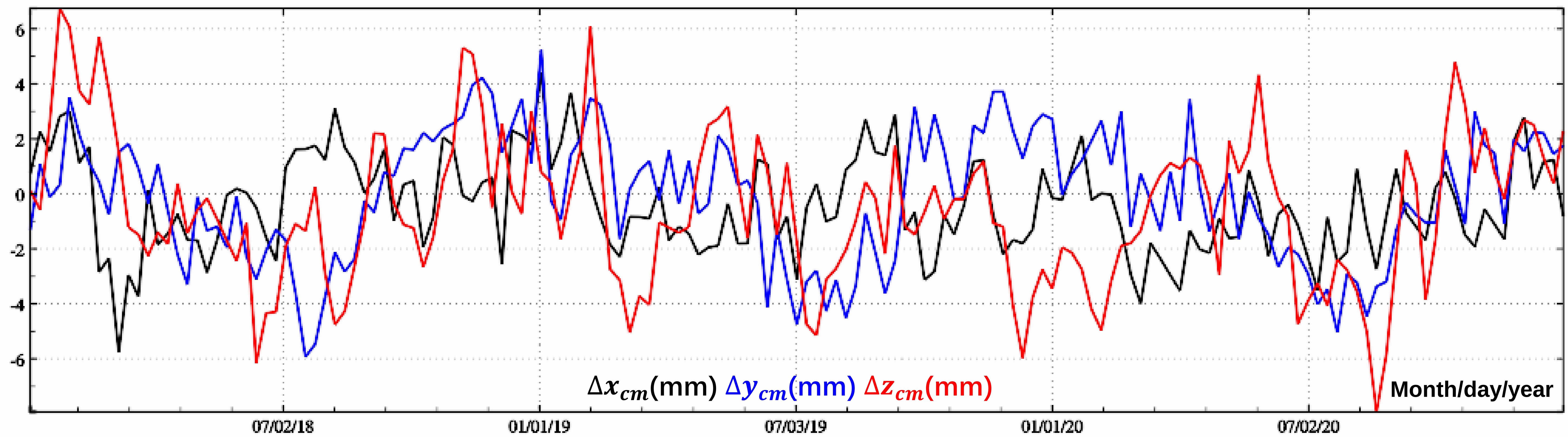
Construction of global surface data grid in spherical coordinates




Spherical harmonic analysis on global surface load time series
Spherical harmonic analysis on global surface atmosphere variations
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Construction of global surface data grid in spherical coordinates
Spherical harmonic analysis on global surface atmosphere variations
Spherical harmonic analysis on global land water variations
Spherical harmonic analysis on global sea level variations
Open any surface atmosphere spherical coordinate grid file
Save program process as
Surface load spherical harmonic analysis and load effect synthesis
Set the wildcards of the file names
Ordinal number of first wildcard in the file name 7
Number of consecutive wildcards in file name 10
Set termination condition of the iteration
Residual standard deviation threshold (a) 1.0 ‰
Termination condition of residual decrease (b) 1.0 ‰
The surface harmonic functions in the spherical harmonic coefficient model are defined on the spherical surface whose radius is equal to the equatorial radius a of the Earth.
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/atmos60m/grdchg2020112512.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/atmos60m/grdchg2020120212.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/atmos60m/grdchg2020120912.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/atmos60m/grdchg2020121612.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/atmos60m/grdchg2020122312.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/atmos60m/grdchg2020123012.dat
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-19 22:47:06
>> Complete the spherical harmonic analysis for 157 surface atmosphere variation gric
** The program outputs the surface atmosphere load spherical harmonic coefficient
iteration process statistics files pro***.ini and residual atmosphere grid files rnt***.dat.
wildcards.
** The file header of the airpress***cs.dat the geocentric gravitational constant GM (×
a(m) of the Earth, zero-degree term aΔC₀₀ (hPa) and relative error Θ (%). Where Θ is the
deviation of the last step iteration as a percentage of the standard deviation of the original gr
are also known as the scale parameter of the spherical harmonic coefficient model in which the surface harmonic functions are defined on the spherical surface whose radius is equal to the equatorial radius of the Earth.
>> Computation end time: 2024-10-19 23:05:53
Set the results folder
Import setting parameters
Start computation
airpress2018010312cs.dat
pro2018010312.ini
number of iterations, mean, SD, minimum, maximun
180-degree spherical harmonic coefficient model
3.986004418 6378137.00 -0.1761 1.061
GM(×10^14 m^3/s^2) a(m) zero-degree term (hPa/mbar), relative erro(%)
the scale parameter
The degree number n of spherical harmonic coefficient model is equal to the number of global surface load cell-grids in the latitude direction. For example, the 0.25° × 0.25° global surface load grid corresponds to n=720.

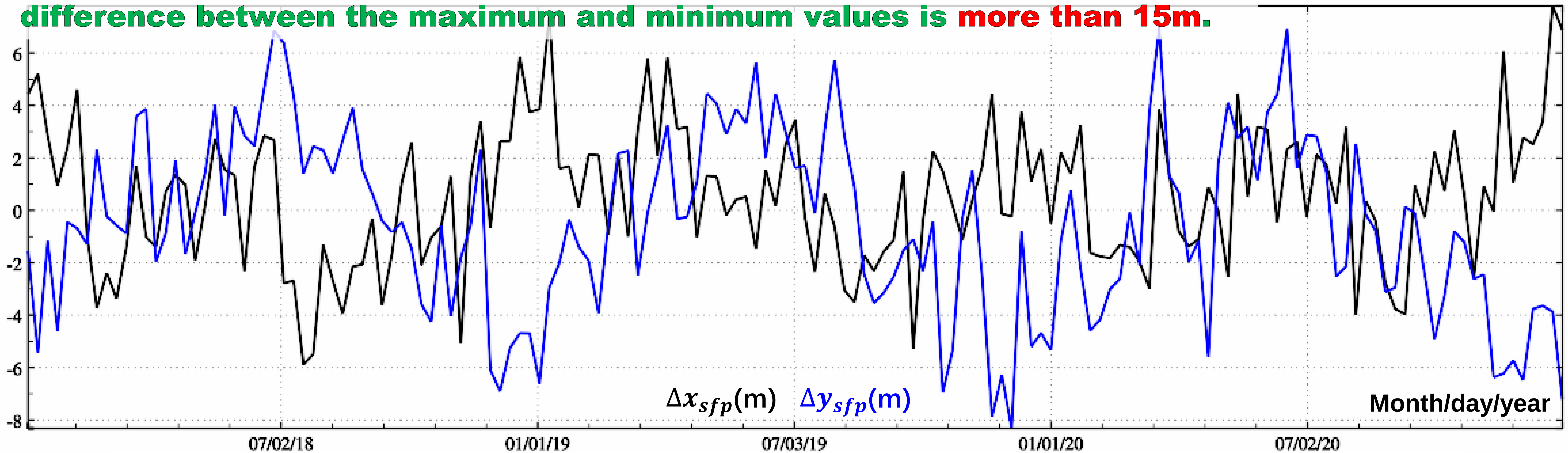

Spherical harmonic analysis on global surface load time series
Spherical harmonic analysis on global land water variations
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Construction of global surface data grid in spherical coordinates
Spherical harmonic analysis on global surface atmosphere variations
Spherical harmonic analysis on global land water variations
Spherical harmonic analysis on global sea level variations
Open any land water spherical coordinate grid file
Save program process as
Surface load spherical harmonic analysis and load effect synthesis
Set the wildcards of the file names
Ordinal number of first wildcard in the file name 7
Number of consecutive wildcards in file name 10
Set termination condition of the iteration
Residual standard deviation threshold (a) 1.0 ‰
Termination condition of residual decrease (b) 1.0 ‰
Open the land-sea terrain spherical coordinate grid file
The surface harmonic functions in the spherical harmonic coefficient model are defined on the spherical surface whose radius is equal to the equatorial radius a of the Earth.
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/landw60m/grdchg2020081912.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/landw60m/grdchg2020082612.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/landw60m/grdchg2020090212.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/landw60m/grdchg2020090912.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/landw60m/grdchg2020091612.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/landw60m/grdchg2020092312.dat
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-19 23:12:37
>> Complete the spherical harmonic analysis for 143 land water variation grids!
** The program outputs the land water load spherical harmonic coefficient model
process statistics files pro***.ini and residual land water variation grid files rnt***
wildcards.
** The file header of the lndwater***cs.dat the geocentric gravitational const
a(m) of the Earth, zero-degree term aΔC₀₀ (cm) and relative error Θ (%). Whe
deviation of the last step iteration as a percentage of the standard deviation of th
are also known as the scale parameter of the spherical harmonic coefficient model
functions are defined on the spherical surface whose radius is equal to the equatorial radius of the Earth.
>> Computation end time: 2024-10-19 23:34:25
Set the results folder
Import setting parameters
Start computation
lndwater2018010312cs.dat
3.986004418 6378137.00 0.3233 6.980
GM(×10¹⁴m³/s²) a(m) zero-degree term (cm), relative erro(%)
the scale parameter
pro2018010312.ini
number of iterations, mean, SD, minimum, maximum
The degree number n of spherical harmonic coefficient model is equal to the number of global surface load cell-grids in the latitude direction. For example, the 0.25˚ × 0.25˚ global surface load grid corresponds to n=720.


Spherical harmonic analysis on global surface load time series
Spherical harmonic analysis on global sea level variations
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Construction of global surface data grid in spherical coordinates
Spherical harmonic analysis on global surface atmosphere variations
Spherical harmonic analysis on global land water variations
Spherical harmonic analysis on global sea level variations
Open any sea level variation spherical coordinate grid file
Set the wildcards of the file names
Ordinal number of first wildcard in the file name 7
Number of consecutive wildcards in file name 10
Set termination condition of the iteration
Residual standard deviation threshold (a) 1.0 ‰
Termination condition of residual decrease (b) 1.0 ‰
Open the land-sea terrain spherical coordinate grid file
The surface harmonic functions in the spherical harmonic coefficient model are defined on the spherical surface whose radius is equal to the equatorial radius a of the Earth.
Save program process as
Surface load spherical harmonic analysis and load effect synthesis
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/seal60m/grdchg2020112512.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/seal60m/grdchg2020120212.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/seal60m/grdchg2020120912.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/seal60m/grdchg2020121612.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/seal60m/grdchg2020122312.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/seal60m/grdchg2020122912.dat
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-19 23:36:37
>> Complete the spherical harmonic analysis for 157 sea level variation grids!
** The program outputs the sea level variation load spherical harmonic coefficient model files seachgr***cs.dat, iteration process statistics files pro***.ini and residual sea level variation grid files rnt***.dat. *** is the instance of the given wildcards.
** The file header of the seachg***cs.dat: the geocentric gravitational constant GM (×10¹⁴m³/s²), equatoriaradius a(m) of the Earth, zero-degree term aΔC₀₀ (cm) and relative error Θ (%). Where Θ is the residual standard deviation of the last step iteration as a percentage of the sta
are also known as the scale parameter of the spherical harr
functions are defined on the spherical surface whose radius
>> Computation end time: 2024-10-20 00:11:21
Set the results folder
Import setting parame
sealevel2018010312cs.dat
3.986004418 6378137.00 0.1482 12.259
GM(×10¹⁴m³/s²) a(m) zero-degree term (cm), relative erro(%)
the scale parameter
sealevel2018010312cs.dat
pro2018010312.ini
number of iterations, mean, SD, minimum, maximun
The degree number n of spherical harmonic coefficient model is equal to the number of global surface load cell-grids in the latitude direction. For example, the 0.25° × 0.25° global surface load grid corresponds to n=720.

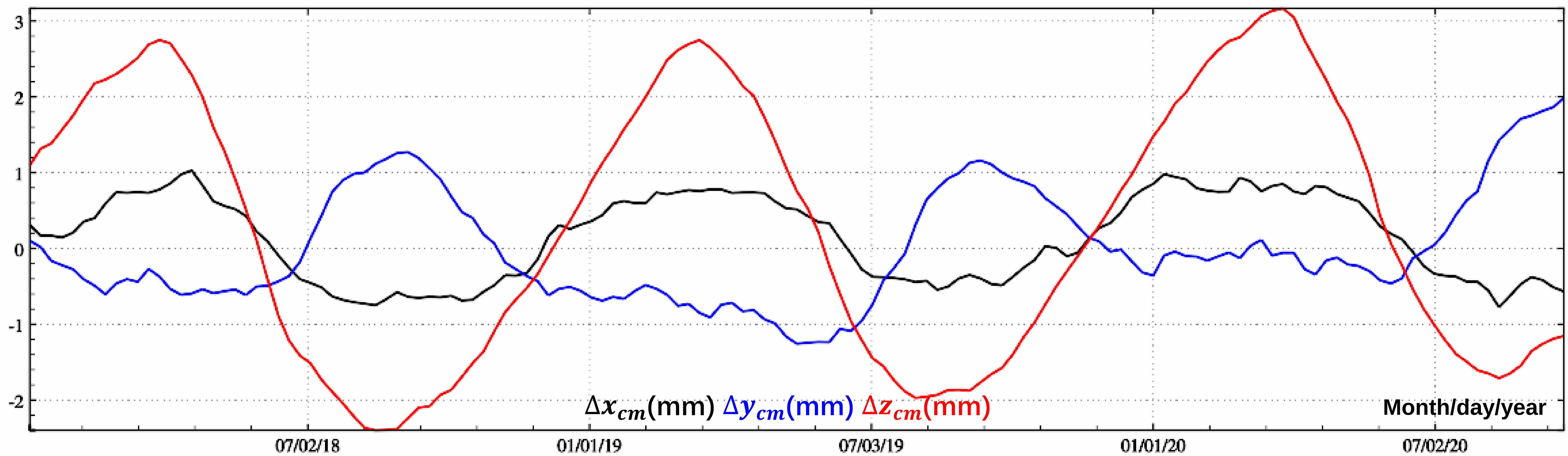


The surface atmosphere load effect time series (mm) on Earth's mass centric variations

The atmospheric load effect on the figure polar shift is the largest, and the difference between the maximum and minimum values is more than 15m.

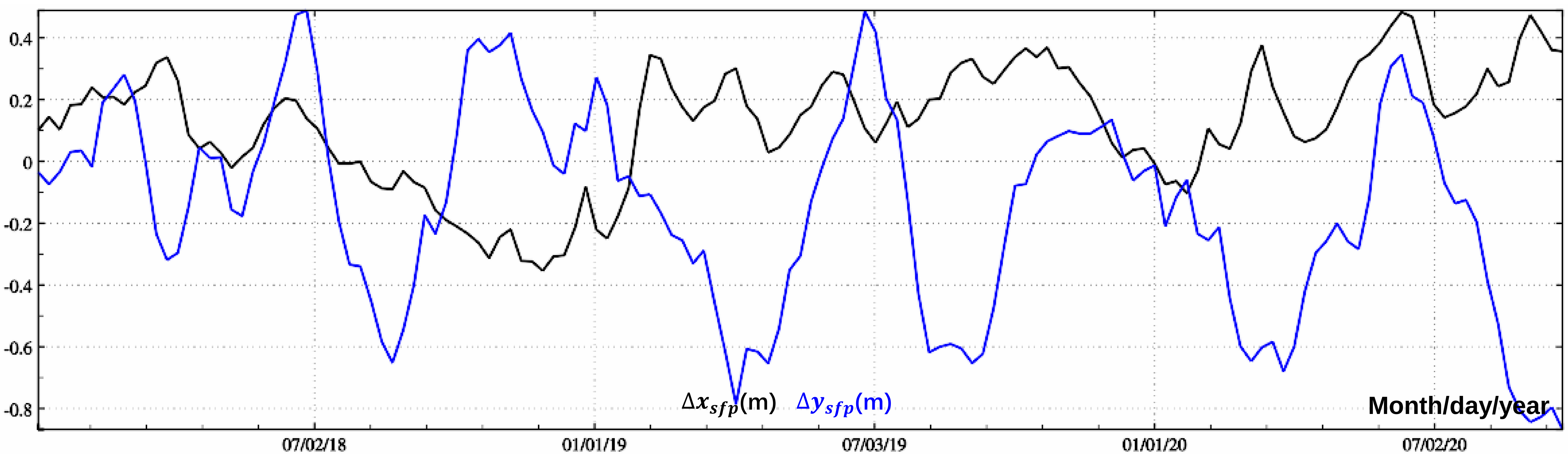


The surface atmosphere variation load effect time series (m) on Earth's figure polar shift in ITRS

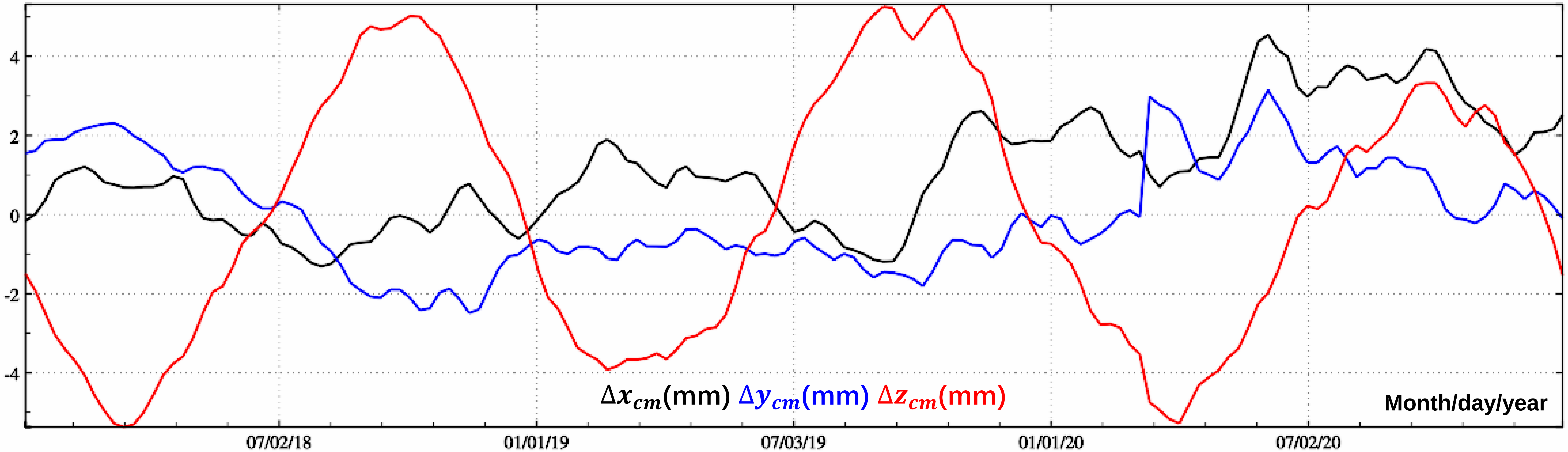


The global land water variation load effect time series (mm) on Earth's mass centric variations

The land water load effect on the figure polar shift can reach 1.2m.

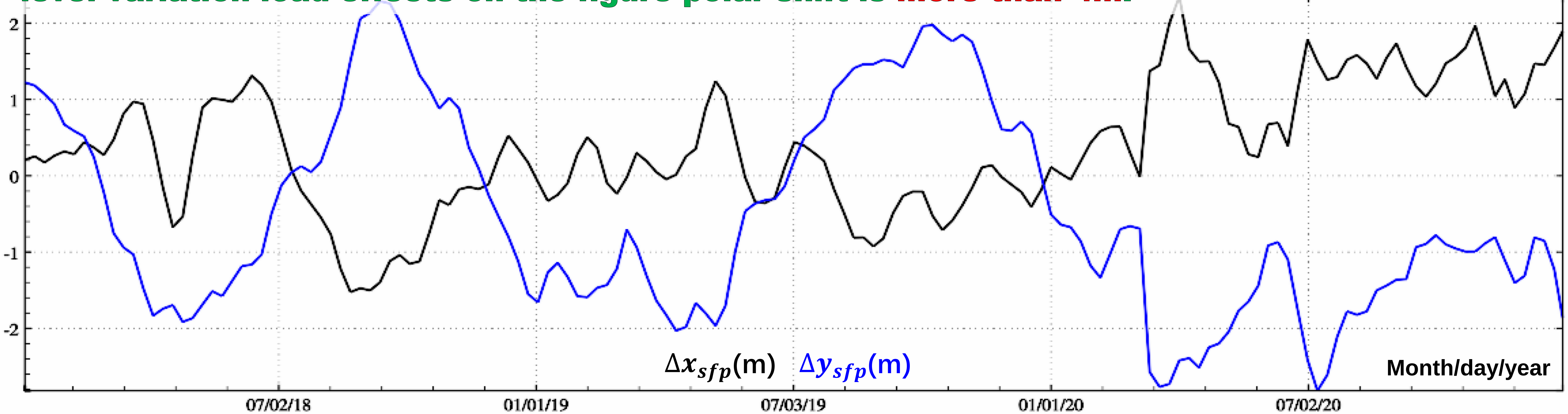


The global land water variation load effect time series (m) on Earth's figure polar shift in ITRS

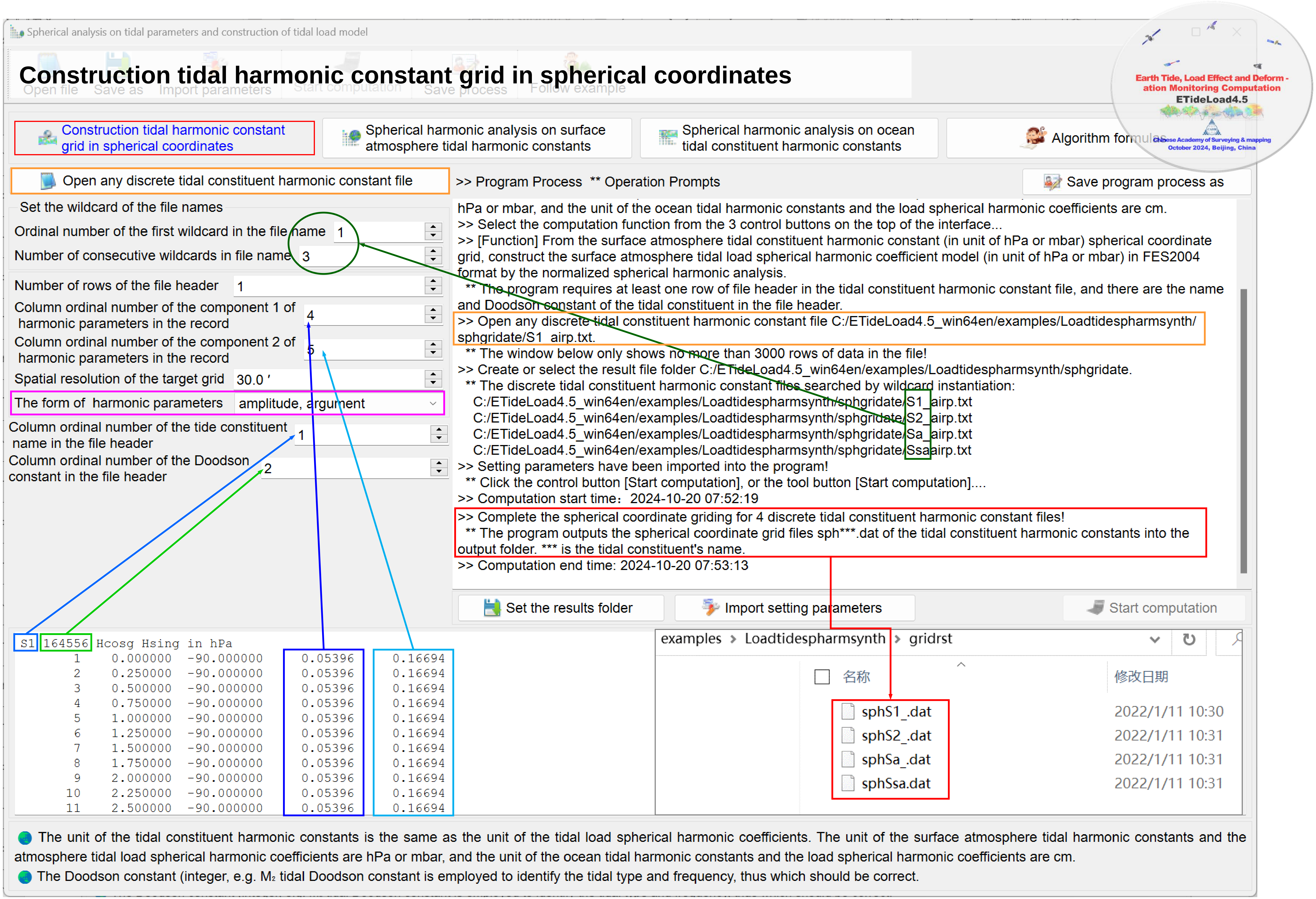


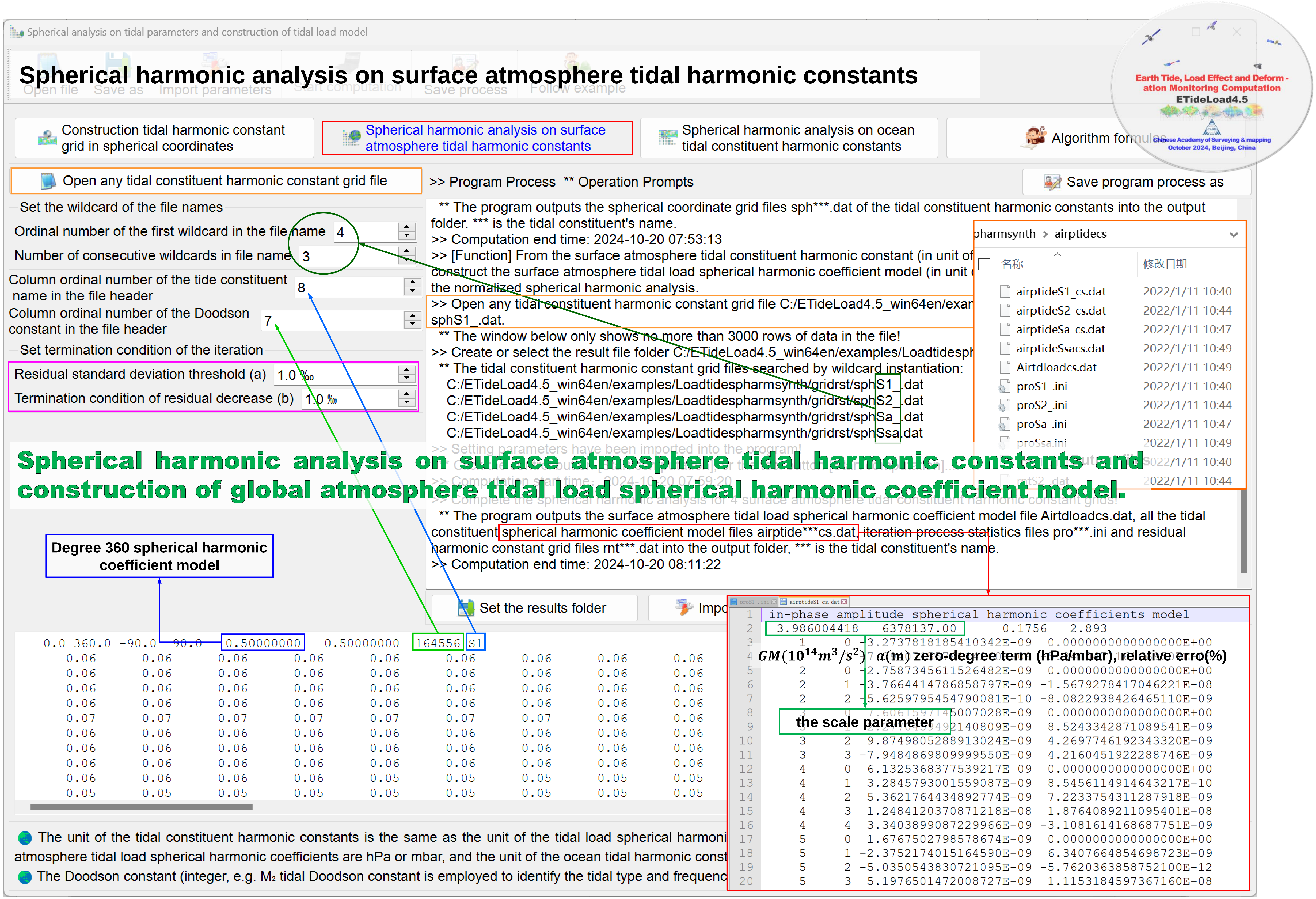
The global sea level variation load effect time series (mm) on Earth's mass centric variations

The difference between the maximum and minimum values of the sea level variation load effects on the figure polar shift is more than 4m.



The global sea level variation load effect time series (m) on Earth's figure polar shift in ITRS


Spherical analysis on tidal parameters and construction of tidal load model
Construction tidal harmonic constant grid in spherical coordinates
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Construction tidal harmonic constant grid in spherical coordinates
Spherical harmonic analysis on surface atmosphere tidal harmonic constants
Spherical harmonic analysis on ocean tidal constituent harmonic constants
Algorithm formulas
Open any discrete tidal constituent harmonic constant file
>> Program Process ** Operation Prompts
Save program process as
Set the wildcard of the file names
Ordinal number of the first wildcard in the file name 1
Number of consecutive wildcards in file name 3
Number of rows of the file header 1
Column ordinal number of the component 1 of harmonic parameters in the record 4
Column ordinal number of the component 2 of harmonic parameters in the record 5
Spatial resolution of the target grid 30.0 ′
The form of harmonic parameters amplitude, argument
Column ordinal number of the tide constituent name in the file header 1
Column ordinal number of the Doodson constant in the file header 2
hPa or mbar, and the unit of the ocean tidal harmonic constants and the load spherical harmonic coefficients are cm.
>> Select the computation function from the 3 control buttons on the top of the interface...
>> [Function] From the surface atmosphere tidal constituent harmonic constant (in unit of hPa or mbar) spherical coordinate grid, construct the surface atmosphere tidal load spherical harmonic coefficient model (in unit of hPa or mbar) in FES2004 format by the normalized spherical harmonic analysis.
** The program requires at least one row of file header in the tidal constituent harmonic constant file, and there are the name and Doodson constant of the tidal constituent in the file header.
>> Open any discrete tidal constituent harmonic constant file C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/sphgridate/S1_airp.txt.
** The window below only shows no more than 3000 rows of data in the file!
>> Create or select the result file folder C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/sphgridate.
** The discrete tidal constituent harmonic constant files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/sphgridate/S1_airp.txt
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/sphgridate/S2_airp.txt
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/sphgridate/Sa_airp.txt
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/sphgridate/Ssaairp.txt
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-20 07:52:19
>> Complete the spherical coordinate griding for 4 discrete tidal constituent harmonic constant files!
** The program outputs the spherical coordinate grid files sph***.dat of the tidal constituent harmonic constants into the output folder. *** is the tidal constituent's name.
>> Computation end time: 2024-10-20 07:53:13
Set the results folder
Import setting parameters
Start computation
S1 164556 Hcosg Hsing in hPa
1 0.000000 -90.000000 0.05396 0.16694
2 0.250000 -90.000000 0.05396 0.16694
3 0.500000 -90.000000 0.05396 0.16694
4 0.750000 -90.000000 0.05396 0.16694
5 1.000000 -90.000000 0.05396 0.16694
6 1.250000 -90.000000 0.05396 0.16694
7 1.500000 -90.000000 0.05396 0.16694
8 1.750000 -90.000000 0.05396 0.16694
9 2.000000 -90.000000 0.05396 0.16694
10 2.250000 -90.000000 0.05396 0.16694
11 2.500000 -90.000000 0.05396 0.16694
examples › Loadtidespharmsynth › gridrst
名称
修改日期
sphS1_.dat 2022/1/11 10:30
sphS2_.dat 2022/1/11 10:31
sphSa_.dat 2022/1/11 10:31
sphSsa.dat 2022/1/11 10:31
The unit of the tidal constituent harmonic constants is the same as the unit of the tidal load spherical harmonic coefficients. The unit of the surface atmosphere tidal harmonic constants and the atmosphere tidal load spherical harmonic coefficients are hPa or mbar, and the unit of the ocean tidal harmonic constants and the load spherical harmonic coefficients are cm.
The Doodson constant (integer, e.g. M2 tidal Doodson constant is employed to identify the tidal type and frequency, thus which should be correct.


Spherical analysis on tidal parameters and construction of tidal load model
Spherical harmonic analysis on surface atmosphere tidal harmonic constants
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Construction tidal harmonic constant grid in spherical coordinates
Spherical harmonic analysis on surface atmosphere tidal harmonic constants
Spherical harmonic analysis on ocean tidal constituent harmonic constants
Algorithm formulas
Open any tidal constituent harmonic constant grid file
>> Program Process ** Operation Prompts
Save program process as
Set the wildcard of the file names
Ordinal number of the first wildcard in the file name 4
Number of consecutive wildcards in file name 3
Column ordinal number of the tide constituent name in the file header 8
Column ordinal number of the Doodson constant in the file header 7
Set termination condition of the iteration
Residual standard deviation threshold (a) 1.0 ‰
Termination condition of residual decrease (b) 1.0 ‰
** The program outputs the spherical coordinate grid files sph***.dat of the tidal constituent harmonic constants into the output folder. *** is the tidal constituent's name.
>> Computation end time: 2024-10-20 07:53:13
>> [Function] From the surface atmosphere tidal constituent harmonic constant (in unit of
construct the surface atmosphere tidal load spherical harmonic coefficient model (in unit
the normalized spherical harmonic analysis.
>> Open any tidal constituent harmonic constant grid file C:/ETideLoad4.5_win64en/exan
sphS1_.dat.
** The window below only shows no more than 3000 rows of data in the file!
>> Create or select the result file folder C:/ETideLoad4.5_win64en/examples/Loadtidesph
** The tidal constituent harmonic constant grid files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/gridrst/sphS1_.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/gridrst/sphS2_.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/gridrst/sphSa_.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/gridrst/sphSsa.dat
>> Setting parameters have been imported into the program!
>> Computation start time: 2024-10-20 07:59:20
>> Complete the spherical harmonic analysis for 4 surface atmosphere tidal constituent harmonic constant grids!
** The program outputs the surface atmosphere tidal load spherical harmonic coefficient model file Airtdloadcs.dat, all the tidal constituent spherical harmonic coefficient model files airptide***cs.dat, iteration process statistics files pro***.ini and residual harmonic constant grid files rnt***.dat into the output folder, *** is the tidal constituent's name.
>> Computation end time: 2024-10-20 08:11:22
pharmsynth > airptidecs
名称 修改日期
airptideS1_cs.dat 2022/1/11 10:40
airptideS2_cs.dat 2022/1/11 10:44
airptideSa_cs.dat 2022/1/11 10:47
airptideSsacs.dat 2022/1/11 10:49
Airtdloadcs.dat 2022/1/11 10:49
proS1_.ini 2022/1/11 10:40
proS2_.ini 2022/1/11 10:44
proSa_.ini 2022/1/11 10:47
proSsa.ini 2022/1/11 10:49
Spherical harmonic analysis on surface atmosphere tidal harmonic constants and construction of global atmosphere tidal load spherical harmonic coefficient model.
Set the results folder
Degree 360 spherical harmonic coefficient model
0.0 360.0 -90.0 90.0 0.50000000 0.50000000 164556 S1
in-phase amplitude spherical harmonic coefficients model
3.986004418 6378137.00 0.1756 2.893
$GM(10^{14}m^3/s^2)$ a(m) zero-degree term (hPa/mbar), relative erro(%)
the scale parameter
1 0 3.27378185410342E-09 0.0000000000000000E+00
2 0 2.7587345611526482E-09 0.0000000000000000E+00
2 1 3.7664414786858797E-09 -1.5679278417046221E-08
2 2 5.6259795454790081E-10 -8.0822938426465110E-09
3 2 9.8749805288913024E-09 4.2697746192343320E-09
3 3 -7.9484869809999550E-09 4.2160451922288746E-09
4 0 6.1325368377539217E-09 0.0000000000000000E+00
4 1 3.2845793001559087E-09 8.5456114914643217E-10
4 2 5.3621764434892774E-09 7.2233754311287918E-09
4 3 1.2484120370871218E-08 1.8764089211095401E-08
4 4 3.3403899087229966E-09 -3.1081614168687751E-09
5 0 1.6767502798578674E-09 0.0000000000000000E+00
5 1 -2.3752174015164590E-09 6.3407664854698723E-09
5 2 -5.0350543830721095E-09 -5.7620363858752100E-12
5 3 5.1976501472008727E-09 1.1153184597367160E-08
The unit of the tidal constituent harmonic constants is the same as the unit of the tidal load spherical harmoni
atmosphere tidal load spherical harmonic coefficients are hPa or mbar, and the unit of the ocean tidal harmonic const
The Doodson constant (integer, e.g. M_2 tidal Doodson constant is employed to identify the tidal type and frequenc

Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
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October 2024, Beijing, China

airptideS1_cs.dat | proS1_.ini | Airtdloadcs.dat

Surface atmospheric tidal load normalized spherical harmonic coefficient model in hPa or mbar.
Created by ETideLoad, ZHANG Chuanyin, Chinese Academy of Surveying and Mapping.

Doodson	name	n	m	Csin+	Ccos+	Csin-	Ccos-	C+	eps+	C-	eps-
164.556	S1	1	0	-0.01044593	0.00562824	-0.01044593	0.00562824	0.011866	298.3157	0.011866	298.3157
164.556	S1	1	1	-0.02016686	-0.30983778	-0.02700702	0.03082551	0.310493	183.7240	0.040983	318.7776
164.556	S1	2	0	-0.00880807	0.02708492	-0.00880807	0.02708492	0.028481	341.9854	0.028481	341.9854
164.556	S1	2	1	-0.00267857	-0.06099820	-0.02133360	0.03899757	0.061057	182.5144	0.044451	331.3192
164.556	S1	2	2	0.04746516	-0.07024418	-0.05104501	-0.01871795	0.084777	145.9525	0.054369	249.8623
164.556	S1	3	0	0.02424426	0.01222005	0.02424426	0.01222005	0.027150	63.2501	0.027150	63.2501
164.556	S1	3	1	-0.00065416	0.08663644	0.01517276	0.03225602	0.086639	359.5674	0.035646	25.1916
164.556	S1	3	2	0.05672425	-0.01538354	0.00625213	-0.04261689	0.058773	105.1736	0.043073	171.6539
164.556	S1	3	3	0.01546691	0.03548381	-0.06617256	0.00859525	0.038708	23.5517	0.066728	277.4008
164.556	S1	4	0	0.01956420	-0.01827060	0.01956420	-0.01827060	0.026769	133.0418	0.026769	133.0418
164.556	S1	4	1	-0.01459744	0.00148107	0.03555613	-0.00398511	0.014672	275.7935	0.035779	96.3950
164.556	S1	4	2	0.01934232	0.02790035	0.01483035	-0.01817240	0.033949	34.7322	0.023456	140.7824
164.556	S1	4	3	0.05868605	0.05584202	0.02090025	-0.06381922	0.081009	46.4225	0.067154	161.8668
164.556	S1	4	4	0.05071872	-0.00993816	-0.02940598	0.00988633	0.051683	101.0865	0.031023	288.5827
164.556	S1	5	0	0.00535373	-0.01557249	0.00535373	-0.01557249	0.016467	161.0273	0.016467	161.0273
164.556	S1	5	1	-0.01117229	0.00673870	-0.00397207	-0.03368705	0.013047	301.0968	0.033920	186.7247
164.556	S1	5	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.016359	286.6570
164.556	S1	5	3	0.01540811	0.05344217	0.01772763	-0.01768282	0.055619	16.0830	0.025039	134.9275
164.556	S1	5	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	238.5496	0.028100	42.2838
164.556	S1	5	5	0.06196212	-0.00041678	-0.00316231	0.00014887	0.061964	90.3854	0.003166	272.6952
164.556	S1	6	0	-0.01902007	-0.00031063	-0.01902007	-0.00031063	0.019023	269.0643	0.019023	269.0643
164.556	S1	6	1	0.01292417	0.05007315	-0.01614491	-0.03693554	0.051714	14.4725	0.040310	203.6106
164.556	S1	6	2	-0.02124270	0.00967981	-0.00563026	0.00828166	0.023344	294.4977	0.010014	325.7903

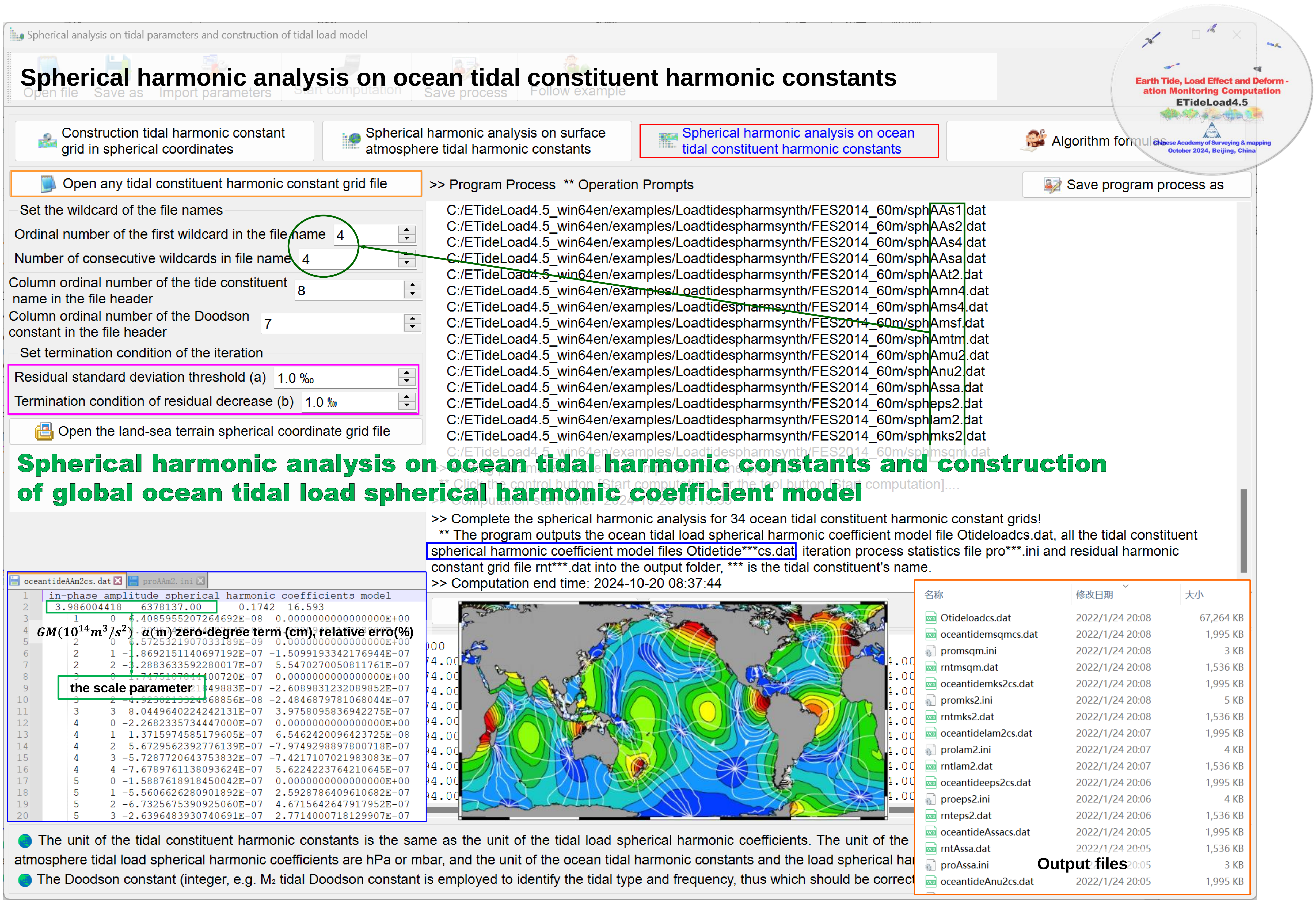
Atmosphere tidal load spherical harmonic coefficient model ECMWF2006cs360.dat constructed by ETideload4.5

airptideS1_cs.dat | proS1_.ini | Airtdloadcs.dat | Otideloadcs.dat | Airtd0ne.dat

3.986004418 6378137.00

name	Doodson	C10+	C10-	C11+	C11-	S11+	S11-
S1	164.556	-0.32755435E-08	0.17648553E-08	-0.73961840E-08	-0.43745105E-07	-0.53411096E-07	-0.10724379E-08
S2	273.555	-0.63049967E-09	0.13744707E-08	0.80115817E-10	0.52363295E-08	0.33900139E-08	-0.10865938E-08
Sa	56.565	0.82105514E-07	-0.16159915E-06	-0.35243498E-07	-0.82919083E-08	0.35037721E-07	-0.12165101E-06
Ssa	57.555	0.65256321E-08	0.64837464E-07	-0.35845502E-07	-0.25039833E-07	0.12771654E-07	0.24911463E-07

First-degree atmosphere tidal load spherical harmonic coefficient file from ECMWF2006cs360.dat. Which could be employed to forecast of atmosphere tidal load effects on Earth's mass centric variations or all-element geodetic variation effects due to Earth's mass centric variation of atmosphere tide.


Spherical analysis on tidal parameters and construction of tidal load model
Spherical harmonic analysis on ocean tidal constituent harmonic constants
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Construction tidal harmonic constant grid in spherical coordinates
Spherical harmonic analysis on surface atmosphere tidal harmonic constants
Spherical harmonic analysis on ocean tidal constituent harmonic constants
Algorithm formulas
Open any tidal constituent harmonic constant grid file
>> Program Process ** Operation Prompts
Save program process as
Set the wildcard of the file names
Ordinal number of the first wildcard in the file name 4
Number of consecutive wildcards in file name 4
Column ordinal number of the tide constituent name in the file header 8
Column ordinal number of the Doodson constant in the file header 7
Set termination condition of the iteration
Residual standard deviation threshold (a) 1.0 ‰
Termination condition of residual decrease (b) 1.0 ‰
Open the land-sea terrain spherical coordinate grid file
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphAAs1.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphAAs2.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphAAs4.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphAAsa.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphAAt2.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphAmn4.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphAms4.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphAmsf.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphAmtm.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphAmu2.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphAnu2.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphAssa.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/spheps2.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphlam2.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphmks2.dat
Spherical harmonic analysis on ocean tidal harmonic constants and construction of global ocean tidal load spherical harmonic coefficient model
>> Complete the spherical harmonic analysis for 34 ocean tidal constituent harmonic constant grids!
** The program outputs the ocean tidal load spherical harmonic coefficient model file Otideloadcs.dat, all the tidal constituent spherical harmonic coefficient model files Otidetide***cs.dat, iteration process statistics file pro***.ini and residual harmonic constant grid file rnt***.dat into the output folder, *** is the tidal constituent's name.
>> Computation end time: 2024-10-20 08:37:44
oceantideAAm2cs.dat
proAAm2.ini
in-phase amplitude spherical harmonic coefficients model
3.986004418 6378137.00 0.1742 16.593
$GM(10^{14}m^3/s^2)$ a(m) zero-degree term (cm), relative erro(%)
1 0 6.4085955207264692E-08 0.0000000000000000E+00
2 0 .5725321907033189E-09 0.0000000000000000E+00
2 1 -1.8692151140697192E-07 -1.5099193342176944E-07
2 2 -3.2883633592280017E-07 5.5470270050811761E-07
the scale parameter
3 3 8.0449640224242131E-07 3.9758095836942275E-07
4 0 -2.2682335734447000E-07 0.0000000000000000E+00
4 1 1.3715974585179605E-07 6.5462420096423725E-08
4 2 5.6729562392776139E-07 -7.9749298897800718E-07
4 3 -5.7287720643753832E-07 -7.4217107021983083E-07
4 4 -7.6789761138093624E-07 5.6224223764210645E-07
5 0 -1.5887618918450042E-07 0.0000000000000000E+00
5 1 -5.5606626280901892E-07 2.5928786409160682E-07
5 2 -6.7325675390925060E-07 4.6715642647917952E-07
5 3 -2.6396483930740691E-07 2.7714000718129907E-07
名称 修改日期 大小
Otideloadcs.dat 2022/1/24 20:08 67,264 KB
oceantidemsqmcs.dat 2022/1/24 20:08 1,995 KB
promsqm.ini 2022/1/24 20:08 3 KB
rntmsqm.dat 2022/1/24 20:08 1,536 KB
oceantidemks2cs.dat 2022/1/24 20:08 1,995 KB
promks2.ini 2022/1/24 20:08 5 KB
rntmks2.dat 2022/1/24 20:08 1,536 KB
oceantidelam2cs.dat 2022/1/24 20:07 1,995 KB
prolam2.ini 2022/1/24 20:07 4 KB
rntlam2.dat 2022/1/24 20:07 1,536 KB
oceantideeps2cs.dat 2022/1/24 20:06 1,995 KB
proeps2.ini 2022/1/24 20:06 4 KB
rnteps2.dat 2022/1/24 20:06 1,536 KB
oceantideAssacs.dat 2022/1/24 20:05 1,995 KB
rntAssa.dat 2022/1/24 20:05 1,536 KB
proAssa.ini 3 KB
oceantideAnu2cs.dat 2022/1/24 20:05 1,995 KB
Output files
The unit of the tidal constituent harmonic constants is the same as the unit of the tidal load spherical harmonic coefficients. The unit of the atmosphere tidal load spherical harmonic coefficients are hPa or mbar, and the unit of the ocean tidal harmonic constants and the load spherical har
The Doodson constant (integer, e.g. M2 tidal Doodson constant is employed to identify the tidal type and frequency, thus which should be correct

Loadfmcmsfptm.txt | Otideloadcs.dat

Ocean tidal height load normalized spherical harmonic coefficient model in cm.
Created by ETideLoad, ZHANG Chuanyin, Chinese Academy of Surveying and Mapping.

Doodson	name	n	m	Csin+	Ccos+	Csin-	Ccos-	C+	eps+	C-	eps-
247.455	2N2	1	0	0.00458562	0.00231038	0.00458562	0.00231038	0.005135	63.2596	0.005135	63.2596
247.455	2N2	1	1	-0.00773380	0.00473565	0.01063946	-0.00152991	0.009069	301.4805	0.010749	98.1828
247.455	2N2	2	0	0.01415077	-0.00470716	0.01415077	-0.00470716	0.014913	108.3994	0.014913	108.3994
247.455	2N2	2	1	-0.01749377	0.01964053	-0.02057617	0.01244109	0.026302	318.3086	0.024045	301.1587
247.455	2N2	2	2	-0.05076973	0.15409810	0.03408330	-0.00708020	0.162246	341.7648	0.034811	101.7353
247.455	2N2	3	0	-0.00345932	-0.05402235	-0.00345932	-0.05402235	0.054133	183.6639	0.054133	183.6639
247.455	2N2	3	1	0.00459468	0.02860553	0.08674509	0.04125120	0.028972	9.1250	0.096054	64.5668
247.455	2N2	3	2	-0.01359111	-0.04803085	0.00043095	0.01917460	0.049917	195.7997	0.019179	1.2875
247.455	2N2	3	3	0.11576000	0.04745531	0.10043379	-0.03897379	0.125109	67.7090	0.107731	111.2090
247.455	2N2	4	0	-0.04607076	0.02579335	-0.04607076	0.02579335	0.052800	299.2429	0.052800	299.2429
247.455	2N2	4	1	0.03322584	0.01467790	0.01394749	0.02945707	0.036324	66.1660	0.032592	25.3369
247.455	2N2	4	2	0.06616682	-0.16308472	0.08023800	0.03608357	0.175996	157.9166	0.087978	65.7862
247.455	2N2	4	3	-0.04323293	-0.08712246	-0.08031745	0.08908738	0.097259	206.3921	0.119948	317.9635
247.455	2N2	4	4	-0.07108370	0.11911427	-0.03283587	0.04029420	0.138712	329.1726	0.051979	320.8233
247.455	2N2	5	0	0.00423674	0.05025371	0.00423674	0.05025371	0.050432	4.8190	0.050432	4.8190
247.455	2N2	5	1	-0.06599377	0.02863740	-0.06611923	-0.08775797	0.071939	293.4580	0.109878	216.9954
247.455	2N2	5	2	0.03191636	0.09160043	-0.12292118	0.09809027	0.097002	19.2099	0.157262	308.5896
247.455	2N2	5	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	332.6324	0.039828	234.1757
247.455	2N2	5	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	91.5042	0.082186	282.7617
247.455	2N2	5	5	0.07170340	0.02947675	0.04405895	[illegible]	0.077526	67.6528	0.095534	152.5364
247.455	2N2	6	0	0.03947937	-0.02794239	0.03947937	-0.02794239	0.048367	125.2898	0.048367	125.2898
247.455	2N2	6	1	-0.03340601	-0.04901155	0.00654233	-0.02479353	0.059314	214.2781	0.025642	165.2182
247.455	2N2	6	2	0.01502432	0.05093430	-0.00472606	-0.04361353	0.053104	16.4347	0.043869	186.1846
247.455	2N2	6	3	0.00272363	0.04846491	-0.00102382	0.02626808	0.048541	3.2165	0.026288	357.7680
247.455	2N2	6	4	0.05940714	-0.01371178	0.06957119	0.00812134	0.060969	102.9969	0.070044	83.3418
247.455	2N2	6	5	-0.06310363	-0.02281638	0.02184442	0.02667029	0.067102	250.1215	0.034474	39.3193
247.455	2N2	6	6	0.06505389	0.01875362	0.05082476	0.11432385	0.067703	73.9189	0.125112	23.9684
247.455	2N2	7	0	0.03231974	0.00130979	0.03231974	0.00130979	0.032346	87.6793	0.032346	87.6793
247.455	2N2	7	1	0.01740544	-0.02827998	0.01240391	0.00333515	0.033207	148.3890	0.012844	74.9503
247.455	2N2	7	2	-0.05289712	0.01334177	0.03482823	-0.08565262	0.054554	284.1559	0.092463	157.8723
247.455	2N2	7	3	-0.04490640	0.03300070	-0.01170604	0.00335994	0.055728	306.3113	0.012179	286.0149
247.455	2N2	7	4	0.02847534	-0.01480133	-0.04298436	-0.00624406	0.032092	117.4652	0.043436	261.7348
247.455	2N2	7	5	0.03444464	-0.04692621	-0.05161881	0.01841567	0.058211	143.7207	0.054805	289.6345
247.455	2N2	7	6	0.03370577	-0.00688833	-0.04456603	-0.02386590	0.034402	101.5503	0.050554	241.8302
247.455	2N2	7	7	0.03170557	-0.04712240	0.03534061	0.04767806	0.056796	146.0660	0.059348	36.5471
247.455	2N2	8	0	0.00128965	0.01929829	0.00128965	0.01929829	0.019341	3.8232	0.019341	3.8232
247.455	2N2	8	1	0.02942979	-0.03337153	0.00149069	-0.01387328	0.044495	138.5915	0.013953	173.8671

Ocean tidal load spherical harmonic coefficient model FES2014b360cs.dat constructed by ETideload4.5

Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China

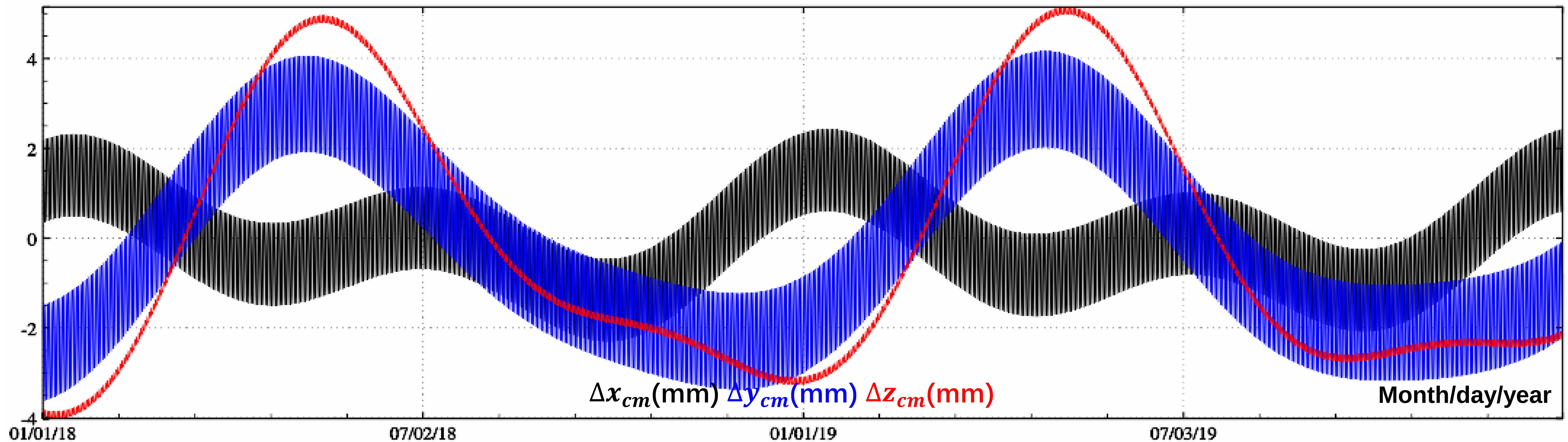
oceantideA2n2cs.dat | proA2n2.ini | OtideOne.dat

3.986004418 6378137.00

name	Doodson	C10+	C10-	C11+	C11-	S11+	S11-
2N2	247.455	0.14379190E-08	0.72446933E-09	0.45556662E-09	0.50261431E-09	0.98234968E-09	0.28806626E-08
J1	175.455	0.22805765E-08	-0.14599680E-07	0.11146859E-07	0.31354016E-08	0.49073923E-08	0.50239288E-08
K1	165.555	0.65903198E-07	-0.23618735E-06	0.15240517E-06	0.54510351E-07	0.57951321E-07	0.91115166E-07
K2	275.555	0.58820344E-08	0.78223673E-09	0.82634785E-08	0.17098158E-07	0.28274727E-08	0.95641986E-09
L2	265.455	0.99527541E-09	0.43369491E-10	0.27208849E-08	0.18838893E-08	-0.93316186E-09	-0.31242492E-09
M2	255.555	0.64086749E-07	0.33741274E-07	0.82092113E-07	0.76976307E-08	-0.39331272E-07	0.74234937E-07
M3	355.555	0.51159035E-10	0.26216133E-10	0.20622631E-10	-0.16737336E-10	-0.74054752E-10	-0.32502465E-10
M4	455.555	-0.12877739E-09	-0.82078020E-09	0.21241775E-09	0.89312487E-09	-0.11238411E-09	-0.11882183E-08
M6	655.555	0.18174228E-08	0.30921490E-09	0.36600543E-09	0.36841599E-09	-0.72147727E-09	-0.13743491E-09
M8	855.555	-0.59854172E-10	-0.29503418E-11	0.41858427E-10	0.58809710E-10	-0.34465624E-10	0.81925459E-11
Mf	75.555	0.23994538E-07	0.23160661E-08	0.14961765E-07	-0.19050356E-07	0.57231952E-08	-0.38155669E-08
Mm	65.455	0.12211587E-07	-0.10619733E-08	-0.13680094E-08	-0.93454574E-08	0.34149364E-08	-0.61740212E-09
N2	245.655	0.16604395E-07	0.24692742E-08	0.10060051E-07	0.75631673E-09	-0.49125733E-09	0.20845840E-07
N4	435.755	-0.11170849E-09	-0.41029169E-10	0.37178942E-10	-0.10703469E-09	-0.53442667E-10	-0.19926918E-10
O1	145.555	0.23239277E-07	-0.16830188E-06	0.86481239E-07	0.11802879E-07	0.58555768E-07	0.34726677E-07
P1	163.555	0.16600812E-07	-0.74602430E-07	0.48235157E-07	0.14146460E-07	[illegible]	[illegible]E-07
Q1	135.655	0.40244812E-08	-0.29117940E-07	0.15908436E-07	0.77164577E-09	0.12770867E-07	0.14909422E-08
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]E-09
S1	164.556	-0.40129653E-08	0.48653114E-08	-0.48716881E-08	0.11419251E-07	0.74509139E-08	-0.34899535E-09
S2	273.555	0.22430236E-07	0.94564697E-08	0.50377828E-07	0.49157638E-07	-0.61338730E-08	0.76805145E-08
S4	491.555	0.32089047E-09	0.14407638E-09	0.12925319E-11	0.14038268E-09	0.10308541E-09	0.11742749E-09
Sa	56.554	0.21793187E-09	0.12972260E-09	0.71714382E-10	0.49927099E-10	-0.42733149E-10	-0.53422994E-10
T2	272.556	0.13719484E-08	0.73425584E-09	0.20944307E-08	0.29614380E-08	0.13767437E-09	0.10318216E-08
MN4	445.655	-0.70793273E-09	-0.76823301E-10	0.24279253E-09	-0.66374018E-09	-0.14062685E-09	0.16716883E-09
MS4	473.555	0.32582237E-09	-0.10684852E-08	0.10873236E-08	0.38092589E-09	-0.40703836E-09	-0.28009461E-09
Msf	73.555	0.52032006E-09	0.12958178E-08	0.20898774E-09	0.69234415E-09	0.16108594E-08	0.36734674E-09
Mtm	85.455	0.38057222E-08	0.89028662E-09	0.47545363E-08	-0.16109463E-08	0.13034435E-08	0.46197838E-10
mu2	237.555	0.27230195E-08	-0.54548861E-09	0.80856645E-09	0.28475772E-08	0.30945151E-08	0.39961507E-08
nu2	245.655	0.31512988E-08	0.13274377E-08	0.16643629E-08	0.77176190E-09	-0.34369557E-09	0.49489633E-08
Ssa	57.555	0.85592993E-08	-0.21041028E-09	-0.85777470E-08	-0.10849053E-08	0.38854237E-09	-0.73333943E-09
eps2	227.655	0.15232320E-08	-0.54284574E-09	0.18709319E-08	-0.17678032E-09	0.14037532E-08	-0.64291979E-09
lam2	263.655	0.77975910E-09	-0.46145888E-09	0.29230225E-08	-0.81098933E-09	-0.68691816E-09	-0.10714953E-08
MKS2	257.555	-0.76338045E-11	-0.81694611E-10	0.81955321E-10	0.53313693E-09	0.52931064E-09	0.23733568E-09
Msqm	93.555	0.17382639E-09	-0.21085098E-11	0.98864729E-10	0.18391545E-09	-0.15315104E-09	-0.66456652E-11

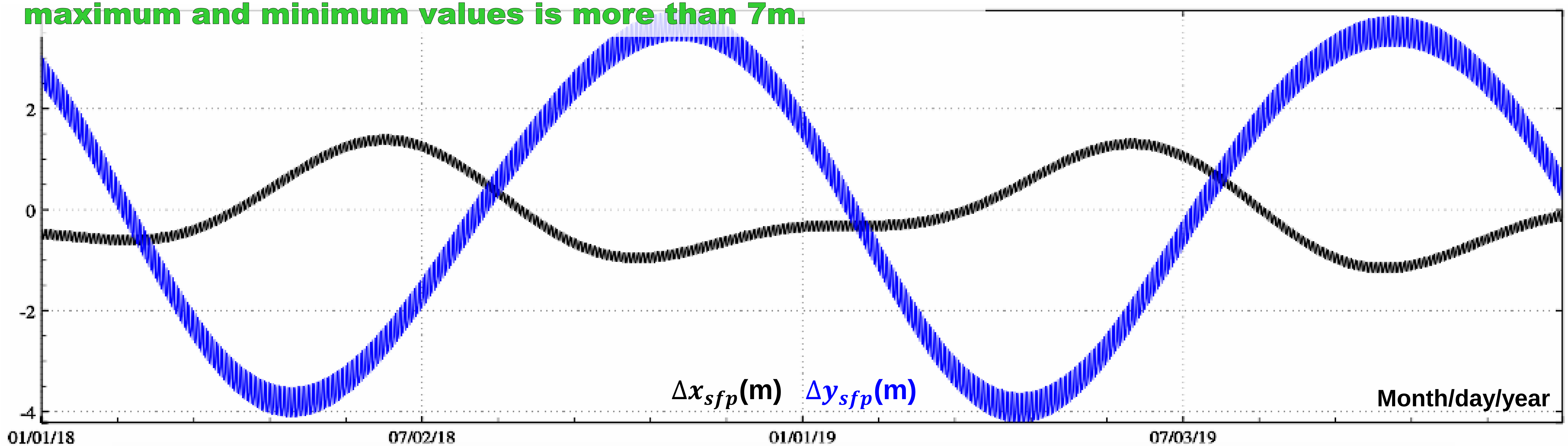
First-degree ocean tidal load spherical harmonic coefficient file from FES2014b360cs.dat. Which could be employed to forecast of ocean tidal load effects on Earth's mass centric variations or all-element geodetic variation effects due to Earth's mass centric variation of ocean tide.

Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China

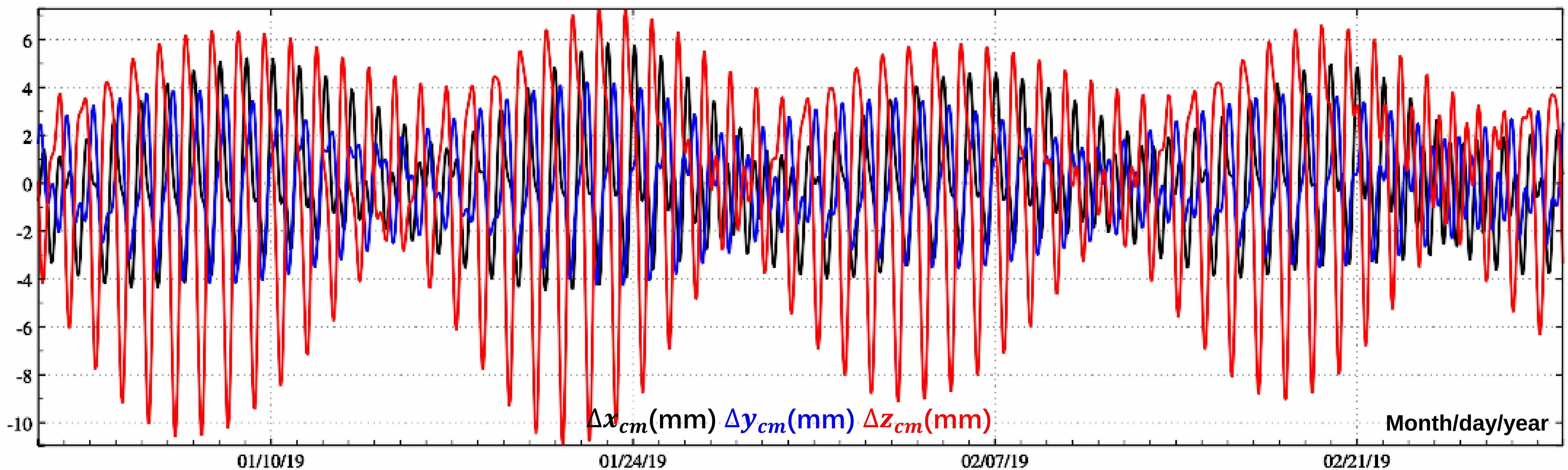


The atmosphere tidal load effect time series on Earth's mass centric variation

The annual amplitude is large, and the difference between maximum and minimum values is more than 7m.

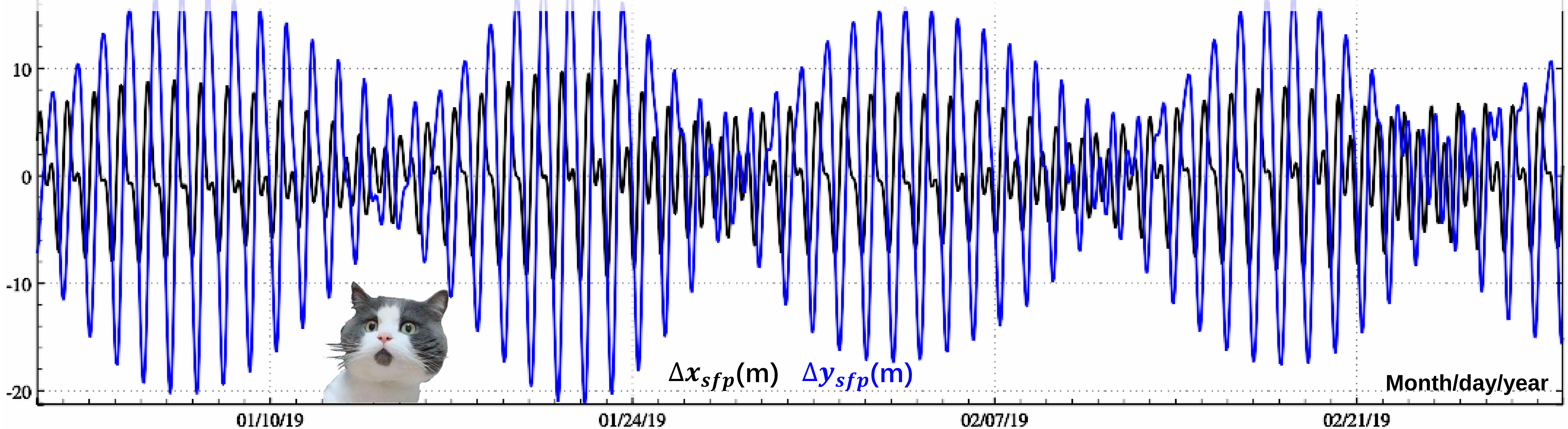


The surface atmosphere tidal load effect time series (m) on Earth's figure polar shifts in ITRS

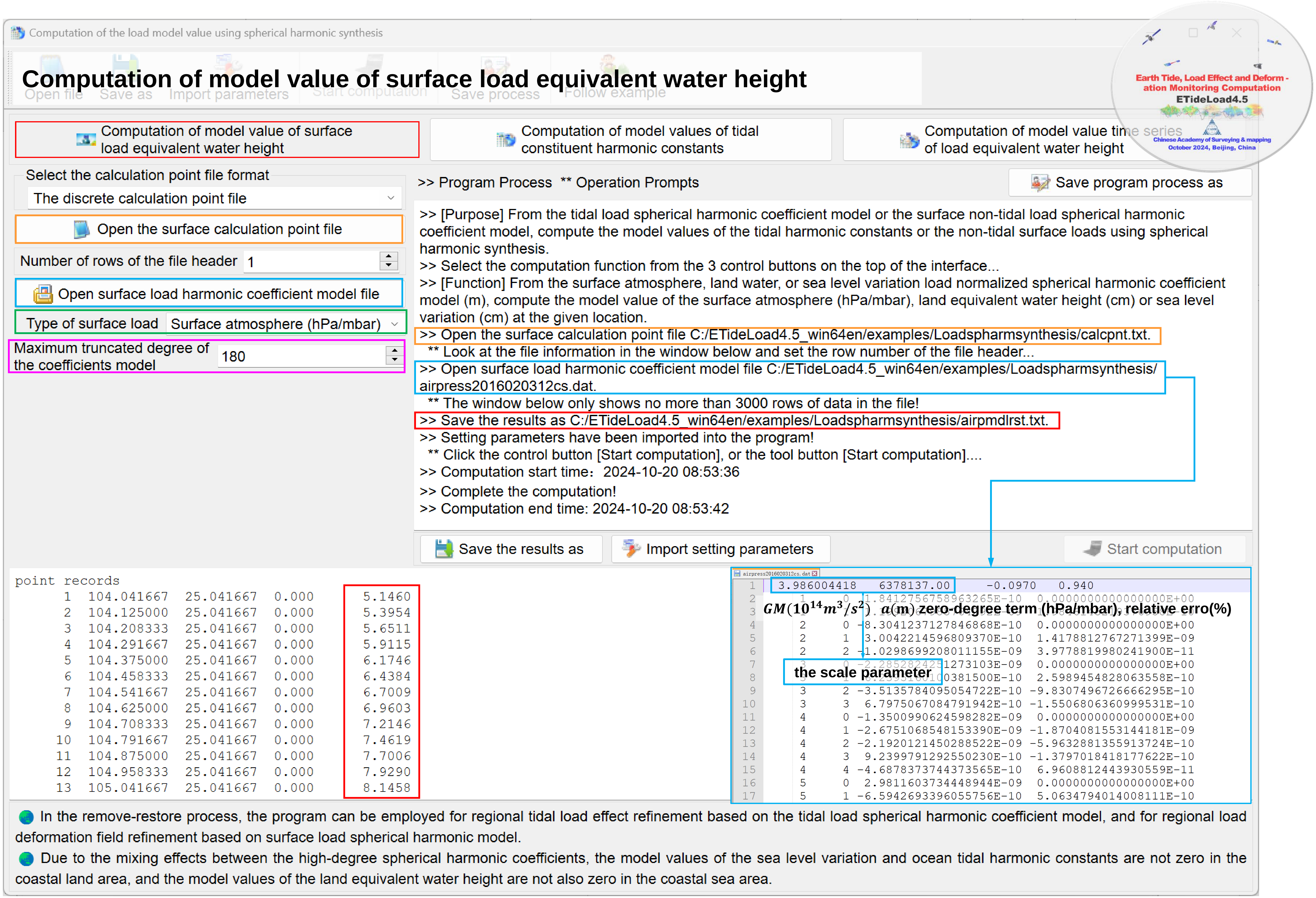


The ocean tidal load effect time series (mm) on Earth's mass centric variations

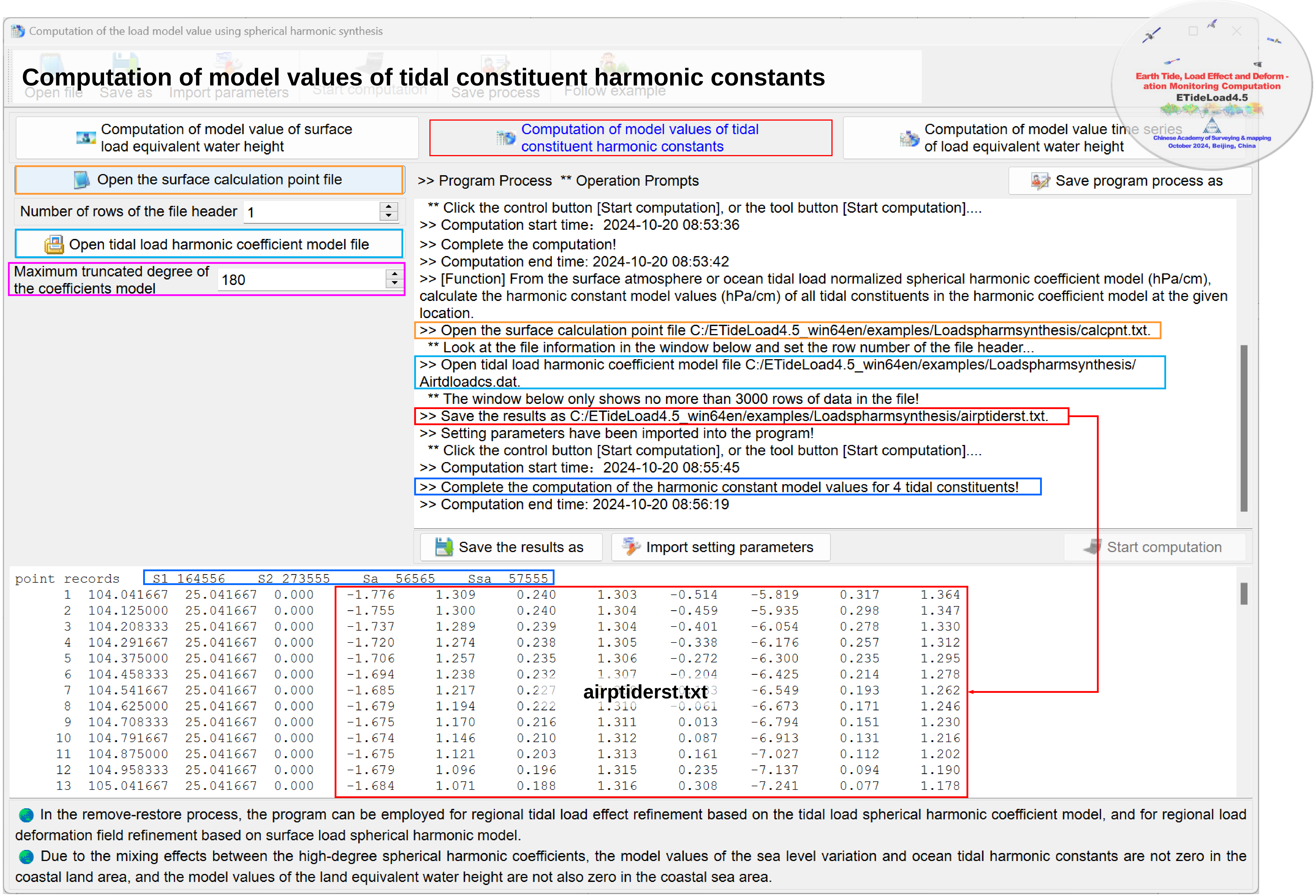
The ocean tidal load effects on the Earth's figure polar shift are dominated by diurnal variation, and the difference between maximum and minimum values can reach 40m in one month.



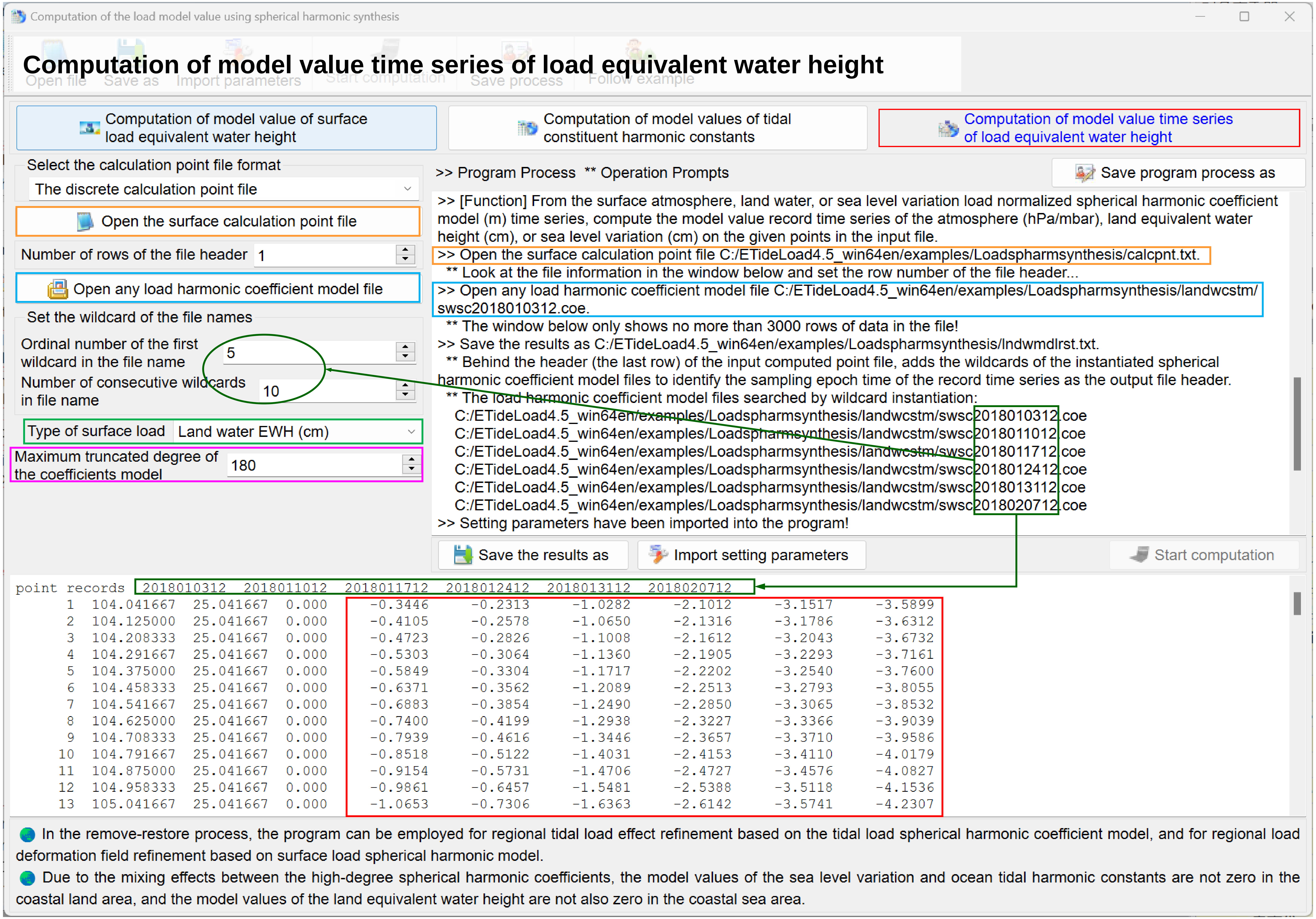
The ocean tidal load effect time series (m) on Earth's figure polar shifts in ITRS



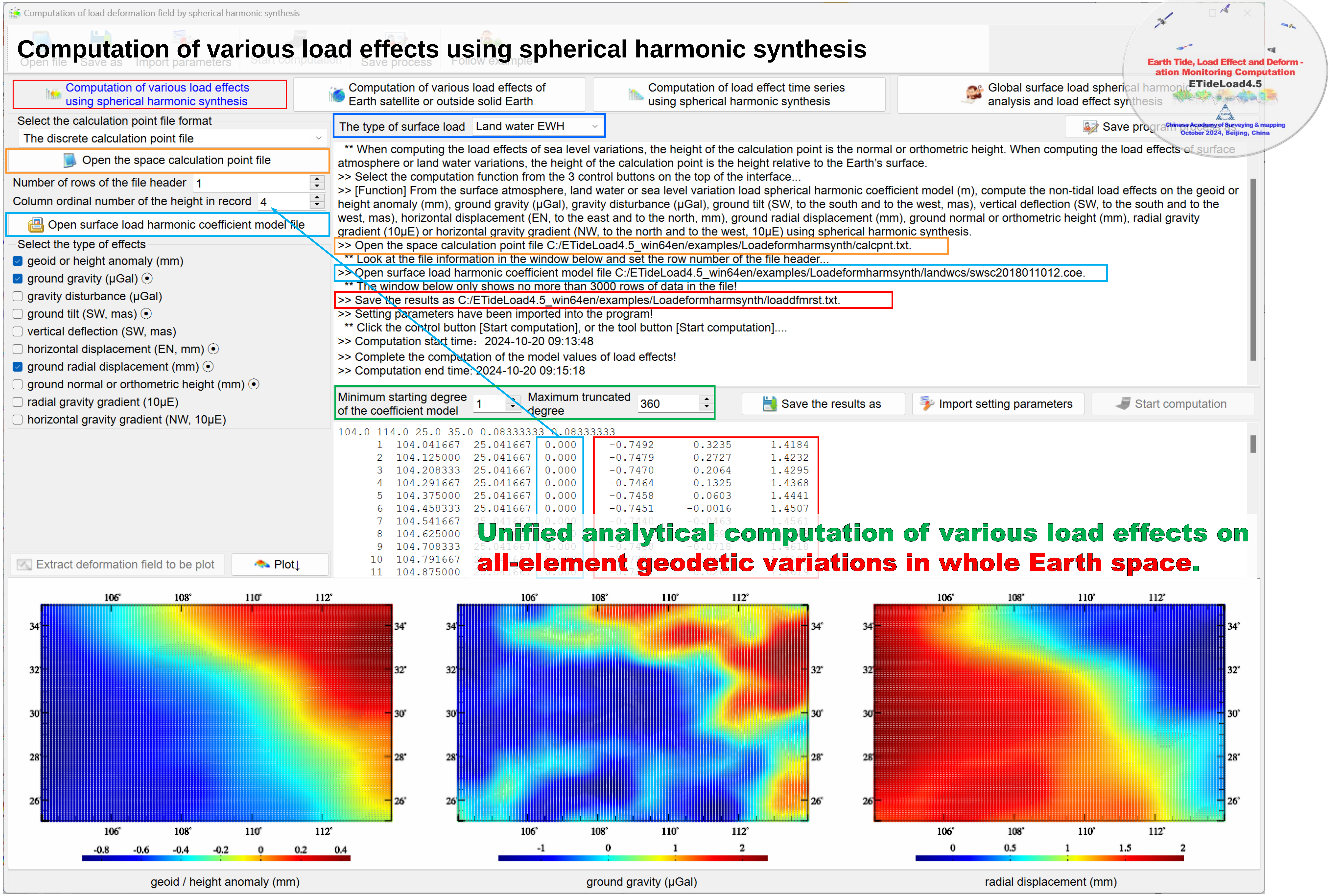
Computation of the load model value using spherical harmonic synthesis
Computation of model value of surface load equivalent water height
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of model value of surface load equivalent water height
Computation of model values of tidal constituent harmonic constants
Computation of model value time series of load equivalent water height
Select the calculation point file format
The discrete calculation point file
Open the surface calculation point file
Number of rows of the file header 1
Open surface load harmonic coefficient model file
Type of surface load Surface atmosphere (hPa/mbar)
Maximum truncated degree of the coefficients model 180
>> Program Process ** Operation Prompts
Save program process as
>> [Purpose] From the tidal load spherical harmonic coefficient model or the surface non-tidal load spherical harmonic coefficient model, compute the model values of the tidal harmonic constants or the non-tidal surface loads using spherical harmonic synthesis.
>> Select the computation function from the 3 control buttons on the top of the interface...
>> [Function] From the surface atmosphere, land water, or sea level variation load normalized spherical harmonic coefficient model (m), compute the model value of the surface atmosphere (hPa/mbar), land equivalent water height (cm) or sea level variation (cm) at the given location.
>> Open the surface calculation point file C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/calcpnt.txt.
** Look at the file information in the window below and set the row number of the file header...
>> Open surface load harmonic coefficient model file C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/airpress2016020312cs.dat.
** The window below only shows no more than 3000 rows of data in the file!
>> Save the results as C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/airpmdlrst.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time： 2024-10-20 08:53:36
>> Complete the computation!
>> Computation end time: 2024-10-20 08:53:42
Save the results as
Import setting parameters
Start computation
point records
1 104.041667 25.041667 0.000 5.1460
2 104.125000 25.041667 0.000 5.3954
3 104.208333 25.041667 0.000 5.6511
4 104.291667 25.041667 0.000 5.9115
5 104.375000 25.041667 0.000 6.1746
6 104.458333 25.041667 0.000 6.4384
7 104.541667 25.041667 0.000 6.7009
8 104.625000 25.041667 0.000 6.9603
9 104.708333 25.041667 0.000 7.2146
10 104.791667 25.041667 0.000 7.4619
11 104.875000 25.041667 0.000 7.7006
12 104.958333 25.041667 0.000 7.9290
13 105.041667 25.041667 0.000 8.1458
airpress2016020312cs.dat
3.986004418 6378137.00 -0.0970 0.940
$GM(10^{14}m^3/s^2)$ a(m) zero-degree term (hPa/mbar), relative erro(%)
the scale parameter
2 0 -8.3041237127846868E-10 0.0000000000000000E+00
2 1 3.0042214596809370E-10 1.4178812767271399E-09
2 2 -1.0298699208011155E-09 3.9778819980241900E-11
3 2 -3.5135784095054722E-10 -9.8307496726666295E-10
3 3 6.7975067084791942E-10 -1.5506806360999531E-10
4 0 -1.3500990624598282E-09 0.0000000000000000E+00
4 1 -2.6751068548153390E-09 -1.8704081553144181E-09
4 2 -2.1920121450288522E-09 -5.9632881355913724E-10
4 3 9.2399791292550230E-10 -1.3797018418177622E-10
4 4 -4.6878373744373565E-10 6.9608812443930559E-11
5 0 2.9811603734448944E-09 0.0000000000000000E+00
5 1 -6.5942693396055756E-10 5.0634794014008111E-10
In the remove-restore process, the program can be employed for regional tidal load effect refinement based on the tidal load spherical harmonic coefficient model, and for regional load deformation field refinement based on surface load spherical harmonic model.
Due to the mixing effects between the high-degree spherical harmonic coefficients, the model values of the sea level variation and ocean tidal harmonic constants are not zero in the coastal land area, and the model values of the land equivalent water height are not also zero in the coastal sea area.

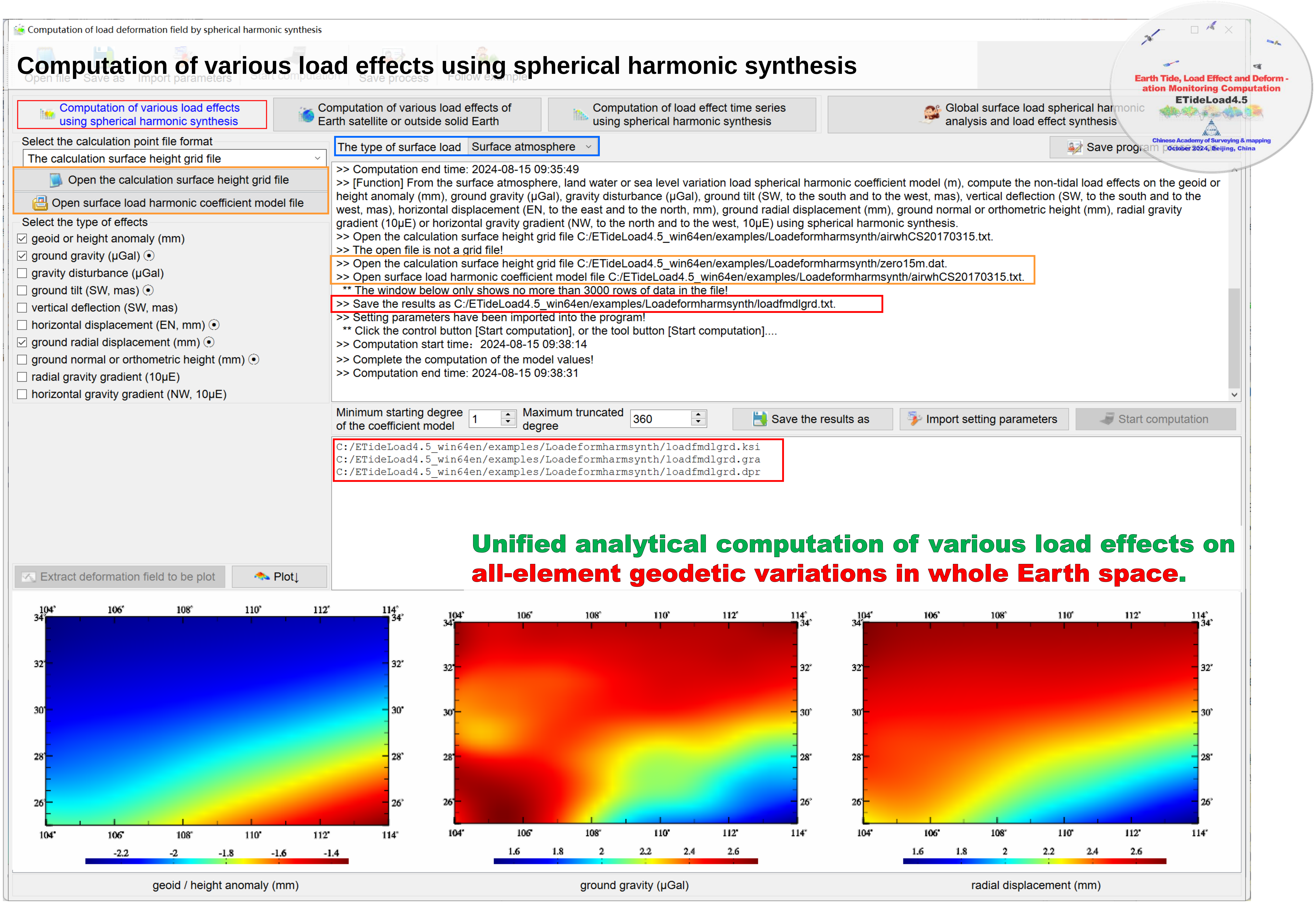


Computation of the load model value using spherical harmonic synthesis
Computation of model values of tidal constituent harmonic constants
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of model value of surface load equivalent water height
Computation of model values of tidal constituent harmonic constants
Computation of model value time series of load equivalent water height
Open the surface calculation point file
Number of rows of the file header 1
Open tidal load harmonic coefficient model file
Maximum truncated degree of the coefficients model 180
>> Program Process ** Operation Prompts
Save program process as
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-20 08:53:36
>> Complete the computation!
>> Computation end time: 2024-10-20 08:53:42
>> [Function] From the surface atmosphere or ocean tidal load normalized spherical harmonic coefficient model (hPa/cm), calculate the harmonic constant model values (hPa/cm) of all tidal constituents in the harmonic coefficient model at the given location.
>> Open the surface calculation point file C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/calcpnt.txt.
** Look at the file information in the window below and set the row number of the file header...
>> Open tidal load harmonic coefficient model file C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/Airtdloadcs.dat.
** The window below only shows no more than 3000 rows of data in the file!
>> Save the results as C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/airptiderst.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-20 08:55:45
>> Complete the computation of the harmonic constant model values for 4 tidal constituents!
>> Computation end time: 2024-10-20 08:56:19
Save the results as
Import setting parameters
Start computation
point records S1 164556 S2 273555 Sa 56565 Ssa 57555
1 104.041667 25.041667 0.000 -1.776 1.309 0.240 1.303 -0.514 -5.819 0.317 1.364
2 104.125000 25.041667 0.000 -1.755 1.300 0.240 1.304 -0.459 -5.935 0.298 1.347
3 104.208333 25.041667 0.000 -1.737 1.289 0.239 1.304 -0.401 -6.054 0.278 1.330
4 104.291667 25.041667 0.000 -1.720 1.274 0.238 1.305 -0.338 -6.176 0.257 1.312
5 104.375000 25.041667 0.000 -1.706 1.257 0.235 1.306 -0.272 -6.300 0.235 1.295
6 104.458333 25.041667 0.000 -1.694 1.238 0.232 1.307 -0.204 -6.425 0.214 1.278
7 104.541667 25.041667 0.000 -1.685 1.217 0.227 -6.549 0.193 1.262
8 104.625000 25.041667 0.000 -1.679 1.194 0.222 1.310 -0.061 -6.673 0.171 1.246
9 104.708333 25.041667 0.000 -1.675 1.170 0.216 1.311 0.013 -6.794 0.151 1.230
10 104.791667 25.041667 0.000 -1.674 1.146 0.210 1.312 0.087 -6.913 0.131 1.216
11 104.875000 25.041667 0.000 -1.675 1.121 0.203 1.313 0.161 -7.027 0.112 1.202
12 104.958333 25.041667 0.000 -1.679 1.096 0.196 1.315 0.235 -7.137 0.094 1.190
13 105.041667 25.041667 0.000 -1.684 1.071 0.188 1.316 0.308 -7.241 0.077 1.178
airptiderst.txt
In the remove-restore process, the program can be employed for regional tidal load effect refinement based on the tidal load spherical harmonic coefficient model, and for regional load deformation field refinement based on surface load spherical harmonic model.
Due to the mixing effects between the high-degree spherical harmonic coefficients, the model values of the sea level variation and ocean tidal harmonic constants are not zero in the coastal land area, and the model values of the land equivalent water height are not also zero in the coastal sea area.



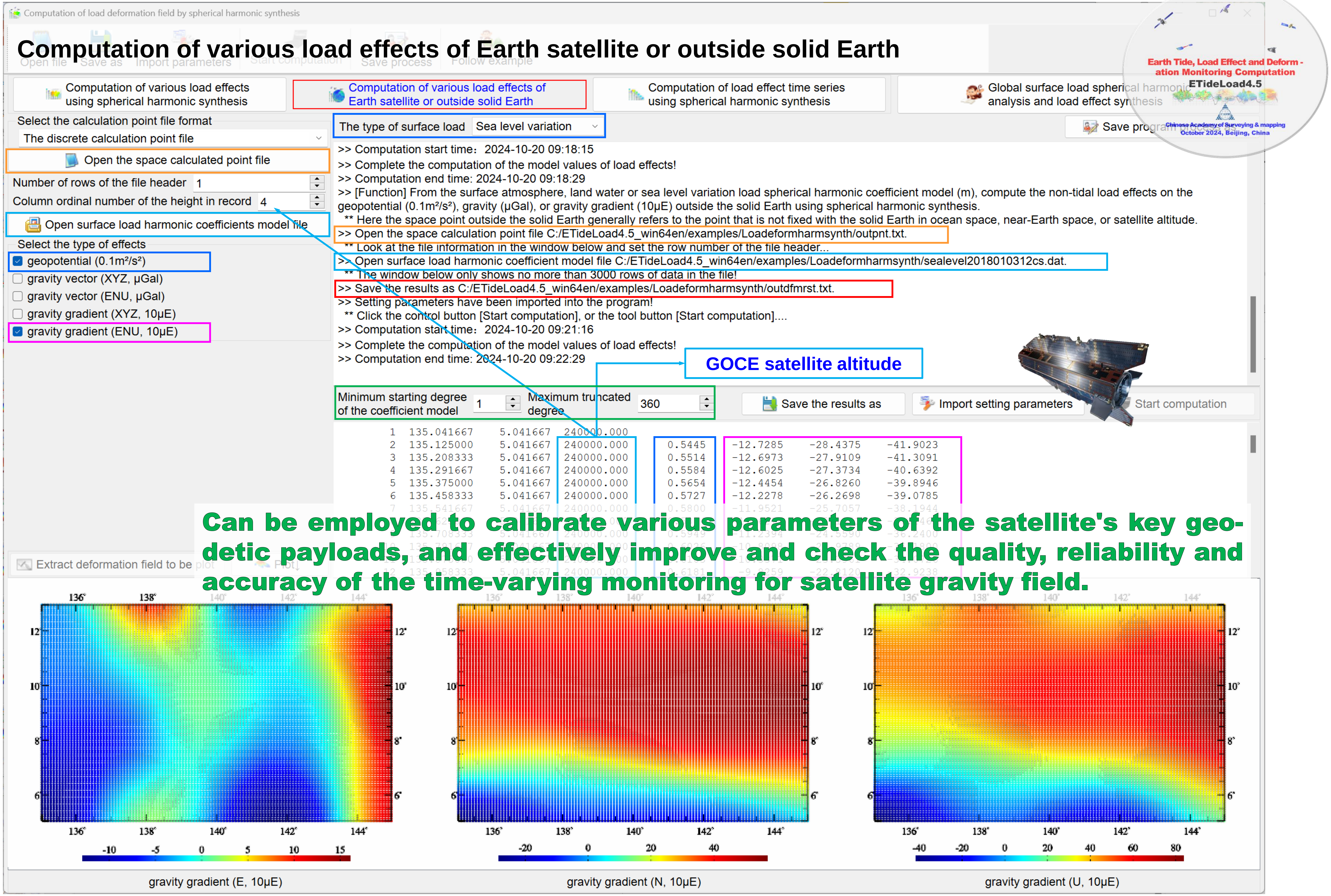
Computation of the load model value using spherical harmonic synthesis
Computation of model value time series of load equivalent water height
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Computation of model value of surface load equivalent water height
Computation of model values of tidal constituent harmonic constants
Computation of model value time series of load equivalent water height
Select the calculation point file format
The discrete calculation point file
Open the surface calculation point file
Number of rows of the file header 1
Open any load harmonic coefficient model file
Set the wildcard of the file names
Ordinal number of the first wildcard in the file name 5
Number of consecutive wildcards in file name 10
Type of surface load Land water EWH (cm)
Maximum truncated degree of the coefficients model 180
>> Program Process ** Operation Prompts
Save program process as
>> [Function] From the surface atmosphere, land water, or sea level variation load normalized spherical harmonic coefficient model (m) time series, compute the model value record time series of the atmosphere (hPa/mbar), land equivalent water height (cm), or sea level variation (cm) on the given points in the input file.
>> Open the surface calculation point file C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/calcpnt.txt.
** Look at the file information in the window below and set the row number of the file header...
>> Open any load harmonic coefficient model file C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/landwcstm/swsc2018010312.coe.
** The window below only shows no more than 3000 rows of data in the file!
>> Save the results as C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/lndwmdlrst.txt.
** Behind the header (the last row) of the input computed point file, adds the wildcards of the instantiated spherical harmonic coefficient model files to identify the sampling epoch time of the record time series as the output file header.
** The load harmonic coefficient model files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/landwcstm/swsc2018010312.coe
C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/landwcstm/swsc2018011012.coe
C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/landwcstm/swsc2018011712.coe
C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/landwcstm/swsc2018012412.coe
C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/landwcstm/swsc2018013112.coe
C:/ETideLoad4.5_win64en/examples/Loadspharmsynthesis/landwcstm/swsc2018020712.coe
>> Setting parameters have been imported into the program!
Save the results as
Import setting parameters
Start computation
point records 2018010312 2018011012 2018011712 2018012412 2018013112 2018020712
1 104.041667 25.041667 0.000 -0.3446 -0.2313 -1.0282 -2.1012 -3.1517 -3.5899
2 104.125000 25.041667 0.000 -0.4105 -0.2578 -1.0650 -2.1316 -3.1786 -3.6312
3 104.208333 25.041667 0.000 -0.4723 -0.2826 -1.1008 -2.1612 -3.2043 -3.6732
4 104.291667 25.041667 0.000 -0.5303 -0.3064 -1.1360 -2.1905 -3.2293 -3.7161
5 104.375000 25.041667 0.000 -0.5849 -0.3304 -1.1717 -2.2202 -3.2540 -3.7600
6 104.458333 25.041667 0.000 -0.6371 -0.3562 -1.2089 -2.2513 -3.2793 -3.8055
7 104.541667 25.041667 0.000 -0.6883 -0.3854 -1.2490 -2.2850 -3.3065 -3.8532
8 104.625000 25.041667 0.000 -0.7400 -0.4199 -1.2938 -2.3227 -3.3366 -3.9039
9 104.708333 25.041667 0.000 -0.7939 -0.4616 -1.3446 -2.3657 -3.3710 -3.9586
10 104.791667 25.041667 0.000 -0.8518 -0.5122 -1.4031 -2.4153 -3.4110 -4.0179
11 104.875000 25.041667 0.000 -0.9154 -0.5731 -1.4706 -2.4727 -3.4576 -4.0827
12 104.958333 25.041667 0.000 -0.9861 -0.6457 -1.5481 -2.5388 -3.5118 -4.1536
13 105.041667 25.041667 0.000 -1.0653 -0.7306 -1.6363 -2.6142 -3.5741 -4.2307
In the remove-restore process, the program can be employed for regional tidal load effect refinement based on the tidal load spherical harmonic coefficient model, and for regional load deformation field refinement based on surface load spherical harmonic model.
Due to the mixing effects between the high-degree spherical harmonic coefficients, the model values of the sea level variation and ocean tidal harmonic constants are not zero in the coastal land area, and the model values of the land equivalent water height are not also zero in the coastal sea area.


Computation of load deformation field by spherical harmonic synthesis
Computation of various load effects using spherical harmonic synthesis
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of various load effects using spherical harmonic synthesis
Computation of various load effects of Earth satellite or outside solid Earth
Computation of load effect time series using spherical harmonic synthesis
Global surface load spherical harmonic analysis and load effect synthesis
Select the calculation point file format
The discrete calculation point file
Open the space calculation point file
Number of rows of the file header 1
Column ordinal number of the height in record 4
Open surface load harmonic coefficient model file
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
Extract deformation field to be plot
Plot↓
The type of surface load Land water EWH
Save process
** When computing the load effects of sea level variations, the height of the calculation point is the normal or orthometric height. When computing the load effects of surface atmosphere or land water variations, the height of the calculation point is the height relative to the Earth's surface.
>> Select the computation function from the 3 control buttons on the top of the interface...
>> [Function] From the surface atmosphere, land water or sea level variation load spherical harmonic coefficient model (m), compute the non-tidal load effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (10μE) or horizontal gravity gradient (NW, to the north and to the west, 10μE) using spherical harmonic synthesis.
>> Open the space calculation point file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/calcpnt.txt.
** Look at the file information in the window below and set the row number of the file header...
>> Open surface load harmonic coefficient model file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/landwcs/swsc2018011012.coe.
** The window below only shows no more than 3000 rows of data in the file!
>> Save the results as C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/loaddfmrst.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-20 09:13:48
>> Complete the computation of the model values of load effects!
>> Computation end time: 2024-10-20 09:15:18
Minimum starting degree of the coefficient model 1
Maximum truncated degree 360
Save the results as
Import setting parameters
Start computation
104.0 114.0 25.0 35.0 0.08333333 0.08333333
1 104.041667 25.041667 0.000 -0.7492 0.3235 1.4184
2 104.125000 25.041667 0.000 -0.7479 0.2727 1.4232
3 104.208333 25.041667 0.000 -0.7470 0.2064 1.4295
4 104.291667 25.041667 0.000 -0.7464 0.1325 1.4368
5 104.375000 25.041667 0.000 -0.7458 0.0603 1.4441
6 104.458333 25.041667 0.000 -0.7451 -0.0016 1.4507
7 104.541667
8 104.625000
9 104.708333
10 104.791667
11 104.875000
Unified analytical computation of various load effects on all-element geodetic variations in whole Earth space.
geoid / height anomaly (mm)
ground gravity (μGal)
radial displacement (mm)

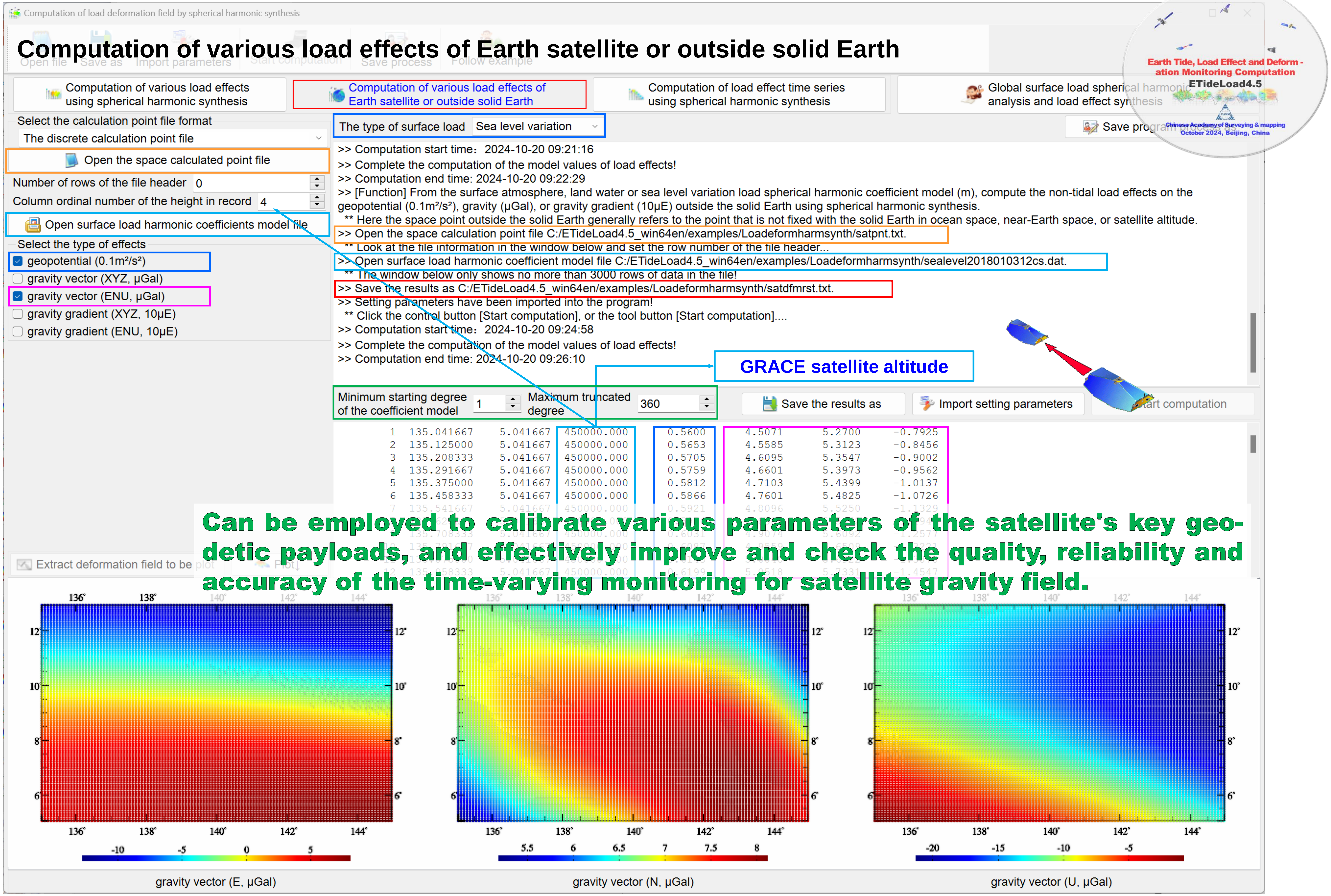


Computation of load deformation field by spherical harmonic synthesis
Computation of various load effects using spherical harmonic synthesis
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of various load effects using spherical harmonic synthesis
Computation of various load effects of Earth satellite or outside solid Earth
Computation of load effect time series using spherical harmonic synthesis
Global surface load spherical harmonic analysis and load effect synthesis
Select the calculation point file format
The calculation surface height grid file
Open the calculation surface height grid file
Open surface load harmonic coefficient model file
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
The type of surface load
Surface atmosphere
Save program process
>> Computation end time: 2024-08-15 09:35:49
>> [Function] From the surface atmosphere, land water or sea level variation load spherical harmonic coefficient model (m), compute the non-tidal load effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (10μE) or horizontal gravity gradient (NW, to the north and to the west, 10μE) using spherical harmonic synthesis.
>> Open the calculation surface height grid file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/airwhCS20170315.txt.
>> The open file is not a grid file!
>> Open the calculation surface height grid file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/zero15m.dat.
>> Open surface load harmonic coefficient model file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/airwhCS20170315.txt.
** The window below only shows no more than 3000 rows of data in the file!
>> Save the results as C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/loadfmdlgrd.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-08-15 09:38:14
>> Complete the computation of the model values!
>> Computation end time: 2024-08-15 09:38:31
Minimum starting degree of the coefficient model
1
Maximum truncated degree
360
Save the results as
Import setting parameters
Start computation
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/loadfmdlgrd.ksi
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/loadfmdlgrd.gra
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/loadfmdlgrd.dpr
Unified analytical computation of various load effects on all-element geodetic variations in whole Earth space.
Extract deformation field to be plot
Plot↓
geoid / height anomaly (mm)
ground gravity (μGal)
radial displacement (mm)

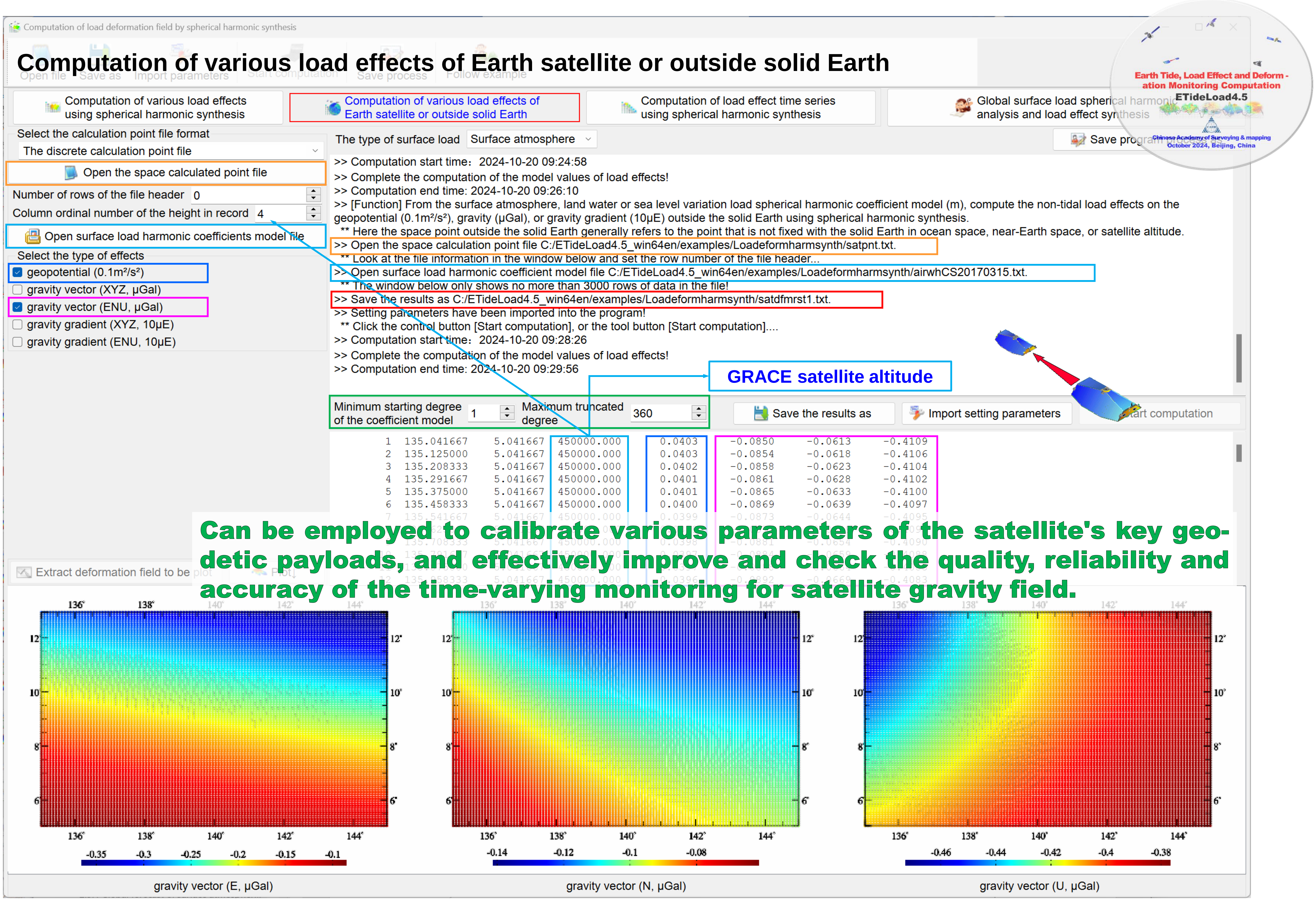
Computation of various load effects of Earth satellite or outside solid Earth



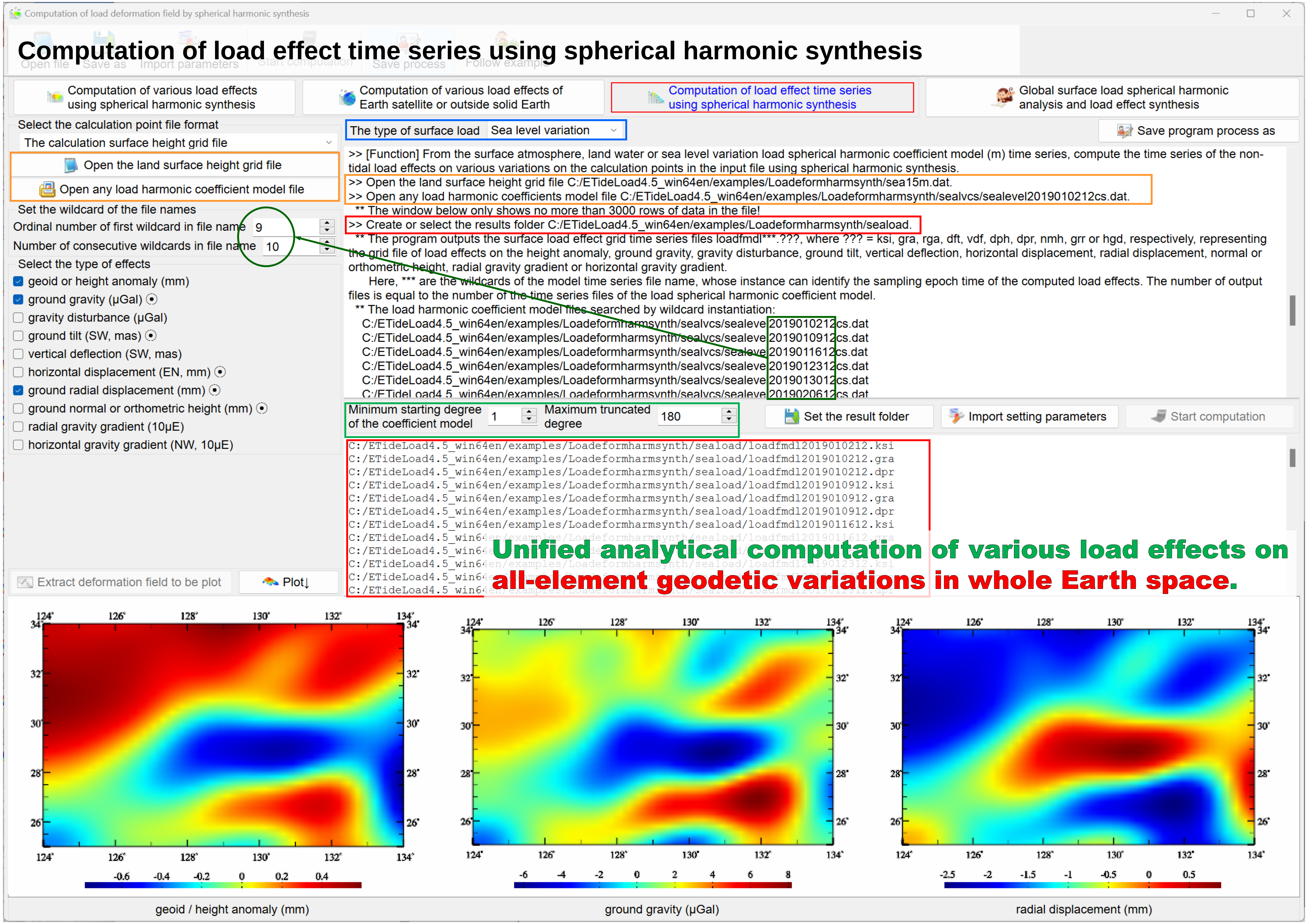
Can be employed to calibrate various parameters of the satellite's key geodetic payloads, and effectively improve and check the quality, reliability and accuracy of the time-varying monitoring for satellite gravity field.

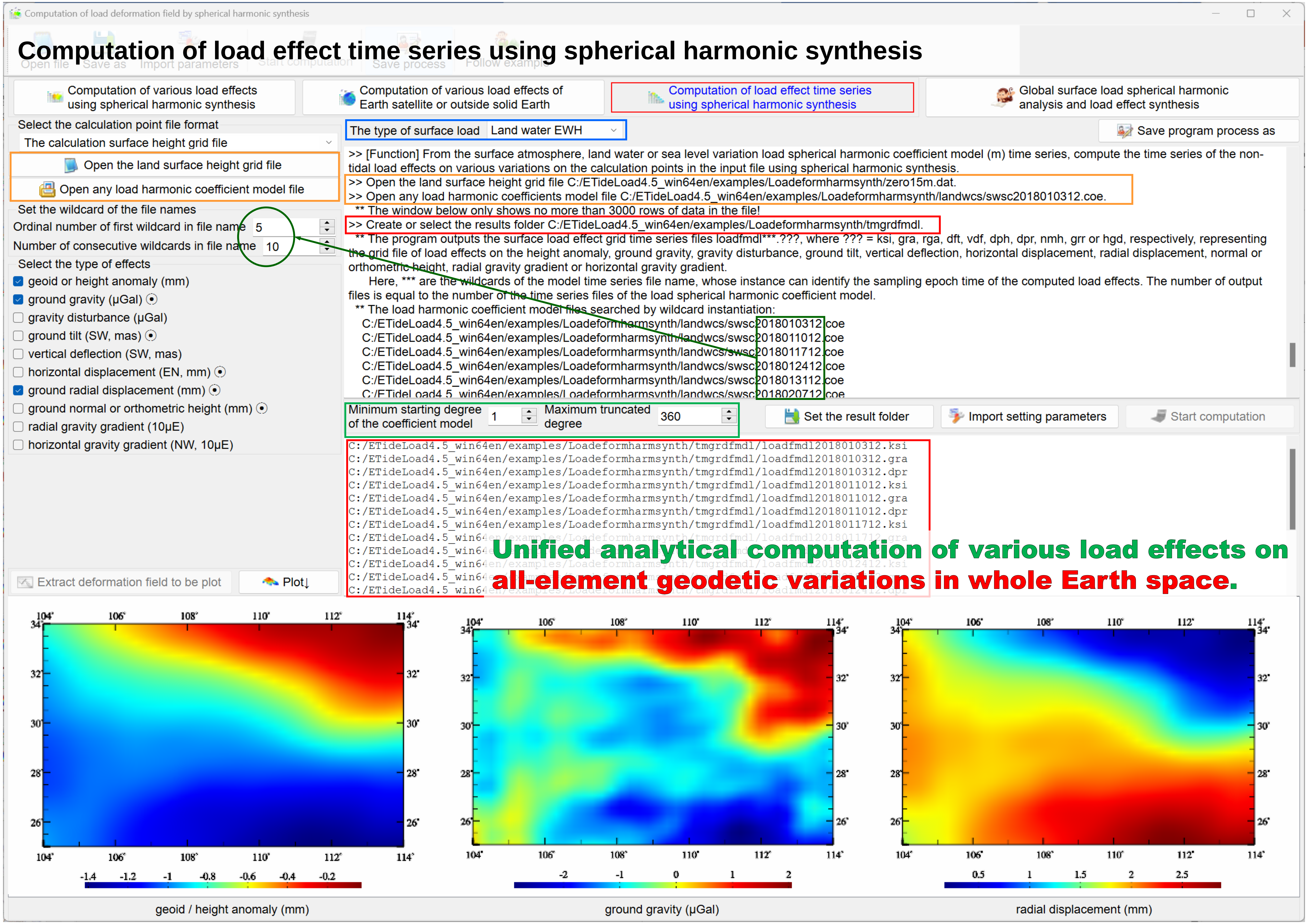


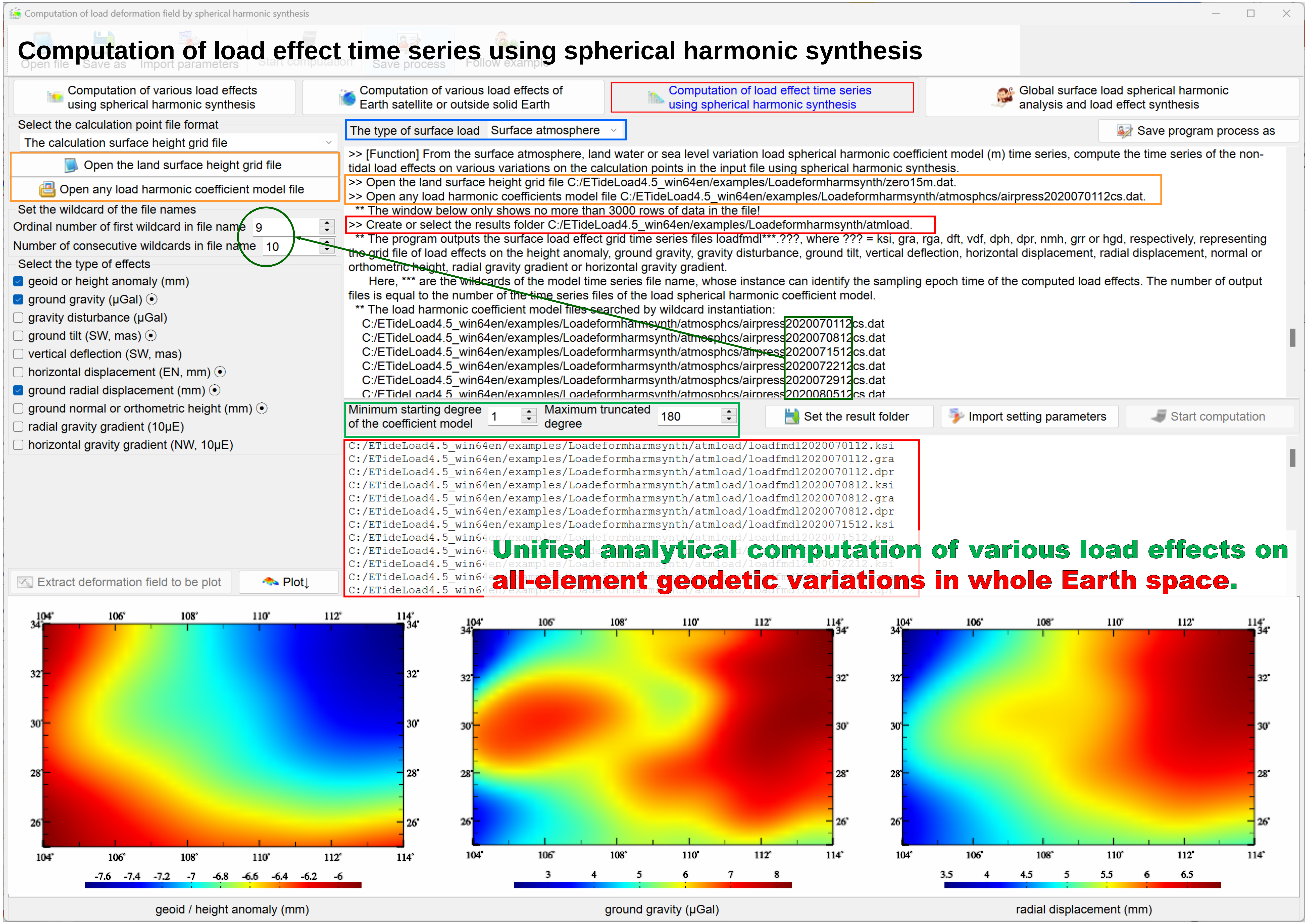
Computation of load deformation field by spherical harmonic synthesis
Computation of various load effects of Earth satellite or outside solid Earth
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of various load effects using spherical harmonic synthesis
Computation of various load effects of Earth satellite or outside solid Earth
Computation of load effect time series using spherical harmonic synthesis
Global surface load spherical harmonic analysis and load effect synthesis
Select the calculation point file format
The discrete calculation point file
Open the space calculated point file
Number of rows of the file header 0
Column ordinal number of the height in record 4
Open surface load harmonic coefficients model file
Select the type of effects
geopotential (0.1m²/s²)
gravity vector (XYZ, μGal)
gravity vector (ENU, μGal)
gravity gradient (XYZ, 10μE)
gravity gradient (ENU, 10μE)
The type of surface load Sea level variation
Save program process
>> Computation start time: 2024-10-20 09:21:16
>> Complete the computation of the model values of load effects!
>> Computation end time: 2024-10-20 09:22:29
>> [Function] From the surface atmosphere, land water or sea level variation load spherical harmonic coefficient model (m), compute the non-tidal load effects on the geopotential (0.1m²/s²), gravity (μGal), or gravity gradient (10μE) outside the solid Earth using spherical harmonic synthesis.
** Here the space point outside the solid Earth generally refers to the point that is not fixed with the solid Earth in ocean space, near-Earth space, or satellite altitude.
>> Open the space calculation point file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/satpnt.txt.
** Look at the file information in the window below and set the row number of the file header...
>> Open surface load harmonic coefficient model file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/sealevel2018010312cs.dat.
** The window below only shows no more than 3000 rows of data in the file!
>> Save the results as C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/satdfmrst.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-20 09:24:58
>> Complete the computation of the model values of load effects!
>> Computation end time: 2024-10-20 09:26:10
GRACE satellite altitude
Minimum starting degree of the coefficient model 1
Maximum truncated degree 360
Save the results as
Import setting parameters
Start computation
1 135.041667 5.041667 450000.000 0.5600 4.5071 5.2700 -0.7925
2 135.125000 5.041667 450000.000 0.5653 4.5585 5.3123 -0.8456
3 135.208333 5.041667 450000.000 0.5705 4.6095 5.3547 -0.9002
4 135.291667 5.041667 450000.000 0.5759 4.6601 5.3973 -0.9562
5 135.375000 5.041667 450000.000 0.5812 4.7103 5.4399 -1.0137
6 135.458333 5.041667 450000.000 0.5866 4.7601 5.4825 -1.0726
Extract deformation field to be plot
Can be employed to calibrate various parameters of the satellite's key geodetic payloads, and effectively improve and check the quality, reliability and accuracy of the time-varying monitoring for satellite gravity field.
gravity vector (E, μGal)
gravity vector (N, μGal)
gravity vector (U, μGal)

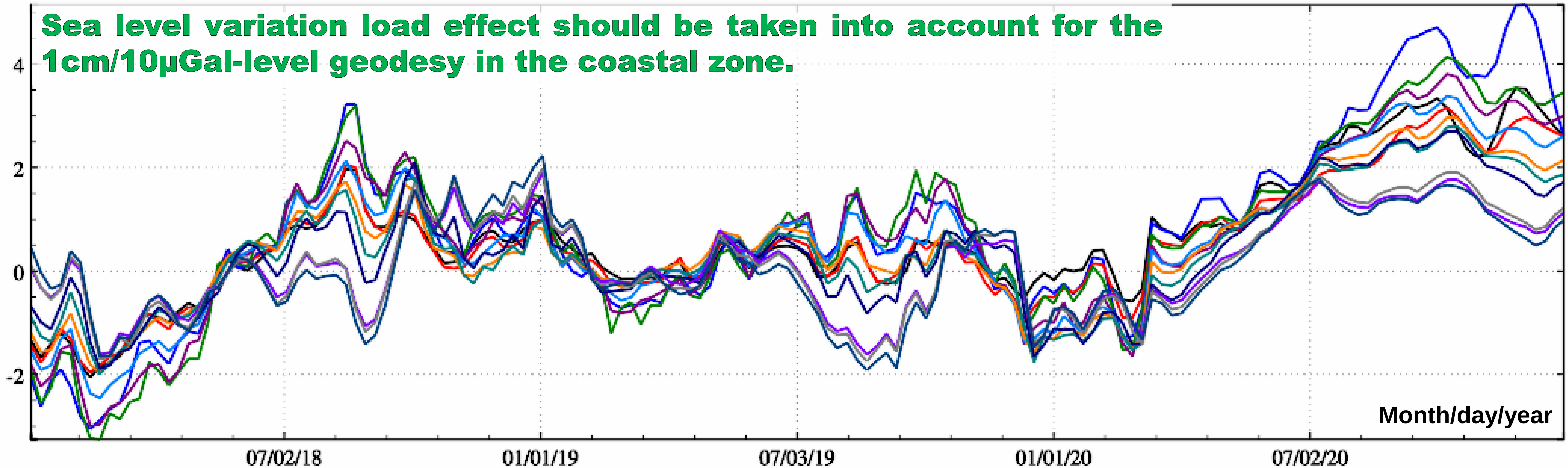


Computation of load deformation field by spherical harmonic synthesis
Computation of various load effects of Earth satellite or outside solid Earth
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of various load effects using spherical harmonic synthesis
Computation of various load effects of Earth satellite or outside solid Earth
Computation of load effect time series using spherical harmonic synthesis
Global surface load spherical harmonic analysis and load effect synthesis
Select the calculation point file format
The discrete calculation point file
Open the space calculated point file
Number of rows of the file header 0
Column ordinal number of the height in record 4
Open surface load harmonic coefficients model file
Select the type of effects
geopotential (0.1m²/s²)
gravity vector (XYZ, μGal)
gravity vector (ENU, μGal)
gravity gradient (XYZ, 10μE)
gravity gradient (ENU, 10μE)
The type of surface load Surface atmosphere
Save program process
>> Computation start time: 2024-10-20 09:24:58
>> Complete the computation of the model values of load effects!
>> Computation end time: 2024-10-20 09:26:10
>> [Function] From the surface atmosphere, land water or sea level variation load spherical harmonic coefficient model (m), compute the non-tidal load effects on the geopotential (0.1m²/s²), gravity (μGal), or gravity gradient (10μE) outside the solid Earth using spherical harmonic synthesis.
** Here the space point outside the solid Earth generally refers to the point that is not fixed with the solid Earth in ocean space, near-Earth space, or satellite altitude.
>> Open the space calculation point file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/satpnt.txt.
** Look at the file information in the window below and set the row number of the file header...
>> Open surface load harmonic coefficient model file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/airwhCS20170315.txt.
** The window below only shows no more than 3000 rows of data in the file!
>> Save the results as C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/satdfmrst1.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-20 09:28:26
>> Complete the computation of the model values of load effects!
>> Computation end time: 2024-10-20 09:29:56
GRACE satellite altitude
Minimum starting degree of the coefficient model 1
Maximum truncated degree 360
Save the results as
Import setting parameters
Start computation
1 135.041667 5.041667 450000.000 0.0403 -0.0850 -0.0613 -0.4109
2 135.125000 5.041667 450000.000 0.0403 -0.0854 -0.0618 -0.4106
3 135.208333 5.041667 450000.000 0.0402 -0.0858 -0.0623 -0.4104
4 135.291667 5.041667 450000.000 0.0401 -0.0861 -0.0628 -0.4102
5 135.375000 5.041667 450000.000 0.0401 -0.0865 -0.0633 -0.4100
6 135.458333 5.041667 450000.000 0.0400 -0.0869 -0.0639 -0.4097
Can be employed to calibrate various parameters of the satellite's key geodetic payloads, and effectively improve and check the quality, reliability and accuracy of the time-varying monitoring for satellite gravity field.
Extract deformation field to be plot
gravity vector (E, μGal)
gravity vector (N, μGal)
gravity vector (U, μGal)

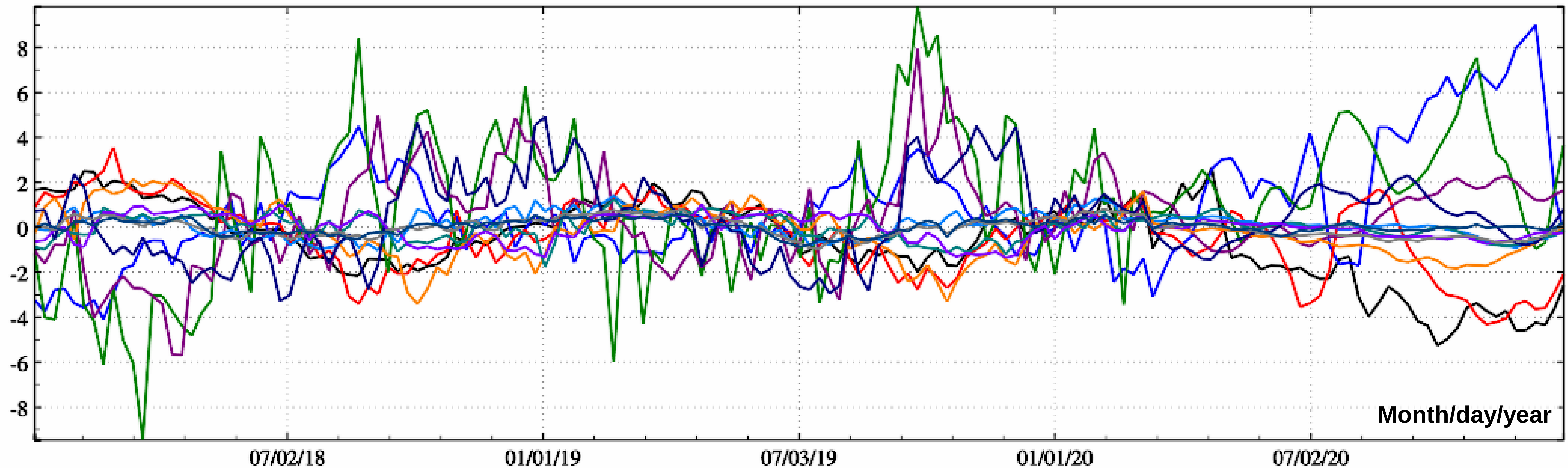

Computation of load deformation field by spherical harmonic synthesis
Computation of load effect time series using spherical harmonic synthesis
Computation of various load effects using spherical harmonic synthesis
Computation of various load effects of Earth satellite or outside solid Earth
Computation of load effect time series using spherical harmonic synthesis
Global surface load spherical harmonic analysis and load effect synthesis
Select the calculation point file format
The calculation surface height grid file
Open the land surface height grid file
Open any load harmonic coefficient model file
Set the wildcard of the file names
Ordinal number of first wildcard in file name 9
Number of consecutive wildcards in file name 10
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
The type of surface load
Sea level variation
Save program process as
>> [Function] From the surface atmosphere, land water or sea level variation load spherical harmonic coefficient model (m) time series, compute the time series of the non-tidal load effects on various variations on the calculation points in the input file using spherical harmonic synthesis.
>> Open the land surface height grid file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/sea15m.dat.
>> Open any load harmonic coefficients model file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/sealvcs/sealevel2019010212cs.dat.
** The window below only shows no more than 3000 rows of data in the file!
>> Create or select the results folder C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/seaload.
** The program outputs the surface load effect grid time series files loadfmdl***.???, where ??? = ksi, gra, rga, dft, vdf, dph, dpr, nmh, grr or hgd, respectively, representing the grid file of load effects on the height anomaly, ground gravity, gravity disturbance, ground tilt, vertical deflection, horizontal displacement, radial displacement, normal or orthometric height, radial gravity gradient or horizontal gravity gradient.
Here, *** are the wildcards of the model time series file name, whose instance can identify the sampling epoch time of the computed load effects. The number of output files is equal to the number of the time series files of the load spherical harmonic coefficient model.
** The load harmonic coefficient model files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/sealvcs/sealevel2019010212cs.dat
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/sealvcs/sealevel2019010912cs.dat
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/sealvcs/sealevel2019011612cs.dat
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/sealvcs/sealevel2019012312cs.dat
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/sealvcs/sealevel2019013012cs.dat
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/sealvcs/sealevel2019020612cs.dat
Minimum starting degree of the coefficient model 1
Maximum truncated degree 180
Set the result folder
Import setting parameters
Start computation
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/seaload/loadfmdl2019010212.ksi
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/seaload/loadfmdl2019010212.gra
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/seaload/loadfmdl2019010212.dpr
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/seaload/loadfmdl2019010912.ksi
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/seaload/loadfmdl2019010912.gra
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/seaload/loadfmdl2019010912.dpr
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/seaload/loadfmdl2019011612.ksi
Extract deformation field to be plot
Plot↓
Unified analytical computation of various load effects on all-element geodetic variations in whole Earth space.
geoid / height anomaly (mm)
ground gravity (μGal)
radial displacement (mm)


Computation of load deformation field by spherical harmonic synthesis
Computation of load effect time series using spherical harmonic synthesis
Computation of various load effects using spherical harmonic synthesis
Computation of various load effects of Earth satellite or outside solid Earth
Computation of load effect time series using spherical harmonic synthesis
Global surface load spherical harmonic analysis and load effect synthesis
Select the calculation point file format
The calculation surface height grid file
Open the land surface height grid file
Open any load harmonic coefficient model file
Set the wildcard of the file names
Ordinal number of first wildcard in file name 5
Number of consecutive wildcards in file name 10
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
The type of surface load Land water EWH
Save program process as
>> [Function] From the surface atmosphere, land water or sea level variation load spherical harmonic coefficient model (m) time series, compute the time series of the non-tidal load effects on various variations on the calculation points in the input file using spherical harmonic synthesis.
>> Open the land surface height grid file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/zero15m.dat.
>> Open any load harmonic coefficients model file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/landwcs/swsc2018010312.coe.
** The window below only shows no more than 3000 rows of data in the file!
>> Create or select the results folder C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/tmgrdfmdl.
** The program outputs the surface load effect grid time series files loadfmdl***.???, where ??? = ksi, gra, rga, dft, vdf, dph, dpr, nmh, grr or hgd, respectively, representing the grid file of load effects on the height anomaly, ground gravity, gravity disturbance, ground tilt, vertical deflection, horizontal displacement, radial displacement, normal or orthometric height, radial gravity gradient or horizontal gravity gradient.
Here, *** are the wildcards of the model time series file name, whose instance can identify the sampling epoch time of the computed load effects. The number of output files is equal to the number of the time series files of the load spherical harmonic coefficient model.
** The load harmonic coefficient model files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/landwcs/swsc2018010312.coe
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/landwcs/swsc2018011012.coe
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/landwcs/swsc2018011712.coe
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/landwcs/swsc2018012412.coe
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/landwcs/swsc2018013112.coe
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/landwcs/swsc2018020712.coe
Minimum starting degree of the coefficient model 1
Maximum truncated degree 360
Set the result folder
Import setting parameters
Start computation
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/tmgrdfmdl/loadfmdl2018010312.ksi
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/tmgrdfmdl/loadfmdl2018010312.gra
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/tmgrdfmdl/loadfmdl2018010312.dpr
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/tmgrdfmdl/loadfmdl2018011012.ksi
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/tmgrdfmdl/loadfmdl2018011012.gra
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/tmgrdfmdl/loadfmdl2018011012.dpr
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/tmgrdfmdl/loadfmdl2018011712.ksi
Unified analytical computation of various load effects on all-element geodetic variations in whole Earth space.
Extract deformation field to be plot
Plot↓
104° 106° 108° 110° 112° 114°
34° 32° 30° 28° 26°
-1.4 -1.2 -1 -0.8 -0.6 -0.4 -0.2
-2 -1 0 1 2
0.5 1 1.5 2 2.5
geoid / height anomaly (mm)
ground gravity (μGal)
radial displacement (mm)

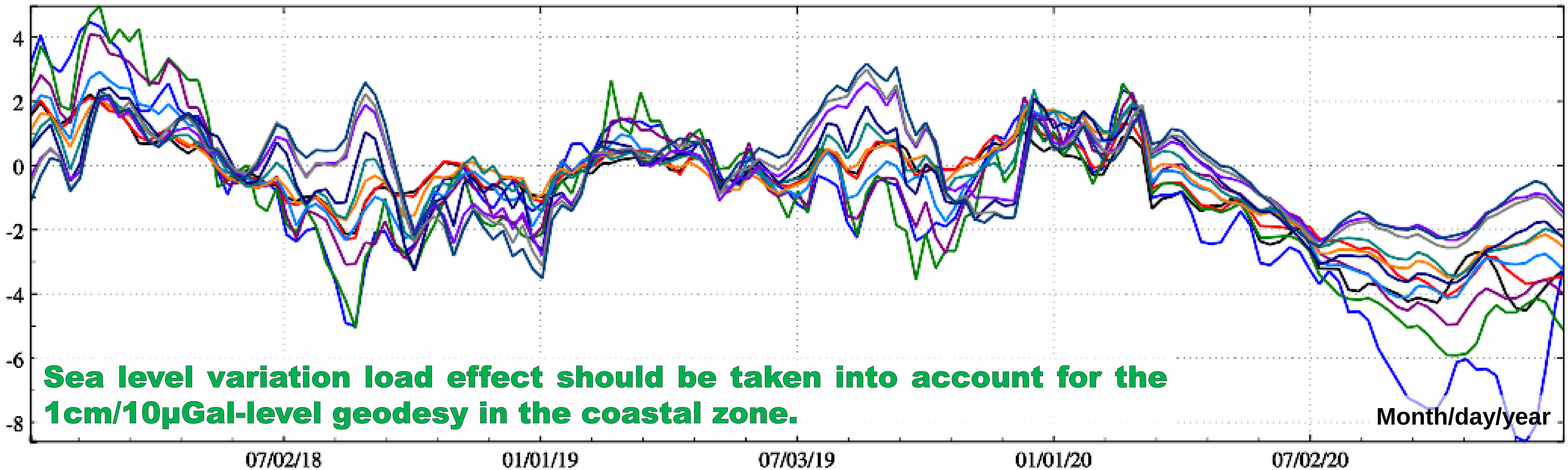

Computation of load deformation field by spherical harmonic synthesis
Computation of load effect time series using spherical harmonic synthesis
Computation of various load effects using spherical harmonic synthesis
Computation of various load effects of Earth satellite or outside solid Earth
Computation of load effect time series using spherical harmonic synthesis
Global surface load spherical harmonic analysis and load effect synthesis
Select the calculation point file format
The calculation surface height grid file
Open the land surface height grid file
Open any load harmonic coefficient model file
Set the wildcard of the file names
Ordinal number of first wildcard in file name 9
Number of consecutive wildcards in file name 10
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (10μE)
horizontal gravity gradient (NW, 10μE)
Extract deformation field to be plot
Plot↓
The type of surface load Surface atmosphere
Save program process as
>> [Function] From the surface atmosphere, land water or sea level variation load spherical harmonic coefficient model (m) time series, compute the time series of the non-tidal load effects on various variations on the calculation points in the input file using spherical harmonic synthesis.
>> Open the land surface height grid file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/zero15m.dat.
>> Open any load harmonic coefficients model file C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmosphcs/airpress2020070112cs.dat.
** The window below only shows no more than 3000 rows of data in the file!
>> Create or select the results folder C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmload.
** The program outputs the surface load effect grid time series files loadfmdl***.???, where ??? = ksi, gra, rga, dft, vdf, dph, dpr, nmh, grr or hgd, respectively, representing the grid file of load effects on the height anomaly, ground gravity, gravity disturbance, ground tilt, vertical deflection, horizontal displacement, radial displacement, normal or orthometric height, radial gravity gradient or horizontal gravity gradient.
Here, *** are the wildcards of the model time series file name, whose instance can identify the sampling epoch time of the computed load effects. The number of output files is equal to the number of the time series files of the load spherical harmonic coefficient model.
** The load harmonic coefficient model files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmosphcs/airpress2020070112cs.dat
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmosphcs/airpress2020070812cs.dat
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmosphcs/airpress2020071512cs.dat
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmosphcs/airpress2020072212cs.dat
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmosphcs/airpress2020072912cs.dat
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmosphcs/airpress2020080512cs.dat
Minimum starting degree of the coefficient model 1
Maximum truncated degree 180
Set the result folder
Import setting parameters
Start computation
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmload/loadfmdl2020070112.ksi
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmload/loadfmdl2020070112.gra
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmload/loadfmdl2020070112.dpr
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmload/loadfmdl2020070812.ksi
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmload/loadfmdl2020070812.gra
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmload/loadfmdl2020070812.dpr
C:/ETideLoad4.5_win64en/examples/Loadeformharmsynth/atmload/loadfmdl2020071512.ksi
Unified analytical computation of various load effects on all-element geodetic variations in whole Earth space.
104° 106° 108° 110° 112° 114°
34° 32° 30° 28° 26°
-7.6 -7.4 -7.2 -7 -6.8 -6.6 -6.4 -6.2 -6
3 4 5 6 7 8
3.5 4 4.5 5 5.5 6 6.5
geoid / height anomaly (mm)
ground gravity (μGal)
radial displacement (mm)



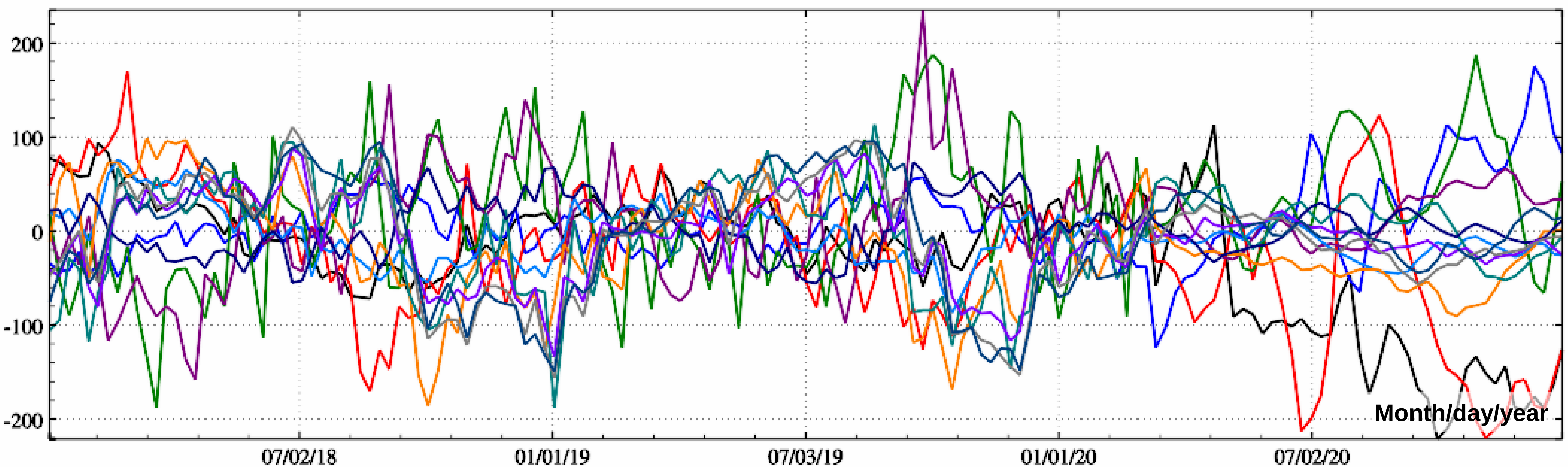
Sea level variation load effect weekly time series on the geoid (mm) at 12 tide gauges along Chinese coast



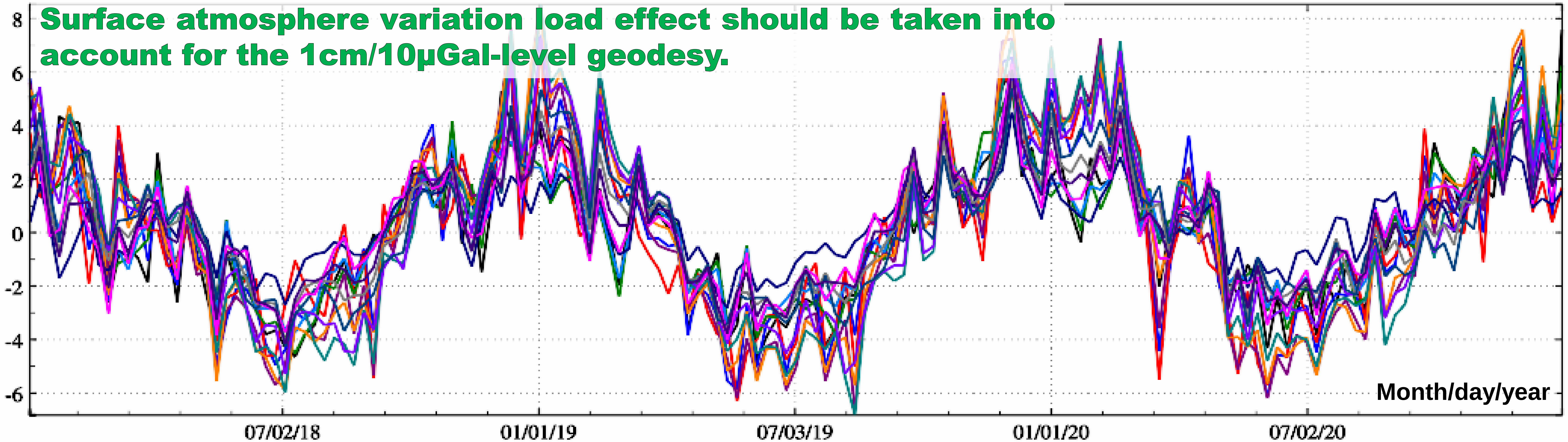
Sea level variation load effect weekly time series on the ground gravity (μGal) at 12 tide gauges along Chinese coast



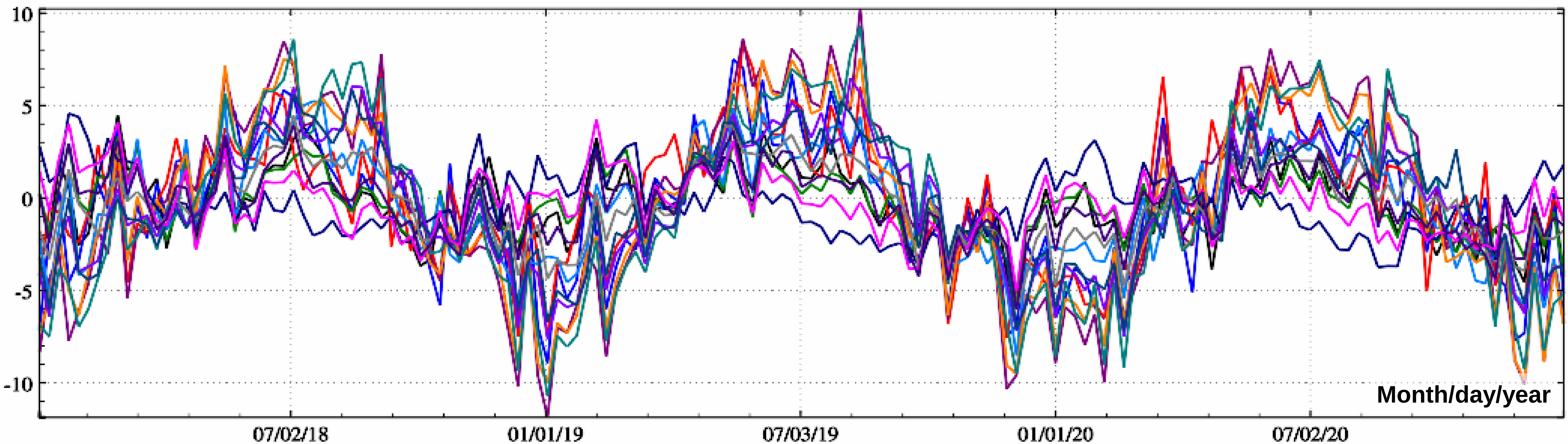
Sea level variation load effect weekly time series on the ellipsoidal height (mm) at 12 tide gauges along Chinese coast



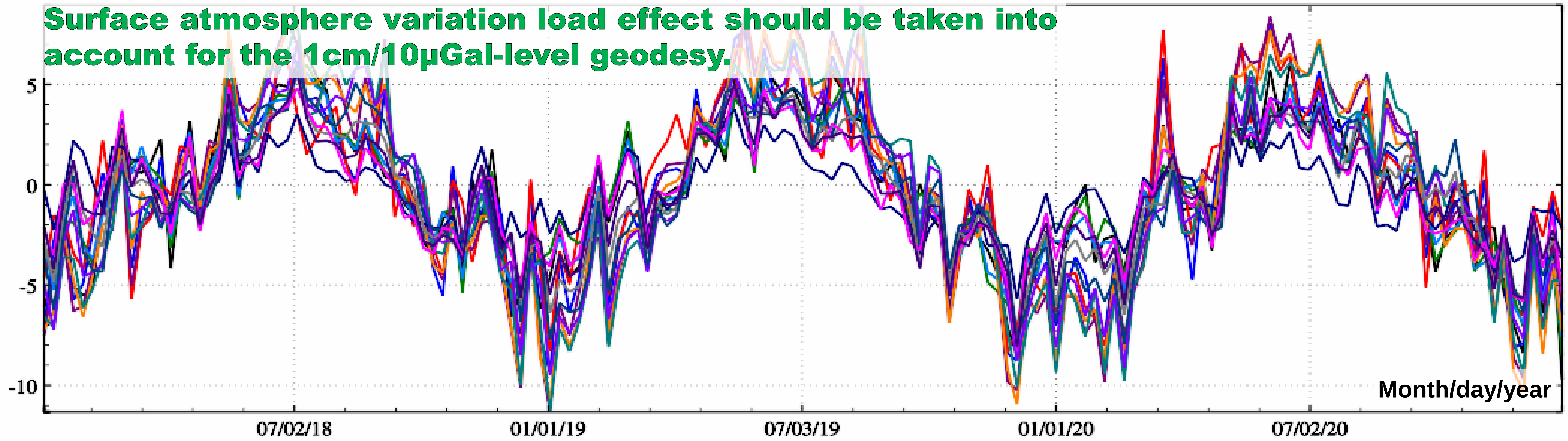
Sea level variation load effect weekly time series on the radial gradient (10μE) at 12 tide gauges along Chinese coast



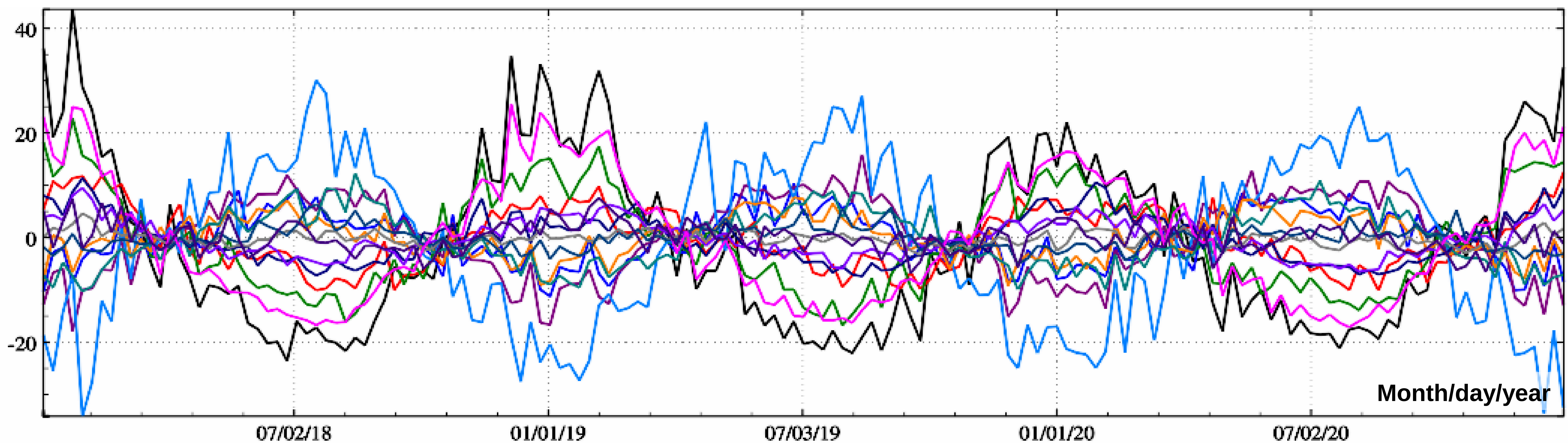
Surface atmosphere variation load effect weekly time series on the geoid (mm) at 14 CORS stations in mainland China



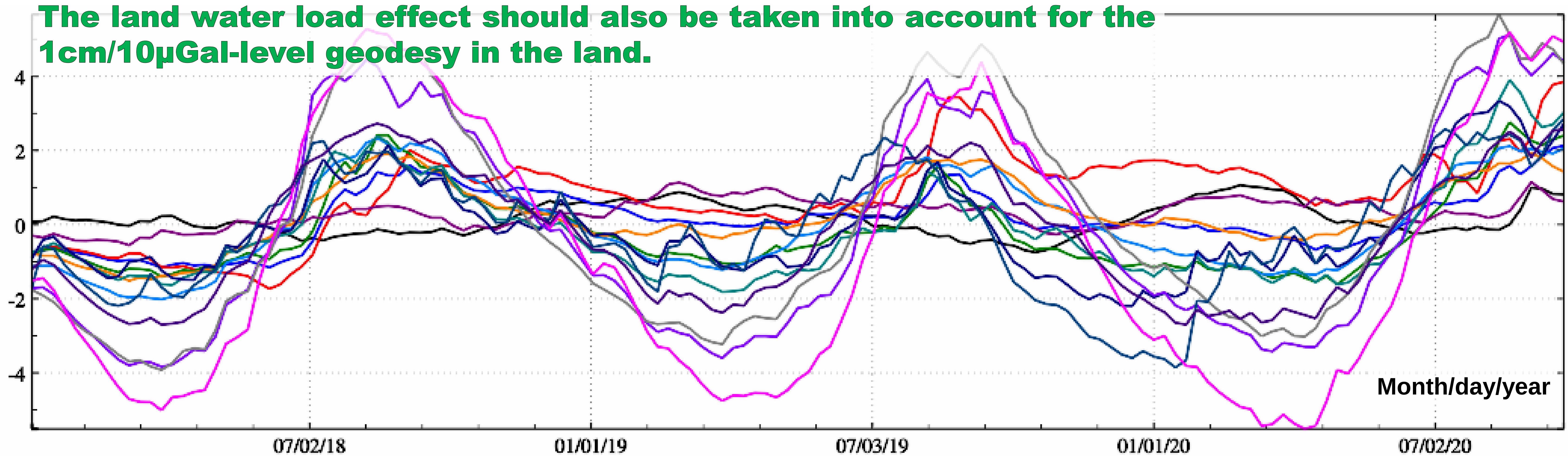
Surface atmosphere variation load effect weekly time series on the ground gravity (μGal) at 14 CORS stations in mainland China



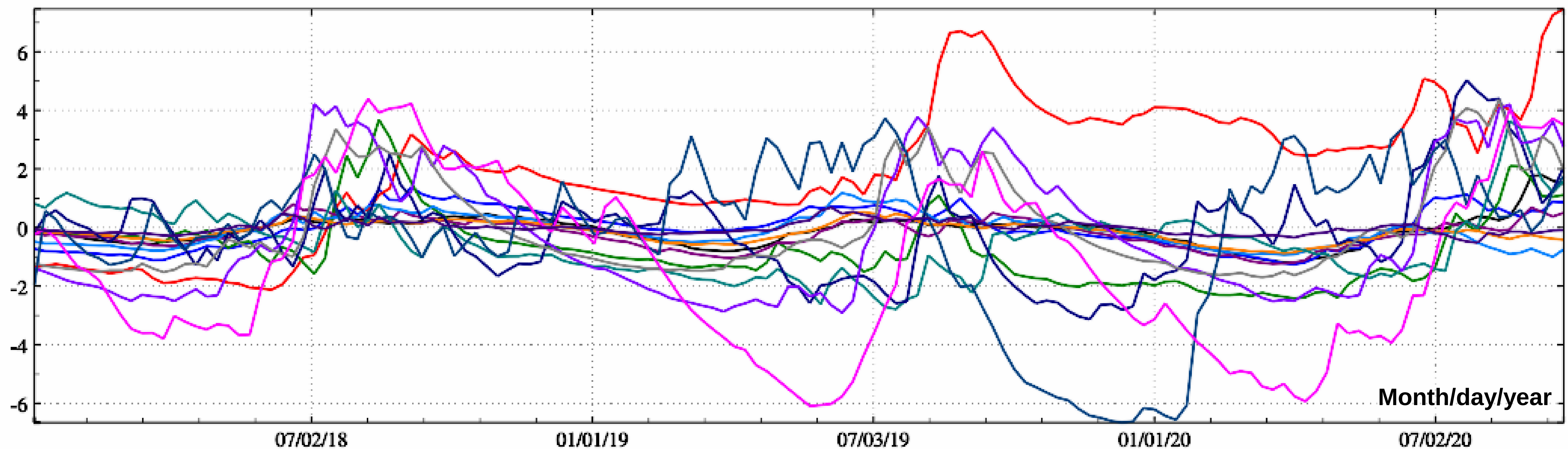
Surface atmosphere variation load effect weekly time series on the ellipsoidal height (mm) at 14 CORS stations in mainland China



Surface atmosphere variation load effect weekly time series on the radial gradient (10μE) at 14 CORS stations in mainland China

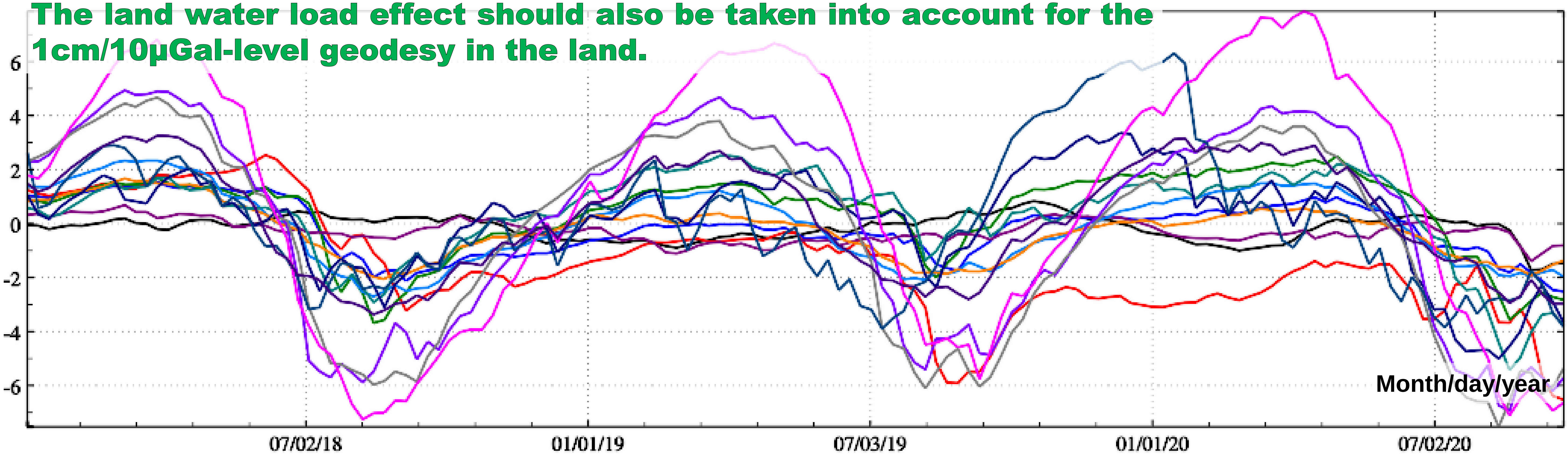


Global land water variation load effect weekly time series on the geoid (mm) at 14 CORS stations in mainland China

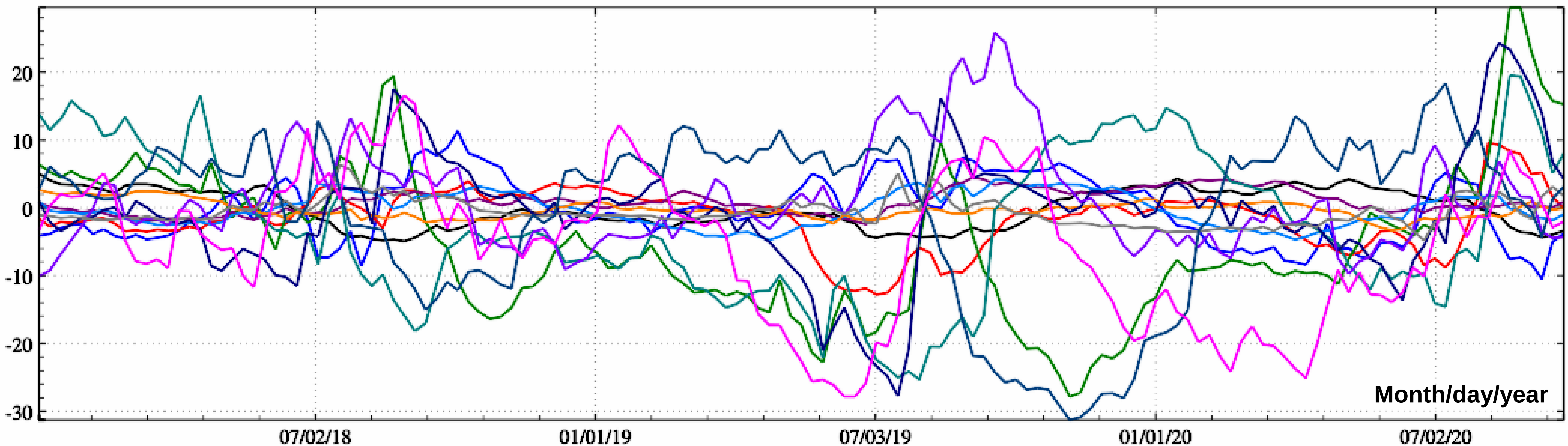


Global land water variation load effect weekly time series on the ground gravity (μGal) at 14 CORS stations in mainland China

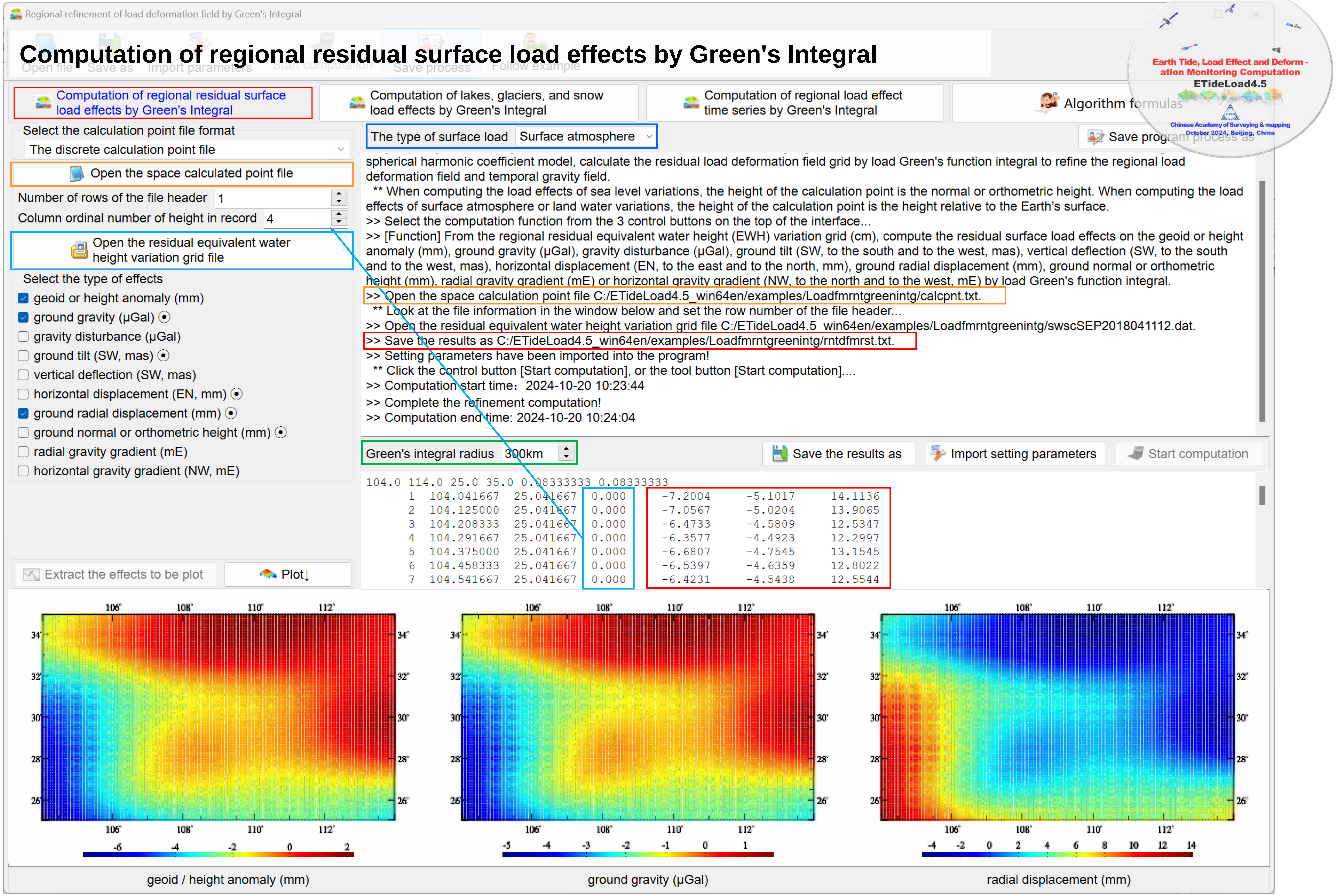
The land water load effect should also be taken into account for the 1cm/10μGal-level geodesy in the land.



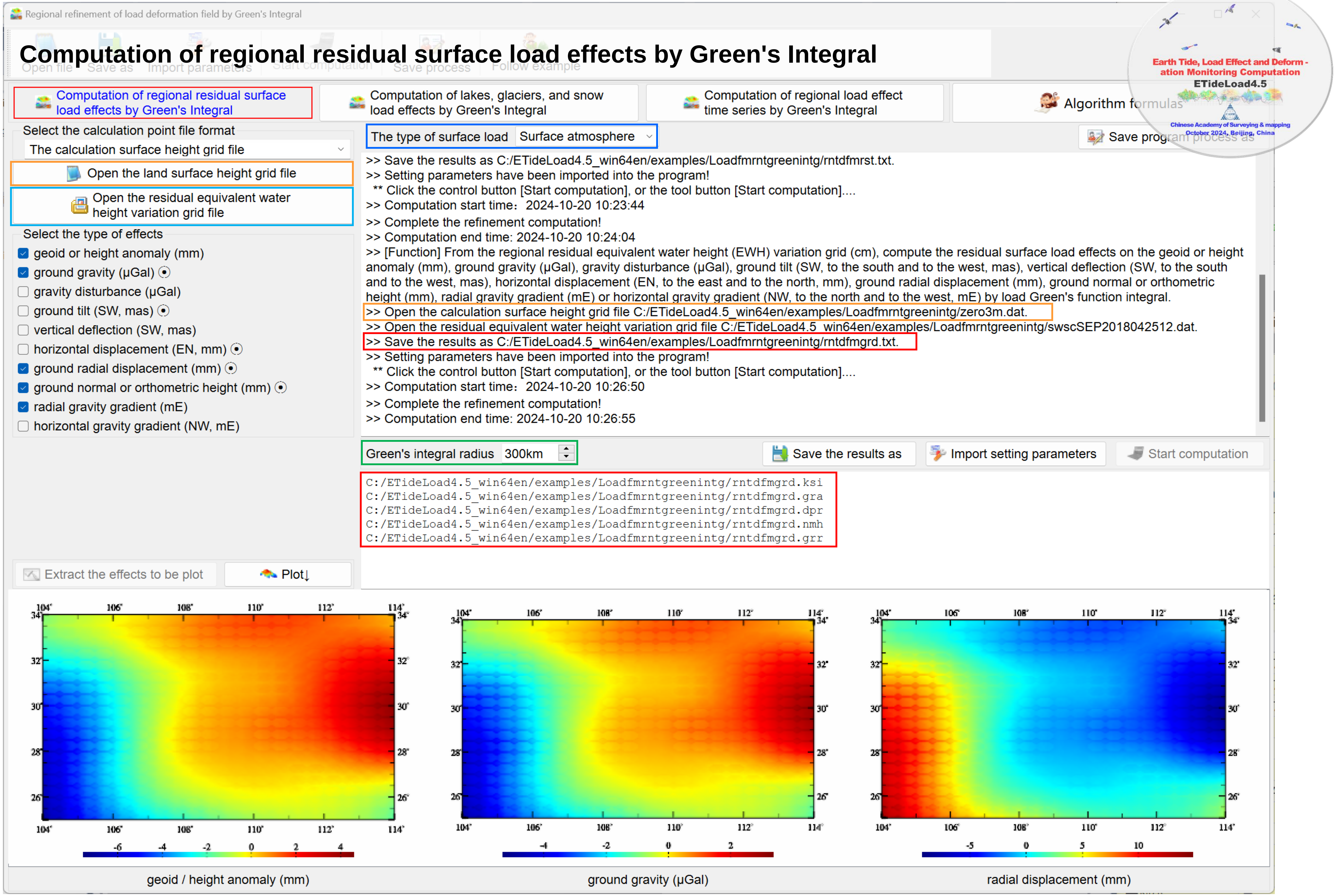
Global land water variation load effect weekly time series on the ellipsoidal height (mm) at 14 CORS stations in mainland China

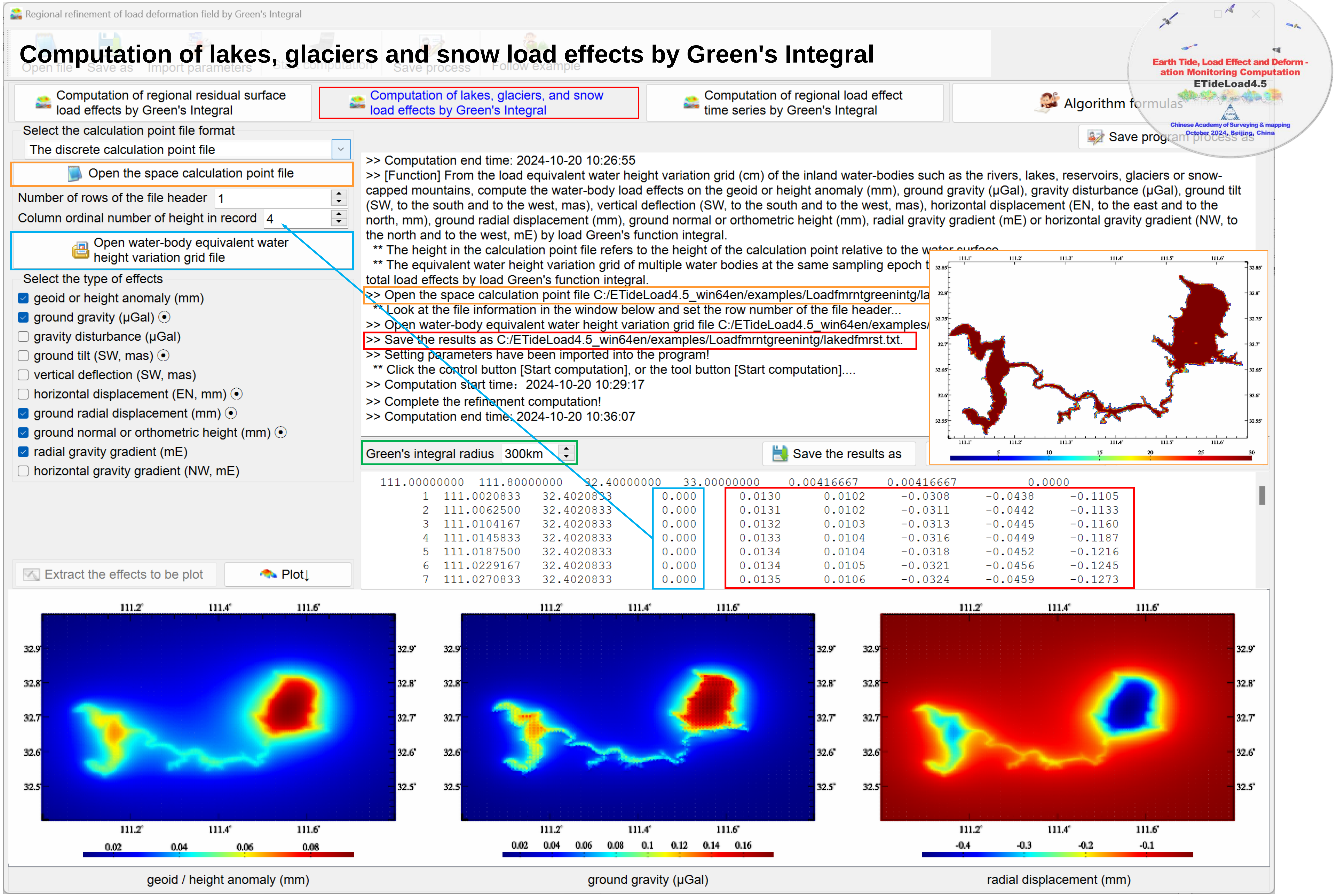


Global land water variation load effect weekly time series on the radial gradient (10μE) at 14 CORS stations in mainland China

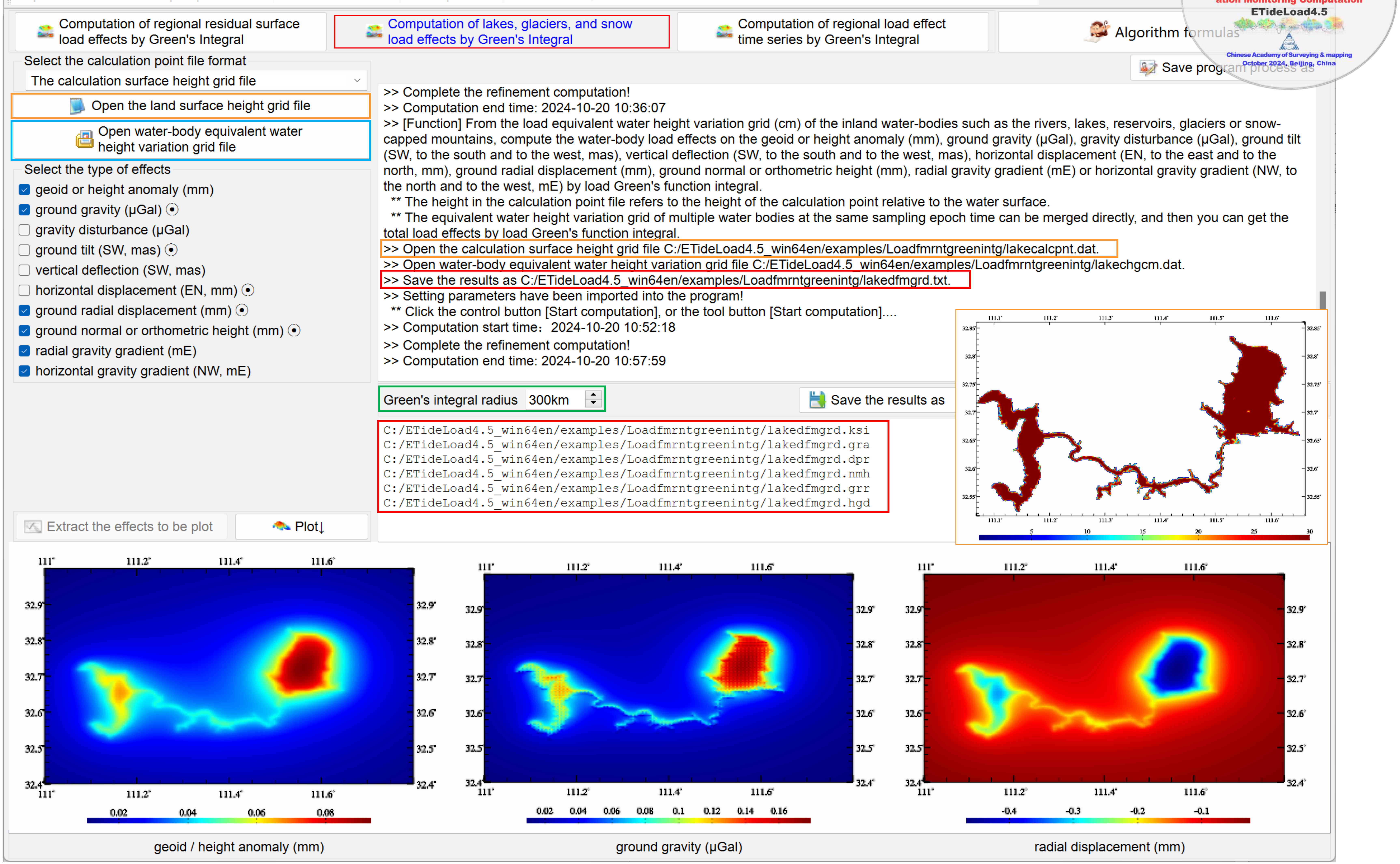

Regional refinement of load deformation field by Green's Integral
Computation of regional residual surface load effects by Green's Integral
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of regional residual surface load effects by Green's Integral
Computation of lakes, glaciers, and snow load effects by Green's Integral
Computation of regional load effect time series by Green's Integral
Algorithm formulas
Select the calculation point file format
The discrete calculation point file
Open the space calculated point file
Number of rows of the file header 1
Column ordinal number of height in record 4
Open the residual equivalent water height variation grid file
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (mE)
horizontal gravity gradient (NW, mE)
Extract the effects to be plot
Plot↓
The type of surface load Surface atmosphere
Save program process as
spherical harmonic coefficient model, calculate the residual load deformation field grid by load Green's function integral to refine the regional load deformation field and temporal gravity field.
** When computing the load effects of sea level variations, the height of the calculation point is the normal or orthometric height. When computing the load effects of surface atmosphere or land water variations, the height of the calculation point is the height relative to the Earth's surface.
>> Select the computation function from the 3 control buttons on the top of the interface...
>> [Function] From the regional residual equivalent water height (EWH) variation grid (cm), compute the residual surface load effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (mE) or horizontal gravity gradient (NW, to the north and to the west, mE) by load Green's function integral.
>> Open the space calculation point file C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/calcpnt.txt.
** Look at the file information in the window below and set the row number of the file header...
>> Open the residual equivalent water height variation grid file C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/swscSEP2018041112.dat.
>> Save the results as C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/rntdfmrst.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-20 10:23:44
>> Complete the refinement computation!
>> Computation end time: 2024-10-20 10:24:04
Green's integral radius 300km
Save the results as
Import setting parameters
Start computation
104.0 114.0 25.0 35.0 0.08333333 0.08333333
1 104.041667 25.041667 0.000 -7.2004 -5.1017 14.1136
2 104.125000 25.041667 0.000 -7.0567 -5.0204 13.9065
3 104.208333 25.041667 0.000 -6.4733 -4.5809 12.5347
4 104.291667 25.041667 0.000 -6.3577 -4.4923 12.2997
5 104.375000 25.041667 0.000 -6.6807 -4.7545 13.1545
6 104.458333 25.041667 0.000 -6.5397 -4.6359 12.8022
7 104.541667 25.041667 0.000 -6.4231 -4.5438 12.5544
geoid / height anomaly (mm)
ground gravity (μGal)
radial displacement (mm)

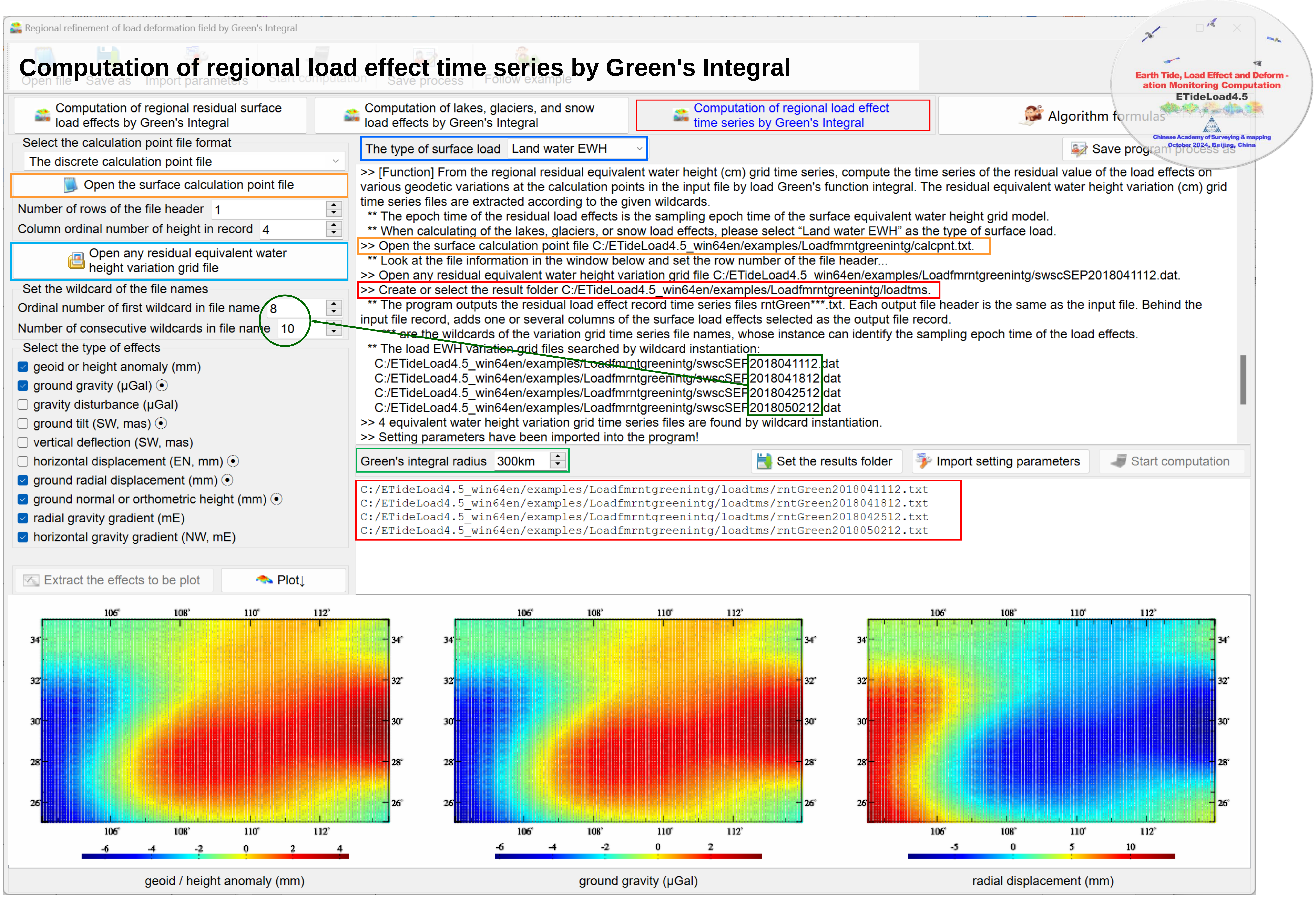
Computation of regional residual surface load effects by Green's Integral



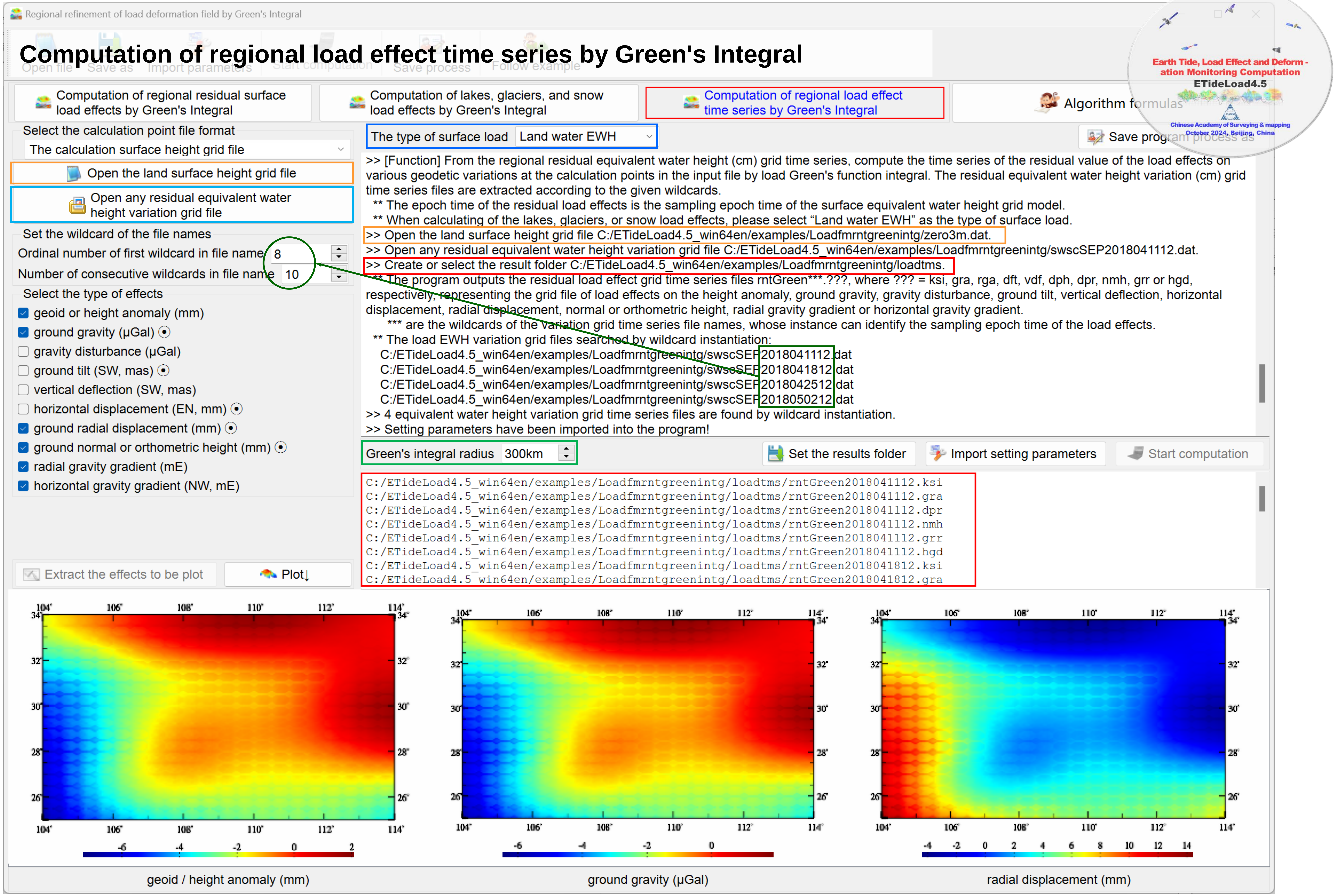

Regional refinement of load deformation field by Green's Integral
Computation of lakes, glaciers and snow load effects by Green's Integral
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of regional residual surface load effects by Green's Integral
Computation of lakes, glaciers, and snow load effects by Green's Integral
Computation of regional load effect time series by Green's Integral
Algorithm formulas
Save program process as
Select the calculation point file format
The discrete calculation point file
Open the space calculation point file
Number of rows of the file header 1
Column ordinal number of height in record 4
Open water-body equivalent water height variation grid file
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (mE)
horizontal gravity gradient (NW, mE)
Extract the effects to be plot
Plot↓
>> Computation end time: 2024-10-20 10:26:55
>> [Function] From the load equivalent water height variation grid (cm) of the inland water-bodies such as the rivers, lakes, reservoirs, glaciers or snow-capped mountains, compute the water-body load effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (mE) or horizontal gravity gradient (NW, to the north and to the west, mE) by load Green's function integral.
** The height in the calculation point file refers to the height of the calculation point relative to the water surface.
** The equivalent water height variation grid of multiple water bodies at the same sampling epoch t
total load effects by load Green's function integral.
>> Open the space calculation point file C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/la
** Look at the file information in the window below and set the row number of the file header...
>> Open water-body equivalent water height variation grid file C:/ETideLoad4.5_win64en/examples/
>> Save the results as C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/lakedfmrst.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-20 10:29:17
>> Complete the refinement computation!
>> Computation end time: 2024-10-20 10:36:07
Green's integral radius 300km
Save the results as
111.00000000 111.80000000 32.40000000 33.00000000 0.00416667 0.00416667 0.0000
1 111.0020833 32.4020833 0.000 0.0130 0.0102 -0.0308 -0.0438 -0.1105
2 111.0062500 32.4020833 0.000 0.0131 0.0102 -0.0311 -0.0442 -0.1133
3 111.0104167 32.4020833 0.000 0.0132 0.0103 -0.0313 -0.0445 -0.1160
4 111.0145833 32.4020833 0.000 0.0133 0.0104 -0.0316 -0.0449 -0.1187
5 111.0187500 32.4020833 0.000 0.0134 0.0104 -0.0318 -0.0452 -0.1216
6 111.0229167 32.4020833 0.000 0.0134 0.0105 -0.0321 -0.0456 -0.1245
7 111.0270833 32.4020833 0.000 0.0135 0.0106 -0.0324 -0.0459 -0.1273
geoid / height anomaly (mm)
ground gravity (μGal)
radial displacement (mm)

Computation of lakes, glaciers and snow load effects by Green's Integral

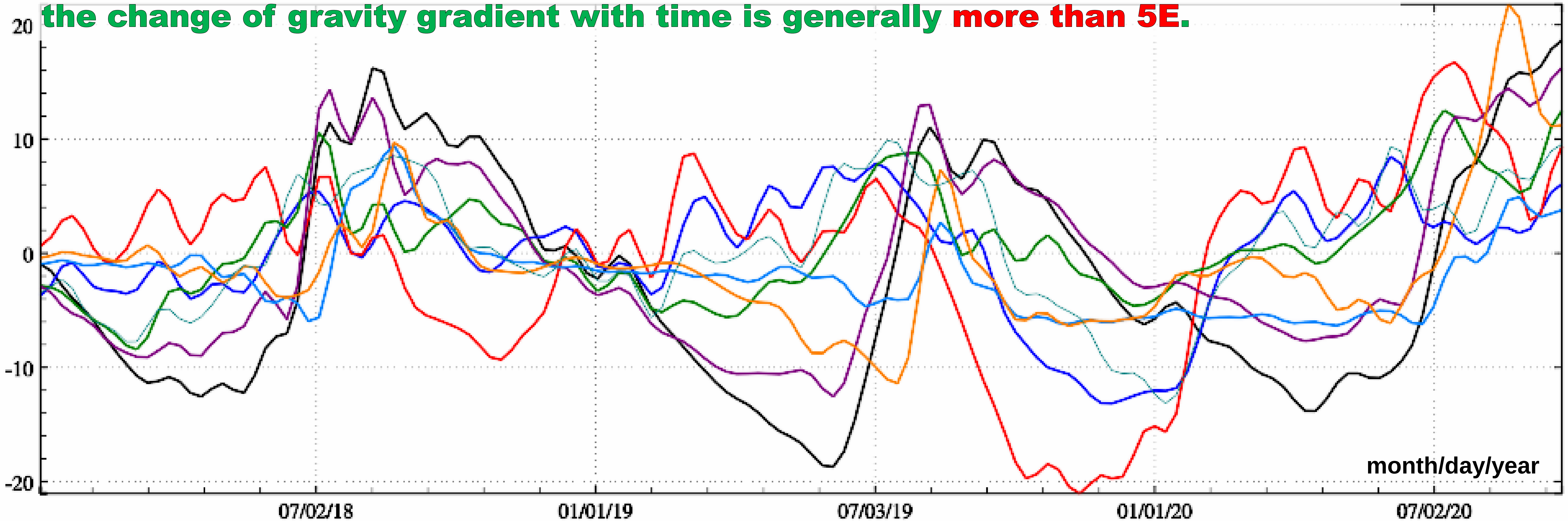



Regional refinement of load deformation field by Green's Integral
Computation of regional load effect time series by Green's Integral
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Computation of regional residual surface load effects by Green's Integral
Computation of lakes, glaciers, and snow load effects by Green's Integral
Computation of regional load effect time series by Green's Integral
Algorithm formulas
Select the calculation point file format
The discrete calculation point file
Open the surface calculation point file
Number of rows of the file header 1
Column ordinal number of height in record 4
Open any residual equivalent water height variation grid file
Set the wildcard of the file names
Ordinal number of first wildcard in file name 8
Number of consecutive wildcards in file name 10
Select the type of effects
geoid or height anomaly (mm)
ground gravity (μGal)
gravity disturbance (μGal)
ground tilt (SW, mas)
vertical deflection (SW, mas)
horizontal displacement (EN, mm)
ground radial displacement (mm)
ground normal or orthometric height (mm)
radial gravity gradient (mE)
horizontal gravity gradient (NW, mE)
Extract the effects to be plot
Plot↓
The type of surface load Land water EWH
Save program process as
>> [Function] From the regional residual equivalent water height (cm) grid time series, compute the time series of the residual value of the load effects on various geodetic variations at the calculation points in the input file by load Green's function integral. The residual equivalent water height variation (cm) grid time series files are extracted according to the given wildcards.
** The epoch time of the residual load effects is the sampling epoch time of the surface equivalent water height grid model.
** When calculating of the lakes, glaciers, or snow load effects, please select "Land water EWH" as the type of surface load.
>> Open the surface calculation point file C:/ETideLoad4.5_win64en/examples/Loadfmrntgreeningtg/calcpnt.txt.
** Look at the file information in the window below and set the row number of the file header...
>> Open any residual equivalent water height variation grid file C:/ETideLoad4.5_win64en/examples/Loadfmrntgreeningtg/swscSEP2018041112.dat.
>> Create or select the result folder C:/ETideLoad4.5_win64en/examples/Loadfmrntgreeningtg/loadtms.
** The program outputs the residual load effect record time series files rntGreen***.txt. Each output file header is the same as the input file. Behind the input file record, adds one or several columns of the surface load effects selected as the output file record.
*** are the wildcards of the variation grid time series file names, whose instance can identify the sampling epoch time of the load effects.
** The load EWH variation grid files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreeningtg/swscSEP2018041112.dat
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreeningtg/swscSEP2018041812.dat
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreeningtg/swscSEP2018042512.dat
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreeningtg/swscSEP2018050212.dat
>> 4 equivalent water height variation grid time series files are found by wildcard instantiation.
>> Setting parameters have been imported into the program!
Green's integral radius 300km
Set the results folder
Import setting parameters
Start computation
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreeningtg/loadtms/rntGreen2018041112.txt
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreeningtg/loadtms/rntGreen2018041812.txt
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreeningtg/loadtms/rntGreen2018042512.txt
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreeningtg/loadtms/rntGreen2018050212.txt
geoid / height anomaly (mm)
ground gravity (μGal)
radial displacement (mm)

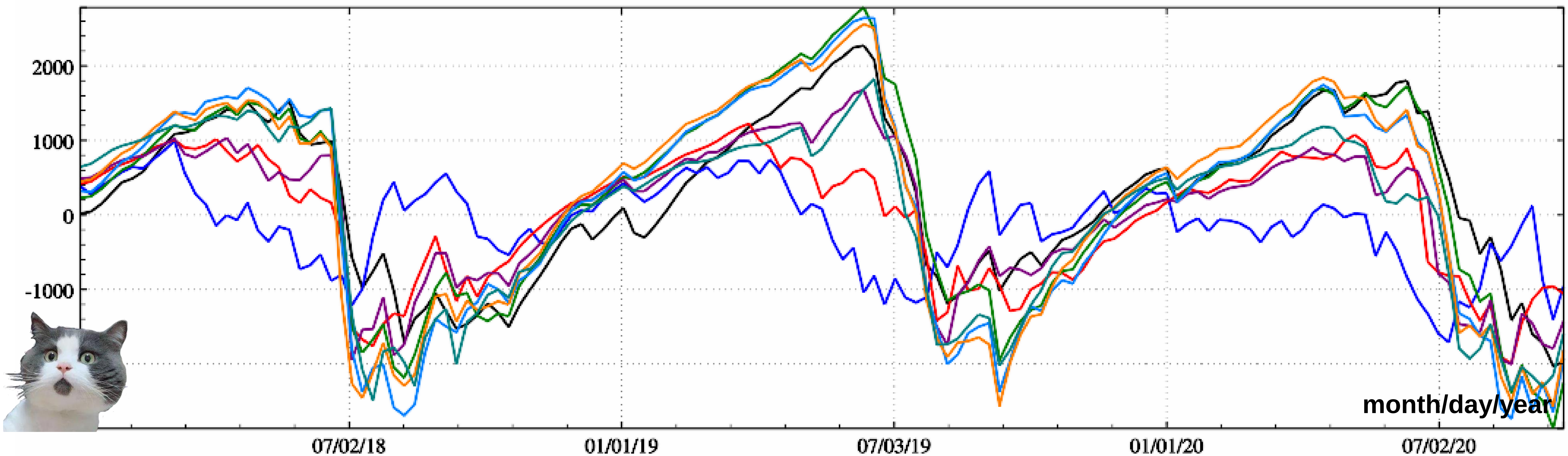
Computation of regional load effect time series by Green's Integral



The change of surface gravity with time is generally more than 20μGal, while the change of gravity gradient with time is generally more than 5E.

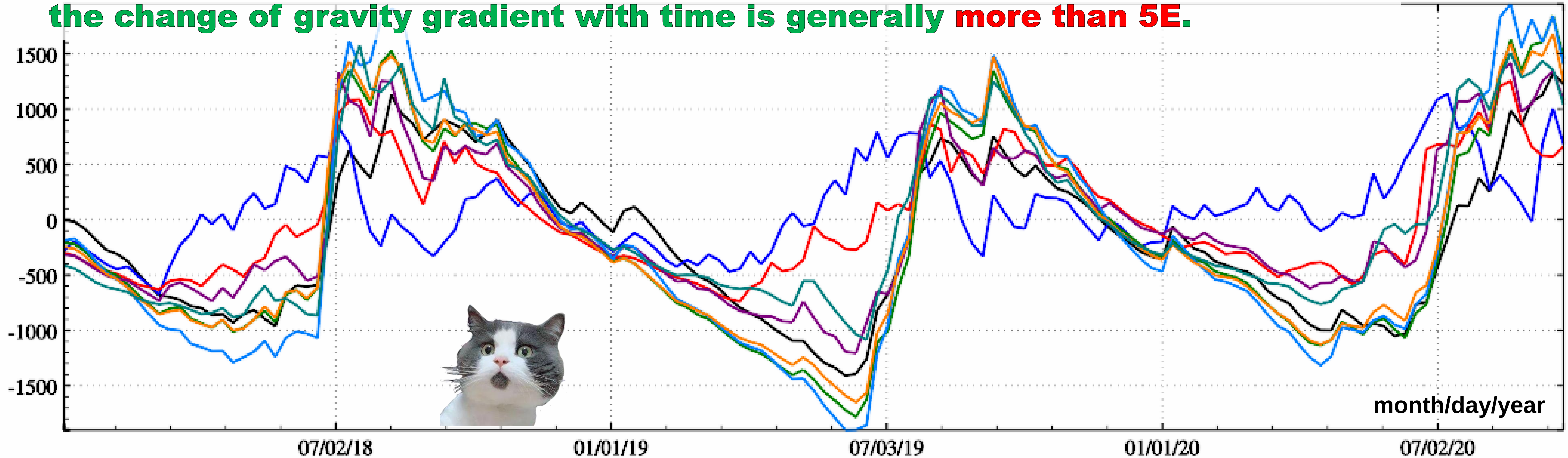


30′×30′ residual soil water load effects in Chinese mainland (Green integral): ground gravity variation (μGal)

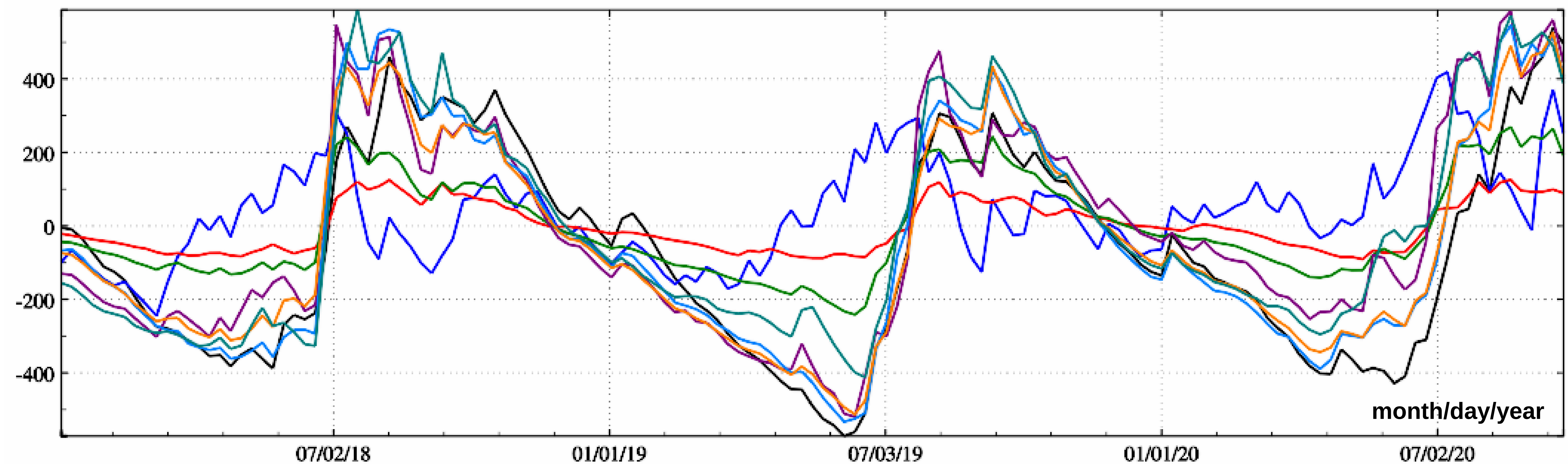


30′×30′ residual soil water load effects in Chinese mainland (Green integral): radial gradient variation (mE)

The change of surface gravity with time is generally more than 20μGal, while the change of gravity gradient with time is generally more than 5E.

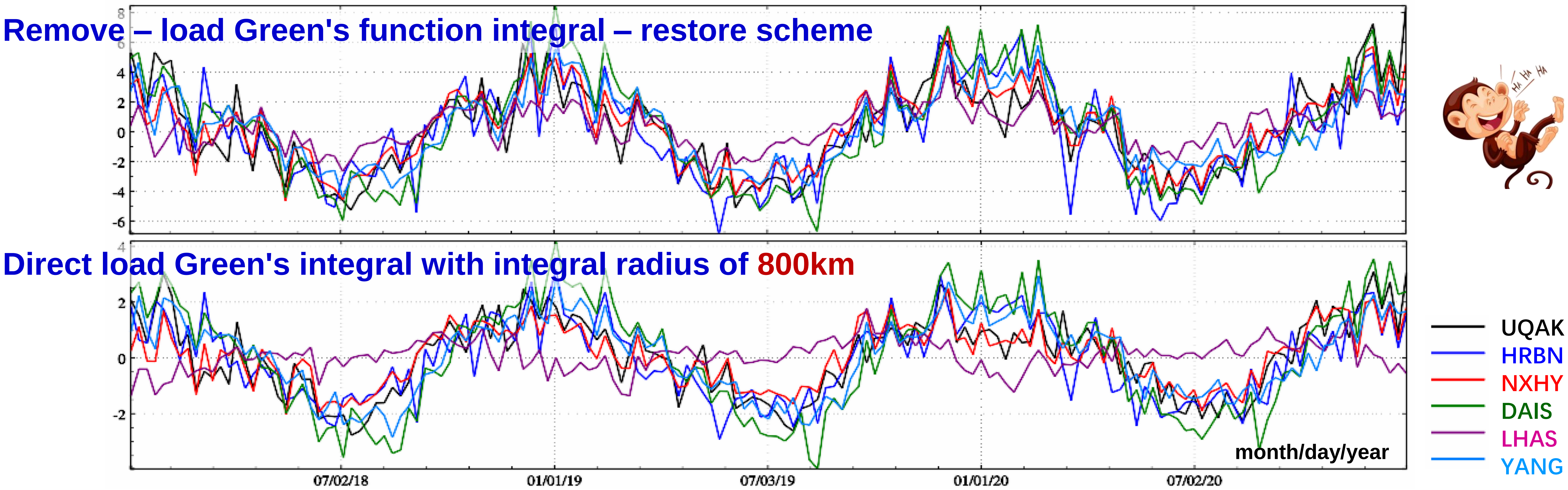


30′×30′ residual soil water load effects in Chinese mainland (Green integral): horizontal gradient variation (N, mE)

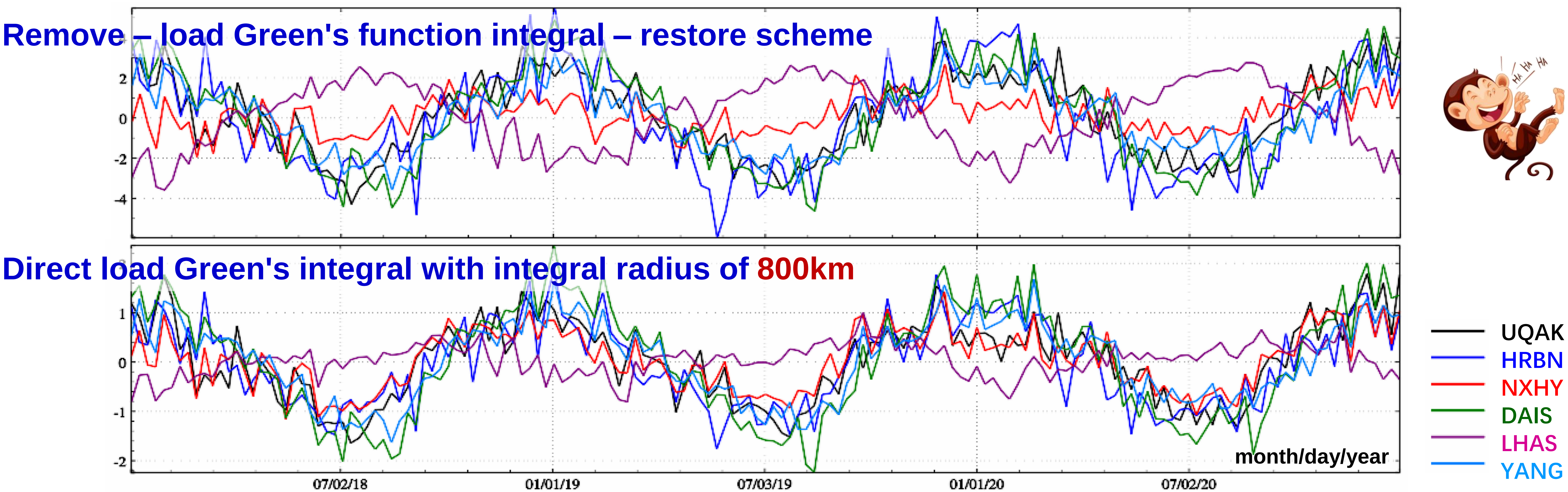


30′×30′ residual soil water load effects in Chinese mainland (Green integral): horizontal gradient variation (W, mE)

The calculated load effect signal by the direct load Green's integral is not sufficient and thus is difficult to meet the high-precision geodesy.

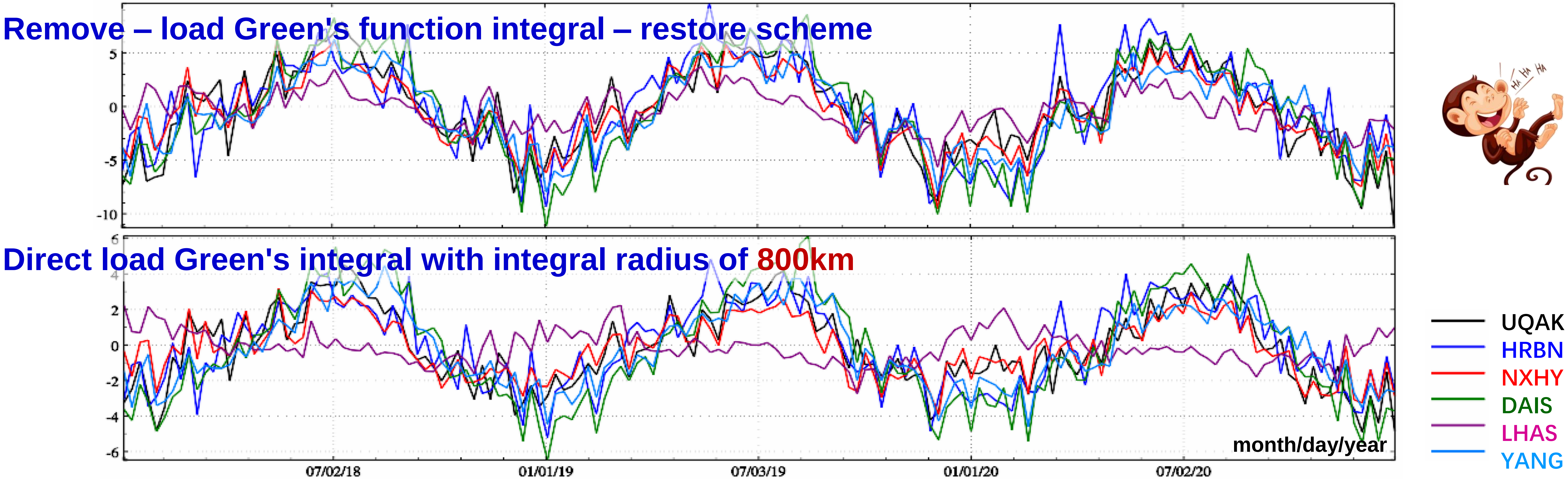


Surface atmosphere load effect time series on geoid (mm) at 6 CORS stations in mainland China using two scheme

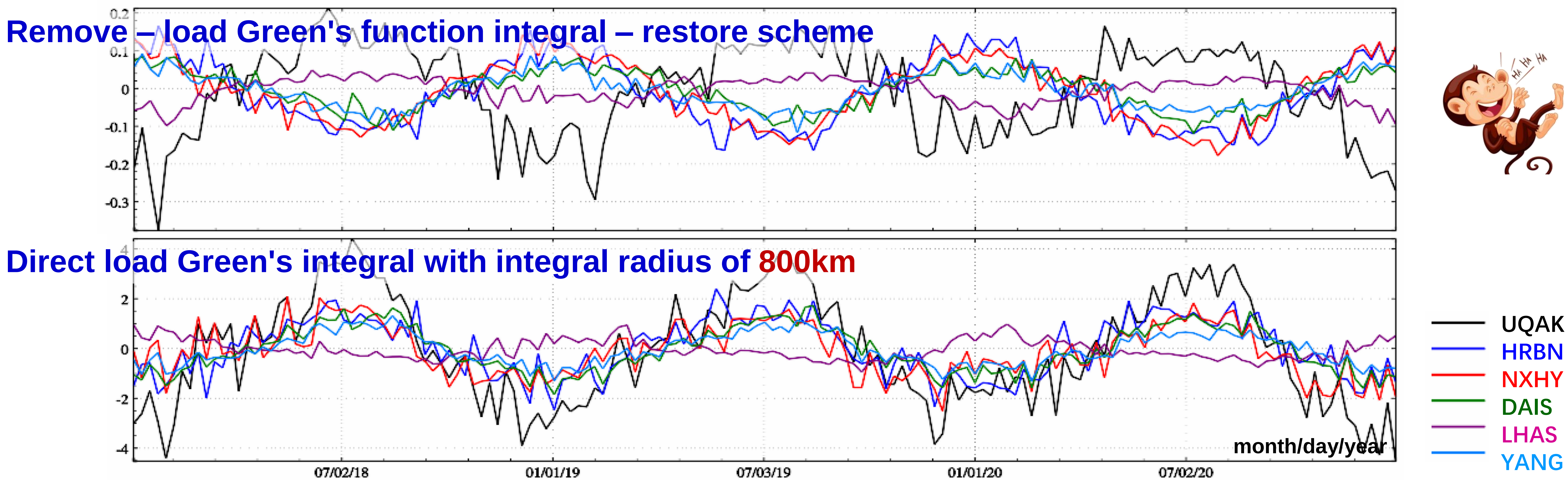


Surface atmosphere load effect time series on ground gravity (mGal) at 6 CORS stations in mainland China using two scheme

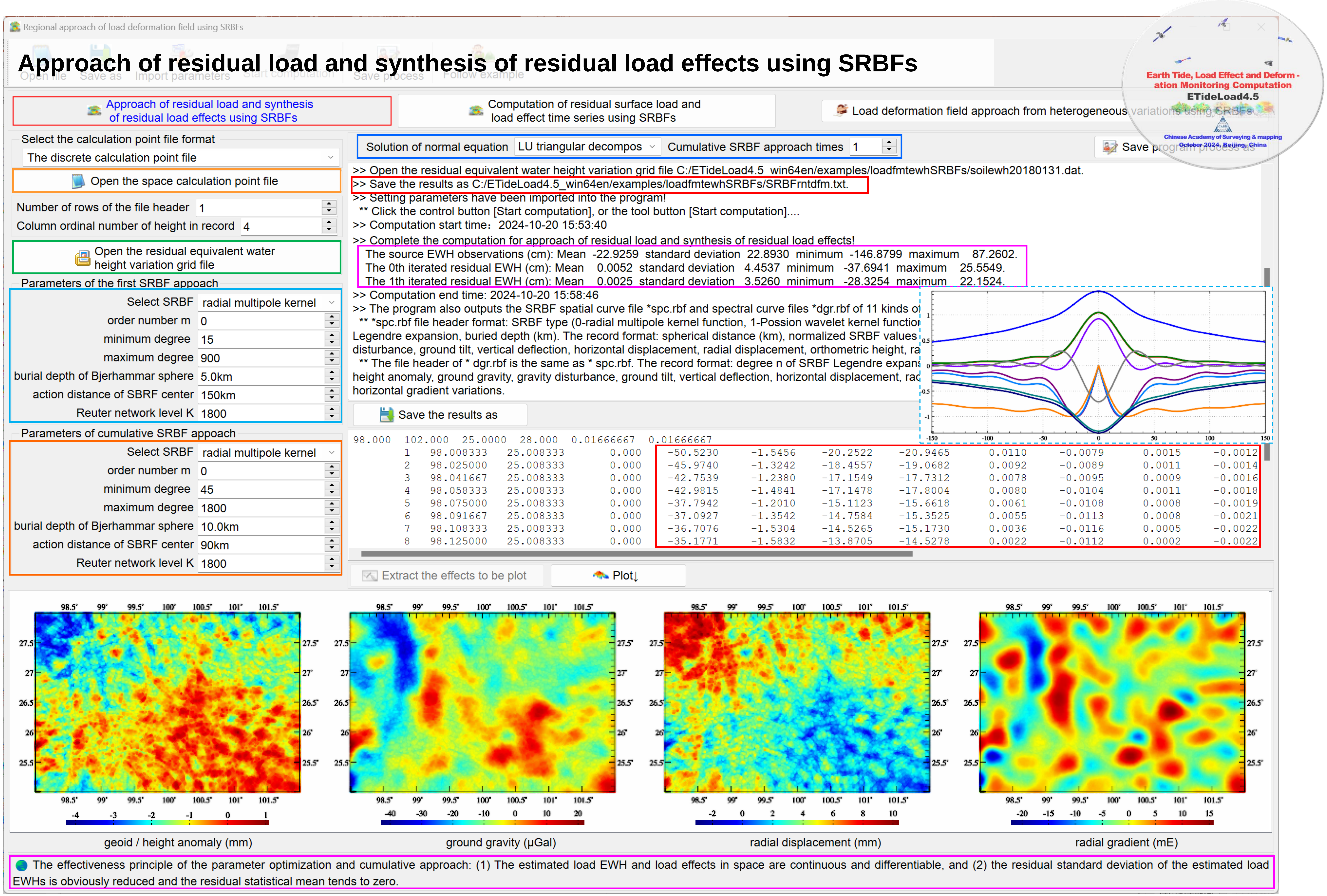
The calculated load effect signal by the direct load Green's integral is not sufficient and thus is difficult to meet the high-precision geodesy.

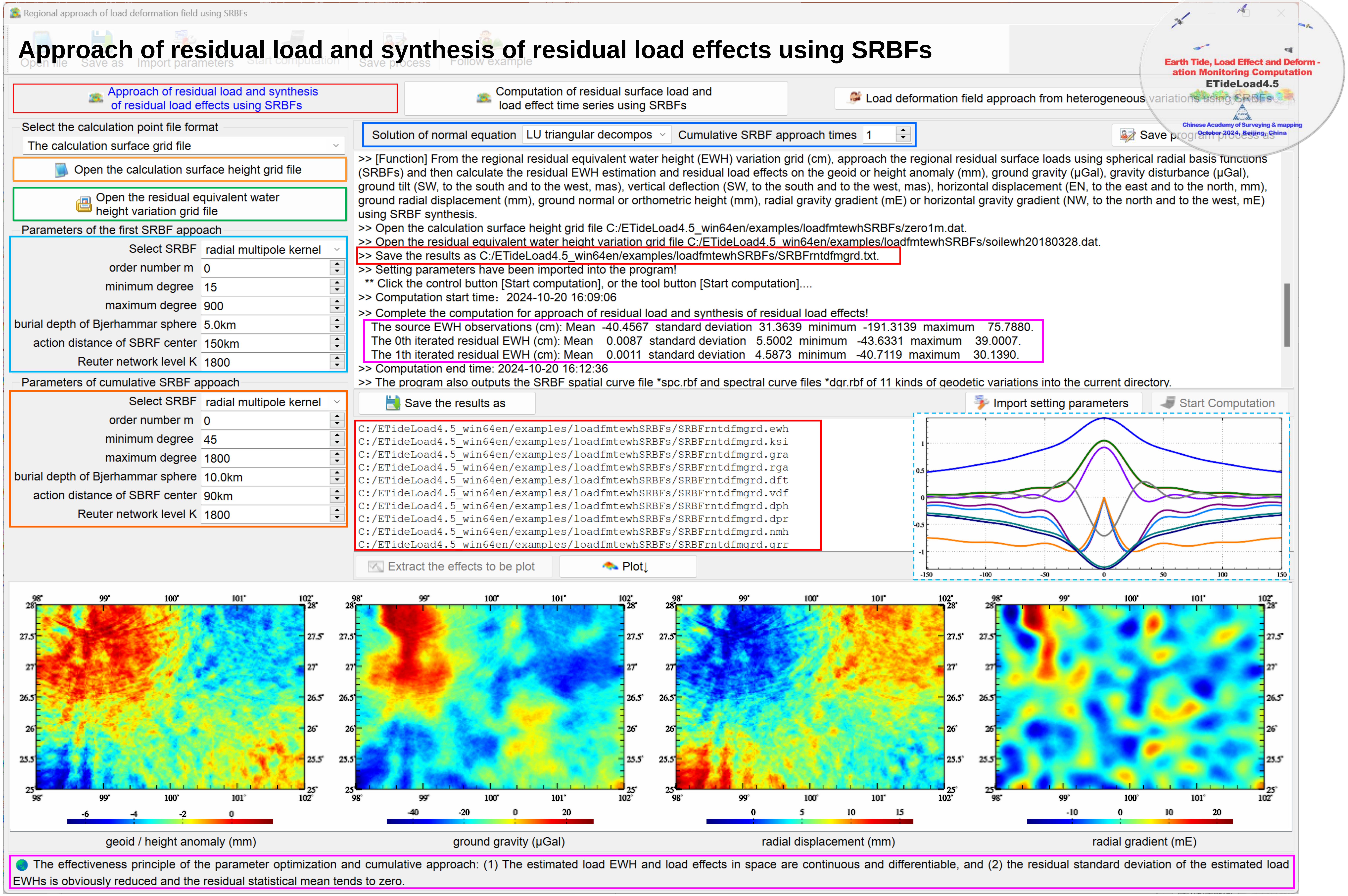


Surface atmosphere load effect time series on ellipsoidal height (mm) at 6 CORS stations in mainland China using two scheme

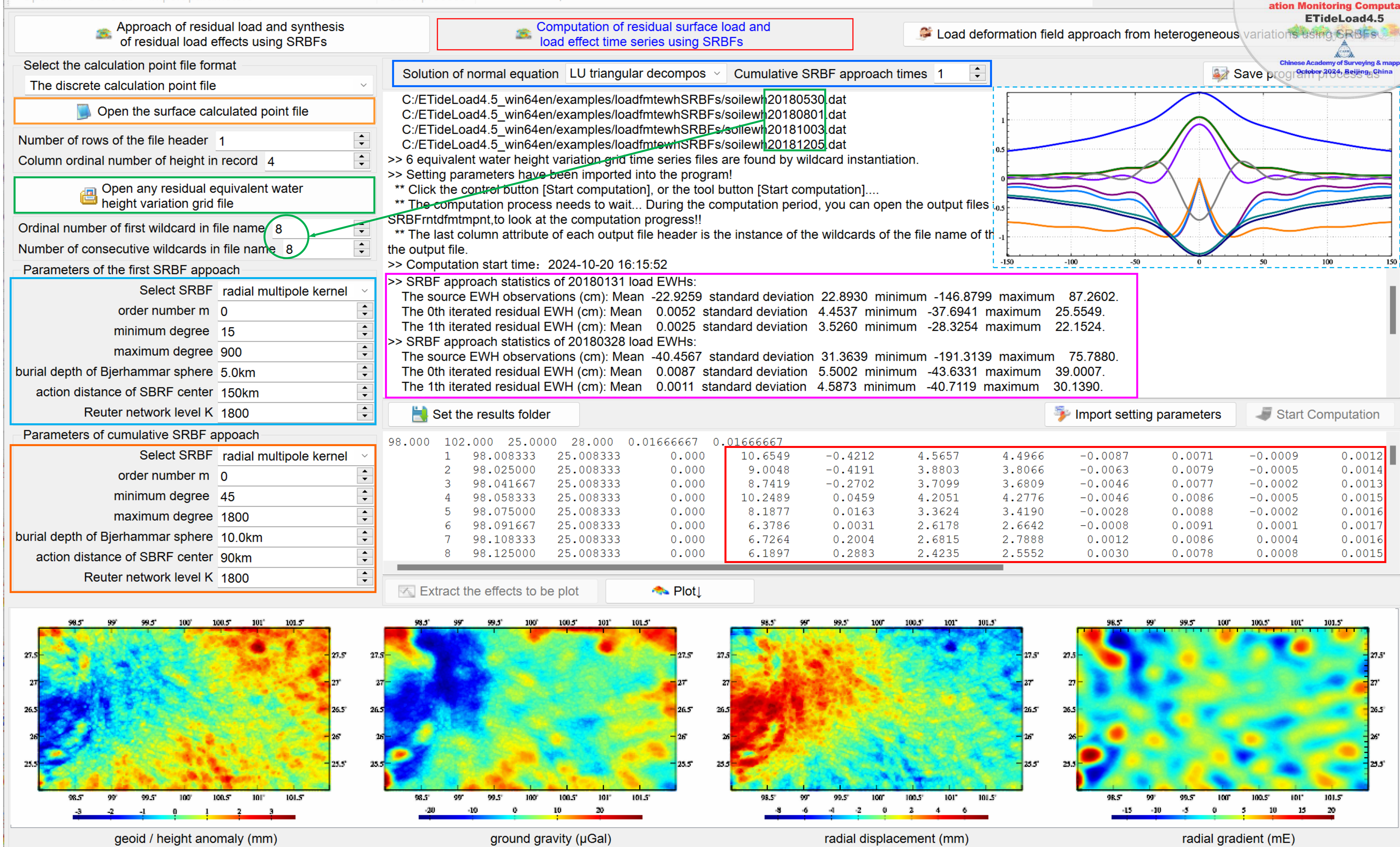


Surface atmosphere load effect time series on radial gravity gradient (mE) at 6 CORS stations in mainland China using two scheme


Regional approach of load deformation field using SRBFs
Approach of residual load and synthesis of residual load effects using SRBFs
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Approach of residual load and synthesis of residual load effects using SRBFs
Computation of residual surface load and load effect time series using SRBFs
Load deformation field approach from heterogeneous variations using SRBFs
Select the calculation point file format
The discrete calculation point file
Open the space calculation point file
Number of rows of the file header 1
Column ordinal number of height in record 4
Open the residual equivalent water height variation grid file
Parameters of the first SRBF appoach
Select SRBF radial multipole kernel
order number m 0
minimum degree 15
maximum degree 900
burial depth of Bjerhammar sphere 5.0km
action distance of SBRF center 150km
Reuter network level K 1800
Parameters of cumulative SRBF appoach
Select SRBF radial multipole kernel
order number m 0
minimum degree 45
maximum degree 1800
burial depth of Bjerhammar sphere 10.0km
action distance of SBRF center 90km
Reuter network level K 1800
Solution of normal equation LU triangular decompos
Cumulative SRBF approach times 1
Save program process as
>> Open the residual equivalent water height variation grid file C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/soilewh20180131.dat.
>> Save the results as C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfm.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-20 15:53:40
>> Complete the computation for approach of residual load and synthesis of residual load effects!
The source EWH observations (cm): Mean -22.9259 standard deviation 22.8930 minimum -146.8799 maximum 87.2602.
The 0th iterated residual EWH (cm): Mean 0.0052 standard deviation 4.4537 minimum -37.6941 maximum 25.5549.
The 1th iterated residual EWH (cm): Mean 0.0025 standard deviation 3.5260 minimum -28.3254 maximum 22.1524.
>> Computation end time: 2024-10-20 15:58:46
>> The program also outputs the SRBF spatial curve file *spc.rbf and spectral curve files *dgr.rbf of 11 kinds of
** *spc.rbf file header format: SRBF type (0-radial multipole kernel function, 1-Possion wavelet kernel functio
Legendre expansion, buried depth (km). The record format: spherical distance (km), normalized SRBF values
disturbance, ground tilt, vertical deflection, horizontal displacement, radial displacement, orthometric height, ra
** The file header of * dgr.rbf is the same as * spc.rbf. The record format: degree n of SRBF Legendre expans
height anomaly, ground gravity, gravity disturbance, ground tilt, vertical deflection, horizontal displacement, rad
horizontal gradient variations.
Save the results as
98.000 102.000 25.0000 28.000 0.01666667 0.01666667
1 98.008333 25.008333 0.000 -50.5230 -1.5456 -20.2522 -20.9465 0.0110 -0.0079 0.0015 -0.0012
2 98.025000 25.008333 0.000 -45.9740 -1.3242 -18.4557 -19.0682 0.0092 -0.0089 0.0011 -0.0014
3 98.041667 25.008333 0.000 -42.7539 -1.2380 -17.1549 -17.7312 0.0078 -0.0095 0.0009 -0.0016
4 98.058333 25.008333 0.000 -42.9815 -1.4841 -17.1478 -17.8004 0.0080 -0.0104 0.0011 -0.0018
5 98.075000 25.008333 0.000 -37.7942 -1.2010 -15.1123 -15.6618 0.0061 -0.0108 0.0008 -0.0019
6 98.091667 25.008333 0.000 -37.0927 -1.3542 -14.7584 -15.3525 0.0055 -0.0113 0.0008 -0.0021
7 98.108333 25.008333 0.000 -36.7076 -1.5304 -14.5265 -15.1730 0.0036 -0.0116 0.0005 -0.0022
8 98.125000 25.008333 0.000 -35.1771 -1.5832 -13.8705 -14.5278 0.0022 -0.0112 0.0002 -0.0022
Extract the effects to be plot
Plot
geoid / height anomaly (mm)
ground gravity (μGal)
radial displacement (mm)
radial gradient (mE)
The effectiveness principle of the parameter optimization and cumulative approach: (1) The estimated load EWH and load effects in space are continuous and differentiable, and (2) the residual standard deviation of the estimated load EWHs is obviously reduced and the residual statistical mean tends to zero.

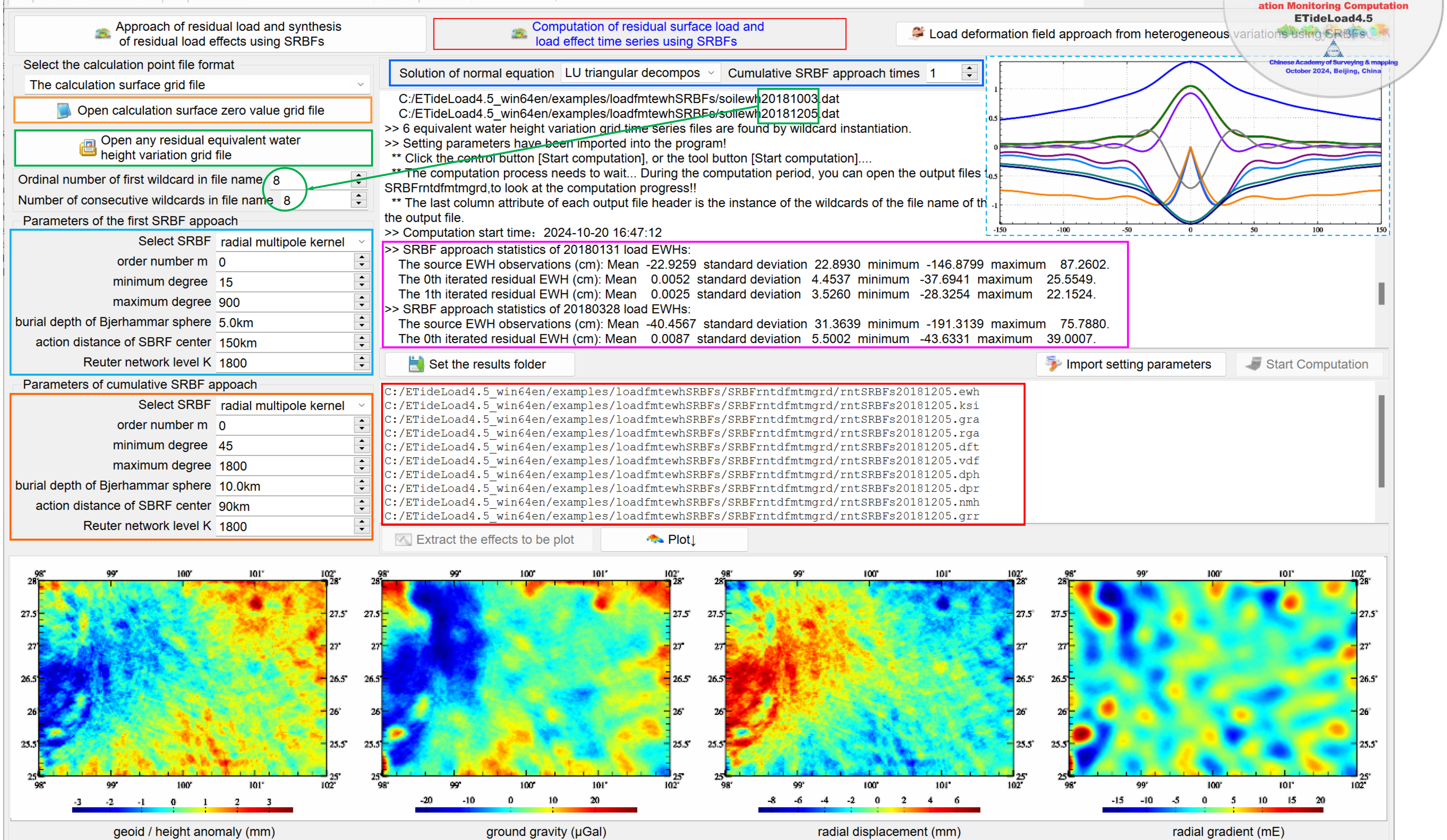

Regional approach of load deformation field using SRBFs
Approach of residual load and synthesis of residual load effects using SRBFs
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Approach of residual load and synthesis of residual load effects using SRBFs
Computation of residual surface load and load effect time series using SRBFs
Load deformation field approach from heterogeneous variations using SRBFs
Select the calculation point file format
The calculation surface grid file
Open the calculation surface height grid file
Open the residual equivalent water height variation grid file
Parameters of the first SRBF appoach
Select SRBF radial multipole kernel
order number m 0
minimum degree 15
maximum degree 900
burial depth of Bjerhammar sphere 5.0km
action distance of SBRF center 150km
Reuter network level K 1800
Parameters of cumulative SRBF appoach
Select SRBF radial multipole kernel
order number m 0
minimum degree 45
maximum degree 1800
burial depth of Bjerhammar sphere 10.0km
action distance of SBRF center 90km
Reuter network level K 1800
Solution of normal equation LU triangular decompos
Cumulative SRBF approach times 1
Save program process as
>> [Function] From the regional residual equivalent water height (EWH) variation grid (cm), approach the regional residual surface loads using spherical radial basis functions (SRBFs) and then calculate the residual EWH estimation and residual load effects on the geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (mE) or horizontal gravity gradient (NW, to the north and to the west, mE) using SRBF synthesis.
>> Open the calculation surface height grid file C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/zero1m.dat.
>> Open the residual equivalent water height variation grid file C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/soilewh20180328.dat.
>> Save the results as C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-20 16:09:06
>> Complete the computation for approach of residual load and synthesis of residual load effects!
The source EWH observations (cm): Mean -40.4567 standard deviation 31.3639 minimum -191.3139 maximum 75.7880.
The 0th iterated residual EWH (cm): Mean 0.0087 standard deviation 5.5002 minimum -43.6331 maximum 39.0007.
The 1th iterated residual EWH (cm): Mean 0.0011 standard deviation 4.5873 minimum -40.7119 maximum 30.1390.
>> Computation end time: 2024-10-20 16:12:36
>> The program also outputs the SRBF spatial curve file *spc.rbf and spectral curve files *dgr.rbf of 11 kinds of geodetic variations into the current directory.
Save the results as
Import setting parameters
Start Computation
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.ewh
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.ksi
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.gra
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.rga
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.dft
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.vdf
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.dph
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.dpr
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.nmh
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.grr
Extract the effects to be plot
Plot
geoid / height anomaly (mm)
ground gravity (μGal)
radial displacement (mm)
radial gradient (mE)
The effectiveness principle of the parameter optimization and cumulative approach: (1) The estimated load EWH and load effects in space are continuous and differentiable, and (2) the residual standard deviation of the estimated load EWHs is obviously reduced and the residual statistical mean tends to zero.

Computation of residual surface load and load effect time series using SRBFs



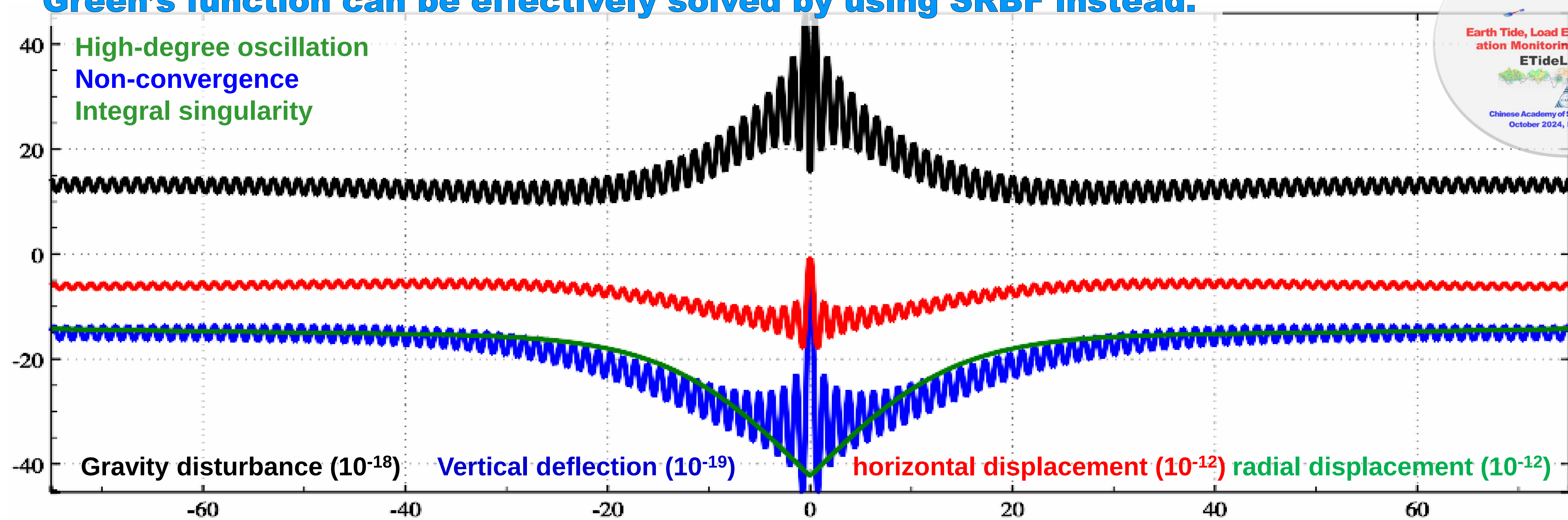
The effectiveness principle of the parameter optimization and cumulative approach: (1) The estimated load EWH and load effects in space are continuous and differentiable, and (2) the residual standard deviation of the estimated load EWHs is obviously reduced and the residual statistical mean tends to zero.

Computation of residual surface load and load effect time series using SRBFs

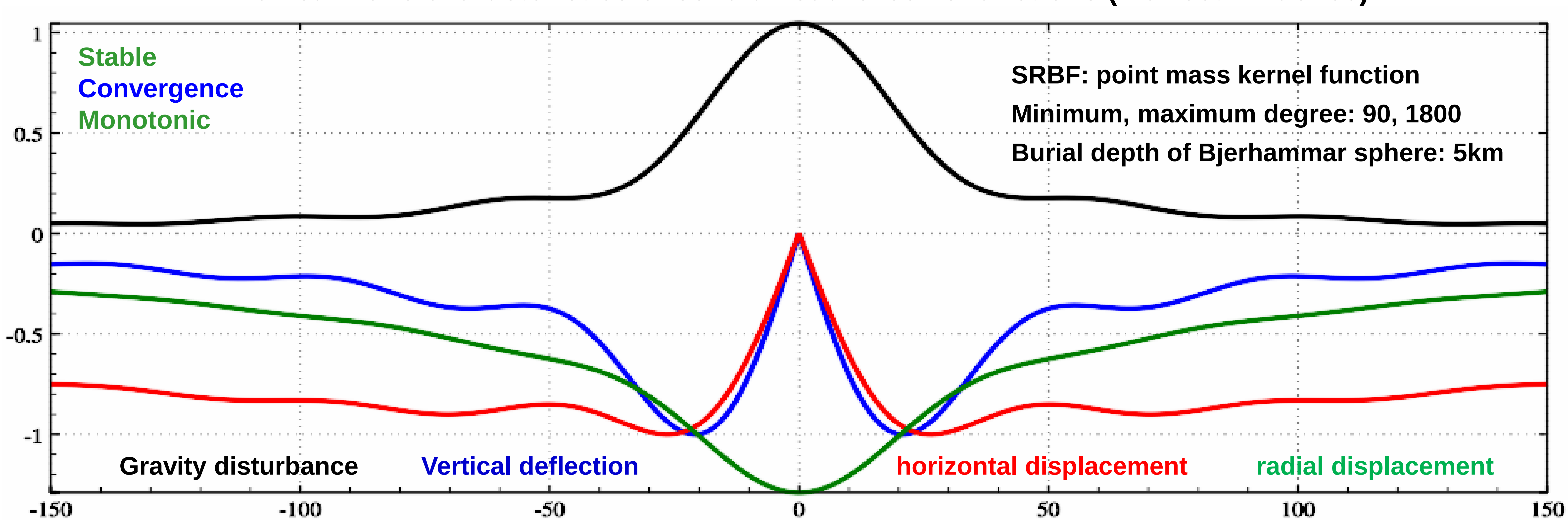


The effectiveness principle of the parameter optimization and cumulative approach: (1) The estimated load EWH and load effects in space are continuous and differentiable, and (2) the residual standard deviation of the estimated load EWHs is obviously reduced and the residual statistical mean tends to zero.

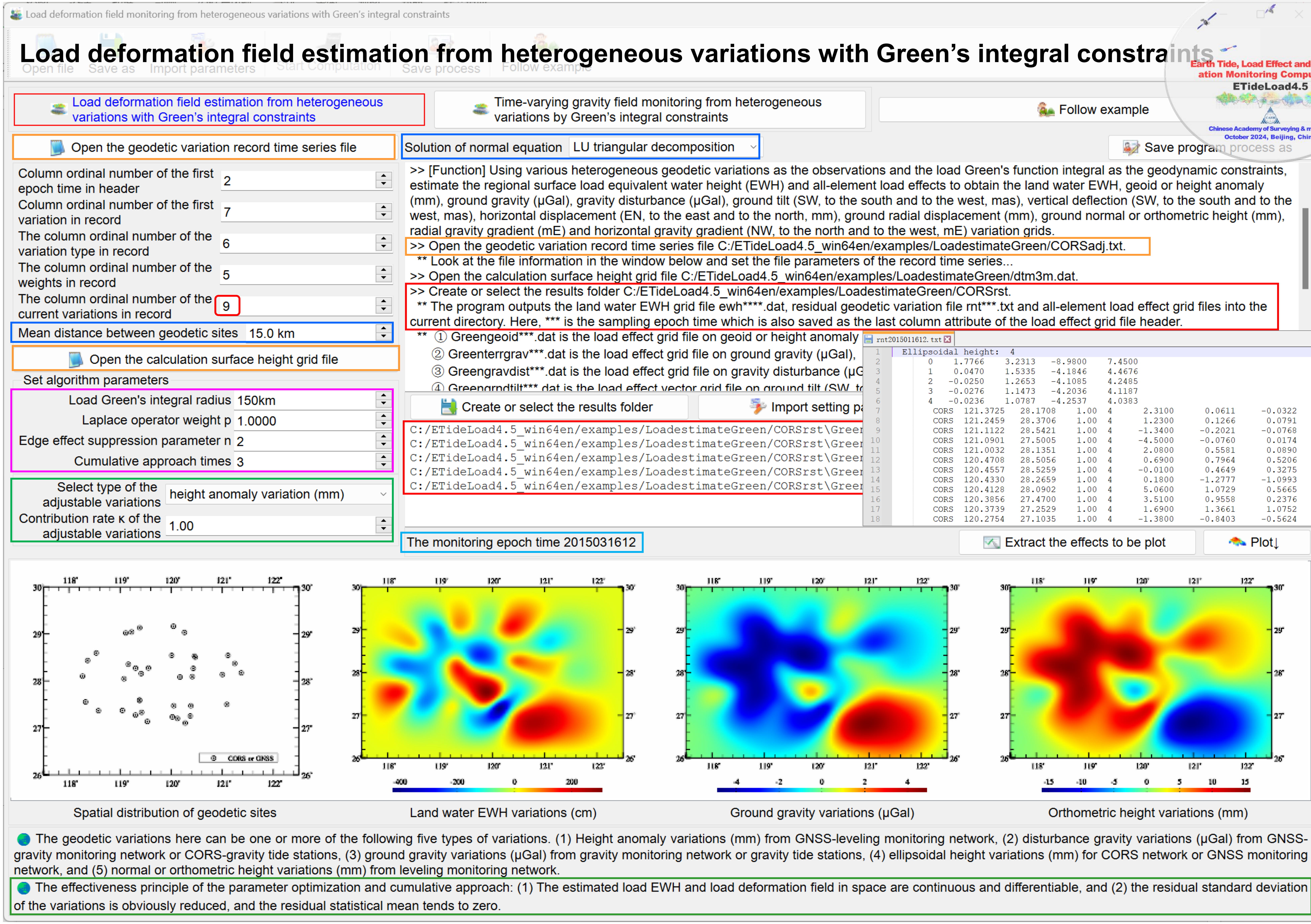
The high-degree oscillation and non-convergence troubles of load Green's function can be effectively solved by using SRBF instead.

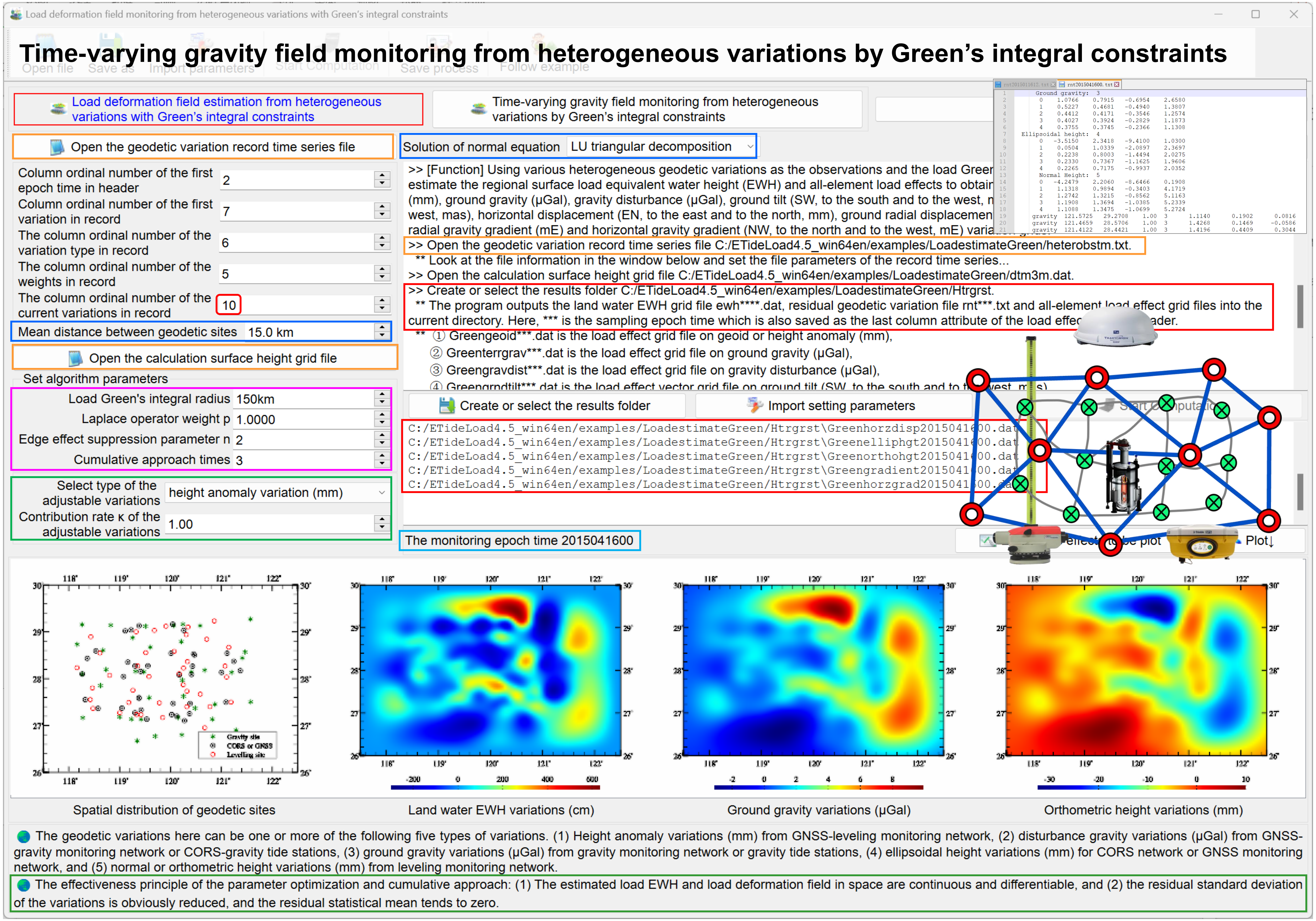


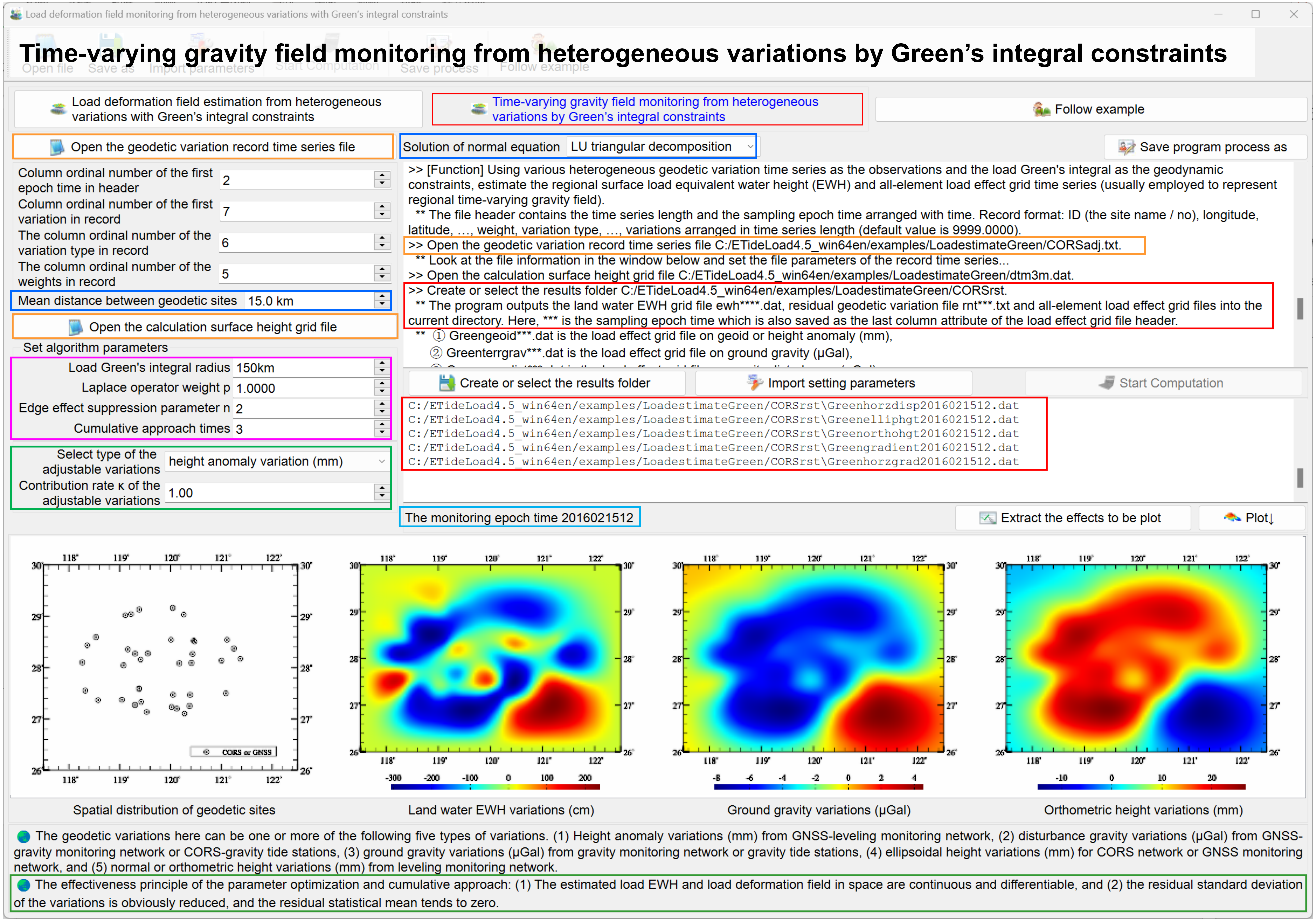
The near-zone characteristics of several load Green's functions (Indirect influence)



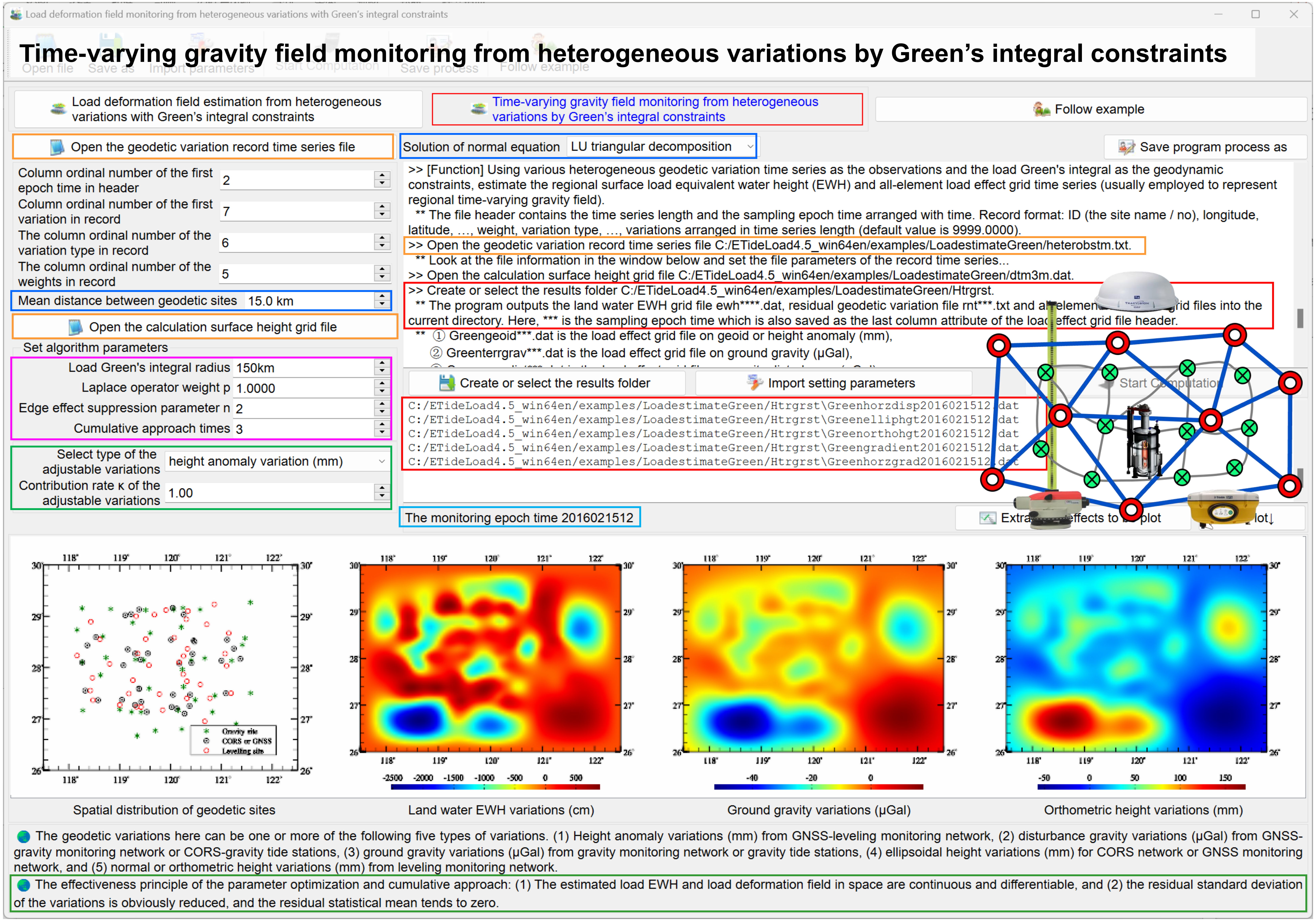
The near-zone characteristics of load effect SRBFs on several geodetic variations

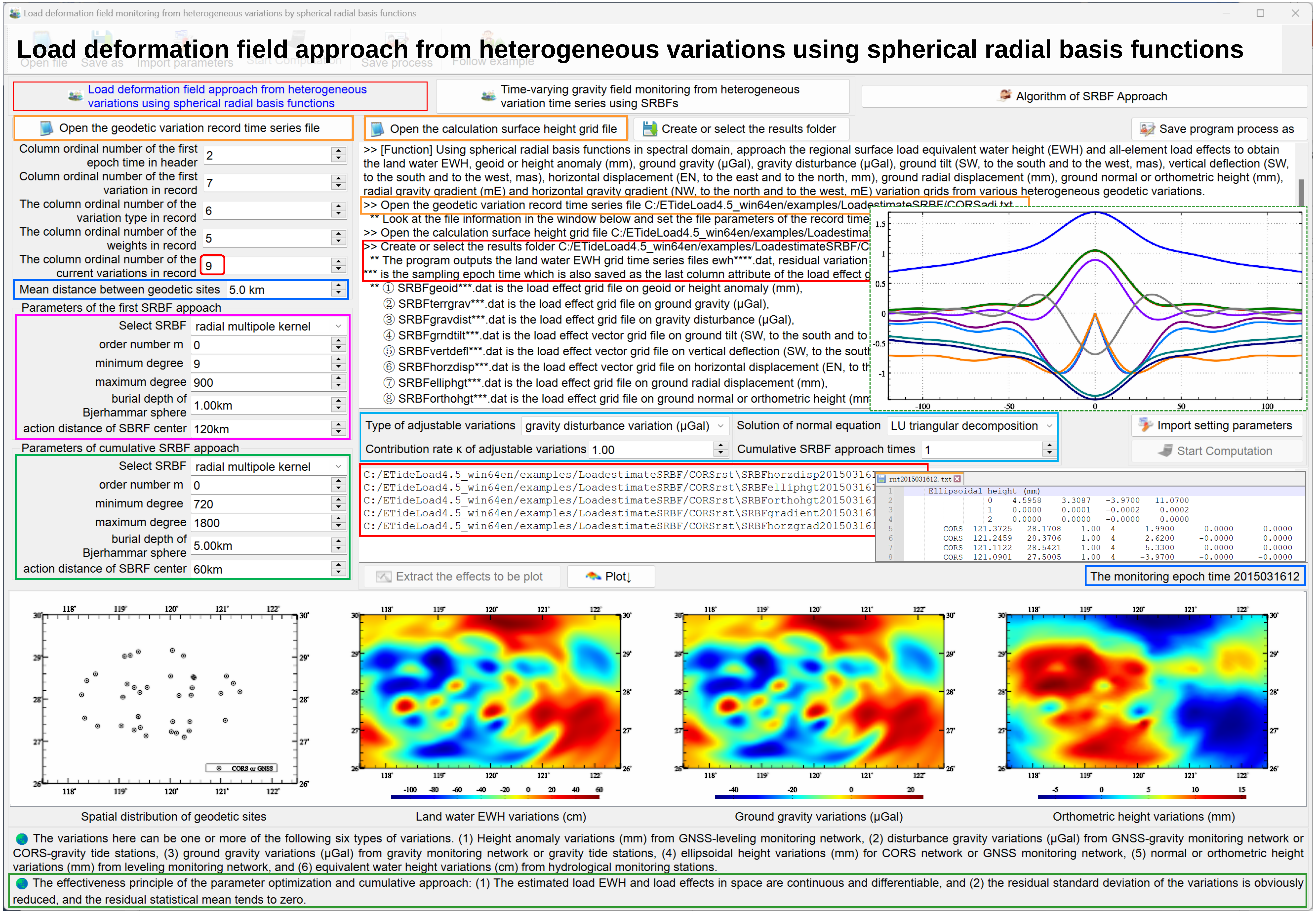

Load deformation field monitoring from heterogeneous variations with Green's integral constraints
Load deformation field estimation from heterogeneous variations with Green's integral constraints
Open file
Save as
Import parameters
Start Computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Load deformation field estimation from heterogeneous variations with Green's integral constraints
Time-varying gravity field monitoring from heterogeneous variations by Green's integral constraints
Follow example
Open the geodetic variation record time series file
Solution of normal equation
LU triangular decomposition
Save program process as
Column ordinal number of the first epoch time in header
2
Column ordinal number of the first variation in record
7
The column ordinal number of the variation type in record
6
The column ordinal number of the weights in record
5
The column ordinal number of the current variations in record
9
Mean distance between geodetic sites
15.0 km
Open the calculation surface height grid file
Set algorithm parameters
Load Green's integral radius
150km
Laplace operator weight p
1.0000
Edge effect suppression parameter n
2
Cumulative approach times
3
Select type of the adjustable variations
height anomaly variation (mm)
Contribution rate κ of the adjustable variations
1.00
>> [Function] Using various heterogeneous geodetic variations as the observations and the load Green's function integral as the geodynamic constraints, estimate the regional surface load equivalent water height (EWH) and all-element load effects to obtain the land water EWH, geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (mE) and horizontal gravity gradient (NW, to the north and to the west, mE) variation grids.
>> Open the geodetic variation record time series file C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSadj.txt.
** Look at the file information in the window below and set the file parameters of the record time series...
>> Open the calculation surface height grid file C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/dtm3m.dat.
>> Create or select the results folder C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst.
** The program outputs the land water EWH grid file ewh****.dat, residual geodetic variation file rnt***.txt and all-element load effect grid files into the current directory. Here, *** is the sampling epoch time which is also saved as the last column attribute of the load effect grid file header.
** ① Greengeoid***.dat is the load effect grid file on geoid or height anomaly
② Greenterrgrav***.dat is the load effect grid file on ground gravity (μGal),
③ Greengravdist***.dat is the load effect grid file on gravity disturbance (μG
④ Greengrndtilt***.dat is the load effect vector grid file on ground tilt (SW, to
Create or select the results folder
Import setting pa
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greer
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greer
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greer
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greer
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greer
rnt2015011612.txt
Ellipsoidal height: 4
0 1.7766 3.2313 -8.9800 7.4500
1 0.0470 1.5335 -4.1846 4.4676
2 -0.0250 1.2653 -4.1085 4.2485
3 -0.0276 1.1473 -4.2036 4.1187
4 -0.0236 1.0787 -4.2537 4.0383
CORS 121.3725 28.1708 1.00 4 2.3100 0.0611 -0.0322
CORS 121.2459 28.3706 1.00 4 1.2300 0.1266 0.0791
CORS 121.1122 28.5421 1.00 4 -1.3400 -0.2021 -0.0768
CORS 121.0901 27.5005 1.00 4 -4.5000 -0.0760 0.0174
CORS 121.0032 28.1351 1.00 4 2.0800 0.5581 0.0890
CORS 120.4708 28.5056 1.00 4 0.6900 0.7964 0.5206
CORS 120.4557 28.5259 1.00 4 -0.0100 0.4649 0.3275
CORS 120.4330 28.2659 1.00 4 0.1800 -1.2777 -1.0993
CORS 120.4128 28.0902 1.00 4 5.0600 1.0729 0.5665
CORS 120.3856 27.4700 1.00 4 3.5100 0.9558 0.2376
CORS 120.3739 27.2529 1.00 4 1.6900 1.3661 1.0752
CORS 120.2754 27.1035 1.00 4 -1.3800 -0.8403 -0.5624
The monitoring epoch time 2015031612
Extract the effects to be plot
Plot
CORS or GNSS
Spatial distribution of geodetic sites
Land water EWH variations (cm)
Ground gravity variations (μGal)
Orthometric height variations (mm)
The geodetic variations here can be one or more of the following five types of variations. (1) Height anomaly variations (mm) from GNSS-leveling monitoring network, (2) disturbance gravity variations (μGal) from GNSS-gravity monitoring network or CORS-gravity tide stations, (3) ground gravity variations (μGal) from gravity monitoring network or gravity tide stations, (4) ellipsoidal height variations (mm) for CORS network or GNSS monitoring network, and (5) normal or orthometric height variations (mm) from leveling monitoring network.
The effectiveness principle of the parameter optimization and cumulative approach: (1) The estimated load EWH and load deformation field in space are continuous and differentiable, and (2) the residual standard deviation of the variations is obviously reduced, and the residual statistical mean tends to zero.

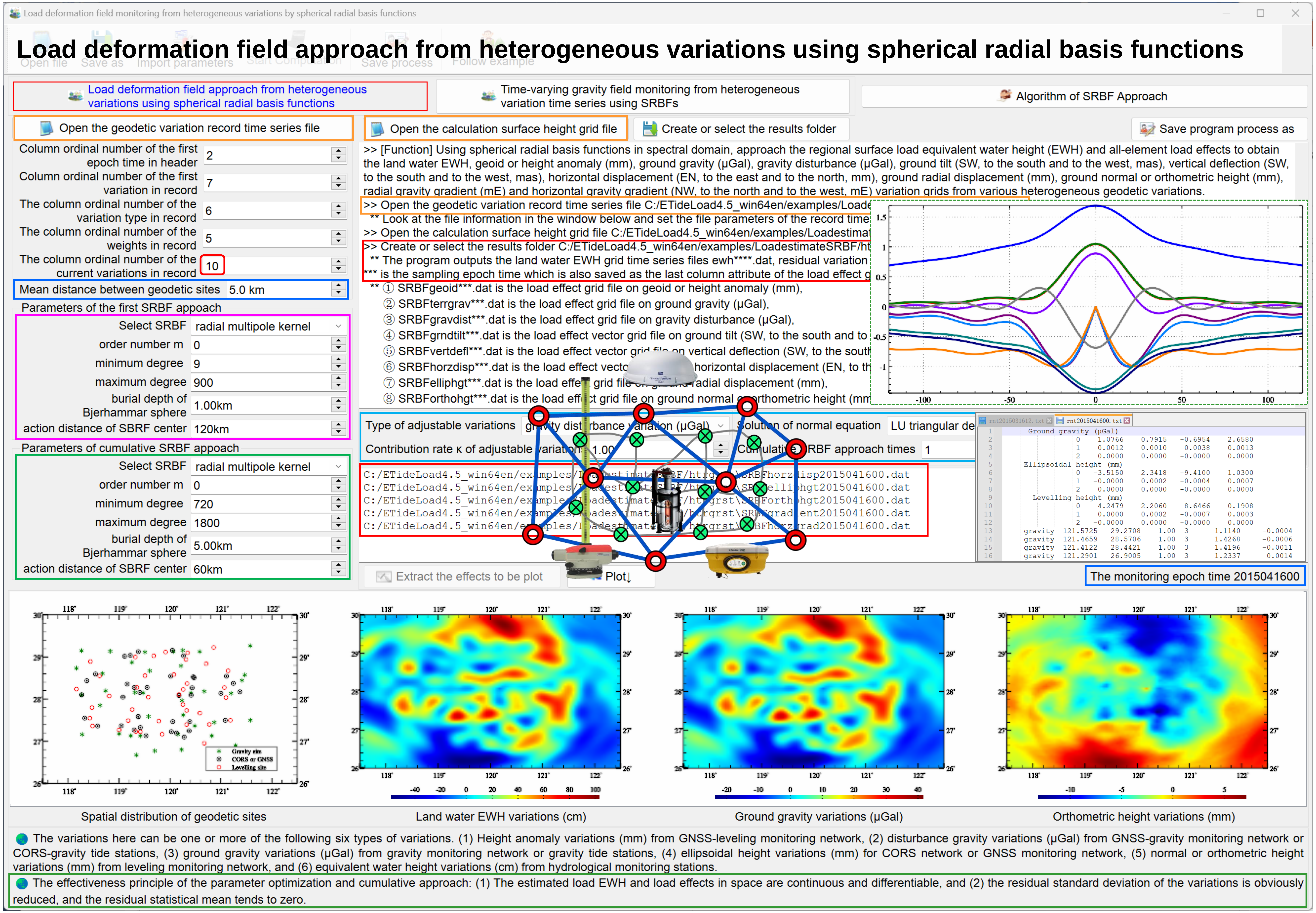

Load deformation field monitoring from heterogeneous variations with Green's integral constraints
Time-varying gravity field monitoring from heterogeneous variations by Green's integral constraints
Open file
Save as
Import parameters
Start Computation
Save process
Follow example
Load deformation field estimation from heterogeneous variations with Green's integral constraints
Time-varying gravity field monitoring from heterogeneous variations by Green's integral constraints
Open the geodetic variation record time series file
Solution of normal equation
LU triangular decomposition
Column ordinal number of the first epoch time in header
2
Column ordinal number of the first variation in record
7
The column ordinal number of the variation type in record
6
The column ordinal number of the weights in record
5
The column ordinal number of the current variations in record
10
Mean distance between geodetic sites
15.0 km
Open the calculation surface height grid file
Set algorithm parameters
Load Green's integral radius
150km
Laplace operator weight p
1.0000
Edge effect suppression parameter n
2
Cumulative approach times
3
Select type of the adjustable variations
height anomaly variation (mm)
Contribution rate κ of the adjustable variations
1.00
>> [Function] Using various heterogeneous geodetic variations as the observations and the load Green
estimate the regional surface load equivalent water height (EWH) and all-element load effects to obtain
(mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west,
west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacemen
radial gravity gradient (mE) and horizontal gravity gradient (NW, to the north and to the west, mE) varia
>> Open the geodetic variation record time series file C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/heterobstm.txt.
** Look at the file information in the window below and set the file parameters of the record time series...
>> Open the calculation surface height grid file C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/dtm3m.dat.
>> Create or select the results folder C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst.
** The program outputs the land water EWH grid file ewh****.dat, residual geodetic variation file rnt***.txt and all-element load effect grid files into the
current directory. Here, *** is the sampling epoch time which is also saved as the last column attribute of the load effe
** ① Greengeoid***.dat is the load effect grid file on geoid or height anomaly (mm),
② Greenterrgrav***.dat is the load effect grid file on ground gravity (μGal),
③ Greengravdist***.dat is the load effect grid file on gravity disturbance (μGal),
④ Greengrndtilt***.dat is the load effect vector grid file on ground tilt (SW, to the south and to the west, mas),
Create or select the results folder
Import setting parameters
Start Computation
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greenhorzdisp2015041600.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greenelliphgt2015041600.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greenorthohgt2015041600.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greengradient2015041600.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greenhorzgrad2015041600.dat
The monitoring epoch time 2015041600
Select file to be plot
Plot
Gravity site
CORS or GNSS
Leveling site
Spatial distribution of geodetic sites
Land water EWH variations (cm)
Ground gravity variations (μGal)
Orthometric height variations (mm)
The geodetic variations here can be one or more of the following five types of variations. (1) Height anomaly variations (mm) from GNSS-leveling monitoring network, (2) disturbance gravity variations (μGal) from GNSS-gravity monitoring network or CORS-gravity tide stations, (3) ground gravity variations (μGal) from gravity monitoring network or gravity tide stations, (4) ellipsoidal height variations (mm) for CORS network or GNSS monitoring network, and (5) normal or orthometric height variations (mm) from leveling monitoring network.
The effectiveness principle of the parameter optimization and cumulative approach: (1) The estimated load EWH and load deformation field in space are continuous and differentiable, and (2) the residual standard deviation of the variations is obviously reduced, and the residual statistical mean tends to zero.

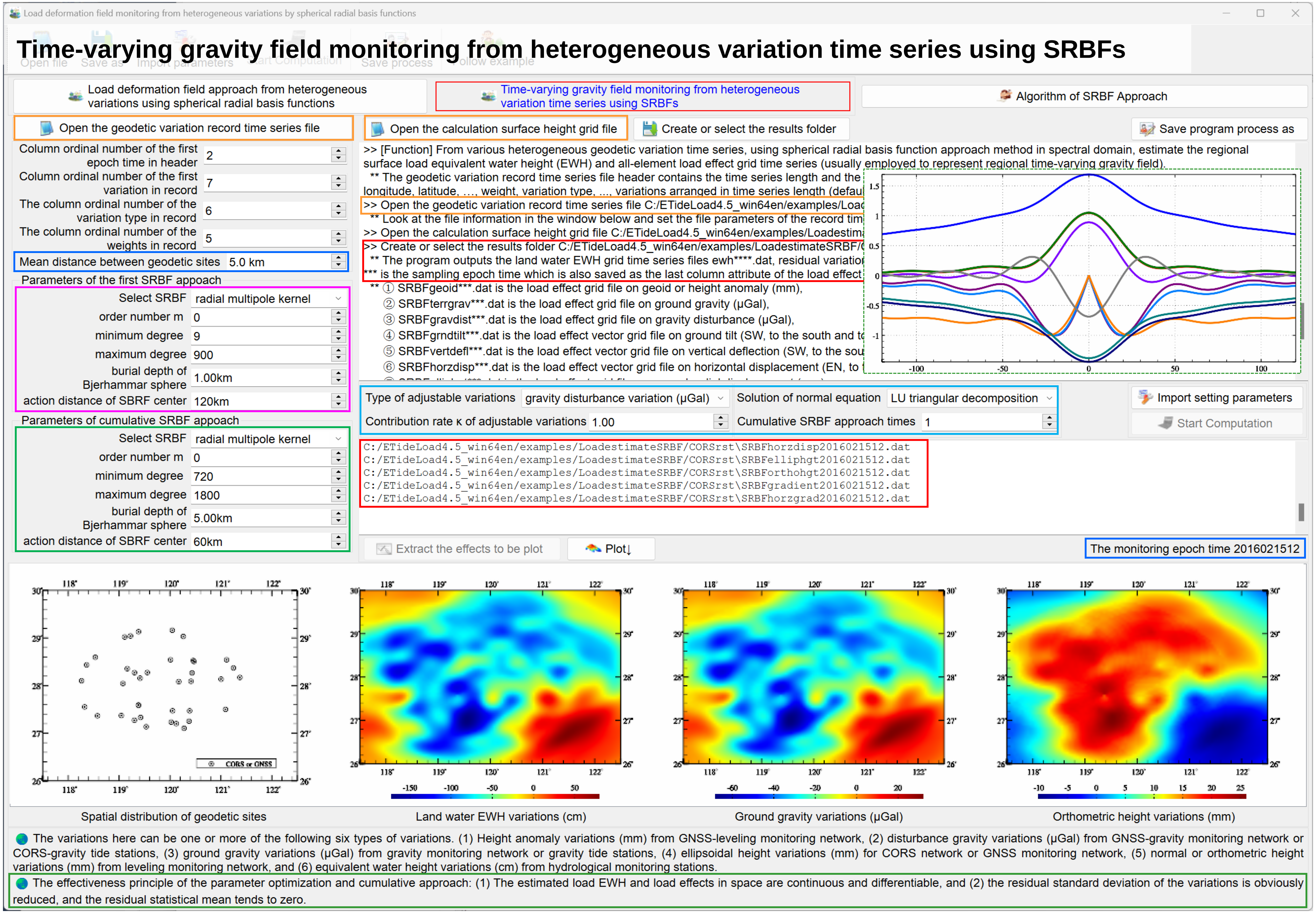


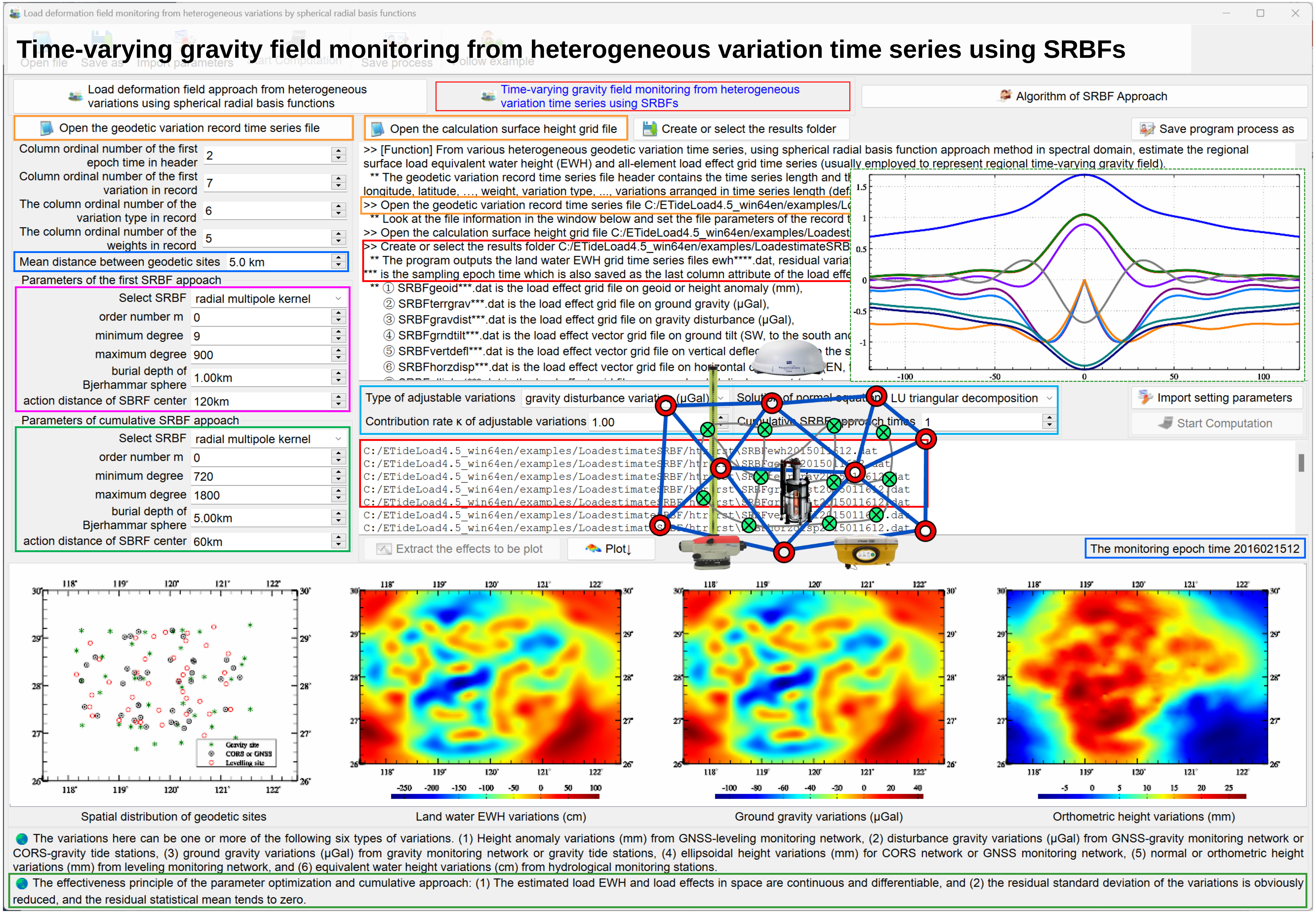
Load deformation field monitoring from heterogeneous variations with Green's integral constraints
Time-varying gravity field monitoring from heterogeneous variations by Green's integral constraints
Load deformation field estimation from heterogeneous variations with Green's integral constraints
Time-varying gravity field monitoring from heterogeneous variations by Green's integral constraints
Follow example
Open the geodetic variation record time series file
Solution of normal equation
LU triangular decomposition
Save program process as
Column ordinal number of the first epoch time in header 2
Column ordinal number of the first variation in record 7
The column ordinal number of the variation type in record 6
The column ordinal number of the weights in record 5
Mean distance between geodetic sites 15.0 km
Open the calculation surface height grid file
Set algorithm parameters
Load Green's integral radius 150km
Laplace operator weight p 1.0000
Edge effect suppression parameter n 2
Cumulative approach times 3
Select type of the adjustable variations
height anomaly variation (mm)
Contribution rate κ of the adjustable variations 1.00
>> [Function] Using various heterogeneous geodetic variation time series as the observations and the load Green's integral as the geodynamic constraints, estimate the regional surface load equivalent water height (EWH) and all-element load effect grid time series (usually employed to represent regional time-varying gravity field).
** The file header contains the time series length and the sampling epoch time arranged with time. Record format: ID (the site name / no), longitude, latitude, …, weight, variation type, …, variations arranged in time series length (default value is 9999.0000).
>> Open the geodetic variation record time series file C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSadj.txt.
** Look at the file information in the window below and set the file parameters of the record time series...
>> Open the calculation surface height grid file C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/dtm3m.dat.
>> Create or select the results folder C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst.
** The program outputs the land water EWH grid file ewh****.dat, residual geodetic variation file rnt***.txt and all-element load effect grid files into the current directory. Here, *** is the sampling epoch time which is also saved as the last column attribute of the load effect grid file header.
** ① Greengeoid***.dat is the load effect grid file on geoid or height anomaly (mm),
② Greenterrgrav***.dat is the load effect grid file on ground gravity (μGal),
Create or select the results folder
Import setting parameters
Start Computation
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greenhorzdisp2016021512.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greenelliphgt2016021512.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greenorthohgt2016021512.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greengradient2016021512.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greenhorzgrad2016021512.dat
The monitoring epoch time 2016021512
Extract the effects to be plot
Plot↓
CORS or GNSS
-300 -200 -100 0 100 200
-8 -6 -4 -2 0 2 4
-10 0 10 20
Spatial distribution of geodetic sites
Land water EWH variations (cm)
Ground gravity variations (μGal)
Orthometric height variations (mm)
The geodetic variations here can be one or more of the following five types of variations. (1) Height anomaly variations (mm) from GNSS-leveling monitoring network, (2) disturbance gravity variations (μGal) from GNSS-gravity monitoring network or CORS-gravity tide stations, (3) ground gravity variations (μGal) from gravity monitoring network or gravity tide stations, (4) ellipsoidal height variations (mm) for CORS network or GNSS monitoring network, and (5) normal or orthometric height variations (mm) from leveling monitoring network.
The effectiveness principle of the parameter optimization and cumulative approach: (1) The estimated load EWH and load deformation field in space are continuous and differentiable, and (2) the residual standard deviation of the variations is obviously reduced, and the residual statistical mean tends to zero.

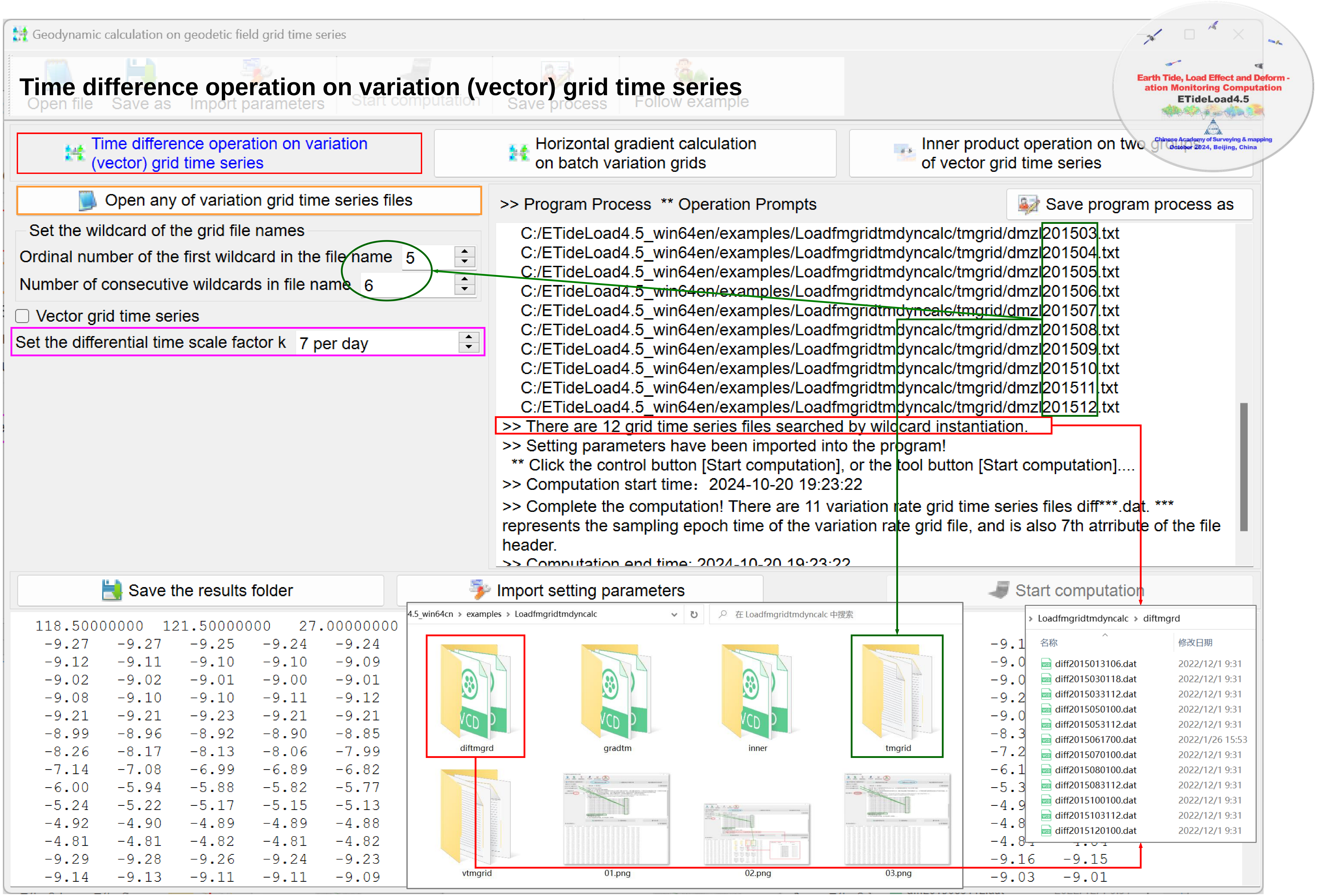

Load deformation field monitoring from heterogeneous variations with Green's integral constraints
Time-varying gravity field monitoring from heterogeneous variations by Green's integral constraints
Load deformation field estimation from heterogeneous variations with Green's integral constraints
Time-varying gravity field monitoring from heterogeneous variations by Green's integral constraints
Follow example
Open the geodetic variation record time series file
Solution of normal equation
LU triangular decomposition
Save program process as
Column ordinal number of the first epoch time in header
2
Column ordinal number of the first variation in record
7
The column ordinal number of the variation type in record
6
The column ordinal number of the weights in record
5
Mean distance between geodetic sites
15.0 km
Open the calculation surface height grid file
Set algorithm parameters
Load Green's integral radius
150km
Laplace operator weight p
1.0000
Edge effect suppression parameter n
2
Cumulative approach times
3
Select type of the adjustable variations
height anomaly variation (mm)
Contribution rate κ of the adjustable variations
1.00
>> [Function] Using various heterogeneous geodetic variation time series as the observations and the load Green's integral as the geodynamic constraints, estimate the regional surface load equivalent water height (EWH) and all-element load effect grid time series (usually employed to represent regional time-varying gravity field).
** The file header contains the time series length and the sampling epoch time arranged with time. Record format: ID (the site name / no), longitude, latitude, …, weight, variation type, …, variations arranged in time series length (default value is 9999.0000).
>> Open the geodetic variation record time series file C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/heterobstm.txt.
** Look at the file information in the window below and set the file parameters of the record time series...
>> Open the calculation surface height grid file C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/dtm3m.dat.
>> Create or select the results folder C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst.
** The program outputs the land water EWH grid file ewh****.dat, residual geodetic variation file rnt***.txt and all-element load effect grid files into the current directory. Here, *** is the sampling epoch time which is also saved as the last column attribute of the load effect grid file header.
** ① Greengeoid***.dat is the load effect grid file on geoid or height anomaly (mm),
② Greenterrgrav***.dat is the load effect grid file on ground gravity (μGal),
Create or select the results folder
Import setting parameters
Start Computation
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greenhorzdisp2016021512.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greenelliphgt2016021512.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greenorthohgt2016021512.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greengradient2016021512.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greenhorzgrad2016021512.dat
The monitoring epoch time 2016021512
Gravity site
CORS or GNSS
Leveling site
Spatial distribution of geodetic sites
Land water EWH variations (cm)
Ground gravity variations (μGal)
Orthometric height variations (mm)
The geodetic variations here can be one or more of the following five types of variations. (1) Height anomaly variations (mm) from GNSS-leveling monitoring network, (2) disturbance gravity variations (μGal) from GNSS-gravity monitoring network or CORS-gravity tide stations, (3) ground gravity variations (μGal) from gravity monitoring network or gravity tide stations, (4) ellipsoidal height variations (mm) for CORS network or GNSS monitoring network, and (5) normal or orthometric height variations (mm) from leveling monitoring network.
The effectiveness principle of the parameter optimization and cumulative approach: (1) The estimated load EWH and load deformation field in space are continuous and differentiable, and (2) the residual standard deviation of the variations is obviously reduced, and the residual statistical mean tends to zero.


Load deformation field monitoring from heterogeneous variations by spherical radial basis functions
Load deformation field approach from heterogeneous variations using spherical radial basis functions
Load deformation field approach from heterogeneous variations using spherical radial basis functions
Time-varying gravity field monitoring from heterogeneous variation time series using SRBFs
Algorithm of SRBF Approach
Open the geodetic variation record time series file
Open the calculation surface height grid file
Create or select the results folder
Save program process as
Column ordinal number of the first epoch time in header 2
Column ordinal number of the first variation in record 7
The column ordinal number of the variation type in record 6
The column ordinal number of the weights in record 5
The column ordinal number of the current variations in record 9
Mean distance between geodetic sites 5.0 km
Parameters of the first SRBF appoach
Select SRBF radial multipole kernel
order number m 0
minimum degree 9
maximum degree 900
burial depth of Bjerhammar sphere 1.00km
action distance of SRBF center 120km
Parameters of cumulative SRBF appoach
Select SRBF radial multipole kernel
order number m 0
minimum degree 720
maximum degree 1800
burial depth of Bjerhammar sphere 5.00km
action distance of SRBF center 60km
>> [Function] Using spherical radial basis functions in spectral domain, approach the regional surface load equivalent water height (EWH) and all-element load effects to obtain the land water EWH, geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (mE) and horizontal gravity gradient (NW, to the north and to the west, mE) variation grids from various heterogeneous geodetic variations.
>> Open the geodetic variation record time series file C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSadj.txt
** Look at the file information in the window below and set the file parameters of the record time
>> Open the calculation surface height grid file C:/ETideLoad4.5_win64en/examples/Loadestimat
>> Create or select the results folder C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/C
** The program outputs the land water EWH grid time series files ewh****.dat, residual variation
*** is the sampling epoch time which is also saved as the last column attribute of the load effect g
** ① SRBFgeoid***.dat is the load effect grid file on geoid or height anomaly (mm),
② SRBFterrgrav***.dat is the load effect grid file on ground gravity (μGal),
③ SRBFgravdist***.dat is the load effect grid file on gravity disturbance (μGal),
④ SRBFgrndtilt***.dat is the load effect vector grid file on ground tilt (SW, to the south and to
⑤ SRBFvertdefl***.dat is the load effect vector grid file on vertical deflection (SW, to the sout
⑥ SRBFhorzdisp***.dat is the load effect vector grid file on horizontal displacement (EN, to th
⑦ SRBFelliphgt***.dat is the load effect grid file on ground radial displacement (mm),
⑧ SRBForthohgt***.dat is the load effect grid file on ground normal or orthometric height (mm
Type of adjustable variations gravity disturbance variation (μGal)
Solution of normal equation LU triangular decomposition
Contribution rate κ of adjustable variations 1.00
Cumulative SRBF approach times 1
Import setting parameters
Start Computation
C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst\SRBFhorzdisp20150316
C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst\SRBFelliphgt20150316
C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst\SRBForthohgt20150316
C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst\SRBFgradient20150316
C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst\SRBFhorzgrad20150316
Ellipsoidal height (mm)
Extract the effects to be plot
Plot↓
The monitoring epoch time 2015031612
CORS or GNSS
Spatial distribution of geodetic sites
Land water EWH variations (cm)
Ground gravity variations (μGal)
Orthometric height variations (mm)
The variations here can be one or more of the following six types of variations. (1) Height anomaly variations (mm) from GNSS-leveling monitoring network, (2) disturbance gravity variations (μGal) from GNSS-gravity monitoring network or CORS-gravity tide stations, (3) ground gravity variations (μGal) from gravity monitoring network or gravity tide stations, (4) ellipsoidal height variations (mm) for CORS network or GNSS monitoring network, (5) normal or orthometric height variations (mm) from leveling monitoring network, and (6) equivalent water height variations (cm) from hydrological monitoring stations.
The effectiveness principle of the parameter optimization and cumulative approach: (1) The estimated load EWH and load effects in space are continuous and differentiable, and (2) the residual standard deviation of the variations is obviously reduced, and the residual statistical mean tends to zero.

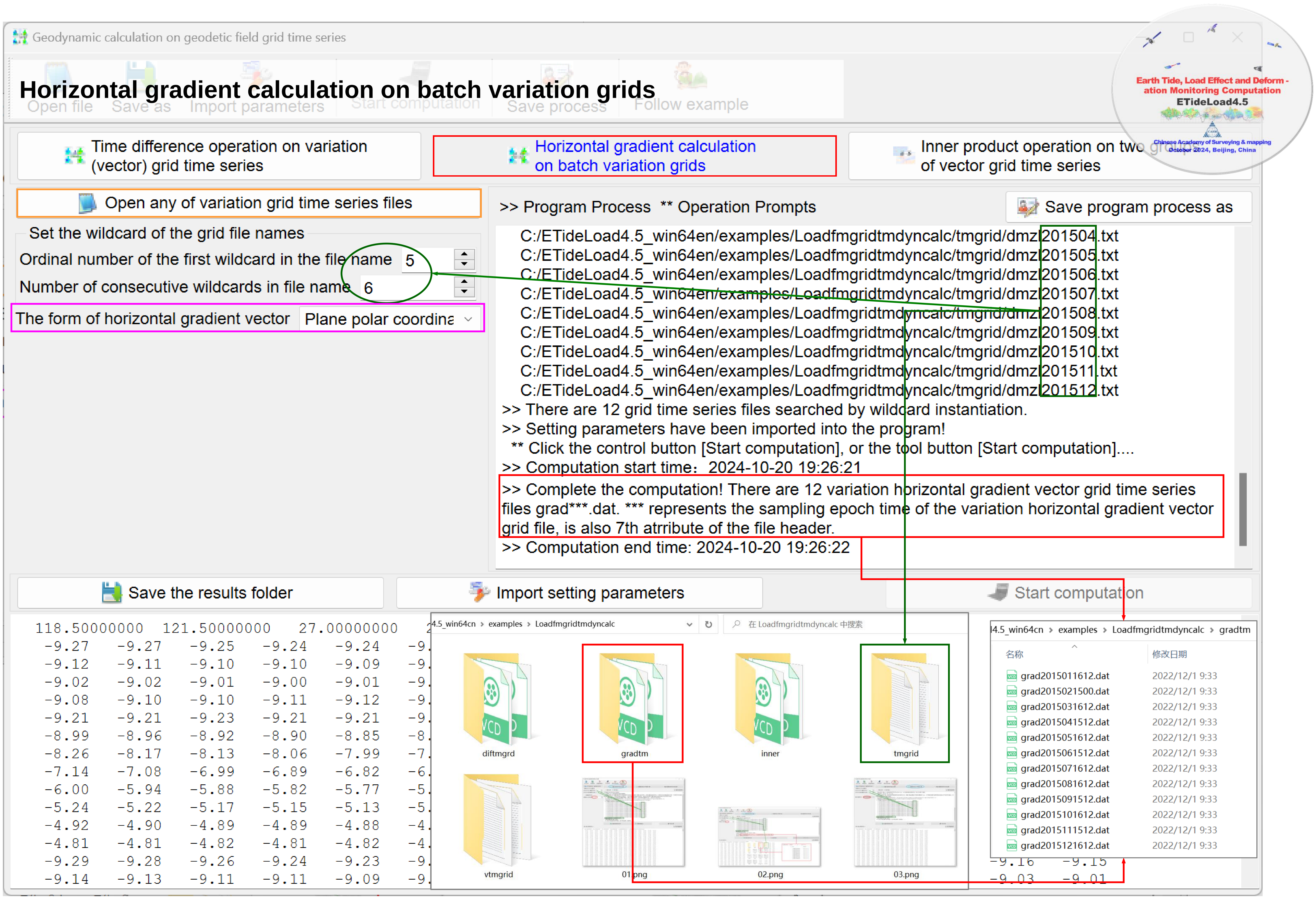

Load deformation field monitoring from heterogeneous variations by spherical radial basis functions
Load deformation field approach from heterogeneous variations using spherical radial basis functions
Load deformation field approach from heterogeneous variations using spherical radial basis functions
Time-varying gravity field monitoring from heterogeneous variation time series using SRBFs
Algorithm of SRBF Approach
Open the geodetic variation record time series file
Open the calculation surface height grid file
Create or select the results folder
Save program process as
Column ordinal number of the first epoch time in header 2
Column ordinal number of the first variation in record 7
The column ordinal number of the variation type in record 6
The column ordinal number of the weights in record 5
The column ordinal number of the current variations in record 10
Mean distance between geodetic sites 5.0 km
Parameters of the first SRBF appoach
Select SRBF radial multipole kernel
order number m 0
minimum degree 9
maximum degree 900
burial depth of Bjerhammar sphere 1.00km
action distance of SRBF center 120km
Parameters of cumulative SRBF appoach
Select SRBF radial multipole kernel
order number m 0
minimum degree 720
maximum degree 1800
burial depth of Bjerhammar sphere 5.00km
action distance of SRBF center 60km
>> [Function] Using spherical radial basis functions in spectral domain, the regional surface load equivalent water height (EWH) and all-element load effects to obtain the land water EWH, geoid or height anomaly (mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, to the south and to the west, mas), vertical deflection (SW, to the south and to the west, mas), horizontal displacement (EN, to the east and to the north, mm), ground radial displacement (mm), ground normal or orthometric height (mm), radial gravity gradient (mE) and horizontal gravity gradient (NW, to the north and to the west, mE) variation grids from various heterogeneous geodetic variations.
Type of adjustable variations
Solution of normal equation LU triangular
Contribution rate κ of adjustable
Cumulative SRBF approach times 1
Extract the effects to be plot
Plot
The monitoring epoch time 2015041600
Spatial distribution of geodetic sites
Land water EWH variations (cm)
Ground gravity variations (μGal)
Orthometric height variations (mm)
The variations here can be one or more of the following six types of variations. (1) Height anomaly variations (mm) from GNSS-leveling monitoring network, (2) disturbance gravity variations (μGal) from GNSS-gravity monitoring network or CORS-gravity tide stations, (3) ground gravity variations (μGal) from gravity monitoring network or gravity tide stations, (4) ellipsoidal height variations (mm) for CORS network or GNSS monitoring network, (5) normal or orthometric height variations (mm) from leveling monitoring network, and (6) equivalent water height variations (cm) from hydrological monitoring stations.
The effectiveness principle of the parameter optimization and cumulative approach: (1) The estimated load EWH and load effects in space are continuous and differentiable, and (2) the residual standard deviation of the variations is obviously reduced, and the residual statistical mean tends to zero.


Load deformation field monitoring from heterogeneous variations by spherical radial basis functions
Time-varying gravity field monitoring from heterogeneous variation time series using SRBFs
Load deformation field approach from heterogeneous variations using spherical radial basis functions
Time-varying gravity field monitoring from heterogeneous variation time series using SRBFs
Algorithm of SRBF Approach
Open the geodetic variation record time series file
Open the calculation surface height grid file
Create or select the results folder
Save program process as
Column ordinal number of the first epoch time in header 2
Column ordinal number of the first variation in record 7
The column ordinal number of the variation type in record 6
The column ordinal number of the weights in record 5
Mean distance between geodetic sites 5.0 km
Parameters of the first SRBF appoach
Select SRBF radial multipole kernel
order number m 0
minimum degree 9
maximum degree 900
burial depth of Bjerhammar sphere 1.00km
action distance of SRBF center 120km
Parameters of cumulative SRBF appoach
Select SRBF radial multipole kernel
order number m 0
minimum degree 720
maximum degree 1800
burial depth of Bjerhammar sphere 5.00km
action distance of SRBF center 60km
>> [Function] From various heterogeneous geodetic variation time series, using spherical radial basis function approach method in spectral domain, estimate the regional surface load equivalent water height (EWH) and all-element load effect grid time series (usually employed to represent regional time-varying gravity field).
** The geodetic variation record time series file header contains the time series length and the longitude, latitude, ..., weight, variation type, ..., variations arranged in time series length (defau
>> Open the geodetic variation record time series file C:/ETideLoad4.5_win64en/examples/Loa
** Look at the file information in the window below and set the file parameters of the record tim
>> Open the calculation surface height grid file C:/ETideLoad4.5_win64en/examples/Loadestim
>> Create or select the results folder C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/C
** The program outputs the land water EWH grid time series files ewh****.dat, residual variatio
*** is the sampling epoch time which is also saved as the last column attribute of the load effect
** ① SRBFgeoid***.dat is the load effect grid file on geoid or height anomaly (mm),
② SRBFterrgrav***.dat is the load effect grid file on ground gravity (μGal),
③ SRBFgravdist***.dat is the load effect grid file on gravity disturbance (μGal),
④ SRBFgrndtilt***.dat is the load effect vector grid file on ground tilt (SW, to the south and to
⑤ SRBFvertdefl***.dat is the load effect vector grid file on vertical deflection (SW, to the sou
⑥ SRBFhorzdisp***.dat is the load effect vector grid file on horizontal displacement (EN, to
Type of adjustable variations gravity disturbance variation (μGal)
Solution of normal equation LU triangular decomposition
Import setting parameters
Contribution rate κ of adjustable variations 1.00
Cumulative SRBF approach times 1
Start Computation
C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst\SRBFhorzdisp2016021512.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst\SRBFelliphgt2016021512.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst\SRBForthohgt2016021512.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst\SRBFgradient2016021512.dat
C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst\SRBFhorzgrad2016021512.dat
Extract the effects to be plot
Plot↓
The monitoring epoch time 2016021512
CORS or GNSS
Spatial distribution of geodetic sites
Land water EWH variations (cm)
Ground gravity variations (μGal)
Orthometric height variations (mm)
The variations here can be one or more of the following six types of variations. (1) Height anomaly variations (mm) from GNSS-leveling monitoring network, (2) disturbance gravity variations (μGal) from GNSS-gravity monitoring network or CORS-gravity tide stations, (3) ground gravity variations (μGal) from gravity monitoring network or gravity tide stations, (4) ellipsoidal height variations (mm) for CORS network or GNSS monitoring network, (5) normal or orthometric height variations (mm) from leveling monitoring network, and (6) equivalent water height variations (cm) from hydrological monitoring stations.
The effectiveness principle of the parameter optimization and cumulative approach: (1) The estimated load EWH and load effects in space are continuous and differentiable, and (2) the residual standard deviation of the variations is obviously reduced, and the residual statistical mean tends to zero.

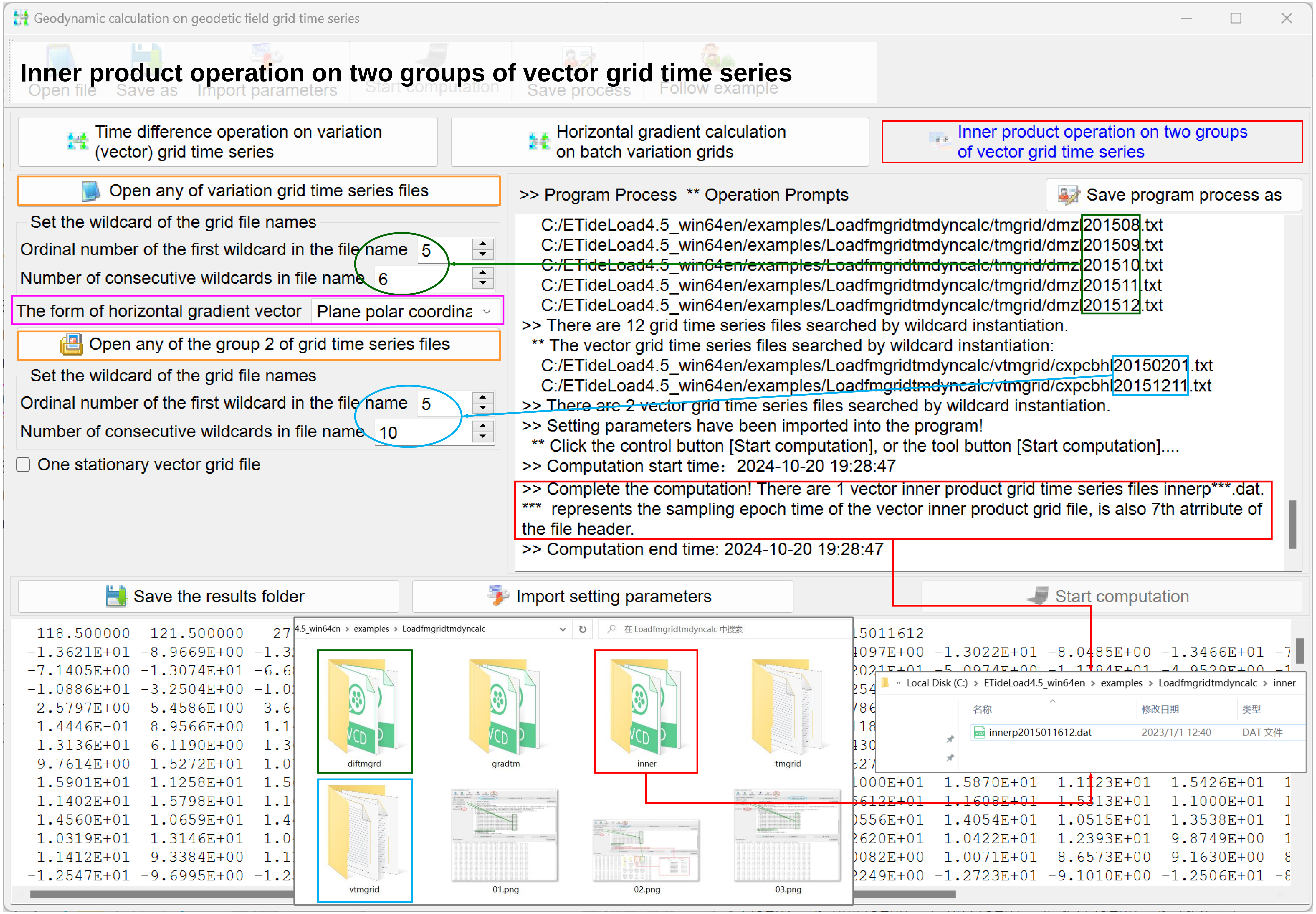

Load deformation field monitoring from heterogeneous variations by spherical radial basis functions
Time-varying gravity field monitoring from heterogeneous variation time series using SRBFs
Load deformation field approach from heterogeneous variations using spherical radial basis functions
Time-varying gravity field monitoring from heterogeneous variation time series using SRBFs
Algorithm of SRBF Approach
Open the geodetic variation record time series file
Open the calculation surface height grid file
Create or select the results folder
Save program process as
Column ordinal number of the first epoch time in header 2
Column ordinal number of the first variation in record 7
The column ordinal number of the variation type in record 6
The column ordinal number of the weights in record 5
Mean distance between geodetic sites 5.0 km
Parameters of the first SRBF appoach
Select SRBF radial multipole kernel
order number m 0
minimum degree 9
maximum degree 900
burial depth of Bjerhammar sphere 1.00km
action distance of SRBF center 120km
Parameters of cumulative SRBF appoach
Select SRBF radial multipole kernel
order number m 0
minimum degree 720
maximum degree 1800
burial depth of Bjerhammar sphere 5.00km
action distance of SRBF center 60km
>> [Function] From various heterogeneous geodetic variation time series, using spherical radial basis function approach method in spectral domain, estimate the regional surface load equivalent water height (EWH) and all-element load effect grid time series (usually employed to represent regional time-varying gravity field).
** The geodetic variation record time series file header contains the time series length and the longitude, latitude, ..., weight, variation type, ..., variations arranged in time series length
>> Open the geodetic variation record time series file C:/ETideLoad4.5_win64en/examples/L
** Look at the file information in the window below and set the file parameters of the record
>> Open the calculation surface height grid file C:/ETideLoad4.5_win64en/examples/Loadest
>> Create or select the results folder C:/ETideLoad4.5_win64en/examples/LoadestimateSRB
** The program outputs the land water EWH grid time series files ewh****.dat, residual varia
*** is the sampling epoch time which is also saved as the last column attribute of the load effe
** ① SRBFgeoid***.dat is the load effect grid file on geoid or height anomaly (mm),
② SRBFterrgrav***.dat is the load effect grid file on ground gravity (μGal),
③ SRBFgravdist***.dat is the load effect grid file on gravity disturbance (μGal),
④ SRBFgrndtilt***.dat is the load effect vector grid file on ground tilt (SW, to the south and
⑤ SRBFvertdefl***.dat is the load effect vector grid file on vertical deflec
⑥ SRBFhorzdisp***.dat is the load effect vector grid file on horizontal
1.5
1
0.5
0
-0.5
-1
-100
-50
0
50
100
Type of adjustable variations gravity disturbance variati (μGal)
Contribution rate κ of adjustable variations 1.00
LU triangular decomposition
Cumulative SRBF approach times 1
Import setting parameters
Start Computation
C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/ht
Extract the effects to be plot
Plot↓
The monitoring epoch time 2016021512
118° 119° 120° 121° 122°
30° 29° 28° 27° 26°
Gravity site
CORS or GNSS
Levelling site
-250 -200 -150 -100 -50 0 50 100
-100 -80 -60 -40 -20 0 20 40
-5 0 5 10 15 20 25
Spatial distribution of geodetic sites
Land water EWH variations (cm)
Ground gravity variations (μGal)
Orthometric height variations (mm)
The variations here can be one or more of the following six types of variations. (1) Height anomaly variations (mm) from GNSS-leveling monitoring network, (2) disturbance gravity variations (μGal) from GNSS-gravity monitoring network or CORS-gravity tide stations, (3) ground gravity variations (μGal) from gravity monitoring network or gravity tide stations, (4) ellipsoidal height variations (mm) for CORS network or GNSS monitoring network, (5) normal or orthometric height variations (mm) from leveling monitoring network, and (6) equivalent water height variations (cm) from hydrological monitoring stations.
The effectiveness principle of the parameter optimization and cumulative approach: (1) The estimated load EWH and load effects in space are continuous and differentiable, and (2) the residual standard deviation of the variations is obviously reduced, and the residual statistical mean tends to zero.



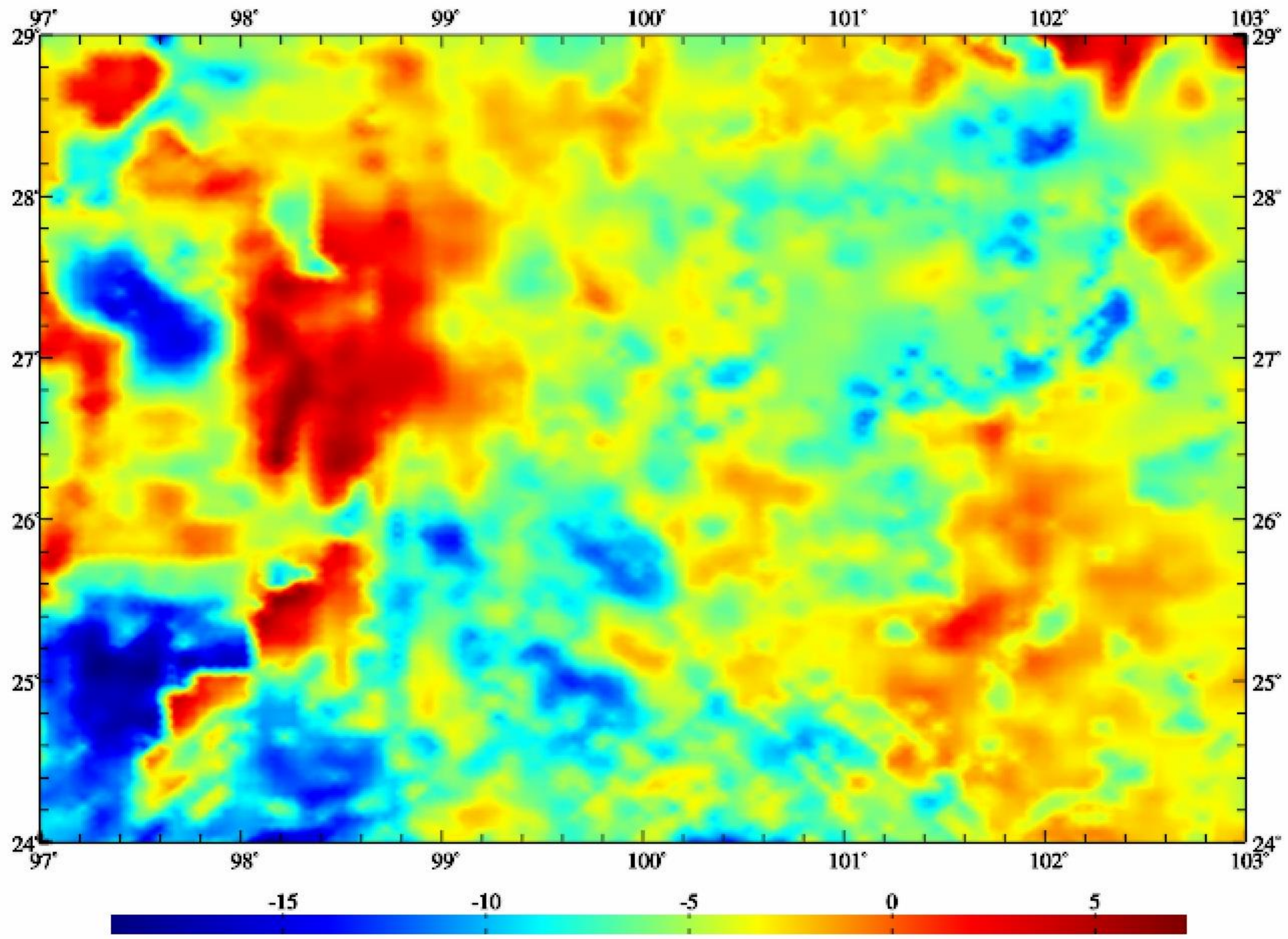
Geodynamic calculation on geodetic field grid time series
Time difference operation on variation (vector) grid time series
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Time difference operation on variation (vector) grid time series
Horizontal gradient calculation on batch variation grids
Inner product operation on two groups of vector grid time series
Open any of variation grid time series files
Set the wildcard of the grid file names
Ordinal number of the first wildcard in the file name 5
Number of consecutive wildcards in file name 6
Vector grid time series
Set the differential time scale factor k 7 per day
>> Program Process ** Operation Prompts
Save program process as
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201503.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201504.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201505.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201506.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201507.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201508.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201509.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201510.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201511.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201512.txt
>> There are 12 grid time series files searched by wildcard instantiation.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-20 19:23:22
>> Complete the computation! There are 11 variation rate grid time series files diff***.dat. *** represents the sampling epoch time of the variation rate grid file, and is also 7th atrribute of the file header.
>> Computation end time: 2024-10-20 19:23:22
Save the results folder
Import setting parameters
Start computation
118.50000000 121.50000000 27.00000000
-9.27 -9.27 -9.25 -9.24 -9.24
-9.12 -9.11 -9.10 -9.10 -9.09
-9.02 -9.02 -9.01 -9.00 -9.01
-9.08 -9.10 -9.10 -9.11 -9.12
-9.21 -9.21 -9.23 -9.21 -9.21
-8.99 -8.96 -8.92 -8.90 -8.85
-8.26 -8.17 -8.13 -8.06 -7.99
-7.14 -7.08 -6.99 -6.89 -6.82
-6.00 -5.94 -5.88 -5.82 -5.77
-5.24 -5.22 -5.17 -5.15 -5.13
-4.92 -4.90 -4.89 -4.89 -4.88
-4.81 -4.81 -4.82 -4.81 -4.82
-9.29 -9.28 -9.26 -9.24 -9.23
-9.14 -9.13 -9.11 -9.11 -9.09
4.5_win64cn › examples › Loadfmgridtmdyncalc
在 Loadfmgridtmdyncalc 中搜索
diftmgrd
gradtm
inner
tmgrid
vtmgrid
01.png
02.png
03.png
› Loadfmgridtmdyncalc › diftmgrd
名称
修改日期
diff2015013106.dat 2022/12/1 9:31
diff2015030118.dat 2022/12/1 9:31
diff2015033112.dat 2022/12/1 9:31
diff2015050100.dat 2022/12/1 9:31
diff2015053112.dat 2022/12/1 9:31
diff2015061700.dat 2022/1/26 15:53
diff2015070100.dat 2022/12/1 9:31
diff2015080100.dat 2022/12/1 9:31
diff2015083112.dat 2022/12/1 9:31
diff2015100100.dat 2022/12/1 9:31
diff2015103112.dat 2022/12/1 9:31
diff2015120100.dat 2022/12/1 9:31
-9.16 -9.15
-9.03 -9.01

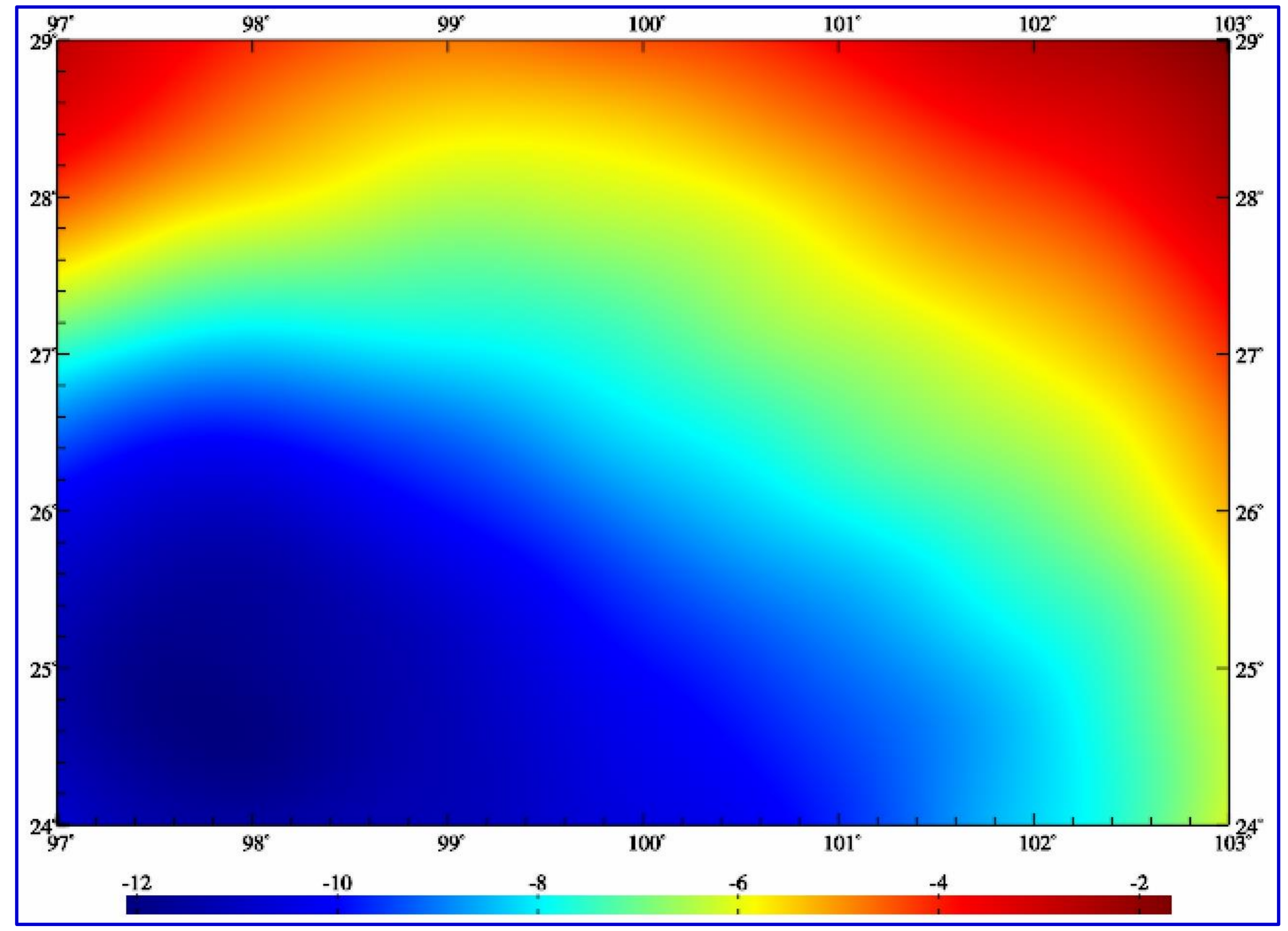


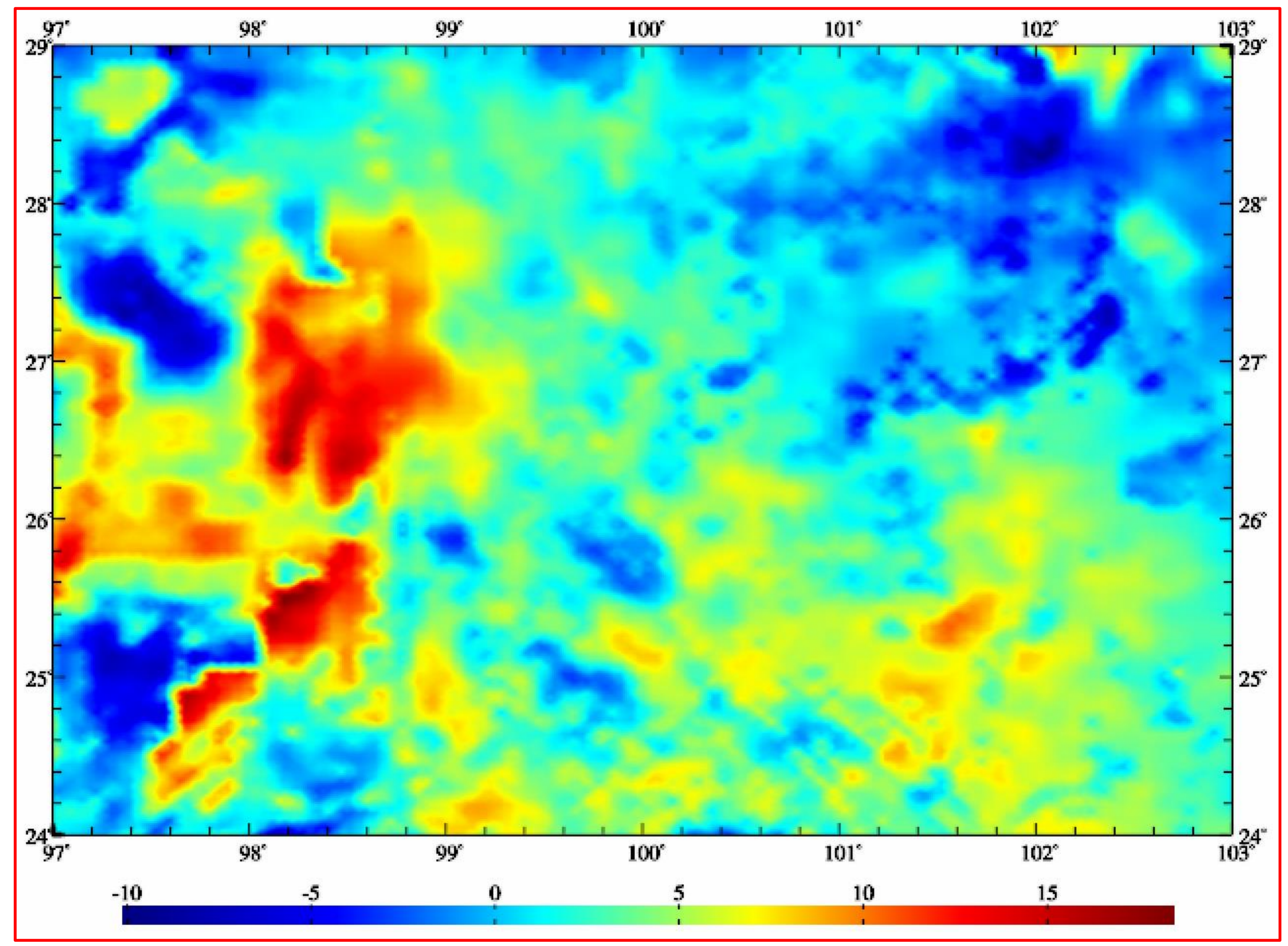
Geodynamic calculation on geodetic field grid time series
Horizontal gradient calculation on batch variation grids
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Time difference operation on variation (vector) grid time series
Horizontal gradient calculation on batch variation grids
Inner product operation on two groups of vector grid time series
Open any of variation grid time series files
Set the wildcard of the grid file names
Ordinal number of the first wildcard in the file name 5
Number of consecutive wildcards in file name 6
The form of horizontal gradient vector Plane polar coordina
>> Program Process ** Operation Prompts
Save program process as
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201504.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201505.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201506.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201507.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201508.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201509.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201510.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201511.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201512.txt
>> There are 12 grid time series files searched by wildcard instantiation.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-20 19:26:21
>> Complete the computation! There are 12 variation horizontal gradient vector grid time series files grad***.dat. *** represents the sampling epoch time of the variation horizontal gradient vector grid file, is also 7th atrribute of the file header.
>> Computation end time: 2024-10-20 19:26:22
Save the results folder
Import setting parameters
Start computation
118.50000000 121.50000000 27.00000000
-9.27 -9.27 -9.25 -9.24 -9.24
-9.12 -9.11 -9.10 -9.10 -9.09
-9.02 -9.02 -9.01 -9.00 -9.01
-9.08 -9.10 -9.10 -9.11 -9.12
-9.21 -9.21 -9.23 -9.21 -9.21
-8.99 -8.96 -8.92 -8.90 -8.85
-8.26 -8.17 -8.13 -8.06 -7.99
-7.14 -7.08 -6.99 -6.89 -6.82
-6.00 -5.94 -5.88 -5.82 -5.77
-5.24 -5.22 -5.17 -5.15 -5.13
-4.92 -4.90 -4.89 -4.89 -4.88
-4.81 -4.81 -4.82 -4.81 -4.82
-9.29 -9.28 -9.26 -9.24 -9.23
-9.14 -9.13 -9.11 -9.11 -9.09
4.5_win64cn › examples › Loadfmgridtmdyncalc
在 Loadfmgridtmdyncalc 中搜索
diftmgrd
gradtm
inner
tmgrid
vtmgrid
01.png
02.png
03.png
4.5_win64cn › examples › Loadfmgridtmdyncalc › gradtm
名称
修改日期
grad2015011612.dat 2022/12/1 9:33
grad2015021500.dat 2022/12/1 9:33
grad2015031612.dat 2022/12/1 9:33
grad2015041512.dat 2022/12/1 9:33
grad2015051612.dat 2022/12/1 9:33
grad2015061512.dat 2022/12/1 9:33
grad2015071612.dat 2022/12/1 9:33
grad2015081612.dat 2022/12/1 9:33
grad2015091512.dat 2022/12/1 9:33
grad2015101612.dat 2022/12/1 9:33
grad2015111512.dat 2022/12/1 9:33
grad2015121612.dat 2022/12/1 9:33
-9.16 -9.15
-9.03 -9.01



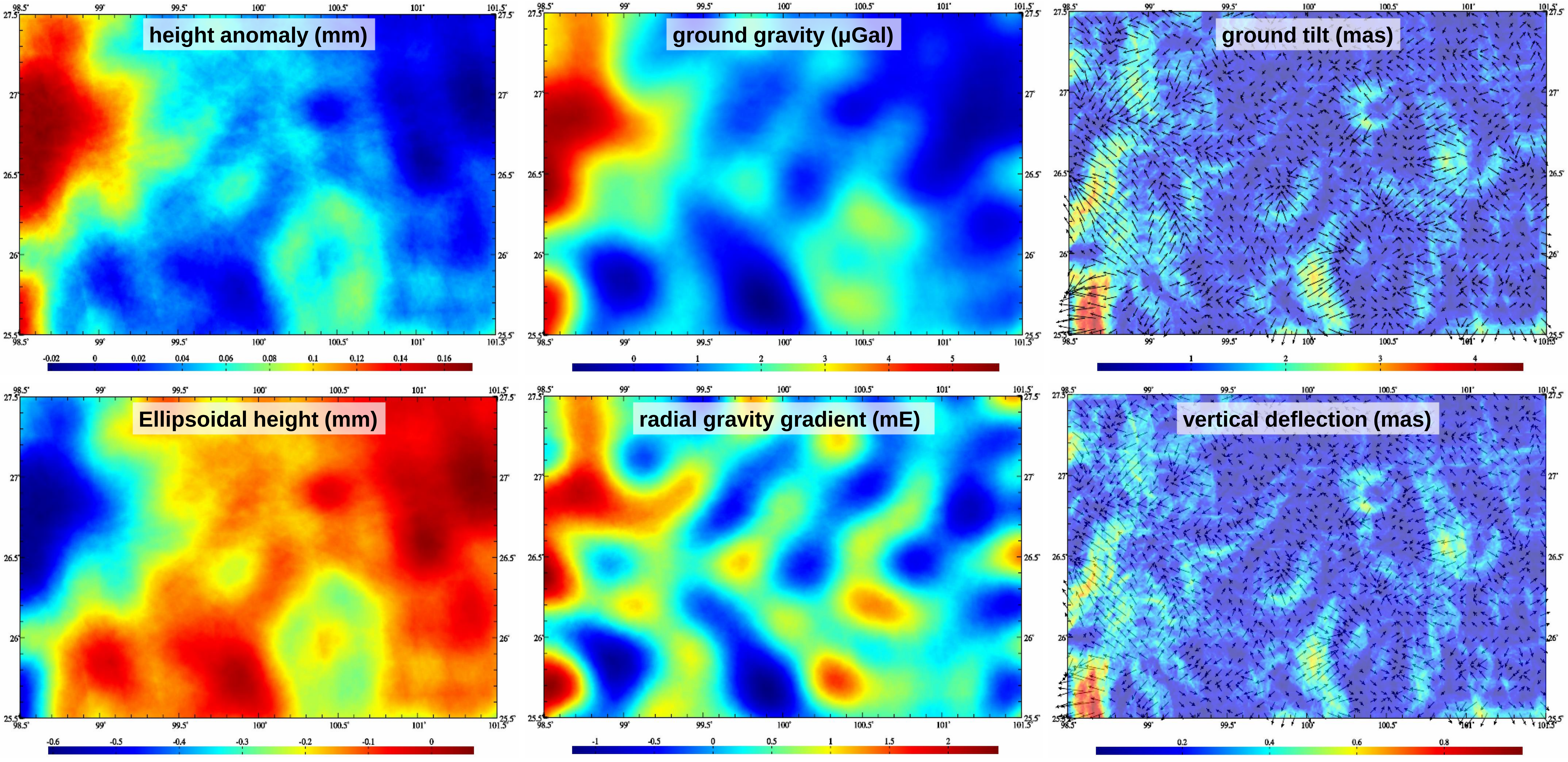
Geodynamic calculation on geodetic field grid time series
Inner product operation on two groups of vector grid time series
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Time difference operation on variation (vector) grid time series
Horizontal gradient calculation on batch variation grids
Inner product operation on two groups of vector grid time series
Open any of variation grid time series files
Set the wildcard of the grid file names
Ordinal number of the first wildcard in the file name 5
Number of consecutive wildcards in file name 6
The form of horizontal gradient vector Plane polar coordina
Open any of the group 2 of grid time series files
Set the wildcard of the grid file names
Ordinal number of the first wildcard in the file name 5
Number of consecutive wildcards in file name 10
One stationary vector grid file
>> Program Process ** Operation Prompts
Save program process as
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201508.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201509.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201510.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201511.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl201512.txt
>> There are 12 grid time series files searched by wildcard instantiation.
** The vector grid time series files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/vtmgrid/cxpcbhl20150201.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/vtmgrid/cxpcbhl20151211.txt
>> There are 2 vector grid time series files searched by wildcard instantiation.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-20 19:28:47
>> Complete the computation! There are 1 vector inner product grid time series files innerp***.dat.
*** represents the sampling epoch time of the vector inner product grid file, is also 7th atrribute of the file header.
>> Computation end time: 2024-10-20 19:28:47
Save the results folder
Import setting parameters
Start computation
4.5_win64cn › examples › Loadfmgridtmdyncalc
在 Loadfmgridtmdyncalc 中搜索
diftmgrd
gradtm
inner
tmgrid
vtmgrid
01.png
02.png
03.png
Local Disk (C:) › ETideLoad4.5_win64en › examples › Loadfmgridtmdyncalc › inner
名称
修改日期
类型
innerp2015011612.dat
2023/1/1 12:40
DAT 文件



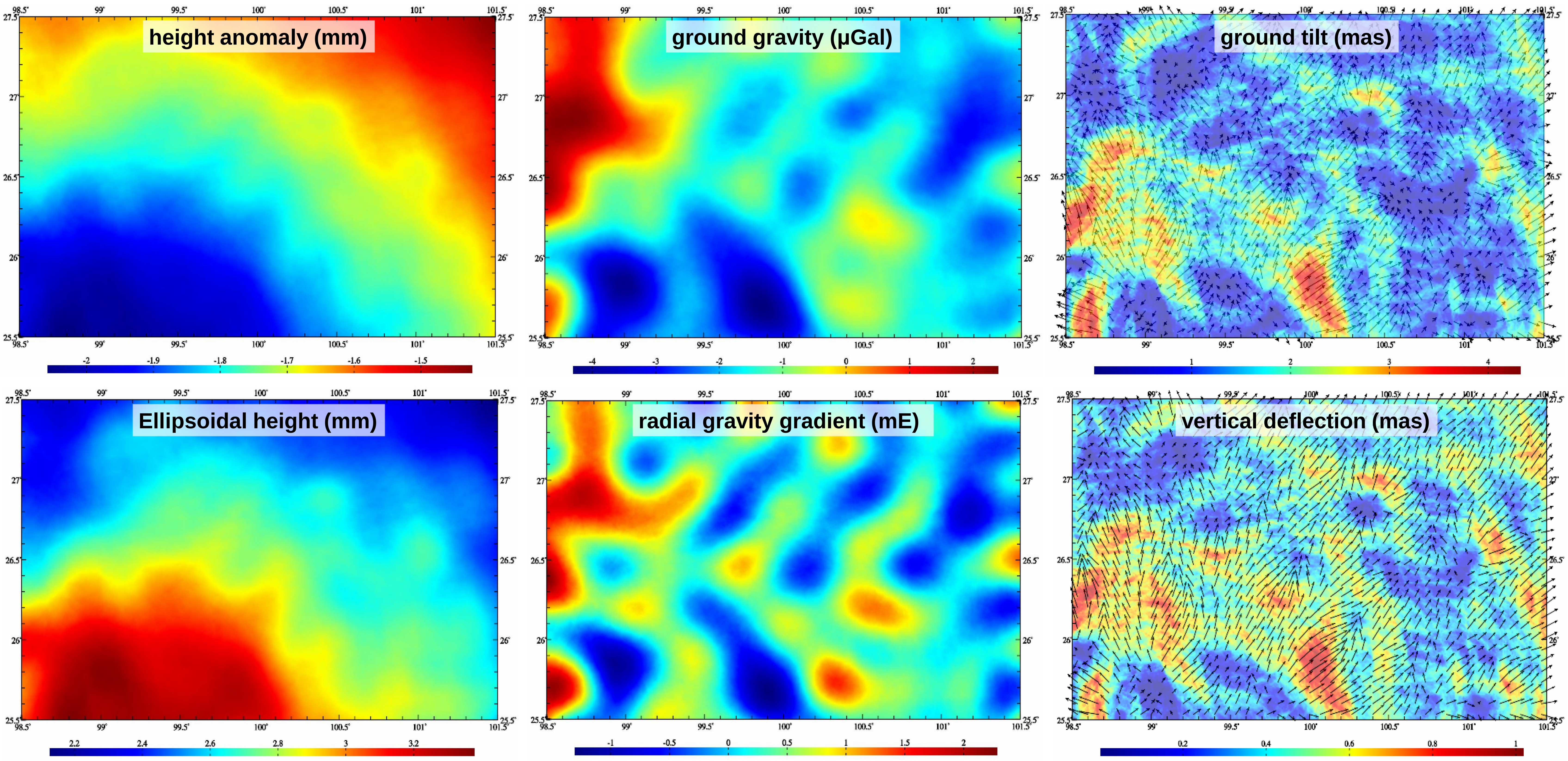




The 1′×1′ land water EWH variation observation, model value and residual grid in the calculation area

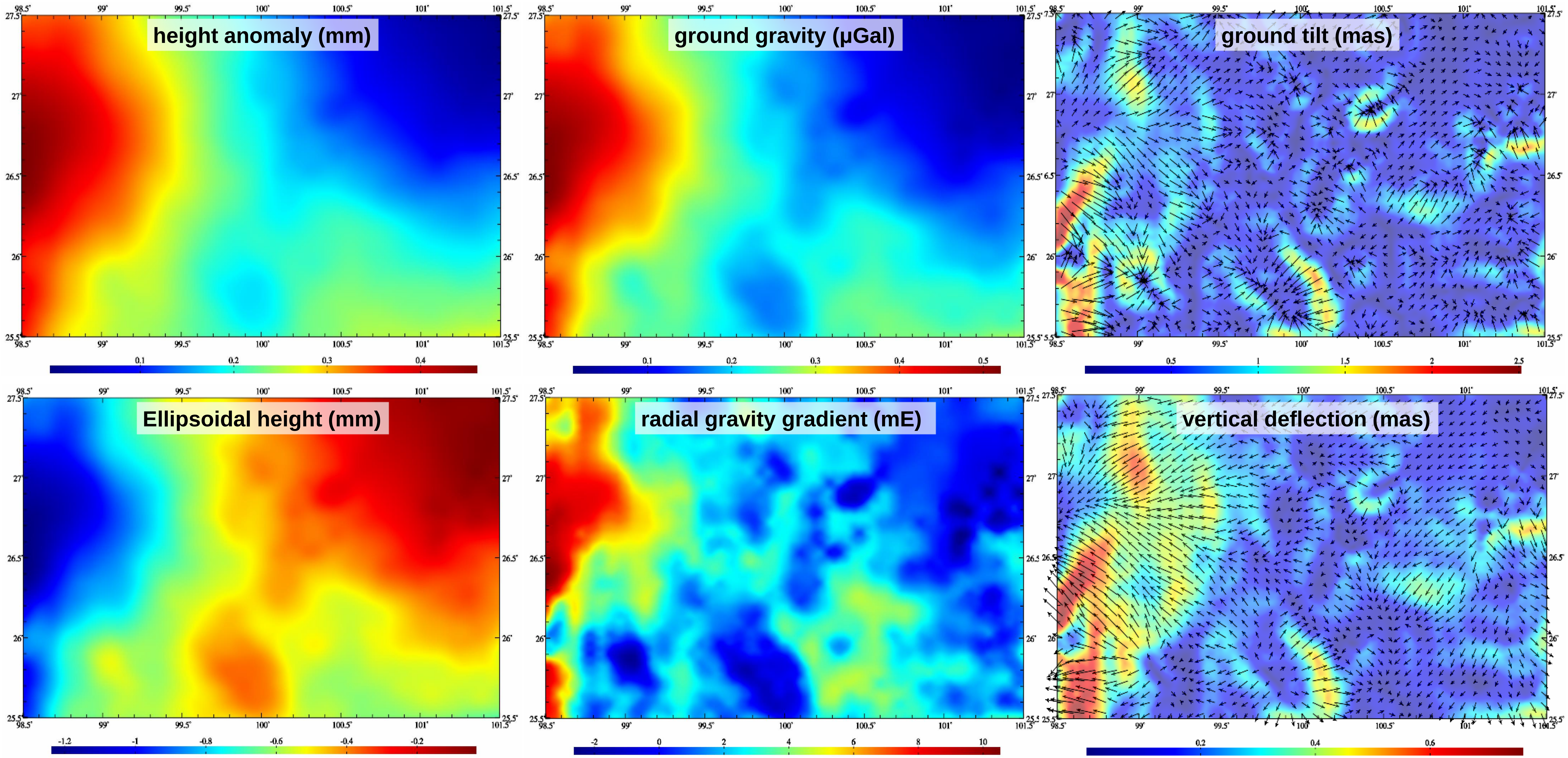


The 1′×1′ land water load deformation field residual value grid using load SRBF approach

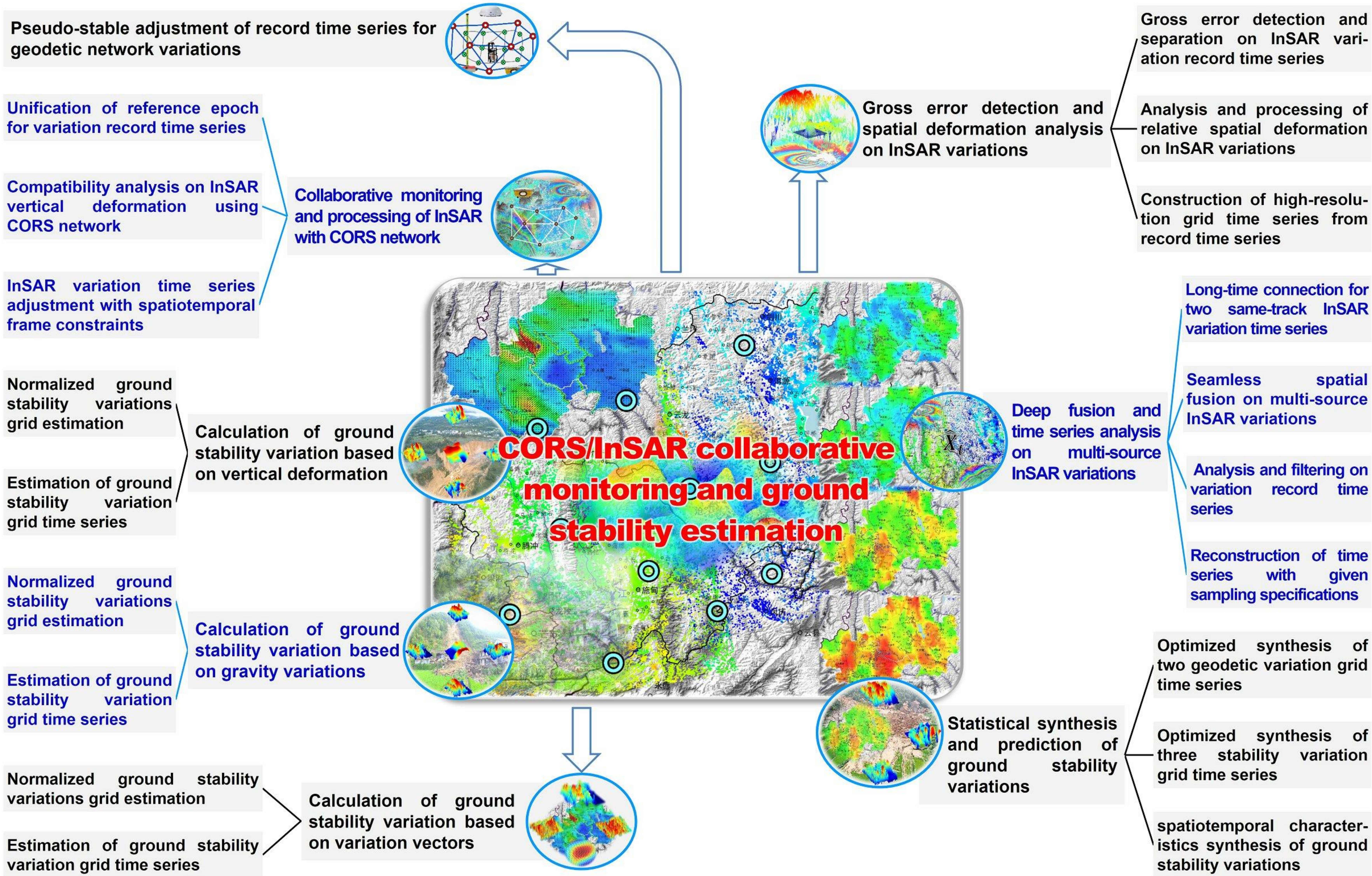


The 1′×1′ land water variation load deformation field grid refined using SRBFs in the result area

The numerical results by the load Green's function integral are larger, and the spatial short-wave structure of numerical results by the load SRBF approach are richer. The spatial distribution characteristics of various geodetic variations of load effects calculated by the two schemes are all similar.

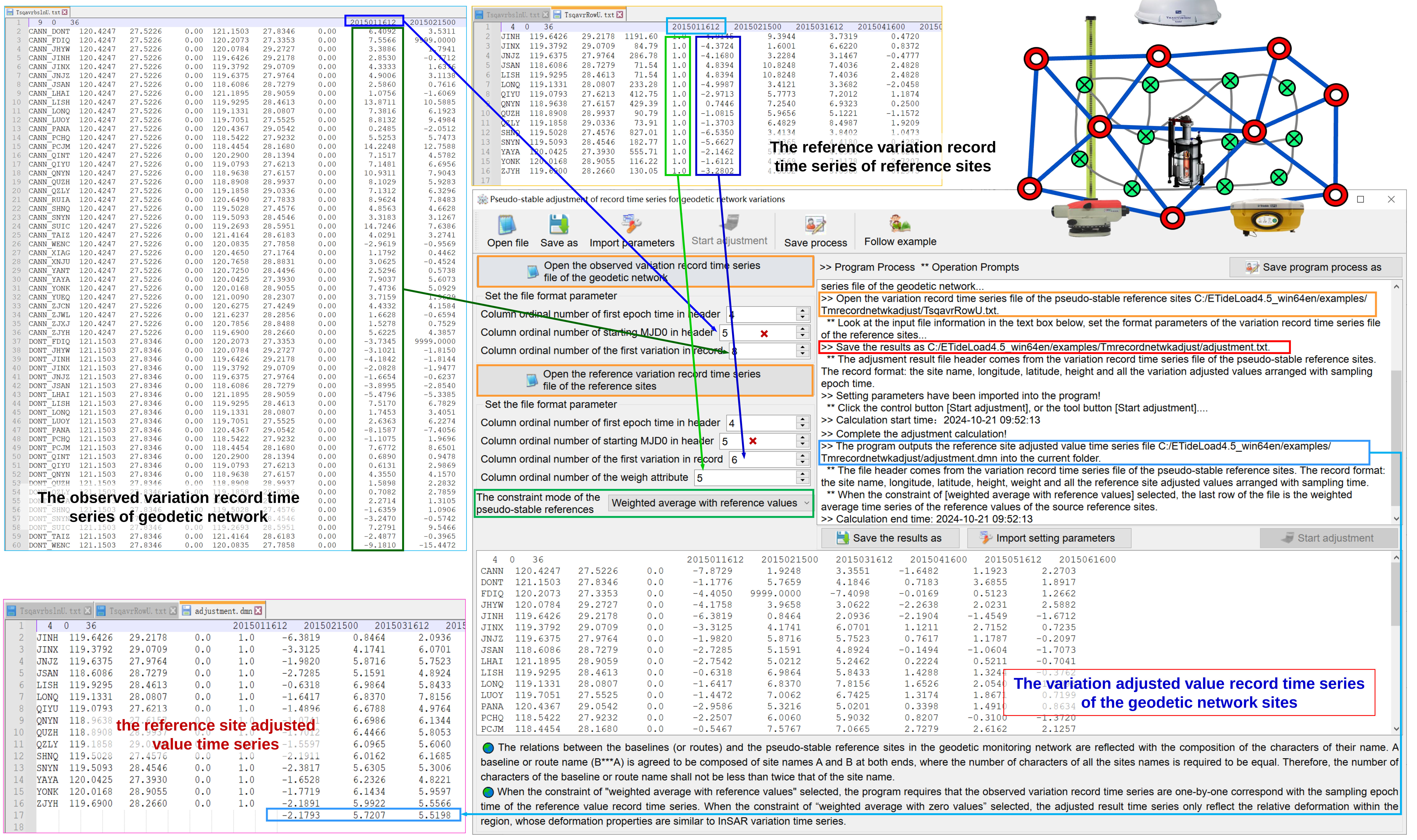


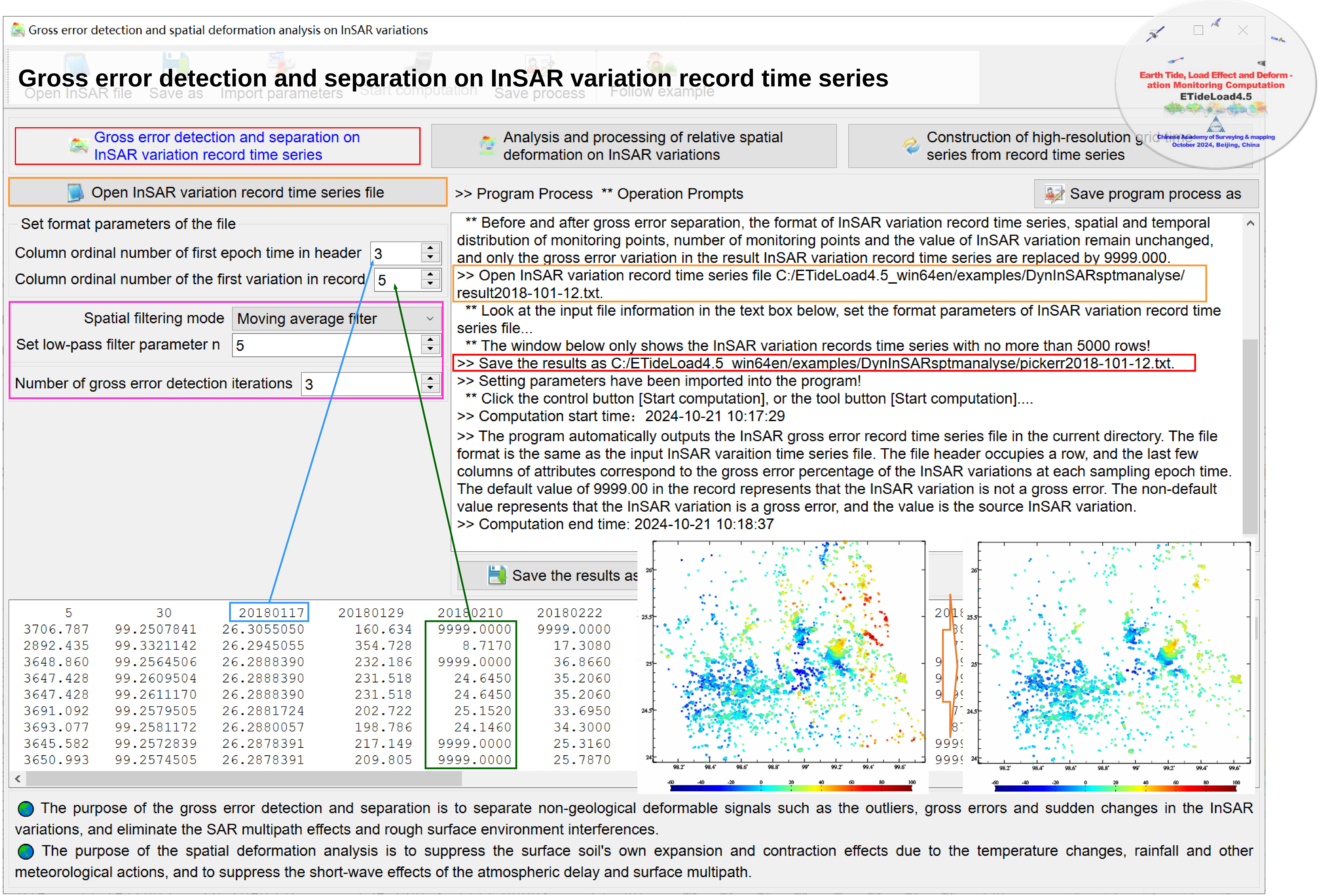
The 1′×1′ land water load deformation field residual value grid using load Green’s integral in the result area



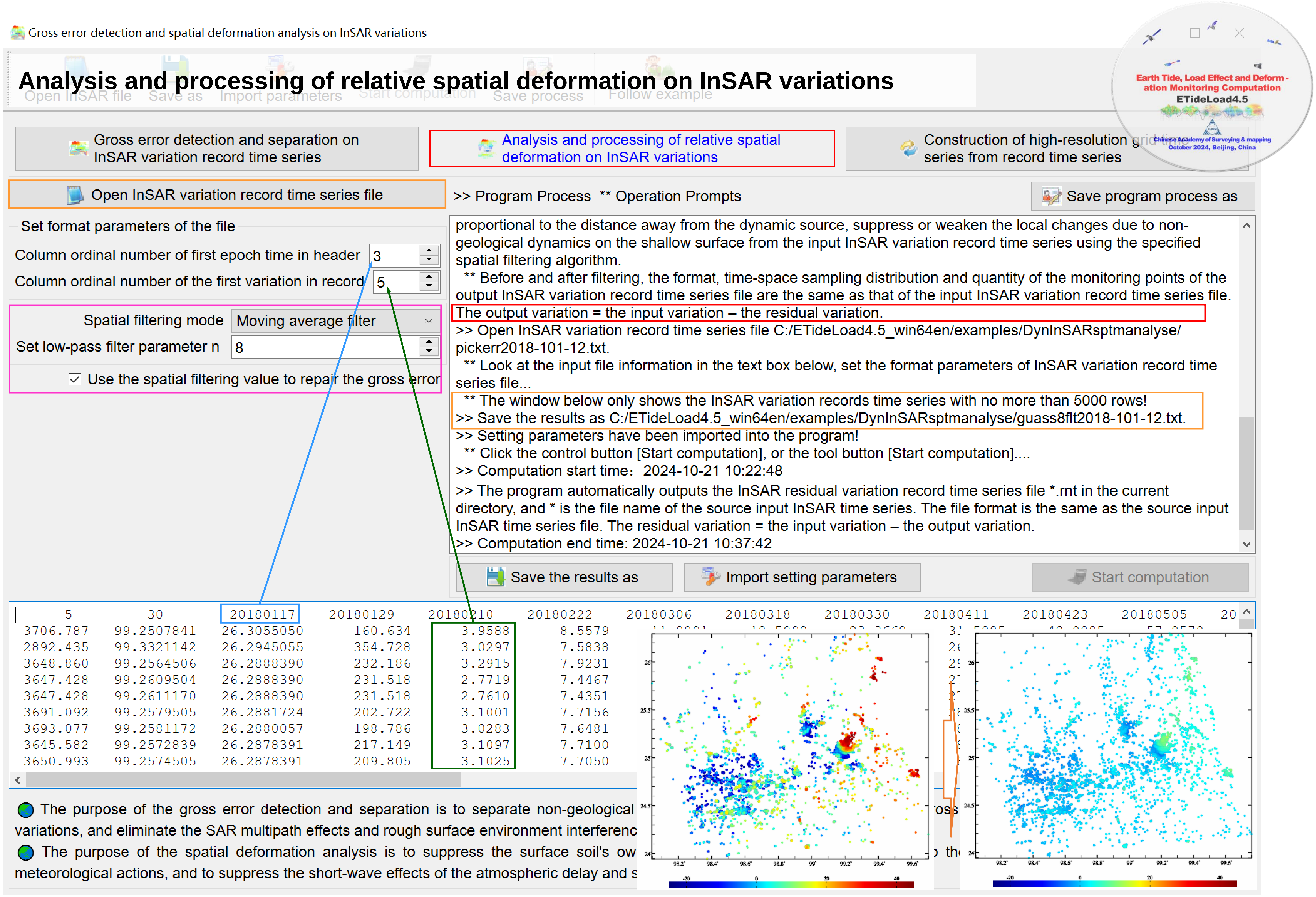
Pseudo-stable adjustment of record time series for geodetic network variations
Gross error detection and separation on InSAR variation record time series
Unification of reference epoch for variation record time series
Gross error detection and spatial deformation analysis on InSAR variations
Analysis and processing of relative spatial deformation on InSAR variations
Compatibility analysis on InSAR vertical deformation using CORS network
Collaborative monitoring and processing of InSAR with CORS network
Construction of high-resolution grid time series from record time series
InSAR variation time series adjustment with spatiotemporal frame constraints
Long-time connection for two same-track InSAR variation time series
Normalized ground stability variations grid estimation
Seamless spatial fusion on multi-source InSAR variations
Calculation of ground stability variation based on vertical deformation
CORS/InSAR collaborative monitoring and ground stability estimation
Deep fusion and time series analysis on multi-source InSAR variations
Estimation of ground stability variation grid time series
Analysis and filtering on variation record time series
Reconstruction of time series with given sampling specifications
Normalized ground stability variations grid estimation
Calculation of ground stability variation based on gravity variations
Optimized synthesis of two geodetic variation grid time series
Estimation of ground stability variation grid time series
Statistical synthesis and prediction of ground stability variations
Optimized synthesis of three stability variation grid time series
Normalized ground stability variations grid estimation
Calculation of ground stability variation based on variation vectors
Estimation of ground stability variation grid time series
spatiotemporal characteristics synthesis of ground stability variations

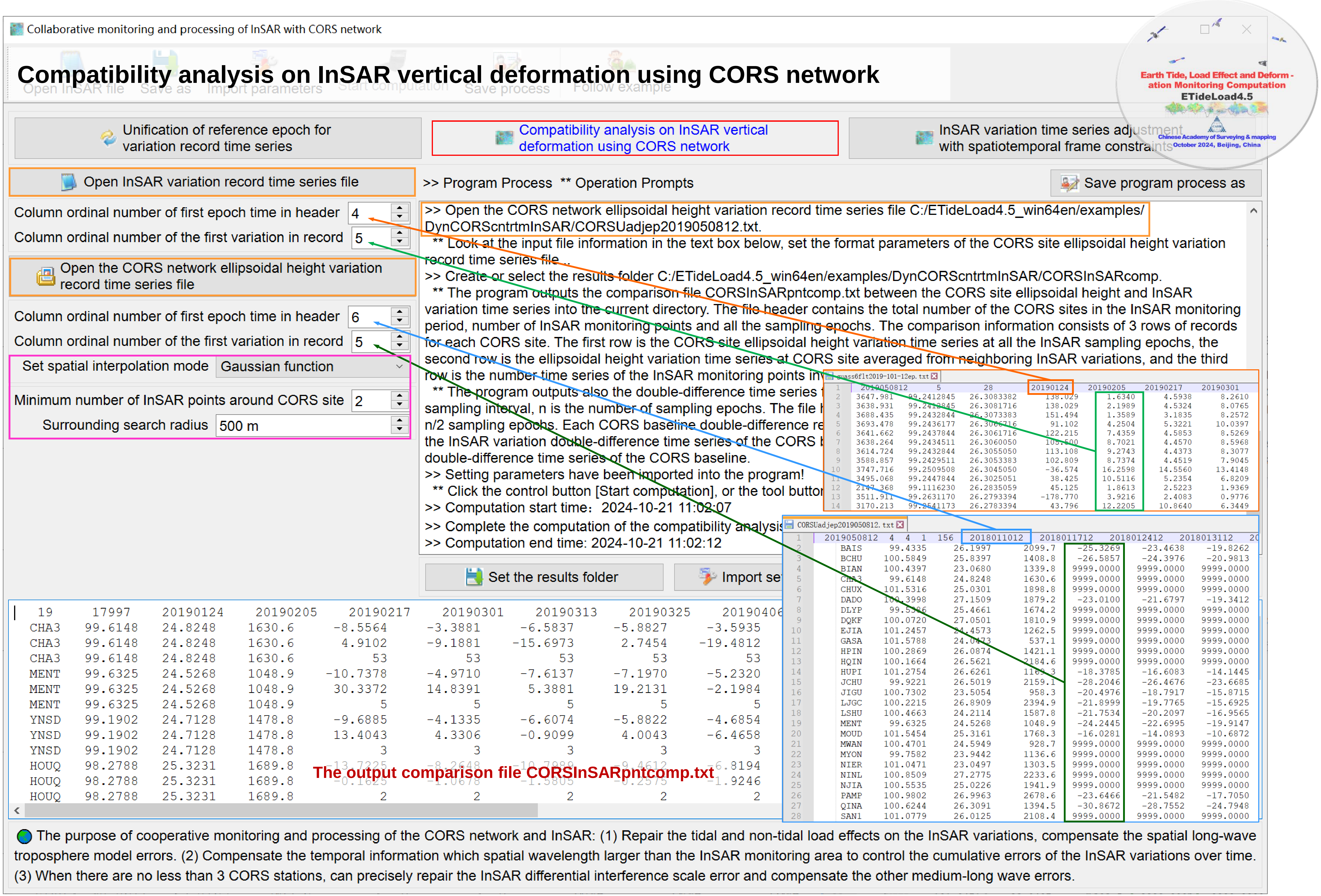
Pseudo-stable adjustment of record time series for geodetic network variations

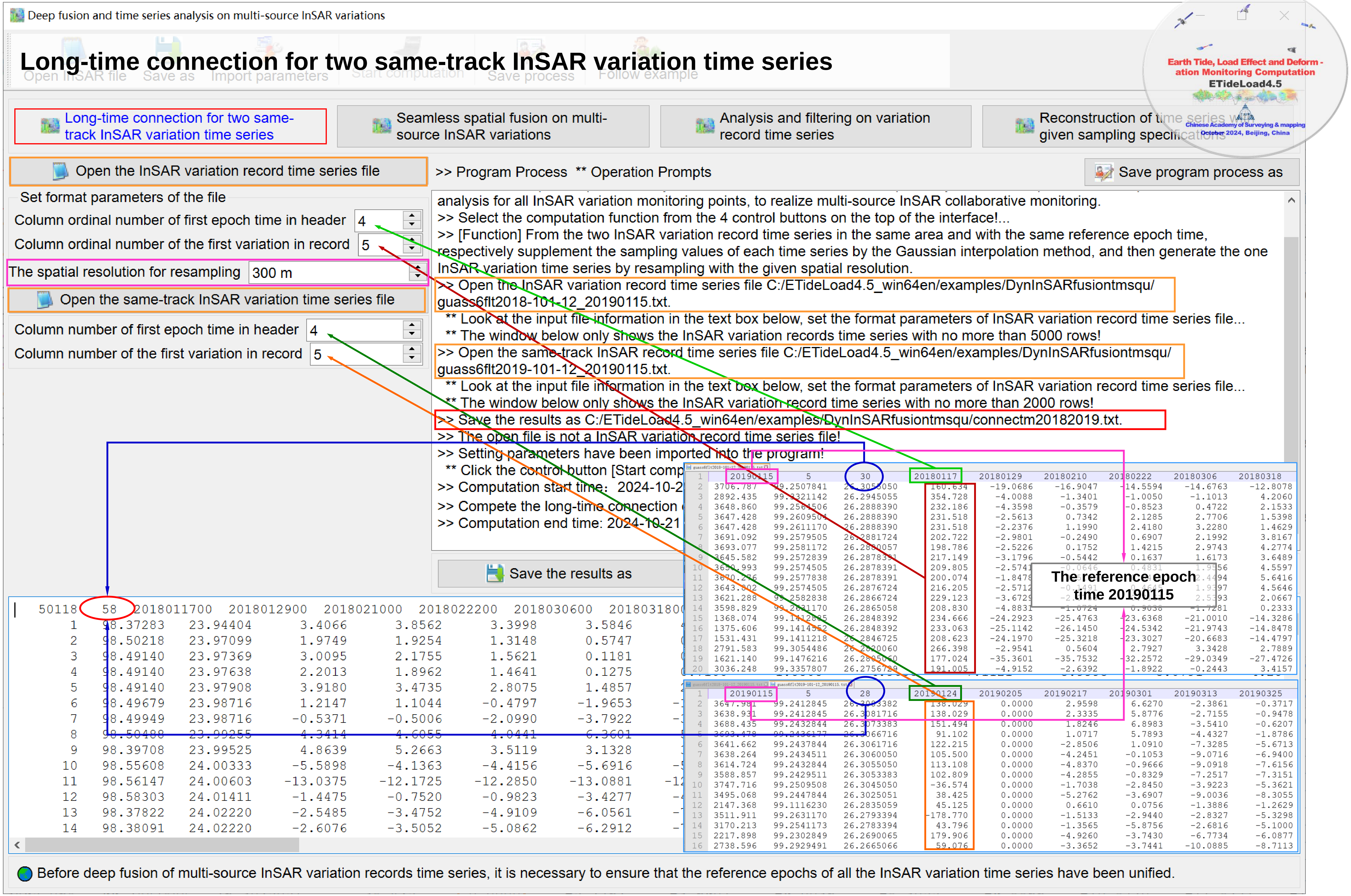


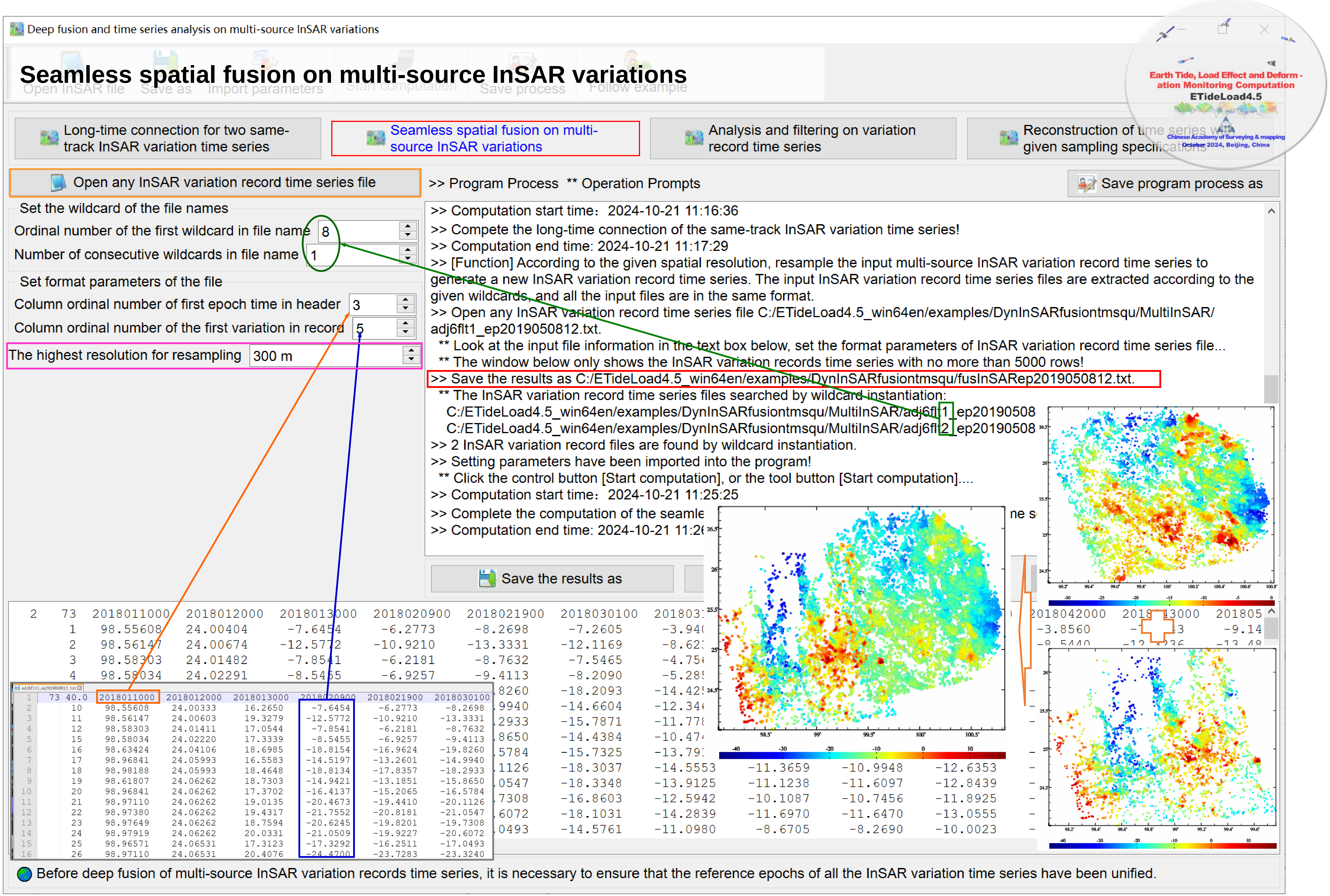


Gross error detection and spatial deformation analysis on InSAR variations
Gross error detection and separation on InSAR variation record time series
Open InSAR file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Gross error detection and separation on InSAR variation record time series
Analysis and processing of relative spatial deformation on InSAR variations
Construction of high-resolution grid time series from record time series
Open InSAR variation record time series file
>> Program Process ** Operation Prompts
Save program process as
Set format parameters of the file
Column ordinal number of first epoch time in header 3
Column ordinal number of the first variation in record 5
Spatial filtering mode Moving average filter
Set low-pass filter parameter n 5
Number of gross error detection iterations 3
** Before and after gross error separation, the format of InSAR variation record time series, spatial and temporal distribution of monitoring points, number of monitoring points and the value of InSAR variation remain unchanged, and only the gross error variation in the result InSAR variation record time series are replaced by 9999.000.
>> Open InSAR variation record time series file C:/ETideLoad4.5_win64en/examples/DynInSARsptmanalyse/result2018-101-12.txt.
** Look at the input file information in the text box below, set the format parameters of InSAR variation record time series file...
** The window below only shows the InSAR variation records time series with no more than 5000 rows!
>> Save the results as C:/ETideLoad4.5_win64en/examples/DynInSARsptmanalyse/pickerr2018-101-12.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-21 10:17:29
>> The program automatically outputs the InSAR gross error record time series file in the current directory. The file format is the same as the input InSAR varaition time series file. The file header occupies a row, and the last few columns of attributes correspond to the gross error percentage of the InSAR variations at each sampling epoch time. The default value of 9999.00 in the record represents that the InSAR variation is not a gross error. The non-default value represents that the InSAR variation is a gross error, and the value is the source InSAR variation.
>> Computation end time: 2024-10-21 10:18:37
Save the results as
5 30 20180117 20180129 20180210 20180222
3706.787 99.2507841 26.3055050 160.634 9999.0000 9999.0000
2892.435 99.3321142 26.2945055 354.728 8.7170 17.3080
3648.860 99.2564506 26.2888390 232.186 9999.0000 36.8660
3647.428 99.2609504 26.2888390 231.518 24.6450 35.2060
3647.428 99.2611170 26.2888390 231.518 24.6450 35.2060
3691.092 99.2579505 26.2881724 202.722 25.1520 33.6950
3693.077 99.2581172 26.2880057 198.786 24.1460 34.3000
3645.582 99.2572839 26.2878391 217.149 9999.0000 25.3160
3650.993 99.2574505 26.2878391 209.805 9999.0000 25.7870
The purpose of the gross error detection and separation is to separate non-geological deformable signals such as the outliers, gross errors and sudden changes in the InSAR variations, and eliminate the SAR multipath effects and rough surface environment interferences.
The purpose of the spatial deformation analysis is to suppress the surface soil's own expansion and contraction effects due to the temperature changes, rainfall and other meteorological actions, and to suppress the short-wave effects of the atmospheric delay and surface multipath.

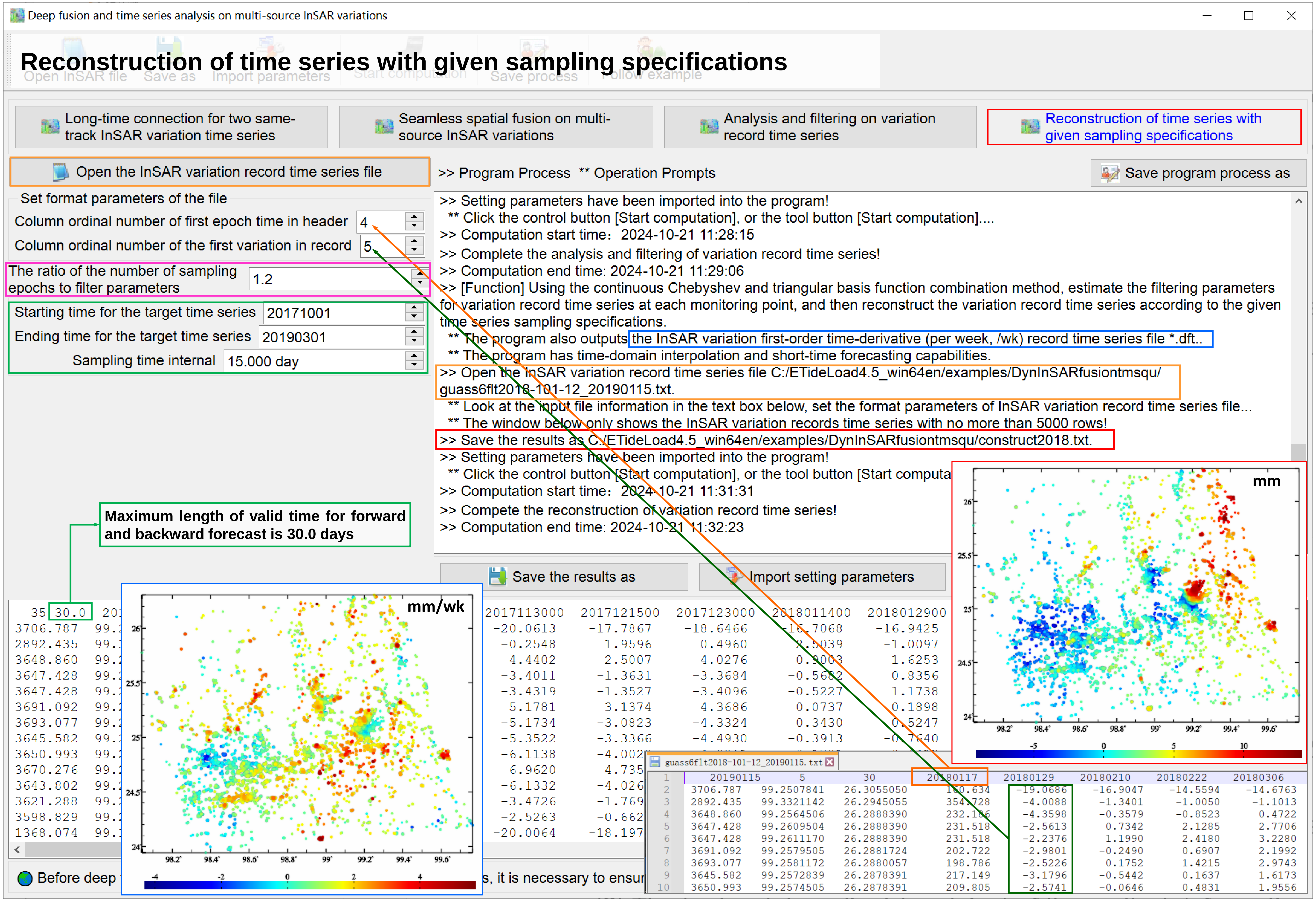

Gross error detection and spatial deformation analysis on InSAR variations
Analysis and processing of relative spatial deformation on InSAR variations
Open InSAR file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Gross error detection and separation on InSAR variation record time series
Analysis and processing of relative spatial deformation on InSAR variations
Construction of high-resolution grid time series from record time series
Open InSAR variation record time series file
>> Program Process ** Operation Prompts
Save program process as
Set format parameters of the file
Column ordinal number of first epoch time in header
3
Column ordinal number of the first variation in record
5
Spatial filtering mode
Moving average filter
Set low-pass filter parameter n
8
Use the spatial filtering value to repair the gross error
proportional to the distance away from the dynamic source, suppress or weaken the local changes due to non-geological dynamics on the shallow surface from the input InSAR variation record time series using the specified spatial filtering algorithm.
** Before and after filtering, the format, time-space sampling distribution and quantity of the monitoring points of the output InSAR variation record time series file are the same as that of the input InSAR variation record time series file.
The output variation = the input variation – the residual variation.
>> Open InSAR variation record time series file C:/ETideLoad4.5_win64en/examples/DynInSARsptmanalyse/pickerr2018-101-12.txt.
** Look at the input file information in the text box below, set the format parameters of InSAR variation record time series file...
** The window below only shows the InSAR variation records time series with no more than 5000 rows!
>> Save the results as C:/ETideLoad4.5_win64en/examples/DynInSARsptmanalyse/guass8flt2018-101-12.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time：2024-10-21 10:22:48
>> The program automatically outputs the InSAR residual variation record time series file *.rnt in the current directory, and * is the file name of the source input InSAR time series. The file format is the same as the source input InSAR time series file. The residual variation = the input variation – the output variation.
>> Computation end time: 2024-10-21 10:37:42
Save the results as
Import setting parameters
Start computation
5 30 20180117 20180129 20180210 20180222 20180306 20180318 20180330 20180411 20180423 20180505 20
3706.787 99.2507841 26.3055050 160.634 3.9588 8.5579
2892.435 99.3321142 26.2945055 354.728 3.0297 7.5838
3648.860 99.2564506 26.2888390 232.186 3.2915 7.9231
3647.428 99.2609504 26.2888390 231.518 2.7719 7.4467
3647.428 99.2611170 26.2888390 231.518 2.7610 7.4351
3691.092 99.2579505 26.2881724 202.722 3.1001 7.7156
3693.077 99.2581172 26.2880057 198.786 3.0283 7.6481
3645.582 99.2572839 26.2878391 217.149 3.1097 7.7100
3650.993 99.2574505 26.2878391 209.805 3.1025 7.7050
The purpose of the gross error detection and separation is to separate non-geological variations, and eliminate the SAR multipath effects and rough surface environment interferenc
The purpose of the spatial deformation analysis is to suppress the surface soil's owi
meteorological actions, and to suppress the short-wave effects of the atmospheric delay and s
98.2° 98.4° 98.6° 98.8° 99° 99.2° 99.4° 99.6°
-20 0 20 40

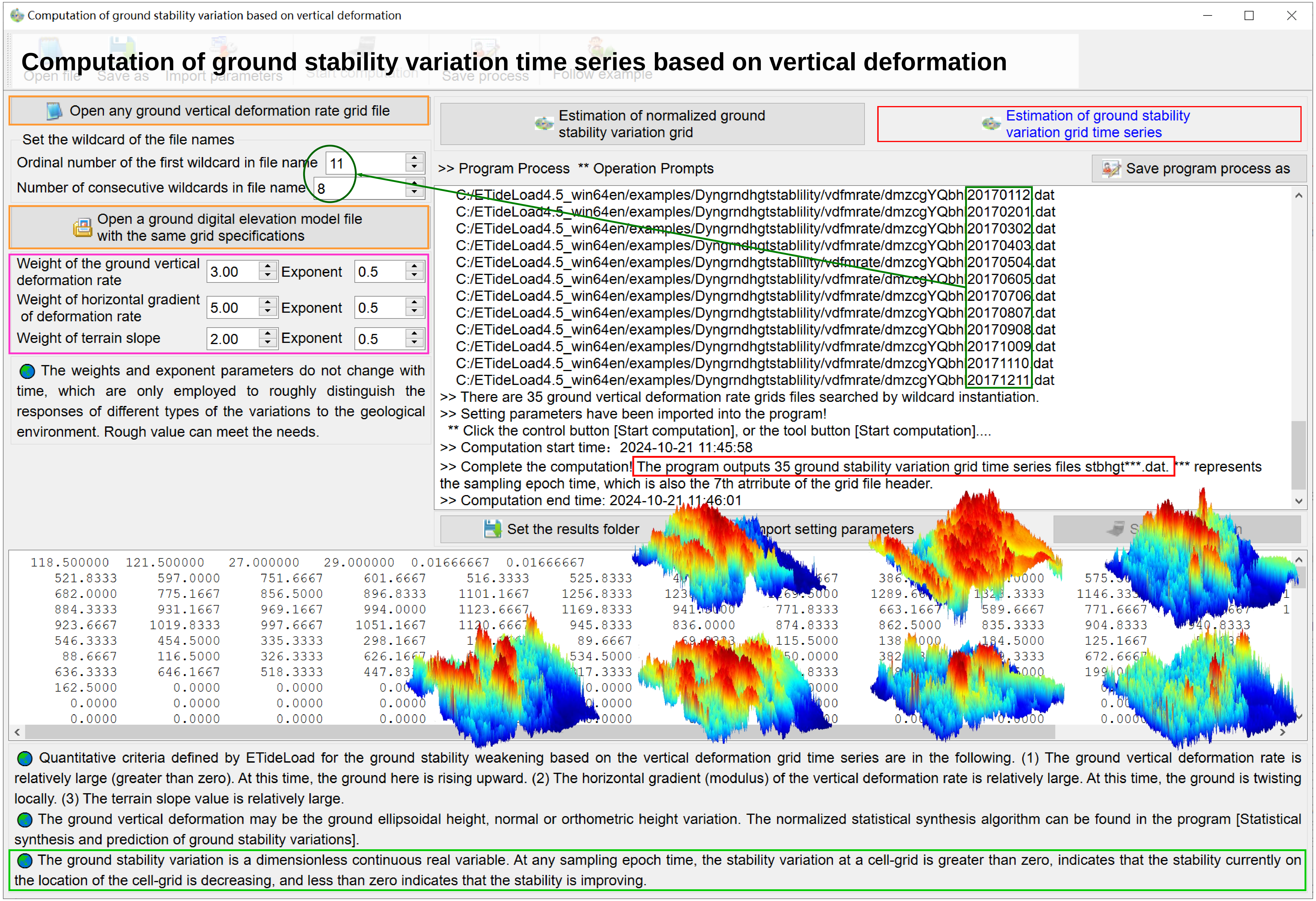

Collaborative monitoring and processing of InSAR with CORS network
Compatibility analysis on InSAR vertical deformation using CORS network
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Unification of reference epoch for variation record time series
Compatibility analysis on InSAR vertical deformation using CORS network
InSAR variation time series adjustment with spatiotemporal frame constraints
Open InSAR variation record time series file
Column ordinal number of first epoch time in header 4
Column ordinal number of the first variation in record 5
Open the CORS network ellipsoidal height variation record time series file
Column ordinal number of first epoch time in header 6
Column ordinal number of the first variation in record 5
Set spatial interpolation mode Gaussian function
Minimum number of InSAR points around CORS site 2
Surrounding search radius 500 m
>> Program Process ** Operation Prompts
Save program process as
>> Open the CORS network ellipsoidal height variation record time series file C:/ETideLoad4.5_win64en/examples/DynCORScntrtmInSAR/CORSUadjep2019050812.txt.
** Look at the input file information in the text box below, set the format parameters of the CORS site ellipsoidal height variation record time series file...
>> Create or select the results folder C:/ETideLoad4.5_win64en/examples/DynCORScntrtmInSAR/CORSInSARcomp.
** The program outputs the comparison file CORSInSARpntcomp.txt between the CORS site ellipsoidal height and InSAR variation time series into the current directory. The file header contains the total number of the CORS sites in the InSAR monitoring period, number of InSAR monitoring points and all the sampling epochs. The comparison information consists of 3 rows of records for each CORS site. The first row is the CORS site ellipsoidal height variation time series at all the InSAR sampling epochs, the second row is the ellipsoidal height variation time series at CORS site averaged from neighboring InSAR variations, and the third row is the number time series of the InSAR monitoring points in
** The program outputs also the double-difference time series
sampling interval, n is the number of sampling epochs. The file h
n/2 sampling epochs. Each CORS baseline double-difference re
the InSAR variation double-difference time series of the CORS b
double-difference time series of the CORS baseline.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button
>> Computation start time: 2024-10-21 11:02:07
>> Complete the computation of the compatibility analysis
>> Computation end time: 2024-10-21 11:02:12
Set the results folder
Import se
19 17997 20190124 20190205 20190217 20190301 20190313 20190325 20190406
CHA3 99.6148 24.8248 1630.6 -8.5564 -3.3881 -6.5837 -5.8827 -3.5935
CHA3 99.6148 24.8248 1630.6 4.9102 -9.1881 -15.6973 2.7454 -19.4812
CHA3 99.6148 24.8248 1630.6 53 53 53 53 53
MENT 99.6325 24.5268 1048.9 -10.7378 -4.9710 -7.6137 -7.1970 -5.2320
MENT 99.6325 24.5268 1048.9 30.3372 14.8391 5.3881 19.2131 -2.1984
MENT 99.6325 24.5268 1048.9 5 5 5 5 5
YNSD 99.1902 24.7128 1478.8 -9.6885 -4.1335 -6.6074 -5.8822 -4.6854
YNSD 99.1902 24.7128 1478.8 13.4043 4.3306 -0.9099 4.0043 -6.4658
YNSD 99.1902 24.7128 1478.8 3 3 3 3 3
HOUQ 98.2788 25.3231 1689.8
HOUQ 98.2788 25.3231 1689.8
HOUQ 98.2788 25.3231 1689.8 2 2 2 2 2
The output comparison file CORSInSARpntcomp.txt
guass6f1t2019-101-12ep.txt
CORSUadjep2019050812.txt
The purpose of cooperative monitoring and processing of the CORS network and InSAR: (1) Repair the tidal and non-tidal load effects on the InSAR variations, compensate the spatial long-wave troposphere model errors. (2) Compensate the temporal information which spatial wavelength larger than the InSAR monitoring area to control the cumulative errors of the InSAR variations over time. (3) When there are no less than 3 CORS stations, can precisely repair the InSAR differential interference scale error and compensate the other medium-long wave errors.

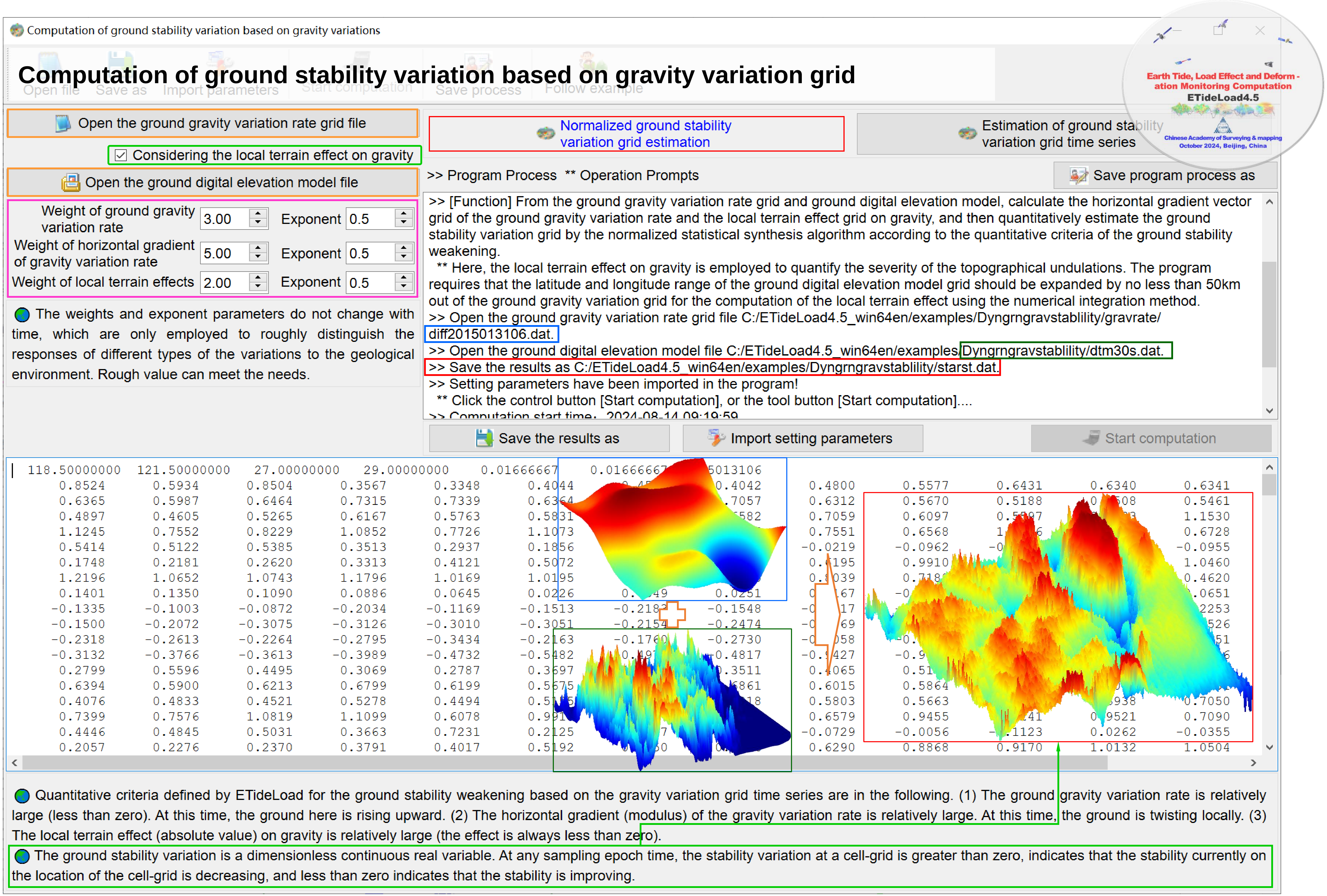

Deep fusion and time series analysis on multi-source InSAR variations
Long-time connection for two same-track InSAR variation time series
Open InSAR file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Long-time connection for two same-track InSAR variation time series
Seamless spatial fusion on multi-source InSAR variations
Analysis and filtering on variation record time series
Reconstruction of time series with given sampling specifications
Open the InSAR variation record time series file
>> Program Process ** Operation Prompts
Save program process as
Set format parameters of the file
Column ordinal number of first epoch time in header 4
Column ordinal number of the first variation in record 5
The spatial resolution for resampling 300 m
Open the same-track InSAR variation time series file
Column number of first epoch time in header 4
Column number of the first variation in record 5
analysis for all InSAR variation monitoring points, to realize multi-source InSAR collaborative monitoring.
>> Select the computation function from the 4 control buttons on the top of the interface!...
>> [Function] From the two InSAR variation record time series in the same area and with the same reference epoch time, respectively supplement the sampling values of each time series by the Gaussian interpolation method, and then generate the one InSAR variation time series by resampling with the given spatial resolution.
>> Open the InSAR variation record time series file C:/ETideLoad4.5_win64en/examples/DynInSARfusiontmsqu/guass6flt2018-101-12_20190115.txt.
** Look at the input file information in the text box below, set the format parameters of InSAR variation record time series file...
** The window below only shows the InSAR variation records time series with no more than 5000 rows!
>> Open the same-track InSAR record time series file C:/ETideLoad4.5_win64en/examples/DynInSARfusiontmsqu/guass6flt2019-101-12_20190115.txt.
** Look at the input file information in the text box below, set the format parameters of InSAR variation record time series file...
** The window below only shows the InSAR variation record time series with no more than 2000 rows!
>> Save the results as C:/ETideLoad4.5_win64en/examples/DynInSARfusiontmsqu/connectm20182019.txt.
>> The open file is not a InSAR variation record time series file!
>> Setting parameters have been imported into the program!
** Click the control button [Start comp
>> Computation start time: 2024-10-2
>> Compete the long-time connection
>> Computation end time: 2024-10-21
Save the results as
The reference epoch time 20190115
50118 58 2018011700 2018012900 2018021000 2018022200 2018030600 2018031800
1 98.37283 23.94404 3.4066 3.8562 3.3998 3.5846
2 98.50218 23.97099 1.9749 1.9254 1.3148 0.5747
3 98.49140 23.97369 3.0095 2.1755 1.5621 0.1181
4 98.49140 23.97638 2.2013 1.8962 1.4641 0.1275
5 98.49140 23.97908 3.9180 3.4735 2.8075 1.4857
6 98.49679 23.98716 1.2147 1.1044 -0.4797 -1.9653
7 98.49949 23.98716 -0.5371 -0.5006 -2.0990 -3.7922
8 98.50488 23.99255 4.3414 4.6055 4.0441 6.3601
9 98.39708 23.99525 4.8639 5.2663 3.5119 3.1328
10 98.55608 24.00333 -5.5898 -4.1363 -4.4156 -5.6916
11 98.56147 24.00603 -13.0375 -12.1725 -12.2850 -13.0881
12 98.58303 24.01411 -1.4475 -0.7520 -0.9823 -3.4277
13 98.37822 24.02220 -2.5485 -3.4752 -4.9109 -6.0561
14 98.38091 24.02220 -2.6076 -3.5052 -5.0862 -6.2912
20190115 5 30 20180117 20180129 20180210 20180222 20180306 20180318
20190115 5 28 20190124 20190205 20190217 20190301 20190313 20190325
Before deep fusion of multi-source InSAR variation records time series, it is necessary to ensure that the reference epochs of all the InSAR variation time series have been unified.

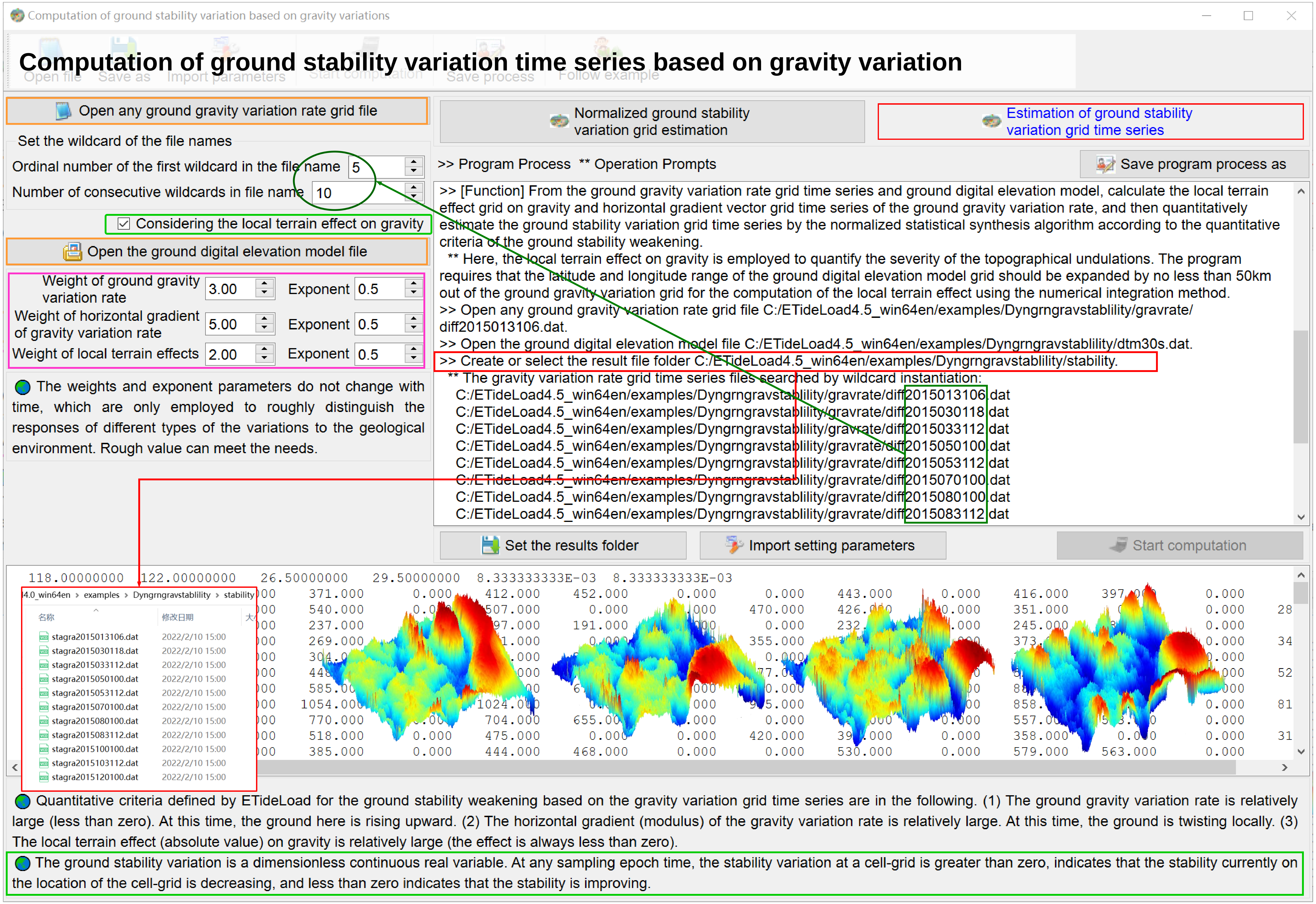


Deep fusion and time series analysis on multi-source InSAR variations
Seamless spatial fusion on multi-source InSAR variations
Open InSAR file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Long-time connection for two same-track InSAR variation time series
Seamless spatial fusion on multi-source InSAR variations
Analysis and filtering on variation record time series
Reconstruction of time series with given sampling specifications
Open any InSAR variation record time series file
>> Program Process ** Operation Prompts
Save program process as
Set the wildcard of the file names
Ordinal number of the first wildcard in file name 8
Number of consecutive wildcards in file name 1
Set format parameters of the file
Column ordinal number of first epoch time in header 3
Column ordinal number of the first variation in record 5
The highest resolution for resampling 300 m
>> Computation start time: 2024-10-21 11:16:36
>> Compete the long-time connection of the same-track InSAR variation time series!
>> Computation end time: 2024-10-21 11:17:29
>> [Function] According to the given spatial resolution, resample the input multi-source InSAR variation record time series to generate a new InSAR variation record time series. The input InSAR variation record time series files are extracted according to the given wildcards, and all the input files are in the same format.
>> Open any InSAR variation record time series file C:/ETideLoad4.5_win64en/examples/DynInSARfusiontmsqu/MultiInSAR/adj6flt1_ep2019050812.txt.
** Look at the input file information in the text box below, set the format parameters of InSAR variation record time series file...
** The window below only shows the InSAR variation records time series with no more than 5000 rows!
>> Save the results as C:/ETideLoad4.5_win64en/examples/DynInSARfusiontmsqu/fusInSARep2019050812.txt.
** The InSAR variation record time series files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/DynInSARfusiontmsqu/MultiInSAR/adj6flt1_ep20190508
C:/ETideLoad4.5_win64en/examples/DynInSARfusiontmsqu/MultiInSAR/adj6flt2_ep20190508
>> 2 InSAR variation record files are found by wildcard instantiation.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-21 11:25:25
>> Complete the computation of the seamle
>> Computation end time: 2024-10-21 11:2
Save the results as
Before deep fusion of multi-source InSAR variation records time series, it is necessary to ensure that the reference epochs of all the InSAR variation time series have been unified.

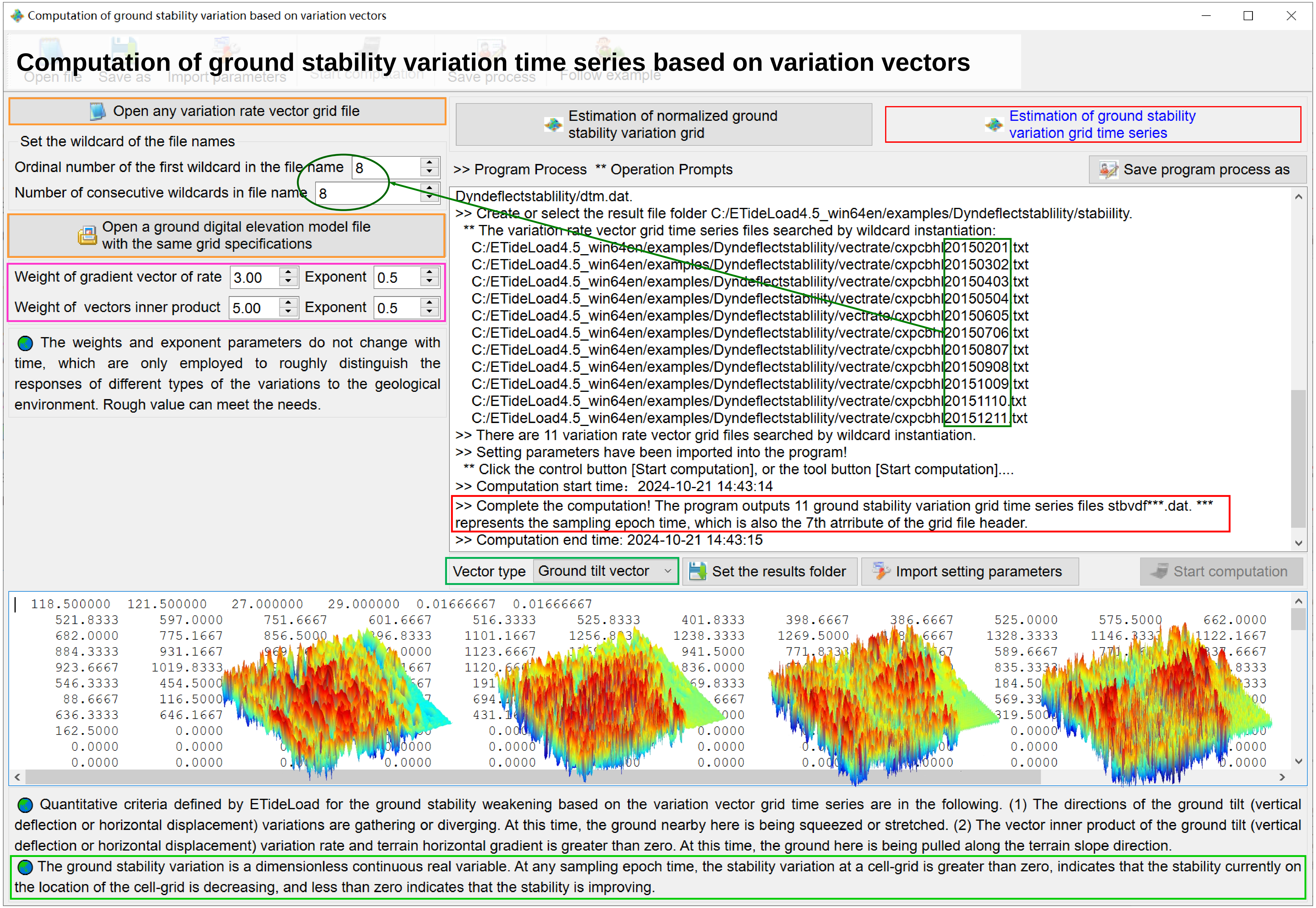

Deep fusion and time series analysis on multi-source InSAR variations
Reconstruction of time series with given sampling specifications
Long-time connection for two same-track InSAR variation time series
Seamless spatial fusion on multi-source InSAR variations
Analysis and filtering on variation record time series
Reconstruction of time series with given sampling specifications
Open the InSAR variation record time series file
>> Program Process ** Operation Prompts
Save program process as
Set format parameters of the file
Column ordinal number of first epoch time in header 4
Column ordinal number of the first variation in record 5
The ratio of the number of sampling epochs to filter parameters 1.2
Starting time for the target time series 20171001
Ending time for the target time series 20190301
Sampling time internal 15.000 day
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-21 11:28:15
>> Complete the analysis and filtering of variation record time series!
>> Computation end time: 2024-10-21 11:29:06
>> [Function] Using the continuous Chebyshev and triangular basis function combination method, estimate the filtering parameters for variation record time series at each monitoring point, and then reconstruct the variation record time series according to the given time series sampling specifications.
** The program also outputs the InSAR variation first-order time-derivative (per week, /wk) record time series file *.dft..
** The program has time-domain interpolation and short-time forecasting capabilities.
>> Open the InSAR variation record time series file C:/ETideLoad4.5_win64en/examples/DynInSARfusiontmsqu/guass6flt2018-101-12_20190115.txt.
** Look at the input file information in the text box below, set the format parameters of InSAR variation record time series file...
** The window below only shows the InSAR variation records time series with no more than 5000 rows!
>> Save the results as C:/ETideLoad4.5_win64en/examples/DynInSARfusiontmsqu/construct2018.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computa
>> Computation start time: 2024-10-21 11:31:31
>> Compete the reconstruction of variation record time series!
>> Computation end time: 2024-10-21 11:32:23
Maximum length of valid time for forward and backward forecast is 30.0 days
Save the results as
Import setting parameters
mm/wk
mm
guass6flt2018-101-12_20190115.txt
Before deep
s, it is necessary to ensur


Computation of ground stability variation based on vertical deformation
Computation of ground stability variation time series based on vertical deformation
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Open any ground vertical deformation rate grid file
Set the wildcard of the file names
Ordinal number of the first wildcard in file name
11
Number of consecutive wildcards in file name
8
Open a ground digital elevation model file with the same grid specifications
Weight of the ground vertical deformation rate
3.00
Exponent
0.5
Weight of horizontal gradient of deformation rate
5.00
Exponent
0.5
Weight of terrain slope
2.00
Exponent
0.5
The weights and exponent parameters do not change with time, which are only employed to roughly distinguish the responses of different types of the variations to the geological environment. Rough value can meet the needs.
Estimation of normalized ground stability variation grid
Estimation of ground stability variation grid time series
>> Program Process ** Operation Prompts
Save program process as
C:/ETideLoad4.5_win64en/examples/Dyngrndhgtstablility/vdfmrate/dmzcgYQbh20170112.dat
C:/ETideLoad4.5_win64en/examples/Dyngrndhgtstablility/vdfmrate/dmzcgYQbh20170201.dat
C:/ETideLoad4.5_win64en/examples/Dyngrndhgtstablility/vdfmrate/dmzcgYQbh20170302.dat
C:/ETideLoad4.5_win64en/examples/Dyngrndhgtstablility/vdfmrate/dmzcgYQbh20170403.dat
C:/ETideLoad4.5_win64en/examples/Dyngrndhgtstablility/vdfmrate/dmzcgYQbh20170504.dat
C:/ETideLoad4.5_win64en/examples/Dyngrndhgtstablility/vdfmrate/dmzcgYQbh20170605.dat
C:/ETideLoad4.5_win64en/examples/Dyngrndhgtstablility/vdfmrate/dmzcgYQbh20170706.dat
C:/ETideLoad4.5_win64en/examples/Dyngrndhgtstablility/vdfmrate/dmzcgYQbh20170807.dat
C:/ETideLoad4.5_win64en/examples/Dyngrndhgtstablility/vdfmrate/dmzcgYQbh20170908.dat
C:/ETideLoad4.5_win64en/examples/Dyngrndhgtstablility/vdfmrate/dmzcgYQbh20171009.dat
C:/ETideLoad4.5_win64en/examples/Dyngrndhgtstablility/vdfmrate/dmzcgYQbh20171110.dat
C:/ETideLoad4.5_win64en/examples/Dyngrndhgtstablility/vdfmrate/dmzcgYQbh20171211.dat
>> There are 35 ground vertical deformation rate grids files searched by wildcard instantiation.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-21 11:45:58
>> Complete the computation! The program outputs 35 ground stability variation grid time series files stbhgt***.dat. *** represents the sampling epoch time, which is also the 7th atrribute of the grid file header.
>> Computation end time: 2024-10-21 11:46:01
Set the results folder
118.500000 121.500000 27.000000 29.000000 0.01666667 0.01666667
521.8333 597.0000 751.6667 601.6667 516.3333 525.8333
682.0000 775.1667 856.5000 896.8333 1101.1667 1256.8333
884.3333 931.1667 969.1667 994.0000 1123.6667 1169.8333
923.6667 1019.8333 997.6667 1051.1667 945.8333
546.3333 454.5000 335.3333 298.1667 89.6667
88.6667 116.5000 326.3333 626.1667
636.3333 646.1667 518.3333
162.5000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000
Quantitative criteria defined by ETideLoad for the ground stability weakening based on the vertical deformation grid time series are in the following. (1) The ground vertical deformation rate is relatively large (greater than zero). At this time, the ground here is rising upward. (2) The horizontal gradient (modulus) of the vertical deformation rate is relatively large. At this time, the ground is twisting locally. (3) The terrain slope value is relatively large.
The ground vertical deformation may be the ground ellipsoidal height, normal or orthometric height variation. The normalized statistical synthesis algorithm can be found in the program [Statistical synthesis and prediction of ground stability variations].
The ground stability variation is a dimensionless continuous real variable. At any sampling epoch time, the stability variation at a cell-grid is greater than zero, indicates that the stability currently on the location of the cell-grid is decreasing, and less than zero indicates that the stability is improving.

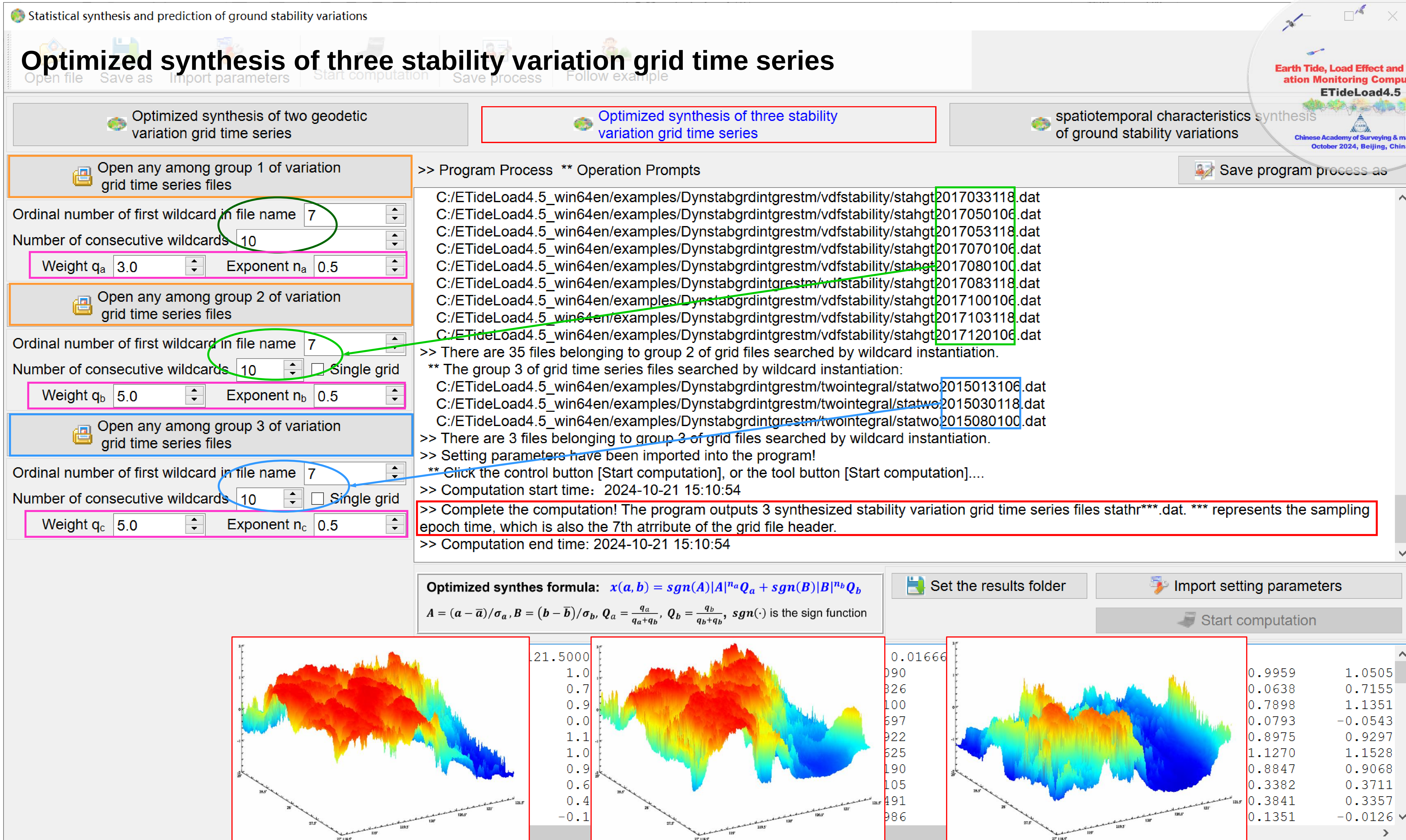

Computation of ground stability variation based on gravity variations
Computation of ground stability variation based on gravity variation grid
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Open the ground gravity variation rate grid file
Considering the local terrain effect on gravity
Open the ground digital elevation model file
Weight of ground gravity variation rate 3.00 Exponent 0.5
Weight of horizontal gradient of gravity variation rate 5.00 Exponent 0.5
Weight of local terrain effects 2.00 Exponent 0.5
The weights and exponent parameters do not change with time, which are only employed to roughly distinguish the responses of different types of the variations to the geological environment. Rough value can meet the needs.
Normalized ground stability variation grid estimation
Estimation of ground stability variation grid time series
>> Program Process ** Operation Prompts
Save program process as
>> [Function] From the ground gravity variation rate grid and ground digital elevation model, calculate the horizontal gradient vector grid of the ground gravity variation rate and the local terrain effect grid on gravity, and then quantitatively estimate the ground stability variation grid by the normalized statistical synthesis algorithm according to the quantitative criteria of the ground stability weakening.
** Here, the local terrain effect on gravity is employed to quantify the severity of the topographical undulations. The program requires that the latitude and longitude range of the ground digital elevation model grid should be expanded by no less than 50km out of the ground gravity variation grid for the computation of the local terrain effect using the numerical integration method.
>> Open the ground gravity variation rate grid file C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/gravrate/diff2015013106.dat.
>> Open the ground digital elevation model file C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/dtm30s.dat.
>> Save the results as C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/starst.dat.
>> Setting parameters have been imported in the program!
** Click the control button [Start computation], or the tool button [Start computation]....
Save the results as
Import setting parameters
Start computation
118.50000000 121.50000000 27.00000000 29.00000000 0.01666667 0.01666667
Quantitative criteria defined by ETideLoad for the ground stability weakening based on the gravity variation grid time series are in the following. (1) The ground gravity variation rate is relatively large (less than zero). At this time, the ground here is rising upward. (2) The horizontal gradient (modulus) of the gravity variation rate is relatively large. At this time, the ground is twisting locally. (3) The local terrain effect (absolute value) on gravity is relatively large (the effect is always less than zero).
The ground stability variation is a dimensionless continuous real variable. At any sampling epoch time, the stability variation at a cell-grid is greater than zero, indicates that the stability currently on the location of the cell-grid is decreasing, and less than zero indicates that the stability is improving.



Computation of ground stability variation based on gravity variations
Computation of ground stability variation time series based on gravity variation
Open any ground gravity variation rate grid file
Set the wildcard of the file names
Ordinal number of the first wildcard in the file name 5
Number of consecutive wildcards in file name 10
Considering the local terrain effect on gravity
Open the ground digital elevation model file
Weight of ground gravity variation rate 3.00 Exponent 0.5
Weight of horizontal gradient of gravity variation rate 5.00 Exponent 0.5
Weight of local terrain effects 2.00 Exponent 0.5
The weights and exponent parameters do not change with time, which are only employed to roughly distinguish the responses of different types of the variations to the geological environment. Rough value can meet the needs.
Normalized ground stability variation grid estimation
Estimation of ground stability variation grid time series
>> Program Process ** Operation Prompts
Save program process as
>> [Function] From the ground gravity variation rate grid time series and ground digital elevation model, calculate the local terrain effect grid on gravity and horizontal gradient vector grid time series of the ground gravity variation rate, and then quantitatively estimate the ground stability variation grid time series by the normalized statistical synthesis algorithm according to the quantitative criteria of the ground stability weakening.
** Here, the local terrain effect on gravity is employed to quantify the severity of the topographical undulations. The program requires that the latitude and longitude range of the ground digital elevation model grid should be expanded by no less than 50km out of the ground gravity variation grid for the computation of the local terrain effect using the numerical integration method.
>> Open any ground gravity variation rate grid file C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/gravrate/diff2015013106.dat.
>> Open the ground digital elevation model file C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/dtm30s.dat.
>> Create or select the result file folder C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/stability.
** The gravity variation rate grid time series files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/gravrate/diff2015013106.dat
C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/gravrate/diff2015030118.dat
C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/gravrate/diff2015033112.dat
C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/gravrate/diff2015050100.dat
C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/gravrate/diff2015053112.dat
C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/gravrate/diff2015070100.dat
C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/gravrate/diff2015080100.dat
C:/ETideLoad4.5_win64en/examples/Dyngrngravstablility/gravrate/diff2015083112.dat
Set the results folder
Import setting parameters
Start computation
118.00000000 122.00000000 26.50000000 29.50000000 8.333333333E-03 8.333333333E-03
4.0_win64en > examples > Dyngrngravstablility > stability
名称 修改日期
stagra2015013106.dat 2022/2/10 15:00
stagra2015030118.dat 2022/2/10 15:00
stagra2015033112.dat 2022/2/10 15:00
stagra2015050100.dat 2022/2/10 15:00
stagra2015053112.dat 2022/2/10 15:00
stagra2015070100.dat 2022/2/10 15:00
stagra2015080100.dat 2022/2/10 15:00
stagra2015083112.dat 2022/2/10 15:00
stagra2015100100.dat 2022/2/10 15:00
stagra2015103112.dat 2022/2/10 15:00
stagra2015120100.dat 2022/2/10 15:00
Quantitative criteria defined by ETideLoad for the ground stability weakening based on the gravity variation grid time series are in the following. (1) The ground gravity variation rate is relatively large (less than zero). At this time, the ground here is rising upward. (2) The horizontal gradient (modulus) of the gravity variation rate is relatively large. At this time, the ground is twisting locally. (3) The local terrain effect (absolute value) on gravity is relatively large (the effect is always less than zero).
The ground stability variation is a dimensionless continuous real variable. At any sampling epoch time, the stability variation at a cell-grid is greater than zero, indicates that the stability currently on the location of the cell-grid is decreasing, and less than zero indicates that the stability is improving.

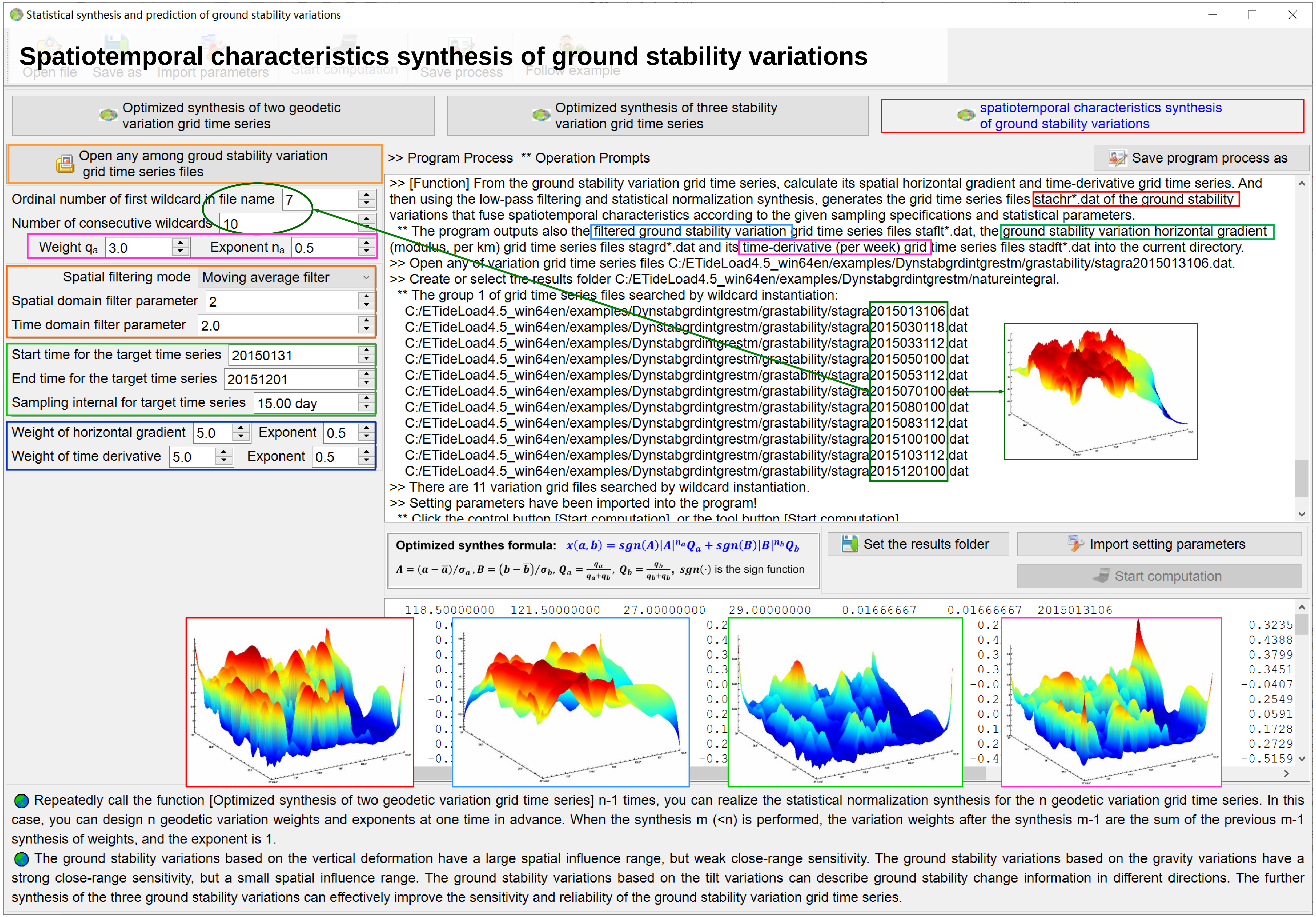

Computation of ground stability variation based on variation vectors
Computation of ground stability variation time series based on variation vectors
Open any variation rate vector grid file
Set the wildcard of the file names
Ordinal number of the first wildcard in the file name 8
Number of consecutive wildcards in file name 8
Open a ground digital elevation model file with the same grid specifications
Weight of gradient vector of rate 3.00 Exponent 0.5
Weight of vectors inner product 5.00 Exponent 0.5
The weights and exponent parameters do not change with time, which are only employed to roughly distinguish the responses of different types of the variations to the geological environment. Rough value can meet the needs.
Estimation of normalized ground stability variation grid
Estimation of ground stability variation grid time series
>> Program Process ** Operation Prompts
Save program process as
Dyndeflectstablity/dtm.dat.
>> Create or select the result file folder C:/ETideLoad4.5_win64en/examples/Dyndeflectstablility/stabiility.
** The variation rate vector grid time series files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/Dyndeflectstablility/vectrate/cxpcbhl20150201.txt
C:/ETideLoad4.5_win64en/examples/Dyndeflectstablility/vectrate/cxpcbhl20150302.txt
C:/ETideLoad4.5_win64en/examples/Dyndeflectstablility/vectrate/cxpcbhl20150403.txt
C:/ETideLoad4.5_win64en/examples/Dyndeflectstablility/vectrate/cxpcbhl20150504.txt
C:/ETideLoad4.5_win64en/examples/Dyndeflectstablility/vectrate/cxpcbhl20150605.txt
C:/ETideLoad4.5_win64en/examples/Dyndeflectstablility/vectrate/cxpcbhl20150706.txt
C:/ETideLoad4.5_win64en/examples/Dyndeflectstablility/vectrate/cxpcbhl20150807.txt
C:/ETideLoad4.5_win64en/examples/Dyndeflectstablility/vectrate/cxpcbhl20150908.txt
C:/ETideLoad4.5_win64en/examples/Dyndeflectstablility/vectrate/cxpcbhl20151009.txt
C:/ETideLoad4.5_win64en/examples/Dyndeflectstablility/vectrate/cxpcbhl20151110.txt
C:/ETideLoad4.5_win64en/examples/Dyndeflectstablility/vectrate/cxpcbhl20151211.txt
>> There are 11 variation rate vector grid files searched by wildcard instantiation.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-21 14:43:14
>> Complete the computation! The program outputs 11 ground stability variation grid time series files stbvdf***.dat. *** represents the sampling epoch time, which is also the 7th atrribute of the grid file header.
>> Computation end time: 2024-10-21 14:43:15
Vector type Ground tilt vector
Set the results folder
Import setting parameters
Start computation
118.500000 121.500000 27.000000 29.000000 0.01666667 0.01666667
Quantitative criteria defined by ETideLoad for the ground stability weakening based on the variation vector grid time series are in the following. (1) The directions of the ground tilt (vertical deflection or horizontal displacement) variations are gathering or diverging. At this time, the ground nearby here is being squeezed or stretched. (2) The vector inner product of the ground tilt (vertical deflection or horizontal displacement) variation rate and terrain horizontal gradient is greater than zero. At this time, the ground here is being pulled along the terrain slope direction.
The ground stability variation is a dimensionless continuous real variable. At any sampling epoch time, the stability variation at a cell-grid is greater than zero, indicates that the stability currently on the location of the cell-grid is decreasing, and less than zero indicates that the stability is improving.

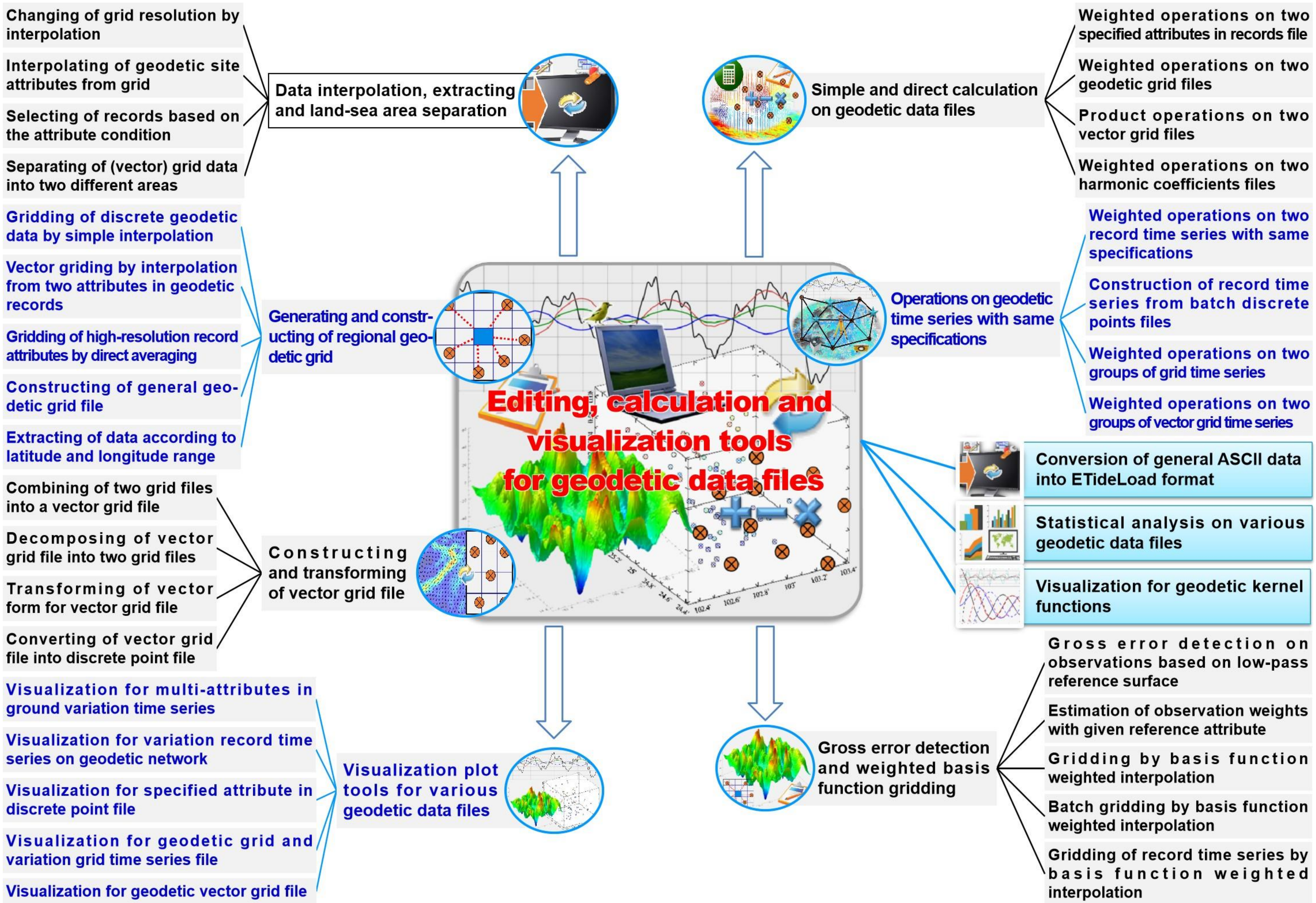
Optimized synthesis of three stability variation grid time series

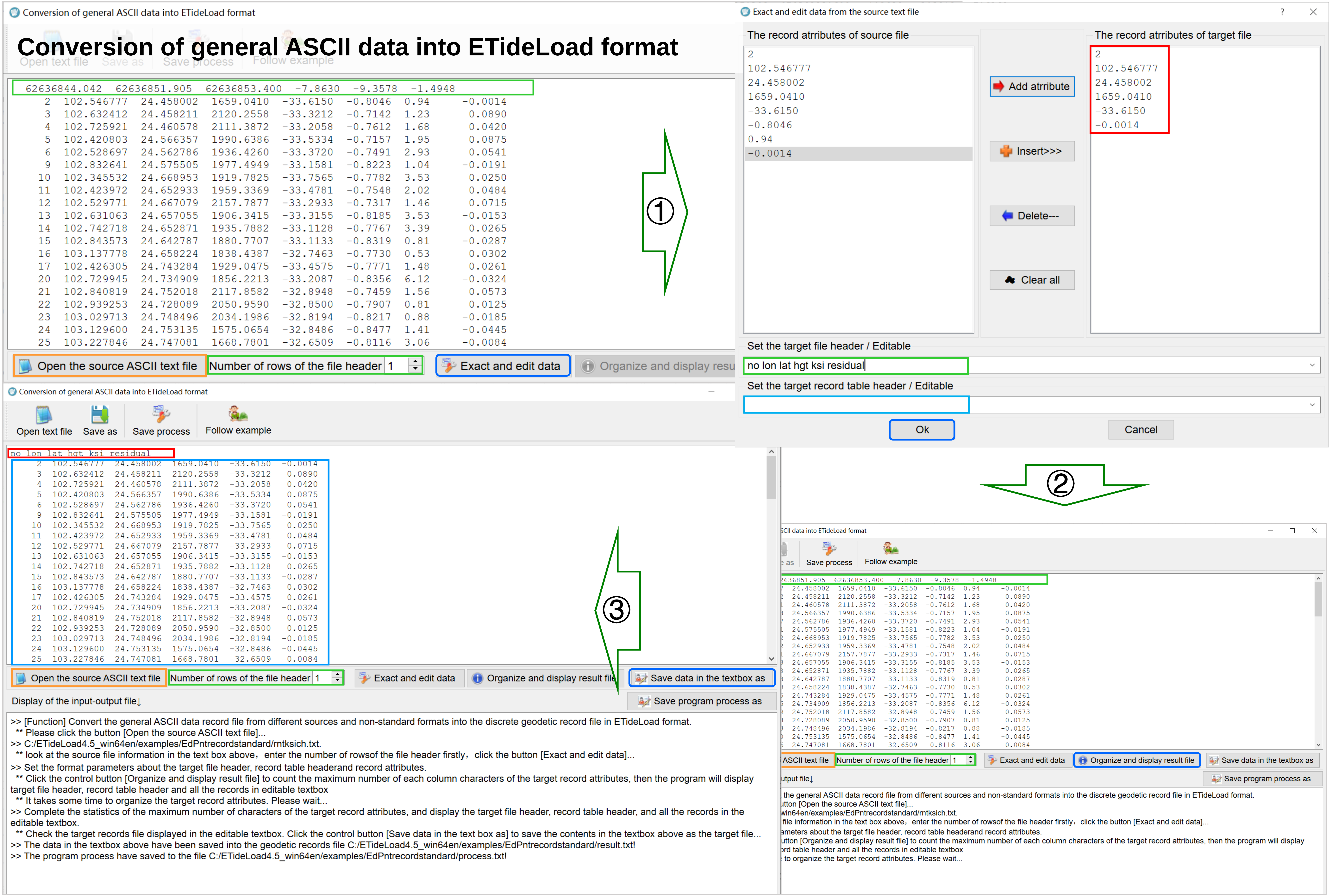


Repeatedly call the function [Optimized synthesis of two geodetic variation grid time series] n-1 times, you can realize the statistical normalization synthesis for the n geodetic variation grid time series. In this case, you can design n geodetic variation weights and exponents at one time in advance. When the synthesis m (<n) is performed, the variation weights after the synthesis m-1 are the sum of the previous m-1 synthesis of weights, and the exponent is 1.

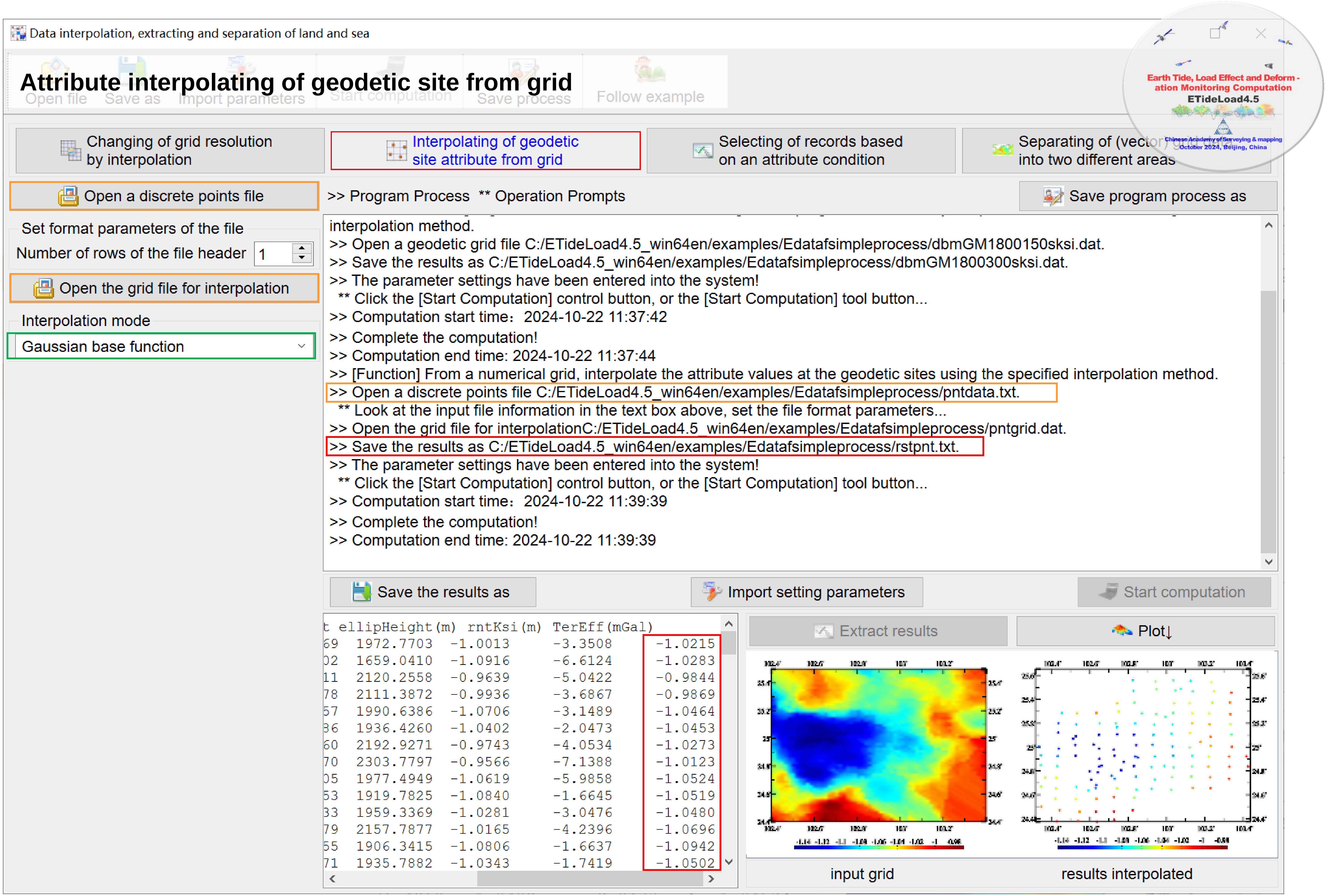
The ground stability variations based on the vertical deformation have a large spatial influence range, but weak close-range sensitivity. The ground stability variations based on the gravity variations have a strong close-range sensitivity, but a small spatial influence range. The ground stability variations based on the tilt variations can describe ground stability change information in different directions. The further synthesis of the three ground stability variations can effectively improve the sensitivity and reliability of the ground stability variation grid time series.

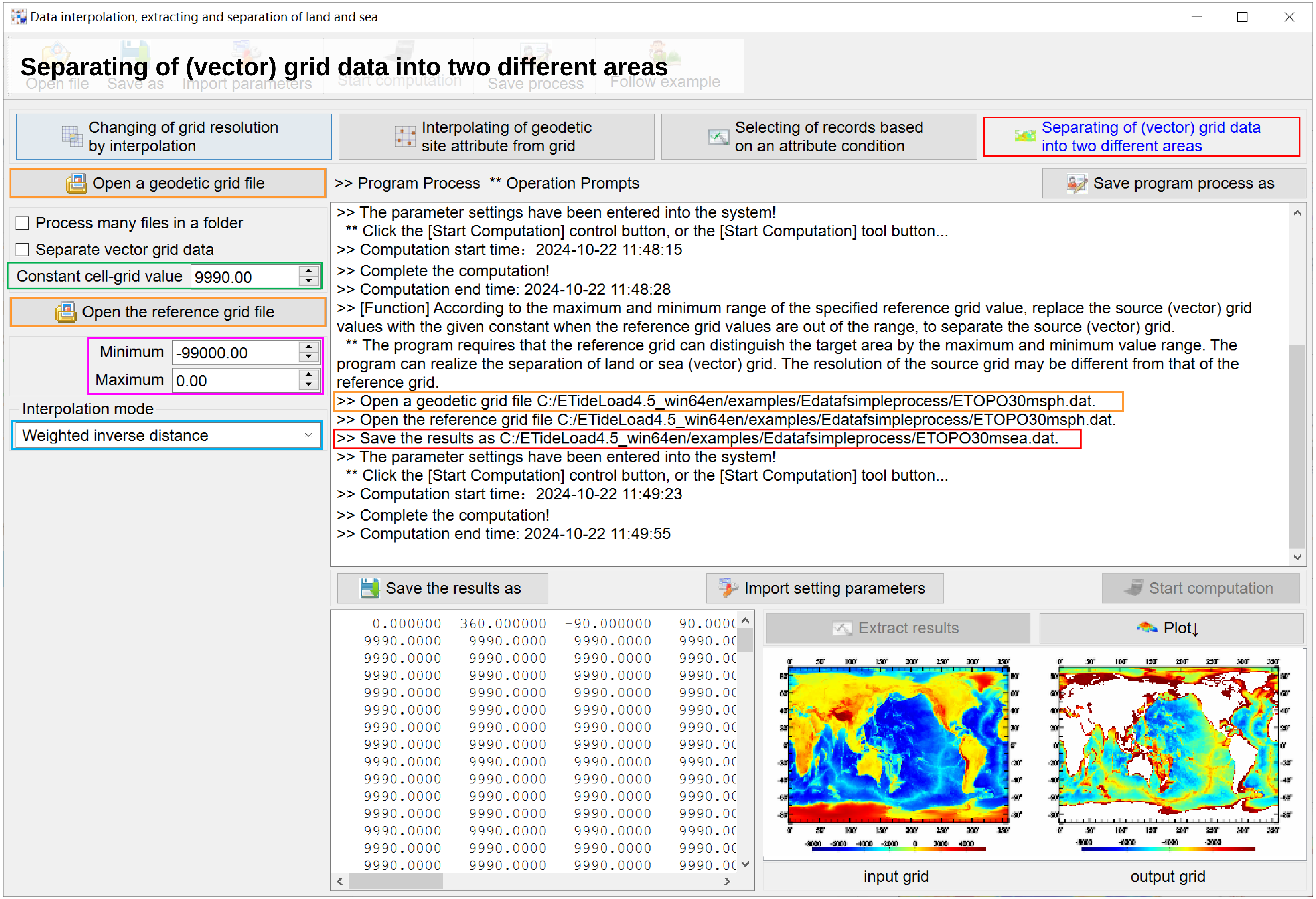

Statistical synthesis and prediction of ground stability variations
Spatiotemporal characteristics synthesis of ground stability variations
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Optimized synthesis of two geodetic variation grid time series
Optimized synthesis of three stability variation grid time series
spatiotemporal characteristics synthesis of ground stability variations
Open any among groud stability variation grid time series files
Ordinal number of first wildcard in file name 7
Number of consecutive wildcards 10
Weight qa 3.0
Exponent na 0.5
Spatial filtering mode Moving average filter
Spatial domain filter parameter 2
Time domain filter parameter 2.0
Start time for the target time series 20150131
End time for the target time series 20151201
Sampling internal for target time series 15.00 day
Weight of horizontal gradient 5.0
Exponent 0.5
Weight of time derivative 5.0
Exponent 0.5
>> Program Process ** Operation Prompts
Save program process as
>> [Function] From the ground stability variation grid time series, calculate its spatial horizontal gradient and time-derivative grid time series. And then using the low-pass filtering and statistical normalization synthesis, generates the grid time series files stachr*.dat of the ground stability variations that fuse spatiotemporal characteristics according to the given sampling specifications and statistical parameters.
** The program outputs also the filtered ground stability variation grid time series files staflt*.dat, the ground stability variation horizontal gradient (modulus, per km) grid time series files stagrd*.dat and its time-derivative (per week) grid time series files stadft*.dat into the current directory.
>> Open any of variation grid time series files C:/ETideLoad4.5_win64en/examples/Dynstabgrdintgrestm/grastability/stagra2015013106.dat.
>> Create or select the results folder C:/ETideLoad4.5_win64en/examples/Dynstabgrdintgrestm/natureintegral.
** The group 1 of grid time series files searched by wildcard instantiation:
C:/ETideLoad4.5_win64en/examples/Dynstabgrdintgrestm/grastability/stagra2015013106.dat
C:/ETideLoad4.5_win64en/examples/Dynstabgrdintgrestm/grastability/stagra2015030118.dat
C:/ETideLoad4.5_win64en/examples/Dynstabgrdintgrestm/grastability/stagra2015033112.dat
C:/ETideLoad4.5_win64en/examples/Dynstabgrdintgrestm/grastability/stagra2015050100.dat
C:/ETideLoad4.5_win64en/examples/Dynstabgrdintgrestm/grastability/stagra2015053112.dat
C:/ETideLoad4.5_win64en/examples/Dynstabgrdintgrestm/grastability/stagra2015070100.dat
C:/ETideLoad4.5_win64en/examples/Dynstabgrdintgrestm/grastability/stagra2015080100.dat
C:/ETideLoad4.5_win64en/examples/Dynstabgrdintgrestm/grastability/stagra2015083112.dat
C:/ETideLoad4.5_win64en/examples/Dynstabgrdintgrestm/grastability/stagra2015100100.dat
C:/ETideLoad4.5_win64en/examples/Dynstabgrdintgrestm/grastability/stagra2015103112.dat
C:/ETideLoad4.5_win64en/examples/Dynstabgrdintgrestm/grastability/stagra2015120100.dat
>> There are 11 variation grid files searched by wildcard instantiation.
>> Setting parameters have been imported into the program!
Optimized synthes formula: $x(a,b) = sgn(A)|A|^{n_a}Q_a + sgn(B)|B|^{n_b}Q_b$
$A = (a-\bar{a})/\sigma_a$, $B = (b-\bar{b})/\sigma_b$, $Q_a = \frac{q_a}{q_a+q_b}$, $Q_b = \frac{q_b}{q_a+q_b}$, $sgn(\cdot)$ is the sign function
Set the results folder
Import setting parameters
Start computation
118.50000000 121.50000000 27.00000000 29.00000000 0.01666667 0.01666667 2015013106
0.3235
0.4388
0.3799
0.3451
-0.0407
0.2549
-0.0591
-0.1728
-0.2729
-0.5159
Repeatedly call the function [Optimized synthesis of two geodetic variation grid time series] n-1 times, you can realize the statistical normalization synthesis for the n geodetic variation grid time series. In this case, you can design n geodetic variation weights and exponents at one time in advance. When the synthesis m (<n) is performed, the variation weights after the synthesis m-1 are the sum of the previous m-1 synthesis of weights, and the exponent is 1.
The ground stability variations based on the vertical deformation have a large spatial influence range, but weak close-range sensitivity. The ground stability variations based on the gravity variations have a strong close-range sensitivity, but a small spatial influence range. The ground stability variations based on the tilt variations can describe ground stability change information in different directions. The further synthesis of the three ground stability variations can effectively improve the sensitivity and reliability of the ground stability variation grid time series.

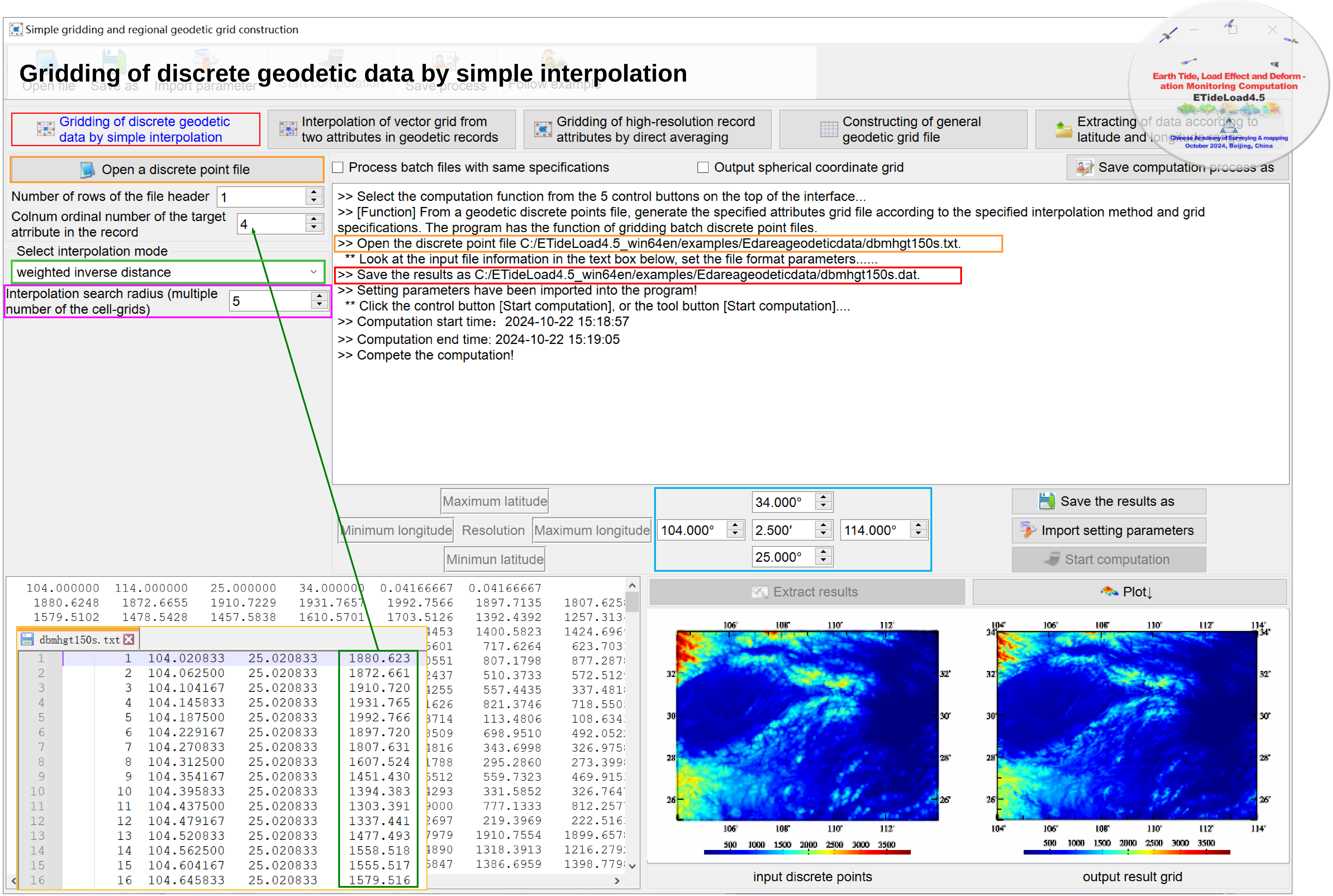

Editing, calculation and visualization tools for geodetic data files
Data interpolation, extracting and land-sea area separation
Changing of grid resolution by interpolation
Interpolating of geodetic site attributes from grid
Selecting of records based on the attribute condition
Separating of (vector) grid data into two different areas
Simple and direct calculation on geodetic data files
Weighted operations on two specified attributes in records file
Weighted operations on two geodetic grid files
Product operations on two vector grid files
Weighted operations on two harmonic coefficients files
Generating and constructing of regional geodetic grid
Gridding of discrete geodetic data by simple interpolation
Vector griding by interpolation from two attributes in geodetic records
Gridding of high-resolution record attributes by direct averaging
Constructing of general geodetic grid file
Extracting of data according to latitude and longitude range
Operations on geodetic time series with same specifications
Weighted operations on two record time series with same specifications
Construction of record time series from batch discrete points files
Weighted operations on two groups of grid time series
Weighted operations on two groups of vector grid time series
Conversion of general ASCII data into ETideLoad format
Statistical analysis on various geodetic data files
Visualization for geodetic kernel functions
Constructing and transforming of vector grid file
Combining of two grid files into a vector grid file
Decomposing of vector grid file into two grid files
Transforming of vector form for vector grid file
Converting of vector grid file into discrete point file
Visualization plot tools for various geodetic data files
Visualization for multi-attributes in ground variation time series
Visualization for variation record time series on geodetic network
Visualization for specified attribute in discrete point file
Visualization for geodetic grid and variation grid time series file
Visualization for geodetic vector grid file
Gross error detection and weighted basis function gridding
Gross error detection on observations based on low-pass reference surface
Estimation of observation weights with given reference attribute
Gridding by basis function weighted interpolation
Batch gridding by basis function weighted interpolation
Gridding of record time series by basis function weighted interpolation

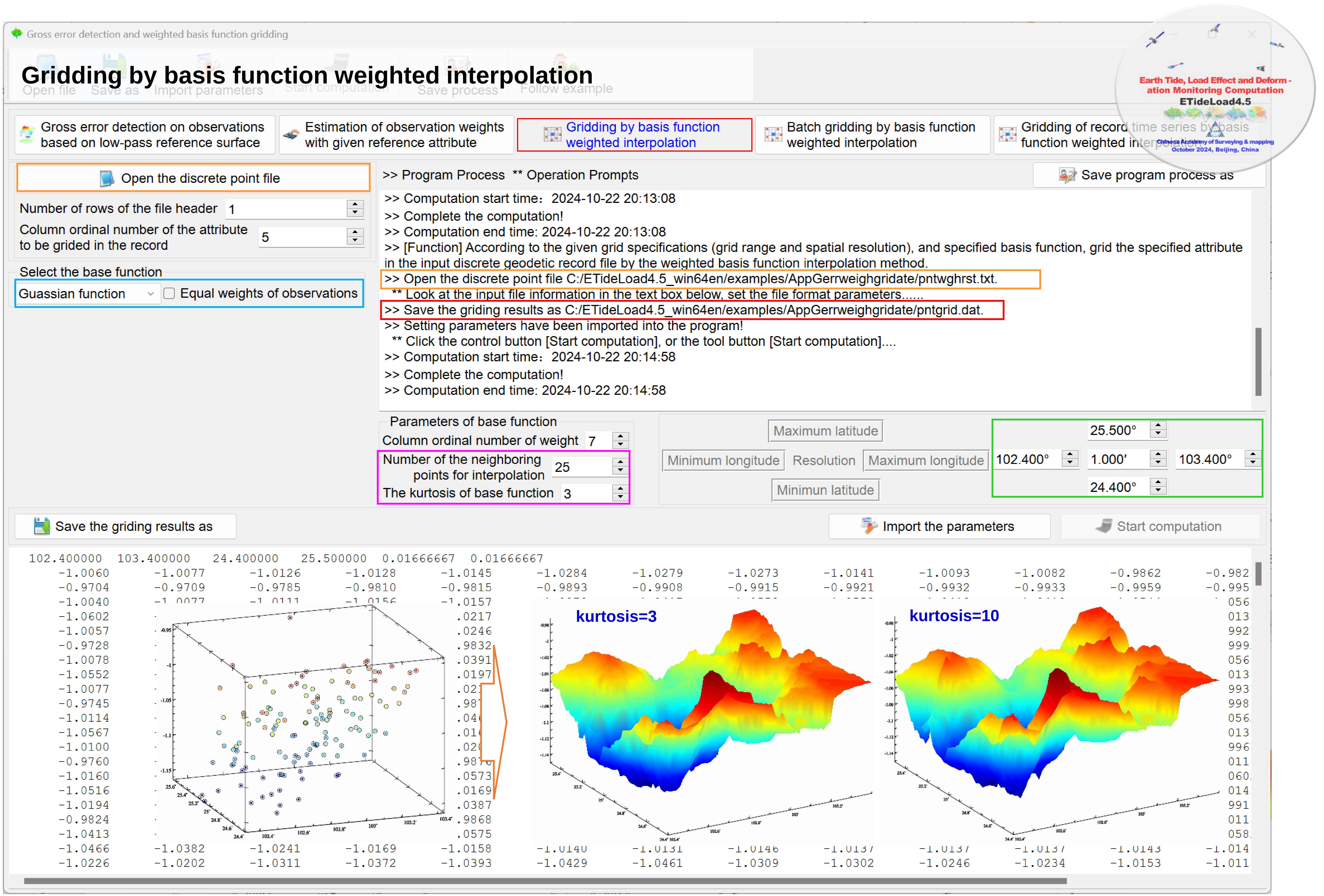


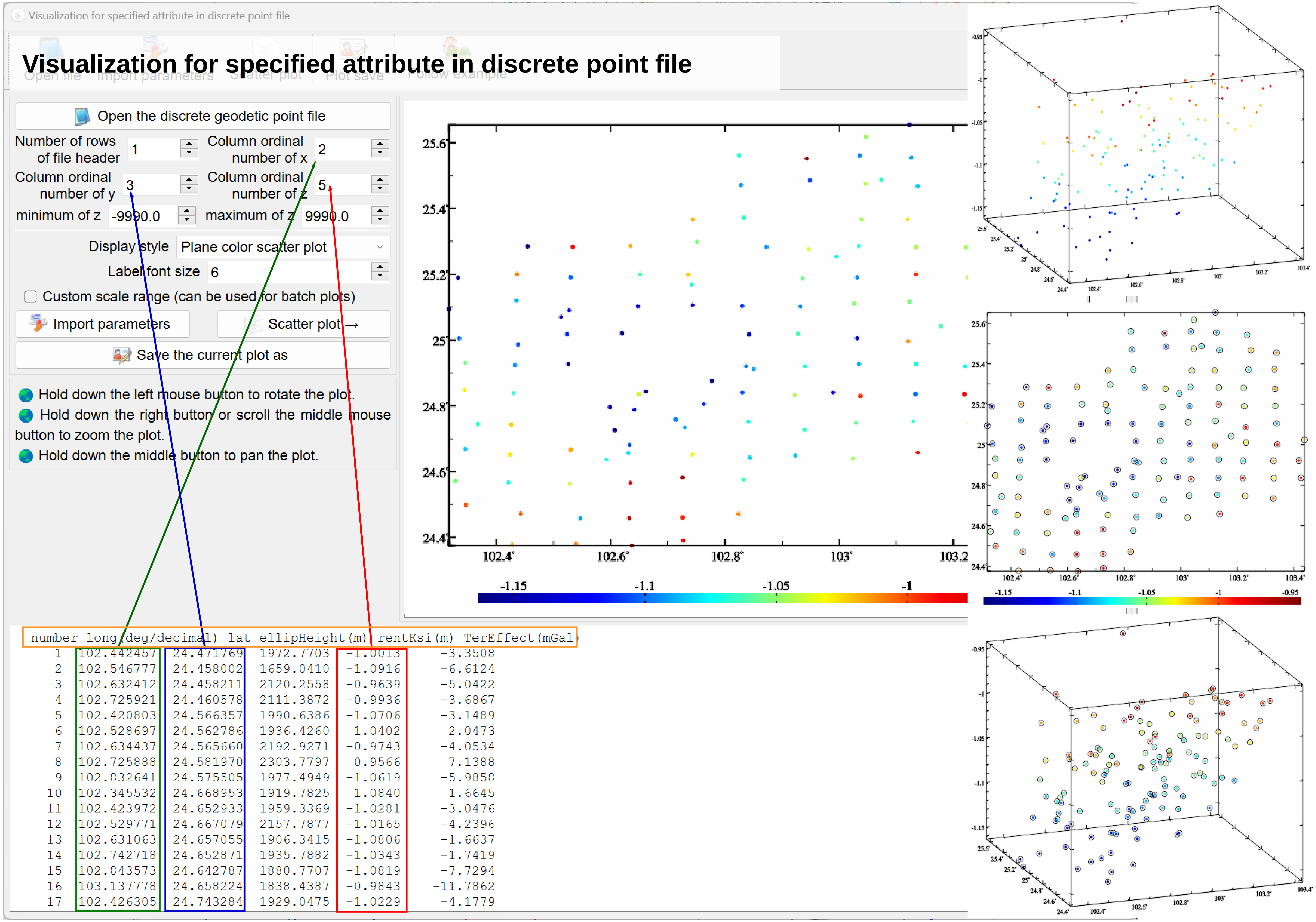
Conversion of general ASCII data into ETideLoad format
Conversion of general ASCII data into ETideLoad format
62636844.042 62636851.905 62636853.400 -7.8630 -9.3578 -1.4948
2 102.546777 24.458002 1659.0410 -33.6150 -0.8046 0.94 -0.0014
3 102.632412 24.458211 2120.2558 -33.3212 -0.7142 1.23 0.0890
4 102.725921 24.460578 2111.3872 -33.2058 -0.7612 1.68 0.0420
5 102.420803 24.566357 1990.6386 -33.5334 -0.7157 1.95 0.0875
6 102.528697 24.562786 1936.4260 -33.3720 -0.7491 2.93 0.0541
9 102.832641 24.575505 1977.4949 -33.1581 -0.8223 1.04 -0.0191
10 102.345532 24.668953 1919.7825 -33.7565 -0.7782 3.53 0.0250
11 102.423972 24.652933 1959.3369 -33.4781 -0.7548 2.02 0.0484
12 102.529771 24.667079 2157.7877 -33.2933 -0.7317 1.46 0.0715
13 102.631063 24.657055 1906.3415 -33.3155 -0.8185 3.53 -0.0153
14 102.742718 24.652871 1935.7882 -33.1128 -0.7767 3.39 0.0265
15 102.843573 24.642787 1880.7707 -33.1133 -0.8319 0.81 -0.0287
16 103.137778 24.658224 1838.4387 -32.7463 -0.7730 0.53 0.0302
17 102.426305 24.743284 1929.0475 -33.4575 -0.7771 1.48 0.0261
20 102.729945 24.734909 1856.2213 -33.2087 -0.8356 6.12 -0.0324
21 102.840819 24.752018 2117.8582 -32.8948 -0.7459 1.56 0.0573
22 102.939253 24.728089 2050.9590 -32.8500 -0.7907 0.81 0.0125
23 103.029713 24.748496 2034.1986 -32.8194 -0.8217 0.88 -0.0185
24 103.129600 24.753135 1575.0654 -32.8486 -0.8477 1.41 -0.0445
25 103.227846 24.747081 1668.7801 -32.6509 -0.8116 3.06 -0.0084
Open the source ASCII text file
Number of rows of the file header 1
Exact and edit data
Organize and display resu
①
Exact and edit data from the source text file
The record atrributes of source file
2
102.546777
24.458002
1659.0410
-33.6150
-0.8046
0.94
-0.0014
Add attribute
Insert>>>
Delete---
Clear all
The record atrributes of target file
2
102.546777
24.458002
1659.0410
-33.6150
-0.0014
Set the target file header / Editable
no lon lat hgt ksi residual
Set the target record table header / Editable
Ok
Cancel
②
Open text file
Save as
Save process
Follow example
no lon lat hgt ksi residual
③
Open the source ASCII text file
Number of rows of the file header 1
Exact and edit data
Organize and display result file
Save data in the textbox as
Display of the input-output file↓
Save program process as
>> [Function] Convert the general ASCII data record file from different sources and non-standard formats into the discrete geodetic record file in ETideLoad format.
** Please click the button [Open the source ASCII text file]...
>> C:/ETideLoad4.5_win64en/examples/EdPntrecordstandard/rntksich.txt.
** look at the source file information in the text box above, enter the number of rowsof the file header firstly, click the button [Exact and edit data]...
>> Set the format parameters about the target file header, record table headerand record attributes.
** Click the control button [Organize and display result file] to count the maximum number of each column characters of the target record attributes, then the program will display target file header, record table header and all the records in editable textbox
** It takes some time to organize the target record attributes. Please wait...
>> Complete the statistics of the maximum number of characters of the target record attributes, and display the target file header, record table header, and all the records in the editable textbox.
** Check the target records file displayed in the editable textbox. Click the control button [Save data in the text box as] to save the contents in the textbox above as the target file...
>> The data in the textbox above have been saved into the geodetic records file C:/ETideLoad4.5_win64en/examples/EdPntrecordstandard/result.txt!
>> The program process have saved to the file C:/ETideLoad4.5_win64en/examples/EdPntrecordstandard/process.txt!


Data interpolation, extracting and separation of land and sea
Attribute interpolating of geodetic site from grid
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Changing of grid resolution by interpolation
Interpolating of geodetic site attribute from grid
Selecting of records based on an attribute condition
Separating of (vector) grid into two different areas
Open a discrete points file
>> Program Process ** Operation Prompts
Save program process as
Set format parameters of the file
Number of rows of the file header 1
Open the grid file for interpolation
Interpolation mode
Gaussian base function
interpolation method.
>> Open a geodetic grid file C:/ETideLoad4.5_win64en/examples/Edatafsimpleprocess/dbmGM1800150sksi.dat.
>> Save the results as C:/ETideLoad4.5_win64en/examples/Edatafsimpleprocess/dbmGM1800300sksi.dat.
>> The parameter settings have been entered into the system!
** Click the [Start Computation] control button, or the [Start Computation] tool button...
>> Computation start time：2024-10-22 11:37:42
>> Complete the computation!
>> Computation end time: 2024-10-22 11:37:44
>> [Function] From a numerical grid, interpolate the attribute values at the geodetic sites using the specified interpolation method.
>> Open a discrete points file C:/ETideLoad4.5_win64en/examples/Edatafsimpleprocess/pntdata.txt.
** Look at the input file information in the text box above, set the file format parameters...
>> Open the grid file for interpolationC:/ETideLoad4.5_win64en/examples/Edatafsimpleprocess/pntgrid.dat.
>> Save the results as C:/ETideLoad4.5_win64en/examples/Edatafsimpleprocess/rstpnt.txt.
>> The parameter settings have been entered into the system!
** Click the [Start Computation] control button, or the [Start Computation] tool button...
>> Computation start time：2024-10-22 11:39:39
>> Complete the computation!
>> Computation end time: 2024-10-22 11:39:39
Save the results as
Import setting parameters
Start computation
t ellipHeight(m) rntKsi(m) TerEff(mGal)
69 1972.7703 -1.0013 -3.3508 -1.0215
02 1659.0410 -1.0916 -6.6124 -1.0283
11 2120.2558 -0.9639 -5.0422 -0.9844
78 2111.3872 -0.9936 -3.6867 -0.9869
57 1990.6386 -1.0706 -3.1489 -1.0464
36 1936.4260 -1.0402 -2.0473 -1.0453
60 2192.9271 -0.9743 -4.0534 -1.0273
70 2303.7797 -0.9566 -7.1388 -1.0123
05 1977.4949 -1.0619 -5.9858 -1.0524
53 1919.7825 -1.0840 -1.6645 -1.0519
33 1959.3369 -1.0281 -3.0476 -1.0480
79 2157.7877 -1.0165 -4.2396 -1.0696
55 1906.3415 -1.0806 -1.6637 -1.0942
71 1935.7882 -1.0343 -1.7419 -1.0502
Extract results
Plot↓
input grid
results interpolated


Data interpolation, extracting and separation of land and sea
Separating of (vector) grid data into two different areas
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Changing of grid resolution by interpolation
Interpolating of geodetic site attribute from grid
Selecting of records based on an attribute condition
Separating of (vector) grid data into two different areas
Open a geodetic grid file
>> Program Process ** Operation Prompts
Save program process as
Process many files in a folder
Separate vector grid data
Constant cell-grid value 9990.00
Open the reference grid file
Minimum -99000.00
Maximum 0.00
Interpolation mode
Weighted inverse distance
>> The parameter settings have been entered into the system!
** Click the [Start Computation] control button, or the [Start Computation] tool button...
>> Computation start time: 2024-10-22 11:48:15
>> Complete the computation!
>> Computation end time: 2024-10-22 11:48:28
>> [Function] According to the maximum and minimum range of the specified reference grid value, replace the source (vector) grid values with the given constant when the reference grid values are out of the range, to separate the source (vector) grid.
** The program requires that the reference grid can distinguish the target area by the maximum and minimum value range. The program can realize the separation of land or sea (vector) grid. The resolution of the source grid may be different from that of the reference grid.
>> Open a geodetic grid file C:/ETideLoad4.5_win64en/examples/Edatafsimpleprocess/ETOPO30msph.dat.
>> Open the reference grid file C:/ETideLoad4.5_win64en/examples/Edatafsimpleprocess/ETOPO30msph.dat.
>> Save the results as C:/ETideLoad4.5_win64en/examples/Edatafsimpleprocess/ETOPO30msea.dat.
>> The parameter settings have been entered into the system!
** Click the [Start Computation] control button, or the [Start Computation] tool button...
>> Computation start time: 2024-10-22 11:49:23
>> Complete the computation!
>> Computation end time: 2024-10-22 11:49:55
Save the results as
Import setting parameters
Start computation
0.000000 360.000000 -90.000000 90.000
9990.0000 9990.0000 9990.0000 9990.0
Extract results
Plot↓
input grid
output grid

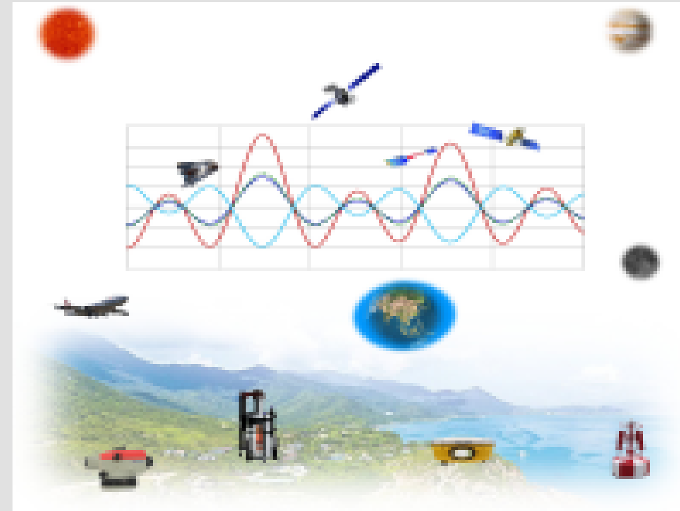

Simple gridding and regional geodetic grid construction
Gridding of discrete geodetic data by simple interpolation
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Gridding of discrete geodetic data by simple interpolation
Interpolation of vector grid from two attributes in geodetic records
Gridding of high-resolution record attributes by direct averaging
Constructing of general geodetic grid file
Extracting of data according to latitude and longitude
Open a discrete point file
Process batch files with same specifications
Output spherical coordinate grid
Save computation process as
Number of rows of the file header
1
Colnum ordinal number of the target atrribute in the record
4
Select interpolation mode
weighted inverse distance
Interpolation search radius (multiple number of the cell-grids)
5
>> Select the computation function from the 5 control buttons on the top of the interface...
>> [Function] From a geodetic discrete points file, generate the specified attributes grid file according to the specified interpolation method and grid specifications. The program has the function of gridding batch discrete point files.
>> Open the discrete point file C:/ETideLoad4.5_win64en/examples/Edareageodeticdata/dbmhgt150s.txt.
** Look at the input file information in the text box below, set the file format parameters......
>> Save the results as C:/ETideLoad4.5_win64en/examples/Edareageodeticdata/dbmhgt150s.dat.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-22 15:18:57
>> Computation end time: 2024-10-22 15:19:05
>> Compete the computation!
Maximum latitude
Minimum longitude
Resolution
Maximum longitude
Minimun latitude
34.000°
104.000°
2.500′
114.000°
25.000°
Save the results as
Import setting parameters
Start computation
Extract results
Plot
dbmhgt150s.txt
1 104.020833 25.020833 1880.623
2 104.062500 25.020833 1872.661
3 104.104167 25.020833 1910.720
4 104.145833 25.020833 1931.765
5 104.187500 25.020833 1992.766
6 104.229167 25.020833 1897.720
7 104.270833 25.020833 1807.631
8 104.312500 25.020833 1607.524
9 104.354167 25.020833 1451.430
10 104.395833 25.020833 1394.383
11 104.437500 25.020833 1303.391
12 104.479167 25.020833 1337.441
13 104.520833 25.020833 1477.493
14 104.562500 25.020833 1558.518
15 104.604167 25.020833 1555.517
16 104.645833 25.020833 1579.516
104.000000 114.000000 25.000000 34.000000 0.04166667 0.04166667
1880.6248 1872.6655 1910.7229 1931.7657 1992.7566 1897.7135 1807.625
1579.5102 1478.5428 1457.5838 1610.5701 1703.5126 1392.4392 1257.313
input discrete points
output result grid


Gross error detection and weighted basis function gridding
Gridding by basis function weighted interpolation
Open file
Save as
Import parameters
Start computation
Save process
Follow example
Earth Tide, Load Effect and Deformation Monitoring Computation
ETideLoad4.5
Chinese Academy of Surveying & mapping
October 2024, Beijing, China
Gross error detection on observations based on low-pass reference surface
Estimation of observation weights with given reference attribute
Gridding by basis function weighted interpolation
Batch gridding by basis function weighted interpolation
Gridding of record time series by basis function weighted interpolation
Open the discrete point file
Number of rows of the file header 1
Column ordinal number of the attribute to be grided in the record 5
Select the base function
Guassian function
Equal weights of observations
>> Program Process ** Operation Prompts
Save program process as
>> Computation start time: 2024-10-22 20:13:08
>> Complete the computation!
>> Computation end time: 2024-10-22 20:13:08
>> [Function] According to the given grid specifications (grid range and spatial resolution), and specified basis function, grid the specified attribute in the input discrete geodetic record file by the weighted basis function interpolation method.
>> Open the discrete point file C:/ETideLoad4.5_win64en/examples/AppGerrweighgridate/pntwghrst.txt.
** Look at the input file information in the text box below, set the file format parameters......
>> Save the griding results as C:/ETideLoad4.5_win64en/examples/AppGerrweighgridate/pntgrid.dat.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2024-10-22 20:14:58
>> Complete the computation!
>> Computation end time: 2024-10-22 20:14:58
Parameters of base function
Column ordinal number of weight 7
Number of the neighboring points for interpolation 25
The kurtosis of base function 3
Maximum latitude 25.500°
Minimum longitude 102.400°
Resolution 1.000′
Maximum longitude 103.400°
Minimun latitude 24.400°
Save the griding results as
Import the parameters
Start computation
102.400000 103.400000 24.400000 25.500000 0.01666667 0.01666667
-1.0060 -1.0077 -1.0126 -1.0128 -1.0145 -1.0284 -1.0279 -1.0273 -1.0141 -1.0093 -1.0082 -0.9862 -0.982
-0.9704 -0.9709 -0.9785 -0.9810 -0.9815 -0.9893 -0.9908 -0.9915 -0.9921 -0.9932 -0.9933 -0.9959 -0.995
-1.0466 -1.0382 -1.0241 -1.0169 -1.0158
-1.0226 -1.0202 -1.0311 -1.0372 -1.0393 -1.0429 -1.0461 -1.0309 -1.0302 -1.0246 -1.0234 -1.0153 -1.011
kurtosis=3
kurtosis=10

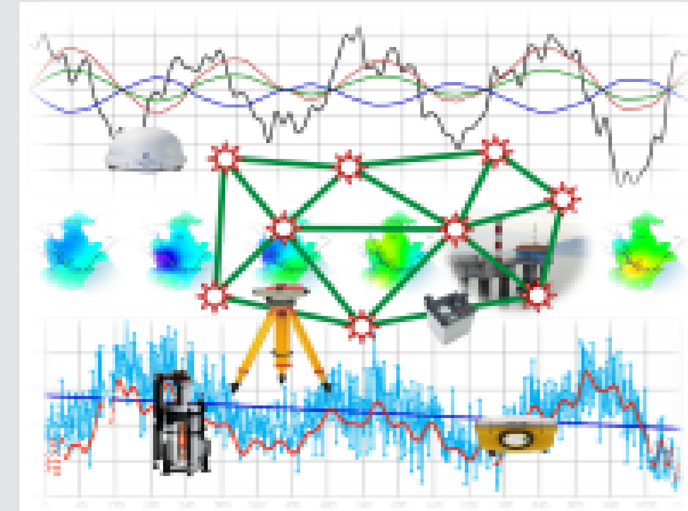

Visualization for specified attribute in discrete point file
Visualization for specified attribute in discrete point file
Open the discrete geodetic point file
Number of rows of file header
1
Column ordinal number of x
2
Column ordinal number of y
3
Column ordinal number of z
5
minimum of z
-9990.0
maximum of z
9990.0
Display style
Plane color scatter plot
Label font size
6
Custom scale range (can be used for batch plots)
Import parameters
Scatter plot →
Save the current plot as
Hold down the left mouse button to rotate the plot.
Hold down the right button or scroll the middle mouse button to zoom the plot.
Hold down the middle button to pan the plot.
number long(deg/decimal) lat ellipHeight(m) rentKsi(m) TerEffect(mGal)
1 102.442457 24.471769 1972.7703 -1.0013 -3.3508
2 102.546777 24.458002 1659.0410 -1.0916 -6.6124
3 102.632412 24.458211 2120.2558 -0.9639 -5.0422
4 102.725921 24.460578 2111.3872 -0.9936 -3.6867
5 102.420803 24.566357 1990.6386 -1.0706 -3.1489
6 102.528697 24.562786 1936.4260 -1.0402 -2.0473
7 102.634437 24.565660 2192.9271 -0.9743 -4.0534
8 102.725888 24.581970 2303.7797 -0.9566 -7.1388
9 102.832641 24.575505 1977.4949 -1.0619 -5.9858
10 102.345532 24.668953 1919.7825 -1.0840 -1.6645
11 102.423972 24.652933 1959.3369 -1.0281 -3.0476
12 102.529771 24.667079 2157.7877 -1.0165 -4.2396
13 102.631063 24.657055 1906.3415 -1.0806 -1.6637
14 102.742718 24.652871 1935.7882 -1.0343 -1.7419
15 102.843573 24.642787 1880.7707 -1.0819 -7.7294
16 103.137778 24.658224 1838.4387 -0.9843 -11.7862
17 102.426305 24.743284 1929.0475 -1.0229 -4.1779
25.6°
25.4°
25.2°
25°
24.8°
24.6°
24.4°
102.4°
102.6°
102.8°
103°
103.2
-1.15
-1.1
-1.05
-1
-0.95

Earth Tide, Load Effects and Deformation Monitoring Computation 4.5

Summary, parameter settings and visualization for ETideLoad4.5



Computation of various tidal and pole-shift effects on all-element geodetic variations



Processing and analysis on non-tidal geodetic variation time series

- Analytically compatible geodetic and geodynamic algorithm package using the numerical standards unified and geophysical models coordinated
- Compatible with and improved the IERS conventions, some geodetic concepts clarified, all the algorithms derivated and verificated completely
- Uniform computation of solid tidal, load tidal, polar shift and mass centric variation effects on all-element geodetic variations in whole Earth space
- Analytical computation of surface load effects on all-element geodetic variations and collaborative monitoring of time-varying Earth gravity field
- Geodetic monitoring of the surface hydrological environment and ground stability variations and prediction of their spatio-temporal evolution

www.zcyphygeodesy.com/en/

ETideLoad4.5 organization structure

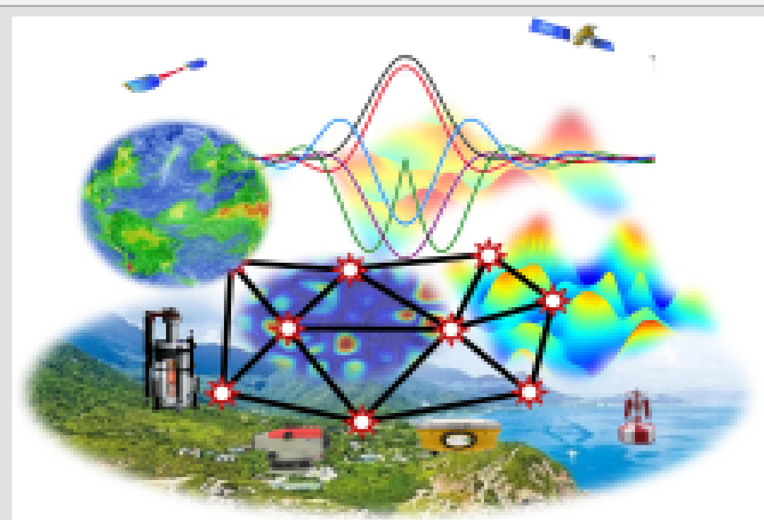
☆ ETideLoad4.5 includes the basic principles, formulas and important methods of geodesy on the deforming Earth to improve higher education environment.

☆ Can be employed to construct scientifically the technology environment for the deep fusion of multi-source heterogeneous earth data and collaborative monitoring of multiply heterogeneous geodetic system.

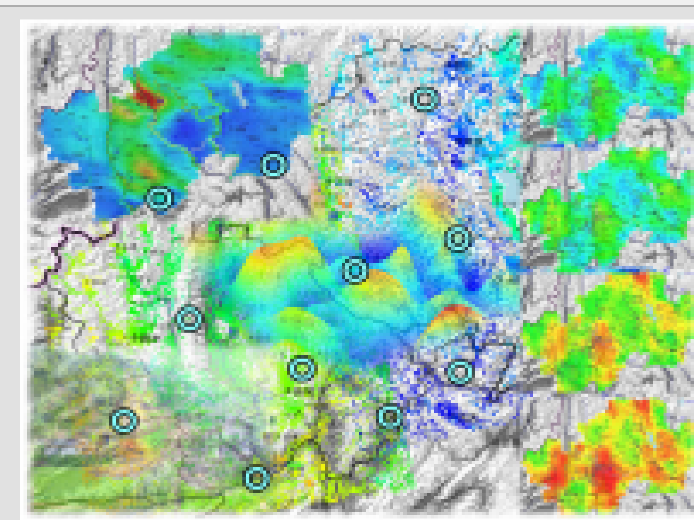
☆ There are the example files saved in the folder C:\ETideLoad4.5_win64en\examples\ for each Win64 program. It will take about 7 working days to complete all the example exercises. Thereafter, you can use ETideLoad4.5 alone.

Models and numerical standards

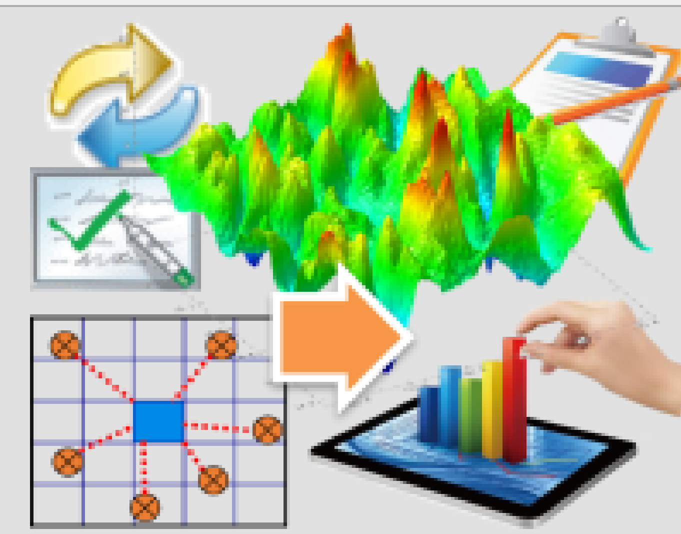
Geodetic variations in ETideLoad



Load deformation field approach and monitoring from heterogeneous variations



CORS/InSAR collaborative monitoring and ground stability estimation



Editing and calculation tools for geodetic data files

Classroom Teaching, Self-Exercise, Science Research and Engineer Computing