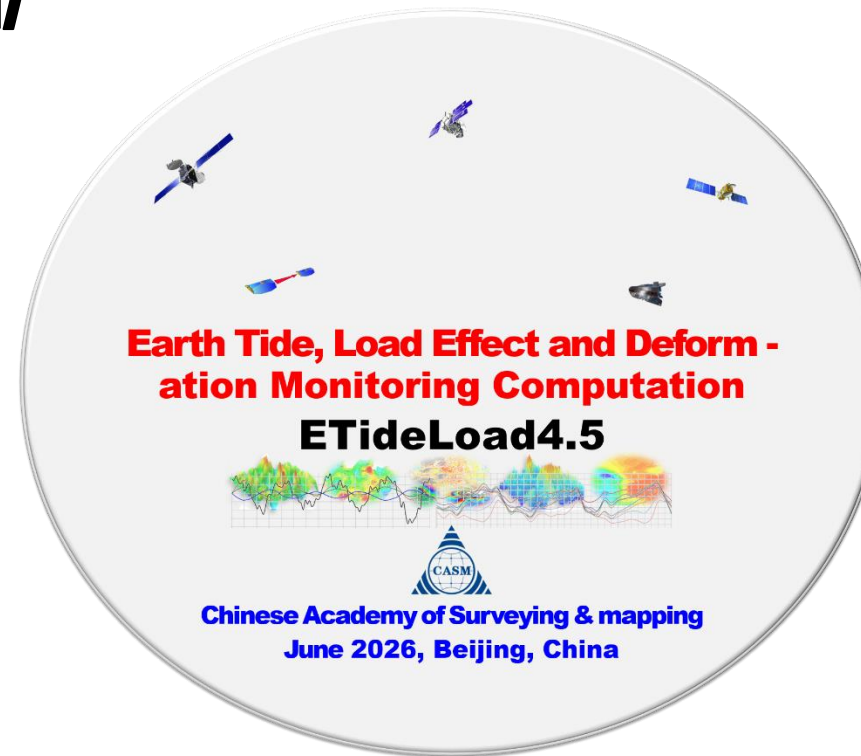




Load Deformation Field Approximation and Monitoring from Heterogeneous Variations

Load Deformation Field Approximation and Monitoring from Heterogeneous Variations

Non-tidal load variations originate from the atmosphere, ocean bottom pressure, soil moisture, groundwater, and glaciers induce temporal variations in the Earth's geopotential, which excite solid Earth deformation, resulting in time-variable geopotential variations observable across all geodetic elements.

Structure of the subsystem

Spherical Harmonic Analysis on Global Surface Load Time Series

Spherical Harmonic Analysis of Tidal Harmonic Constants and Construction of Tidal Load Model

Computation of Load Model Values via Spherical Harmonic Synthesis

Computation of Load Deformation Field via Spherical Harmonic Synthesis

Regional Refinement of Load Deformation Field via Green's Integration

Regional Approximation of Load Deformation Field Using SRBFs

Load Deformation Field Recovery from Heterogeneous Variations via Green's Integral Constraint

SRBF Approximation of Terrestrial Water Variations and Load Effects from Heterogeneous Variations

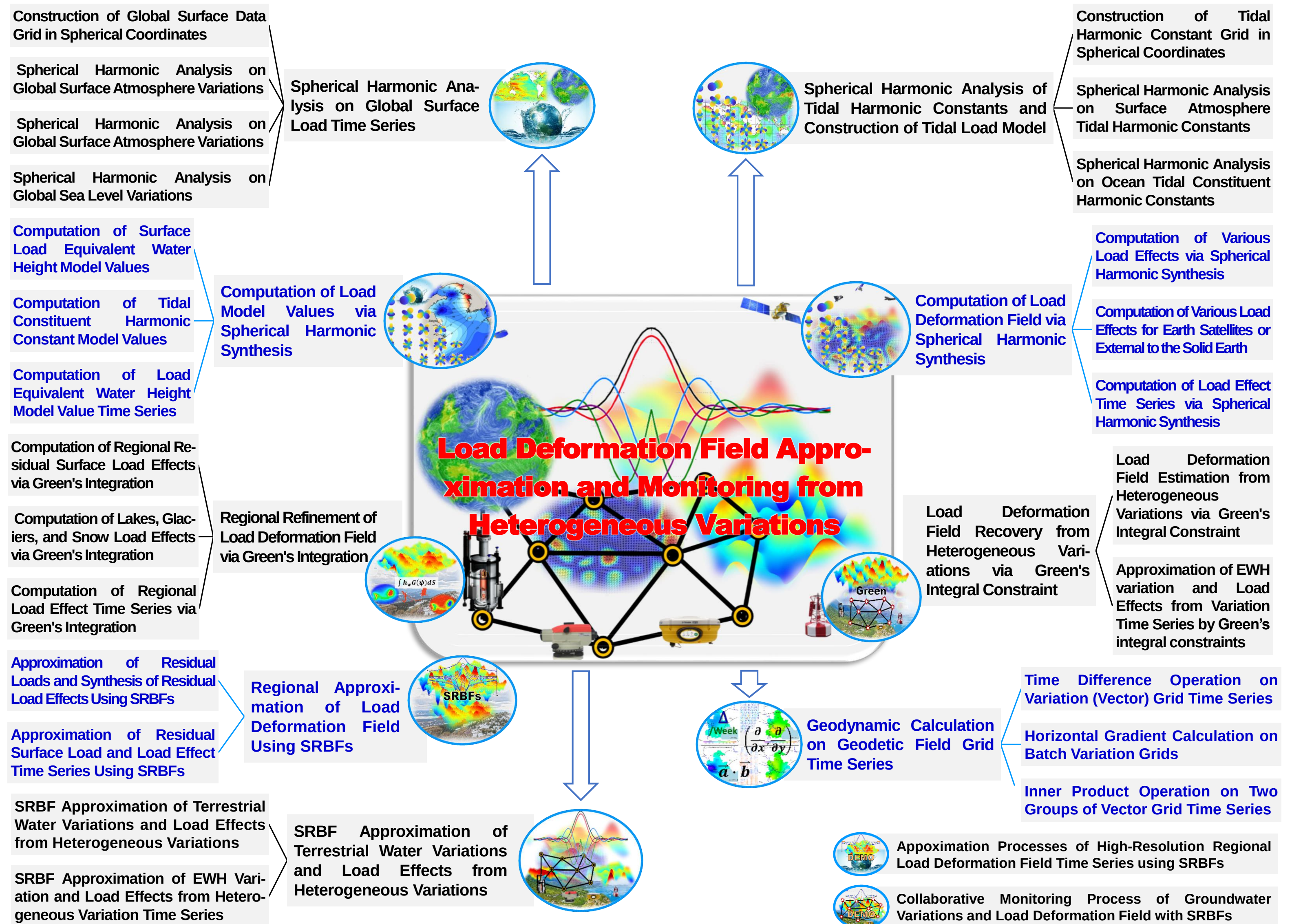
Geodynamic Calculation on Geodetic Field Grid Time Series

Approximation Processes of High-Resolution Regional Load Deformation Field Time Series using SRBFs

Collaborative Monitoring Process of Groundwater Variations and Load Deformation Field with SRBFs

Approximation Processes for Surface Loads and All-element Load Deformation Field with SRBFs

ZAHNG Chuanyin, zhangchy@casm.ac.cn



Construction of global surface data grid in spherical coordinates

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 Terrestrial water Variations

Spherical Harmonic Analysis on Global Sea Level Variations

Open any global surface discrete point data file

Set the wildcards of the file names

Ordinal number of first wildcard in the file name 1

Number of consecutive wildcards in file name 9

The discrete point file format

Number of rows of the file header 1

Column ordinal number of target attribute in record 4

Target grid resolution 30.0'

Save program process as

Load Spherical Harmonic Analysis and Synthesis of Load Effects

>> [Purpose] To construct a normalized surface load Spherical Harmonic (SH) coefficient model from global grid data (e.g., atmosphere, terrestrial water, sea level). This model facilitates the computation of non-tidal load effects on geodetic elements via spherical harmonic synthesis.

>> Select the computation function from the 4 control buttons on the top of the interface...

>> [Function] Generate a spherical coordinate grid model from global discrete point data using the simple average method. If no valid discrete points exist within a grid cell, the cell value is set to zero.

>> Open any global surface discrete point data file C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/gridate/landwater.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/Loadspharmonanalys/gridate.

** The discrete point data files searched by wildcard instantiation:

C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/gridate/landwater.txt

C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/gridate/sealvlchg.txt

>> Setting parameters have been imported into the program!

** Click the control button [Start computation], or the tool button [Start computation]....

>> Computation start time: 2026-06-22 11:34:57

>> Computation end time: 2026-06-22 11:35:22

Set the result file folder

Import setting parameters

Start computation

0.00000000	360.00000000	-90.00000000	90.00000000	0.250000	0.250000	2018011512
1	0.1250000	-89.8750000	0.000			
2	0.3750000	-89.8750000	0.000			
3	0.6250000	-89.8750000	0.000			
4	0.8750000	-89.8750000	0.000			
5	1.1250000	-89.8750000	0.000			
6	1.3750000	-89.8750000	0.000			
7	1.6250000	-89.8750000	0.000			
8	1.8750000	-89.8750000	0.000			
9	2.1250000	-89.8750000	0.000			
10	2.3750000	-89.8750000	0.000			
11	2.6250000	-89.8750000	0.000			

Local Disk (C:) > ETideLoad4.5_win64en > examples > Loadspharmonanalys > gridrst

名称	修改日期	类型	大小
sphlandwater.dat	2022/12/26 12:54	DAT 文件	2,557 KB
sphsealvlchg.dat	2022/12/26 12:55	DAT 文件	2,557 KB

The maximum degree n of the load spherical harmonic coefficient model corresponds to the number of grid cells in the latitude direction. For instance, a $0.25^\circ \times 0.25^\circ$ grid resolution corresponds to $n = 720$.



Follow example

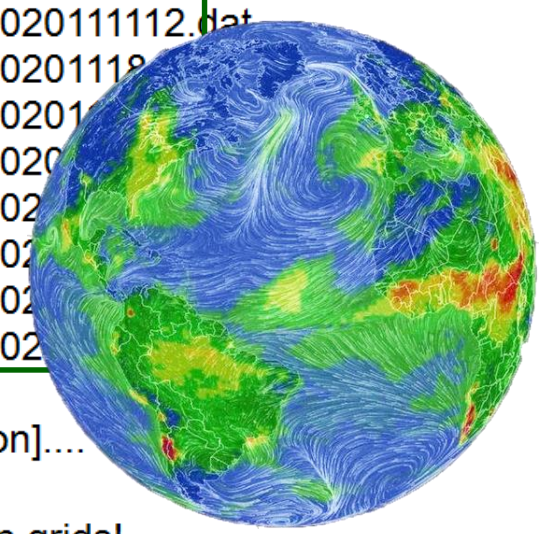
 Spherical Harmonic Analysis on
Global Sea Level Variations

Load Spherical Harmonic Analysis and Synthesis of Load Effects

Termination condition of residual decrease (b) 1.0 ‰

C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/atmos60m/grdchg2020102112.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/atmos60m/grdchg2020102812.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/atmos60m/grdchg2020110412.dat
~~C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/atmos60m/grdchg2020111112.dat~~
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/atmos60m/grdchg2020111812.dat
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/grdchg2021010612.dat

```
>> Computation end time: 2026-06-22 12:04:06
```



180-degree load spherical harmonic coefficient model

	$GM(\times 10^{14} m^3/s^2)$	$a(m)$	zero-degree term (hPa/mbar)	relative error(%)
1	3.986004418	6378137.00	-0.1761	1.061
2	0	5.442500620464125E-11	0.000000000000000E+00	
3	0	3.802943486133981E-10	-6.3625674515077693E-10	
4	2	0	7.861363013559757E-10	0.000000000000000E+00
5	2	1	1.7411917335316819E-09	6.3115303687721207E-10
6	2	2	-9.7232154858684680E-10	7.9180695456711246E-10
7	3	0	-2.2292291637E-09	0.000000000000000E+00
8	3	1	-2.4917196532291637E-10	7.9652739354309352E-10
9	3	2	-2.2138615541591970E-09	-1.3123244146487042E-09
10	3	3	1.0241012445219900E-09	-1.3600733390246473E-10
11	4	0	1.7710699105592897E-09	0.000000000000000E+00
12	4	1	-7.4645748011628615E-10	-3.5148375300150040E-10
13	4	2	-2.9791370856184055E-09	9.4854855513647826E-10
14	4	3	1.4524769188989309E-09	7.6354360426909201E-10
15	4	4	5.7974053889694342E-10	8.4635300136399749E-11

🌐 The maximum degree n of the load spherical harmonic coefficient model corresponds to the number of grid cells in the latitude direction. For instance, a $0.25^\circ \times 0.25^\circ$ grid resolution corresponds to $n = 720$.

Spherical Harmonic Analysis on Global Terrestrial water Variations

Construction of Global Surface Data Grid in Spherical Coordinates

Spherical Harmonic Analysis on Global Surface Atmosphere Variations

Spherical Harmonic Analysis on Global Terrestrial water Variations

Spherical Harmonic Analysis on Global Sea Level Variations

Open any land water variation spherical coordinate grid file

Set the wildcards of the file names

Ordinal number of first wildcard in the file name

Number of consecutive wildcards in file name

Set termination condition of the iteration

Residual standard deviation threshold (a)

Termination condition of residual decrease (b)

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

Load Spherical Harmonic Analysis and Synthesis of Load Effects

```
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/landw60m/grdchg2020072212.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/landw60m/grdchg2020072912.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/landw60m/grdchg2020080512.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/landw60m/grdchg2020081212.dat
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: 2026-06-22 12:06:26

>> Complete the spherical harmonic analysis for 143 land water variation grids!

** The program outputs Terrestrial Water Load SH Model (Indwater***cs.dat) Iteration Statistics (pro***.ini), and Residual Grids (rnt***.dat) *** is the instance of the given wildcards.

** The file header of the Indwater***cs.dat: Geocentric Gravitational Constant GM ($\times 10^{14} \text{ m}^3/\text{s}^2$), Equatorial Radius a (m), Zero-degree term $a\Delta C_{00}$ (hPa), Relative Error Θ (%).

** The program also outputs COM variation Time Series (geocenterlandw.txt) induced variations: Epoch time (Decimal Year), ΔX_{cm} (mm), ΔY_{cm} (mm), ΔZ_{cm} (mm), Data (ETideLoad).

>> Computation end time: 2026-06-22 12:37:40

Set the result file folder

Import setting parameters

Indwater2018010312cs.dat				
1	3.986004418	6378137.00	0.3233	6.980
2	1	0	5.4161495494517116E-10	0.0000000000000000E+00
3	1	1	1.9077501545250107E-10	5.2709554647342320E-11
4	2	0	5.6467115175068137E-10	0.0000000000000000E+00
5	2	1	4.5844404050751017E-11	2.0240200564244726E-11
6	2	2	8.1098570416071924E-11	1.5085062944512367E-10
7	3	0	6.6147679187737971E-10	0.0000000000000000E+00
8	3	1	2.0985071603162932E-10	2.2122230227494451E-10
9	3	2	2.5993285450561679E-11	2.5858637236562612E-10
10	3	3	1.5662015629820256E-12	3.1453510330532493E-10
11	4	0	-2.1426804285782660E-11	0.0000000000000000E+00
12	4	1	3.9997109881976516E-10	3.8079722829269770E-10
13	4	2	7.2734785934906625E-11	3.7420446091482942E-10
14	4	3	3.0098589960811890E-11	7.6495297040055588E-11
15	4	4	-1.7097207839997709E-10	2.1562251557914367E-10

$GM(\times 10^{14} \text{ m}^3/\text{s}^2)$ $a(\text{m})$ zero-degree term (cm), relative error(%)

the scale parameter

```
2.5000000000E-01 2.5000000000E-01
0000 2774.0000 2774.0000 2774.0000 27
0000 2774.0000 2774.0000 2774.0000 27
0000 2774.0000 2774.0000 2774.0000 27
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0000 2794.0000 2794.0000 2794.0000 27
0000 2794.0000 2794.0000 2794.0000 27
0000 2794.0000 2794.0000 2794.0000 27
```

Indwater2018010312cs.dat					
1	0	1.3801	3.9806	-18.6738	16.7511
2	1	0.1031	0.9422	-5.7645	7.8790
3	2	0.0417	0.4895	-4.7948	6.8285
4	3	0.0260	0.3601	-4.3988	6.3837
5	4	0.0209	0.3156	-4.4585	6.2287
6	5	0.0188	0.2980	-4.5210	5.9999
7	6	0.0176	0.2900	-4.5657	5.7698
8	7	0.0169	0.2857	-4.5930	5.5886
9	8	0.0164	0.2832	-4.6083	5.5846
10	9	0.0161	0.2816	-4.6163	5.5847
11	10	0.0159	0.2805	-4.6202	5.5857
12	11	0.0157	0.2797	-4.6221	5.5866
13	12	0.0156	0.2791	-4.6229	5.5872
14	13	0.0156	0.2786	-4.6233	5.5875
15	14	0.0155	0.2780	-4.6235	5.5877
16	15	0.0155	0.2778	-4.6235	5.5877

number of iterations, mean, SD, minimum, maximum

The maximum degree n of the load spherical harmonic coefficient model corresponds to the number of grid cells in the latitude direction. For instance, a $0.25^\circ \times 0.25^\circ$ grid resolution corresponds to $n = 720$.

Spherical Harmonic Analysis on Global Sea Level Variations

Construction of Global Surface Data Grid in Spherical Coordinates

Spherical Harmonic Analysis on Global Surface Atmosphere Variations

Spherical Harmonic Analysis on Global Terrestrial 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

Number of consecutive wildcards in file name

Set termination condition of the iteration

Residual standard deviation threshold (a)

Termination condition of residual decrease (b)

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

Load Spherical Harmonic Analysis and Synthesis of Load Effects

```
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/seal60m/grdchg2020102112.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/seal60m/grdchg2020102812.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/seal60m/grdchg2020110412.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/seal60m/grdchg2020111112.dat
C:/ETideLoad4.5_win64en/examples/Loadspharmonanalys/seal60m/grdchg2020111812.dat
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: 2026-06-22 12:54:39

>> Complete the spherical harmonic analysis for 157 sea level variation grids!

** The program outputs Sea Level Variation Load SH Mode (seachg***cs.dat), Iteration Statistics (pro***.ini), and Residual Grids (rnt***.dat) *** is the instance of the given wildcards.

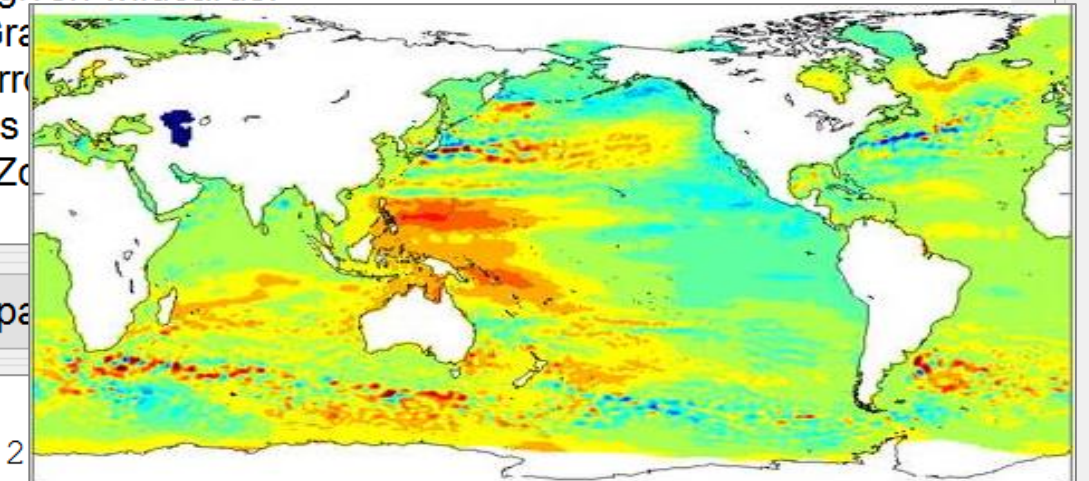
** The file header of the seachg***cs.dat: Geocentric Gravitational Potential, Radius a (m), Zero-degree term $a\Delta C_{00}$ (hPa), Relative Error

** The program also outputs COM variation Time Series (com***.dat), Epoch time (Decimal Year), ΔX_{cm} (mm), ΔY_{cm} (mm), ΔZ_{cm} (mm)

>> Computation end time: 2026-06-22 13:42:40

Set the result file folder

Import setting parameters



sealevel2018010312cs.dat					
1	3.986004418	6378137.00	0.1482	12.259	
2	1	0	-7.1099714241030070E-10	0.0000000000000000E+00	
3	2	0	1.6751189679450448E-10	0.0000000000000000E+00	
4	2	1	1.0298691240132240E-10	-4.8354027549818012E-10	
5	2	2	6.4627313483801362E-10	-1.0376661124700542E-09	
6	3	0	-2.4310321497109673E-10	0.0000000000000000E+00	
7	3	1	3.8058446E-09	-3.6443245955988522E-10	
8	3	2	4.0530961810871272E-10	9.1666926888445966E-11	
9	3	3	-1.1197190742285947E-10	-4.8811906702259529E-10	
10	4	0	-8.4235286957811616E-11	0.0000000000000000E+00	
11	4	1	-5.1282309415176720E-11	2.5307177529937340E-10	
12	4	2	-3.4627064648576430E-10	7.1811239570472555E-10	
13	4	3	-1.5836119076575140E-10	-1.4013498597540113E-10	
14	4	4	2.0672494020177201E-10	2.3876308632158088E-10	

$GM(\times 10^{14} m^3/s^2)$, $a(m)$, zero-degree term (cm), relative error(%)

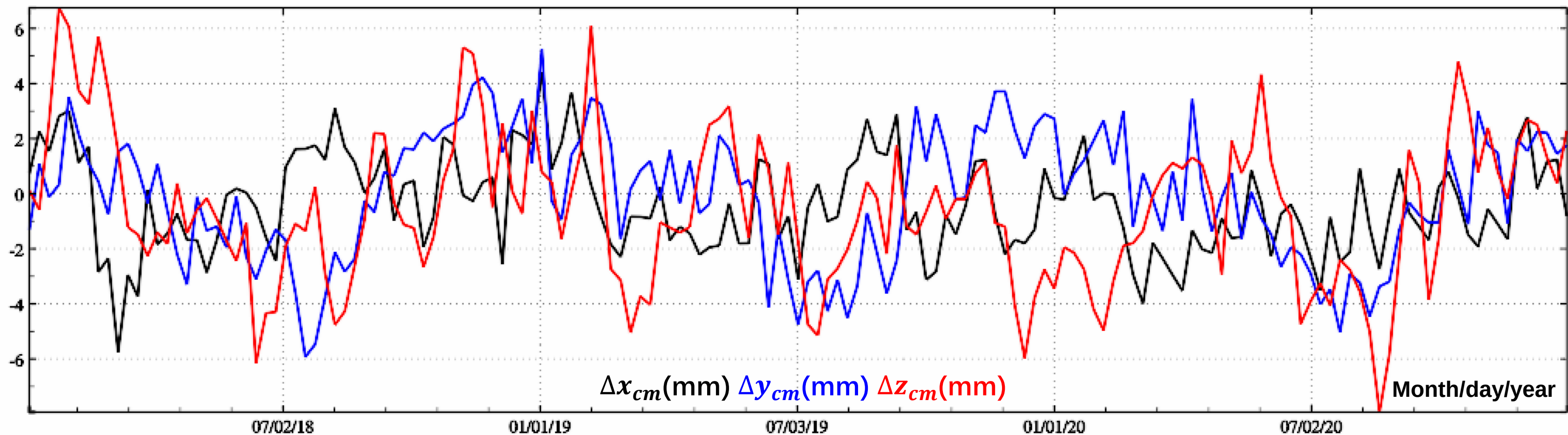
the scale parameter

0	2.5000000000E-01	2.5000000000E-01			
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000
0.0000	2774.0000	2774.0000	2774.0000	2774.0000	2774.0000

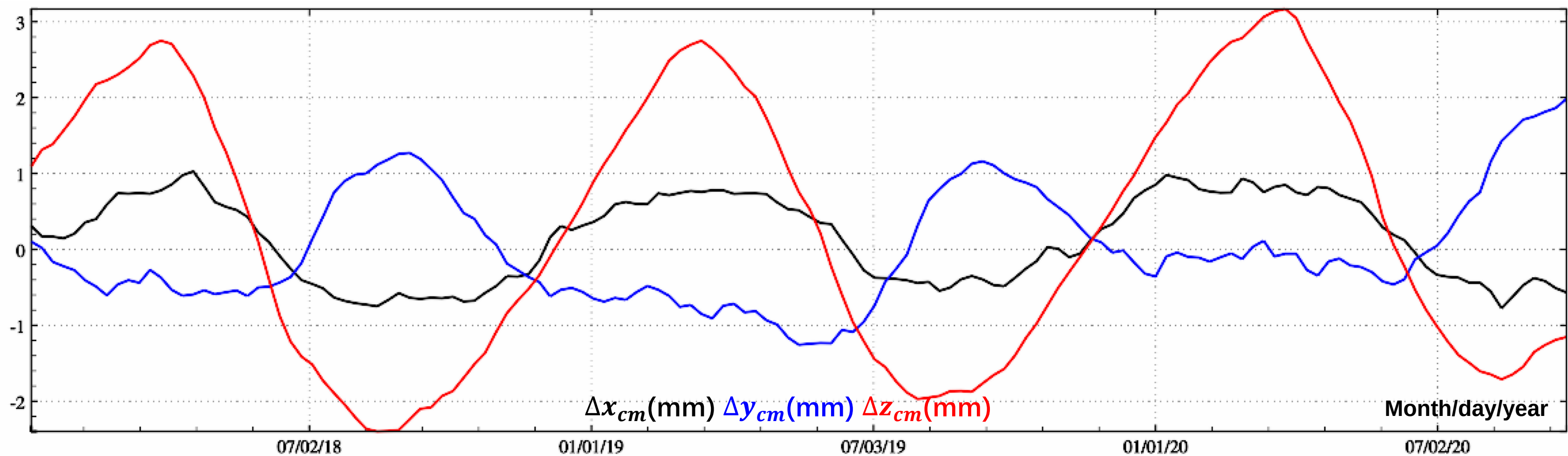
sealevel2018010312cs.dat					
1	0	0.2248	6.0022	-72.5365	62.0915
2	1	0.0437	3.0110	-41.6793	39.1393
3	2	0.0098	2.0946	-29.0016	34.5860
4	3	0.0047	1.6552	-21.2292	31.1485
5	4	0.0040	1.3967	-15.6018	28.7731
6	5	0.0034	1.2288	-15.6526	27.1106
7	6	0.0028	1.1125	-16.6297	25.8610
8	7	0.0022	1.0285	-17.1866	24.8697
9	8	0.0017	0.9659	-17.4713	24.0634
10	9	0.0013	0.9180	-17.5730	23.4037
11	10	0.0010	0.8808	-17.5500	22.8152
12	11	0.0007	0.8514	-17.4465	22.4287

number of iterations, mean, SD, minimum, maximum

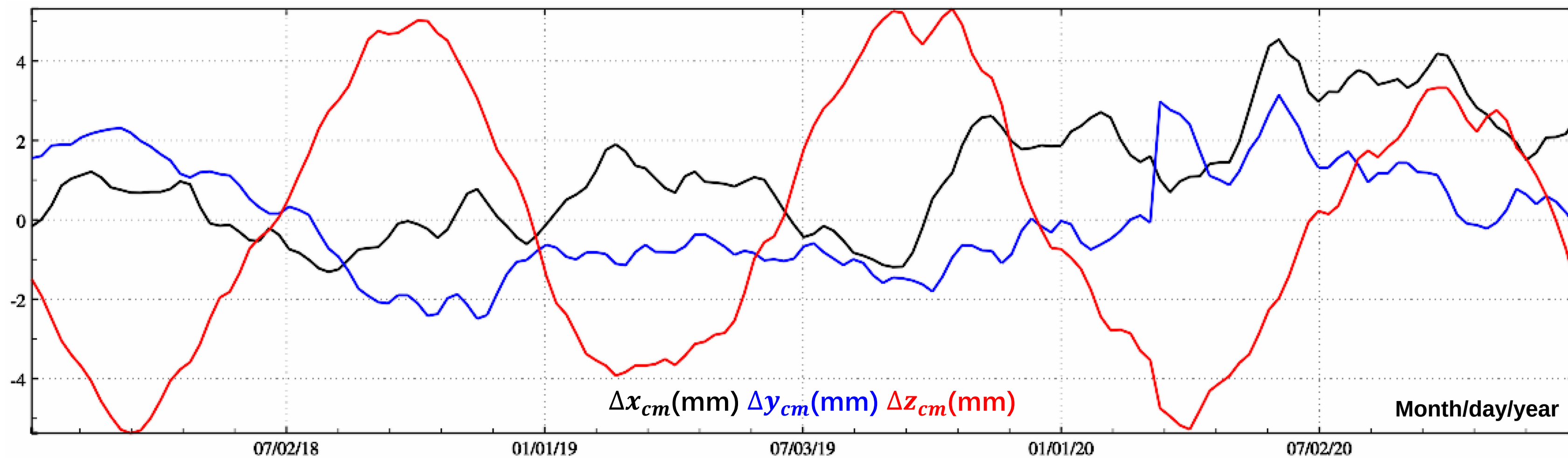
The maximum degree n of the load spherical harmonic coefficient model corresponds to the number of grid cells in the latitude direction. For instance, a $0.25^\circ \times 0.25^\circ$ grid resolution corresponds to $n = 720$.



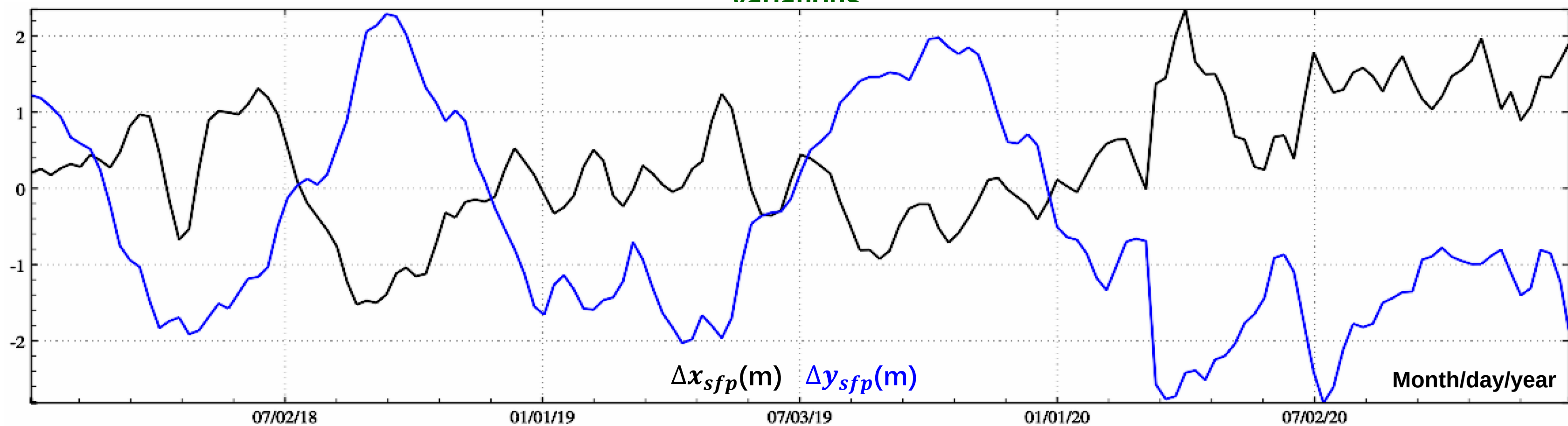
The surface atmosphere load effect time series (mm) on Earth's center of mass (COM)



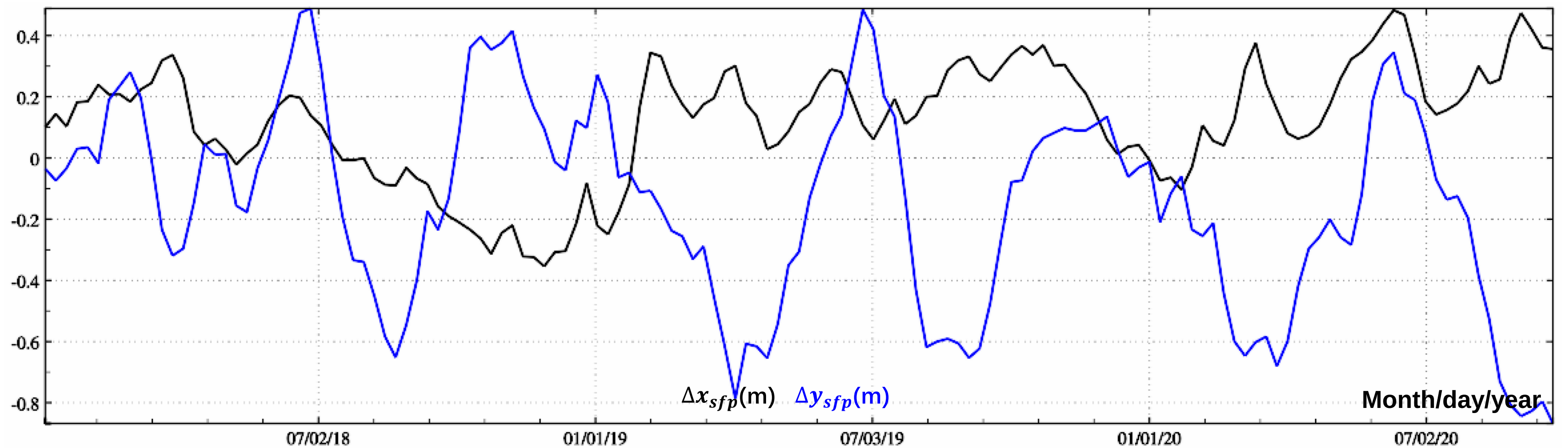
The global land water variation load effect time series (mm) on Earth's center of mass (COM)



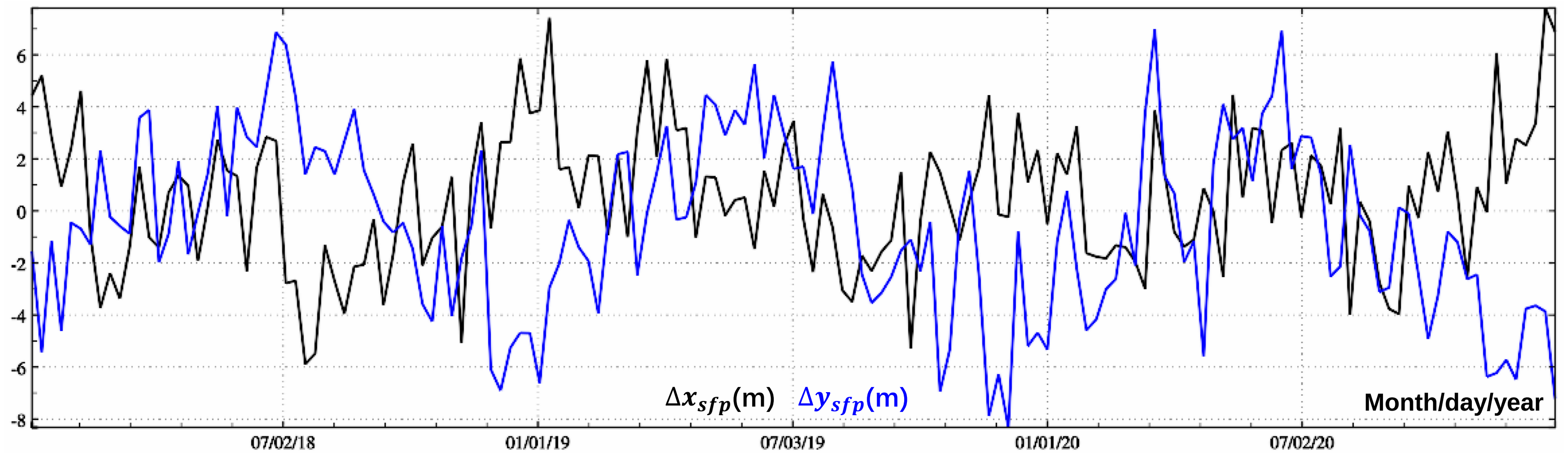
The global sea level variation load effect time series (mm) on Earth's center of mass (COM) variations



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



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



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

Construction of Tidal Harmonic Constant Grid in Spherical Coordinates

Construction of 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

** The degree number maxn of the tidal load spherical harmonic coefficient model corresponds to the number of harmonic constant spherical coordinate cell-grids in the latitude direction. For example, a $0.25^\circ \times 0.25^\circ$ tidal harmonic constant spherical coordinate grid corresponds to maxn = 720.

>> Select the computation function from the 3 control buttons on the top of the interface...

>> [Function] o generate a spherical coordinate grid model of tidal constituent harmonic constant vectors (In-Phase and Out-of-Phase amplitudes) from discrete point data using the simple average method.

** Input File Header Requirement: The program requires at least one header row containing the Tidal Constituent Name and its Doodson Constant.

** Doodson Constant: A unique integer identifier (e.g., for the M_2 tide) used to identify the tidal type and frequency. Note: The Doodson constant must be correct.

>> Open any discrete tidal constituent harmonic constant file C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/sphgrdate/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/sphgrdate.

** The discrete tidal constituent harmonic constant files searched by wildcard instantiation:

C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/sphgrdate/S1_airp.txt
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/sphgrdate/S2_airp.txt
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/sphgrdate/Sa_airp.txt
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/sphgrdate/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: 2026-06-22 15:20:52

>> Complete the spherical coordinate gridding 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: 2026-06-22 15:21:56

Set the result file folder

Import setting parameters

Start computation

S1	164556	Hcosg	Hsing	in hPa
1		0.000000	-90.000000	0.05396
2		0.250000	-90.000000	0.16694
3		0.500000	-90.000000	0.05396
4		0.750000	-90.000000	0.16694
5		1.000000	-90.000000	0.05396
6		1.250000	-90.000000	0.16694
7		1.500000	-90.000000	0.05396
8		1.750000	-90.000000	0.16694
9		2.000000	-90.000000	0.05396
10		2.250000	-90.000000	0.16694
11		2.500000	-90.000000	0.05396
12		2.750000	-90.000000	0.16694

examples > Loadtidespharmsynth > gridrst

名称

修改日期

sphS1_.dat
sphS2_.dat
sphSa_.dat
sphSsa.dat

2022/1/11 10:30
2022/1/11 10:31
2022/1/11 10:31
2022/1/11 10:31

Spherical Harmonics Analysis on Surface Atmosphere

Algorithm formulas

>> Program Process ** Operation Prompts

 Save program process as

Termination condition of residual decrease (b) 1.0 %

** The program also outputs the first-degree atmosphere tidal load spherical harmonic coefficient file AtideOne.dat to the current directory. Header: Geocentric Gravitational Constant GM ($\times 10^{14}$ m³/s²), Equatorial Radius a (m); and Records (Row 4+): Doodson Constant, Constituent Name, C_{10}^+ (In-Phase), C_{10}^- (Out-of-Phase), C_{11}^+ , C_{11}^- , S_{11}^+ , S_{11}^- .

```
>> Computation end time: 2026-06-22 15:45:54
```

 Set the result file folder

 Imp

Degree 360 tidal load spherical harmonic coefficient model

🌐 The units for the tidal constituent harmonic constants are identical to those of the derived tidal load spherical harmonics.

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
rntS1_.dat	2022/1/11 10:40
rntS2_.dat	2022/1/11 10:44

Output files

	in-phase amplitude spherical harmonic coefficients model			
1	3.986004418	6378137.00	0.1756	2.893
2	1	0	-3.2737818185410342E-09	0.0000000000000000E+00
3	2	0	-2.7587345611526482E-09	0.0000000000000000E+00
4	2	1	-3.7664414786858797E-09	-1.5679278417046221E-08
5	2	2	-5.6259795454790081E-10	-8.0822938426465110E-09
6	3	0	-7.6061597145007028E-09	0.0000000000000000E+00
7	3	1	-5.422140809E-09	8.5243342871089541E-09
8	3	2	9.8749805288913024E-09	4.2697746192343320E-09
9	3	3	-7.9484869809999550E-09	4.2160451922288746E-09
10	4	0	6.1325368377539217E-09	0.0000000000000000E+00
11	4	1	3.2845793001559087E-09	8.5456114914643217E-10
12	4	2	5.3621764434892774E-09	7.2233754311287918E-09
13	4	3	1.2484120370871218E-08	1.8764089211095401E-08
14	4	4	3.3403899087229966E-09	-3.1081614168687751E-09
15	5	0	1.6767502798578674E-09	0.0000000000000000E+00
16	5	1	-2.3752174015164590E-09	6.3407664854698723E-09
17	5	2	-5.0350543830721095E-09	-5.7620363858752100E-12
18	5	3	5.1976501472008727E-09	1.1153184597367160E-08

1	Surface atmospheric tidal load normalized spherical harmonic coefficient model in hPa or mbar.											
2	Created by ETideLoad, ZHANG Chuanyin, Chinese Academy of Surveying and Mapping.											
3	Doodson name	n	m	Csin+	Ccos+	Csin-	Ccos-	C+	eps+	C-	eps-	
4	164.556 S1	1	0	-0.01044593	0.00562824	-0.01044593	0.00562824	0.011866	298.3157	0.011866	298.3157	
5	164.556 S1	1	1	-0.02016686	-0.30983778	-0.02700702	0.03082551	0.310493	183.7240	0.040983	318.7776	
6	164.556 S1	2	0	-0.00880807	0.02708492	-0.00880807	0.02708492	0.028481	341.9854	0.028481	341.9854	
7	164.556 S1	2	1	-0.00267857	-0.06099820	-0.02133360	0.03899757	0.061057	182.5144	0.044451	331.3192	
8	164.556 S1	2	2	0.04746516	-0.07024418	-0.05104501	-0.01871795	0.084777	145.9525	0.054369	249.8623	
9	164.556 S1	3	0	0.02424426	0.01222005	0.02424426	0.01222005	0.027150	63.2501	0.027150	63.2501	
10	164.556 S1	3	1	-0.00065416	0.08663644	0.01517276	0.03225602	0.086639	359.5674	0.035646	25.1916	
11	164.556 S1	3	2	0.05672425	-0.01538354	0.00625213	-0.04261689	0.058773	105.1736	0.043073	171.6539	
12	164.556 S1	3	3	0.01546691	0.03548381	-0.06617256	0.00859525	0.038708	23.5517	0.066728	277.4008	
13	164.556 S1	4	0	0.01956420	-0.01827060	0.01956420	-0.01827060	0.026769	133.0418	0.026769	133.0418	
14	164.556 S1	4	1	-0.01459744	0.00148107	0.03555613	-0.00398511	0.014672	275.7935	0.035779	96.3950	
15	164.556 S1	4	2	0.01934232	0.02790035	0.01483035	-0.01817240	0.033949	34.7322	0.023456	140.7824	
16	164.556 S1	4	3	0.05868605	0.05584202	0.02090025	-0.06381922	0.081009	46.4225	0.067154	161.8668	
17	164.556 S1	4	4	0.05071872	-0.00993816	-0.02940598	0.00988633	0.051683	101.0865	0.031023	288.5827	
18	164.556 S1	5	0	0.00535373	-0.01557249	0.00535373	-0.01557249	0.016467	161.0273	0.016467	161.0273	
19	164.556 S1	5	1	-0.01117229	0.00673870	-0.00397207	-0.03368705	0.013047	301.0968	0.033920	186.7247	
20	164.556 S1	5	2	0.01448211	0.01448211	0.011866	-0.011866	0.016359	286.6570	0.016359	286.6570	
21	164.556 S1	5	3	0.01540811	0.05344217	0.01772763	-0.01768282	0.055619	16.0830	0.025039	134.9275	
22	164.556 S1	5	4	-0.02513706	-0.01782036	-0.01890504	0.02278884	0.054153	238.5496	0.028100	42.2838	
23	164.556 S1	5	5	0.06196212	-0.00041678	-0.00316231	0.00014887	0.061964	90.3854	0.003166	272.6952	
24	164.556 S1	6	0	-0.01902007	-0.00031063	-0.01902007	-0.00031063	0.019023	269.0643	0.019023	269.0643	
25	164.556 S1	6	1	0.01292417	0.05007315	-0.01614491	-0.03693554	0.051714	14.4725	0.040310	203.6106	
26	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

1	3.986004418 6378137.00											
2	name Doodson			C10+	C10-	C11+	C11-	S11+	S11-			
3	S1 164.556	-0.32755435E-08	0.17648553E-08	-0.73961840E-08	-0.43745105E-07	-0.53411096E-07	-0.10724379E-08					
4	S2 273.555	-0.63049967E-09	0.13744707E-08	0.80115817E-10	0.52363295E-08	0.33900139E-08	-0.10865938E-08					
5	Sa 56.565	0.82105514E-07	-0.16159915E-06	-0.35243498E-07	-0.82919083E-08	0.35037721E-07	-0.12165101E-06					
6	Ssa 57.555	0.65256321E-08	0.64837464E-07	-0.35845502E-07	-0.25039833E-07	0.12771654E-07	0.24911463E-07					
7												

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 center of mass (COM) or COM variation effect on all geodetic elements due to surface atmosphere tide.

Spherical Harmonic Analysis on Ocean Tidal Constituent Harmonic Constants

Construction of 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 ‰

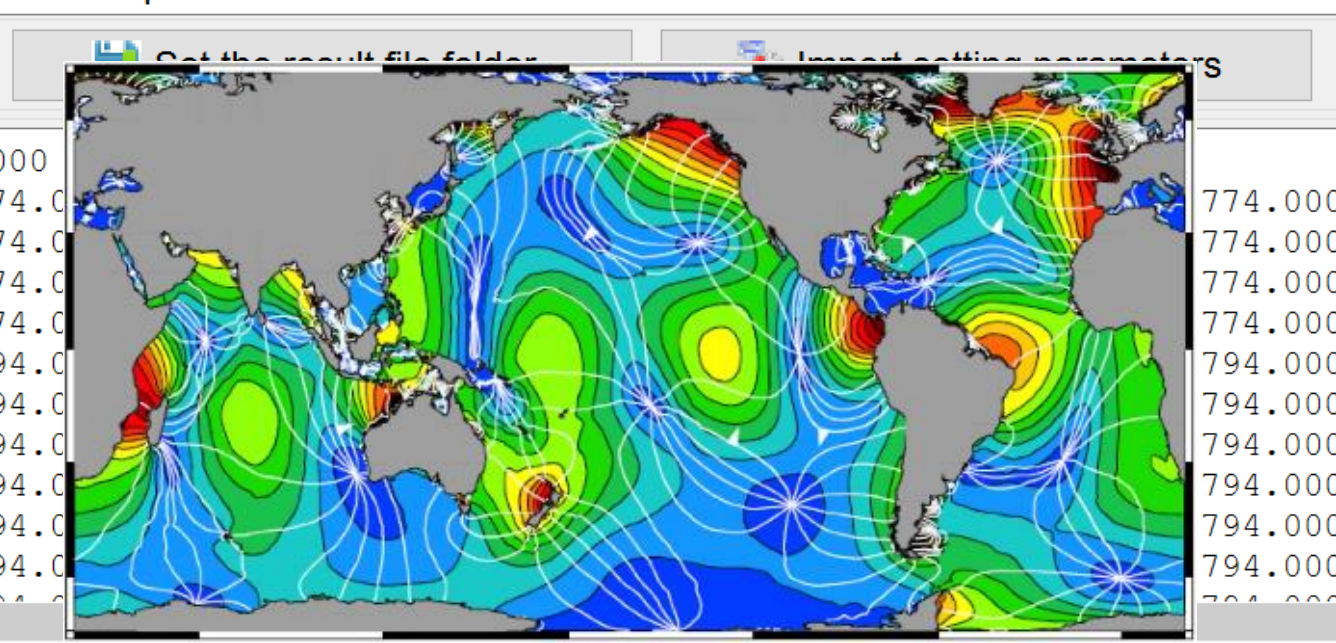
Termination condition of residual decrease (b) 1.0 ‰

Open the land-sea terrain spherical coordinate grid file

C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/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/sphAA2.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/sphAmtn.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/sphsps2.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphlam2.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphmks2.dat
C:/ETideLoad4.5_win64en/examples/Loadtidespharmsynth/FES2014_60m/sphmsqm.dat

>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2026-06-22 15:55:19
>> 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.
** The program also outputs the first-degree ocean tidal load spherical harmonic coefficient file OtideOne.dat to the current directory. Header: Geocentric Gravitational Constant GM ($\times 10^{14} \text{ m}^3/\text{s}^2$), Equatorial Radius a (m); and Records (Row 4+): Doodson Constant, Constituent Name, C_{10}^+ (In-Phase), C_{10}^- (Out-of-Phase), C_{11}^+ , C_{11}^- , S_{11}^+ , S_{11}^- .
>> Computation end time: 2026-06-22 16:27:29

oceanideAAs2cs.dat	proAAs2.ini
in-phase amplitude spherical harmonic coefficients model	
1	3.986004418 6378137.00 0.1742 16.593
2	1 0 4.4085955207264692E-08 0.0000000000000000E+00
3	2 0 4.5725321907033189E-09 0.0000000000000000E+00
4	2 1 -1.8692151140697192E-07 -1.5099193342176944E-07
5	2 2 -2.2883633592280017E-07 5.5470270050811761E-07
6	3 0 -1.7475107044100720E-07 0.0000000000000000E+00
7	3 1 -1.49883E-07 -2.6089831232089852E-07
8	3 2 -4.923021332468856E-08 -2.4846879781068044E-07
9	4 0 8.0449640224242131E-07 3.9758095836942275E-07
10	4 1 -2.2682335734447000E-07 0.0000000000000000E+00
11	4 2 1.3715974585179605E-07 6.5462420096423725E-08
12	4 3 5.6729562392776139E-07 -7.9749298897800718E-07
13	4 4 -5.7287720643753832E-07 -7.4217107021983083E-07
14	5 0 -7.6789761138093624E-07 5.6224223764210645E-07
15	5 1 -1.5887618918450042E-07 0.0000000000000000E+00
16	5 2 -5.5606626280901892E-07 2.5928786409610682E-07
17	5 3 -6.7325675390925060E-07 4.6715642647917952E-07
18	5 4 -2.6396483930740691E-07 2.7714000718129907E-07



名称	修改日期	大小
Otideloadcs.dat	2022/1/24 20:08	67,264 KB
oceanidemsqmcs.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
oceanidemks2cs.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
oceanidelam2cs.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
oceanideeps2cs.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
oceanideAssacs.dat	2022/1/24 20:05	1,995 KB
rntAssa.dat	2022/1/24 20:05	1,536 KB
proAssa.ini	2022/1/24 20:05	3 KB

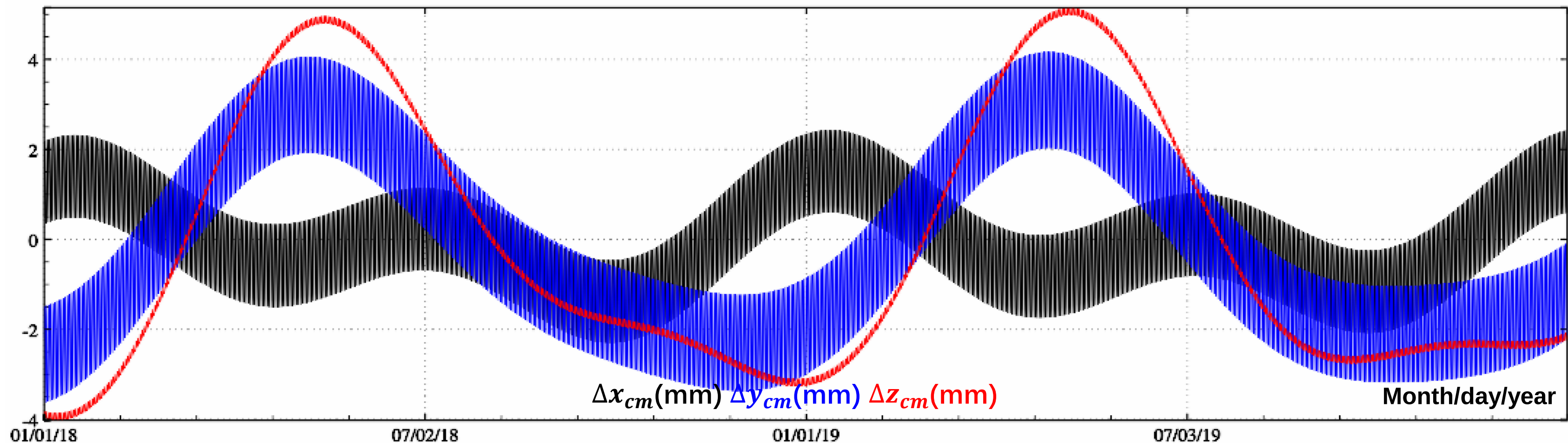
The units for the tidal constituent harmonic constants are identical to those of the derived tidal load spherical harmonic coefficients: Surface Atmos

Loadfmcmsfptm.txt												
Otideloadcs.dat												
1	Ocean tidal height load normalized spherical harmonic coefficient model in cm.											
2	Created by ETideLoad, ZHANG Chuanyin, Chinese Academy of Surveying and Mapping.											
3	Doodson name	n	m	Csin+	Ccos+	Csin-	Ccos-	C+	eps+	C-	eps-	
4	247.455 2N2	1	0	0.00458562	0.00231038	0.00458562	0.00231038	0.005135	63.2596	0.005135	63.2596	
5	247.455 2N2	1	1	-0.00773380	0.00473565	0.01063946	-0.00152991	0.009069	301.4805	0.010749	98.1828	
6	247.455 2N2	2	0	0.01415077	-0.00470716	0.01415077	-0.00470716	0.014913	108.3994	0.014913	108.3994	
7	247.455 2N2	2	1	-0.01749377	0.01964053	-0.02057617	0.01244109	0.026302	318.3086	0.024045	301.1587	
8	247.455 2N2	2	2	-0.05076973	0.15409810	0.03408330	-0.00708020	0.162246	341.7648	0.034811	101.7353	
9	247.455 2N2	3	0	-0.00345932	-0.05402235	-0.00345932	-0.05402235	0.054133	183.6639	0.054133	183.6639	
10	247.455 2N2	3	1	0.00459468	0.02860553	0.08674509	0.04125120	0.028972	9.1250	0.096054	64.5668	
11	247.455 2N2	3	2	-0.01359111	-0.04803085	0.00043095	0.01917460	0.049917	195.7997	0.019179	1.2875	
12	247.455 2N2	3	3	0.11576000	0.04745531	0.10043379	-0.03897379	0.125109	67.7090	0.107731	111.2090	
13	247.455 2N2	4	0	-0.04607076	0.02579335	-0.04607076	0.02579335	0.052800	299.2429	0.052800	299.2429	
14	247.455 2N2	4	1	0.03322584	0.01467790	0.01394749	0.02945707	0.036324	66.1660	0.032592	25.3369	
15	247.455 2N2	4	2	0.06616682	-0.16308472	0.08023800	0.03608357	0.175996	157.9166	0.087978	65.7862	
16	247.455 2N2	4	3	-0.04323293	-0.08712246	-0.08031745	0.08908738	0.097259	206.3921	0.119948	317.9635	
17	247.455 2N2	4	4	-0.07108370	0.11911427	-0.03283587	0.04029420	0.138712	329.1726	0.051979	320.8233	
18	247.455 2N2	5	0	0.00423674	0.05025371	0.00423674	0.05025371	0.050432	4.8190	0.050432	4.8190	
19	247.455 2N2	5	1	-0.06599377	0.02863740	-0.06611923	-0.08775797	0.071939	293.4580	0.109878	216.9954	
20	247.455 2N2	5	2	0.03191636	0.09160043	-0.12292118	0.09809027	0.097002	19.2099	0.157262	308.5896	
21	247.455 2N2	5	3	-0.04622506	0.08929614	-0.05225552	0.02551105	0.100551	332.6324	0.039828	234.1757	
22	247.455 2N2	5	4	0.12678142	-0.02340802	-0.08015548	0.01815451	0.128829	91.5042	0.082186	282.7617	
23	247.455 2N2	5	5	0.07170340	0.02947675	0.04405895	-0.08476786	0.077526	67.6528	0.095534	152.5364	
24	247.455 2N2	6	0	0.03947937	-0.02794239	0.03947937	-0.02794239	0.048367	125.2898	0.048367	125.2898	
25	247.455 2N2	6	1	-0.03340601	-0.04901155	0.00654233	-0.02479353	0.059314	214.2781	0.025642	165.2182	
26	247.455 2N2	6	2	0.01502432	0.05093430	-0.00472606	-0.04361353	0.053104	16.4347	0.043869	186.1846	
27	247.455 2N2	6	3	0.00272363	0.04846491	-0.00102382	0.02626808	0.048541	3.2165	0.026288	357.7680	
28	247.455 2N2	6	4	0.05940714	-0.01371178	0.06957119	0.00812134	0.060969	102.9969	0.070044	83.3418	
29	247.455 2N2	6	5	-0.06310363	-0.02281638	0.02184442	0.02667029	0.067102	250.1215	0.034474	39.3193	
30	247.455 2N2	6	6	0.06505389	0.01875362	0.05082476	0.11432385	0.067703	73.9189	0.125112	23.9684	
31	247.455 2N2	7	0	0.03231974	0.00130979	0.03231974	0.00130979	0.032346	87.6793	0.032346	87.6793	
32	247.455 2N2	7	1	0.01740544	-0.02827998	0.01240391	0.00333515	0.033207	148.3890	0.012844	74.9503	
33	247.455 2N2	7	2	-0.05289712	0.01334177	0.03482823	-0.08565262	0.054554	284.1559	0.092463	157.8723	
34	247.455 2N2	7	3	-0.04490640	0.03300070	-0.01170604	0.00335994	0.055728	306.3113	0.012179	286.0149	
35	247.455 2N2	7	4	0.02847534	-0.01480133	-0.04298436	-0.00624406	0.032092	117.4652	0.043436	261.7348	
36	247.455 2N2	7	5	0.03444464	-0.04692621	-0.05161881	0.01841567	0.058211	143.7207	0.054805	289.6345	
37	247.455 2N2	7	6	0.03370577	-0.00688833	-0.04456603	-0.02386590	0.034402	101.5503	0.050554	241.8302	
38	247.455 2N2	7	7	0.03170557	-0.04712240	0.03534061	0.04767806	0.056796	146.0660	0.059348	36.5471	
39	247.455 2N2	8	0	0.00128965	0.01929829	0.00128965	0.01929829	0.019341	3.8232	0.019341	3.8232	
40	247.455 2N2	8	1	0.02942979	-0.03337153	0.00149069	-0.01387328	0.044495	138.5915	0.013953	173.8671	

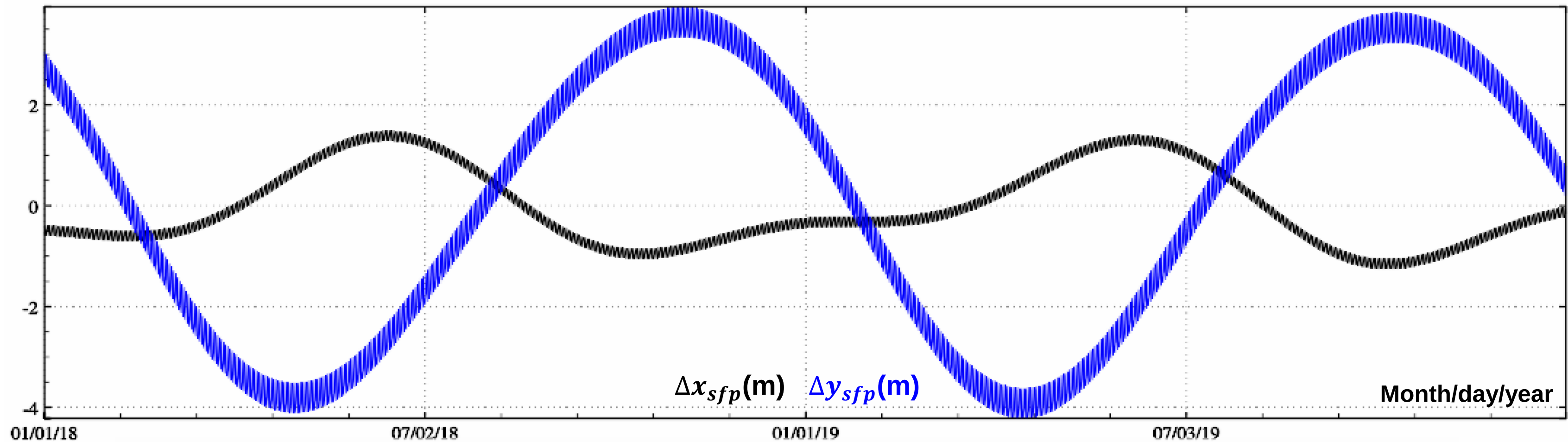
Ocean tidal load spherical harmonic coefficient model
FES2014b360cs.dat constructed by ETideload4.5

oceanA2n2cs.dat x proA2n2. ini x OtideOne. dat x									
1	3.986004418	6378137.00							
2	name	Doodson	C10+	C10-	C11+	C11-	S11+	S11-	
3	2N2	247.455	0.14379190E-08	0.72446933E-09	0.45556662E-09	0.50261431E-09	0.98234968E-09	0.28806626E-08	
4	J1	175.455	0.22805765E-08	-0.14599680E-07	0.11146859E-07	0.31354016E-08	0.49073923E-08	0.50239288E-08	
5	K1	165.555	0.65903198E-07	-0.23618735E-06	0.15240517E-06	0.54510351E-07	0.57951321E-07	0.91115166E-07	
6	K2	275.555	0.58820344E-08	0.78223673E-09	0.82634785E-08	0.17098158E-07	0.28274727E-08	0.95641986E-09	
7	L2	265.455	0.99527541E-09	0.43369491E-10	0.27208849E-08	0.18838893E-08	-0.93316186E-09	-0.31242492E-09	
8	M2	255.555	0.64086749E-07	0.33741274E-07	0.82092113E-07	0.76976307E-08	-0.39331272E-07	0.74234937E-07	
9	M3	355.555	0.51159035E-10	0.26216133E-10	0.20622631E-10	-0.16737336E-10	-0.74054752E-10	-0.32502465E-10	
10	M4	455.555	-0.12877739E-09	-0.82078020E-09	0.21241775E-09	0.89312487E-09	-0.11238411E-09	-0.11882183E-08	
11	M6	655.555	0.18174228E-08	0.30921490E-09	0.36600543E-09	0.36841599E-09	-0.72147727E-09	-0.13743491E-09	
12	M8	855.555	-0.59854172E-10	-0.29503418E-11	0.41858427E-10	0.58809710E-10	-0.34465624E-10	0.81925459E-11	
13	Mf	75.555	0.23994538E-07	0.23160661E-08	0.14961765E-07	-0.19050356E-07	0.57231952E-08	-0.38155669E-08	
14	Mm	65.455	0.12211587E-07	-0.10619733E-08	-0.13680094E-08	-0.93454574E-08	0.34149364E-08	-0.61740212E-09	
15	N2	245.655	0.16604395E-07	0.24692742E-08	0.10060051E-07	0.75631673E-09	-0.49125733E-09	0.20845840E-07	
16	N4	435.755	-0.11170849E-09	-0.41029169E-10	0.37178942E-10	-0.10703469E-09	-0.53442667E-10	-0.19926918E-10	
17	O1	145.555	0.23239277E-07	-0.16830188E-06	0.86481239E-07	0.11802879E-07	0.58555768E-07	0.34726677E-07	
18	P1	163.555	0.16600812E-07	-0.74602430E-07	0.48235157E-07	0.14146460E-07	-0.16880410E-07	0.27001988E-07	
19	Q1	135.655	0.40244812E-08	-0.29117940E-07	0.15908436E-07	0.77164577E-09	0.12770867E-07	0.14909422E-08	
20	Q2	144.555	0.40244812E-08	-0.29117940E-07	0.15908436E-07	0.77164577E-09	0.12770867E-07	0.14909422E-08	
21	S1	164.555	-0.40129653E-08	0.48653114E-08	-0.48716881E-08	0.11419251E-07	0.74509139E-08	-0.34899535E-09	
22	S2	273.555	0.22430236E-07	0.94364697E-08	0.30377828E-07	0.49137638E-07	-0.61338730E-08	0.76805145E-08	
23	S4	491.555	0.32089047E-09	0.14407638E-09	0.12925319E-11	0.14038268E-09	0.10308541E-09	0.11742749E-09	
24	Sa	56.554	0.21793187E-09	0.12972260E-09	0.71714382E-10	0.49927099E-10	-0.42733149E-10	-0.53422994E-10	
25	T2	272.556	0.13719484E-08	0.73425584E-09	0.20944307E-08	0.29614380E-08	0.13767437E-09	0.10318216E-08	
26	MN4	445.655	-0.70793273E-09	-0.76823301E-10	0.24279253E-09	-0.66374018E-09	-0.14062685E-09	0.16716883E-09	
27	MS4	473.555	0.32582237E-09	-0.10684852E-08	0.10873236E-08	0.38092589E-09	-0.40703836E-09	-0.28009461E-09	
28	Msf	73.555	0.52032006E-09	0.12958178E-08	0.20898774E-09	0.69234415E-09	0.16108594E-08	0.36734674E-09	
29	Mtm	85.455	0.38057222E-08	0.89028662E-09	0.47545363E-08	-0.16109463E-08	0.13034435E-08	0.46197838E-10	
30	mu2	237.555	0.27230195E-08	-0.54548861E-09	0.80856645E-09	0.28475772E-08	0.30945151E-08	0.39961507E-08	
31	nu2	245.655	0.31512988E-08	0.13274377E-08	0.16643629E-08	0.77176190E-09	-0.34369557E-09	0.49489633E-08	
32	Ssa	57.555	0.85592993E-08	-0.21041028E-09	-0.85777470E-08	-0.10849053E-08	0.38854237E-09	-0.73333943E-09	
33	eps2	227.655	0.15232320E-08	-0.54284574E-09	0.18709319E-08	-0.17678032E-09	0.14037532E-08	-0.64291979E-09	
34	lam2	263.655	0.77975910E-09	-0.46145888E-09	0.29230225E-08	-0.81098933E-09	-0.68691816E-09	-0.10714953E-08	
35	MKS2	257.555	-0.76338045E-11	-0.81694611E-10	0.81955321E-10	0.53313693E-09	0.52931064E-09	0.23733568E-09	
36	Msqm	93.555	0.17382639E-09	-0.21085098E-11	0.98864729E-10	0.18391545E-09	-0.15315104E-09	-0.66456652E-11	
37									

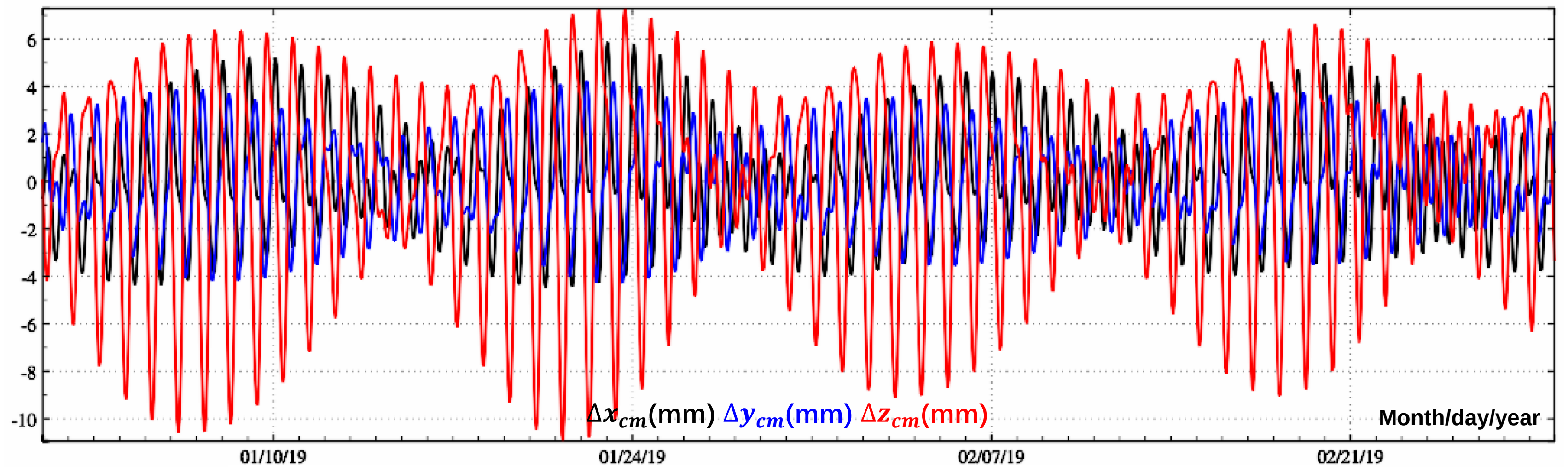
First-degree ocean tidal load spherical harmonic coefficient file from FES2014b360cs.dat. Which could be employed to forecast of ocean tidal load effects on Earth's center of mass (COM) or COM variation effect on all geodetic elements due to ocean tide.



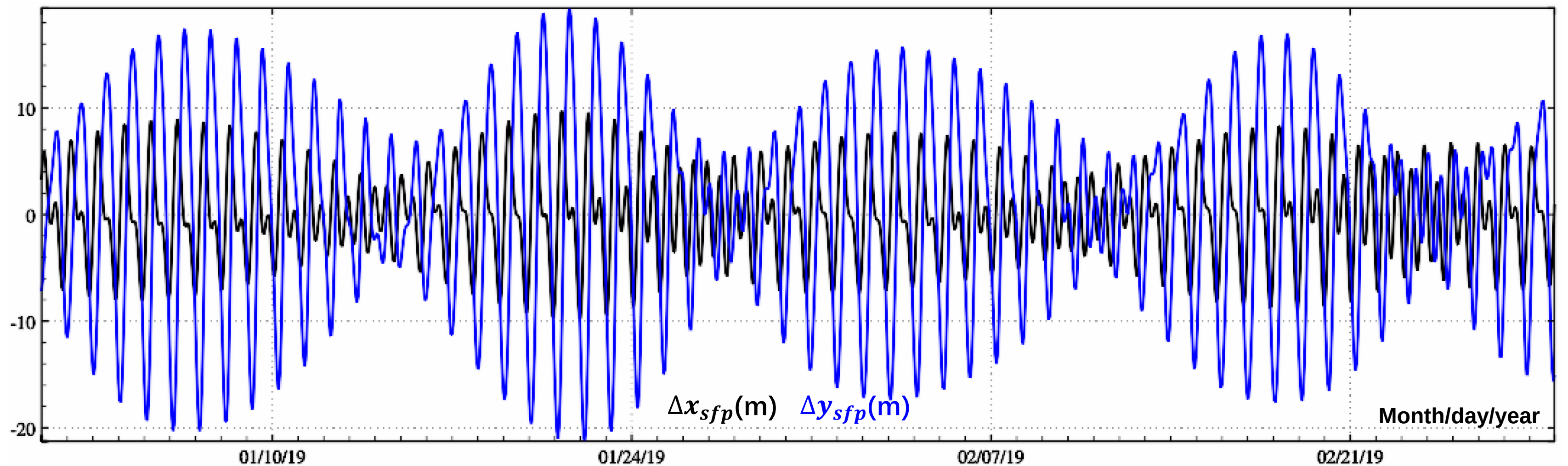
The atmosphere tidal load effect time series on Earth's center of mass (COM)



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



The ocean tidal load effect time series (mm) on Earth's center of mass (COM)



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

Computation of Various Load Effects via Spherical Harmonic Synthesis

Computation of Surface Load Equivalent Water Height Model Values

Computation of Tidal Constituent Harmonic Constant Model Values

Computation of Load Equivalent Water Height Model Value Time Series

Select the calculation point file format
The discrete computation point file

Open the surface computation 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] To compute the model values of tidal harmonic constants or non-tidal surface loads via Spherical Harmonic Synthesis (SHS) from the provided tidal load or surface non-tidal load spherical harmonic coefficient models.
>> Select the computation function from the 3 control buttons on the top of the interface...
>> [Function] To compute the surface atmosphere (hPa/mbar), terrestrial equivalent water height (cm), or sea level variation (cm) at specified locations from the normalized spherical harmonic coefficient model (unit: m) via Spherical Harmonic Synthesis (SHS).
>> Open the surface computation 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: 2026-06-23 14:11:19
>> Complete the computation!
>> Computation end time: 2026-06-23 14:11:28

Save the results asImport setting parametersStart 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

1	3.986004418	6378137.00	-0.0970	0.940
2	1	0	1.8412756758963265E-10	0.0000000000000000E+00
3	2	0	-8.3041237127846868E-10	0.0000000000000000E+00
4	2	1	3.0042214596809370E-10	1.4178812767271399E-09
5	2	2	-1.0298699208011155E-09	3.9778819980241900E-11
6	3	0	-2.2852824251273103E-09	0.0000000000000000E+00
7	3	1	6.7975067084791942E-10	2.5989454828063558E-10
8	3	2	-3.5135784095054722E-10	-9.8307496726666295E-10
9	3	3	6.7975067084791942E-10	-1.5506806360999531E-10
10	4	0	-1.3500990624598282E-09	0.0000000000000000E+00
11	4	1	-2.6751068548153390E-09	-1.8704081553144181E-09
12	4	2	-2.1920121450288522E-09	-5.9632881355913724E-10
13	4	3	9.2399791292550230E-10	-1.3797018418177622E-10
14	4	4	-4.6878373744373565E-10	6.9608812443930559E-11
15	5	0	2.9811603734448944E-09	0.0000000000000000E+00
16	5	1	-6.5942693396055756E-10	5.0634794014008111E-10
17	5	2		

This module supports the Remove-Restore technique. It can be employed for: Regional tidal load effect refinement using a tidal load spherical harmonic coefficient model as the reference tidal field; and Regional load deformation field refinement using a surface load spherical harmonic model as the reference load field.

Due to spectral leakage and aliasing inherent in high-degree spherical harmonic synthesis: Computed values for Sea Level Variation and Ocean Tidal Harmonic Constants may be non-zero in coastal land areas; and Computed values for Terrestrial Equivalent Water Height may be non-zero in coastal sea areas.

Computation of Tidal Constituent Harmonic Constant Model Values

Open file Save as Import parameters Start computation Save process Follow example



Computation of Surface Load Equivalent Water Height Model Values



Computation of Tidal Constituent Harmonic Constant Model Values



Computation of Load Equivalent Water Height Model Value Time Series



Open the surface computation 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

>> Setting parameters have been imported into the program!

** Click the control button [Start computation], or the tool button [Start computation]....

>> Computation start time: 2026-06-23 14:11:19

>> Complete the computation!

>> Computation end time: 2026-06-23 14:11:28

>> [Function] To calculate the harmonic constant model values (units: hPa or cm) for all tidal constituents contained in a tidal load spherical harmonic coefficient model at specified locations, using the normalized spherical harmonic coefficient model.

>> Open the surface computation 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/Airtloadcs.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: 2026-06-23 14:13:18

>> Complete the computation of the harmonic constant model values for 4 tidal constituents!

>> Computation end time: 2026-06-23 14:14:13



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 1.307 -0.204 -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

This module supports the Remove-Restore technique. It can be employed for: Regional tidal load effect refinement using a tidal load spherical harmonic coefficient model as the reference tidal field; and Regional load deformation field refinement using a surface load spherical harmonic model as the reference load field.

Due to spectral leakage and aliasing inherent in high-degree spherical harmonic synthesis: Computed values for Sea Level Variation and Ocean Tidal Harmonic Constants may be non-zero in coastal land areas; and Computed values for Terrestrial Equivalent Water Height may be non-zero in coastal sea areas.

Computation of Load Equivalent Water Height Model Value Time Series

Open file Save as Import parameters Start computation Save process Follow example



Computation of Surface Load Equivalent Water Height Model Values



Computation of Tidal Constituent Harmonic Constant Model Values



Computation of Load Equivalent Water Height Model Value Time Series

Select the calculation point file format

The discrete computation point file



Open the surface computation 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

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!

** 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/Loadspharmsynthesis/landwcstm/swsc2018011012.txt, to look at the computation progress!

** The last column attribute of each output file header is the instance of the wildcards of the file name of surface load harmonic coefficient model file, which represents the sampling epoch time of the output file.

>> Computation start time: 2026-06-23 14:16:58

>> Complete the computation of the load EWH model values of 6 sampling epoch time!

>> Output Internal Test File (Loadfmcmsfptm.txt) to the current directory.

** Header: The first row is the file header.

** Records: Starting from the second row, each record stores the sampling epoch time, 8 columns of surface load effects on the first and second degree normalized geopotential coefficients ΔC_{10} , ΔC_{11} , ΔS_{11} , ΔC_{20} , ΔC_{21} , ΔS_{21} , ΔC_{22} , ΔS_{22} ($\times 10^{-10}$), 3 columns of surface load effects on Earth's center of mass Δx_{cm} , Δy_{cm} , Δz_{cm} (units: mm), and 2 columns of surface load effects on Earth's figure pole Δx_{sfp} , Δy_{sfp} (in ITRS, m).

>> Computation end time: 2026-06-23 14:18:11



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

This module supports the Remove-Restore technique. It can be employed for: Regional tidal load effect refinement using a tidal load spherical harmonic coefficient model as the reference tidal field; and Regional load deformation field refinement using a surface load spherical harmonic model as the reference load field.

Due to spectral leakage and aliasing inherent in high-degree spherical harmonic synthesis: Computed values for Sea Level Variation and Ocean Tidal Harmonic Constants may be non-zero in coastal land areas; and Computed values for Terrestrial Equivalent Water Height may be non-zero in coastal sea areas.

Computation of Various Load Effects via Spherical Harmonic Synthesis

Computation of Various Load Effects via Spherical Harmonic Synthesis

Computation of Various Load Effects for Earth Satellites or External to the Solid Earth

Computation of Load Effect Time Series via Spherical Harmonic Synthesis

Global Load Spherical Harmonic Analysis and Synthesis of Load Effects

Select the computation point file format

The discrete computation point file

Open the space computation 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 ($10\mu\text{E}$)
- ☐ horizontal gravity gradient (NW, $10\mu\text{E}$)

The type of surface load Land water EWH

Atmosphere or Terrestrial Water Variation loads, the height of the computation point refers to the height relative to the Earth's surface.

>> Select the computation function from the 3 control buttons on the top of the interface...

>> [Function] This function computes the non-tidal load effects on a comprehensive set of geodetic elements from the input surface atmosphere, terrestrial water, or sea level variation load spherical harmonic coefficient model (m) via spherical harmonic synthesis. The target elements include: 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 ($10\mu\text{E}$), or horizontal gravity gradient (NW, $10\mu\text{E}$).

>> Open the space computation 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: 2026-06-23 16:28:57

>> Complete the computation of the model values of load effects!

>> Computation end time: 2026-06-23 16:30:57

Minimum starting degree of the coefficient model 1 Maximum truncated degree 360

Save the results as

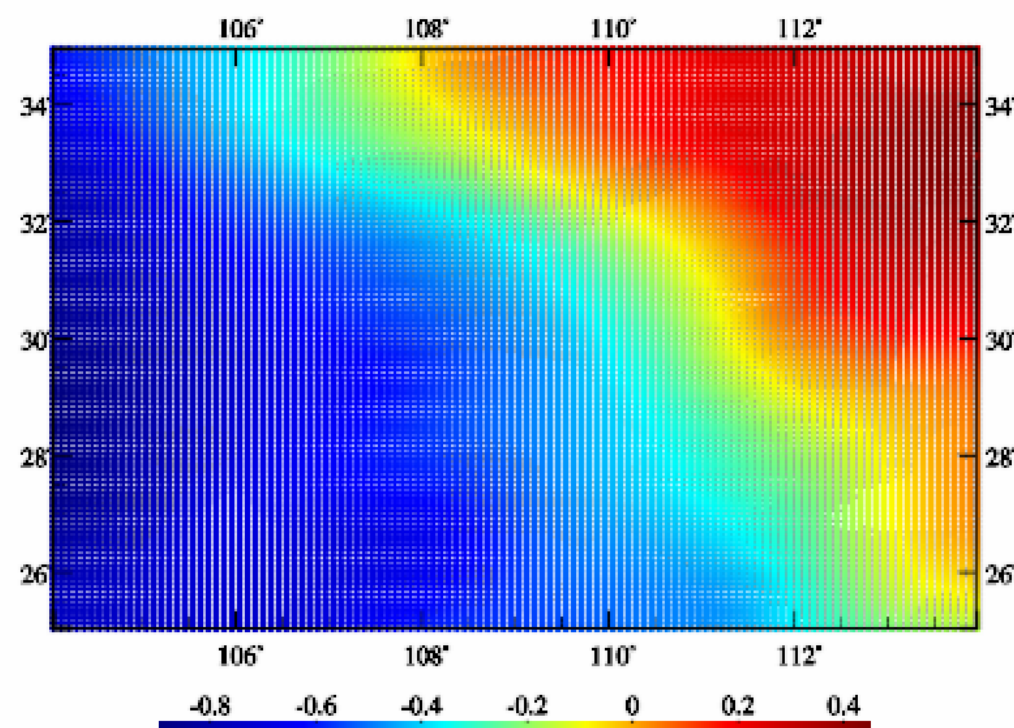
Import setting parameters

Start computation

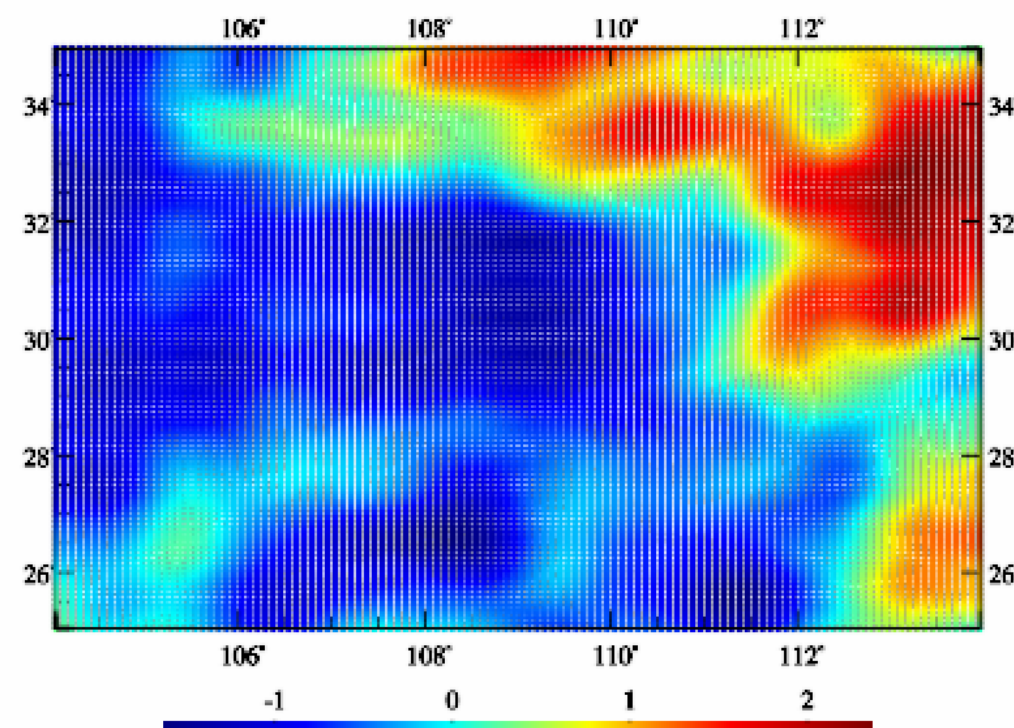
	104.0	114.0	25.0	35.0	0.08333333	0.08333333	
1	104.041667	25.041667	0.000	-0.7492	0.3235	1.4184	
2	104.125000	25.041667	0.000	-0.7479	0.2727	1.4232	
3	104.208333	25.041667	0.000	-0.7470	0.2064	1.4295	
4	104.291667	25.041667	0.000	-0.7464	0.1325	1.4368	
5	104.375000	25.041667	0.000	-0.7458	0.0603	1.4441	
6	104.458333	25.041667	0.000	-0.7451	-0.0016	1.4507	
7	104.541667	25.041667	0.000	-0.7440	-0.0463	1.4561	
8	104.625000	25.041667	0.000	-0.7426	-0.0699	1.4598	
9	104.708333	25.041667	0.000	-0.7408	-0.0718	1.4618	
10	104.791667	25.041667	0.000	-0.7386	-0.0553	1.4623	
11	104.875000	25.041667	0.000	-0.7361	-0.0262	1.4619	

Extract deformation field to be plot

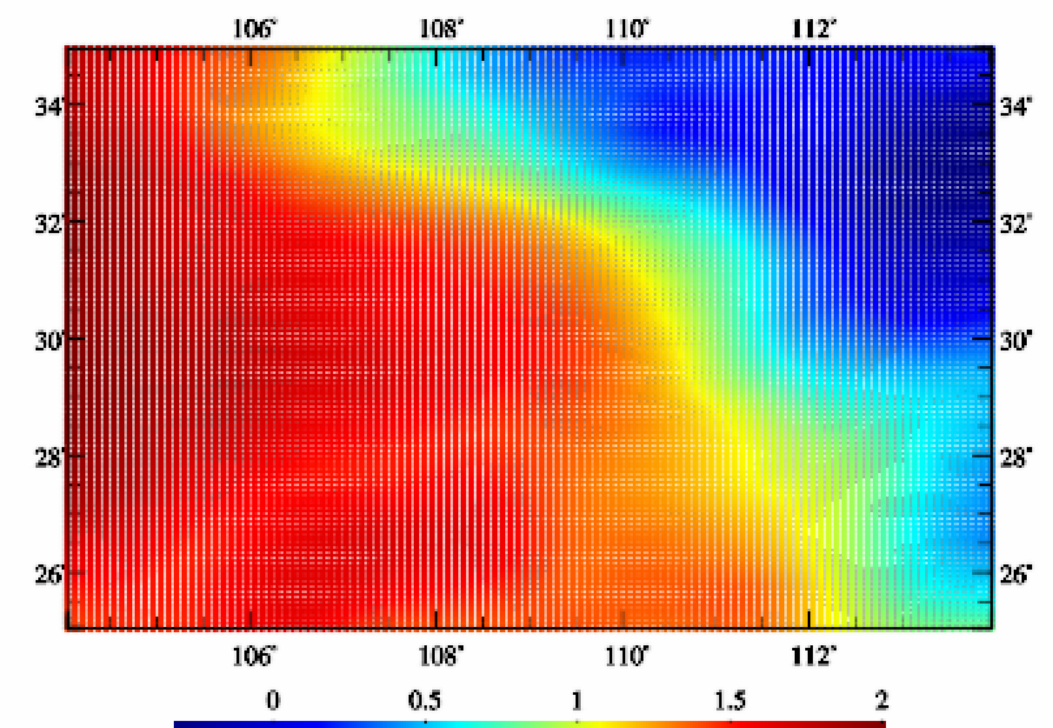
Plot↓



geoid / height anomaly (mm)



ground gravity (μGal)



radial displacement (mm)

Computation of Various Load Effects via Spherical Harmonic Synthesis

Computation of Various Load Effects
via Spherical Harmonic Synthesis

Computation of Various Load Effects for Earth
Satellites or External to the Solid Earth

Computation of Load Effect Time Series
via Spherical Harmonic Synthesis

Global Load Spherical Harmonic Analysis
and Synthesis of Load Effects

Select the computation point file format

The computation surface height grid file

Open the computation 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 ($10\mu\text{E}$)
- ☐ horizontal gravity gradient (NW, $10\mu\text{E}$)

The type of surface load Surface atmosphere

```
>> Computation start time: 2026-06-23 16:28:57
>> Complete the computation of the model values of load effects!
>> Computation end time: 2026-06-23 16:30:57
>> [Function] This function computes the non-tidal load effects on a comprehensive set of geodetic elements from the input surface atmosphere, terrestrial water, or sea level variation load spherical harmonic coefficient model (m) via spherical harmonic synthesis. The target elements include: Geoid or height anomaly (mm), ground gravity ( $\mu\text{Gal}$ ), gravity disturbance ( $\mu\text{Gal}$ ), 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 ( $10\mu\text{E}$ ), or horizontal gravity gradient (NW,  $10\mu\text{E}$ ).
>> Open the computation surface height grid file C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/zero15m.dat.
>> Open surface load harmonic coefficient model file C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/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/Loadeformharmssynth/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: 2026-06-23 16:33:51
>> Complete the computation of the model values of load effects!
>> Computation end time: 2026-06-23 16:34:10
```

Minimum starting degree of the coefficient model 1 Maximum truncated degree 360

Save the results as

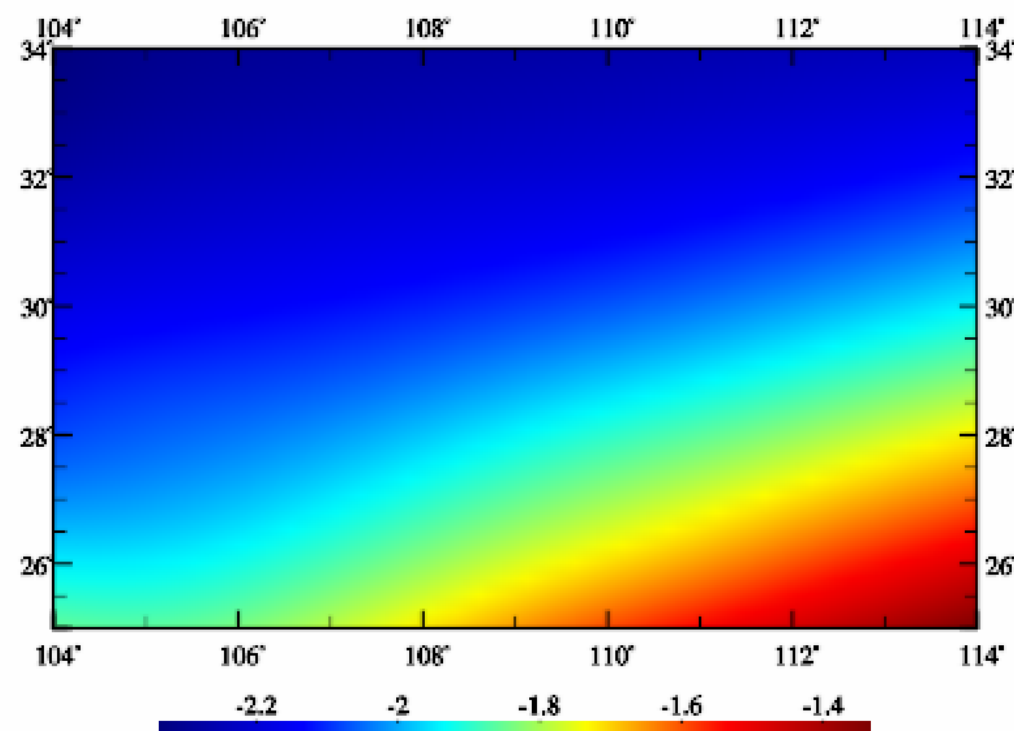
Import setting parameters

Start computation

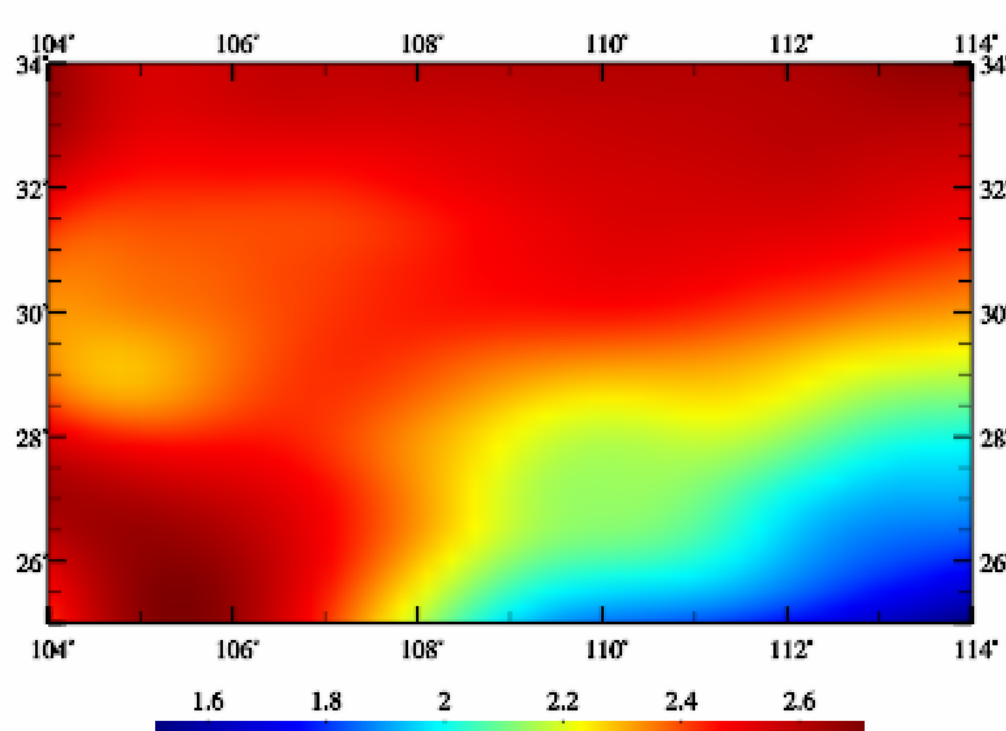
```
C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/loadfmdlgrd.ksi
C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/loadfmdlgrd.gra
C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/loadfmdlgrd.dpr
```

Extract deformation field to be plot

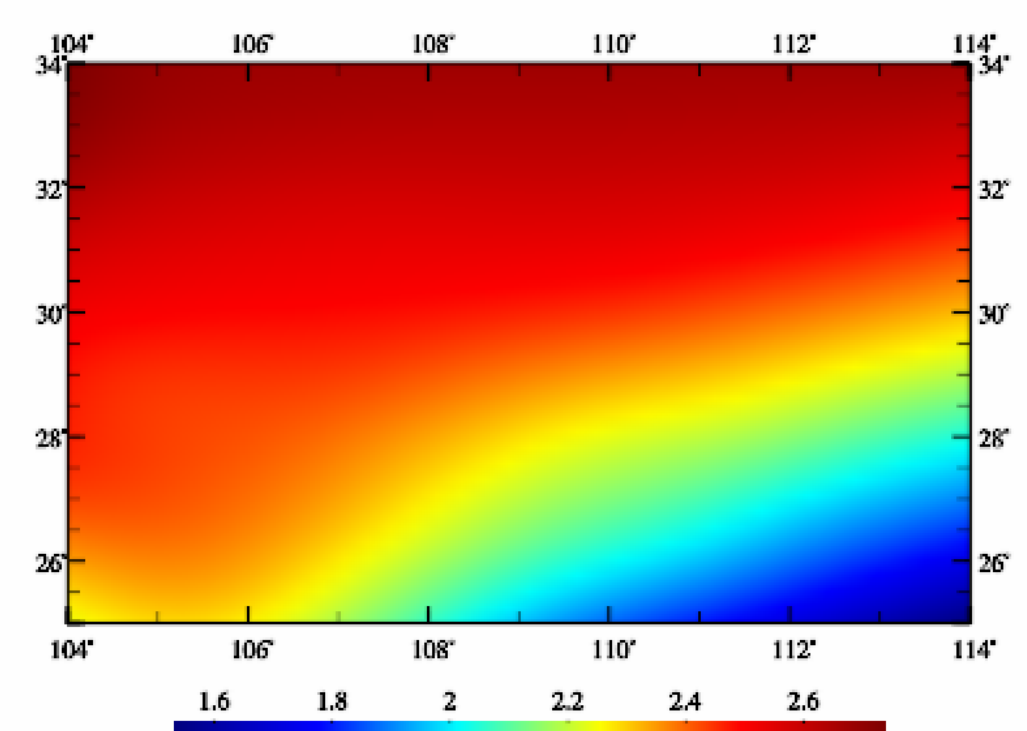
Plot↓



geoid / height anomaly (mm)



ground gravity (μGal)



radial displacement (mm)

Computation of Various Load Effects for Earth Satellites or External to the Solid Earth

Computation of Various Load Effects via Spherical Harmonic Synthesis

Computation of Various Load Effects for Earth Satellites or External to the Solid Earth

Computation of Load Effect Time Series via Spherical Harmonic Synthesis

Global Load Spherical Harmonic Analysis and Synthesis of Load Effects

Select the computation point file format

The discrete computation point file

Open the space computation point file

Number of rows of the file header 1

Column ordinal number of the height in record 4

Open surface load harmonic coefficients model file

Select the type of effects

☒ geopotential ($0.1\text{m}^2/\text{s}^2$)

☐ gravity vector (XYZ, μGal)

☐ gravity vector (ENU, μGal)

☐ gravity gradient (XYZ, $10\mu\text{E}$)

☒ gravity gradient (ENU, $10\mu\text{E}$)

The type of surface load Sea level variation

>> Computation start time: 2026-06-23 16:33:51

>> Complete the computation of the model values of load effects!

>> Computation end time: 2026-06-23 16:34:10

>> [Function] This function computes the non-tidal load effects on the geopotential ($0.1\text{m}^2/\text{s}^2$), gravity (μGal), or gravity gradient ($10\mu\text{E}$) at points located in space external to the solid Earth (e.g., ocean space, near-Earth space, or satellite altitudes) external to the solid Earth from the input surface atmosphere, terrestrial water, or sea level variation load spherical harmonic coefficient model (m) via spherical harmonic synthesis..

** Here the space point external to 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 computation point file C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/outpnt.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/Loadeformharmssynth/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/Loadeformharmssynth/outdfmrst.txt.

>> Setting parameters have been imported into the program!

** Click the control button [Start computation], or the tool button [Start computation]....

>> Computation start time: 2026-06-23 16:38:59

>> Complete the computation of the model values of load effects!

>> Computation end time: 2026-06-23 16:40:37

GOCE 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	240000.000				
2	135.125000	5.041667	240000.000	0.5445	-12.7285	-28.4375	-41.9023
3	135.208333	5.041667	240000.000	0.5514	-12.6973	-27.9109	-41.3091
4	135.291667	5.041667	240000.000	0.5584	-12.6025	-27.3734	-40.6392
5	135.375000	5.041667	240000.000	0.5654	-12.4454	-26.8260	-39.8946
6	135.458333	5.041667	240000.000	0.5727	-12.2278	-26.2698	-39.0785
7	135.541667	5.041667	240000.000	0.5800	-11.9521	-25.7057	-38.1944
8	135.625000	5.041667	240000.000	0.5874	-11.6215	-25.1351	-37.2466
9	135.708333	5.041667	240000.000	0.5949	-11.2394	-24.5590	-36.2400
10	135.791667	5.041667	240000.000	0.6026	-10.8098	-23.9789	-35.1800
11	135.875000	5.041667	240000.000	0.6103	-10.3371	-23.3961	-34.0726
12	135.958333	5.041667	240000.000	0.6181	-9.8259	-22.8120	-32.9238

Extract deformation field to be plot

Plot

gravity gradient (E, $10\mu\text{E}$)

gravity gradient (N, $10\mu\text{E}$)

gravity gradient (U, $10\mu\text{E}$)

Computation of Various Load Effects for Earth Satellites or External to the Solid Earth

Computation of Various Load Effects via Spherical Harmonic Synthesis

Select the computation point file format

The discrete computation point file

Open the space computation 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 ($0.1\text{m}^2/\text{s}^2$)

☐ gravity vector (XYZ, μGal)

☒ gravity vector (ENU, μGal)

☐ gravity gradient (XYZ, $10\mu\text{E}$)

☐ gravity gradient (ENU, $10\mu\text{E}$)

Extract deformation field to be plot

Plot

Computation of Various Load Effects for Earth Satellites or External to the Solid Earth

The type of surface load Sea level variation

>> Computation start time: 2026-06-23 16:38:59

>> Complete the computation of the model values of load effects!

>> Computation end time: 2026-06-23 16:40:37

>> [Function] This function computes the non-tidal load effects on the geopotential ($0.1\text{m}^2/\text{s}^2$), gravity (μGal), or gravity gradient ($10\mu\text{E}$) at points located in space external to the solid Earth (e.g., ocean space, near-Earth space, or satellite altitudes) external to the solid Earth from the input surface atmosphere, terrestrial water, or sea level variation load spherical harmonic coefficient model (m) via spherical harmonic synthesis.

** Here the space point external to 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 computation point file C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/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/Loadeformharmssynth/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/Loadeformharmssynth/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: 2026-06-23 16:42:50

>> Complete the computation of the model values of load effects!

>> Computation end time: 2026-06-23 16:44:28

Minimum starting degree of the coefficient model 1

Maximum truncated degree 360

Save the results as

Import setting parameters

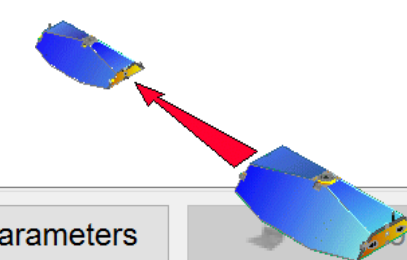
Start computation

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
7	135.541667	5.041667	450000.000	0.5921	4.8096	5.5250	-1.1329
8	135.625000	5.041667	450000.000	0.5976	4.8587	5.5672	-1.1946
9	135.708333	5.041667	450000.000	0.6031	4.9074	5.6092	-1.2577
10	135.791667	5.041667	450000.000	0.6087	4.9559	5.6509	-1.3221
11	135.875000	5.041667	450000.000	0.6143	5.0040	5.6922	-1.3878
12	135.958333	5.041667	450000.000	0.6199	5.0518	5.7331	-1.4547

gravity vector (E, μGal)

gravity vector (N, μGal)

gravity vector (U, μGal)



GRACE satellite altitude

Computation of Load Effect Time Series via Spherical Harmonic Synthesis

Computation of Various Load Effects via Spherical Harmonic Synthesis

Computation of Various Load Effects for Earth Satellites or External to the Solid Earth

Computation of Load Effect Time Series via Spherical Harmonic Synthesis

Global Load Spherical Harmonic Analysis and Synthesis of Load Effects

Select the computation point file format

The computation 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 ($10\mu\text{E}$)
☐ horizontal gravity gradient (NW, $10\mu\text{E}$)

The type of surface load Sea level variation

C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealvcs/sealevel2019060512cs.dat
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealvcs/sealevel2019061212cs.dat
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealvcs/sealevel2019061912cs.dat
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealvcs/sealevel2019062612cs.dat
 >> 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 files folder C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealload, to look at the computation progress!!
 ** The last column attribute of each output file header is the instance of the wildcards of the file name of the model time series, which represents the sampling epoch time of the output file.
 >> Computation start time: 2026-06-23 16:49:33
 >> Complete the computation of the model values for 26 load deformation field!
 ** Output Internal Test File (Loadfmcmsfptm.txt) to the current directory.
 ** Header: The first row is the file header.
 ** Records: Starting from the second row, each record stores the sampling epoch time, 8 columns of surface load effects on the first and second degree normalized geopotential coefficients ΔC_{10} , ΔC_{11} , ΔS_{11} , ΔC_{20} , ΔC_{21} , ΔS_{21} , ΔC_{22} , ΔS_{22} ($\times 10^{-10}$), 3 columns of surface load effects on Earth's center of mass Δx_{cm} , Δy_{cm} , Δz_{cm} (units: mm), and 2 columns of surface load effects on Earth's figure pole Δx_{sfp} , Δy_{sfp} (in ITRS, m).
 >> Computation end time: 2026-06-23 16:50:53

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/Loadeformharmssynth/sealload/loadfmdl2019010212.ksi
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealload/loadfmdl2019010212.gra
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealload/loadfmdl2019010212.dpr
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealload/loadfmdl2019010912.ksi
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealload/loadfmdl2019010912.gra
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealload/loadfmdl2019010912.dpr
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealload/loadfmdl2019011612.ksi
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealload/loadfmdl2019011612.gra
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealload/loadfmdl2019011612.dpr
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealload/loadfmdl2019012312.ksi
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealload/loadfmdl2019012312.gra
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/sealload/loadfmdl2019012312.dpr

Extract deformation field to be plot Plot↓

geoid / height anomaly (mm)
 ground gravity (μGal)
 radial displacement (mm)

Computation of Load Effect Time Series via Spherical Harmonic Synthesis

Computation of Various Load Effects via Spherical Harmonic Synthesis

Computation of Various Load Effects for Earth Satellites or External to the Solid Earth

Computation of Load Effect Time Series via Spherical Harmonic Synthesis

Global Load Spherical Harmonic Analysis and Synthesis of Load Effects

Select the computation point file format

The computation 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 ($10\mu\text{E}$)
☐ horizontal gravity gradient (NW, $10\mu\text{E}$)

Extract deformation field to be plot

Plot↓

The type of surface load Land water EWH

C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/landwcs/swsc2018011712.coe
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/landwcs/swsc2018012412.coe
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/landwcs/swsc2018013112.coe
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/landwcs/swsc2018020712.coe
 >> 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 files folder C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/tmgrdfmdl to look at the computation progress!!
 ** The last column attribute of each output file header is the instance of the wildcards of the file name of the model time series, which represents the sampling epoch time of the output file.
 >> Computation start time: 2026-06-23 16:57:56
 >> Complete the computation of the model values for 6 load deformation field!
 ** Output Internal Test File (Loadfmcmsptm.txt) to the current directory.
 ** Header: The first row is the file header.
 ** Records: Starting from the second row, each record stores the sampling epoch time, 8 columns of surface load effects on the first and second degree normalized geopotential coefficients $\Delta C_{10}, \Delta C_{11}, \Delta S_{11}, \Delta C_{20}, \Delta C_{21}, \Delta S_{21}, \Delta C_{22}, \Delta S_{22}$ ($\times 10^{-10}$), 3 columns of surface load effects on Earth's center of mass $\Delta x_{cm}, \Delta y_{cm}, \Delta z_{cm}$ (units: mm), and 2 columns of surface load effects on Earth's figure pole $\Delta x_{sfp}, \Delta y_{sfp}$ (in ITRS, m).
 >> Computation end time: 2026-06-23 16:58:27

Minimum starting degree of the coefficient model 1 Maximum truncated degree 180

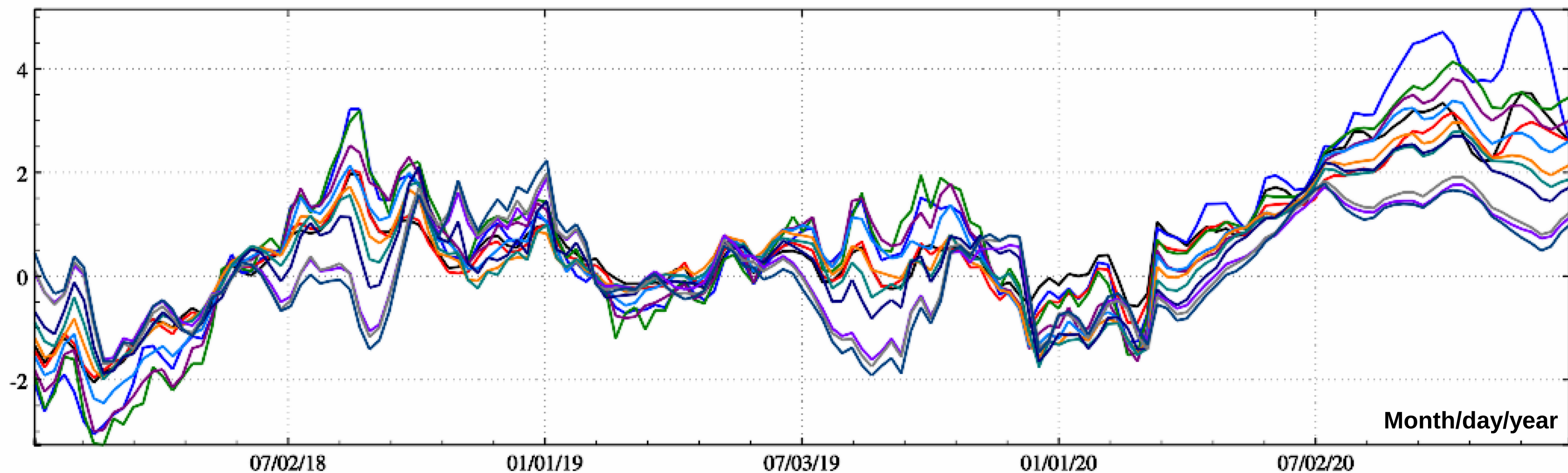
Set the result folder
 Import setting parameters
 Start computation

C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/tmgrdfmdl/loadfmdl2018010312.ksi
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/tmgrdfmdl/loadfmdl2018010312.gra
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/tmgrdfmdl/loadfmdl2018010312.dpr
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/tmgrdfmdl/loadfmdl2018011012.ksi
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/tmgrdfmdl/loadfmdl2018011012.gra
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/tmgrdfmdl/loadfmdl2018011012.dpr
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/tmgrdfmdl/loadfmdl2018011712.ksi
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/tmgrdfmdl/loadfmdl2018011712.gra
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/tmgrdfmdl/loadfmdl2018011712.dpr
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/tmgrdfmdl/loadfmdl2018012412.ksi
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/tmgrdfmdl/loadfmdl2018012412.gra
 C:/ETideLoad4.5_win64en/examples/Loadeformharmssynth/tmgrdfmdl/loadfmdl2018012412.dpr

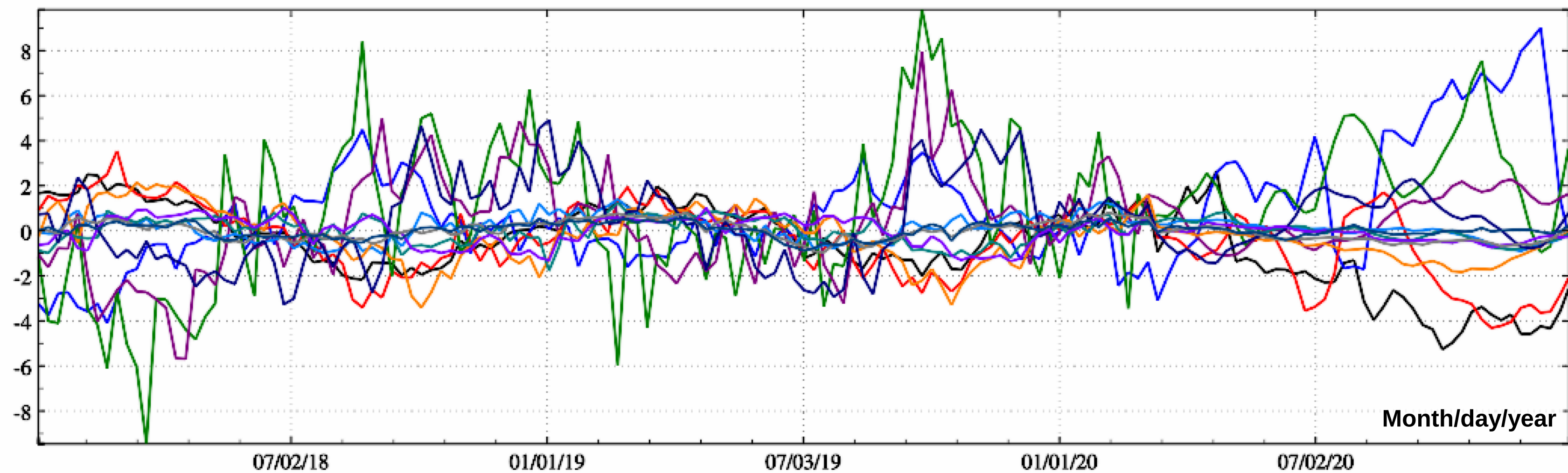
geoid / height anomaly (mm)

ground gravity (μGal)

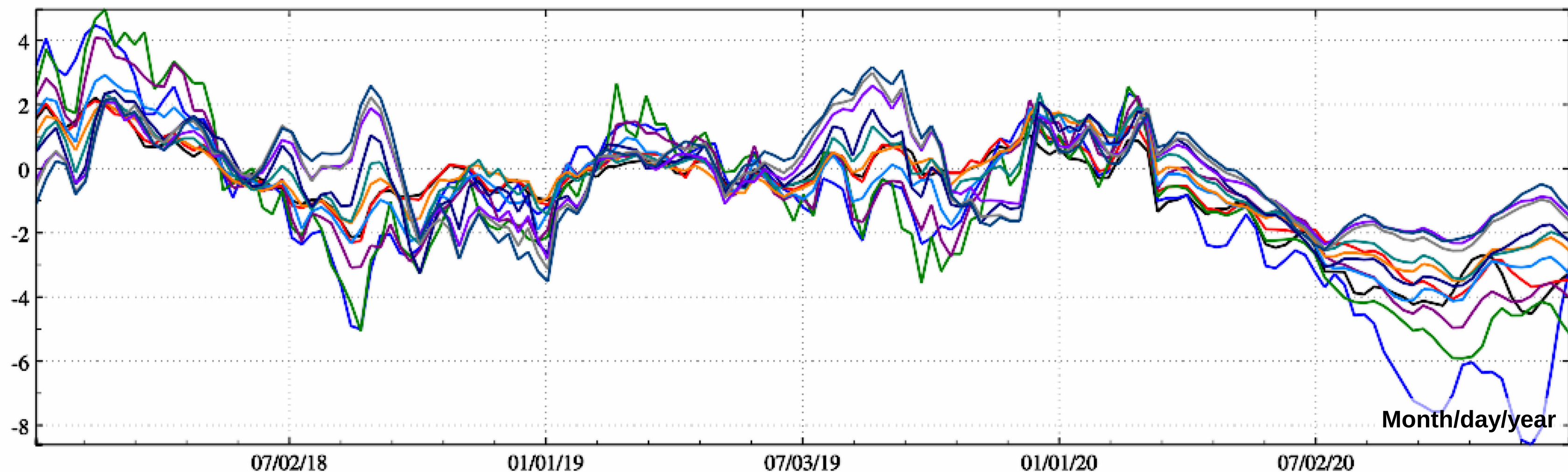
radial displacement (mm)



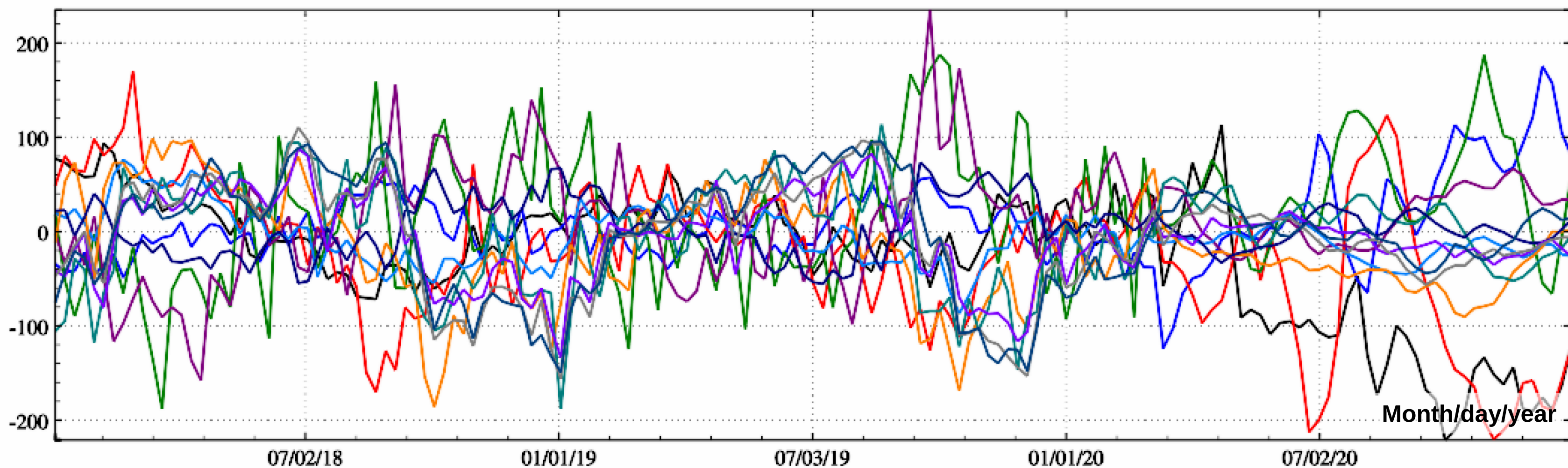
Sea level variation load effect weekly time series on the geoid (mm) at 12 tide gauges along Chinese coast



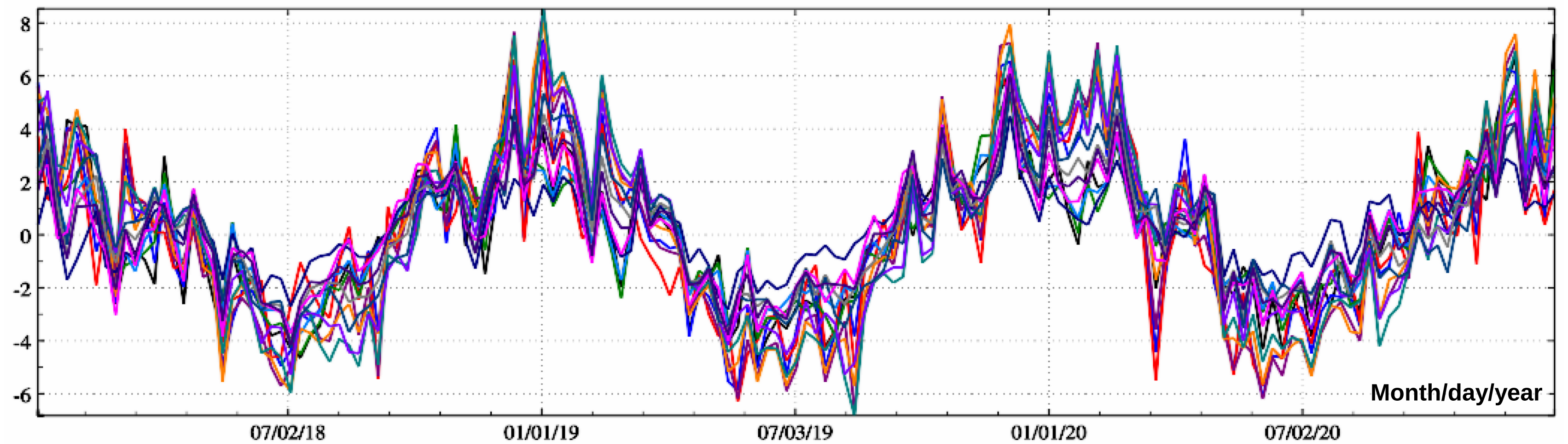
Sea level variation load effect weekly time series on the ground gravity (μGal) at 12 tide gauges along Chinese coast



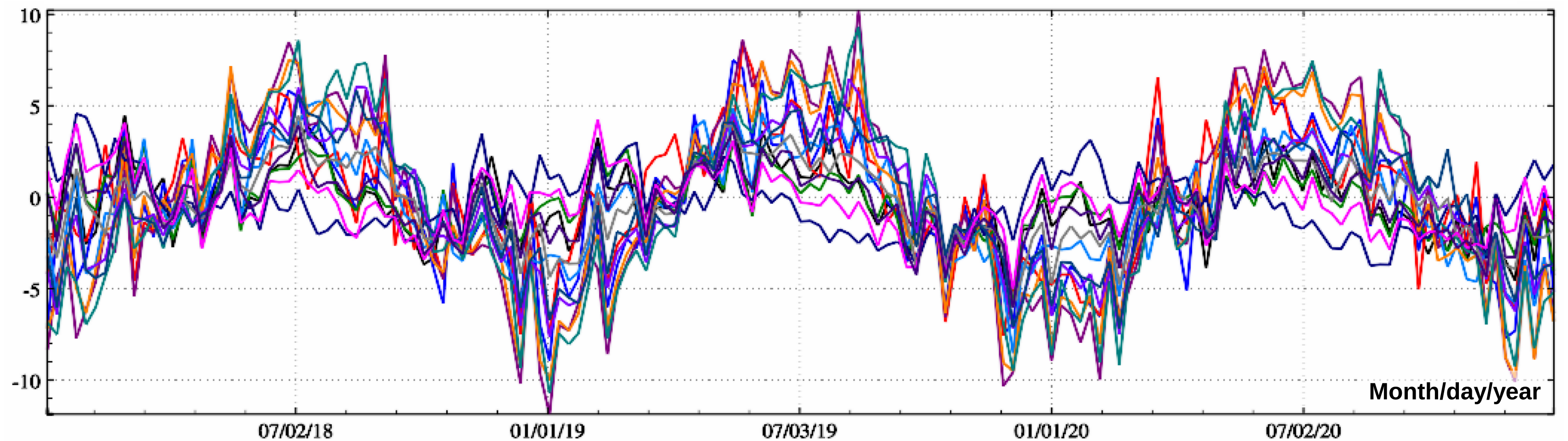
Sea level variation load effect weekly time series on the ellipsoidal height (mm) at 12 tide gauges along Chinese coast



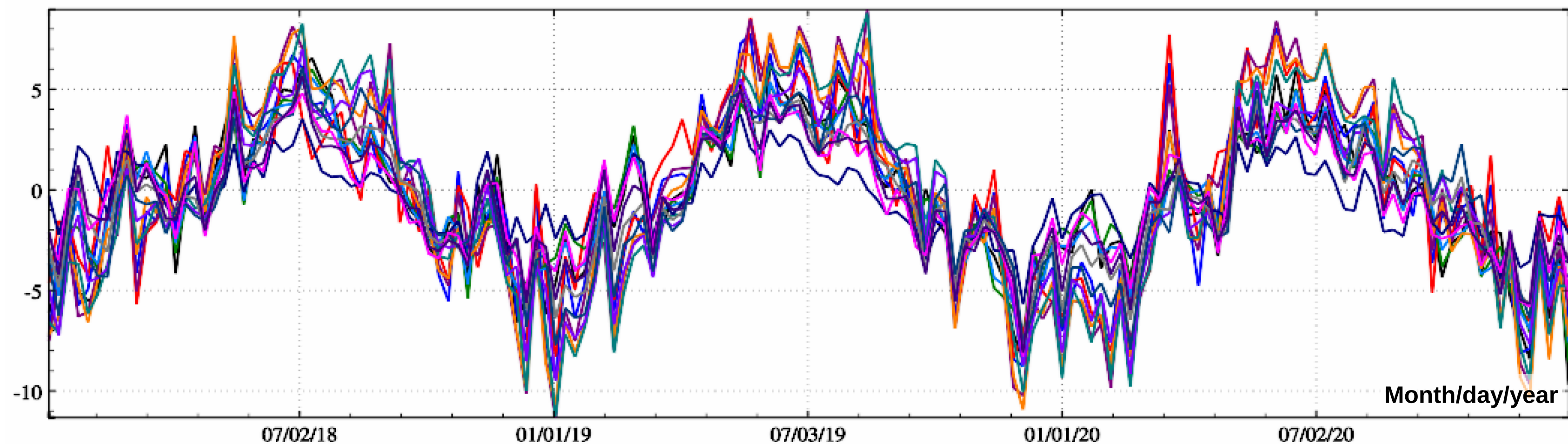
Sea level variation load effect weekly time series on the radial gradient ($10\mu\text{E}$) at 12 tide gauges along Chinese coast



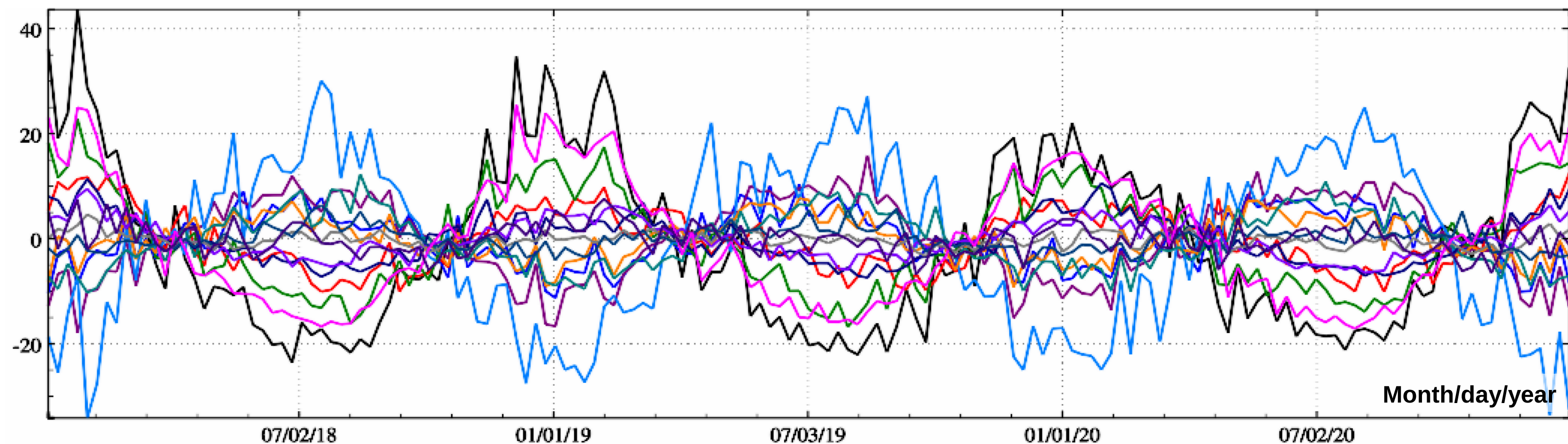
Surface atmosphere variation load effect weekly time series on the geoid (mm) at 14 CORS stations in mainland China



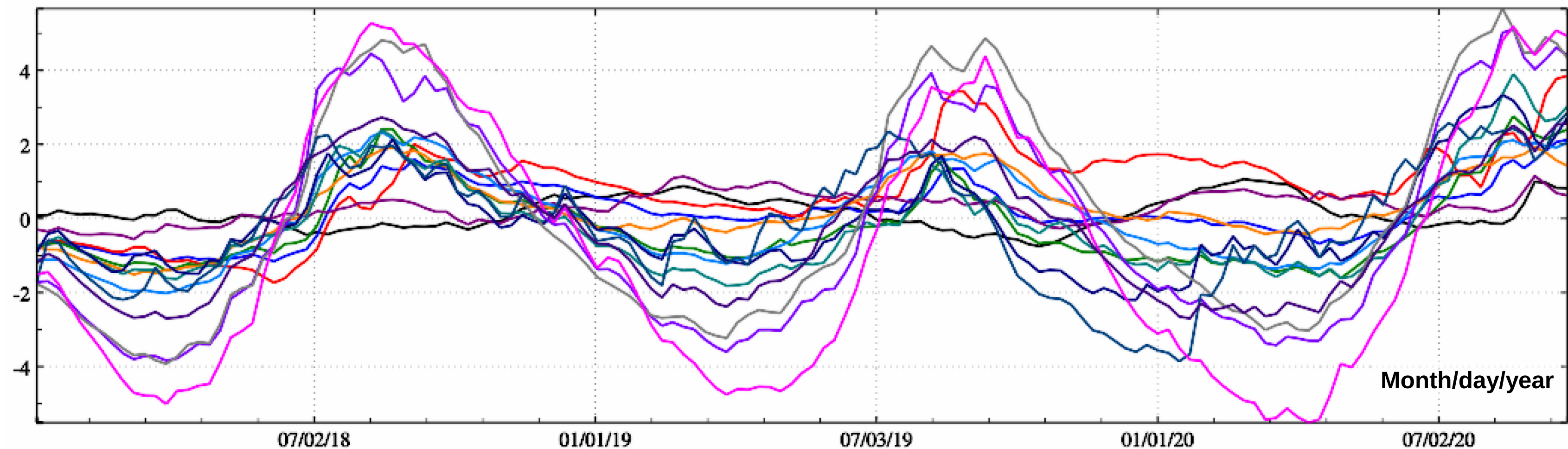
Surface atmosphere variation load effect weekly time series on the ground gravity (μGal) at 14 CORS stations in mainland China



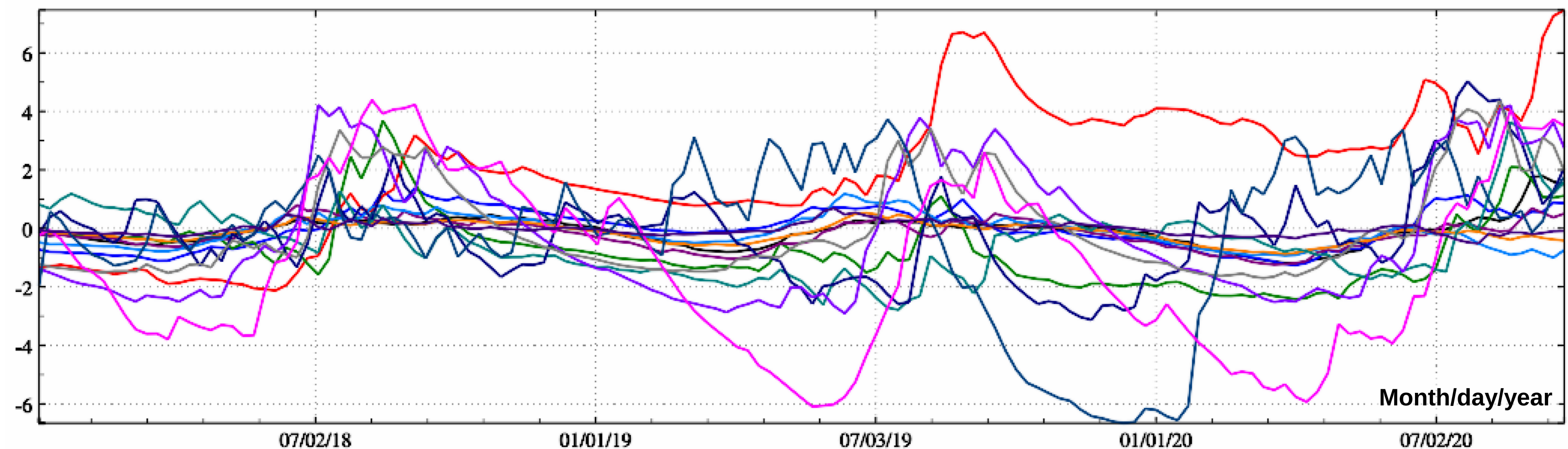
Surface atmosphere variation load effect weekly time series on the ellipsoidal height (mm) at 14 CORS stations in mainland China



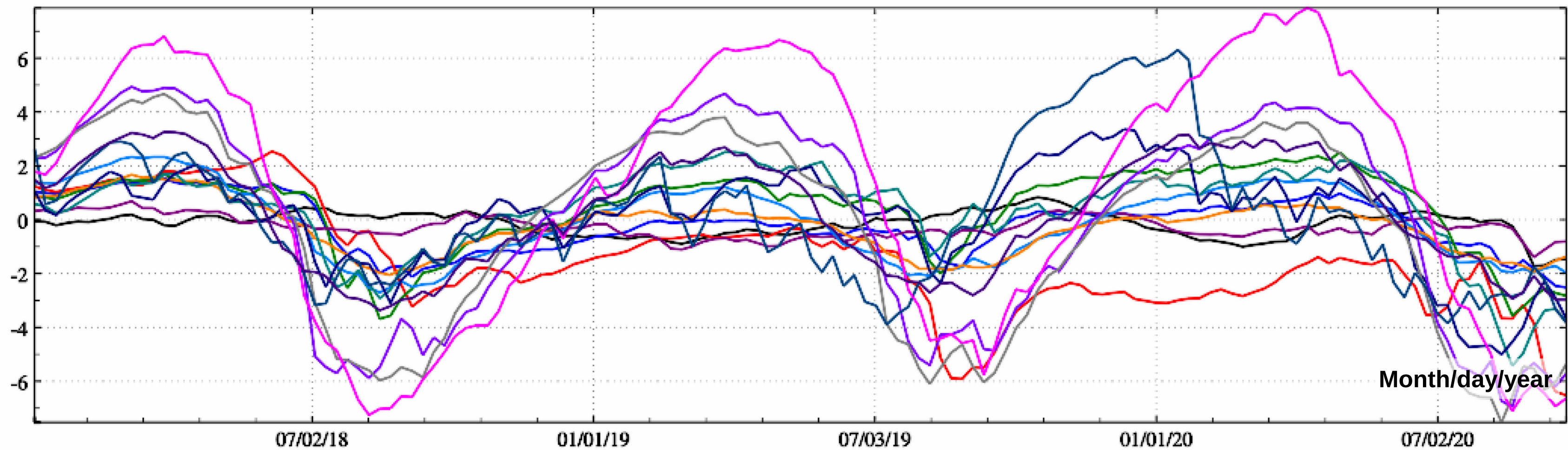
Surface atmosphere variation load effect weekly time series on the radial gradient (10 μ E) at 14 CORS stations in mainland China



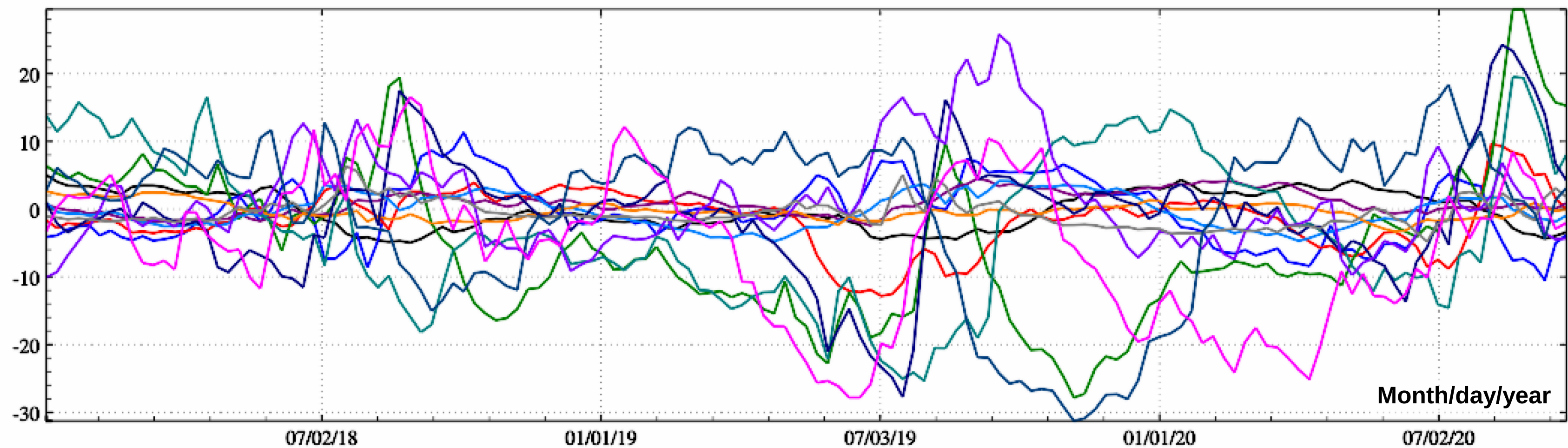
Global land water variation load effect weekly time series on the geoid (mm) at 14 CORS stations in mainland China



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



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 (10 μ E) at 14 CORS stations in mainland China

Computation of Regional Residual Surface Load Effects via Green's Integration

Computation of Regional Residual Surface Load Effects via Green's Integration

Computation of Lakes, Glaciers, and Snow Load Effects via Green's Integration

Computation of Regional Load Effect Time Series via Green's Integration

Algorithm formulas

Select the computation point file format

The discrete computation point file

Open the space computation 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

grid (represented as Equivalent Water Height, EWH) from which the global reference model has been removed. This process refines the regional load deformation field and temporal gravity field.

** Note on Computation Point Height: For Sea Level Variation loads, use Normal or Orthometric Height; and For Surface Atmosphere or Terrestrial Water Variation loads, use 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), this function computes the residual load effects on 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, mE) via load Green's function integration.

>> Open the space computation 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: 2026-06-24 09:58:31

>> Complete the refinement computation!

>> Computation end time: 2026-06-24 09:58:54

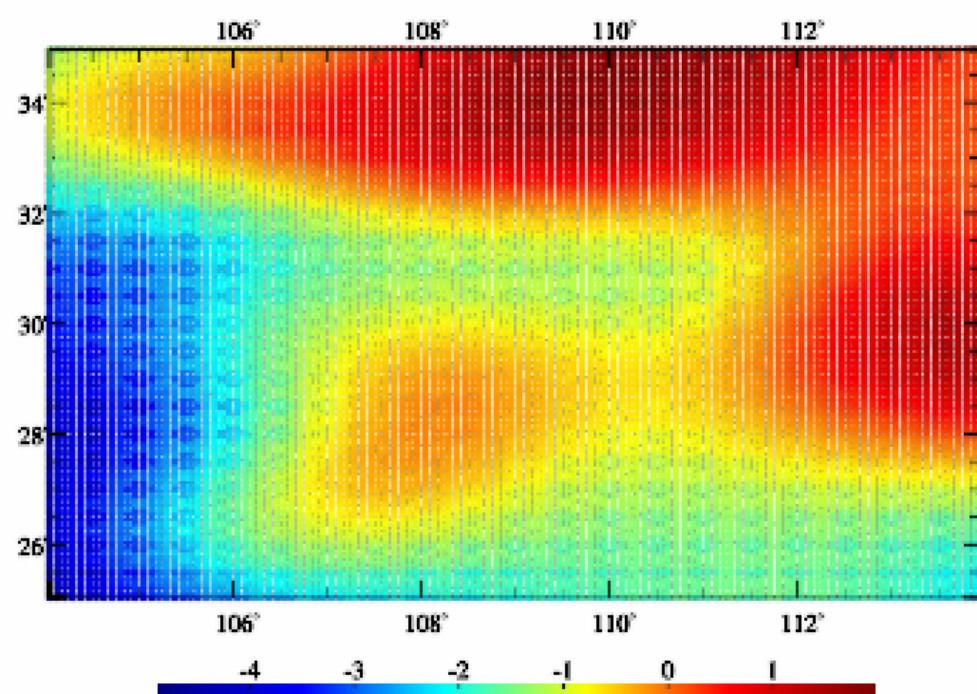
Green's integral radius 200km

Save the results as

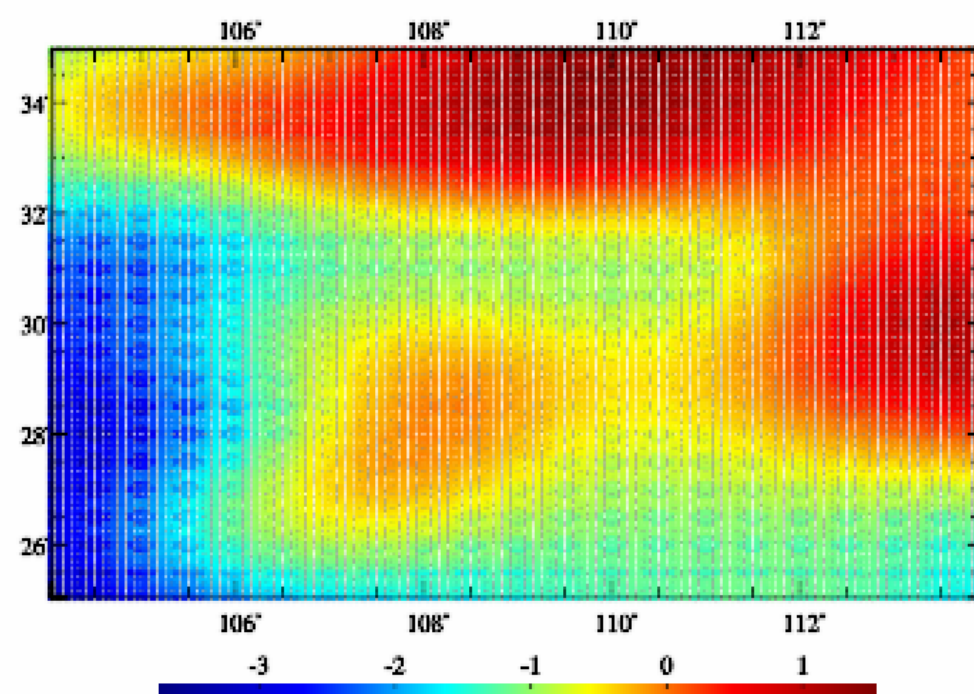
Import setting parameters

Start computation

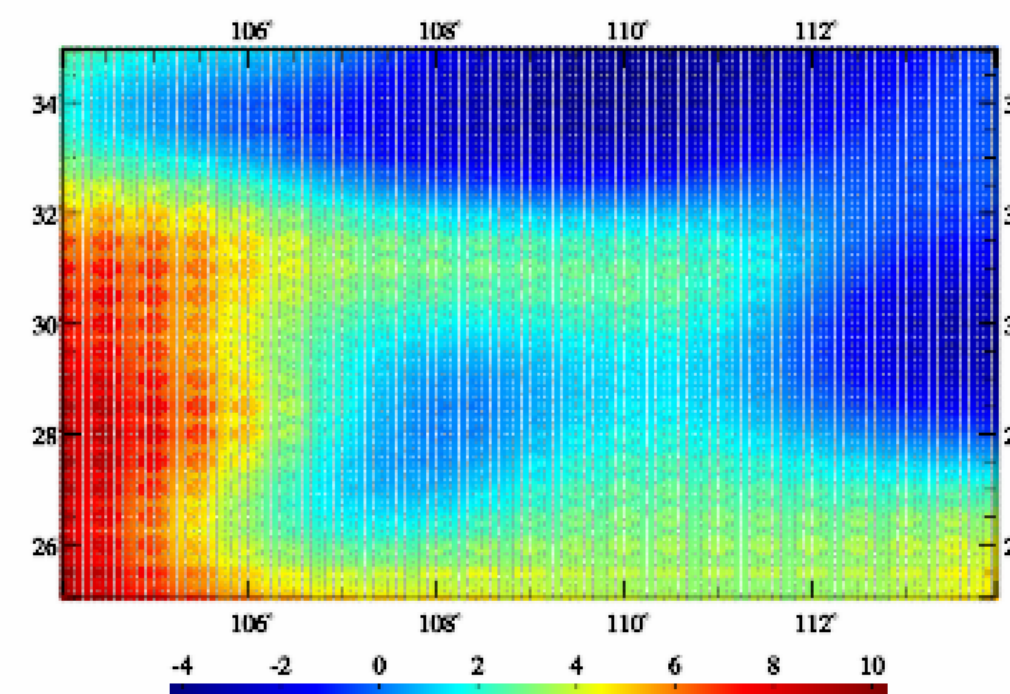
	104.0	114.0	25.0	35.0	0.08333333	0.08333333	
1	104.041667	25.041667	0.000	-4.8869	-3.7365	10.3277	
2	104.125000	25.041667	0.000	-4.8332	-3.7064	10.2616	
3	104.208333	25.041667	0.000	-4.1772	-3.2158	8.7561	
4	104.291667	25.041667	0.000	-4.0208	-3.1012	8.4475	
5	104.375000	25.041667	0.000	-4.5213	-3.4739	9.6114	
6	104.458333	25.041667	0.000	-4.3950	-3.3692	9.2881	
7	104.541667	25.041667	0.000	-4.3121	-3.2968	9.0991	



geoid / height anomaly (mm)



ground gravity (μGal)



radial displacement (mm)

Computation of Regional Residual Surface Load Effects via Green's Integration

Computation of Regional Residual Surface Load Effects via Green's Integration

Computation of Lakes, Glaciers, and Snow Load Effects via Green's Integration

Computation of Regional Load Effect Time Series via Green's Integration

Algorithm formulas

Select the computation point file format

The computation surface height grid file

Open the land surface height grid file

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)

The type of surface load Surface atmosphere

Save program process as

```
>> 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: 2026-06-24 09:58:31
>> Complete the refinement computation!
>> Computation end time: 2026-06-24 09:58:54
>> [Function] From the Regional Residual Equivalent Water Height (EWH) Variation Grid (cm), this function computes the residual load effects on Geoid or height anomaly (mm), ground gravity ( $\mu\text{Gal}$ ), gravity disturbance ( $\mu\text{Gal}$ ), 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, mE) via load Green's function integration.
>> Open the computation surface height grid file C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/zero3m.dat.
>> Open the residual equivalent water height variation grid file C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/swscSEP2018042512.dat.
>> Save the results as C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/rntdfmgrd.txt.
>> Setting parameters have been imported into the program!
** Click the control button [Start computation], or the tool button [Start computation]....
>> Computation start time: 2026-06-24 10:01:17
>> Complete the refinement computation!
>> Computation end time: 2026-06-24 10:01:20
```

Green's integral radius 200km

Save the results as

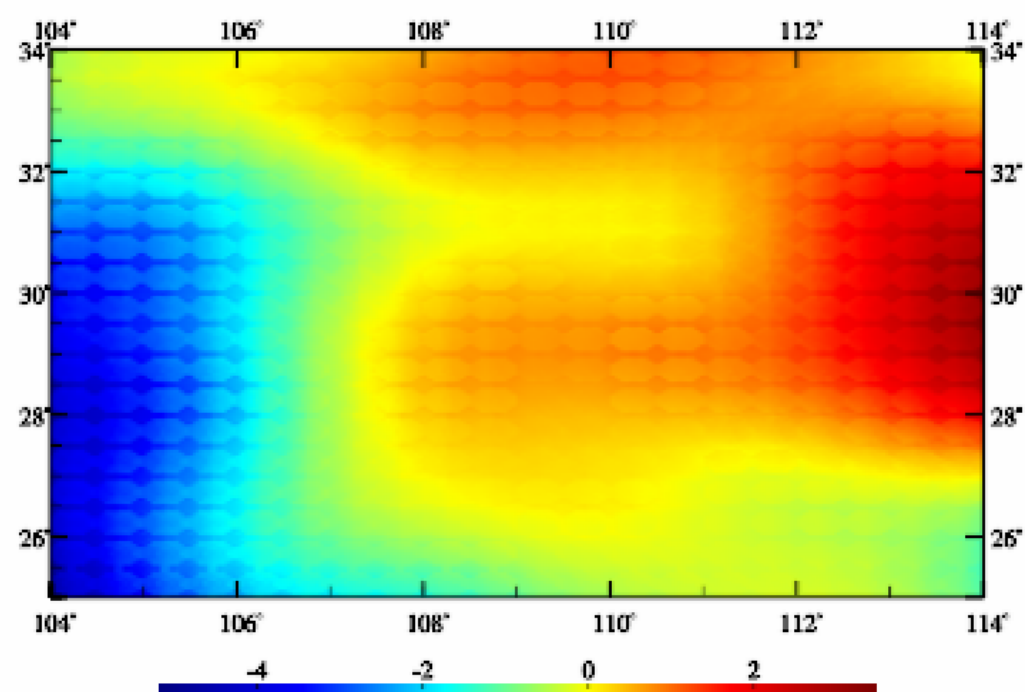
Import setting parameters

Start computation

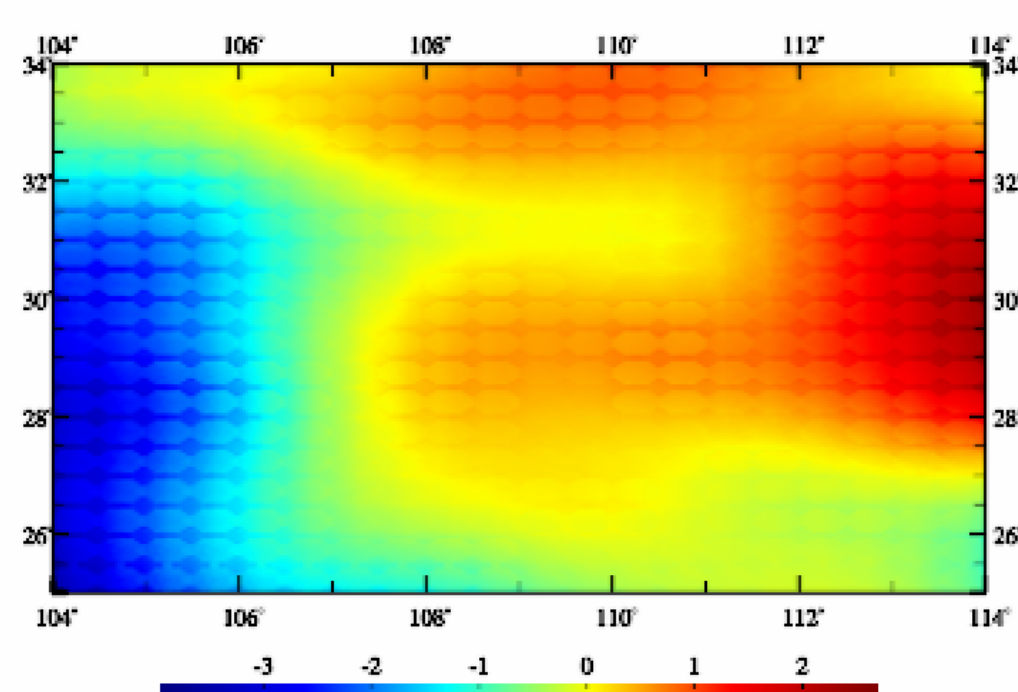
```
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/rntdfmgrd.ksi
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/rntdfmgrd.gra
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/rntdfmgrd.dpr
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/rntdfmgrd.nmh
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/rntdfmgrd.grr
```

Extract the effects to be plot

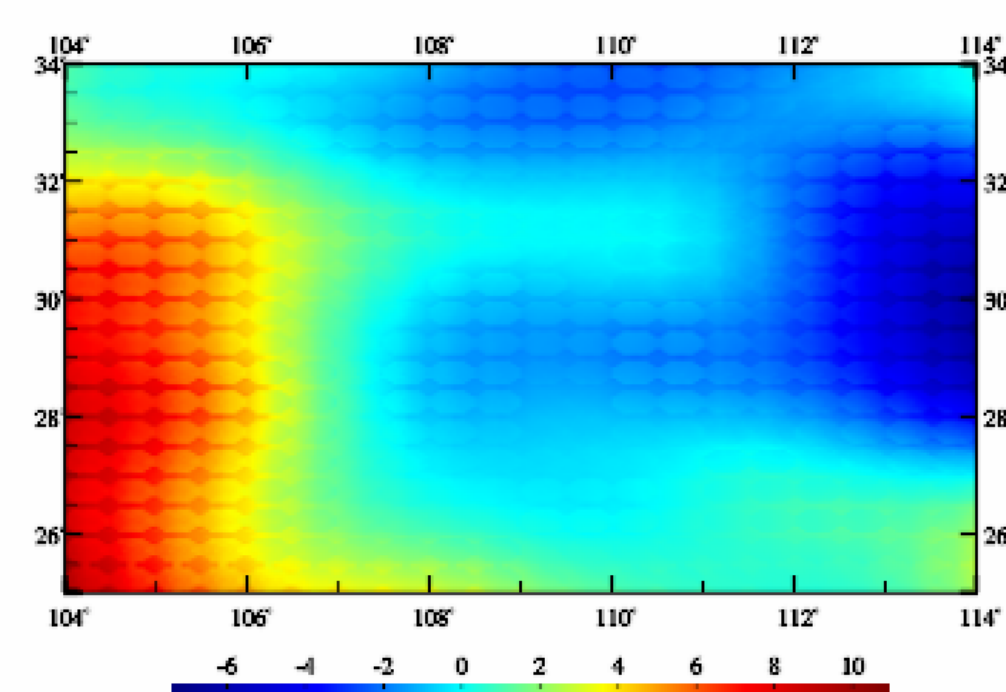
Plot↓



geoid / height anomaly (mm)



ground gravity (μGal)



radial displacement (mm)

Computation of Lakes, Glaciers, and Snow Load Effects via Green's Integration

Computation of Regional Residual Surface Load Effects via Green's Integration

Computation of Lakes, Glaciers, and Snow Load Effects via Green's Integration

Computation of Regional Load Effect Time Series via Green's Integration

Algorithm formulas

Select the computation point file format

The discrete computation point file

Open the space computation 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

>> Complete the refinement computation!

>> Computation end time: 2026-06-24 10:01:20

>> [Function] This function computes the load effects of inland water bodies (rivers, lakes, reservoirs), glaciers, and snow-covered mountains on 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, mE) via load Green's function integration. The input is the Load Equivalent Water Height (EWH) Variation Grid (cm) specific to these hydrological features.

** The height in the computation point file refers to the height of the computation point relative to the water/ice surface.

** The EWH grids of multiple water bodies at the same epoch can be merged directly to compute the total load effect via a single integration.

>> Open the space computation point file C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/lakecalcpnt.txt.

** 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/Loadfmrntgreenintg/lakechgcm.dat.

>> 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: 2026-06-24 10:04:17

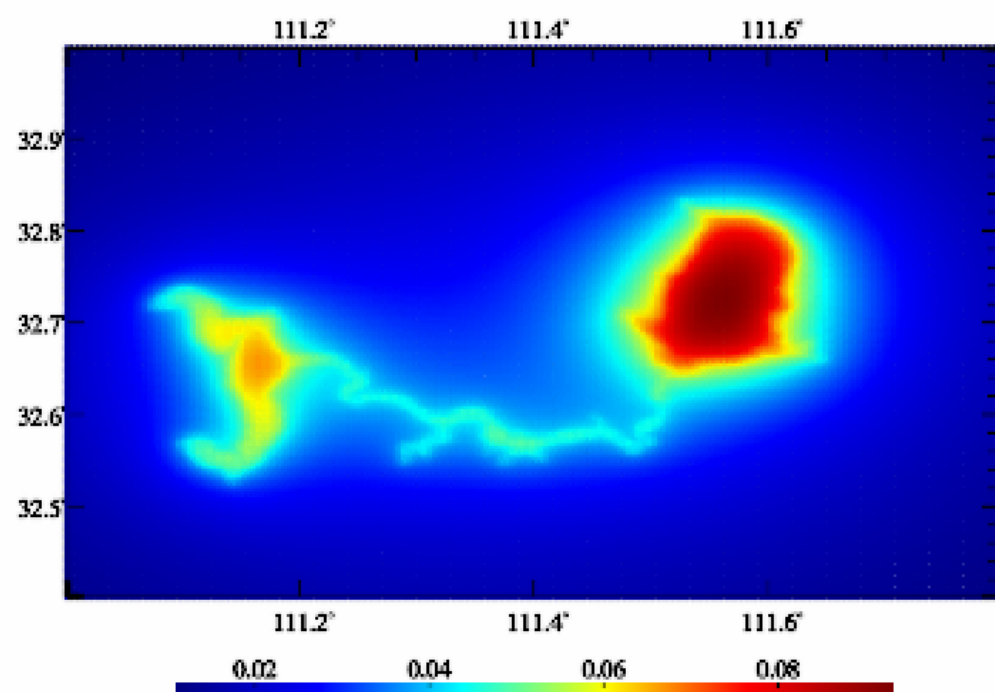
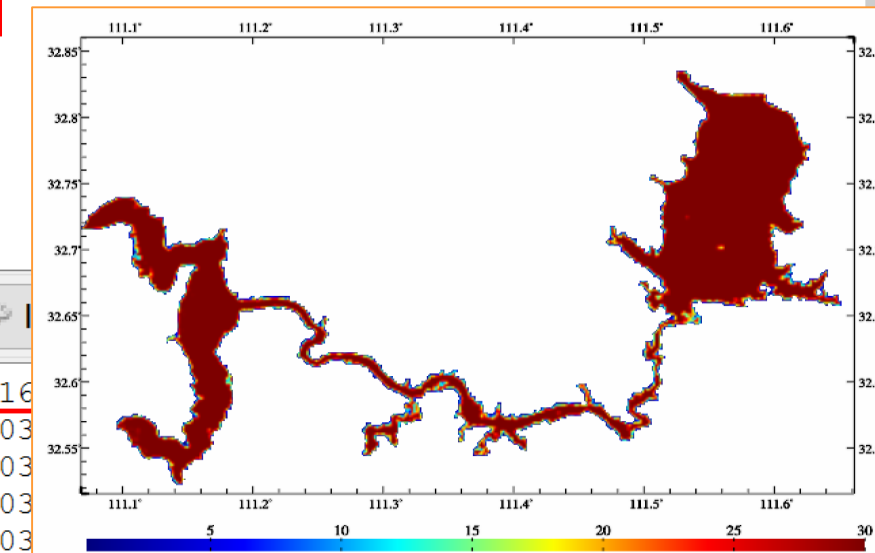
>> Complete the refinement computation!

>> Computation end time: 2026-06-24 10:12:29

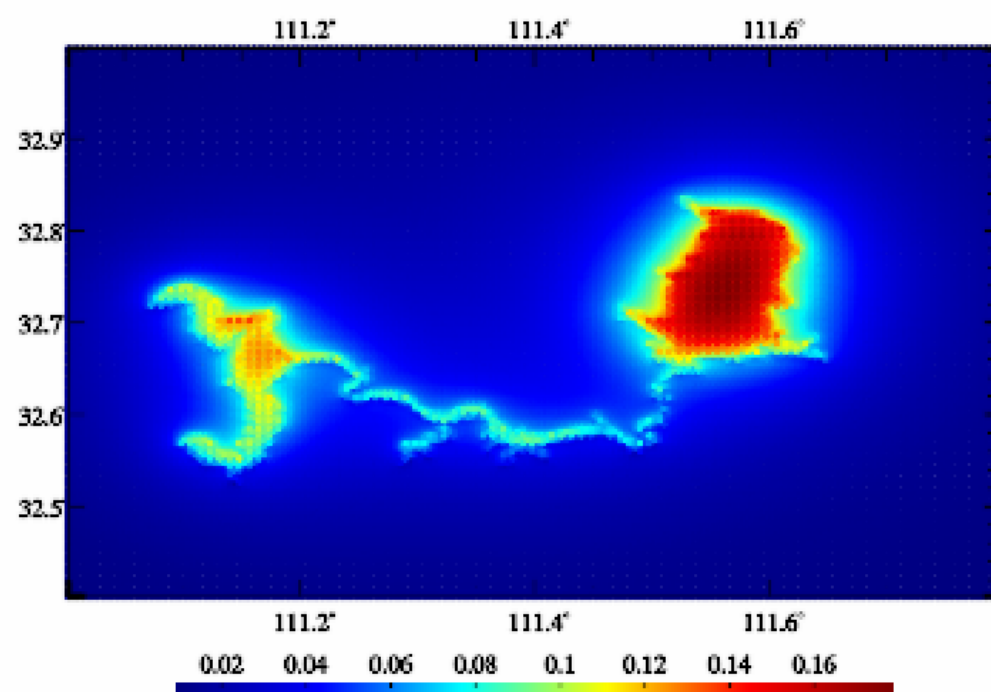
Green's integral radius 200km

Save the results as

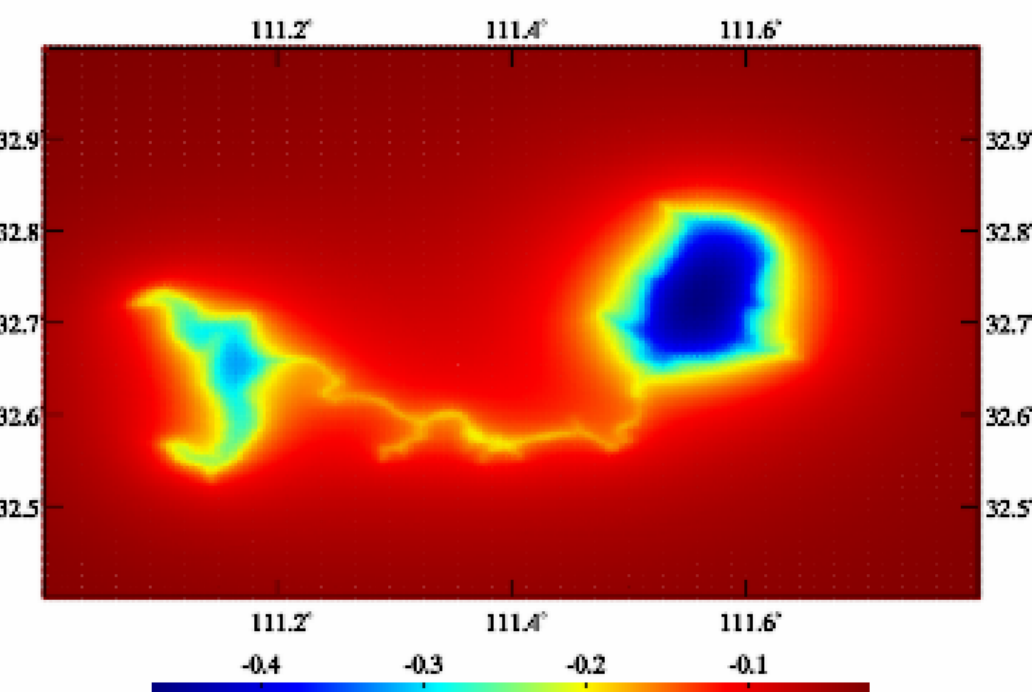
111.00000000	111.80000000	32.40000000	33.00000000	0.00416667	0.00416667			
1	111.0020833	32.4020833	0.000	0.0130	0.0102	-0.0318	-0.0452	-0.1216
2	111.0062500	32.4020833	0.000	0.0131	0.0102	-0.0321	-0.0456	-0.1245
3	111.0104167	32.4020833	0.000	0.0132	0.0103	-0.0324	-0.0459	-0.1273
4	111.0145833	32.4020833	0.000	0.0133	0.0104			
5	111.0187500	32.4020833	0.000	0.0134	0.0104			
6	111.0229167	32.4020833	0.000	0.0134	0.0105			
7	111.0270833	32.4020833	0.000	0.0135	0.0106			



geoid / height anomaly (mm)



ground gravity (μGal)



radial displacement (mm)

Computation of Lakes, Glaciers, and Snow Load Effects via Green's Integration

Computation of Regional Residual Surface Load Effects via Green's Integration

Computation of Lakes, Glaciers, and Snow Load Effects via Green's Integration

Computation of Regional Load Effect Time Series via Green's Integration

Algorithm formulas

Save program process as

Select the computation point file format

The computation surface height grid file

Open the land surface height grid file

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)

>> Computation start time: 2026-06-24 10:04:17

>> Complete the refinement computation!

>> Computation end time: 2026-06-24 10:12:29

>> [Function] This function computes the load effects of inland water bodies (rivers, lakes, reservoirs), glaciers, and snow-covered mountains on 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, mE) via load Green's function integration. The input is the Load Equivalent Water Height (EWH) Variation Grid (cm) specific to these hydrological features.

** The height in the computation point file refers to the height of the computation point relative to the water/ice surface.

** The EWH grids of multiple water bodies at the same epoch can be merged directly to compute the total load effect via a single integration.

>> Open the computation surface height grid file C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/lakecalcpnt.dat.

>> Open water-body equivalent water height variation grid file C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/lakechgcm.dat.

>> Save the results as C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/rntdfmgrd.txt.

>> Setting parameters have been imported into the program!

** Click the control button [Start computation], or the tool button [Start computation]....

>> Computation start time: 2026-06-24 10:16:38

>> Complete the refinement computation!

>> Computation end time: 2026-06-24 10:23:51

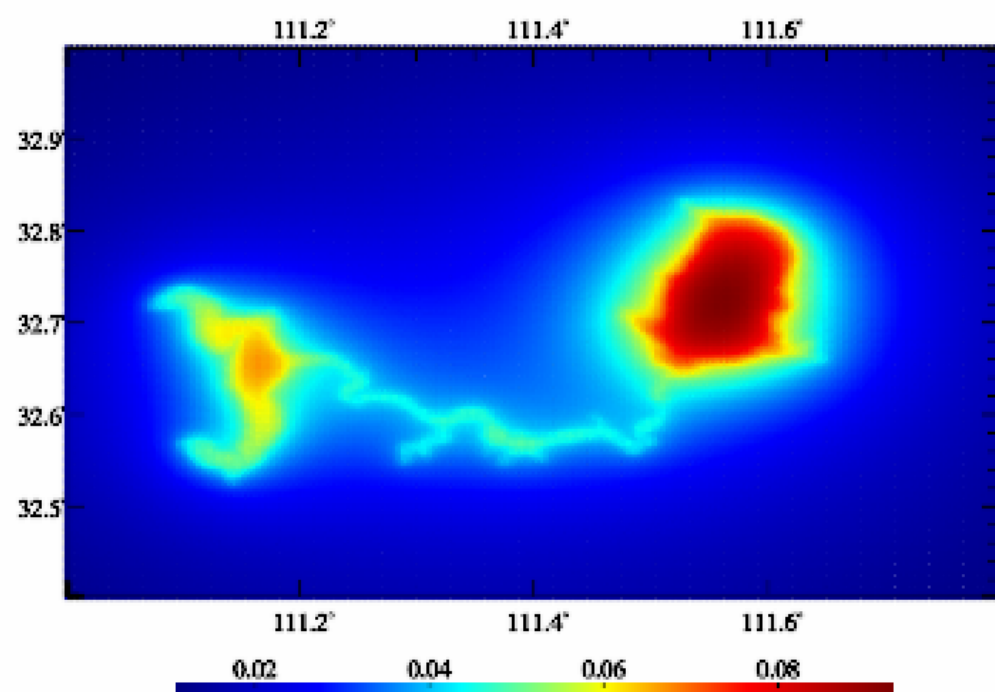
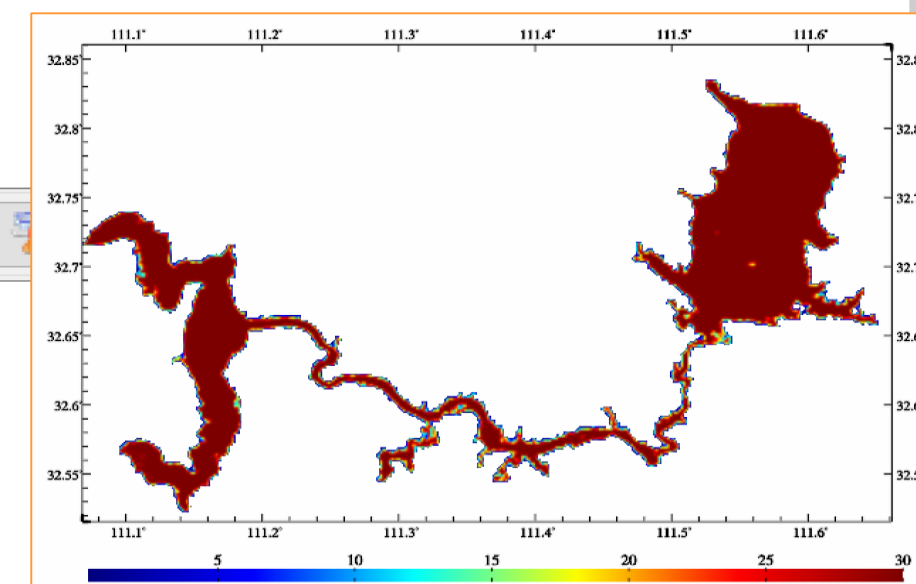
Green's integral radius 200km

Save the results as

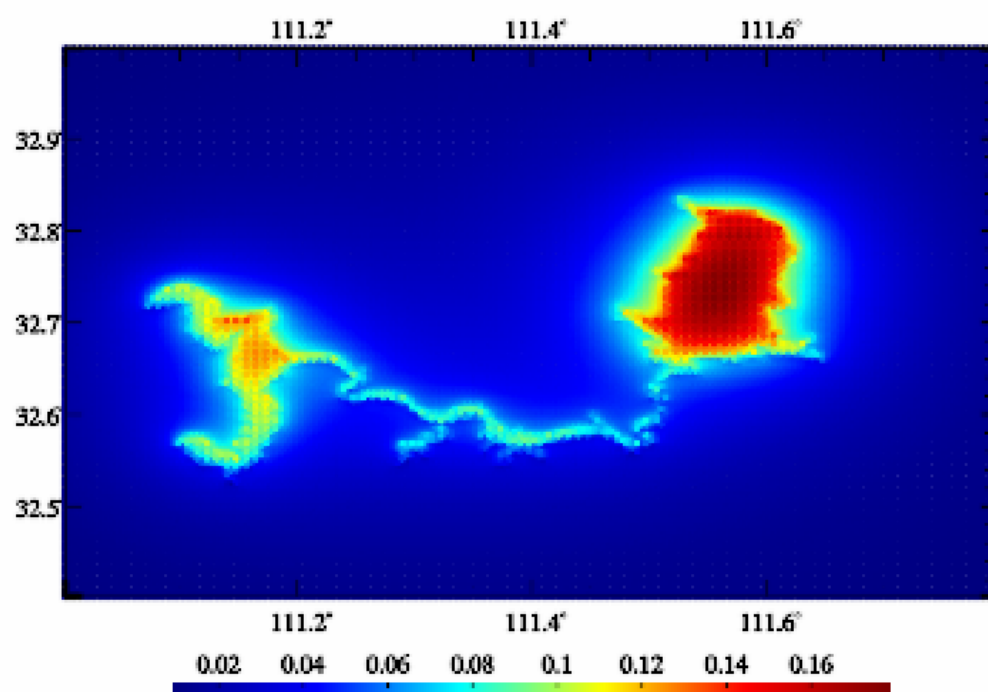
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/rntdfmgrd.ksi
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/rntdfmgrd.gra
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/rntdfmgrd.dpr
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/rntdfmgrd.nmh
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/rntdfmgrd.grr

Extract the effects to be plot

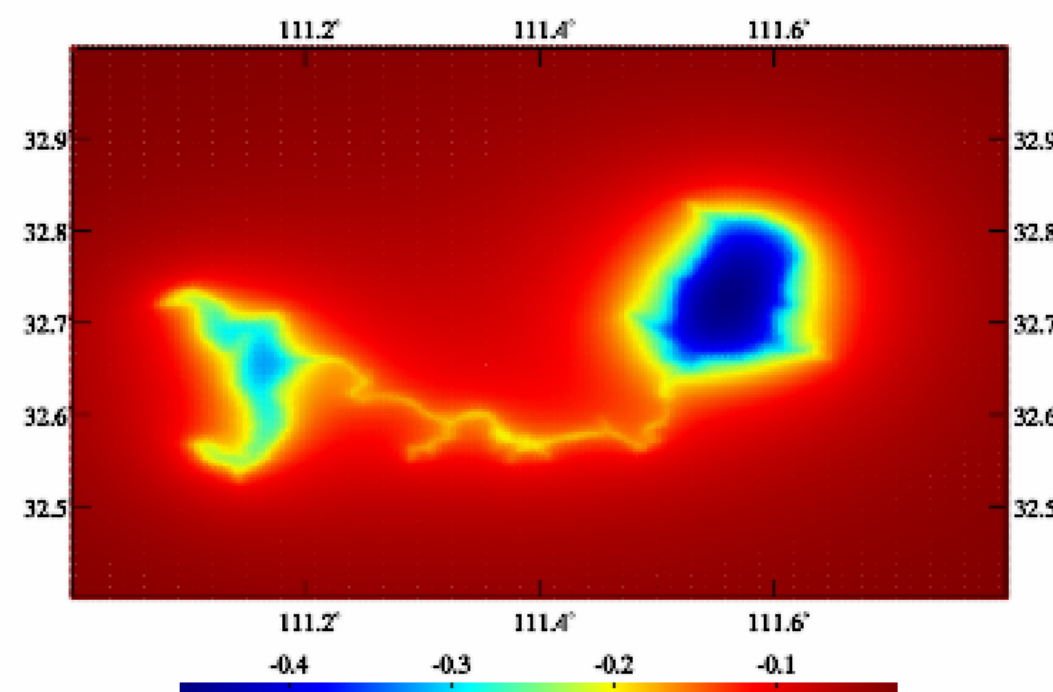
Plot↓



geoid / height anomaly (mm)



ground gravity (μGal)



radial displacement (mm)

Computation of Regional Load Effect Time Series via Green's Integration

Computation of Regional Residual Surface Load Effects via Green's Integration

Computation of Lakes, Glaciers, and Snow Load Effects via Green's Integration

Computation of Regional Load Effect Time Series via Green's Integration

Algorithm formulas

Select the computation point file format

The discrete computation point file

Open the surface computation 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

** The program outputs the residual load effect record time series files rntGreen***.txt. Each output file header is identical to the input file. One or several columns of the selected surface load effects are appended to the input file record as the output file record.

*** represents the wildcards of the variation grid time series file names, whose instance identifies the sampling epoch time of the load effects.

** The load EWH variation grid files searched by wildcard instantiation:

C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/swscSEP2018041112.dat

C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/swscSEP2018041812.dat

C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/swscSEP2018042512.dat

C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/swscSEP2018050212.dat

>> 4 equivalent water height variation 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]...

** The computation process requires time.... During this period, you can open the output file directory C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms, to look at the computation progress!!

** The last attribute of each output file header is the instance of the wildcards of the residual EWH grid time series file name, which represents the sampling epoch time of the output file.

>> Computation start time: 2026-06-24 10:34:13

>> Complete the refinement computation of 4 load deformation field!

>> Computation end time: 2026-06-24 10:34:22

Green's integral radius 200km

Set the results folder

Import setting parameters

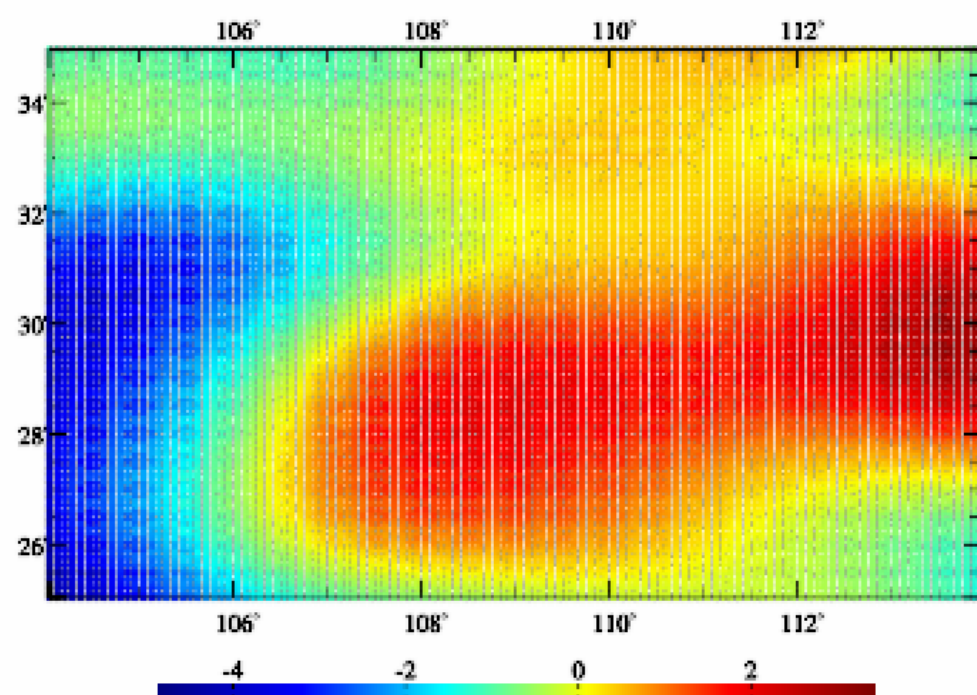
Start computation

C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms/rntGreen2018041112.txt

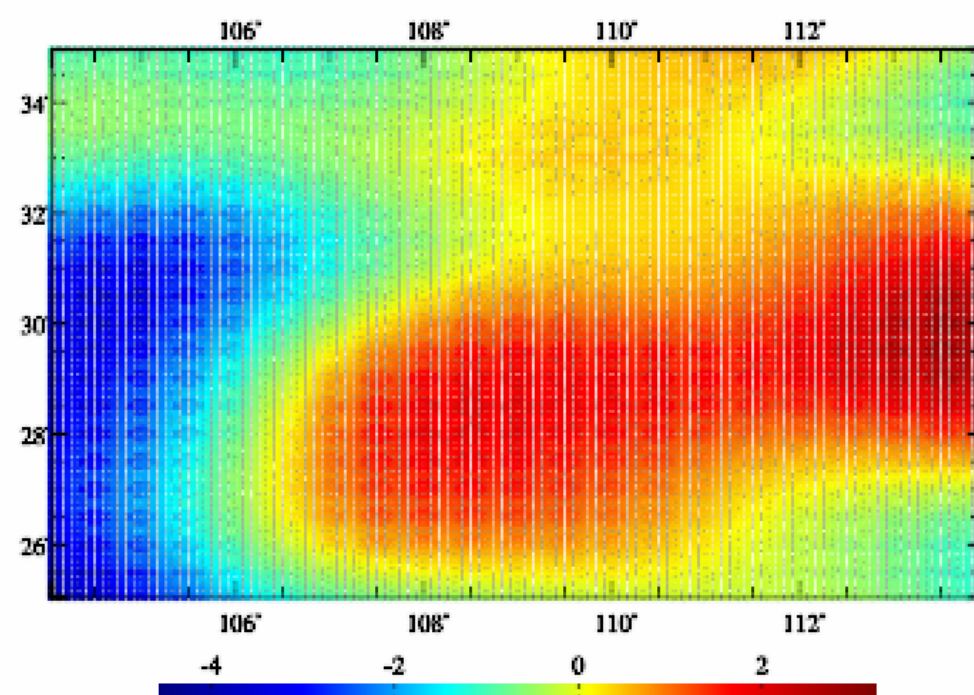
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms/rntGreen2018041812.txt

C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms/rntGreen2018042512.txt

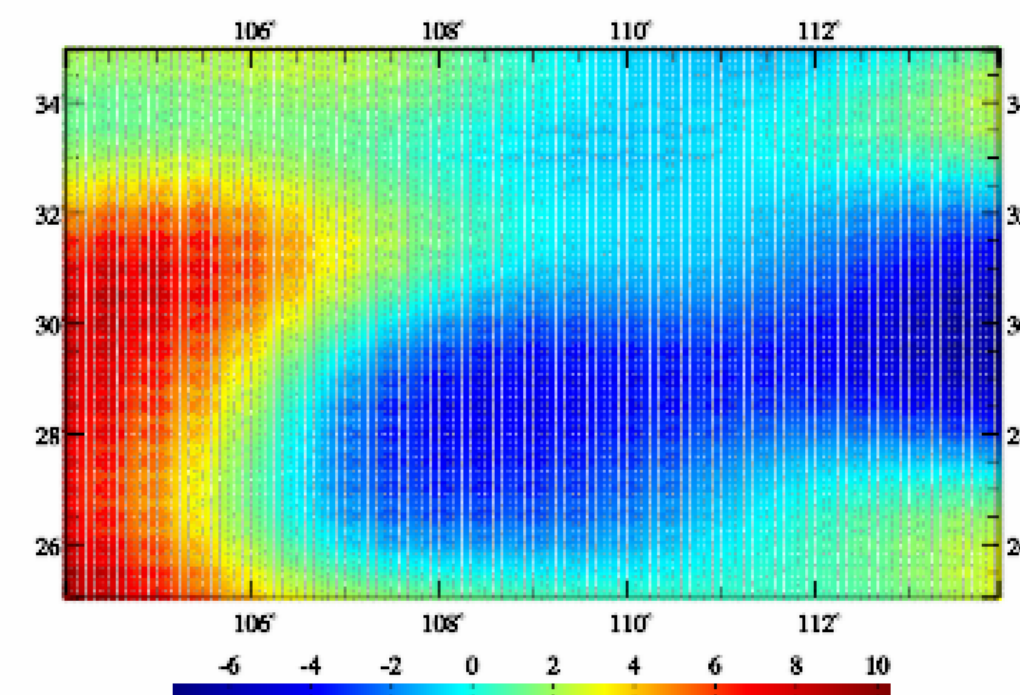
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms/rntGreen2018050212.txt



geoid / height anomaly (mm)



ground gravity (μGal)



radial displacement (mm)

Computation of Regional Load Effect Time Series via Green's Integration

Computation of Regional Residual Surface Load Effects via Green's Integration

Computation of Lakes, Glaciers, and Snow Load Effects via Green's Integration

Computation of Regional Load Effect Time Series via Green's Integration

Algorithm formulas

Select the computation point file format

The computation surface height grid file

Open the land surface height grid file

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

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.

*** represents the wildcards of the variation grid time series file names, whose instance identifies the sampling epoch time of the load effects.

** The load EWH variation grid files searched by wildcard instantiation:

C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/swscSEF2018041112.dat

C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/swscSEF2018041812.dat

C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/swscSEF2018042512.dat

C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/swscSEF2018050212.dat

>> 4 equivalent water height variation 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]...

** The computation process requires time.... During this period, you can open the output file directory C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms, to look at the computation progress!!

** The last attribute of each output file header is the instance of the wildcards of the residual EWH grid time series file name, which represents the sampling epoch time of the output file.

>> Computation start time: 2026-06-24 10:44:14

>> Complete the refinement computation of 4 load deformation field!

>> Computation end time: 2026-06-24 10:44:26

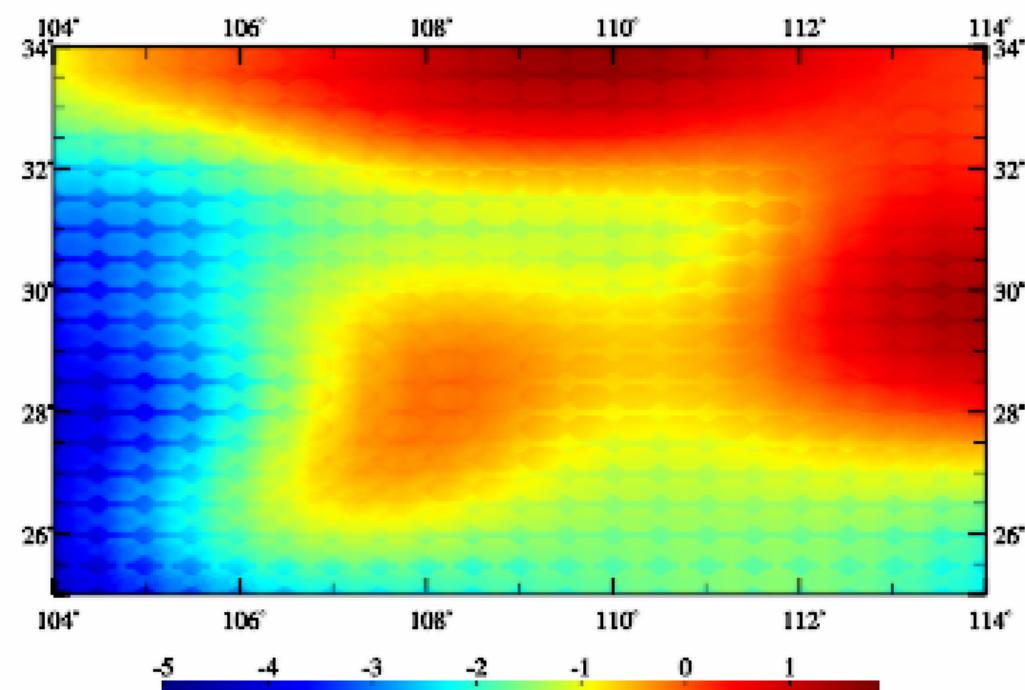
Green's integral radius 200km

Set the results folder

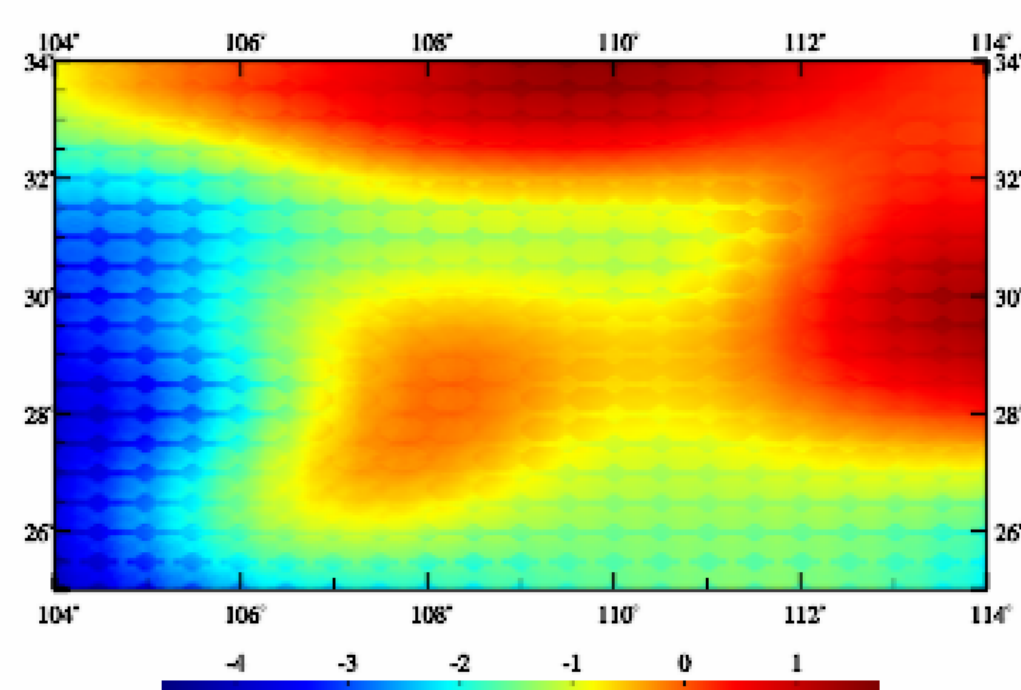
Import setting parameters

Start computation

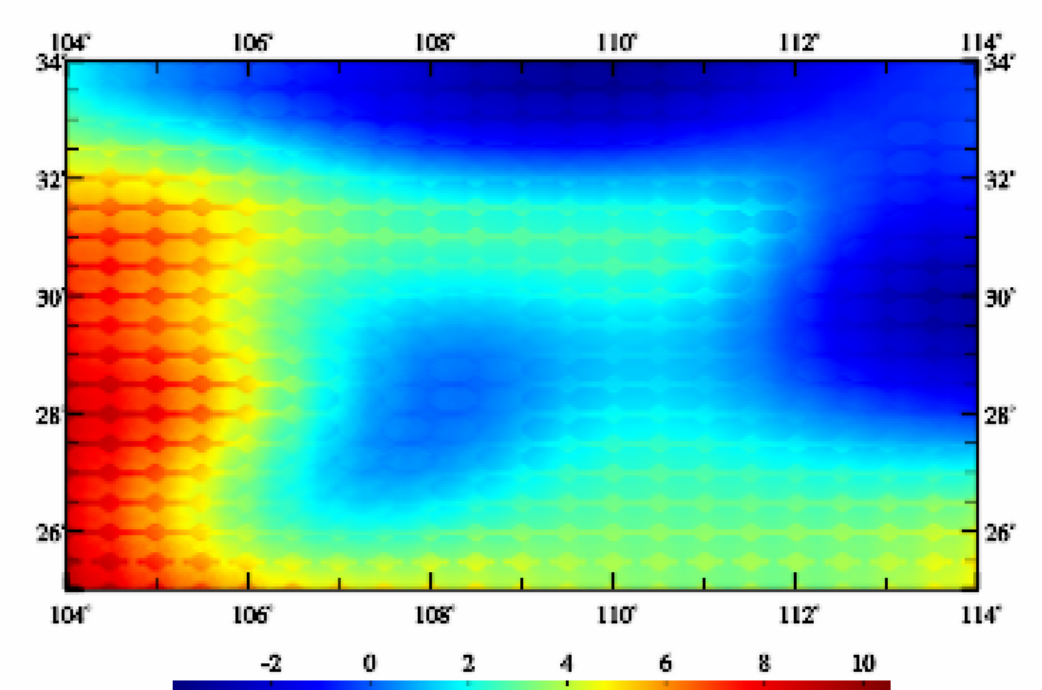
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms/rntGreen2018041112.ksi
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms/rntGreen2018041112.gra
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms/rntGreen2018041112.dpr
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms/rntGreen2018041112.nmh
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms/rntGreen2018041112.grr
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms/rntGreen2018041112.hgd
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms/rntGreen2018041812.ksi
C:/ETideLoad4.5_win64en/examples/Loadfmrntgreenintg/loadtms/rntGreen2018041812.gra



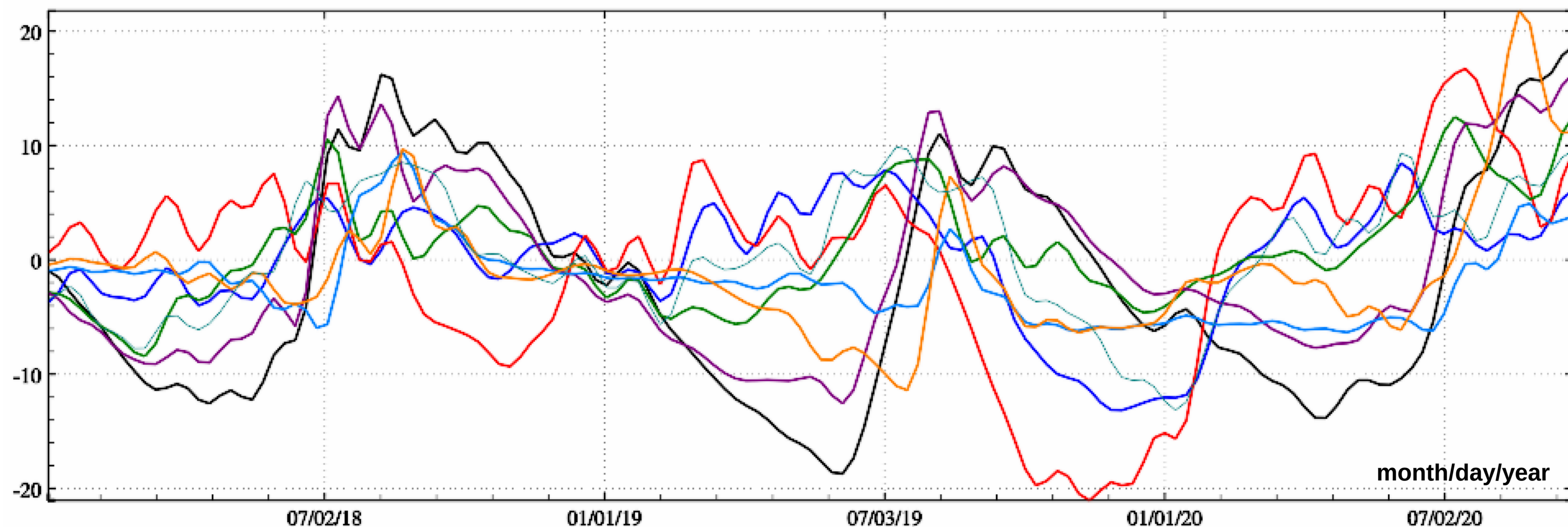
geoid / height anomaly (mm)



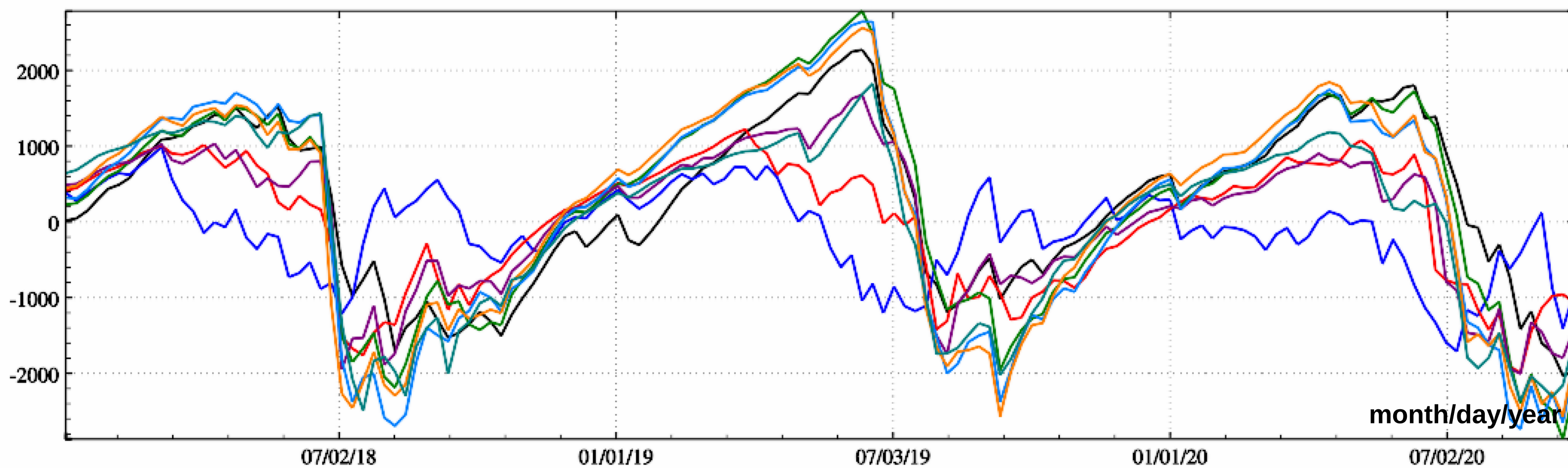
ground gravity (μGal)



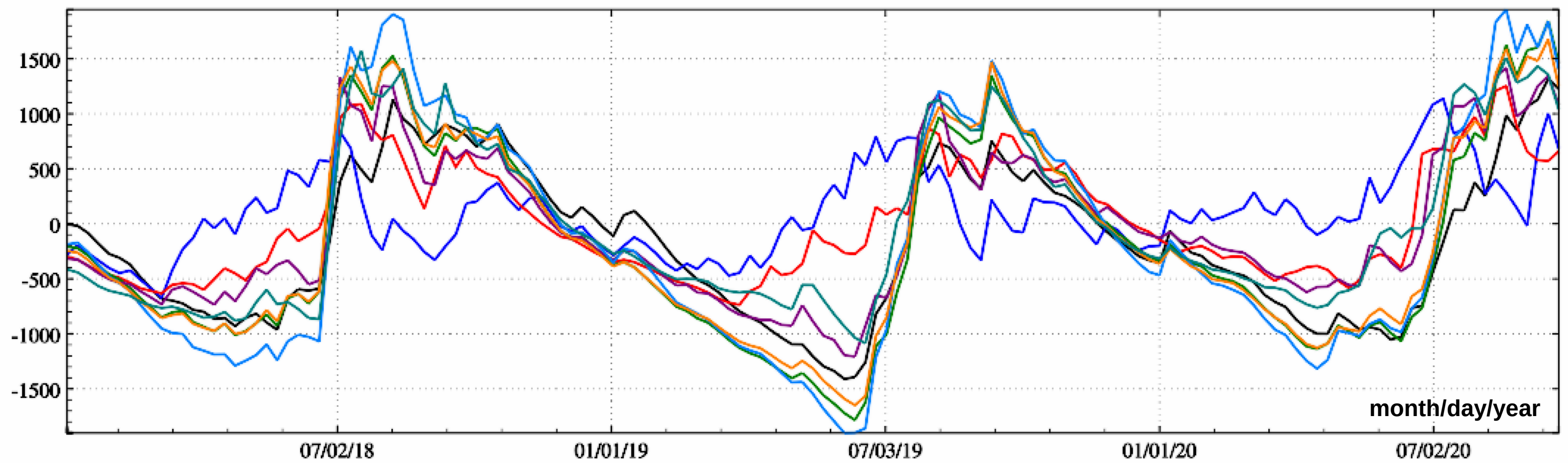
radial displacement (mm)



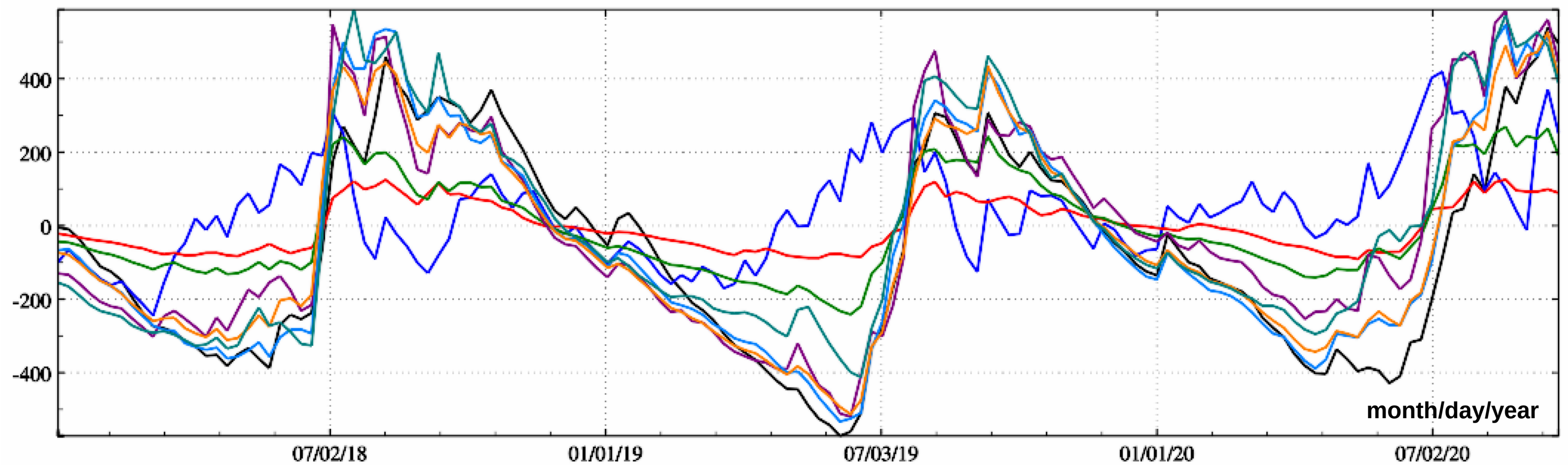
30'×30' residual soil water variation load effects on ground gravity (μGal) in Chinese mainland (Green's integral)



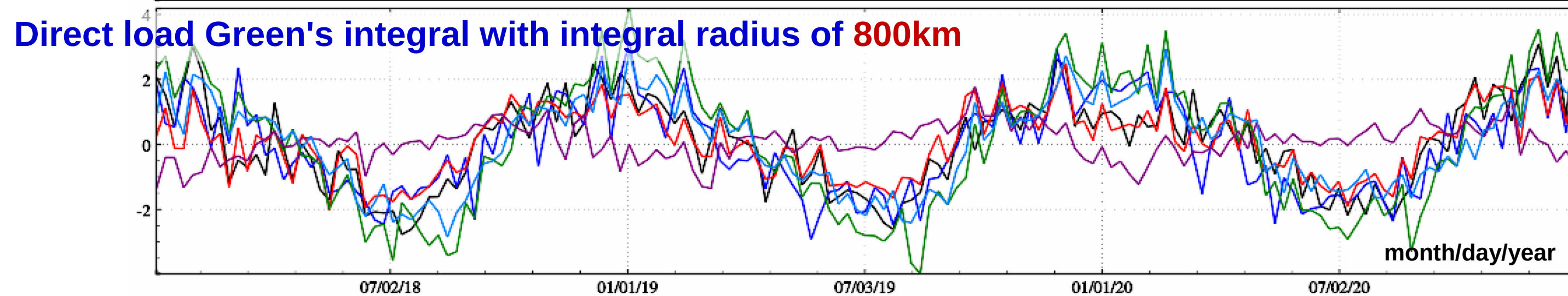
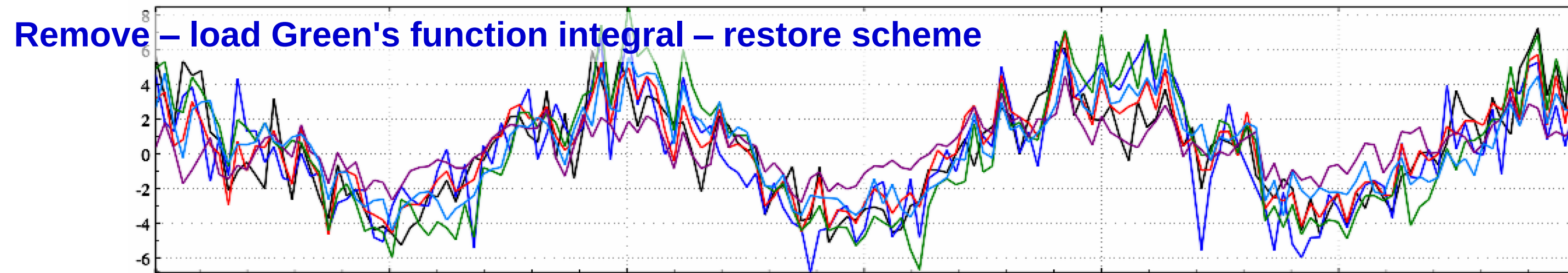
30'×30' residual soil water variation load effects on radial gradient (mE) in Chinese mainland (Green's integral)



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

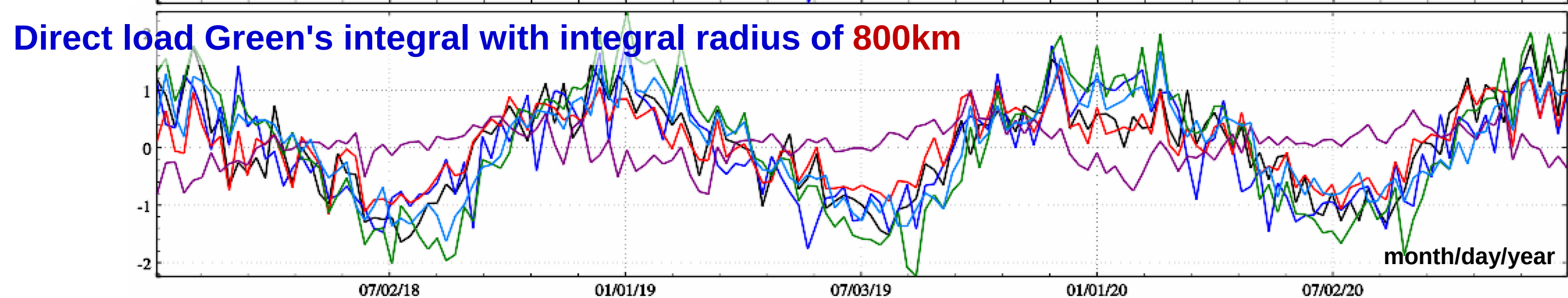
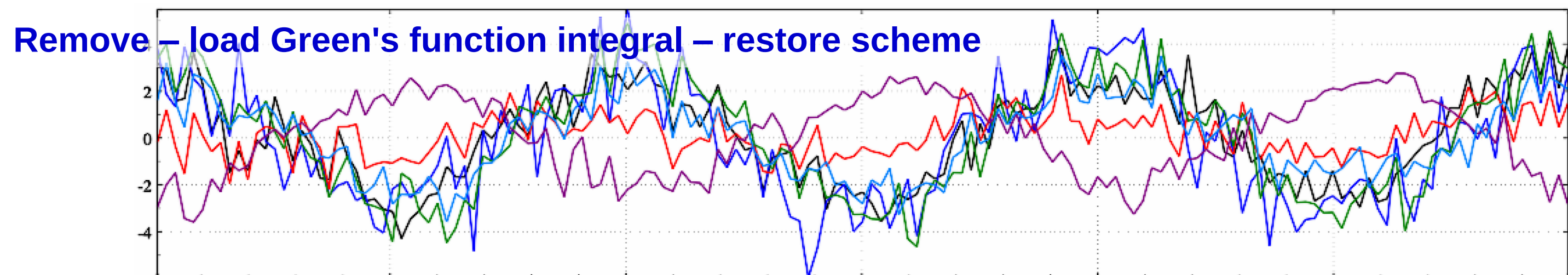


30'×30' residual soil water variation load effects on horizontal gradient (W, mE) in Chinese mainland (Green's integral)



— UQAK
— HRBN
— NXHY
— DAIS
— LHAS
— YANG

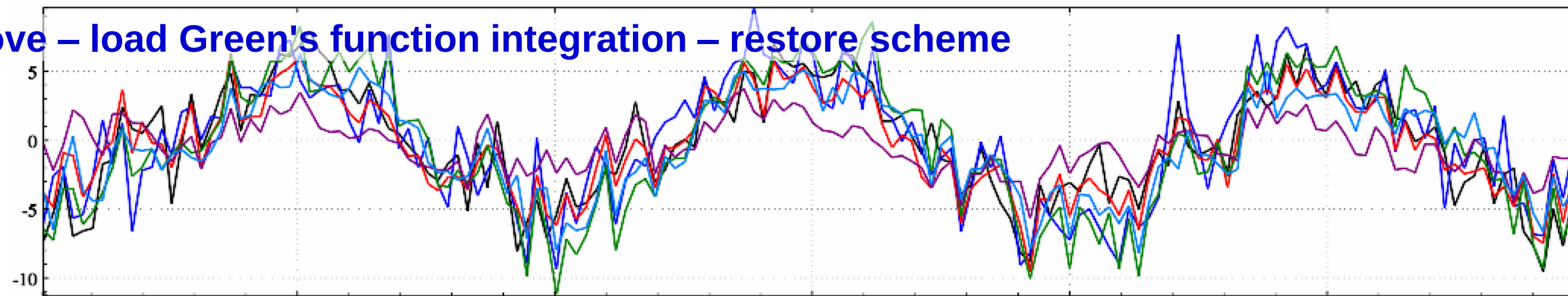
Surface atmosphere load effect time series on geoid (mm) at 6 CORS stations in mainland China using two scheme



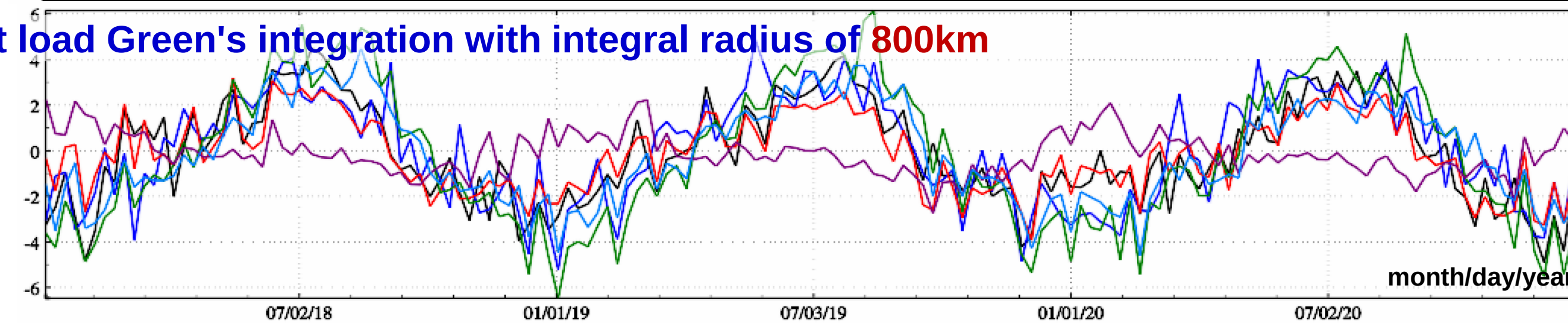
— UQAK
— HRBN
— NXHY
— DAIS
— LHAS
— YANG

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

Remove – load Green's function integration – restore scheme



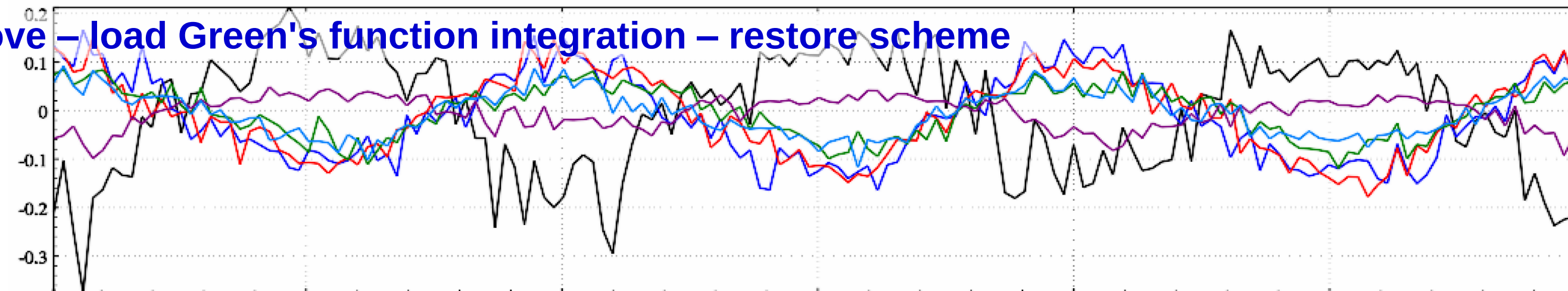
Direct load Green's integration with integral radius of 800km



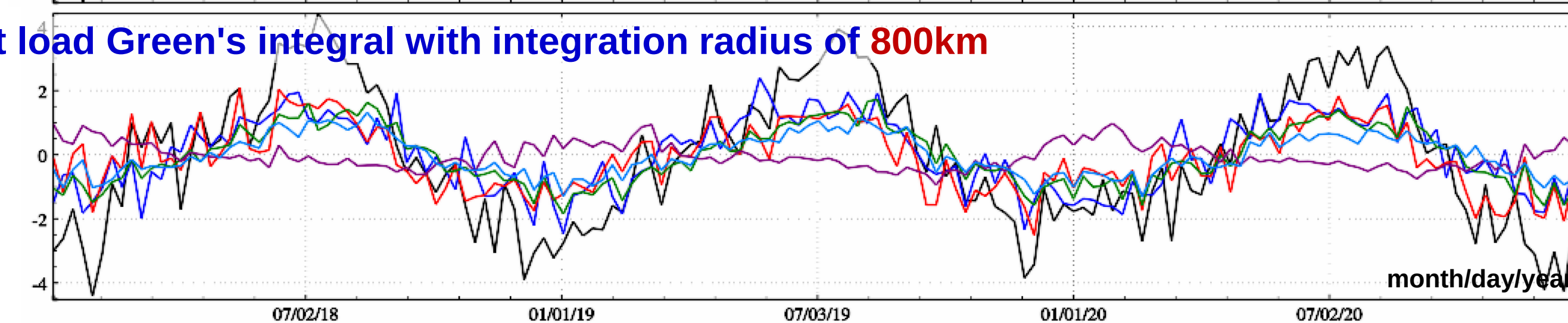
— UQAK
— HRBN
— NXHY
— DAIS
— LHAS
— YANG

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

Remove – load Green's function integration – restore scheme



Direct load Green's integral with integration radius of 800km



— UQAK
— HRBN
— NXHY
— DAIS
— LHAS
— YANG

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

Approximation of Residual Loads and Synthesis of Residual Load Effects Using SRBFs

Approximation of Residual Loads and Synthesis of Residual Load Effects Using SRBFs

Select the computation point file format
The discrete computation point file
Open the space computation 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 approach
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 Q 1800
Parameters of cumulative SRBF approach
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 Q 1800

Approximation of Residual Surface Load and Load Effect Time Series Using SRBFs

Solution of normal equation LU triangular decompo: Cumulative SRBF approach times 1
Save the results as C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfm.txt.
>> 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: 2026-06-24 15:49:02
>> Complete the computation for approximation 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: 2026-06-24 15:56:05
>> The program also outputs the SRBF spatial curve file *spc.rbf and spectral curve file *dgr.rbf for 11 kinds of
** *spc.rbf file header format: SRBF type (0 = radial multipole kernel function, 1 = Poisson wavelet kernel function), Legendre expansion, buried depth (km). The record format: Spherical distance (km), the normalized SRBF value, gravity, gravity disturbance, ground tilt, vertical deflection, horizontal displacement, radial displacement, orthonormal variations.
** The file header of * dgr.rbf is the same as * spc.rbf. The record format: Degree n of SRBF Legendre expansion, load EWH, height anomaly, ground gravity, gravity disturbance, ground tilt, vertical deflection, horizontal displacement, gradient, and 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 -0.001
2 98.025000 25.008333 0.000 -45.9740 -1.3242 -18.4557 -19.0682 0.0092 -0.0089 0.0011 -0.001
3 98.041667 25.008333 0.000 -42.7539 -1.2380 -17.1549 -17.7312 0.0078 -0.0095 0.0009 -0.001
4 98.058333 25.008333 0.000 -42.9815 -1.4841 -17.1478 -17.8004 0.0080 -0.0104 0.0011 -0.001
5 98.075000 25.008333 0.000 -37.7942 -1.2010 -15.1123 -15.6618 0.0061 -0.0108 0.0008 -0.001
6 98.091667 25.008333 0.000 -37.0927 -1.3542 -14.7584 -15.3525 0.0055 -0.0113 0.0008 -0.002
7 98.108333 25.008333 0.000 -36.7076 -1.5304 -14.5265 -15.1730 0.0036 -0.0116 0.0005 -0.002
8 98.125000 25.008333 0.000 -35.1771 -1.5832 -13.8705 -14.5278 0.0022 -0.0112 0.0002 -0.002
Extract the effects to be plot Plot

Regional Surface Load SRBF Approximation and Load effect SRBF Synthesis

Save program process as

geoid / height anomaly (mm)

ground gravity (μGal)

radial displacement (mm)

radial gradient (mE)

The optimization principles for these parameters aim to ensure that the estimated load EWH variations and load effects in space are continuous and differentiable, while minimizing the standard deviation and driving the residual statistical mean toward zero for residual EWH variations.

Approximation of Residual Loads and Synthesis of Residual Load Effects Using SRBFs

Approximation of Residual Loads and Synthesis of Residual Load Effects Using SRBFs

Approximation of Residual Surface Load and Load Effect Time Series Using SRBFs

Regional Surface Load SRBF Approximation and Load effect SRBF Synthesis

Select the computation point file format

The computation surface grid file

Open the computation surface height grid file

Open the residual equivalent water height variation grid file

Parameters of the first SRBF approach

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 Q	1800

Parameters of cumulative SRBF approach

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 Q	1800

Solution of normal equation LU triangular decompo: Cumulative SRBF approach times 1

Save program process as

>> 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: 2026-06-24 15:59:10

>> Complete the computation for approximation 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: 2026-06-24 16:04:47

>> The program also outputs the SRBF spatial curve file *spc.rbf and spectral curve file *dgr.rbf for 11 kinds of geodetic variations into the current directory.

** *spc.rbf file header format: SRBF type (0 = radial multipole kernel function, 1 = Poisson wavelet kernel function), order of SRBF, minimum and maximum degree of SRBF Legendre expansion, buried depth (km). The record format: Spherical distance (km), the normalized SRBF values derived from the load EWH, height anomaly, ground gravity, gravity disturbance, ground tilt, vertical deflection, horizontal displacement, radial displacement, orthometric height, radial gravity gradient, and horizontal gradient variations.

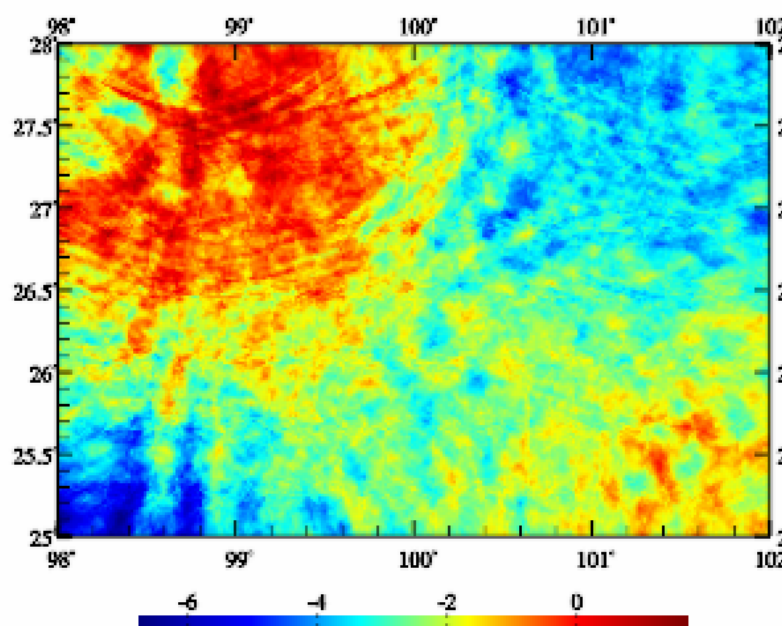
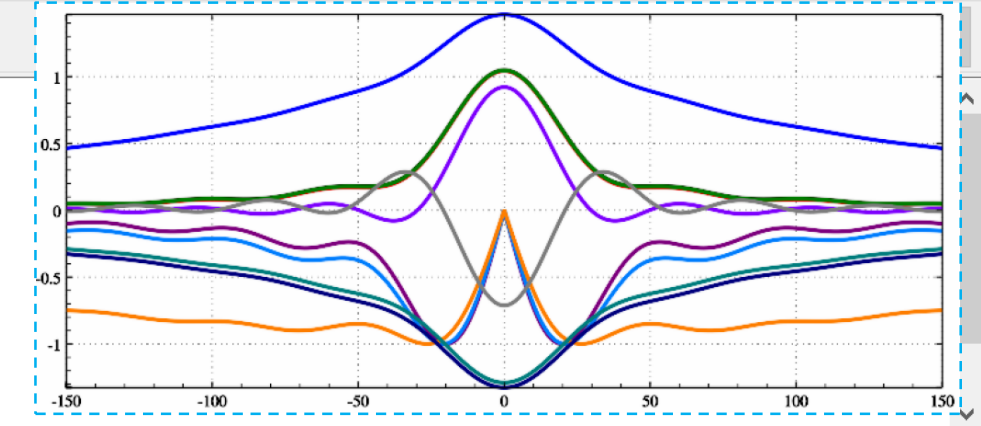
** The file header of * dgr.rbf is the same as * spc.rbf. The record format: Degree n of SRBF Legendre expansion, the degree-n normalized SRBF values derived from the load EWH, height anomaly, ground gravity, gravity disturbance, ground tilt, vertical deflection, horizontal displacement, radial displacement, orthometric height, radial gravity gradient, and horizontal gradient variations.

Save the results as

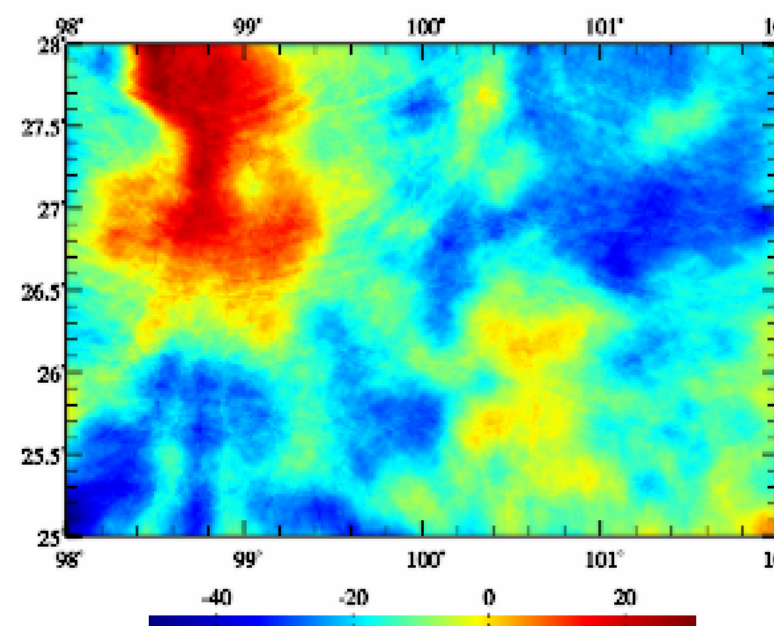
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.ewh
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.ksi
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.gra
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.rga
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmgrd.dft
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

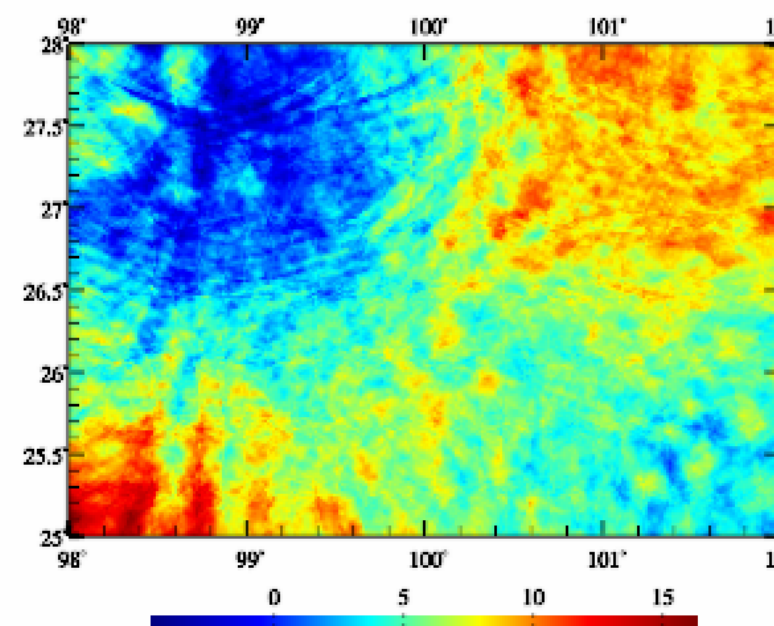
Plot



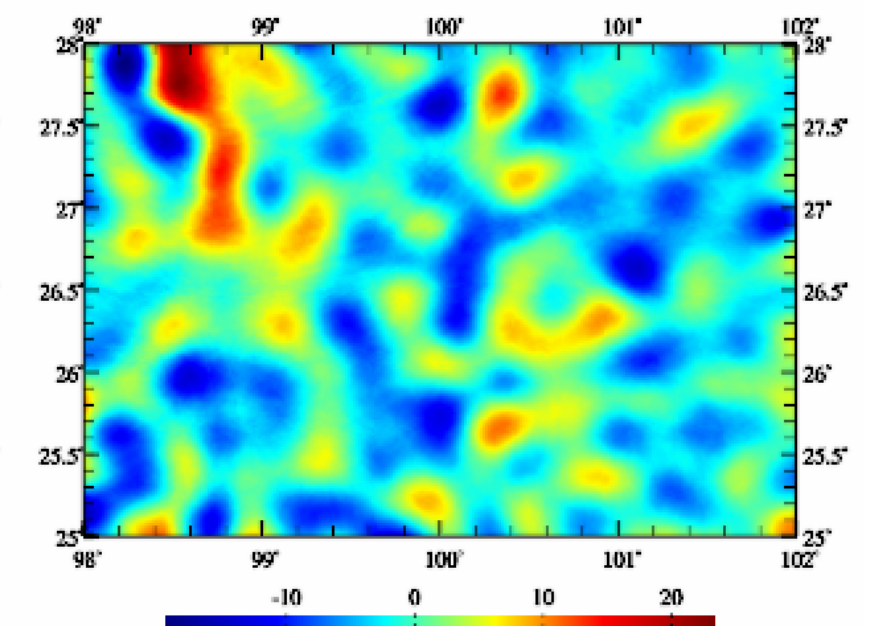
geoid / height anomaly (mm)



ground gravity (μGal)



radial displacement (mm)



radial gradient (mE)

The optimization principles for these parameters aim to ensure that the estimated load EWH variations and load effects in space are continuous and differentiable, while minimizing the standard deviation and driving the residual statistical mean toward zero for residual EWH variations.

Approximation of Residual Surface Load and Load Effect Time Series Using SRBFs

Approximation of Residual Loads and Synthesis of Residual Load Effects Using SRBFs

Select the computation point file format
The computation surface grid file

Open computation surface zero value grid file

Open any residual equivalent water height variation grid file

Ordinal number of first wildcard in file name 8

Number of consecutive wildcards in file name 8

Parameters of the first SRBF approach

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 Q	1800

Parameters of cumulative SRBF approach

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 Q	1800

Approximation of Residual Surface Load and Load Effect Time Series Using SRBFs

Solution of normal equation LU triangular decompo: Cumulative SRBF approach times 1

Save program process as

C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/soilewh20181003.dat
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/soilewh20181205.dat
>> 6 equivalent water height variation 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]....
** The computation process requires time.... During this period, you can open the output file directory C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmtmgrd, to look at the computation progress!!
** The last attribute in the header of each output file records this epoch time to ensure temporal consistency.
>> Computation start time: 2026-06-24 16:55:23

>> SRBF approximation statistics of 20180131 load EWHs:
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.
>> SRBF approximation statistics of 20180328 load EWHs:
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.

Set the result folder

Import setting parameters

Start Computation

C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmtmgrd/rntSRBFs20181205.ewh
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmtmgrd/rntSRBFs20181205.ksi
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmtmgrd/rntSRBFs20181205.gra
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmtmgrd/rntSRBFs20181205.rga
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmtmgrd/rntSRBFs20181205.dft
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmtmgrd/rntSRBFs20181205.vdf
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmtmgrd/rntSRBFs20181205.dph
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmtmgrd/rntSRBFs20181205.dpr
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmtmgrd/rntSRBFs20181205.nmh
C:/ETideLoad4.5_win64en/examples/loadfmtewhSRBFs/SRBFrntdfmtmgrd/rntSRBFs20181205.grr

Extract the effects to be plot

Plot

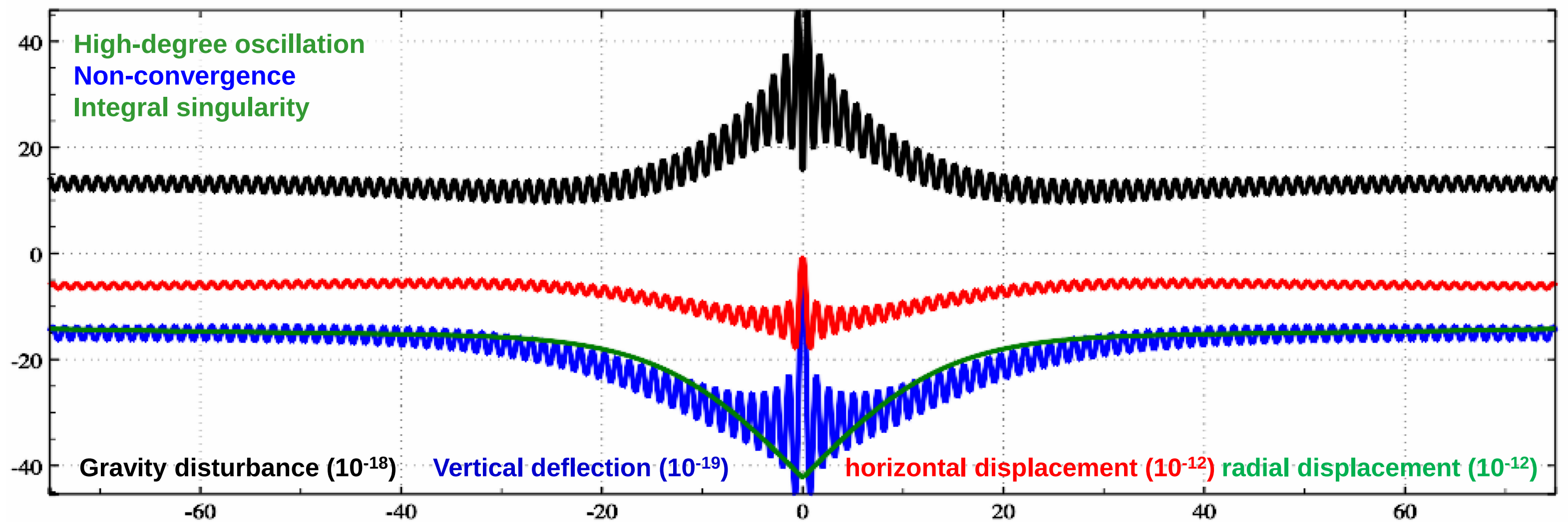
geoid / height anomaly (mm)

ground gravity (μGal)

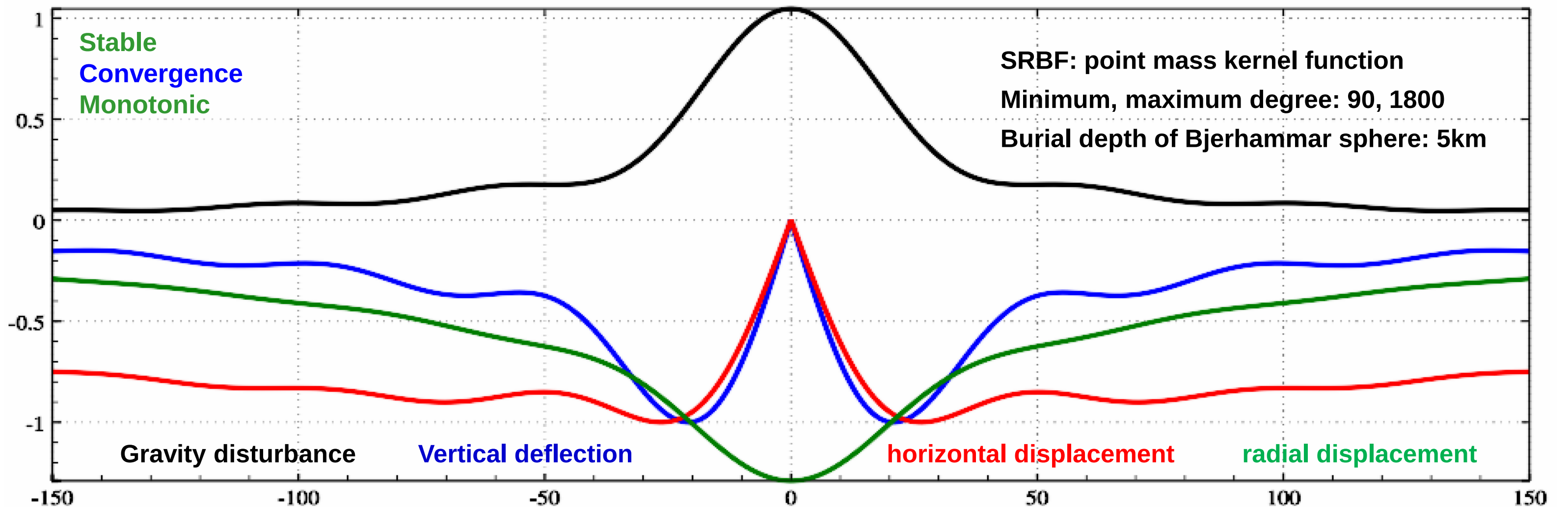
radial displacement (mm)

radial gradient (mE)

The optimization principles for these parameters aim to ensure that the estimated load EWH variations and load effects in space are continuous and differentiable, while minimizing the standard deviation and driving the residual statistical mean toward zero for residual EWH variations.



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



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

Load Deformation Field Estimation from Heterogeneous Variations via Green's Integral Constraint

Open the geodetic variation record time series file

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: 7

Mean distance between geodetic sites: 15.0 km

Open the computation 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 k of the adjustable variations: 1.00

Load Deformation Field Estimation from Heterogeneous Variations via Green's Integral Constraint

Solution of normal equation LU triangular decomposition

>> [Function] Utilizing ground-based geodetic variations observed by heterogeneous networks (e.g., GNSS leveling height anomaly, gravity disturbance, ground gravity, ellipsoidal height, or normal height) as input constraints, and employing Load Green's Function Integration as a dynamic operator, this function estimates the regional terrestrial water EWH variation and its load effect grids on Height anomaly (geoid, 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 (mm), ellipsoidal height (mm), normal height (mm), gravity gradient (mE), and horizontal gravity gradient (NW, mE).

>> 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 computation surface height grid file C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/dtm3m.dat.

>> Create or select the result folder C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst.

** The program generates the estimated terrestrial EWH variation grid files ewh****.dat, corresponding load effect grid files, and residual analysis files rnt***.txt. Here, *** is the sampling epoch time which is also saved as the last column attribute of the load effect grid file header.

** All-Element Load Effect Grids:

Greengeoid***.dat: Height anomaly / Geoid variation (mm)

Greenterrgrav***.dat: Ground gravity variation (μGal)

Greengravdist***.dat: Gravity disturbance variation (μGal)

Greengrndtilt***.dat: Ground tilt variation vector (SW, mas)

Set the result folder

Import setting para

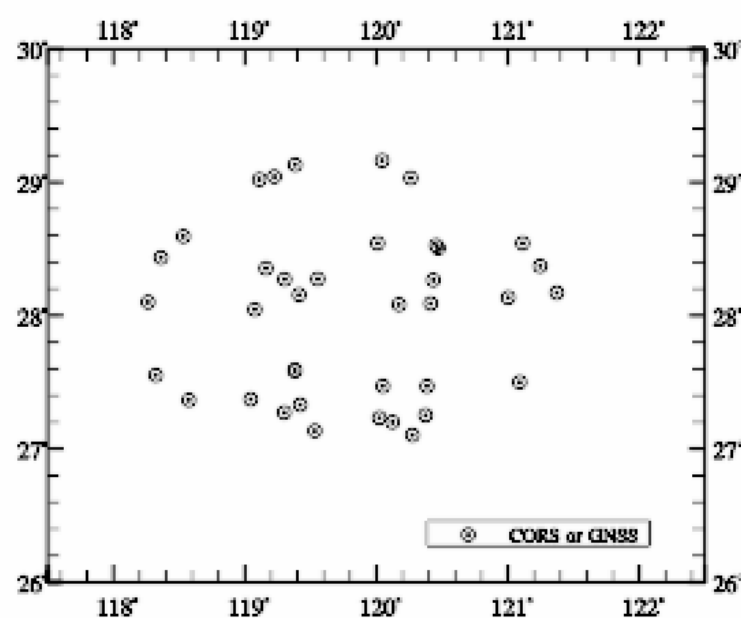
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greenhorz
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greenelli
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greenorth
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greengrad
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst\Greenhorz

rnt2015011612.txt									
1	Ellipsoidal height: 4								
2	0	1.7766	3.2313	-8.9800	7.4500				
3	1	0.0470	1.5335	-4.1846	4.4676				
4	2	-0.0250	1.2653	-4.1085	4.2485				
5	3	-0.0276	1.1473	-4.2036	4.1187				
6	4	-0.0236	1.0787	-4.2537	4.0383				
7	CORS	121.3725	28.1708	1.00	4	2.3100	0.0611	-0.0322	
8	CORS	121.2459	28.3706	1.00	4	1.2300	0.1266	0.0791	
9	CORS	121.1122	28.5421	1.00	4	-1.3400	-0.2021	-0.0768	
10	CORS	121.0901	27.5005	1.00	4	-4.5000	-0.0760	0.0174	
11	CORS	121.0032	28.1351	1.00	4	2.0800	0.5581	0.0890	
12	CORS	120.4708	28.5056	1.00	4	0.6900	0.7964	0.5206	
13	CORS	120.4557	28.5259	1.00	4	-0.0100	0.4649	0.3275	
14	CORS	120.4330	28.2659	1.00	4	0.1800	-1.2777	-1.0993	
15	CORS	120.4128	28.0902	1.00	4	5.0600	1.0729	0.5665	
16	CORS	120.3856	27.4700	1.00	4	3.5100	0.9558	0.2376	
17	CORS	120.3739	27.2529	1.00	4	1.6900	1.3661	1.0752	
18	CORS	120.2754	27.1035	1.00	4	-1.3800	-0.8403	-0.5624	

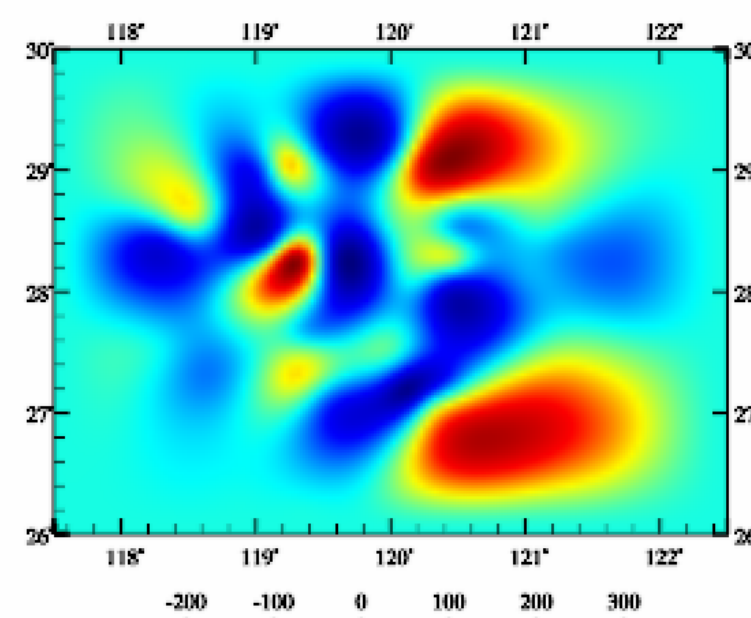
The monitoring epoch time 2015011612

Extract the effects to be plot

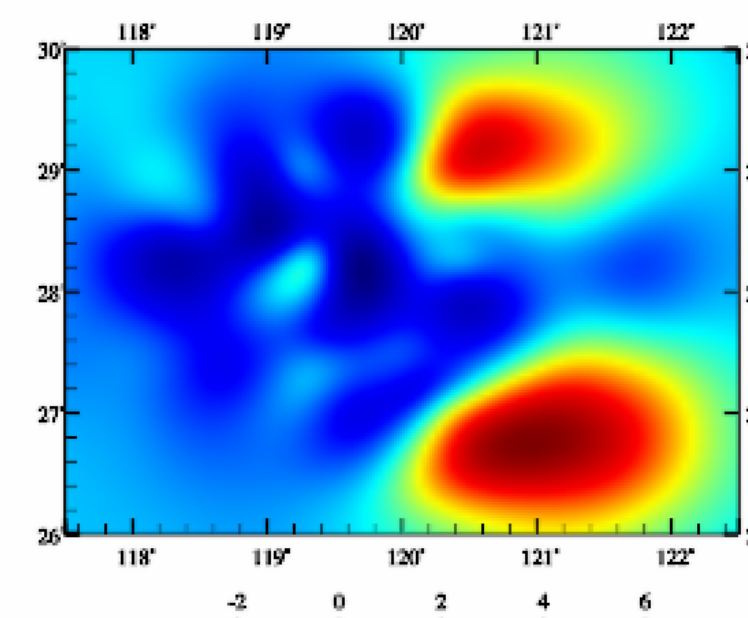
Plot↓



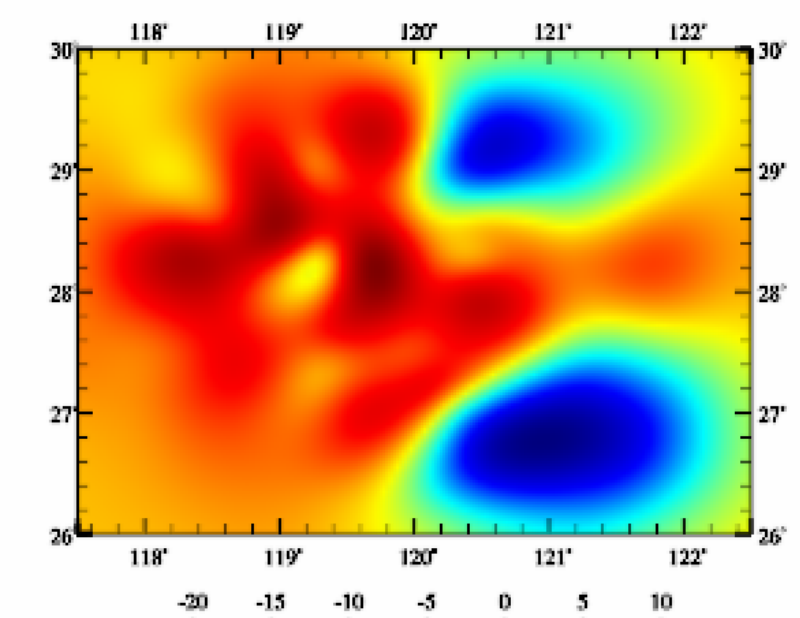
Spatial distribution of geodetic sites



Land water EWH variations (cm)



Ground gravity variations (μGal)



Orthometric height variations (mm)

Acceptable Geodetic Variation Types: (1) Height Anomaly Variation (mm) - Derived from GNSS-leveling networks; (2) Gravity Disturbance Variation (μGal) - Derived from GNSS-gravity networks or CORS-gravity tide stations; (3) Ground Gravity Variation (μGal) - Derived from absolute or relative gravity monitoring networks; (4) Ellipsoidal Height Variation (mm) - Derived from CORS or GNSS monitoring networks; or (5) Normal/Orthometric Height Variation (mm) - Derived from precision leveling networks.

The optimization principles aim to produce spatially continuous and differentiable EWH variation fields while minimizing the standard deviation and driving the statistical mean toward zero for residual observation variations.

Load Deformation Field Estimation from Heterogeneous Variations via Green's Integral Constraint

Open the geodetic variation record time series file

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: 7

Mean distance between geodetic sites: 15.0 km

Open the computation 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 k of the adjustable variations: 1.00

Load Deformation Field Estimation from Heterogeneous Variations via Green's Integral Constraint

Solution of normal equation: LU triangular decomposition

>> [Function] Utilizing ground-based geodetic variations observed by heterogeneous networks (e.g., GNSS leveling height anomaly, gravity disturbance, ground gravity, ellipsoidal height, or normal height) as input constraints, and employing Load Green's Function Integration as a dynamic operator, this function estimates the regional terrestrial water EWH variation and its load effect grids on Height anomaly (geoid, 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 (mm), ellipsoidal height (mm), normal height (mm), gravity gradient (mE), and horizontal gravity gradient (NW, mE).

>> 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 computation surface height grid file C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/dtm3m.dat.

>> Create or select the result folder C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst.

** The program generates the estimated terrestrial EWH variation grid files ewh****.dat, corresponding load effect grid files, and residual analysis files rnt***.txt. Here, *** is the sampling epoch time which is also saved as the last column attribute of the load effect grid file header.

** All-Element Load Effect Grids:

Greengeoid***.dat: Height anomaly / Geoid variation (mm)

Greenterrgrav***.dat: Ground gravity variation (μGal)

Greengravdist***.dat: Gravity disturbance variation (μGal)

Greengrntilt***.dat: Ground tilt variation vector (SW, mas)

Set the result folder

Import setting parameters

C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greenhorzdisp2015011612.dat

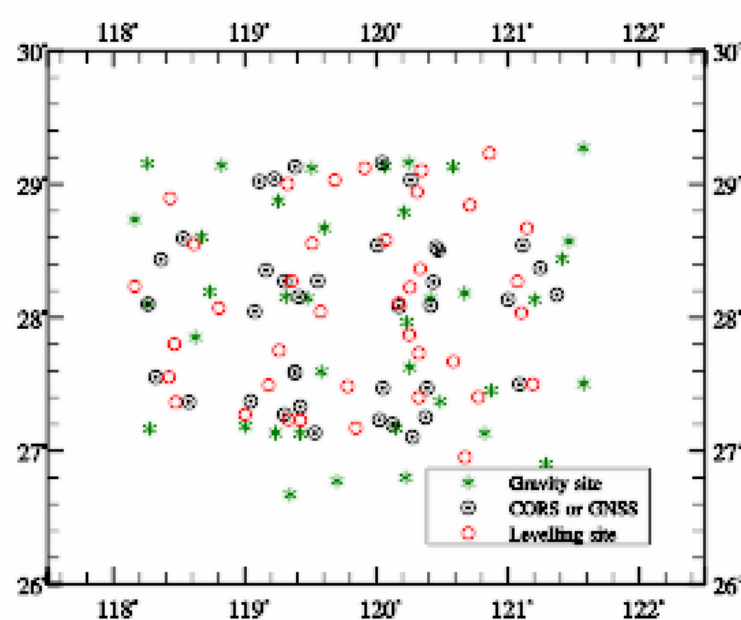
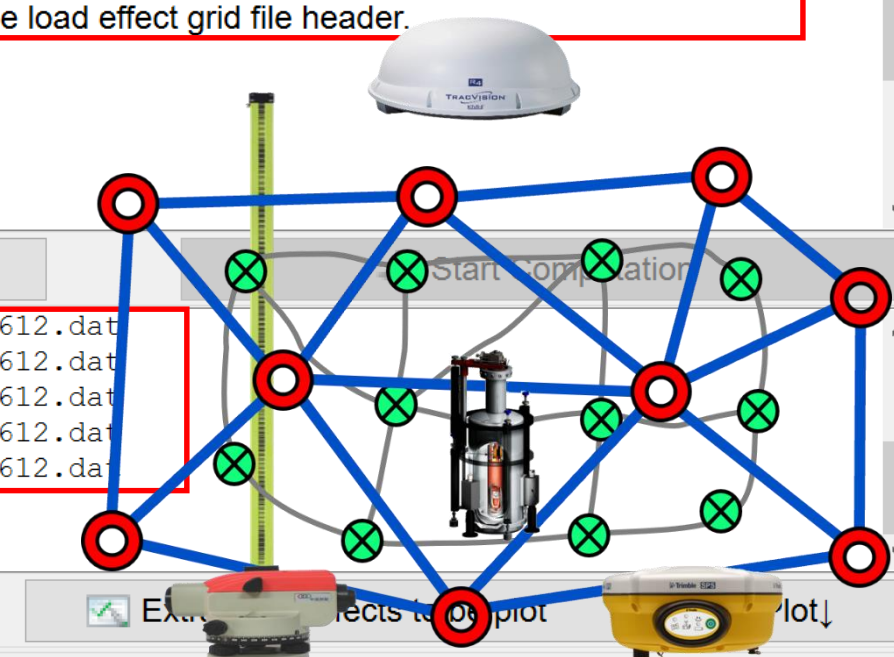
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greenelliphgt2015011612.dat

C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greenorthohgt2015011612.dat

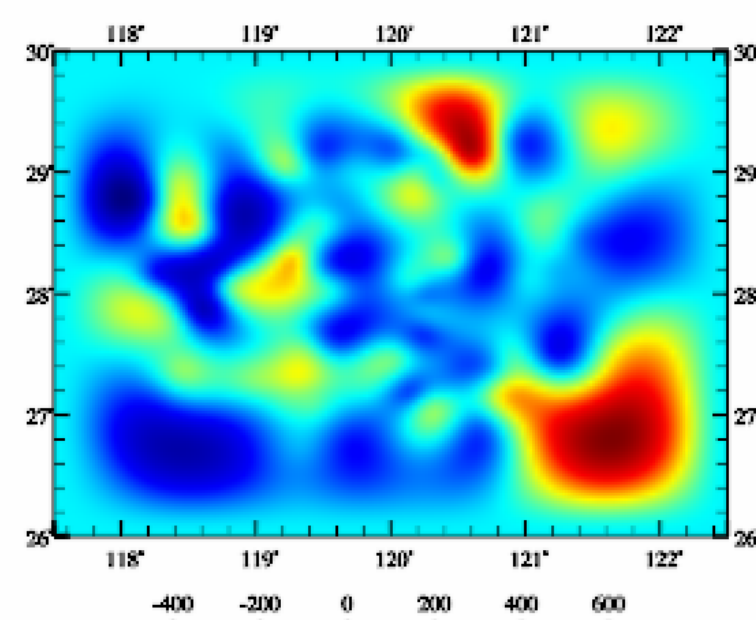
C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greengradient2015011612.dat

C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst\Greenhorzgrad2015011612.dat

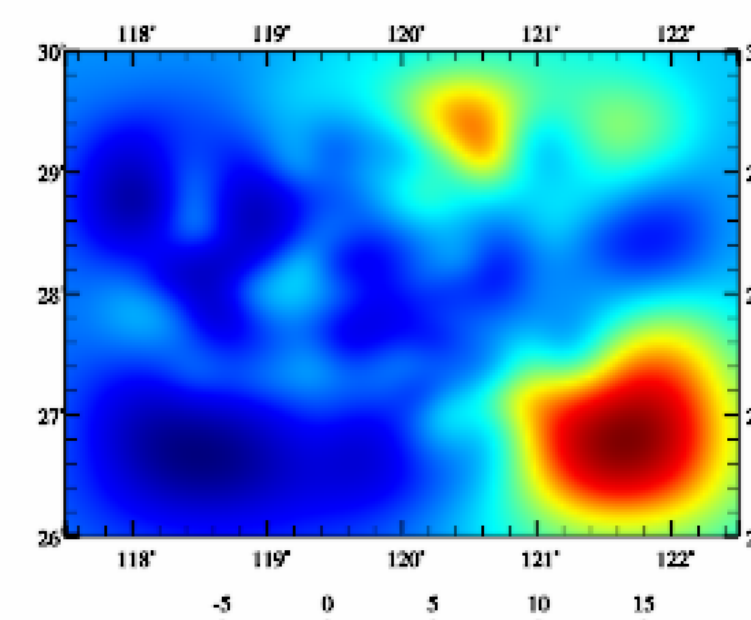
The monitoring epoch time 2015011612



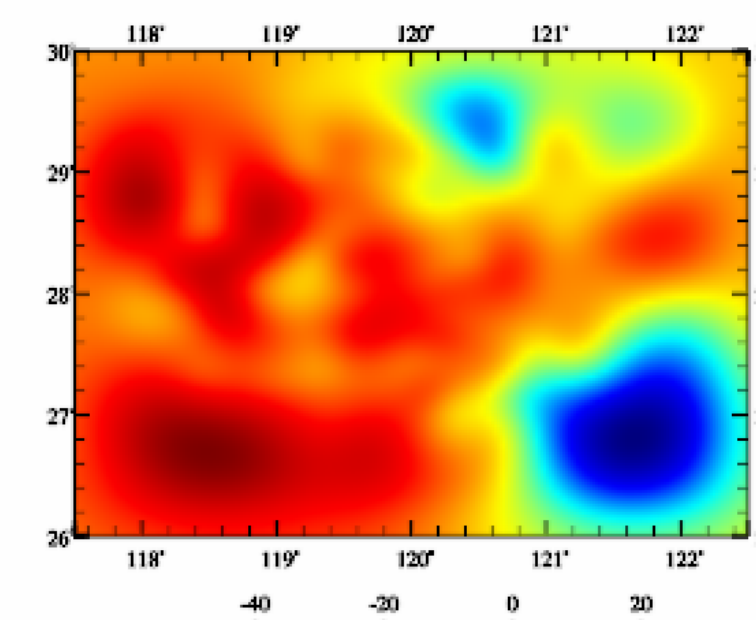
Spatial distribution of geodetic sites



Land water EWH variations (cm)



Ground gravity variations (μGal)



Orthometric height variations (mm)

Acceptable Geodetic Variation Types: (1) Height Anomaly Variation (mm) - Derived from GNSS-leveling networks; (2) Gravity Disturbance Variation (μGal) - Derived from GNSS-gravity networks or CORS-gravity tide stations; (3) Ground Gravity Variation (μGal) - Derived from absolute or relative gravity monitoring networks; (4) Ellipsoidal Height Variation (mm) - Derived from CORS or GNSS monitoring networks; or (5) Normal/Orthometric Height Variation (mm) - Derived from precision leveling networks.

The optimization principles aim to produce spatially continuous and differentiable EWH variation fields while minimizing the standard deviation and driving the statistical mean toward zero for residual observation variations.

Approximation of EWH variation and Load Effect Grid Time Series via Green's integral constraint

Open the geodetic variation record time series file

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 computation 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

Load Deformation Field Estimation from Heterogeneous Variations via Green's Integral Constraint

Solution of normal equation: LU triangular decomposition

Approximation of EWH variation and Load Effect Grid Time Series via Green's integral constraint

Save program process as

>> [Function] Utilizing time-series of heterogeneous geodetic variations as observations and Load Green's Integral as a geodynamic constraint, this module estimates the Terrestrial EWH Variation and All-Element Load Effect Grid Time Series. This is typically used to reconstruct a regional time-varying gravity field.

>> 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 computation surface height grid file C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/dtm3m.dat.

>> Create or select the result folder C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/CORSrst.

** The program generates the estimated terrestrial EWH variation grid files ewh***.dat, corresponding load effect grid files, and residual analysis files rnt***.txt. Here, *** is the sampling epoch time which is also saved as the last column attribute of the load effect grid file header.

** All-Element Load Effect Grids:

- Greengeoid***.dat: Height anomaly / Geoid variation (mm)
- Greenterrgrav***.dat: Ground gravity variation (μGal)
- Greengravdist***.dat: Gravity disturbance variation (μGal)
- Greengrndtilt***.dat: Ground tilt variation vector (SW, mas)
- Greenvertdefl***.dat: Vertical deflection variation vector (SW, mas)
- Greenhorzdisp***.dat: Horizontal displacement vector (EN, mm)
- Greenelliphgt***.dat: Ellipsoidal height variation (mm)

Set the result folder

Import setting parameters

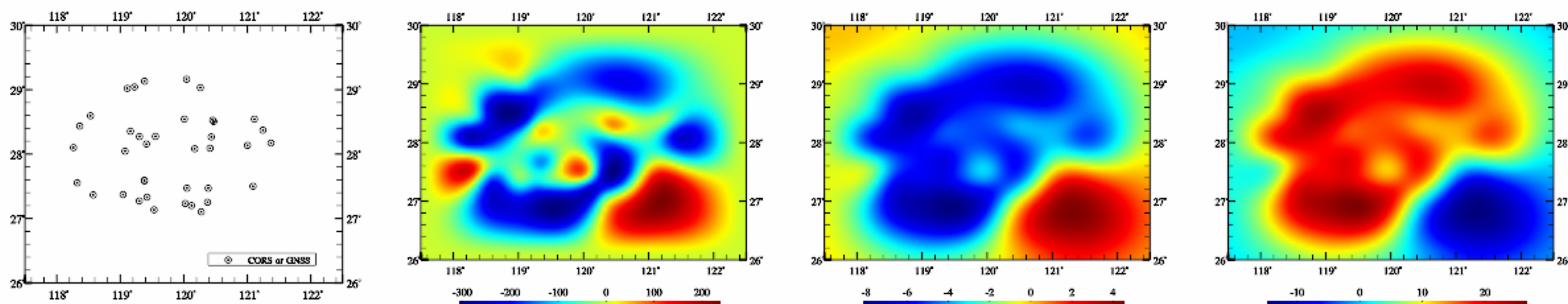
Start Computation

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↓



Spatial distribution of geodetic sites

Land water EWH variations (cm)

Ground gravity variations (μGal)

Orthometric height variations (mm)

Acceptable Geodetic Variation Types: (1) Height Anomaly Variation (mm) - Derived from GNSS-leveling networks; (2) Gravity Disturbance Variation (μGal) - Derived from GNSS-gravity networks or CORS-gravity tide stations; (3) Ground Gravity Variation (μGal) - Derived from absolute or relative gravity monitoring networks; (4) Ellipsoidal Height Variation (mm) - Derived from CORS or GNSS monitoring networks; or (5) Normal/Orthometric Height Variation (mm) - Derived from precision leveling networks.

The optimization principles aim to produce spatially continuous and differentiable EWH variation fields while minimizing the standard deviation and driving the statistical mean toward zero for residual observation variations.

Approximation of EWH variation and Load Effect Grid Time Series via Green's integral constraint

Open the geodetic variation record time series file

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 computation 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

Load Deformation Field Estimation from Heterogeneous Variations via Green's Integral Constraint

Solution of normal equation: LU triangular decomposition

Approximation of EWH variation and Load Effect Grid Time Series via Green's integral constraint

Save program process as

>> [Function] Utilizing time-series of heterogeneous geodetic variations as observations and Load Green's Integral as a geodynamic constraint, this module estimates the Terrestrial EWH Variation and All-Element Load Effect Grid Time Series. This is typically used to reconstruct a regional time-varying gravity field.

>> 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 computation surface height grid file C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/dtm3m.dat.

>> Create or select the result folder C:/ETideLoad4.5_win64en/examples/LoadestimateGreen/Htrgrst.

** The program generates the estimated terrestrial EWH variation grid files ewh****.dat, corresponding load effect grid files, and residual analysis files rnt***.txt. Here, *** is the sampling epoch time which is also saved as the last column attribute of the load effect grid file header.

** All-Element Load Effect Grids:

- Greengeoid***.dat: Height anomaly / Geoid variation (mm)
- Greenterrgrav***.dat: Ground gravity variation (μGal)
- Greengravdist***.dat: Gravity disturbance variation (μGal)
- Greenrndtilt***.dat: Ground tilt variation vector (SW, mas)
- Greenvertdefl***.dat: Vertical deflection variation vector (SW, mas)
- Greenhorzdisp***.dat: Horizontal displacement vector (EN, mm)
- Greenelliphgt***.dat: Ellipsoidal height variation (mm)

Set the result folder

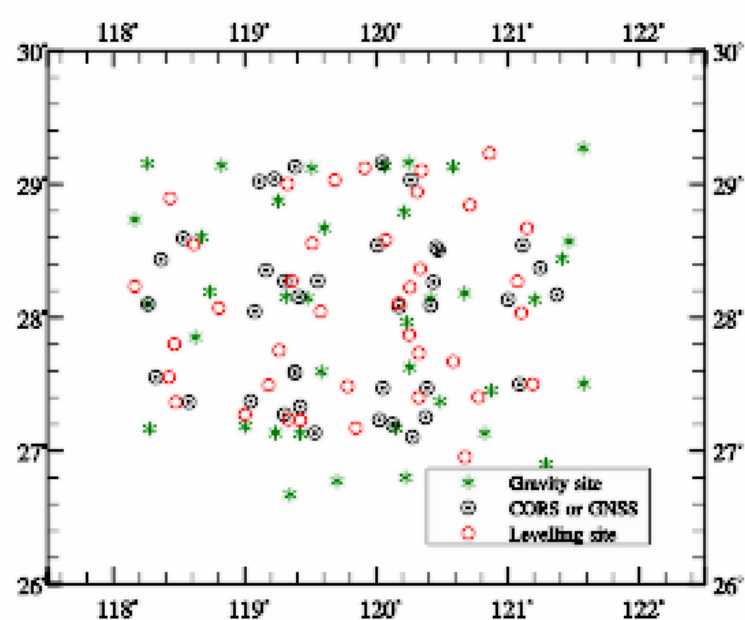
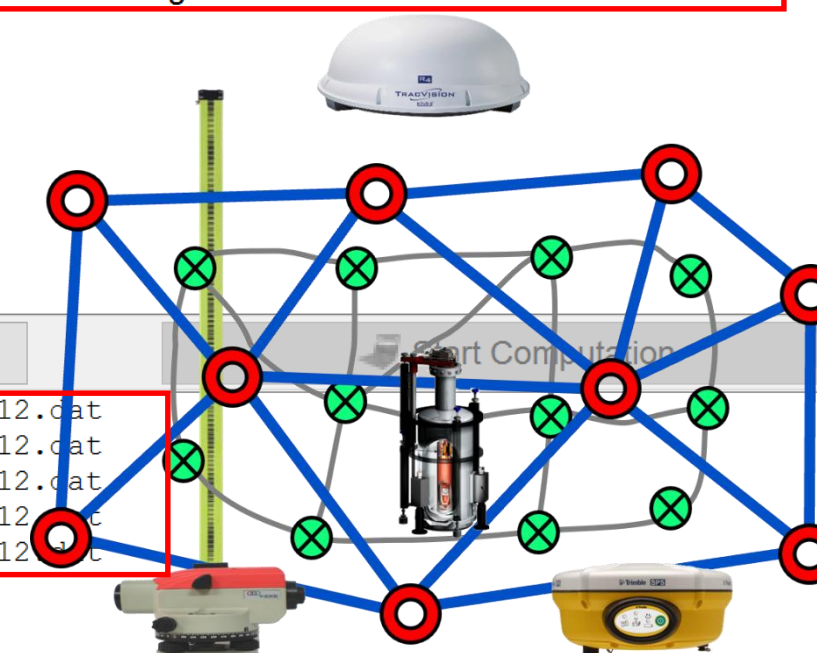
Import setting parameters

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

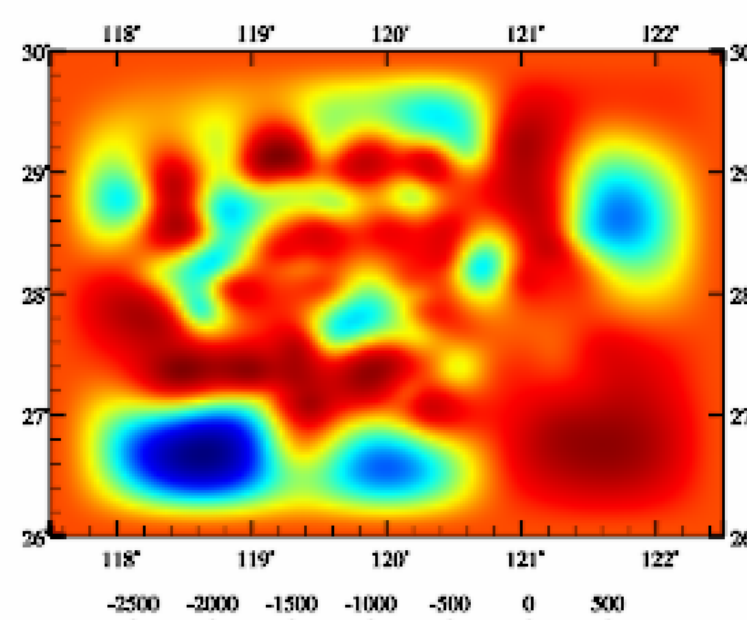
The monitoring epoch time 2016021512

Extract the effects to be plot

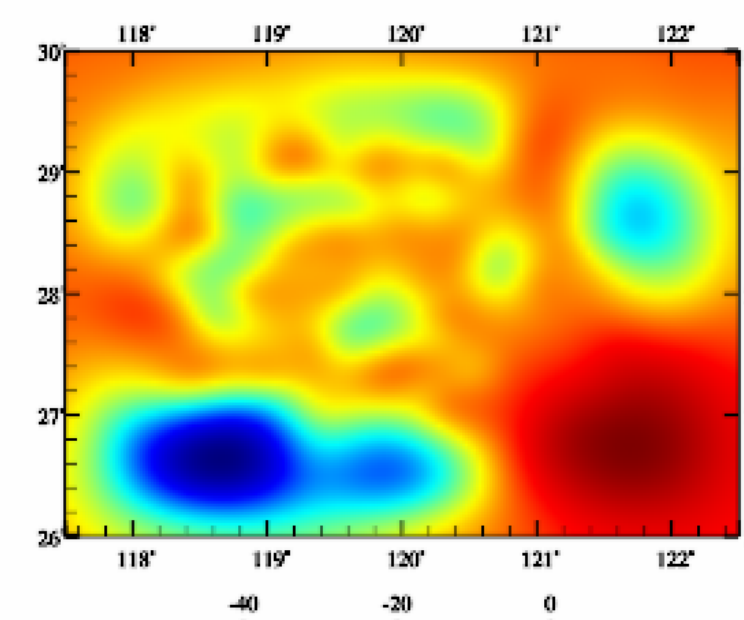
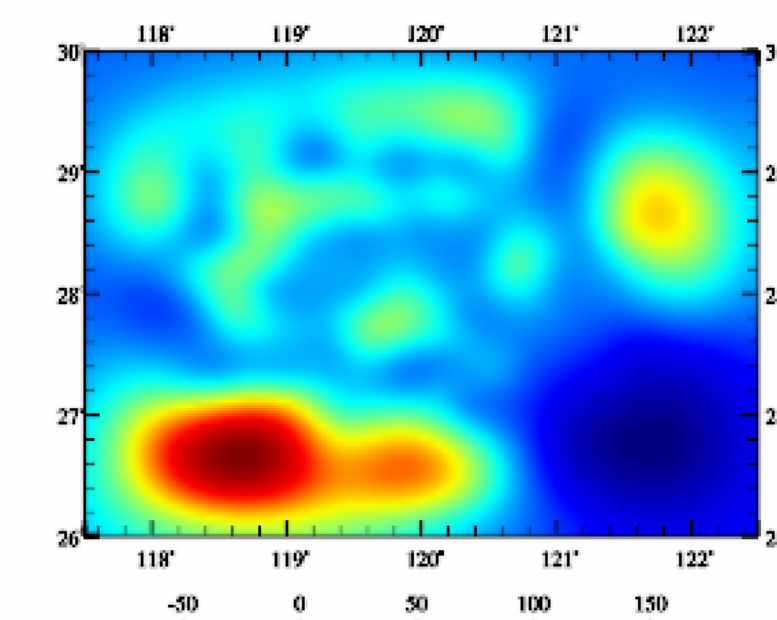
Plot↓



Spatial distribution of geodetic sites



Land water EWH variations (cm)

Ground gravity variations (μGal)

Orthometric height variations (mm)

Acceptable Geodetic Variation Types: (1) Height Anomaly Variation (mm) - Derived from GNSS-leveling networks; (2) Gravity Disturbance Variation (μGal) - Derived from GNSS-gravity networks or CORS-gravity tide stations; (3) Ground Gravity Variation (μGal) - Derived from absolute or relative gravity monitoring networks; (4) Ellipsoidal Height Variation (mm) - Derived from CORS or GNSS monitoring networks; or (5) Normal/Orthometric Height Variation (mm) - Derived from precision leveling networks.

The optimization principles aim to produce spatially continuous and differentiable EWH variation fields while minimizing the standard deviation and driving the statistical mean toward zero for residual observation variations.

SRBF Approximation of Land Water Variations and Load Effects from Heterogeneous Variations

SRBF Approximation of Land Water Variations and Load Effects from Heterogeneous Variations

SRBF Approximation of EWH Variation and Load Effect Time Series from Heterogeneous Variations

Regional Approximation of Load Deformation Field from heterogeneous variations using SRBFs

Open the geodetic variation record time series file

Open the computation surface height grid file

Set the result 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: 8
 The column ordinal number of the observation weights in record: 5
 The column ordinal number of the variation type in record: 6
 The column ordinal number of the system weights in record: 7
 The column ordinal number of the current variations in record: 8

Average Station Spacing: 5.0 km

Parameters of the first SRBF approach

Select SRBF: radial multipole kernel

order number m: 0

minimum degree: 9

maximum degree: 900

burial depth of Bjerhammar sphere: 1.00km

SRBF Center Action Distance: 120km

Parameters of cumulative SRBF approach

Select SRBF: Poisson wavelet kernel

order number m: 0

minimum degree: 720

maximum degree: 1800

burial depth of Bjerhammar sphere: 5.00km

SRBF Center Action Distance: 60km

>> [Function] Utilizing heterogeneous ground-based observable variations – including GNSS-leveling height anomaly (mm), gravity disturbance (μGal), ground gravity (μGal), ellipsoidal height (mm), normal height (mm), or equivalent water height (cm) – as input constraints, and employing the SRBF approximation algorithm, this function estimates the regional terrestrial Equivalent Water Height (EWH) variation (cm) and associated load effects on the 10 geodetic elements: Height anomaly (geoid, mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, mas), vertical deflection (SW, mas), horizontal displacement (EN, mm), geodetic height (mm), normal height (mm), gravity disturbance gradient (mE), and horizontal gravity gradient (NW, E).

>> 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 series...

>> Open the computation surface height grid file C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/dtm3m.dat.

>> Create or select the result folder C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst.

** The program generates the estimated terrestrial EWH variation grid files ewh***.dat, corresponding load effect grid files, and residual analysis files rnt***.txt. Here, *** is the sampling epoch time which is also saved as the last column attribute of the load effect grid file header.

** All-Element Load Effect Grids:

SRBFgeoid***.dat: Height anomaly / Geoid variation (mm)

SRBFterrgrav***.dat: Ground gravity variation (μGal)

SRBFgravdist***.dat: Gravity disturbance variation (μGal)

SRBFgrndtilt***.dat: Ground tilt variation vector (SW, mas)

SRBFvertdefl***.dat: Vertical deflection variation vector (SW, mas)

SRBFhorzdisp***.dat: Horizontal displacement vector (EN, mm)

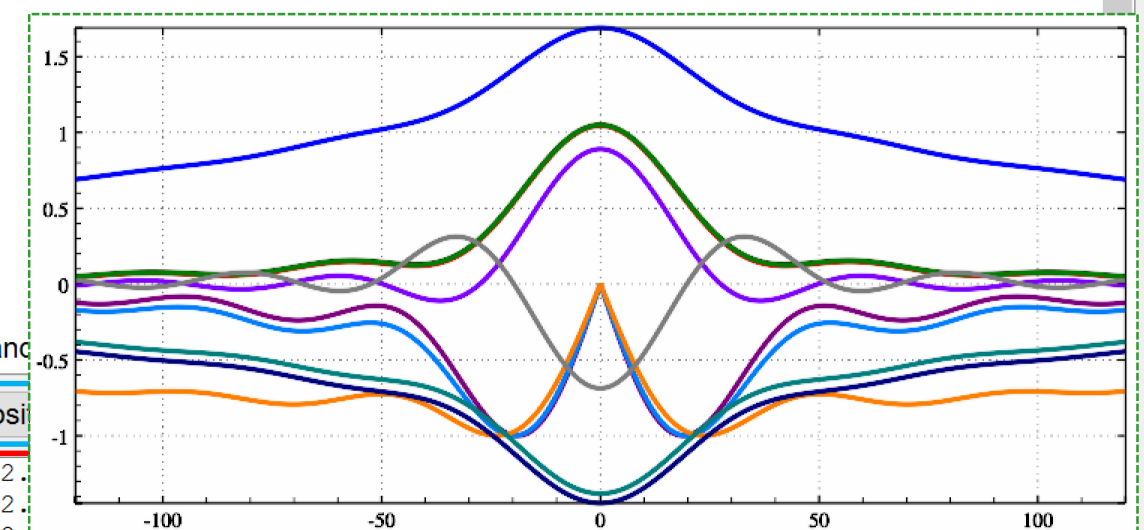
SRBFellipght***.dat: Ellipsoidal height variation (mm)

SRBForthohgt***.dat: Normal height variation (mm)

SRBFgradient***.dat: Radial gravity gradient variation (mE)

SRBFhorzgrad***.dat: Horizontal gravity gradient vector (NW, mE)

** The program also outputs the SRBF spatial curve file *spc.rbf and spectral curve files *dgr.rbf and



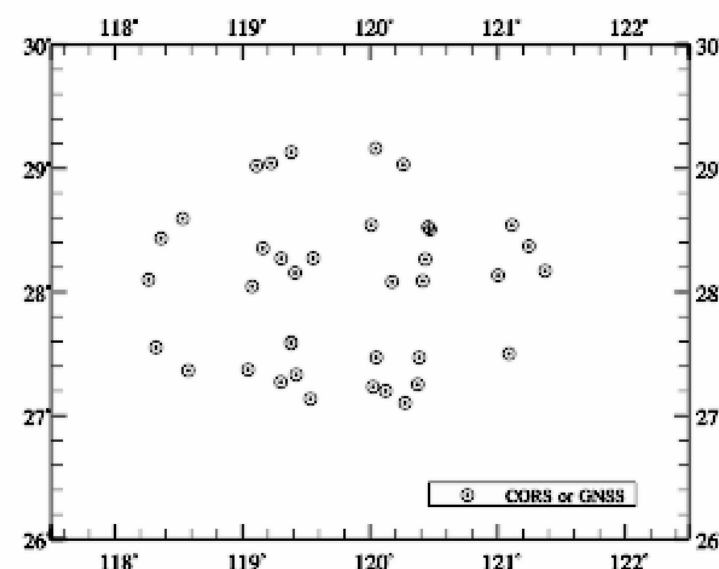
Cumulative SRBF approach times: 1 Solution of normal equation: LU triangular decomposition

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst/SRBFhorzdisp2015011612.dat
 C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst/SRBFellipght2015011612.dat
 C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst/SRBForthohgt2015011612.dat
 C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst/SRBFgradient2015011612.dat
 C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst/SRBFhorzgrad2015011612.dat

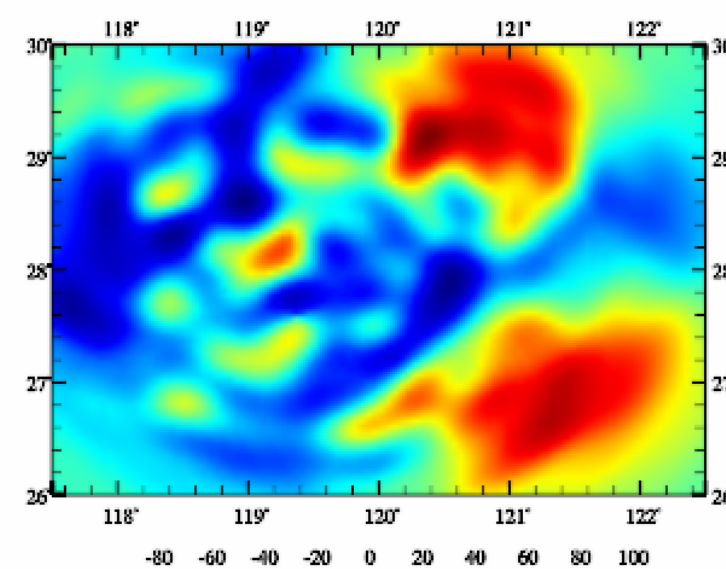
Extract the effects to be plot

Plot

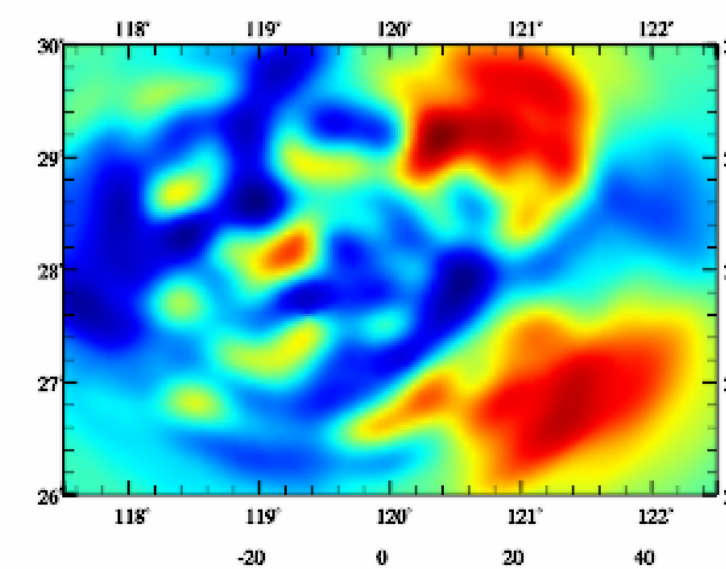
The monitoring epoch time 2015011612



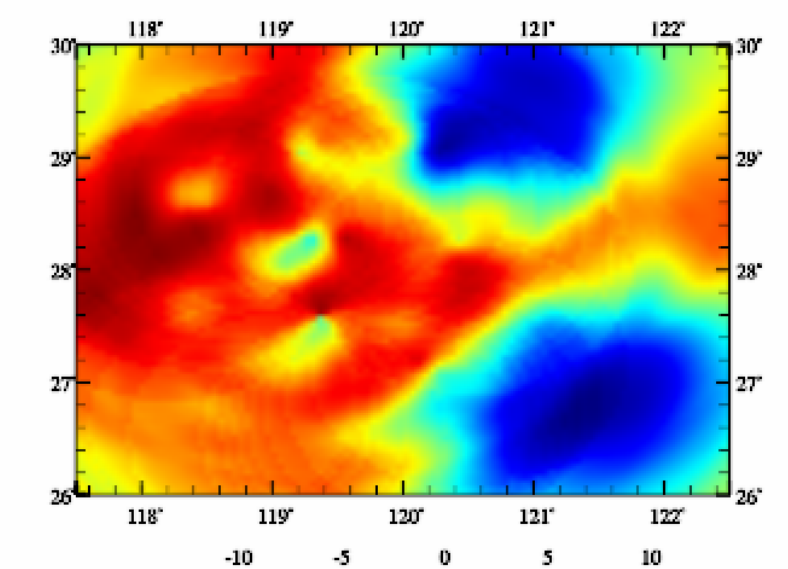
Spatial distribution of geodetic sites



Land water EWH variations (cm)



Ground gravity variations (μGal)



Orthometric height variations (mm)

Acceptable Geodetic Variation Types: (1) Height Anomaly Variation (mm) - Derived from GNSS-leveling networks; (2) Gravity Disturbance Variation (μGal) - Derived from GNSS-gravity networks or CORS-gravity tide stations; (3) Ground Gravity Variation (μGal) - Derived from absolute or relative gravity monitoring networks; (4) Ellipsoidal Height Variation (mm) - Derived from CORS or GNSS monitoring networks; (5) Normal/Orthometric Height Variation (mm) - Derived from precision leveling networks; or (6) Equivalent Water Height (EWH) Variation (cm) - Derived from hydrological monitoring stations.

The optimization principles aim to produce spatially continuous and differentiable EWH variation fields while minimizing the standard deviation and driving the statistical mean toward zero for residual observation variations.

SRBF Approximation of Land Water Variations and Load Effects from Heterogeneous Variations

SRBF Approximation of Land Water Variations and Load Effects from Heterogeneous Variations

SRBF Approximation of EWH Variation and Load Effect Time Series from Heterogeneous Variations

Regional Approximation of Load Deformation Field from heterogeneous variations using SRBFs

Open the geodetic variation record time series file

Open the computation surface height grid file

Set the result 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: 8

The column ordinal number of the observation weights in record: 5

The column ordinal number of the variation type in record: 6

The column ordinal number of the system weights in record: 7

The column ordinal number of the current variations in record: 8

Average Station Spacing: 5.0 km

Parameters of the first SRBF approach

Select SRBF: radial multipole kernel

order number m: 0

minimum degree: 9

maximum degree: 900

burial depth of Bjerhammar sphere: 1.00km

SRBF Center Action Distance: 120km

Parameters of cumulative SRBF approach

Select SRBF: Poisson wavelet kernel

order number m: 0

minimum degree: 720

maximum degree: 1800

burial depth of Bjerhammar sphere: 5.00km

SRBF Center Action Distance: 60km

>> [Function] Utilizing heterogeneous ground-based observable variations – including GNSS-leveling height anomaly (mm), gravity disturbance (μGal), ground gravity (μGal), ellipsoidal height (mm), normal height (mm), or equivalent water height (cm) – as input constraints, and employing the SRBF approximation algorithm, this function estimates the regional terrestrial Equivalent Water Height (EWH) variation (cm) and associated load effects on the 10 geodetic elements: Height anomaly (geoid, mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, mas), vertical deflection (SW, mas), horizontal displacement (EN, mm), geodetic height (mm), normal height (mm), gravity disturbance gradient (mE), and horizontal gravity gradient (NW, E).

>> Open the geodetic variation record time series file C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/heterobstm.txt.

** Look at the file information in the window below and set the file parameters of the record time series...

>> Open the computation surface height grid file C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/dtm3m.dat.

>> Create or select the result folder C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrst.

** The program generates the estimated terrestrial EWH variation grid files ewh***.dat, corresponding load effect grid files, and residual analysis files rnt***.txt. Here, *** is the sampling epoch time which is also saved as the last column attribute of the load effect grid file header.

** All-Element Load Effect Grids:

SRBFgeoid***.dat: Height anomaly / Geoid variation (mm)

SRBFterrgrav***.dat: Ground gravity variation (μGal)

SRBFgravdist***.dat: Gravity disturbance variation (μGal)

SRBFgrndtilt***.dat: Ground tilt variation vector (SW, mas)

SRBFvertdefl***.dat: Vertical deflection variation vector (SW, mas)

SRBFhorzdisp***.dat: Horizontal displacement vector (EN, mm)

SRBFelliphgt***.dat: Ellipsoidal height variation (mm)

SRBForthohgt***.dat: Normal height variation (mm)

SRBFgradient***.dat: Radial gravity gradient variation (mE)

SRBFhorzgrad***.dat: Horizontal gravity gradient vector (NW, mE)

** The program also outputs the SRBF spatial curve file spc.rbf and spectral curve files *dgr.rbf and *dgr.rbf

Cumulative SRBF approach times: 1

Solution of normal equation: LU triandia decomposition

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrst/SRBFhorzdisp2015011612.dat

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrst/SRBFelliphgt2015011612.dat

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrst/SRBForthohgt2015011612.dat

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrst/SRBFgradient2015011612.dat

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrst/SRBFhorzgrad2015011612.dat

Extract the effects to be plot

The monitoring epoch time 2015011612

Spatial distribution of geodetic sites

Land water EWH variations (cm)

Ground gravity variations (μGal)

Orthometric height variations (mm)

Acceptable Geodetic Variation Types: (1) Height Anomaly Variation (mm) - Derived from GNSS-leveling networks; (2) Gravity Disturbance Variation (μGal) - Derived from GNSS-gravity networks or CORS-gravity tide stations; (3) Ground Gravity Variation (μGal) - Derived from absolute or relative gravity monitoring networks; (4) Ellipsoidal Height Variation (mm) - Derived from CORS or GNSS monitoring networks; (5) Normal/Orthometric Height Variation (mm) - Derived from precision leveling networks; or (6) Equivalent Water Height (EWH) Variation (cm) - Derived from hydrological monitoring stations.

The optimization principles aim to produce spatially continuous and differentiable EWH variation fields while minimizing the standard deviation and driving the statistical mean toward zero for residual observation variations.

SRBF Approximation of EWH Variation and Load Effect Time Series from Heterogeneous Variations

SRBF Approximation of Land Water Variations and Load Effects from Heterogeneous Variations

SRBF Approximation of EWH Variation and Load Effect Time Series from Heterogeneous Variations

Regional Approximation of Load Deformation Field from heterogeneous variations using SRBFs

Open the geodetic variation record time series file

Open the computation surface height grid file

Set the result folder

Save program process as

Column ordinal number of the first epoch time in header:

Column ordinal number of the first variation in record:

The column ordinal number of the observation weights in record:

The column ordinal number of the variation type in record:

The column ordinal number of the system weights in record:

Average Station Spacing:

Parameters of the first SRBF approach

Select SRBF	radial multipole kernel
order number m	0
minimum degree	9
maximum degree	900
burial depth of Bjerhammar sphere	1.00km
SRBF Center Action Distance	120km

Parameters of cumulative SRBF approach

Select SRBF	Poisson wavelet kernel
order number m	0
minimum degree	720
maximum degree	1800
burial depth of Bjerhammar sphere	5.00km
SRBF Center Action Distance	60km

>> [Function] Utilizing time-series of heterogeneous ground-based observable variations, this function computes the time series of grids for terrestrial EWH variation (cm) and associated load effects on the 10 geodetic elements: Height anomaly (geoid, mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, mas), vertical deflection (SW, mas), horizontal displacement (EN, mm), geodetic height (mm), normal height (mm), gravity disturbance gradient (mE), and horizontal gravity gradient (NW, E) using SRBF load deformation field approximation algorithm.

>> 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 series...

>> Open the computation surface height grid file C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/dtm3m.dat.

>> Create or select the result folder C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst.

** The program generates the estimated terrestrial EWH variation grid files ewh***.dat, corresponding load effect grid files, and residual analysis files rnt***.txt. Here, *** is the sampling epoch time which is also saved as the last column attribute of the load effect grid file header.

** All-Element Load Effect Grids:

- SRBFgeoid***.dat: Height anomaly / Geoid variation (mm)
- SRBFterrgrav***.dat: Ground gravity variation (μGal)
- SRBFgravdist***.dat: Gravity disturbance variation (μGal)
- SRBFgrndtilt***.dat: Ground tilt variation vector (SW, mas)
- SRBFvertdefl***.dat: Vertical deflection variation vector (SW, mas)
- SRBFhorzdisp***.dat: Horizontal displacement vector (EN, mm)
- SRBFelliphgt***.dat: Ellipsoidal height variation (mm)
- SRBForthohgt***.dat: Normal height variation (mm)
- SRBFgradient***.dat: Radial gravity gradient variation (mE)
- SRBFhorzgrad***.dat: Horizontal gravity gradient vector (NW, mE)

Cumulative SRBF approach times: Solution of normal equation:

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst/SRBFgravdist2016021512.dat
 C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst/SRBFgrndtilt2016021512.dat
 C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/CORSrst/SRBFvertdefl2016021512.dat
 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

The monitoring epoch time 2016021512

Extract the effects to be plot

Plot

Spatial distribution of geodetic sites

Land water EWH variations (cm)

Ground gravity variations (μGal)

Orthometric height variations (mm)

● Acceptable Geodetic Variation Types: (1) Height Anomaly Variation (mm) - Derived from GNSS-leveling networks; (2) Gravity Disturbance Variation (μGal) - Derived from GNSS-gravity networks or CORS-gravity tide stations; (3) Ground Gravity Variation (μGal) - Derived from absolute or relative gravity monitoring networks; (4) Ellipsoidal Height Variation (mm) - Derived from CORS or GNSS monitoring networks; (5) Normal/Orthometric Height Variation (mm) - Derived from precision leveling networks; or (6) Equivalent Water Height (EWH) Variation (cm) - Derived from hydrological monitoring stations.

● The optimization principles aim to produce spatially continuous and differentiable EWH variation fields while minimizing the standard deviation and driving the statistical mean toward zero for residual observation variations.

SRBF Approximation of EWH Variation and Load Effect Time Series from Heterogeneous Variations

SRBF Approximation of Land Water Variations and Load Effects from Heterogeneous Variations

Open the geodetic variation record time series file

Column ordinal number of the first epoch time in header: 2

Column ordinal number of the first variation in record: 8

The column ordinal number of the observation weights in record: 5

The column ordinal number of the variation type in record: 6

The column ordinal number of the system weights in record: 7

Average Station Spacing: 5.0 km

Parameters of the first SRBF approach

Select SRBF: radial multipole kernel

order number m: 0

minimum degree: 9

maximum degree: 900

burial depth of Bjerhammar sphere: 1.00km

SRBF Center Action Distance: 120km

Parameters of cumulative SRBF approach

Select SRBF: Poisson wavelet kernel

order number m: 0

minimum degree: 720

maximum degree: 1800

burial depth of Bjerhammar sphere: 5.00km

SRBF Center Action Distance: 60km

SRBF Approximation of EWH Variation and Load Effect Time Series from Heterogeneous Variations

>> [Function] Utilizing time-series of heterogeneous ground-based observable variations, this function computes the time series of grids for terrestrial EWH variation (cm) and associated load effects on the 10 geodetic elements: Height anomaly (geoid, mm), ground gravity (μGal), gravity disturbance (μGal), ground tilt (SW, mas), vertical deflection (SW, mas), horizontal displacement (EN, mm), geodetic height (mm), normal height (mm), gravity disturbance gradient (mE), and horizontal gravity gradient (NW, E) using SRBF load deformation field approximation algorithm.

>> Open the geodetic variation record time series file C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/heterobstm.txt.

>> Open the computation surface height grid file C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrs.dat

>> Create or select the result folder C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrs/

** The program generates the estimated terrestrial EWH variation grid files ewh***.dat, corresponding sampling epoch time which is also saved as the last column attribute of the load effect grid file header

** All-Element Load Effect Grids:

SRBFgeoid***.dat: Height anomaly / Geoid variation (mm)

SRBFterrgrav***.dat: Ground gravity variation (μGal)

SRBFgravdist***.dat: Gravity disturbance variation (μGal)

SRBFgrndtilt***.dat: Ground tilt variation vector (SW, mas)

SRBFvertdefl***.dat: Vertical deflection variation vector (SW, mas)

SRBFhorzdisp***.dat: Horizontal displacement vector (EN, mm)

SRBFellipght***.dat: Ellipsoidal height variation (mm)

SRBForthohgt***.dat: Normal height variation (mm)

SRBFgradient***.dat: Radial gravity gradient variation (mE)

SRBFhorzgrad***.dat: Horizontal gravity gradient vector (NW, mE)

Cumulative SRBF approach times: 1

Solution of normal equation: LU triangular decomposition

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrs/ SRBFgrndtilt2016021512.dat

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrs/ SRBFvertdefl2016021512.dat

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrs/ SRBFhorzdisp2016021512.dat

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrs/ SRBFellipght2016021512.dat

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrs/ SRBForthohgt2016021512.dat

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrs/ SRBFgradient2016021512.dat

C:/ETideLoad4.5_win64en/examples/LoadestimateSRBF/htrgrs/ SRBFhorzgrad2016021512.dat

Extract the effects to be plot

Plot

Regional Approximation of Load Deformation Field from heterogeneous variations using SRBFs

Save program process as

Import setting parameters

Start Computation

Spatial distribution of geodetic sites

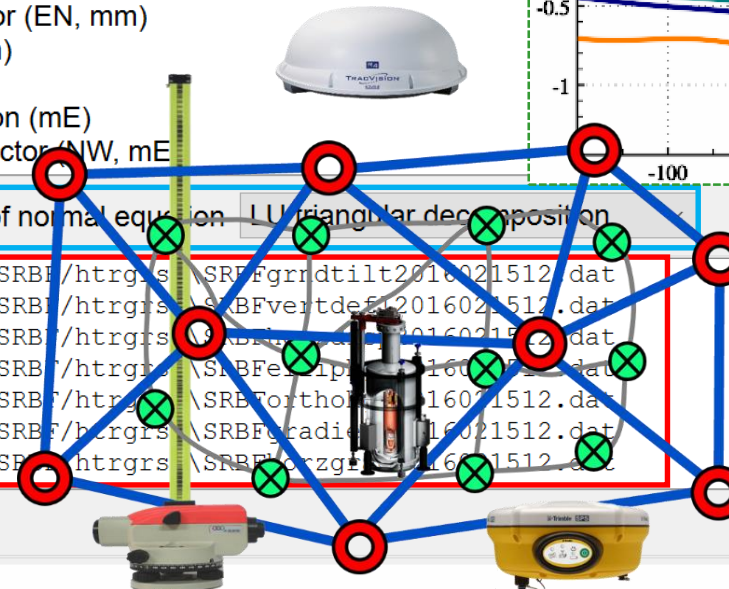
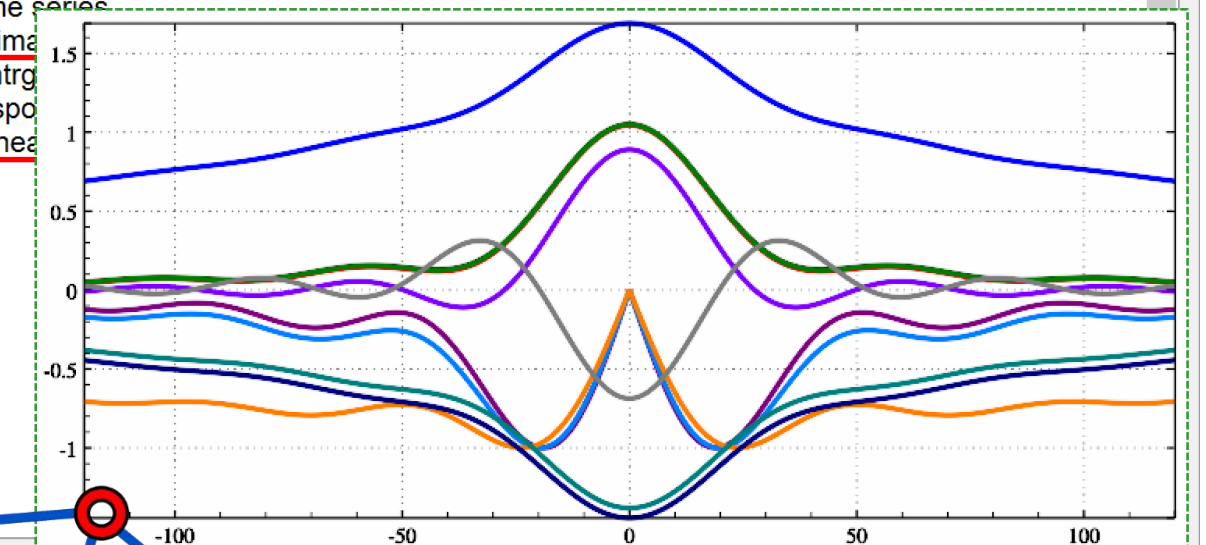
Land water EWH variations (cm)

Ground gravity variations (μGal)

Orthometric height variations (mm)

Acceptable Geodetic Variation Types: (1) Height Anomaly Variation (mm) - Derived from GNSS-leveling networks; (2) Gravity Disturbance Variation (μGal) - Derived from GNSS-gravity networks or CORS-gravity tide stations; (3) Ground Gravity Variation (μGal) - Derived from absolute or relative gravity monitoring networks; (4) Ellipsoidal Height Variation (mm) - Derived from CORS or GNSS monitoring networks; (5) Normal/Orthometric Height Variation (mm) - Derived from precision leveling networks; or (6) Equivalent Water Height (EWH) Variation (cm) - Derived from hydrological monitoring stations.

The optimization principles aim to produce spatially continuous and differentiable EWH variation fields while minimizing the standard deviation and driving the statistical mean toward zero for residual observation variations.



Time Difference Operation on Variation (Vector) Grid Time Series

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 file

- 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

 Save program process as

>> Program Process ** Operation Prompts

```
>> Create or select the result folder C:/ETideLoad4.5_win64en/examples/Loadfmgdtdmdyncalc/
diftmgrd.
```

**** The vector grid time series files searched by wildcard instantiation:**

C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl	201501.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl	201502.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl	201503.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl	201504.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl	201505.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl	201506.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl	201507.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl	201508.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl	201509.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl	201510.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl	201511.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmzl	201512.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: 2026-06-26 09:27:03
```

>> 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 attribute of the file header.

 Save the result folder

4.5 win64cn > examples > Loadfmgridtmdyncalc

在 Loadfmgriidtdyncalc 中搜索

› Loadfmggridtmdyncalc › diftmgrd

	118.50000000	121.50000000	27.00000000	29.00000000	
	-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

diftmgrd

gradtr

inner

tmgrid

vtmgrid

01.png

02.pn

03.png

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

Horizontal Gradient Calculation on Batch Variation Grids

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 file

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 coordinates

>> Program Process ** Operation Prompts

Save program process as

>> Create or select the result folder C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/gradtm.

** The vector grid time series files searched by wildcard instantiation:

C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmz201501.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmz201502.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmz201503.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmz201504.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmz201505.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmz201506.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmz201507.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmz201508.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmz201509.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmz201510.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmz201511.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/tmgrid/dmz201512.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: 2026-06-26 09:30:06

>> 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 attribute of the file header.

Save the result folder

4.5_win64cn > examples > Loadfmgridtmdyncalc

在 Loadfmgridtmdyncalc 中搜索

4.5_win64cn > examples > Loadfmgridtmdyncalc > gradtm



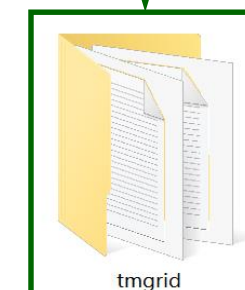
diftmgrid



gradtm



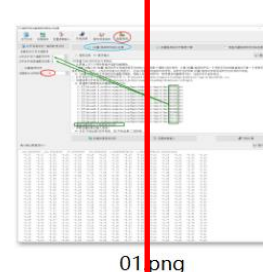
inner



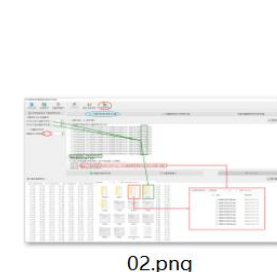
tmgrid



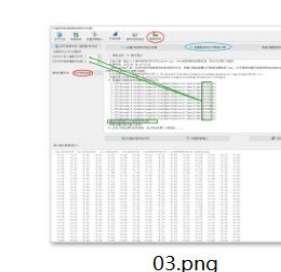
vtmgrid



01.png



02.png



03.png

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

118.50000000	121.50000000	27.00000000	29.0
-9.27	-9.27	-9.25	-9.24
-9.12	-9.11	-9.10	-9.10
-9.02	-9.02	-9.01	-9.00
-9.08	-9.10	-9.10	-9.11
-9.21	-9.21	-9.23	-9.21
-8.99	-8.96	-8.92	-8.90
-8.26	-8.17	-8.13	-8.06
-7.14	-7.08	-6.99	-6.89
-6.00	-5.94	-5.88	-5.82
-5.24	-5.22	-5.17	-5.15
-4.92	-4.90	-4.89	-4.88

-4.94	-4.93
-4.83	-4.82

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 the group 1 of vector grid time series file

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

The form of horizontal gradient vector Plane polar coordinates

Open any of the group 2 of vector grid time series file

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/gradtm/grad2015021500.dat
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/gradtm/grad2015031612.dat
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/gradtm/grad2015041512.dat
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/gradtm/grad2015051612.dat
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C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/gradtm/grad2015071612.dat
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/gradtm/grad2015081612.dat
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/gradtm/grad2015091512.dat
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/gradtm/grad2015101612.dat
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/gradtm/grad2015111512.dat
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/gradtm/grad2015121612.dat

>> 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/cxpcbh2015041512.txt
C:/ETideLoad4.5_win64en/examples/Loadfmgridtmdyncalc/vtmgrid/cxpcbh2015091512.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: 2026-06-26 09:37:49

>> Complete the computation! There are 2 vector inner product grid time series files innerp***.dat.
*** represents the sampling epoch time of the vector inner product grid file, is also 7th attribute of the file header.

Save the result folder

118.500000	121.500000	27.000000
2.9881E+01	1.5869E+01	2.9432E+01
1.0200E+01	2.5320E+01	9.2817E+00
1.9262E+01	2.2855E+00	1.8523E+01
-5.7087E+00	1.0968E+01	-6.8365E+00
3.2636E+00	-1.3444E+01	2.5051E+00
-1.7935E+01	-3.5131E+00	-1.8074E+01
-7.1160E+00	-2.0679E+01	-7.4254E+00
-2.2336E+01	-1.0459E+01	-2.2765E+01
-1.2615E+01	-2.4651E+01	-1.2905E+01
-2.4452E+01	-1.4911E+01	-2.4382E+01

4.5_win64cn > examples > Loadfmgridtmdyncalc

在 Loadfmgridtmdyncalc 中搜索



diftmgrd



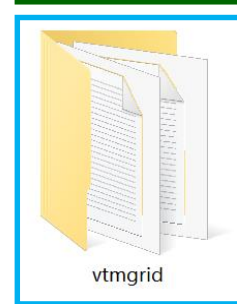
gradtm



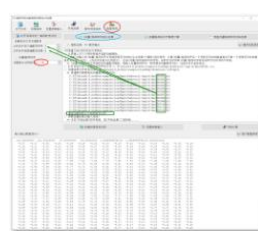
inner



tmgrid



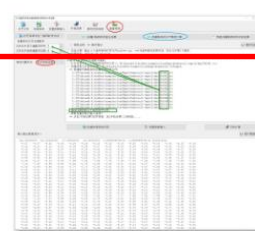
vtmgrid



01.png



02.png



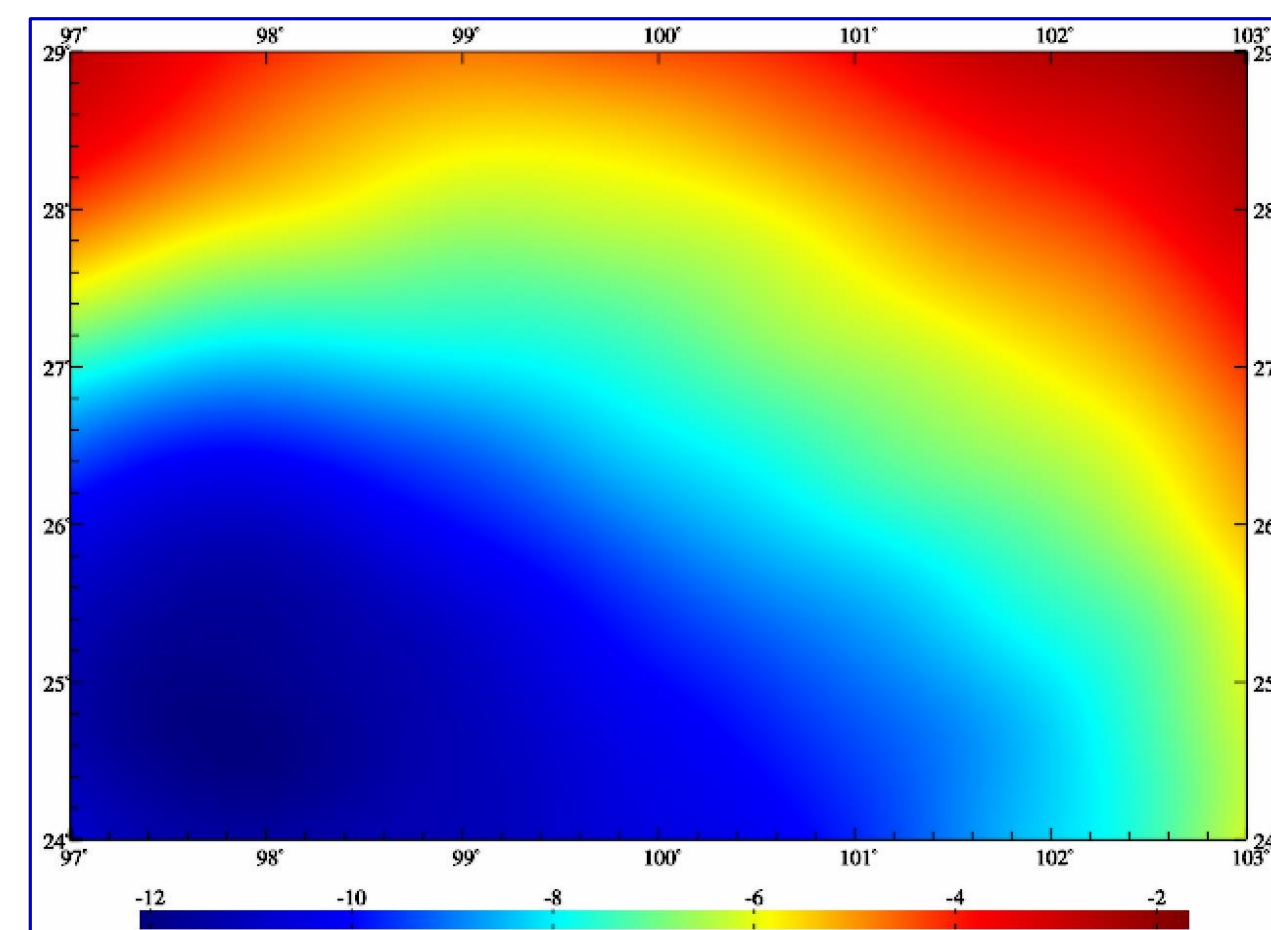
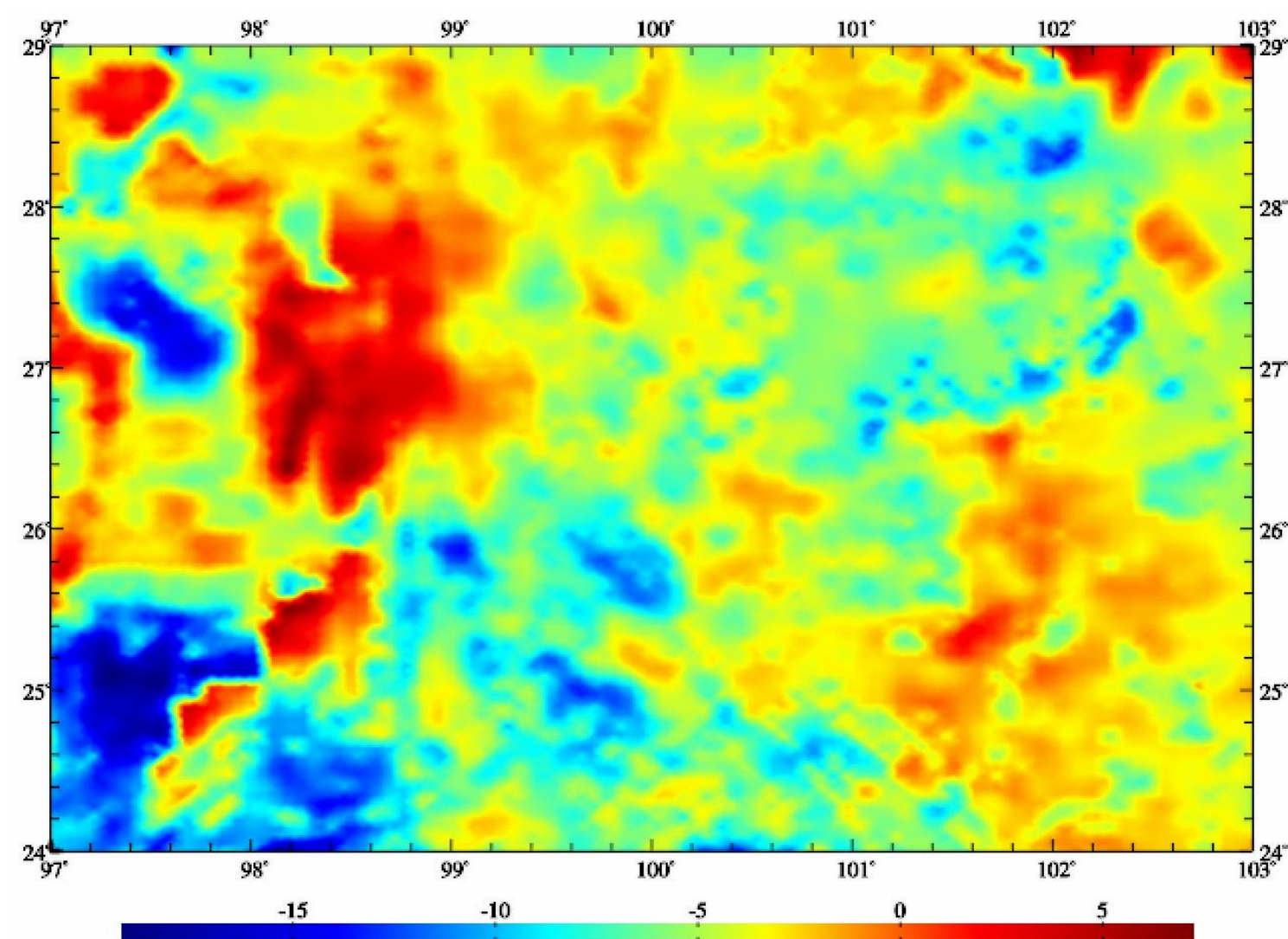
03.png

Start computation

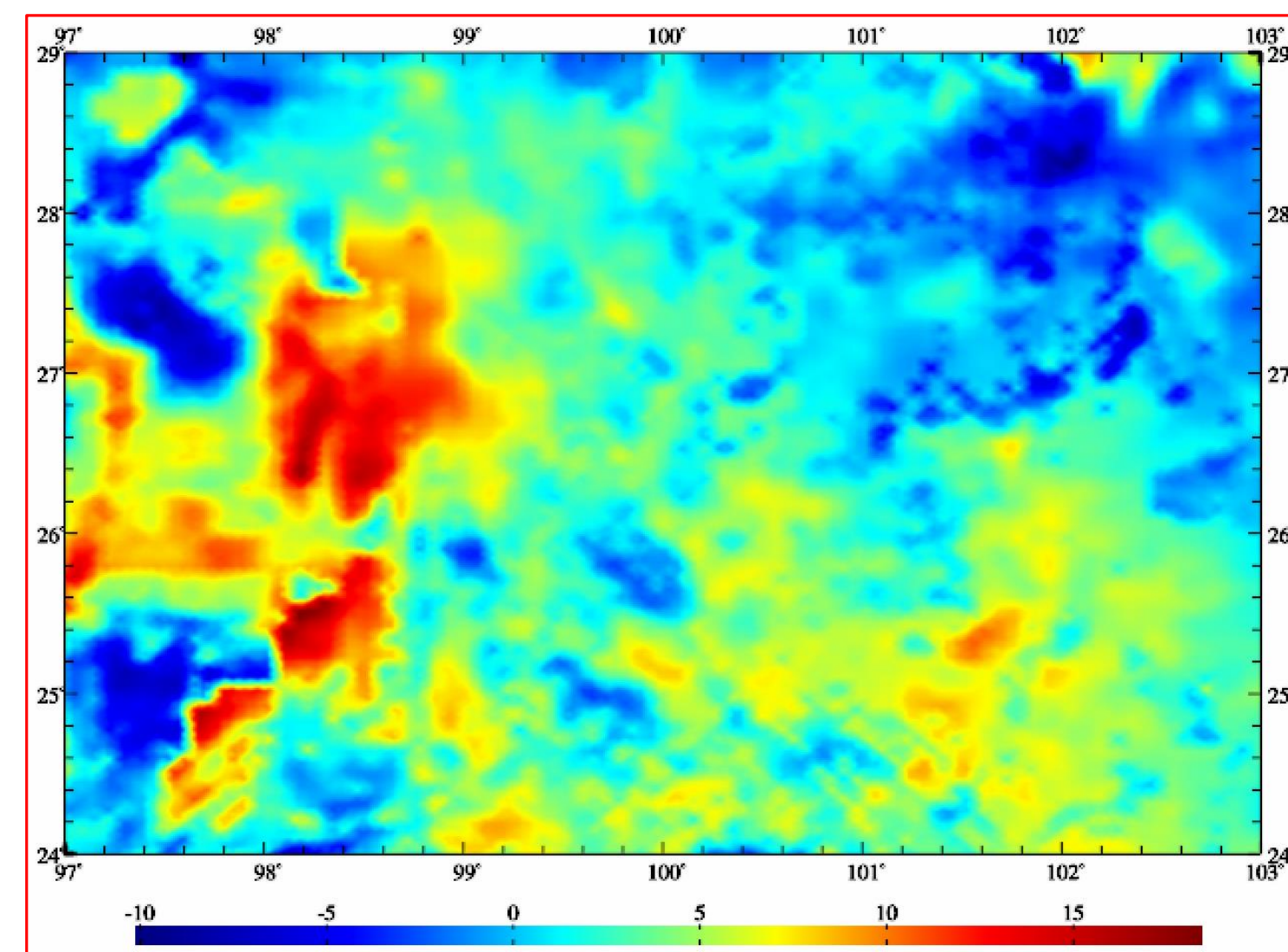
Windows (C:) > ETideLoad4.5_win64en > examples > Loadfmgridtmdyncalc > inner

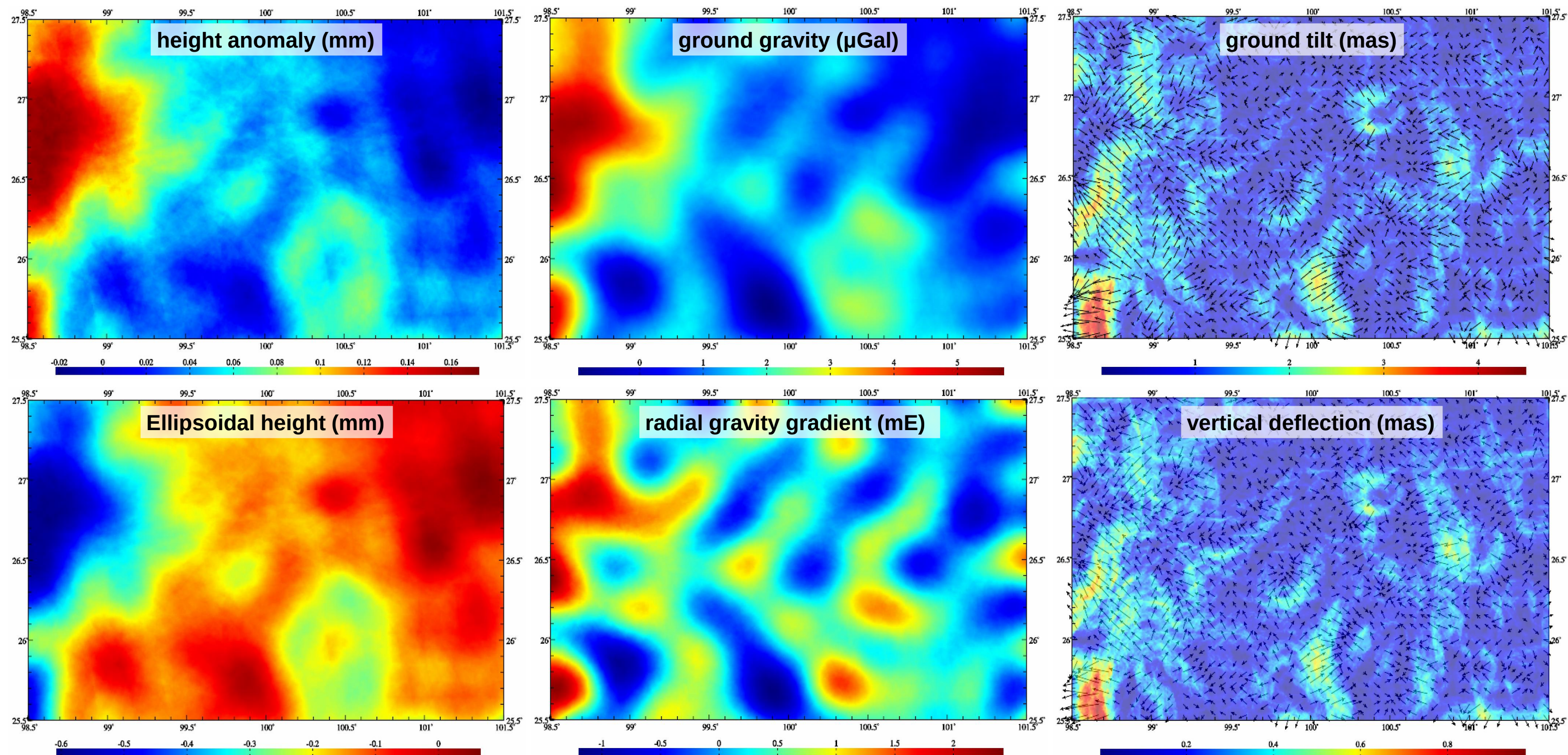
名称	修改日期
innerp2015041512.dat	2026/6/26 9:37
innerp2015091512.dat	2026/6/26 9:37

3+00	-1.9611E+01	-5.7886E+00	-1.9851E+01	-6.0
3+01	-8.8226E+00	-2.1657E+01	-9.1320E+00	-2.2
3+01	-2.3803E+01	-1.1288E+01	-2.3693E+01	-1.1
3+01	-1.4531E+01	-2.4811E+01	-1.4352E+01	-2.4
3+01	-2.4592E+01	-1.5290E+01	-2.4192E+01	-1.5

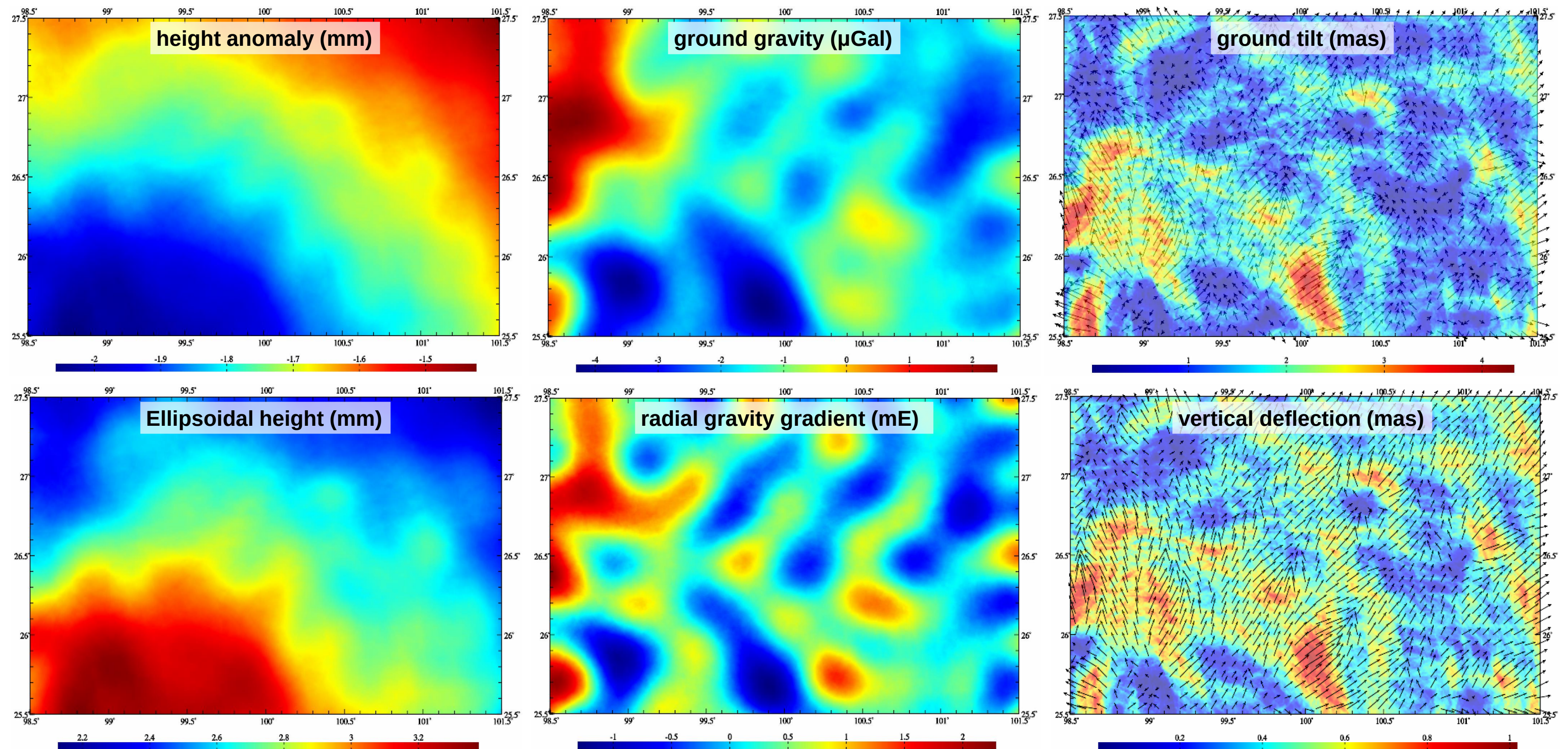


The 1'x1' land water EWH variation observation, model value and residual grid in the computation area

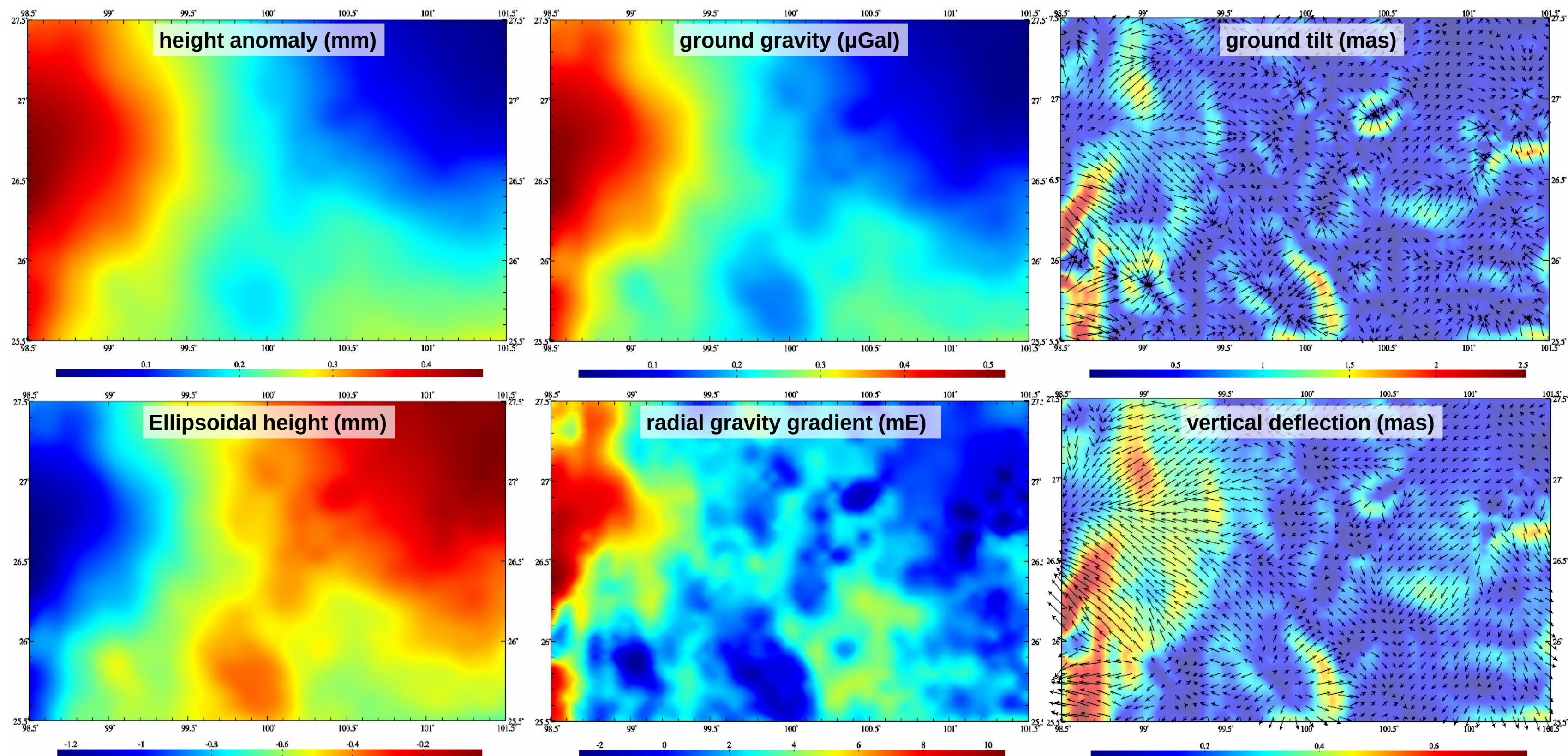




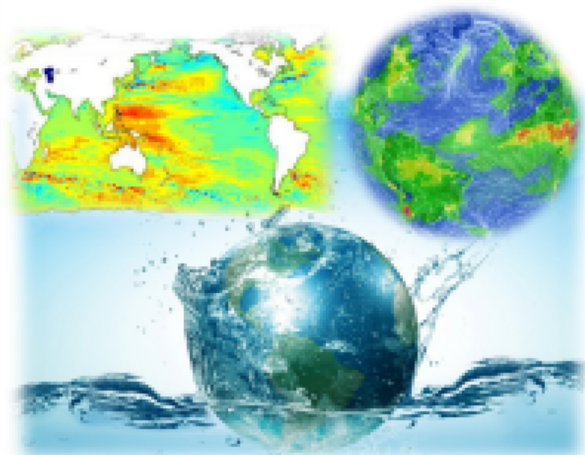
The 1'x1' land water load deformation field residual value grid using load SRBF approximation



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



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

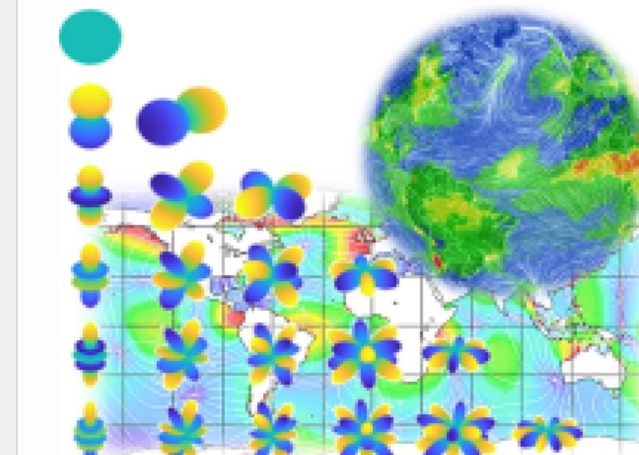


Spherical Harmonic Analysis on Global Surface Load Time Series

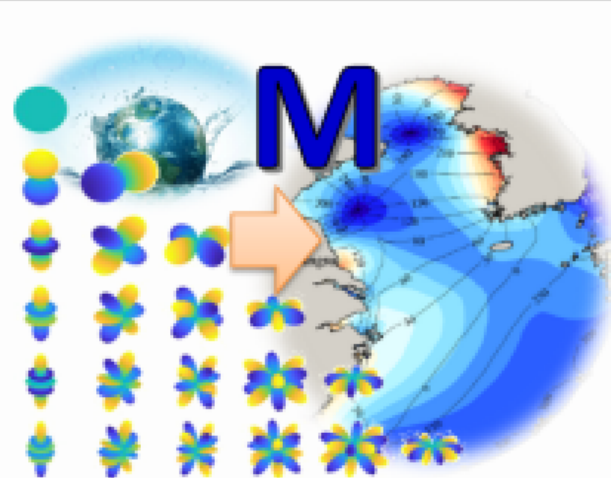
Load Deformation Field Approximation and Monitoring from Heterogeneous Variations

Non-tidal load variations originating from the atmosphere, ocean bottom pressure, soil moisture, groundwater, lakes, and glaciers induce temporal variations in the Earth's geopotential. These variations excite solid Earth deformation, resulting in time-variable signals observable across all geodetic elements.

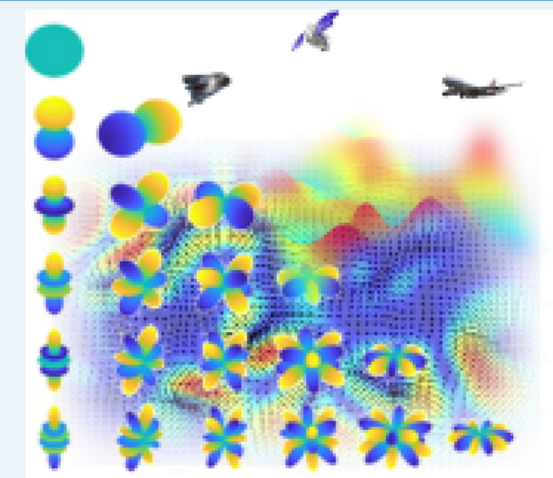
Functional architecture of the subsystem



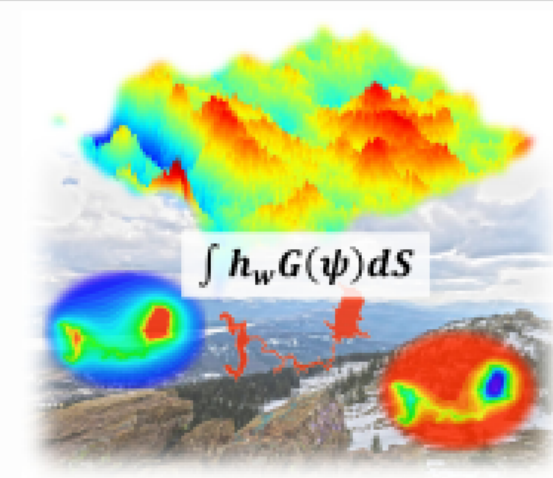
Spherical Harmonic Analysis of Tidal Harmonic Constants and Construction of Tidal Load Model



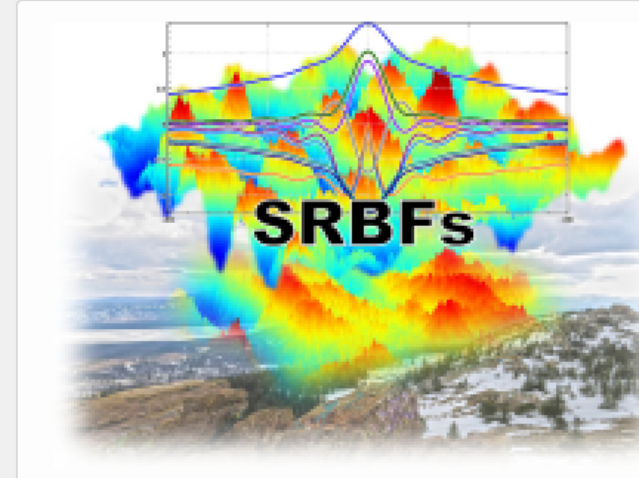
Computation of Load Model Values via Spherical Harmonic Synthesis



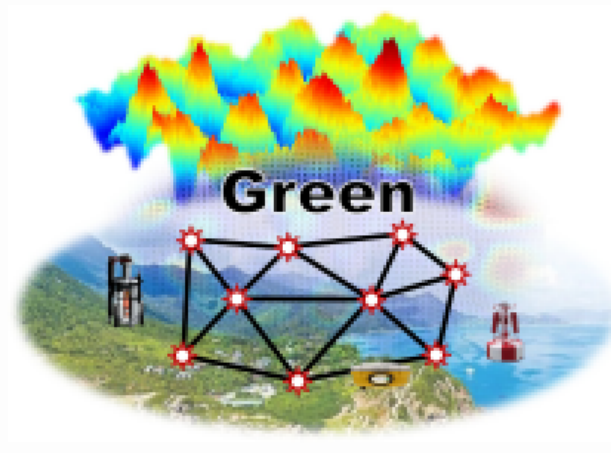
Computation of Load Deformation Field via Spherical Harmonic Synthesis



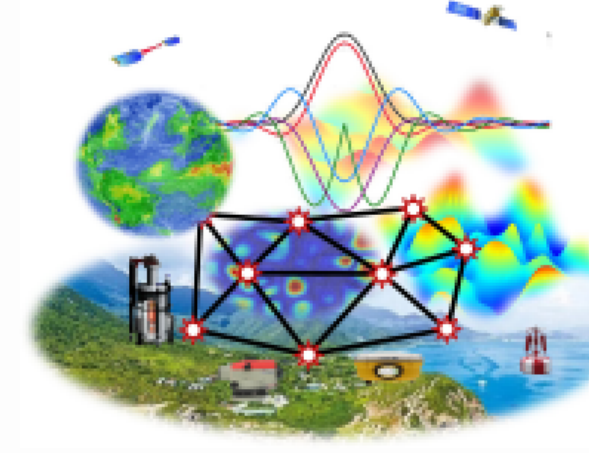
Regional Refinement of Load Deformation Field via Green's Integration



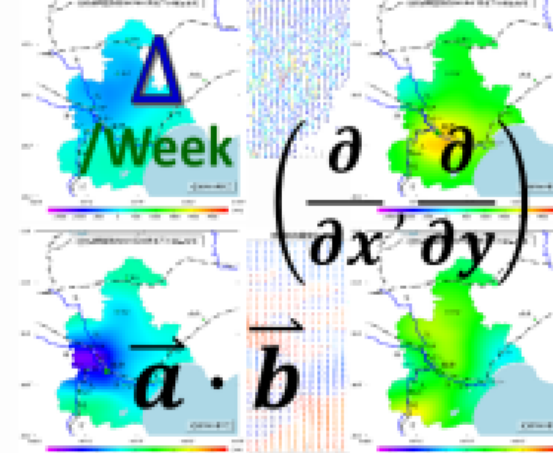
Regional Approximation of Load Deformation Field Using SRBFs



Load Deformation Field Recovery from Heterogeneous Variations via Green's Integral Constraint



SRBF Approximation of Terrestrial Water Variations and Load Effects from Heterogeneous Variations



Geodynamic Calculation on Geodetic Field Grid Time Series

Approximation Processes of High-Resolution Regional Load Deformation Field Time Series using SRBFs

Collaborative Monitoring Process of Groundwater Variations and Load Deformation Field with SRBFs

Approximation Processes for Surface Loads and All-element Load Deformation Field with SRBFs