United Nations
Office for Outer Space Affairs
Latvia Workshop on the
Applications of Global Navigation Satellite Systems

The impact of solid Earth tides on the DGNSS positioning results

M.sc.ing. Diana Haritonova
diana.haritonova@inbox.lv

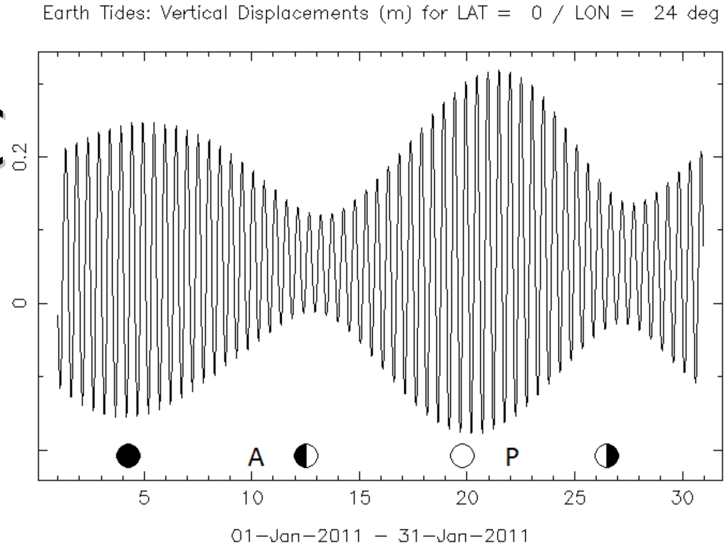
Institute of Geodesy and
Geoinformation (GGI)
University of Latvia

Riga, Latvia
14 – 18 May 2012

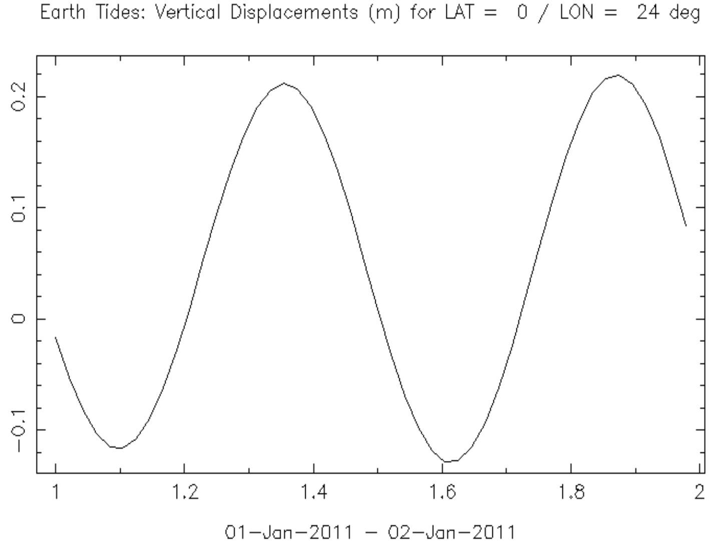
Content

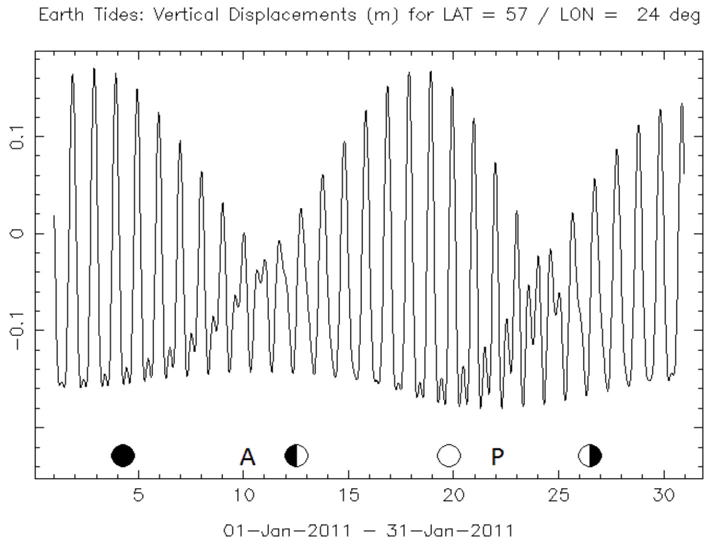
- Introduction: the nature of tide waves;
- The solid Earth tide caused vertical displacements at the EUPOS®-RIGA stations;
- The solid Earth tide caused vertical displacements at the EUREF stations;
- Conclusion.

The nature of tide waves (1)

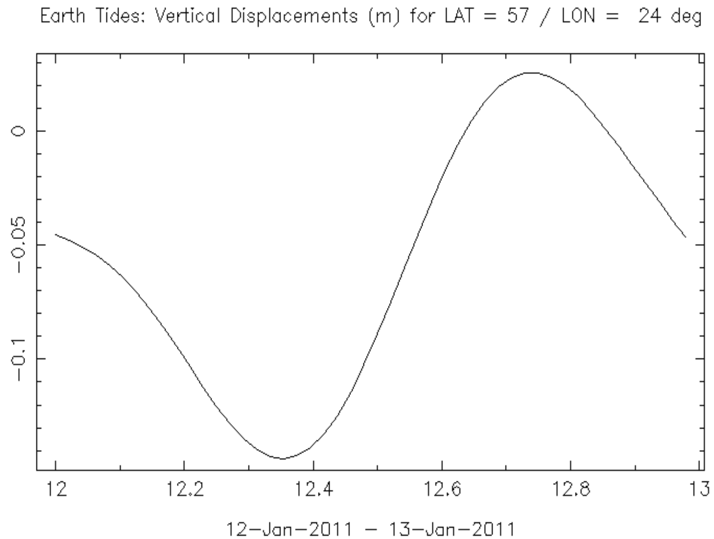


Semidiurnal tides



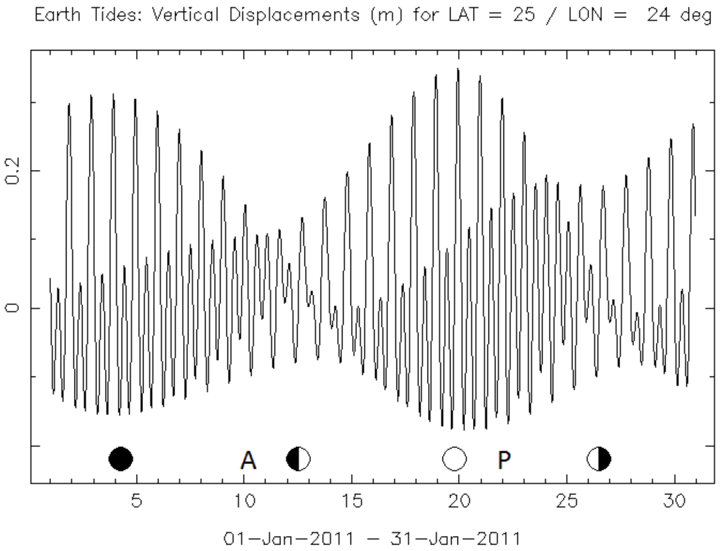


Diurnal tides

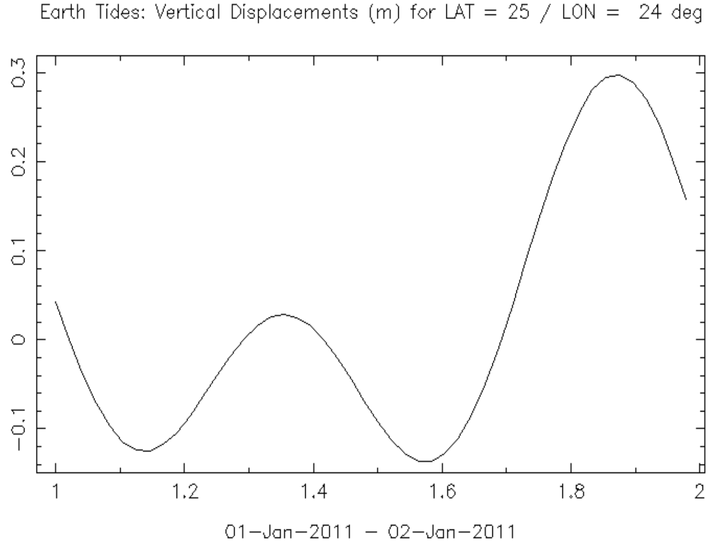


http://www.aiub.unibe.ch/content/services/earth_tides/

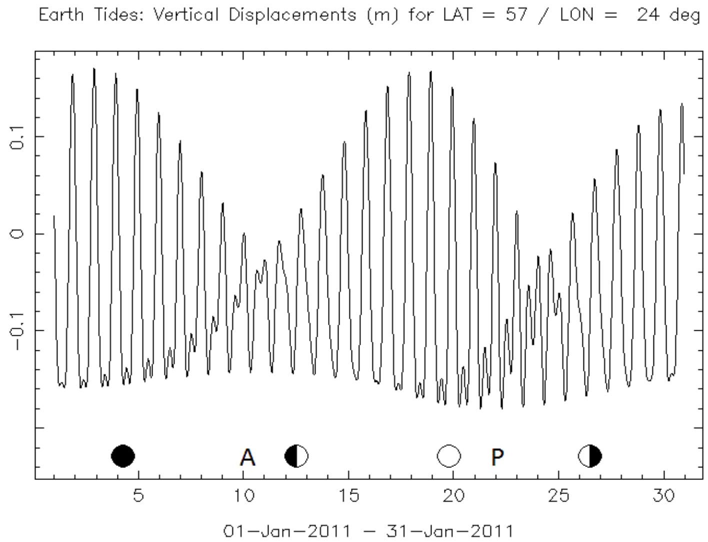
The nature of tide waves (2)



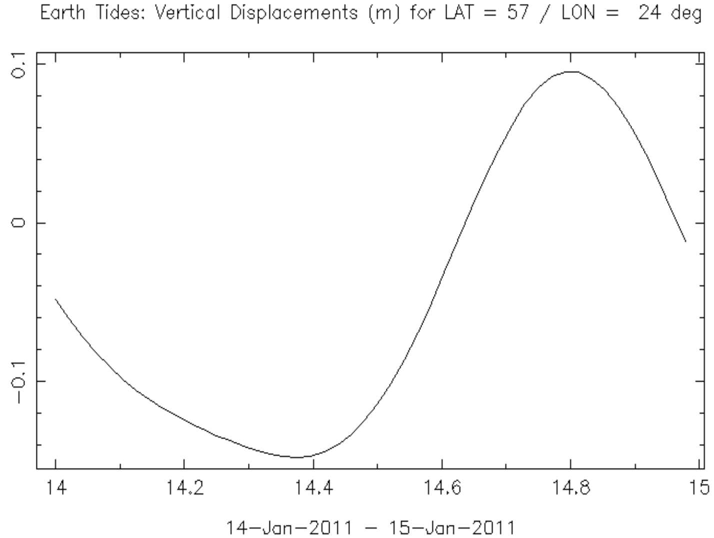
Irregular semidiurnal tides



MIXED TIDES

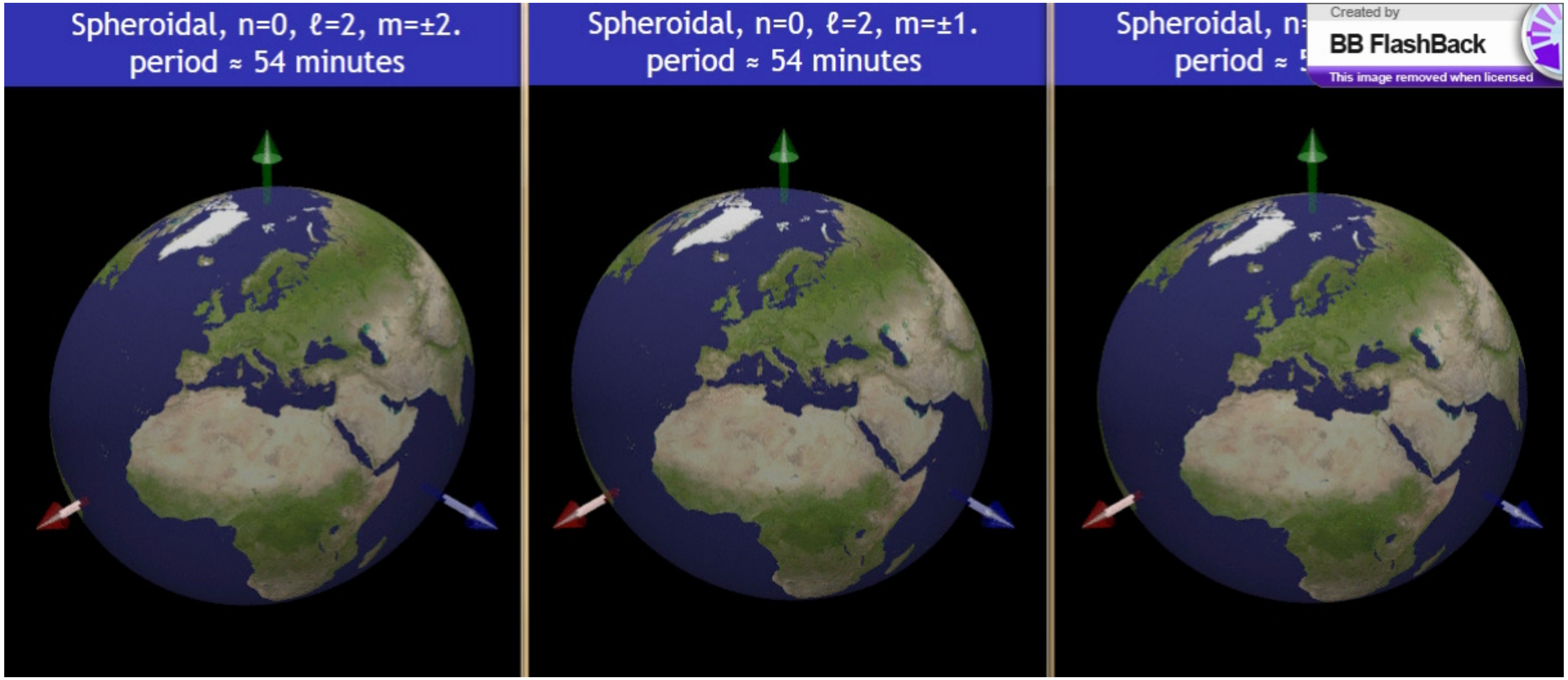


Irregular diurnal tides

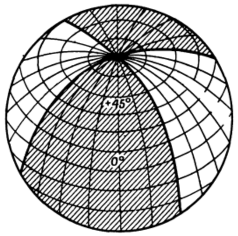


http://www.aiub.unibe.ch/content/services/earth_tides/

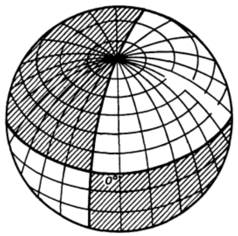
Tidal oscillations of the Earth



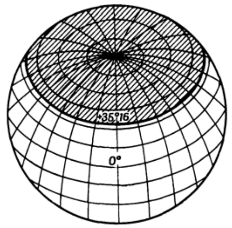
Sectorial
spherical function –
Semidiurnal tides



Tesseral
spherical function –
Diurnal tides



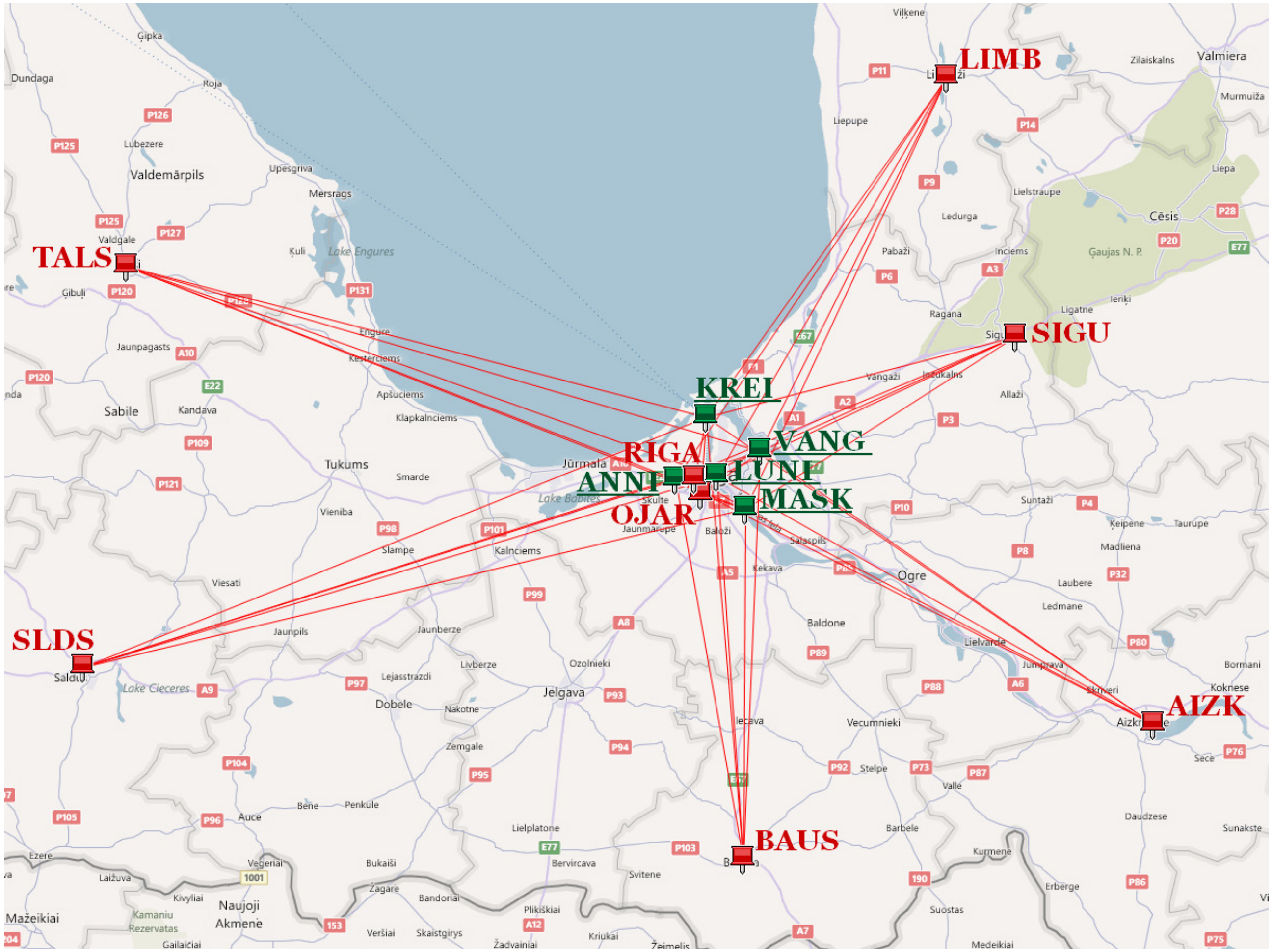
Zonal
spherical function –
Long-period tides



http://icb.u-bourgogne.fr/Nano/manapi/saviot/terre/index.en.html

The solid Earth tide caused vertical displacements at the EUPOS®-RIGA stations

using data of EUPOS®-RIGA, LatPos, EPN and IGS and applying *Bernese GPS Software*.



Solution of 5 kinematic stations and 8 static stations.

EUPOS®-RIGA stations: ANNI, KREI, LUNI, MASK, VANG

LatPos stations: AIZK, BAUS, LIMB, OJAR, SIGU, SLDS, TALS

EUREF station: RIGA

TIDE2000.f

```
C*
      SUBROUTINE TIDE2000(STANAM,XSTA,XSUN,XMON,DMJD,XPOL,YPOL,
     1                    IRCOCN,OCNAMP,OCNPHS,DXTIDE)
CC
CC PURPOSE    :  COMPUTATION OF TIDAL CORRECTIONS OF STATION DISPLACEMENTS
CC               CAUSED BY LUNAR AND SOLAR GRAVITATIONAL ATTRACTION
CC               (SEE IERS STANDARDS 2000)
CC               STEP 1 (HERE GENERAL DEGREE 2 AND 3 CORRECTIONS +
CC                      CALL ST1DIU + CALL ST1SEM + CALL ST1L1)
CC               + STEP 2 (CALL STEP2DIU + CALL ST2LON)
CC                        CORRECTION FOR POLAR MOTION
CC               IT HAS BEEN DECIDED THAT THE STEP 3 NON-CORRECTION FOR
CC               PERMANENT TIDE WOULD NOT BE APPLIED IN ORDER TO AVOID JUMP
CC               IN THE REFERENCE FRAME (THIS STEP 3 MUST ADDED IN ORDER TO
CC               GET THE NON-TIDAL STATION POSITION AND TO BE CONFORMED WITH
CC               THE IAG RESOLUTION.)
CC
CC PARAMETERS :
CC        IN :   STANAM           : STATION NAME                     CH*16
CC               XSTA(I),I=1,2,3,4: GEOCENTRIC POSITION OF THE STATION  R*8
CC               XSUN(I),I=1,2,3,4: GEOC. POSITION OF THE SUN         R*8
CC               XMON(I),I=1,2,3,4: GEOC. POSITION OF THE MOON        R*8
CC               DMJD             : MJD                               R*8
CC               XPOL             : POLAR MOTION (X RAD)              R*8
CC               YPOL             : POLAR MOTION (Y RAD)              R*8
CC               IRCOCN           : OCEAN LOADING FLAG (0: APPLY OL)  I*4
CC               OCNAMP           : OCEAN LOADING AMPLITUDES (M)   R*8(3,MAXOCN)
CC               OCNPHS           : OCEAN LOADING PHASES    (RAD)  R*8(3,MAXOCN)
CC       OUT :   DXTIDE(I),I=1,2,3: DISPLACEMENT VECTOR
CC
CC SR CALLED  :  SPROD, ST1DIU, ST1SEM, ST1L1, STEP2DIU, ST2LON, DMLMTV, OCLOAD
CC
CC AUTHOR     :  V. DEHANT, S. MATHEWS AND J. GIPSON (IERS 1996)
CC                     (TEST BETWEEN TWO SUBROUTINES)
CC AUTHOR     :  V. DEHANT AND S. MATHEWS (IERS 2000)
CC                     (TEST IN THE BERNESE PROGRAM BY C. BRUYNINX)
CC
CC CREATED    :  23-MAR-1996          LAST MODIFIED :  11-OCT-2005
CC
CC CHANGES    :  06-OCT-1997 TS: ADDAPTED FOR THE BERNESE SOFTWARE
CC               10-MAR-1998 TS: ADDED OCEAN LOADING CORRECTIONS
CC               01-FEB-2001 CB: IERS200
CC               02-JUN-2003 CU: ADDAPTED FOR THE BERNESE SOFTWARE V5.0
CC               10-JUN-2003 HU: MASS RATIOS FROM CONST.
CC               12-JUL-2004 HU: FHR FOR STEP 2 IS IN HOURS
CC               11-OCT-2005 MM: GEOCENTER COORDINATES POSSIBLE
CC
CC COPYRIGHT  :  ASTRONOMICAL INSTITUTE
CC      2003     UNIVERSITY OF BERNE
CC               SWITZERLAND
```

```
      USE m_maxdim, ONLY: MAXOCN
      IMPLICIT REAL*8 (A-H,O-Z)
C
      REAL*8   XSTA(*),XSUN(*),XMON(*),DXTIDE(*)
      REAL*8   H20,L20,H3,L3,H2,L2
      REAL*8   SS(3),R(3,3),XCOSTA(3),DOLOAD(3)
C
      REAL*8   OCNAMP(3,MAXOCN)
      REAL*8   OCNPHS(3,MAXOCN)
C
      CHARACTER*16 STANAM, STAERR
C
      INCLUDE 'COMCONST.inc'
C
C NOMINAL SECOND DEGREE AND THIRD DEGREE LOVE NUMBERS AND SHIDA NUMBERS
C ---------------------------------------------------------------------
      DATA H20/0.6078D0/,L20/0.0847D0/,H3/0.292D0/,L3/0.015D0/
      DATA XQUER/0.033D0/,YQUER/0.331D0/
C
C STATION IN GEOCENTER?
C ---------------------
        DO 30 I=1,3
          DXTIDE(I) = 0.D0
30      CONTINUE
            IF (STANAM .EQ. 'ANNI 10721M001') RETURN
            IF (STANAM .EQ. 'KREI 10722M001') RETURN
            IF (STANAM .EQ. 'LUNI 10723M001') RETURN
            IF (STANAM .EQ. 'MASK 10724M001') RETURN
            IF (STANAM .EQ. 'VANG 10725M001') RETURN
      IF (SUM(XSTA(1:3)) .EQ. 0.D0) THEN
        DXTIDE(1:3) = 0.d0
        IF (STAERR .EQ. STANAM) RETURN
        WRITE(LFNERR,'(3(/,A),A16,/,A,F13.5,/)')
     1    ' ### SR TIDE2000: STATION COORDINATES ARE ZERO (GEOCENTER)',
     2    '                  NO TIDAL CORRECTIONS COMPUTED',
     3    '                  STATION NAME: ',STANAM
        STAERR = STANAM
        RETURN
      ENDIF
C
C SCALAR PRODUCT OF STATION VECTOR WITH SUN/MOON VECTOR
C -----------------------------------------------------
      CALL SPROD(XSTA,XSUN,SCS,RSTA,RSUN)
```

Bernese GPS Software V 5.0 routine **TIDE2000.f** computing tidal station displacements conforming to the latest IERS Conventions.

Observation interval selection

Observation time intervals were selected for better representation of tidal wave variety:

Year 2010

- **(14.–31.) January** = 18 days
- **(10.–27.) July** = 18 days

Phases of the Moon
and other
phenomenon

MOON_PHASES.txt

```
PHAENOMENE DES MONDES 2010
--------------------------
Astronomisches Institut, Universitaet Bern
Alle Zeiten in MEZ

Neumond                Erstes Viertel         Vollmond               Letztes Viertel

                                                                     JAN  7.  11:39
JAN 15.   8:11         JAN 23.  11:53         JAN 30.   7:17         FEB  6.   0:48
FEB 14.   3:51         FEB 22.   1:42         FEB 28.  17:37         MAR  7.  16:41
MAR 15.  22:01         MAR 23.  12:00         MAR 30.   3:24         APR  6.  10:36
APR 14.  13:29         APR 21.  19:19         APR 28.  13:17         MAI  6.   5:14
MAI 14.   2:05         MAI 21.   0:42         MAI 28.   0:06         JUN  4.  23:12
JUN 12.  12:15         JUN 19.   5:29         JUN 26.  12:29         JUL  4.  15:35
JUL 11.  20:41         JUL 18.  11:10         JUL 26.   2:35         AUG  3.   5:58
AUG 10.   4:08         AUG 16.  19:14         AUG 24.  18:03         SEP  1.  18:21
SEP  8.  11:30         SEP 15.   6:49         SEP 23.  10:16         OKT  1.   4:52
OKT  7.  19:45         OKT 14.  22:27         OKT 23.   2:35         OKT 30.  13:45
NOV  6.   5:52         NOV 13.  17:38         NOV 21.  18:26         NOV 28.  21:36
DEZ  5.  18:36         DEZ 13.  14:58         DEZ 21.   9:12         DEZ 28.   5:18

Perigaeum              Apogaeum

JAN  1.  21:33         JAN 17.   2:41
JAN 30.  10:05         FEB 13.   3:07
FEB 27.  22:39         MAR 12.  11:06
MAR 28.   5:59         APR  9.   3:44
APR 24.  22:00         MAI  6.  22:53
MAI 20.   9:45         JUN  3.  17:50
JUN 15.  15:59         JUL  1.  11:12
JUL 13.  12:22         JUL 29.   0:48
AUG 10.  18:58         AUG 25.   6:51
SEP  8.   4:58         SEP 21.   9:03
OKT  6.  14:39         OKT 18.  19:18
NOV  3.  18:26         NOV 15.  12:46
NOV 30.  19:56         DEZ 13.   9:35
DEZ 25.  13:16

Aufsteig. Knoten       Maximale Breite        Absteig. Knoten        Minimale Breite

                                              JAN  1.  13:29         JAN  7.  18:59
JAN 15.   0:18         JAN 22.  12:36         JAN 29.   1:03         FEB  4.   1:57
FEB 11.   5:58         FEB 18.  17:16         FEB 25.  10:11         MAR  3.   9:42
MAR 10.   9:07         MAR 17.  19:19         MAR 24.  14:06         MAR 30.  16:22
APR  6.  10:44         APR 13.  20:52         APR 20.  14:38         APR 26.  21:20
MAI  3.  13:34         MAI 11.   0:26         MAI 17.  16:39         MAI 24.   1:25
MAI 30.  19:07         JUN  7.   6:48         JUN 13.  22:55         JUN 20.   5:51
JUN 27.   2:20         JUL  4.  14:28         JUL 11.   8:31         JUL 17.  11:25
JUL 24.   8:58         JUL 31.  20:58         AUG  7.  18:24         AUG 13.  18:03
AUG 20.  13:12         AUG 28.   0:38         SEP  4.   1:15         SEP 10.   0:58
SEP 16.  14:56         SEP 24.   1:49         OKT  1.   3:42         OKT  7.   7:25
```

Output data

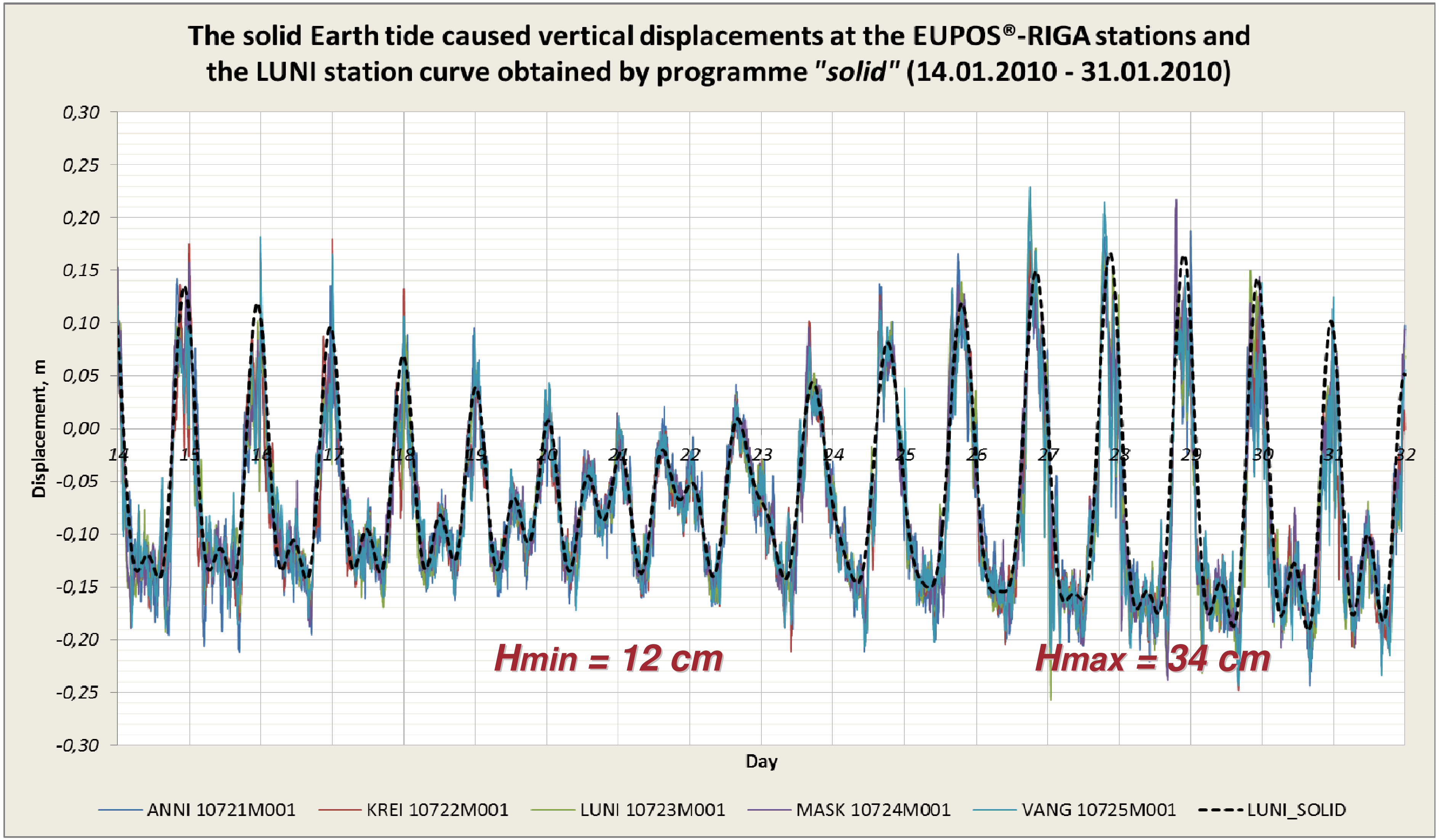
${P}\JAN_10Y\STA\P1_100150.CRD

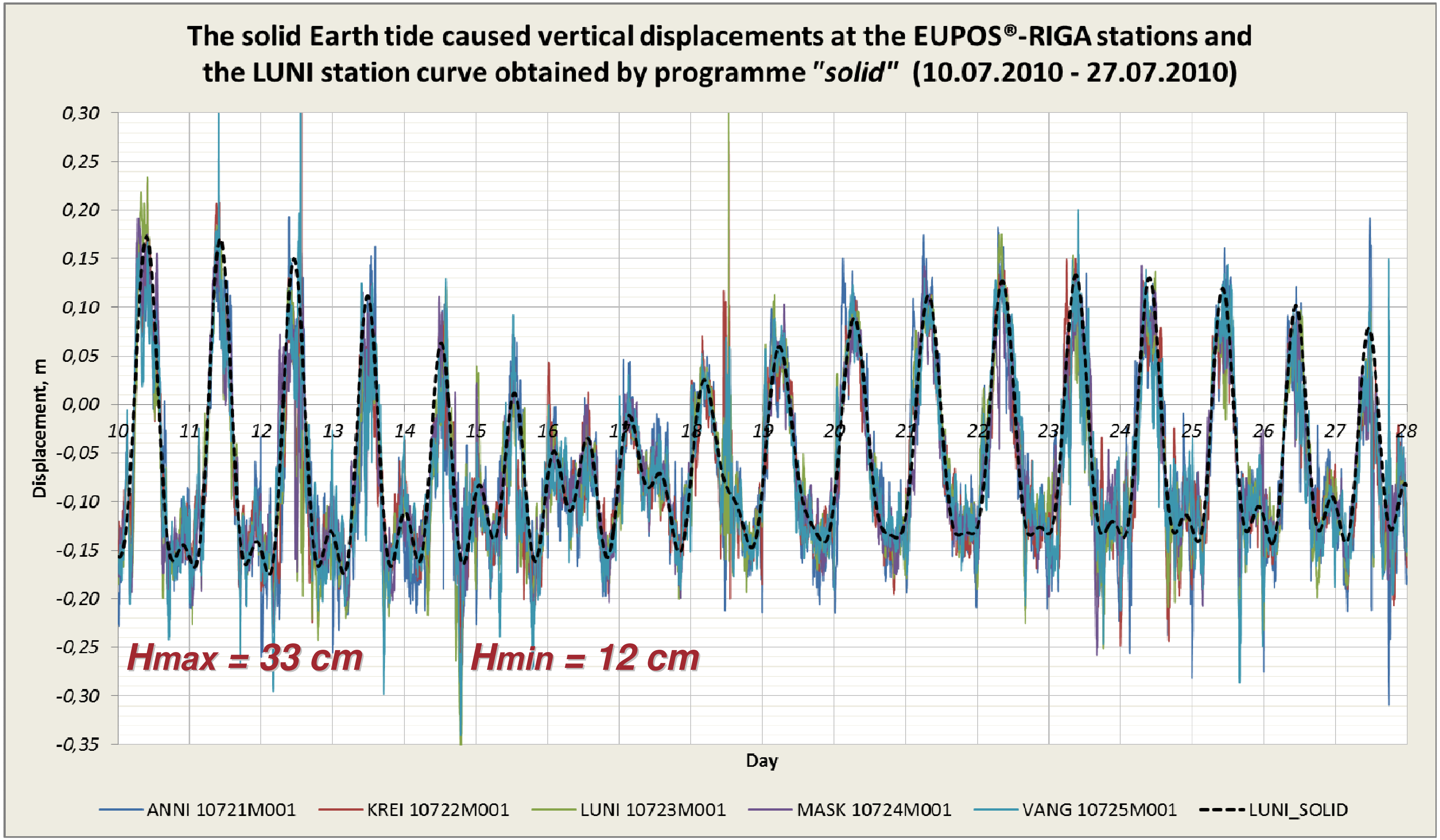
				A priori station coordinates WGS-84			A priori station coordinates Ellipsoidal in local geodetic datum		
num	Station name	obs	e/f/h	X (m)	Y (m)	Z (m)	Latitude	Longitude	Height (m)
1	AIZK 10701M001	Y	FIXED	3183144.7696	1501282.5950	5301551.7382	56 35 56.671259	25 15 0.745170	117.5192
122	SIGU 10716M001	Y	FIXED	3145951.3220	1459815.3190	5335021.1476	57 8 55.778312	24 53 33.746594	133.9002
10	BAUS 10703M001	Y	FIXED	3226814.5647	1449250.3921	5289639.5731	56 24 21.220472	24 11 10.133617	69.3887
97	OJAR 10713M001	Y	FIXED	3185444.1990	1423323.2039	5321411.3919	56 55 31.748184	24 4 33.932562	41.9550
69	LIMB 10710M001	Y	FIXED	3119682.4732	1435782.8964	5356755.2669	57 30 38.227081	24 42 48.524708	115.3802
114	RIGA 12302M002	Y	FIXED	3183899.0997	1421478.5638	5322810.8353	56 56 55.033080	24 3 31.591680	34.7188
65	KREI 10722M001	Y	ESTIM	3175810.1078	1419887.0715	5328038.1710	57 2 4.904786	24 5 20.952570	41.3773
127	TALS 10717M001	Y	FIXED	3193687.2258	1328546.7516	5340897.1851	57 14 47.349019	22 35 12.823968	115.0489
123	SLDS 10720M001	Y	FIXED	3245132.1890	1342447.4558	5306566.9467	56 40 50.178902	22 28 26.107946	144.7759

KINEMATIC COORDINATES: ${P}\JAN_10Y\STA\IGS100150.KIN

EPO: EPOCHS SINCE 2010-01-15 00:00:00 (SAMPLING 300 SEC)

				CORRECTION AND RMS IN METER			ESTIMATED POSITION WRT. FIXED COORD.		
EPO	EPOCH(MJD)	#OBS	STA	LATITUDE	LONGITUDE	HEIGHT	NORTH(M)	EAST(M)	UP(M)
	KREI 10722M001			57 2 4.904786	24 5 20.952570	41.3773			
1	55211.000000	29	KREI	-0.0206 +- 0.006	0.0265 +- 0.004	0.2535 +- 0.024	-0.0206	0.0265	0.2535
2	55211.003472	28	KREI	-0.0170 +- 0.006	0.0248 +- 0.004	0.2368 +- 0.022	-0.0170	0.0248	0.2368
3	55211.006944	28	KREI	-0.0156 +- 0.006	0.0244 +- 0.004	0.2159 +- 0.020	-0.0156	0.0244	0.2159
4	55211.010417	26	KREI	-0.0222 +- 0.006	0.0189 +- 0.004	0.2247 +- 0.018	-0.0222	0.0189	0.2247
5	55211.013889	28	KREI	-0.0352 +- 0.006	0.0218 +- 0.004	0.1979 +- 0.015	-0.0352	0.0218	0.1979
6	55211.017361	29	KREI	-0.0341 +- 0.006	0.0232 +- 0.004	0.1956 +- 0.013	-0.0341	0.0232	0.1956
7	55211.020833	29	KREI	-0.0310 +- 0.006	0.0196 +- 0.004	0.1878 +- 0.012	-0.0310	0.0196	0.1878
8	55211.024306	29	KREI	-0.0375 +- 0.006	0.0154 +- 0.004	0.1781 +- 0.011	-0.0375	0.0154	0.1781
9	55211.027778	28	KREI	-0.0376 +- 0.006	0.0166 +- 0.004	0.1852 +- 0.011	-0.0376	0.0166	0.1852
10	55211.031250	27	KREI	-0.0320 +- 0.006	0.0142 +- 0.004	0.1712 +- 0.011	-0.0320	0.0142	0.1712
11	55211.034722	31	KREI	-0.0293 +- 0.006	0.0135 +- 0.004	0.1554 +- 0.011	-0.0293	0.0135	0.1554
12	55211.038194	30	KREI	-0.0297 +- 0.006	0.0151 +- 0.004	0.1585 +- 0.011	-0.0297	0.0151	0.1585


The solid Earth tide caused vertical displacements at the EUPOS®-RIGA stations and the LUNI station curve obtained by programme "solid" (14.01.2010 - 31.01.2010)
Displacement, m
0,30
0,25
0,20
0,15
0,10
0,05
0,00
-0,05
-0,10
-0,15
-0,20
-0,25
-0,30
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
Day
Hmin = 12 cm
Hmax = 34 cm
ANNI 10721M001
KREI 10722M001
LUNI 10723M001
MASK 10724M001
VANG 10725M001
LUNI_SOLID


The solid Earth tide caused vertical displacements at the EUPOS®-RIGA stations and the LUNI station curve obtained by programme "solid" (10.07.2010 - 27.07.2010)
Displacement, m
0,30
0,25
0,20
0,15
0,10
0,05
0,00
-0,05
-0,10
-0,15
-0,20
-0,25
-0,30
-0,35
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
Day
Hmax = 33 cm
Hmin = 12 cm
ANNI 10721M001
KREI 10722M001
LUNI 10723M001
MASK 10724M001
VANG 10725M001
LUNI_SOLID

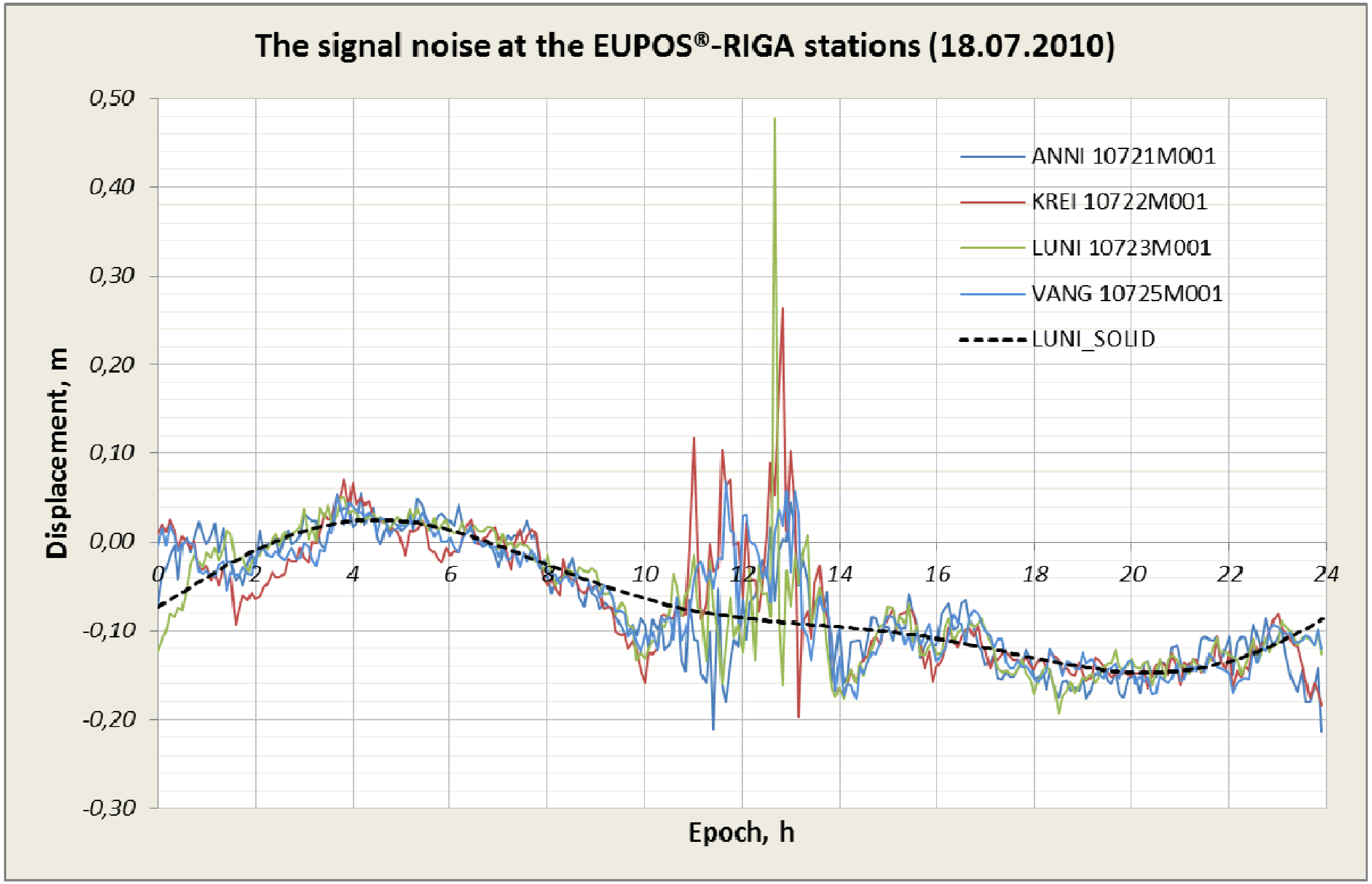
The RMS averages of the EUPOS®-RIGA station vertical displacements, m

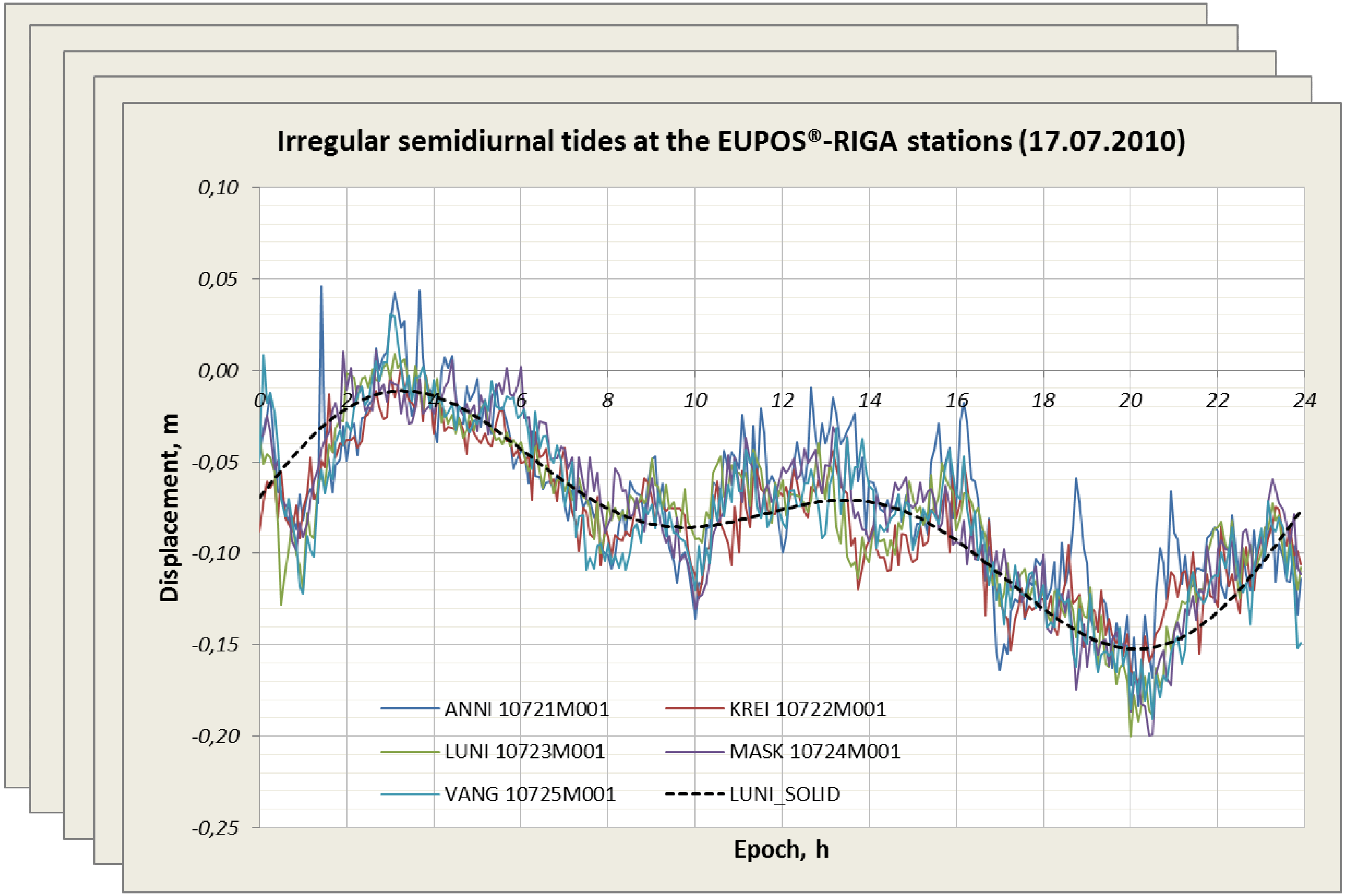
14.01.2010 – 31.01.2010

January	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Average
ANNI	0.014	0.014	0.013	0.013	0.012	0.012	0.013	0.012	0.012	0.012	0.013	0.013	0.015	0.015	0.015	0.014	0.014	0.015	0.013
KREI	0.014	0.014	0.012	0.012	0.012	0.011	0.012	0.011	0.011	0.012	0.012	0.013	0.014	0.014	0.014	0.014	0.014	0.014	0.013
LUNI	0.014	0.015	0.013	0.013	0.012	0.012	0.013	0.011	0.011	0.011	0.012	0.013	0.012	0.014	0.014	0.013	0.014	0.013	0.013
MASK	0.013	0.014	0.012	0.013	0.012	0.011	0.012	0.011	0.011	0.011	0.011	0.012	0.013	0.014	0.014	0.013	0.014	0.013	0.012
VANG	0.015	0.015	0.013	0.013	0.013	0.012	0.014	0.012	0.012	0.012	0.012	0.013	0.013	0.014	0.014	0.014	0.014	0.013	0.013

10.07.2010 – 27.07.2010

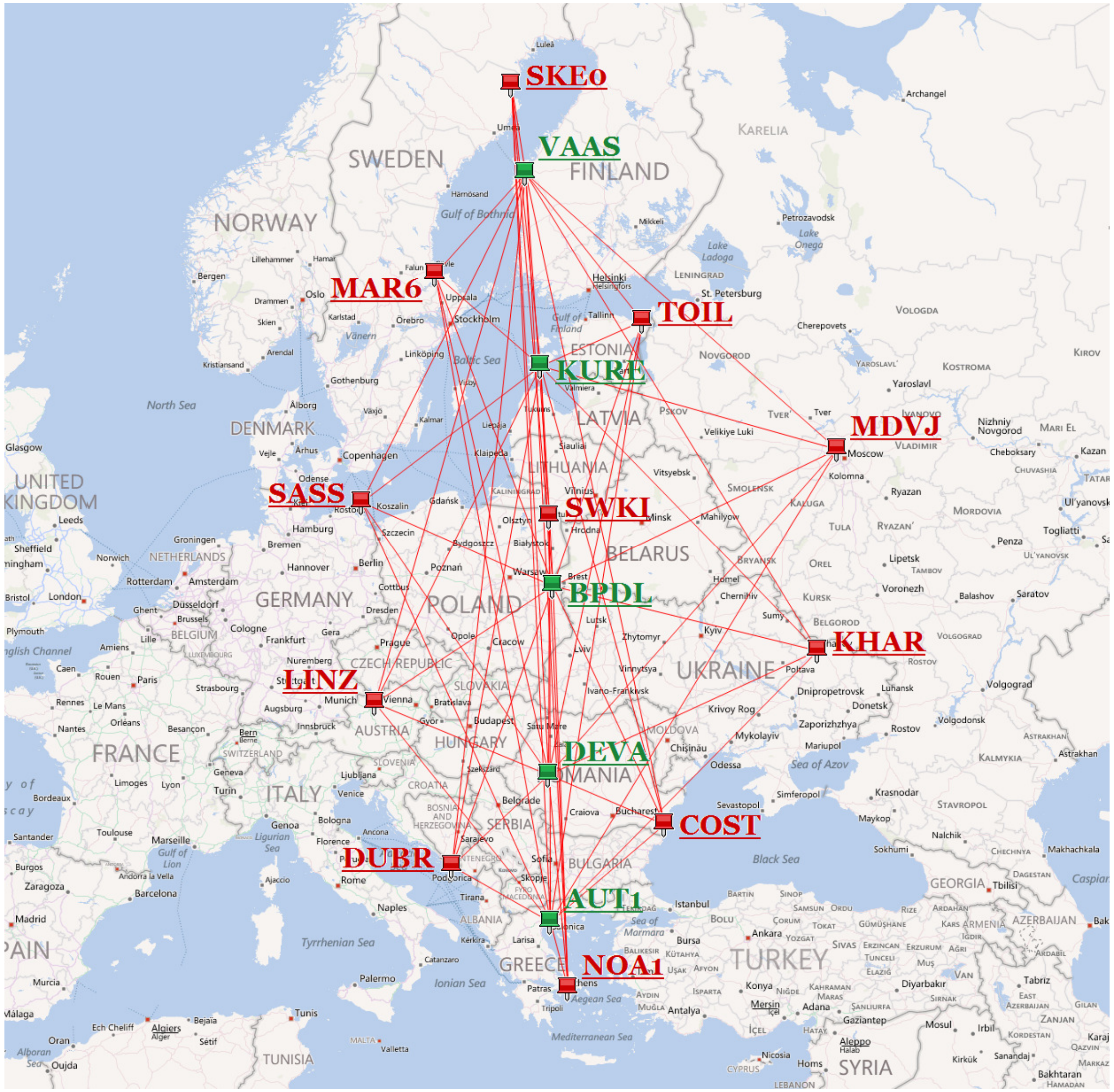
July	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Average
ANNI	0.019	0.019	0.023	0.022	0.029	0.021	0.020	0.017	0.023	0.019	0.018	0.018	0.020	0.028	0.023	0.020	0.018	0.023	0.021
KREI	0.018	0.017	0.024	0.020	0.021	0.020	0.019	0.016	0.029	0.018	0.016	0.017	0.018	0.025	0.021	0.018	0.016	0.020	0.020
LUNI	0.018	0.018	0.022	0.021	0.022	0.020	0.019	0.017	0.029	0.018	0.016	0.018	0.019	0.026	0.022	0.019	0.018	0.026	0.021
MASK	0.017	0.017	0.020	0.019	0.021	0.018	0.018	0.015	-	0.017	0.016	0.016	0.026	0.024	0.020	0.018	0.016	0.019	0.019
VANG	0.018	0.018	0.025	0.021	0.022	0.021	0.020	0.017	0.023	0.018	0.017	0.019	0.019	0.027	0.022	0.020	0.017	0.029	0.021


The signal noise at the EUPOS®-RIGA stations (18.07.2010)
0,50
0,40
0,30
0,20
0,10
0,00
-0,10
-0,20
-0,30
Displacement, m
0
2
4
6
8
10
12
14
16
18
20
22
24
Epoch, h
ANNI 10721M001
KREI 10722M001
LUNI 10723M001
VANG 10725M001
LUNI_SOLID

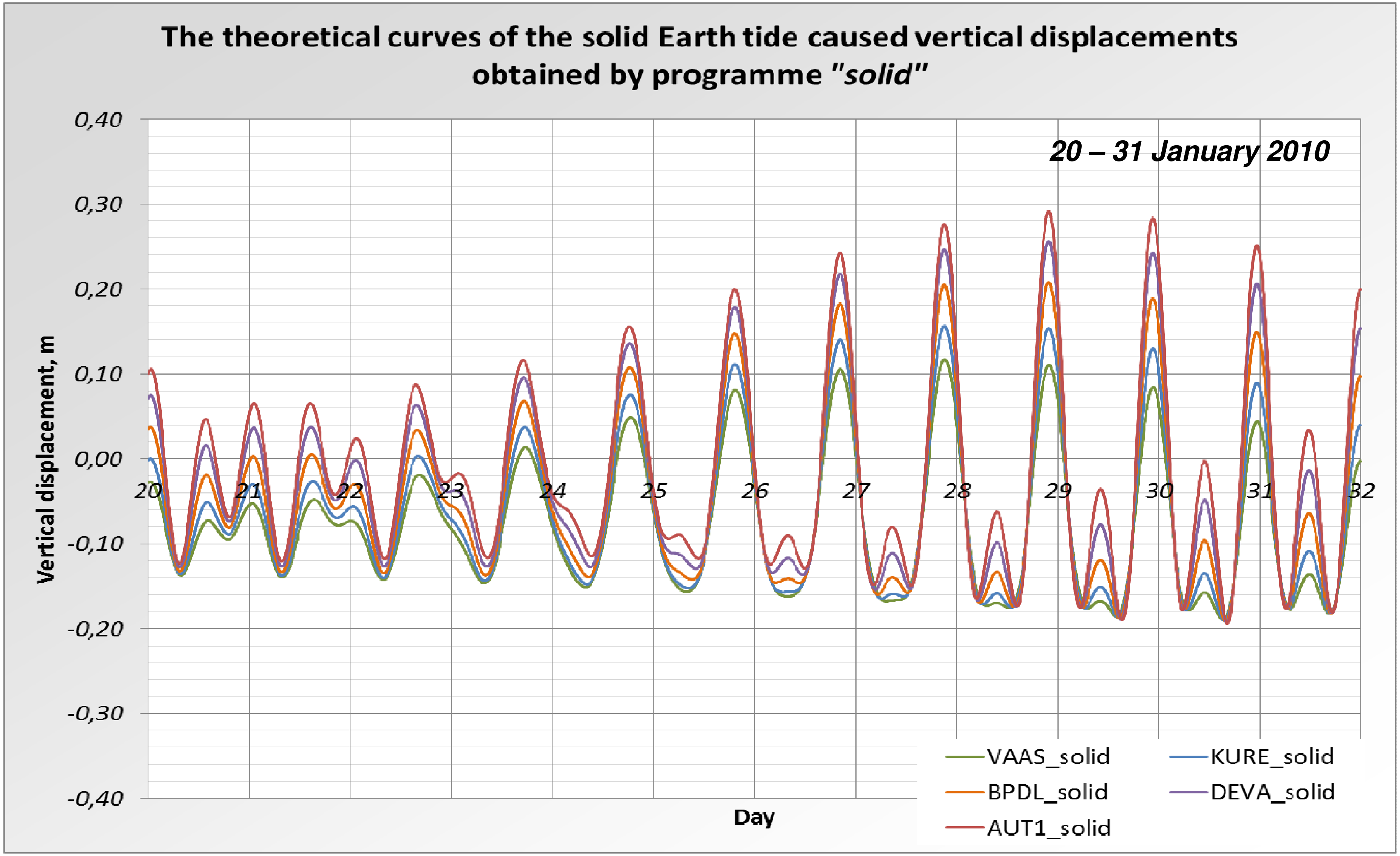

Irregular semidiurnal tides at the EUPOS®-RIGA stations (17.07.2010)
Displacement, m
0,10
0,05
0,00
-0,05
-0,10
-0,15
-0,20
-0,25
0
2
4
6
8
10
12
14
16
18
20
22
24
ANNI 10721M001
KREI 10722M001
LUNI 10723M001
MASK 10724M001
VANG 10725M001
LUNI_SOLID
Epoch, h

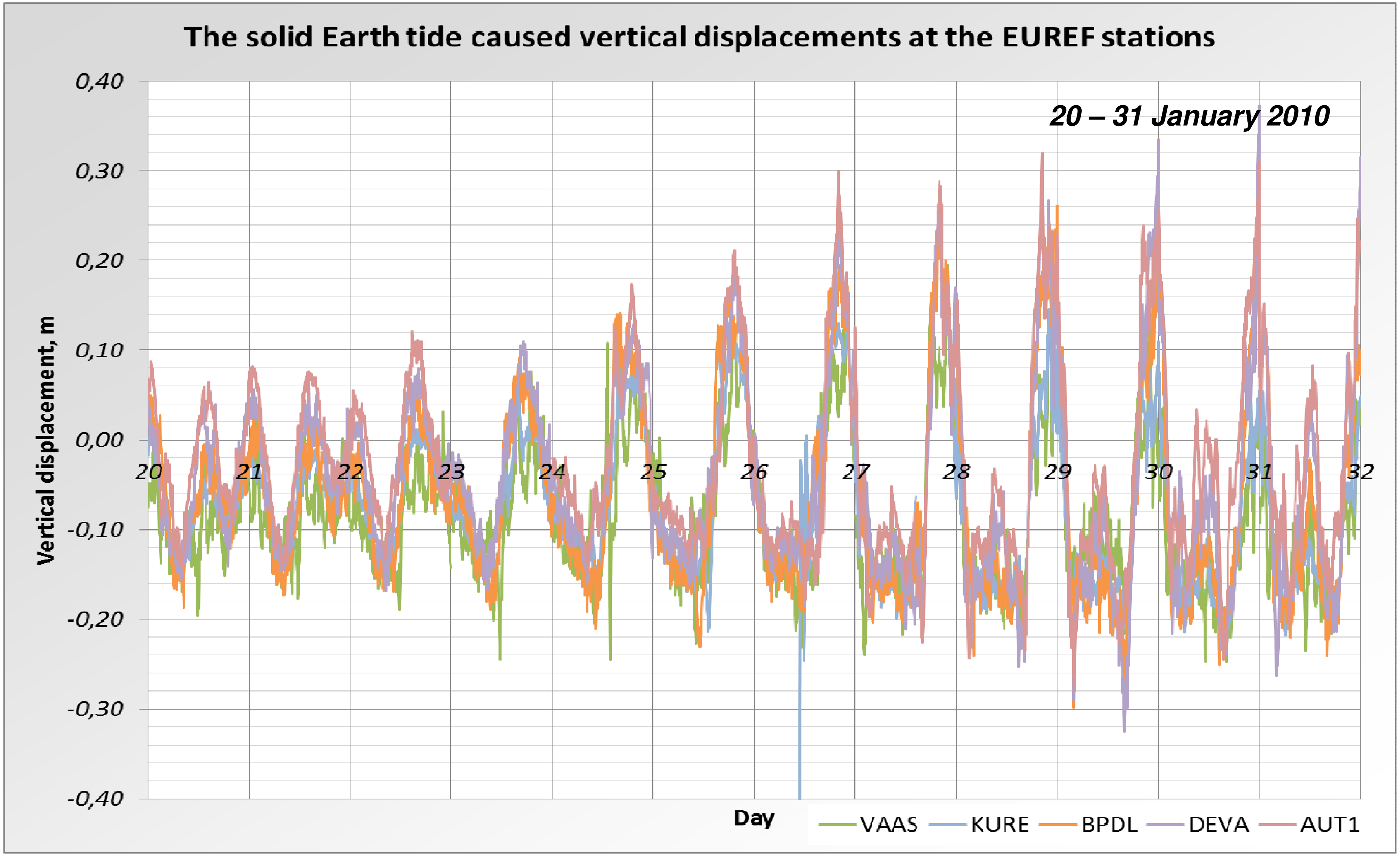
The solid Earth tide caused vertical displacements at the EUREF stations

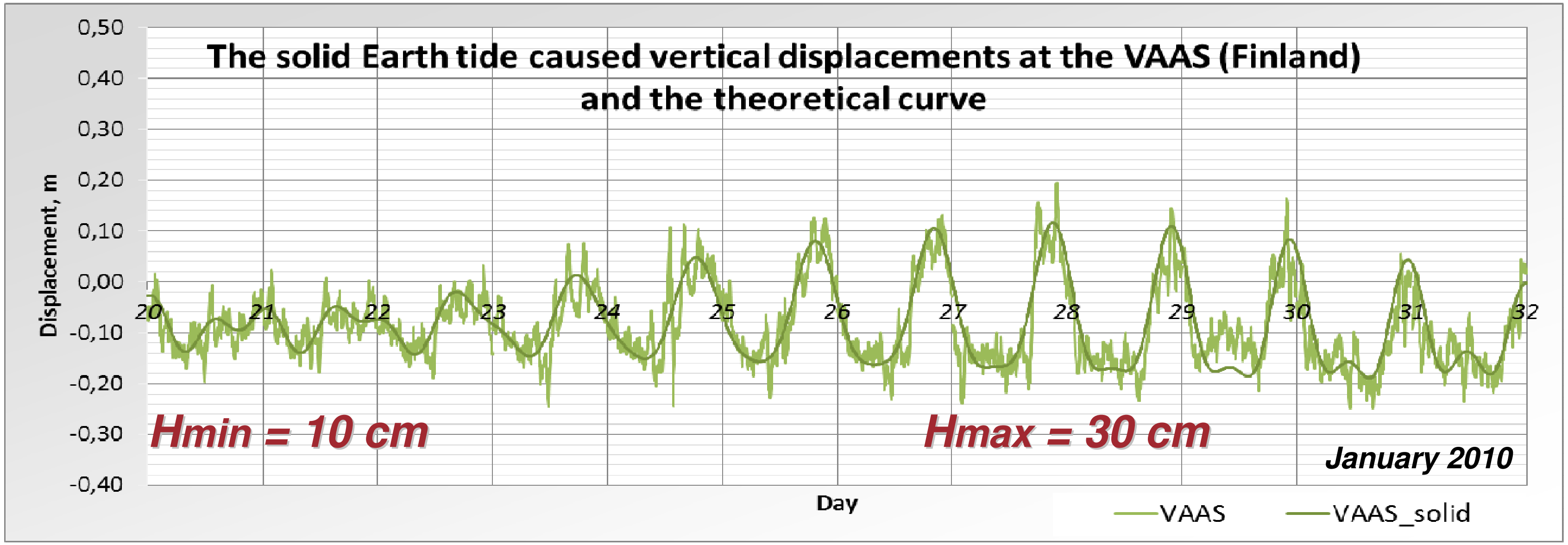
using data
of EPN and IGS and
applying
Bernese GPS Software.

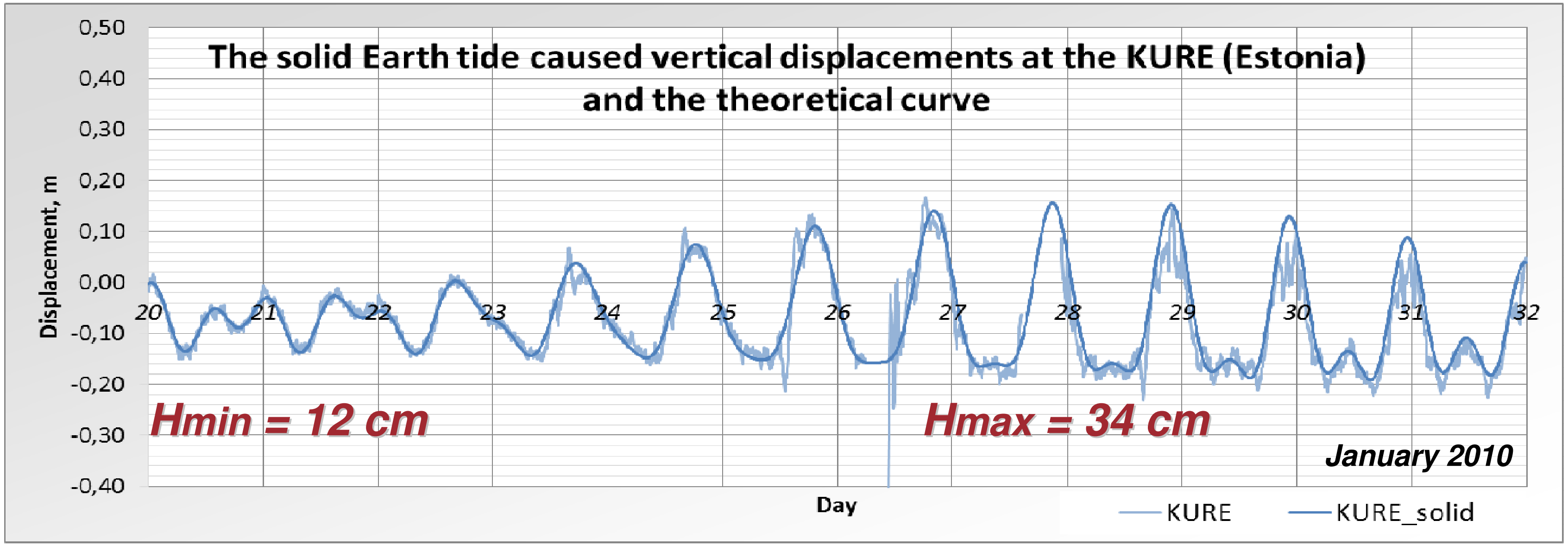


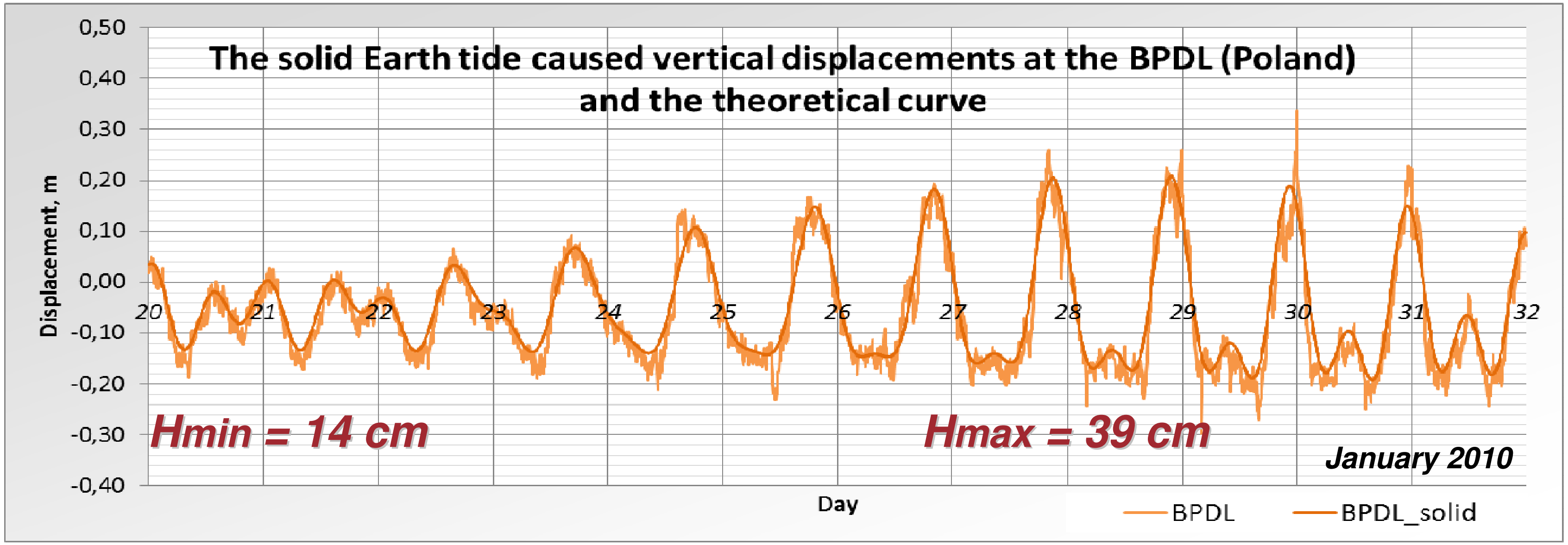
Solution of 5 kinematic stations and 11 static stations.

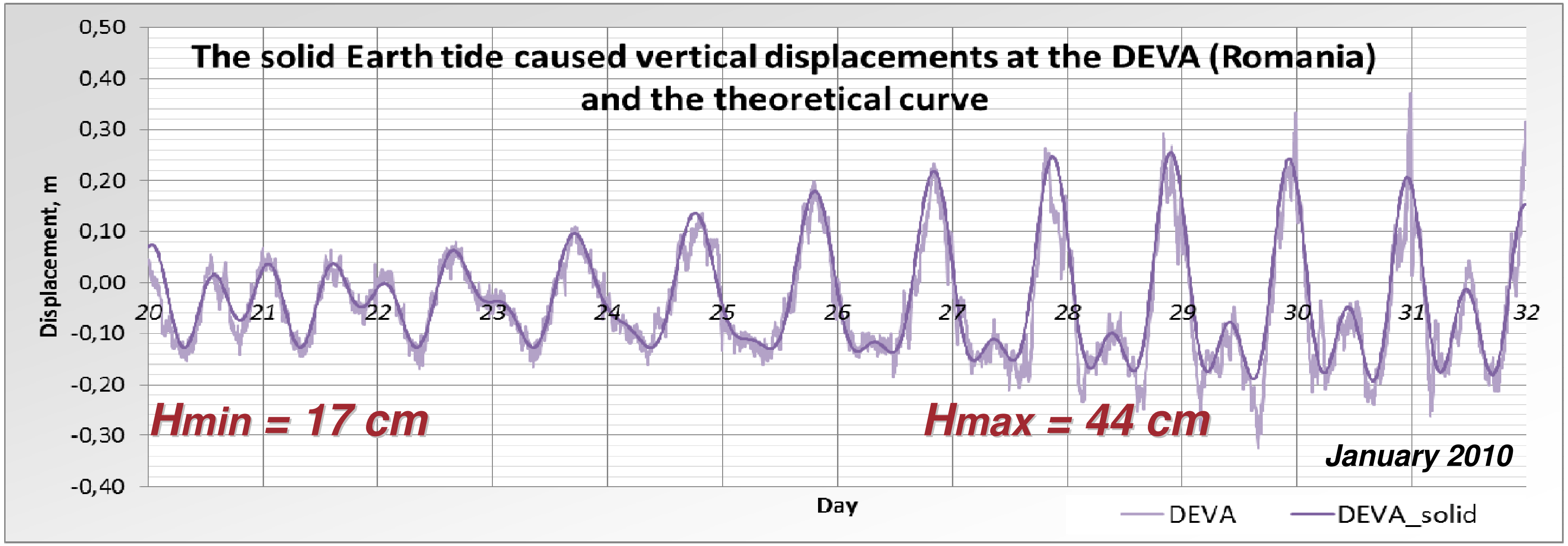

The theoretical curves of the solid Earth tide caused vertical displacements obtained by programme "solid"
20 – 31 January 2010
Vertical displacement, m
0,40
0,30
0,20
0,10
0,00
-0,10
-0,20
-0,30
-0,40
20
21
22
23
24
25
26
27
28
29
30
31
32
Day
VAAS_solid
KURE_solid
BPDL_solid
DEVA_solid
AUT1_solid

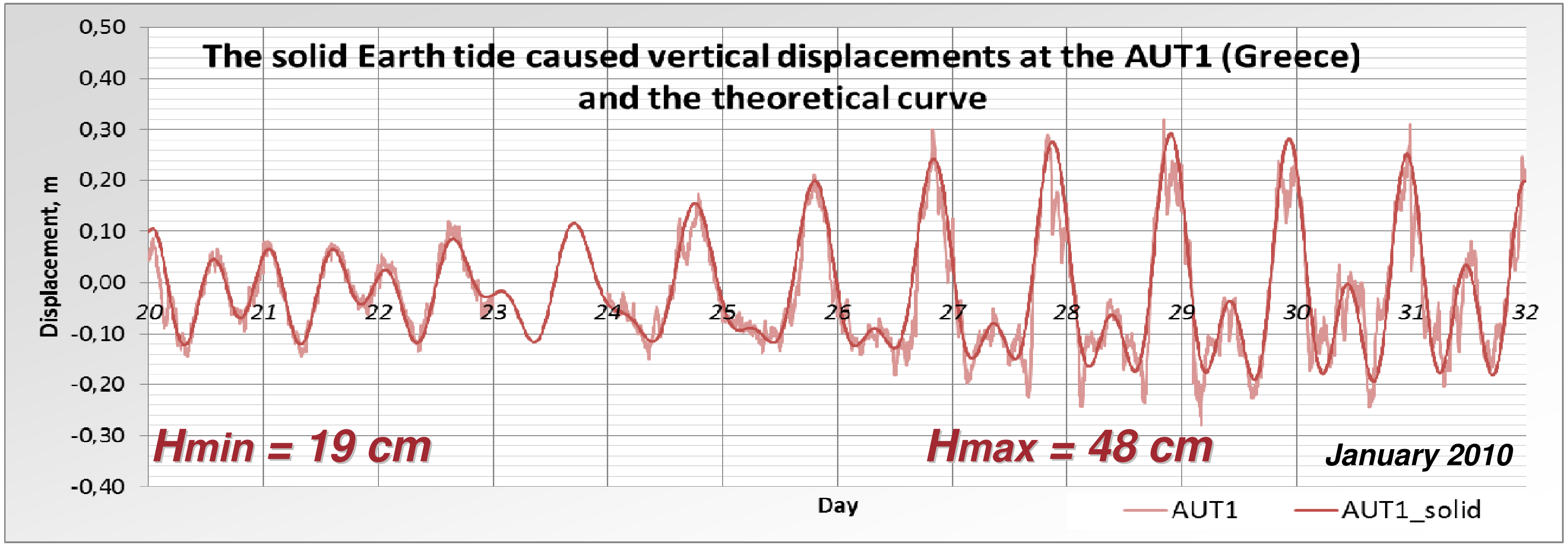

The solid Earth tide caused vertical displacements at the EUREF stations
20 – 31 January 2010
Vertical displacement, m
0,40
0,30
0,20
0,10
0,00
-0,10
-0,20
-0,30
-0,40
20
21
22
23
24
25
26
27
28
29
30
31
32
Day
VAAS
KURE
BPDL
DEVA
AUT1


The solid Earth tide caused vertical displacements at the VAAS (Finland) and the theoretical curve
Displacement, m
0,50
0,40
0,30
0,20
0,10
0,00
-0,10
-0,20
-0,30
-0,40
20 21 22 23 24 25 26 27 28 29 30 31 32
Hmin = 10 cm
Hmax = 30 cm
January 2010
Day
VAAS
VAAS_solid

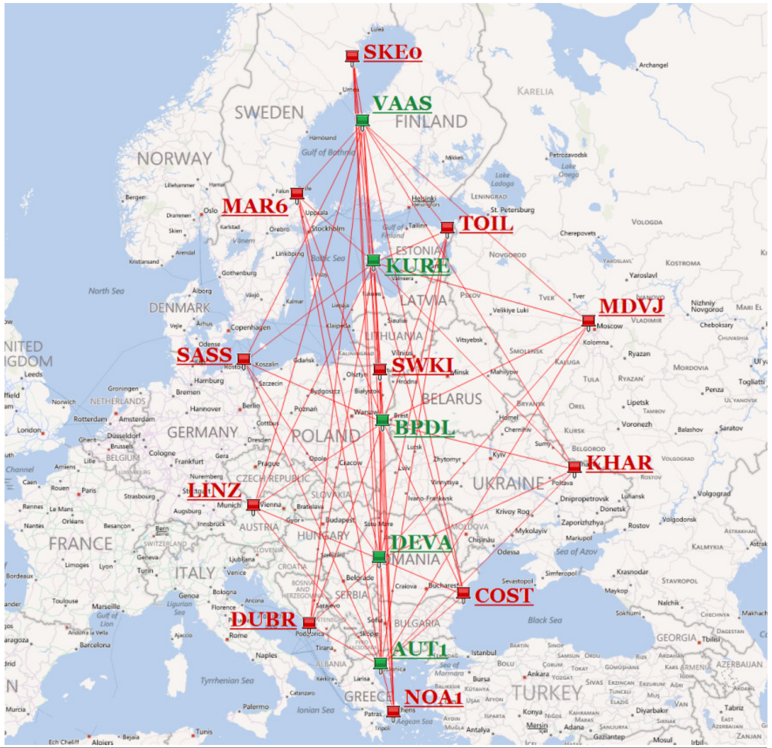

The solid Earth tide caused vertical displacements at the KURE (Estonia) and the theoretical curve
Displacement, m
0,50
0,40
0,30
0,20
0,10
0,00
-0,10
-0,20
-0,30
-0,40
20 21 22 23 24 25 26 27 28 29 30 31 32
Hmin = 12 cm
Hmax = 34 cm
January 2010
Day
KURE
KURE_solid


The solid Earth tide caused vertical displacements at the BPDL (Poland)
and the theoretical curve
Displacement, m
0,50
0,40
0,30
0,20
0,10
0,00
-0,10
-0,20
-0,30
-0,40
20
21
22
23
24
25
26
27
28
29
30
31
32
Hmin = 14 cm
Hmax = 39 cm
January 2010
Day
BPDL
BPDL_solid


The solid Earth tide caused vertical displacements at the DEVA (Romania)
and the theoretical curve
Displacement, m
0,50
0,40
0,30
0,20
0,10
0,00
-0,10
-0,20
-0,30
-0,40
20
21
22
23
24
25
26
27
28
29
30
31
32
Hmin = 17 cm
Hmax = 44 cm
January 2010
Day
DEVA
DEVA_solid


The solid Earth tide caused vertical displacements at the AUT1 (Greece) and the theoretical curve
Displacement, m
0,50
0,40
0,30
0,20
0,10
0,00
-0,10
-0,20
-0,30
-0,40
20
21
22
23
24
25
26
27
28
29
30
31
32
Day
Hmin = 19 cm
Hmax = 48 cm
January 2010
AUT1
AUT1_solid

The solid Earth tide wave heights at the EUREF stations (20-31 January 2010)			
EUREF station	*Hmin, cm*	*Hmax, cm*	*Lat. dif., º*
VAAS (Vaasa, Finland)	*10*	*30*	*≈ 5*
KURE (Kuressaare, Estonia)	*12*	*34*	*≈ 6*
BPDL (Biala Podlaska, Poland)	*14*	*39*	*≈ 6*
DEVA (Deva, Romania)	*17*	*44*	*≈ 5*
AUT1 (Thessaloniki, Greece)	*19*	*48*	



The RMS averages of the EUREF station vertical displacements, m													
January	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*Average*
AUT1 (Thessaloniki, Greece)	0.014	0.013	0.013	-	0.014	0.014	0.015	0.016	0.017	0.017	0.017	0.017	***0.015***
DEVA (Deva, Romania)	0.015	0.014	0.014	0.014	0.015	0.015	0.016	0.016	0.018	0.019	0.017	0.017	***0.016***
BPDL (Biala Podlaska, Poland)	0.011	0.011	0.011	0.012	0.012	0.012	0.012	0.013	0.013	0.014	0.013	0.013	***0.012***
KURE (Kuressaare, Estonia)	0.011	0.011	0.011	0.011	0.012	0.012	(0.044)	0.013	0.013	0.015	0.013	0.013	***0.012***
VAAS (Vaasa, Finland)	0.014	0.014	0.014	0.015	0.016	0.016	0.016	0.016	0.016	0.019	0.016	0.016	***0.016***

Conclusion

- Research findings have shown that the maximum value of the solid Earth tide caused vertical displacement at the EUPOS®-RIGA stations is 34 cm, and the minimum value – 12 cm for selected observation periods.
- In the case of EUREF stations, where latitude difference of the most distant stations is about 22º, the maximum tide caused vertical displacement is from 30 cm (VAAS) to 48 cm (AUT1), and the minimum – from 10 cm (VAAS) to 19 cm (AUT1).
- The Earth station displacement caused by the solid body tides, is the correction which must be observed for determining the Earth station's position. This correction is based on conventional parameters.
- Tidal oscillation has a strictly definite periodicity, which can be determined for any required period of time.
- The study of the Earth's oscillations is a key part of the theory of the Earth's dynamic response to external or internal forces.

Thank You!

M.sc.ing. Diana Haritonova
diana.haritonova@inbox.lv