

National Report of Greece

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National Cadastre and Mapping Agency S.A.**



Outline

1. **The National Cadastre & Mapping Agency S.A.**
2. **Maintenance of HEPOS**
 - **Dealing with electromagnetic interferences**
 - **Displacements caused by the Cephalonia Earthquakes**
3. **Contribution to WG on “Deformation Models”**
4. **Monitoring of ionospheric activity**



1. The National Cadastre & Mapping Agency S.A.

- In June 2013, HEMCO (Hellenic Mapping and Cadastre Organization) was merged with KTIMATOLOGIO S.A. which was then renamed to National Cadastre and Mapping Agency S.A. (NCMA S.A.).
- HEMCO's geodetic and cartographic responsibilities have been transferred to NCMA S.A.
- The rest of HEMCO's responsibilities have been taken over by the Ministry of Environment, Energy and Climate Change.



2. Maintenance of HEPOS

Electromagnetic Interference at RS 030A

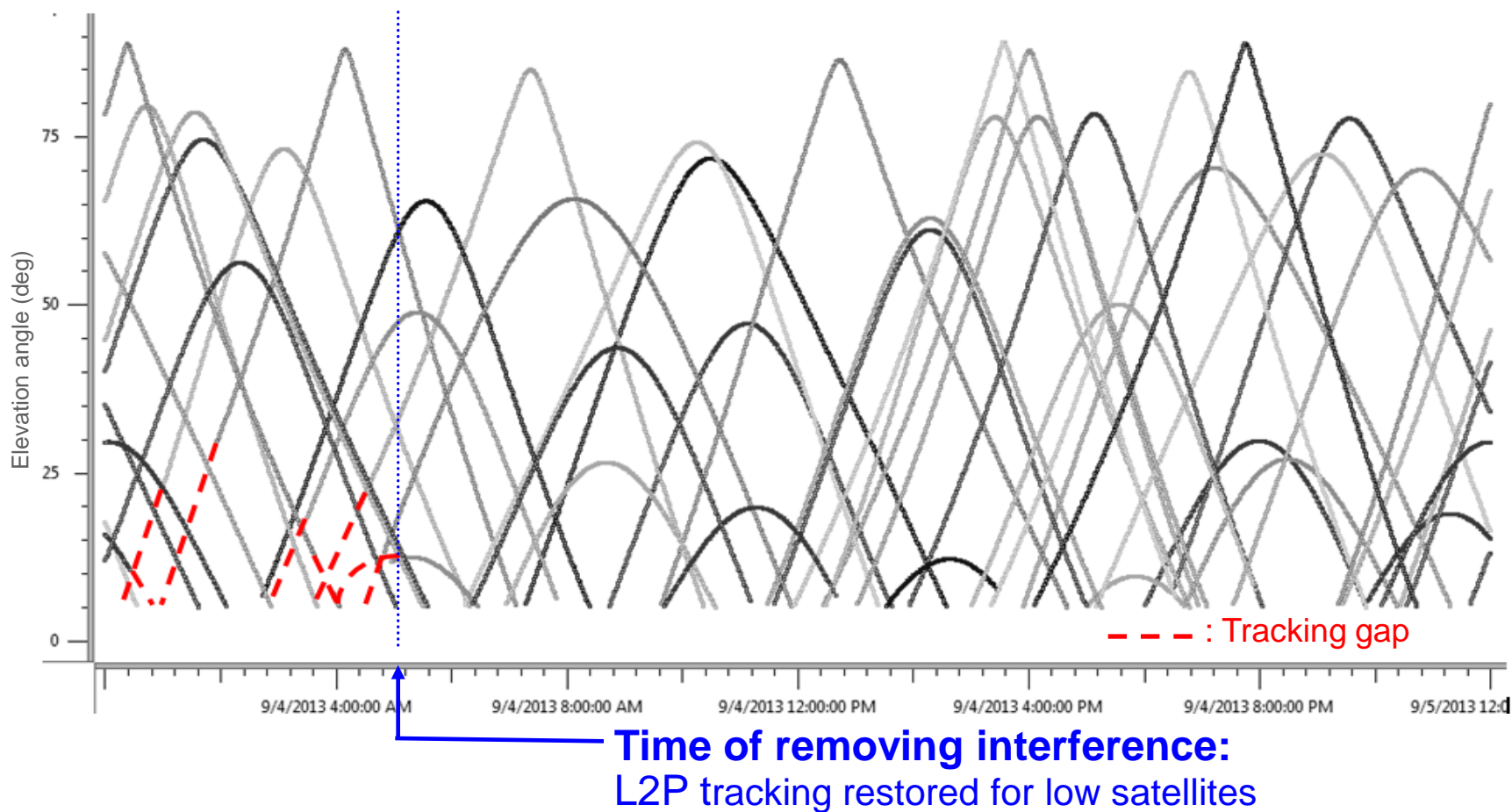
On July 7, 2012 the satellite tracking performance at station 030A (Andravida, NW Peloponnese) became suddenly problematic:

- Difficulties tracking L2 at low elevations
- Reduced SNR values on L1 and L2
- Cycle Slips



2. Maintenance of HEPOS

Electromagnetic Interference at RS 030A: Impact on L2P tracking for low satellites





2. Maintenance of HEPOS

Electromagnetic Interference at RS 030A: The importance of L2C

Unfavorable conditions: No L2P tracking for svcs at low elev. (here 11°-35°).

But: Block IIR-M and IIF (transmitting L2C) could be tracked on L2 using L2C!

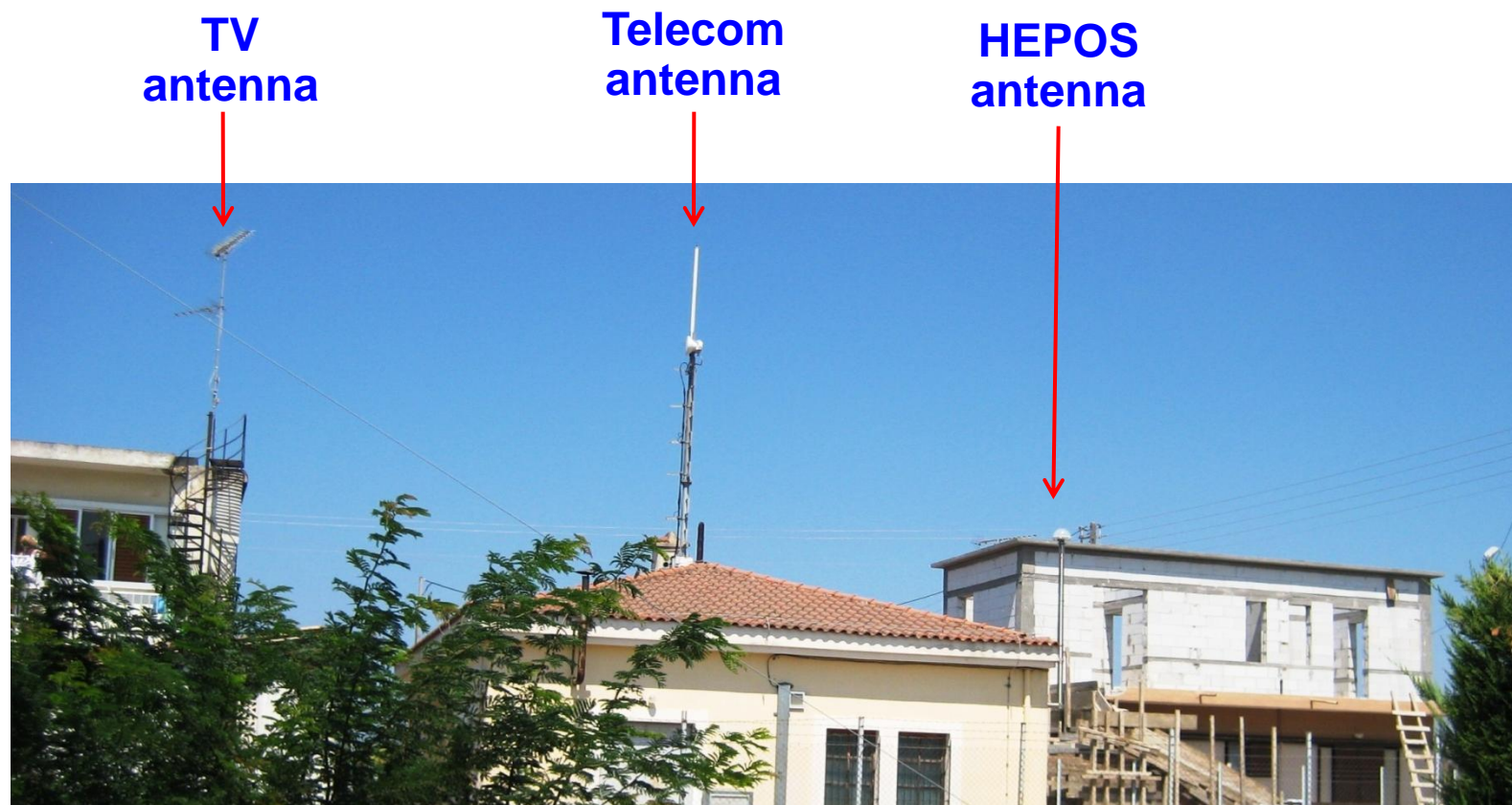
System	PRN	Elev [°]	Az [°]	SnrCA [dB]	SnrP2 [dB]	CA	L2C
GPS	31	35.4	310.0	42	0	4449	4449
GPS	21	16.7	198.0	35	0	855	0
GPS	24	11.7	162.3	34	0	23332	23332
GPS	14	12.5	250.5	38	0	11026	0
GPS	29	68.5	288.1	47	25	9999	9999
GPS	25	73.7	32.3	47	23	13660	13660
GPS	12	40.2	96.8	45	19	20553	20553
GPS	2	28.8	49.1	42	16	13204	0
GPS	5	11.0	97.3	38	0	484	484

12:31:31 Ιούλιος 29 2013 GMT Standard Time



2. Maintenance of HEPOS

Electromagnetic Interference at RS 030A: Station and surrounding area





2. Maintenance of HEPOS

Electromagnetic Interference at RS 030A

Locating the source of interference using portable radiomonitoring device with directional antenna





2. Maintenance of HEPOS

Electromagnetic Interference at RS 030A



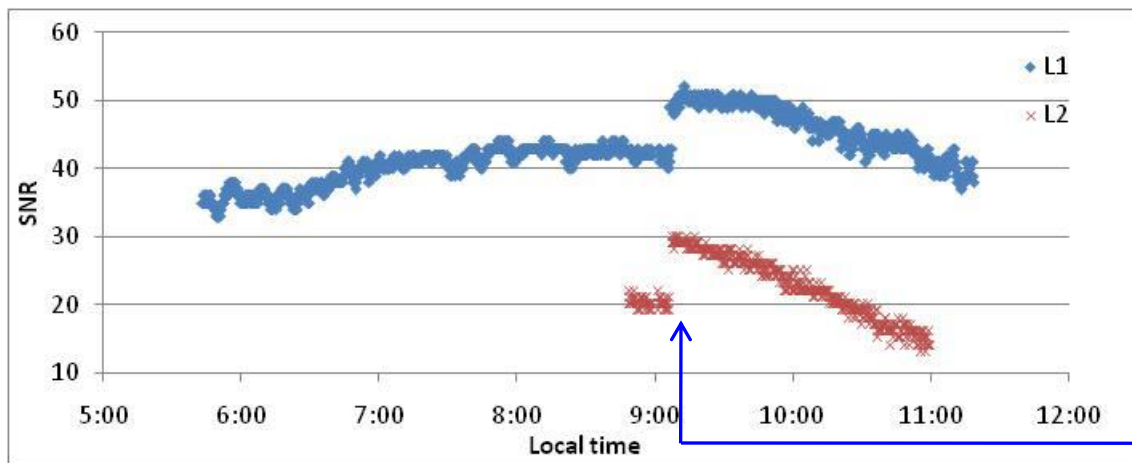
Malfunctioning TV antenna amplifier:

The central frequency of the spurious signal (1568 MHz) is within the tracking bandwidth for L1 (1575.42 MHz).

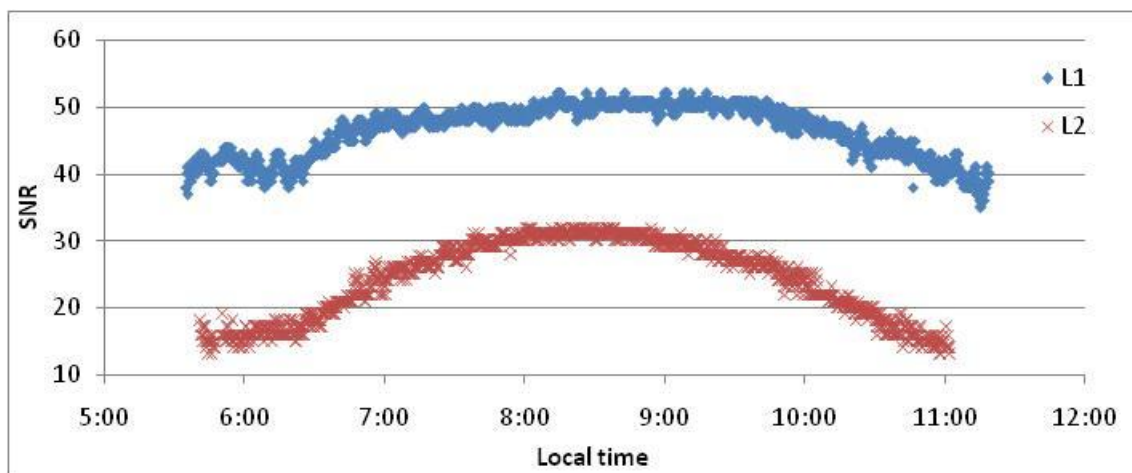


2. Maintenance of HEPOS

Electromagnetic Interference at RS 030A: Impact on SNR



Time of removing interference:
SNR L1 & L2
increased by ~10 dB

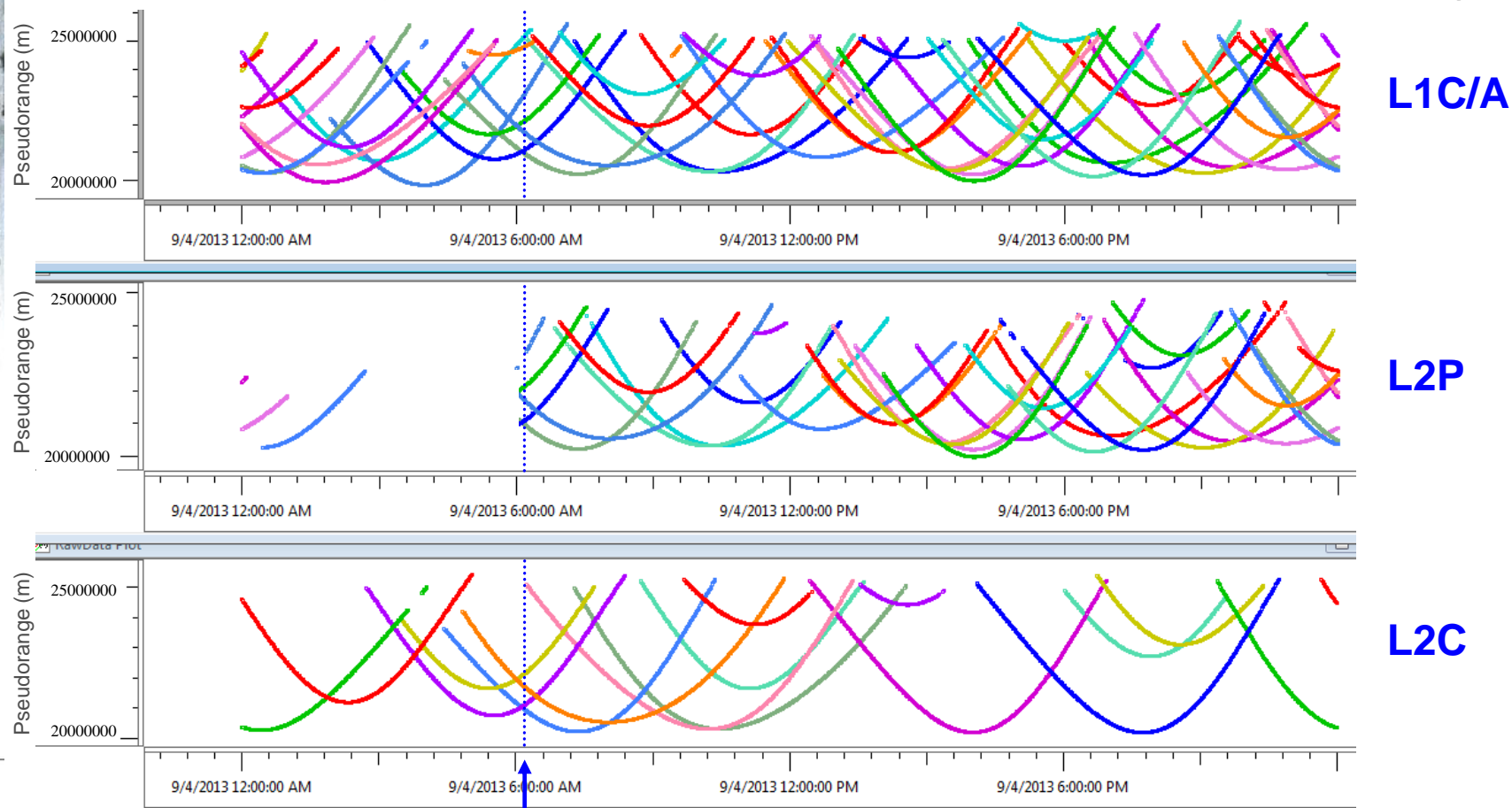


Next day:
SNR for the
same sv



2. Maintenance of HEPOS

Electromagnetic Interference at RS 030A: Code tracking



Time of removing interference:
Tracking for low satellites: restored for L2P, improved for L2C



2. Maintenance of HEPOS

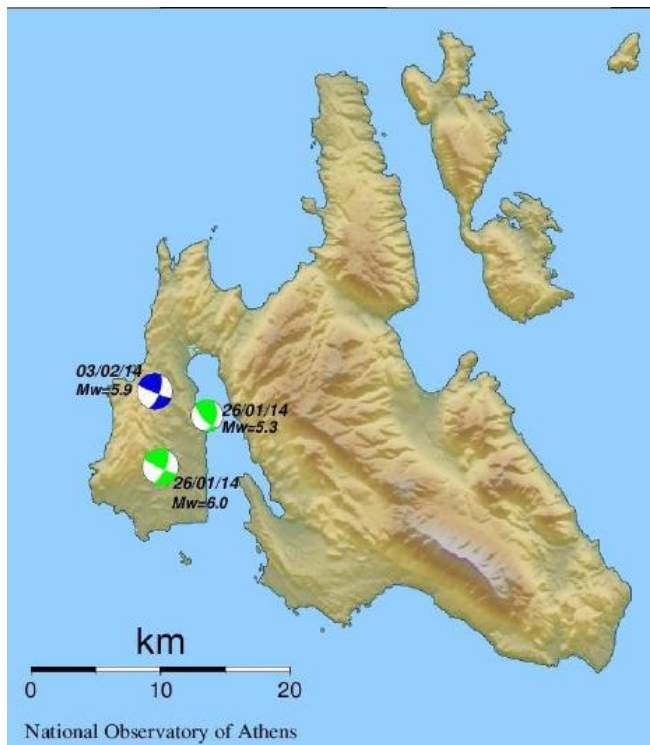
Electromagnetic Interference at RS 030A: Conclusions

- **The severe degradation of L1 tracking led to inability to track L2P at low elevation angles** (receivers using cross-correlation to track L2 under AS).
- **As a result of the interference L1 and L2 SNR was reduced by ~10dB.**
- **Tracking on L2 was not affected for satellites transmitting L2C, which is a civil code.**
- **Extended test proved that the telecom antenna has no influence on GPS tracking.**



2. Maintenance of HEPOS

Displacements caused by the Cephalonia Earthquakes Main events



Main events of the seismic sequence

Date , Time (GMT)	Mw	Depth (km)
26/1/14 13:55:43	6.0	16
26/1/14 18:45:08	5.3	16
3/2/14 03:08:44	5.9	11

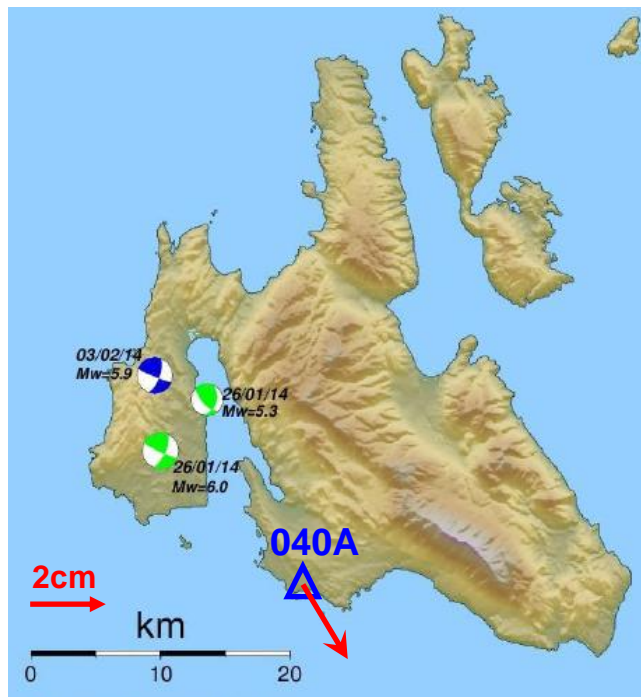


2. Maintenance of HEPOS

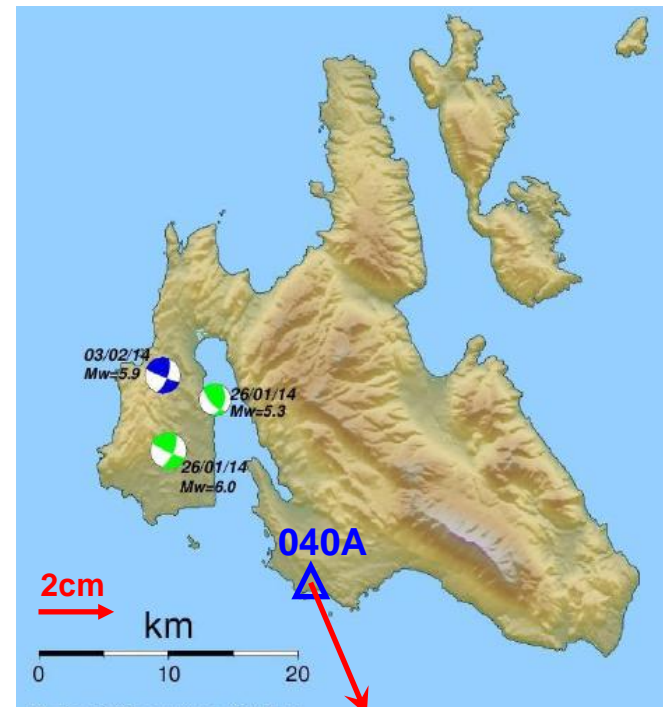
Displacements caused by the Cephalonia Earthquakes

Displacement of HEPOS station 040A (preliminary results)

Displacement due to
the EQs of January 26, 2014



(Total) displacement due to
all EQs up to February 4, 2014





3. Contribution to WG on Deformation Models

The working group on deformation modelling was created in 2012.

The objectives of the WG are¹:

- Evaluation of available GNSS-derived velocity fields
- Inventory and evaluation of available crustal deformation models for Europe or selected parts of it
- Consideration of a deformation model in maintenance and use of national realizations of the ETRS89

(1) H. Steffen and M. Lidberg (2013): "First steps in the development of an EUREF Velocity Model", EUREF Symposium.



3. Contribution to WG on Deformation Models

- NCMA S.A. is carefully studying for years the tectonic deformations in Greece as they have an immediate effect on the operation of HEPOS.
- Thus, for WG and NCMA S.A tectonic deformations are field of common interest for both sides.
- NCMA S.A. is collaborating with the WG and has made available data from 20 HEPOS stations, spanning from 2008 to 2010.



3. Contribution to WG on Deformation Models

HEPOS data made available to the WG



- 20 HEPOS stations
- Time span:
2008-2010



4. Monitoring of ionospheric activity

Motivation

During 2011 and 2012 intense ionospheric activity, seriously affected RTK applications in Greece, mainly in the Southern part of the country.

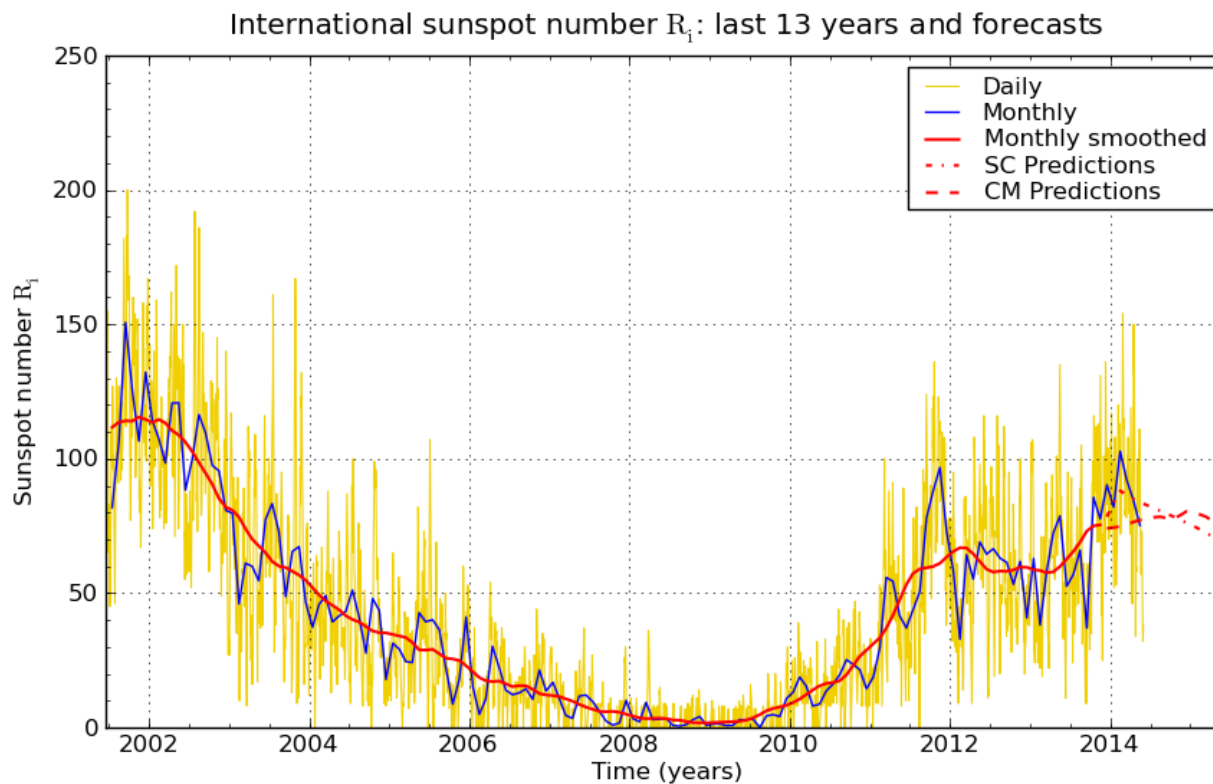
As the maximum of the 24th Solar Cycle was (initially) expected in 2013, the ionospheric activity is continuously monitored for the operation of HEPOS.

The monitored ionospheric activity in 2013 was intense, but at levels comparable to that of 2011 and 2012. The high activity in late 2011 was clearly exceeded only in 2014. This is in agreement with:

- the observed sunspot numbers that reveal a double-peaked Solar Cycle
- the fact that, in this Solar Cycle the second peak in sunspot number was larger than the first. (<http://solarscience.msfc.nasa.gov/predict.shtml>)

4. Monitoring of ionospheric activity

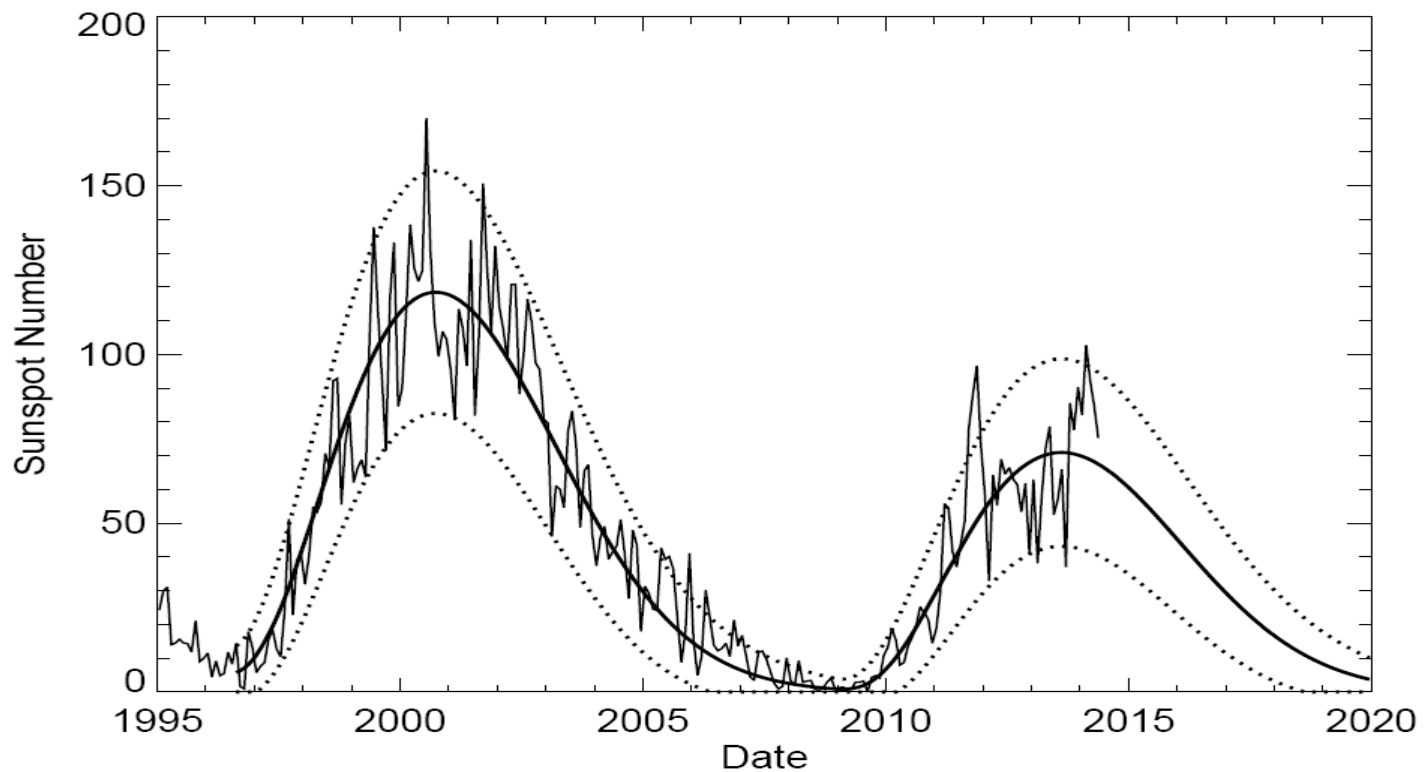
Sunspot number



SILSO graphics (<http://sidc.be>) Royal Observatory of Belgium

4. Monitoring of ionospheric activity

Sunspot number

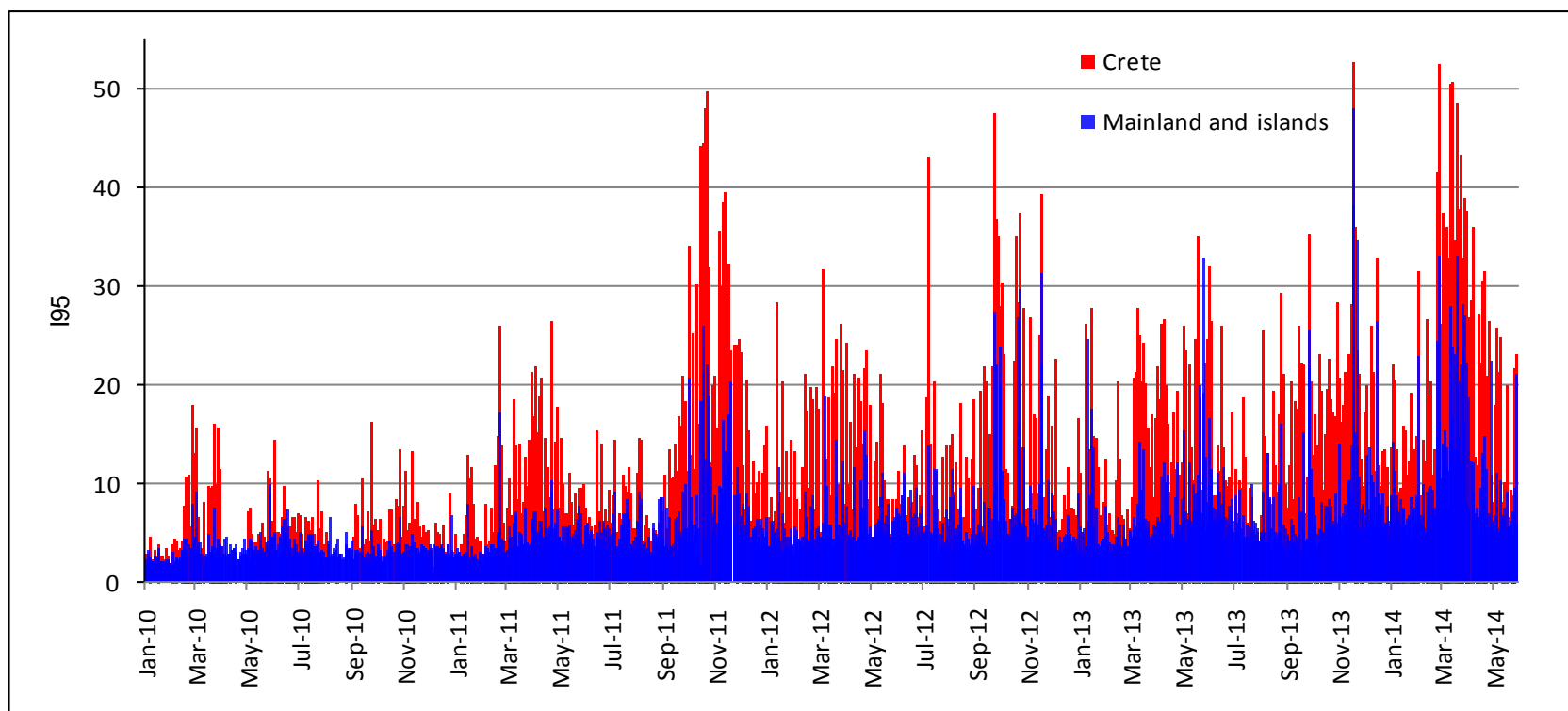


<http://solarscience.msfc.nasa.gov/predict.shtml>



4. Monitoring of ionospheric activity

HEPOS I95 index Daily maximum

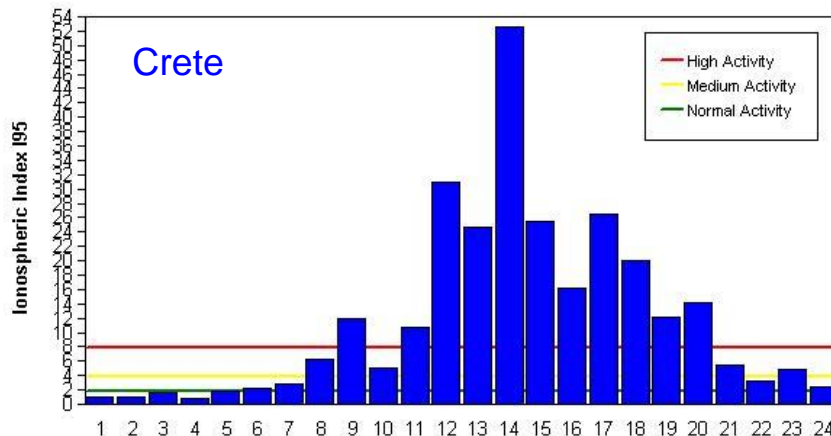
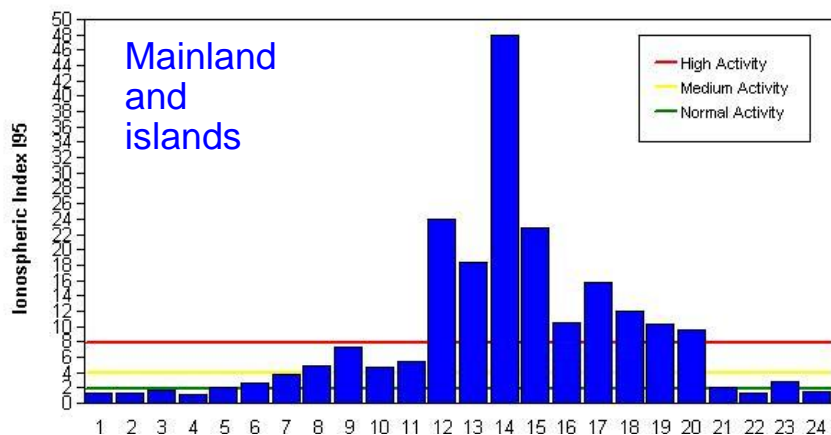




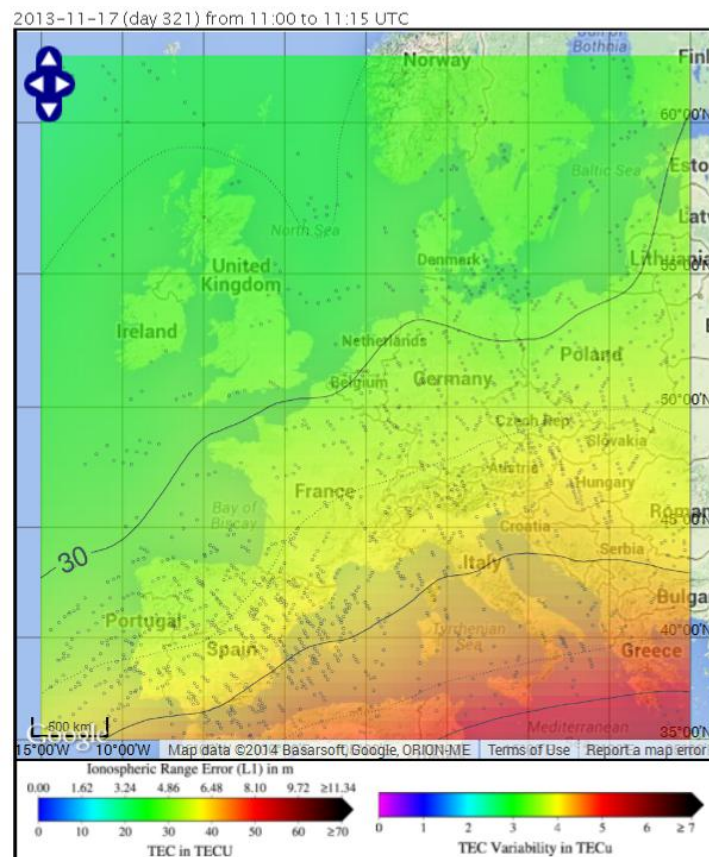
4. Monitoring of ionospheric activity

HEPOS I95 index

17.11.2013: Highest I95 from Jan 2010 to May 2014



Hour of Day



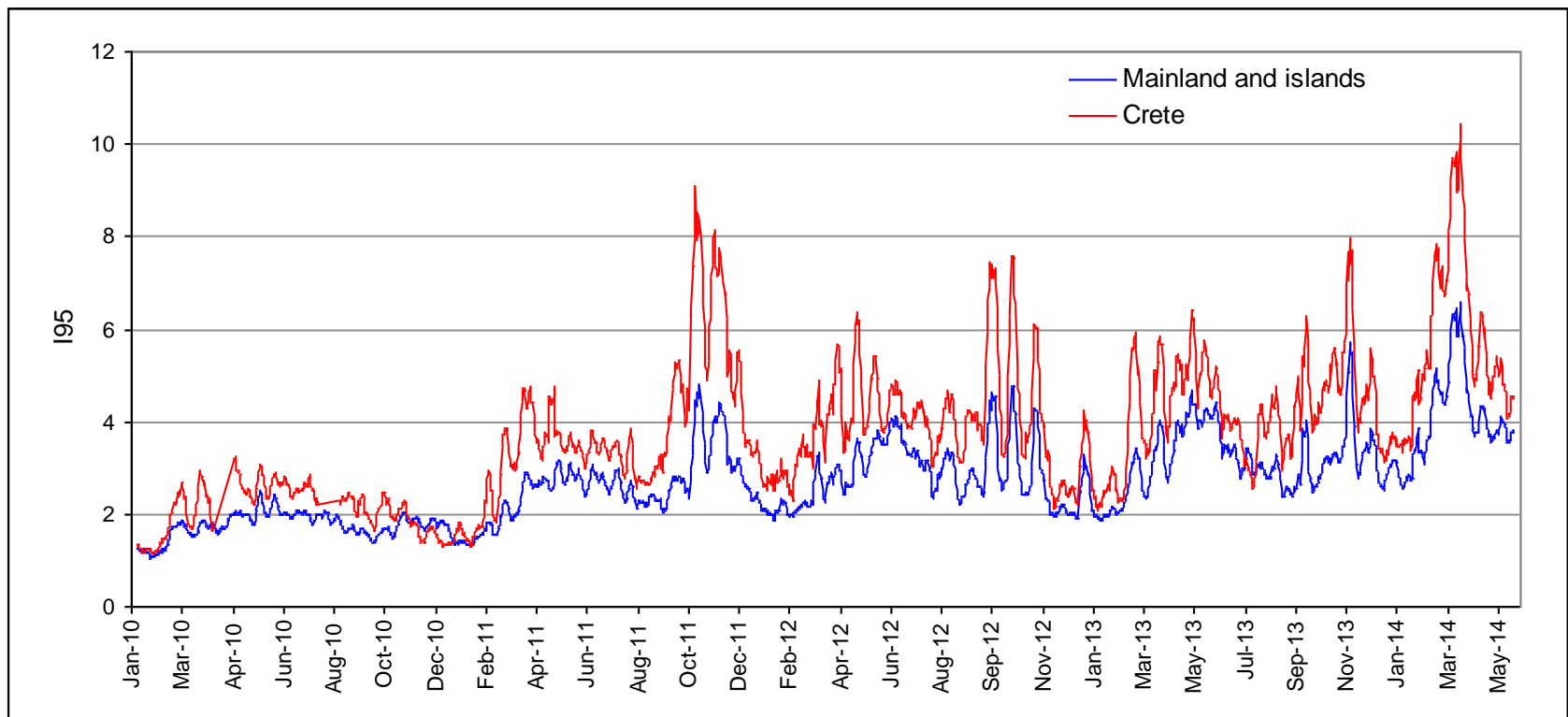
http://gnss.be/Atmospheric_Maps/dynamic_ionospheric_maps.php



4. Monitoring of ionospheric activity

HEPOS I95 index Daily mean

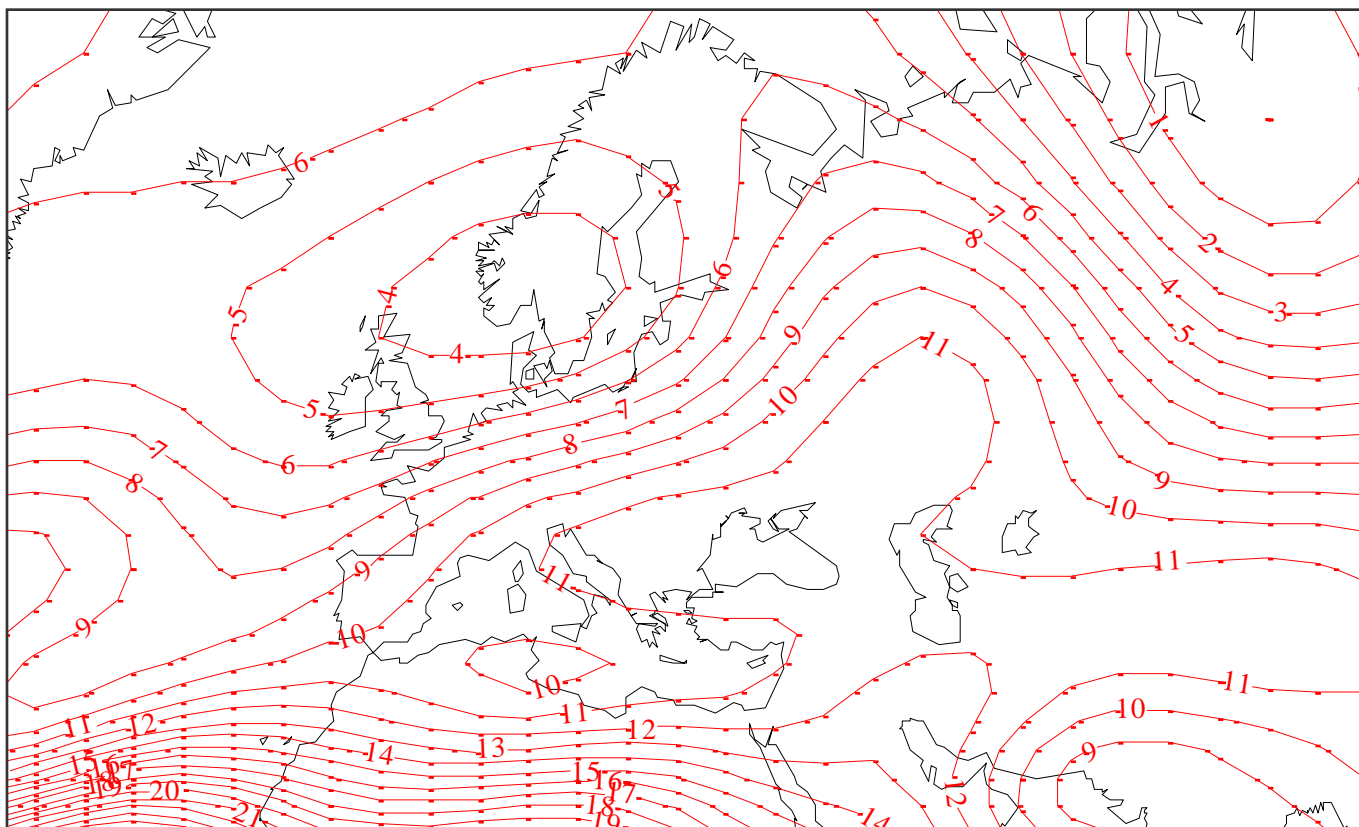
Mean of the 24 hourly values, smoothed with moving average filter (span: 7 days)





4. Monitoring of ionospheric activity

Unusual VTEC geographic distribution over Greece
Period of low activity, 15/11/2010 22:00

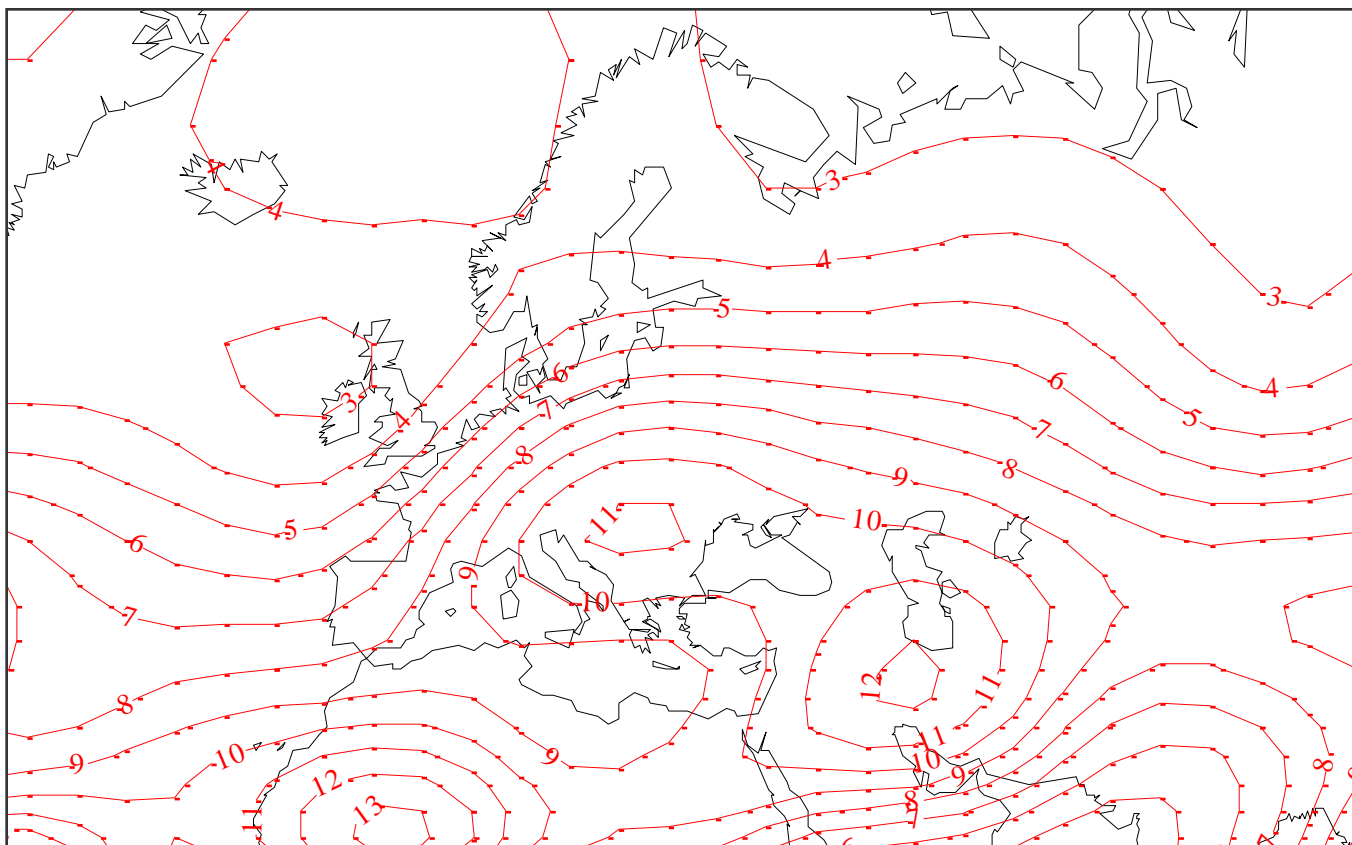


CODE's GIM plotted with GpsTools (Takasu & Kasai, 2005)



4. Monitoring of ionospheric activity

Unusual VTEC geographic distribution over Greece Period of low activity, 1/12/2010 00:00

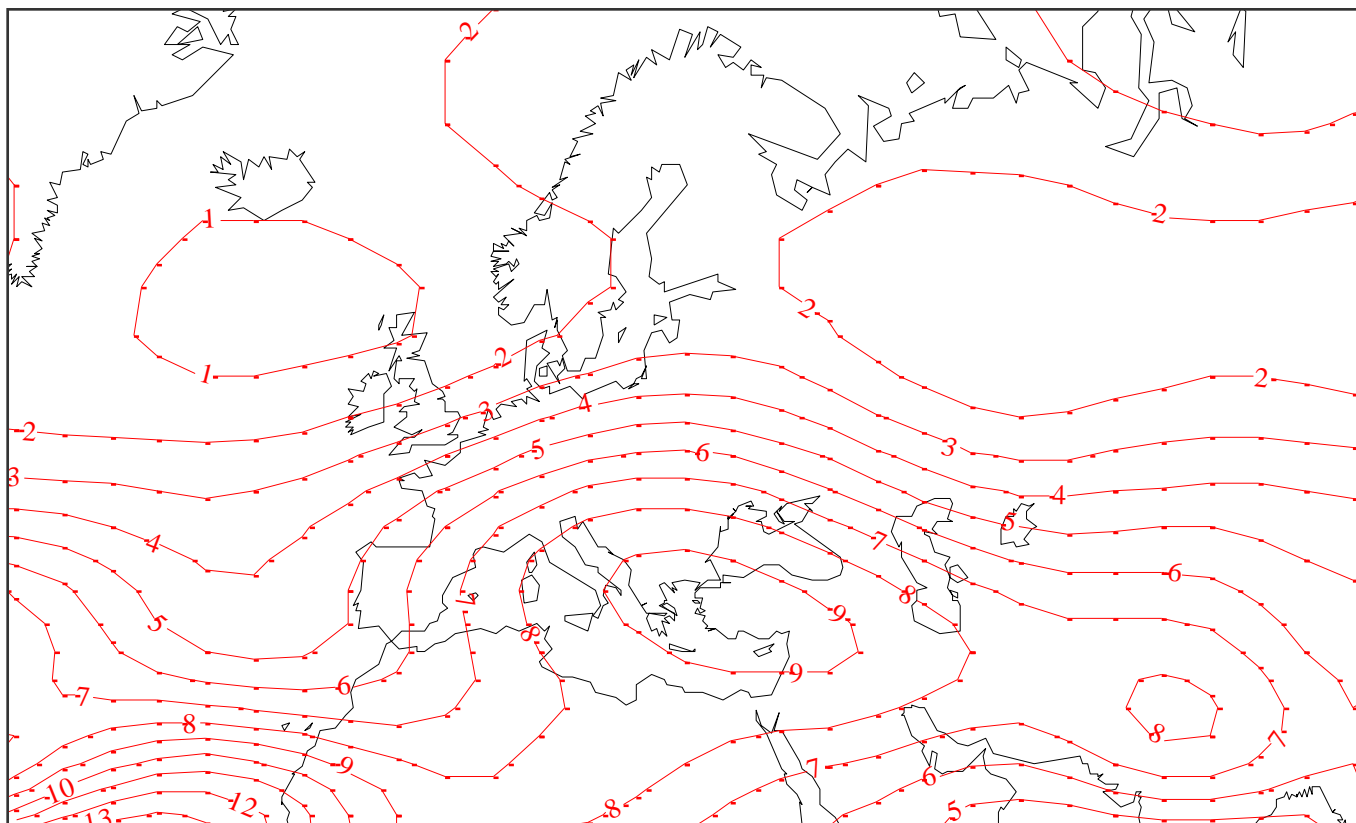


CODE's GIM plotted with GpsTools (Takasu & Kasai, 2005)



4. Monitoring of ionospheric activity

Unusual VTEC geographic distribution over Greece
Period of low activity, 2/1/2011 00:00

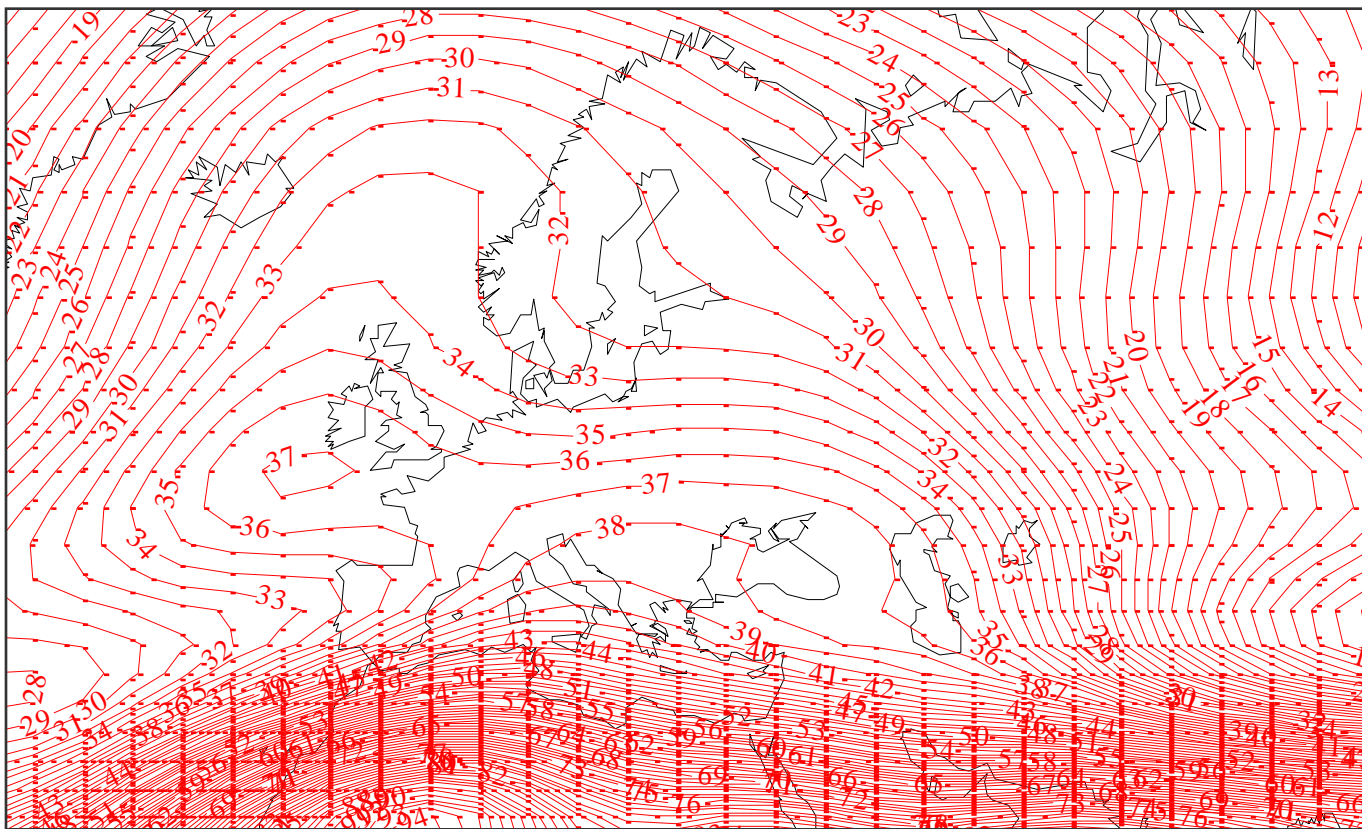


CODE's GIM plotted with GpsTools (Takasu & Kasai, 2005)



4. Monitoring of ionospheric activity

Normal VTEC geographic distribution over Greece
Period of high activity, 14/11/2011 12:00



CODE's GIM plotted with GpsTools (Takasu & Kasai, 2005)

Acknowledgments



Mrs. S. Bouzouki and Mr. A. Patouchas from the Hellenic Telecommunications and Post Commission are kindly acknowledged for identifying the source of RF interference close to HEPOS station 030A.

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