



EPN 6th LAC Workshop, October 22-23 2008,  
Frankfurt am Main, Germany



# Current Activities and Research at ROB LAC

J. Legrand, Q. Baire, N. Bergeot, C. Bruyninx,  
P. Defraigne, S. Pireaux and E. Pottiaux

Royal Observatory of Belgium



# Outline



- EPN Central Bureau
- ROB LAC
- PPP software ATOMIUM
- Troposphere
- Ionosphere
- Reprocessing ROB/EPN
- Reference Frame



# Outline

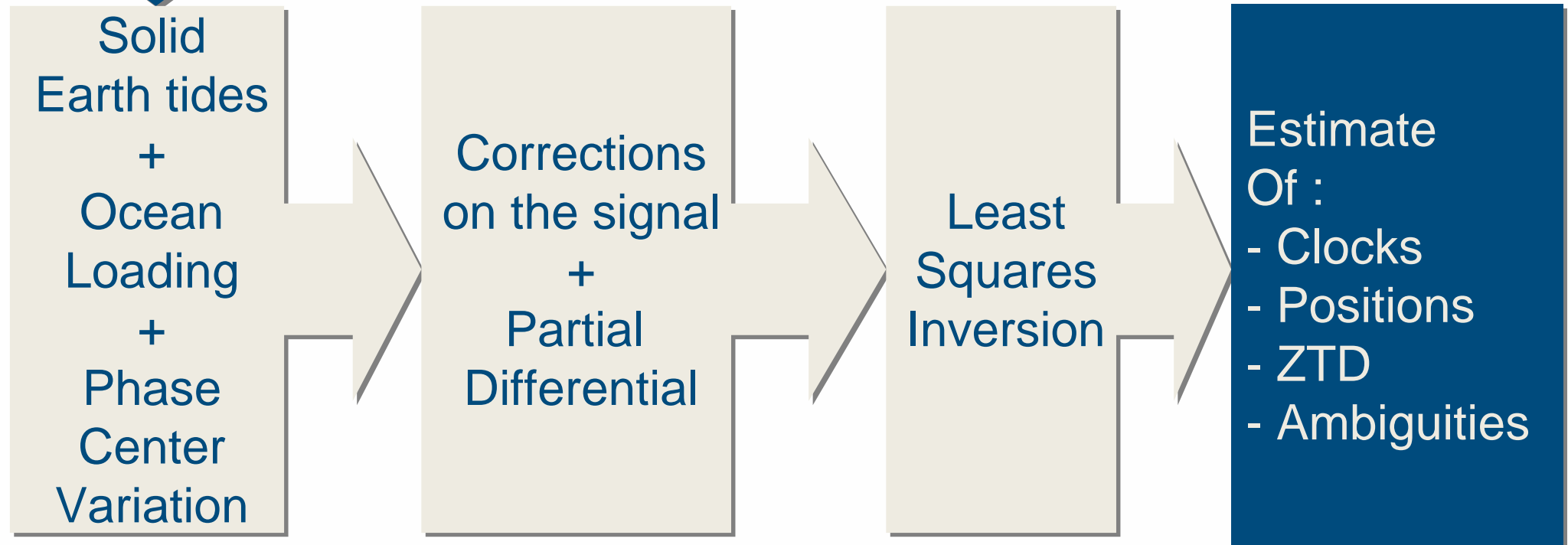


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GNSS\* code  
and phase  
observations  
L3 and P3

## PPP Software Atomium

Atomium Precise Point Positioning (PPP) Software  
initially for Time Transfer (Time Laboratory)

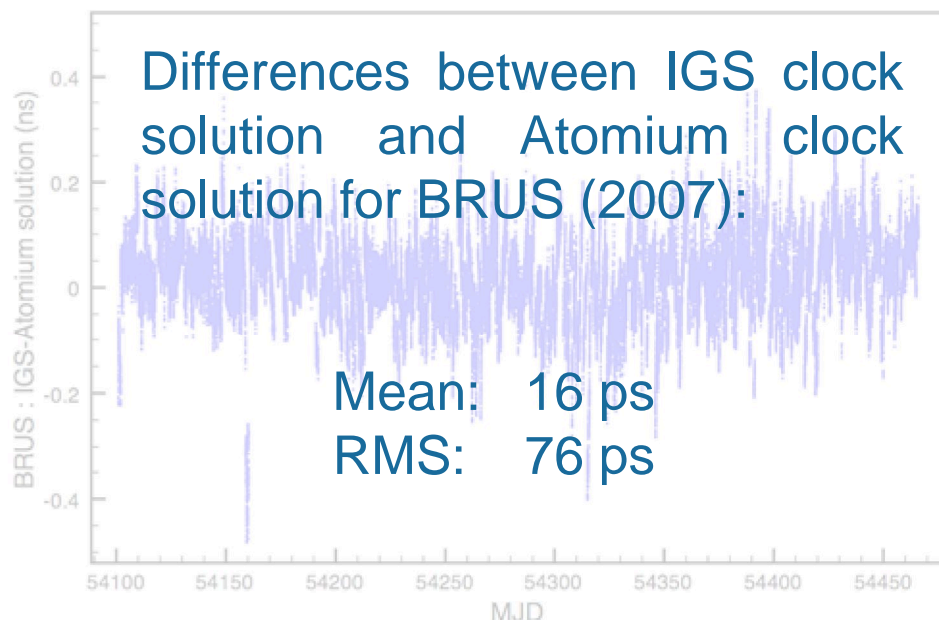


\* GPS, GLONASS,  
Galileo Simulation

Integration of 2nd and 3rd order  
ionospheric corrections (GPS)



## Quality of Clocks



## Quality of Positions

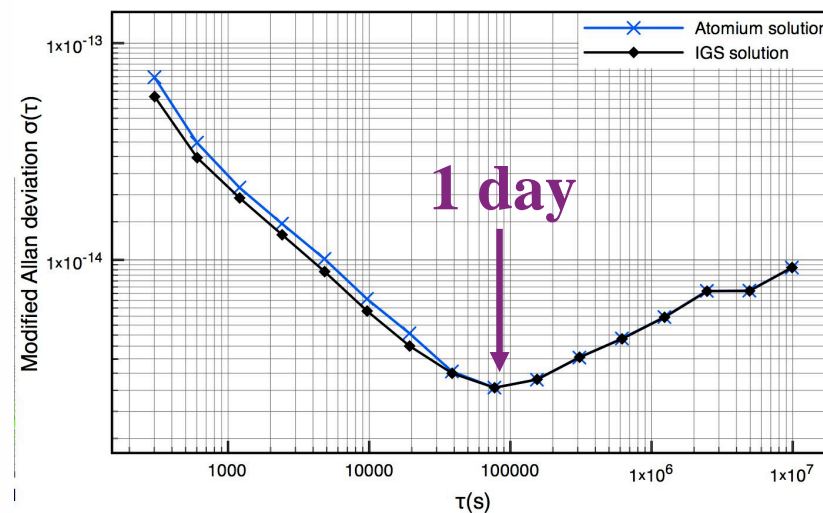
Weekly Repeatability:

East: 2.6 mm

North: 1.8 mm

Up: 4.4 mm

## Modified Allan deviation for IGS and Atomium clock solutions





# Outline



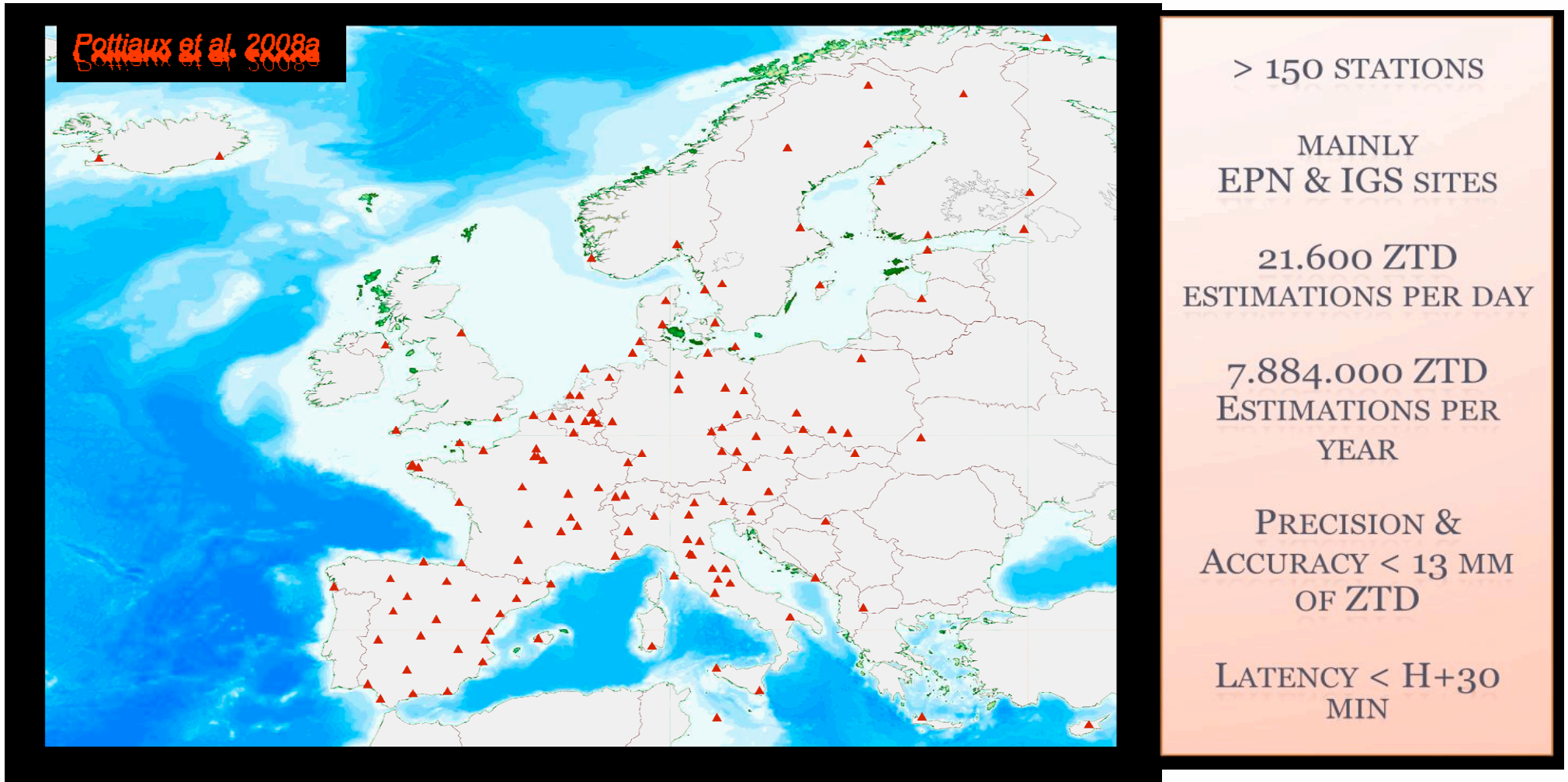
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# Troposphere-related Activities and Research



- E-GVAP analysis center
- Troposphere-related Research Projects Running
  - Impact of Reference Frame, Antenna phase centre variation models, GLONASS and Orbit Quality on Zenith Path Delay Estimations
  - Detection of Small-Scale Tropospheric Phenomena Using GNSS Observations from Dense National Networks



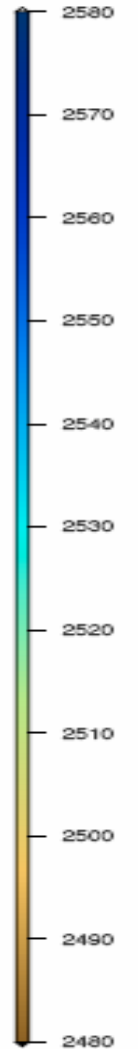
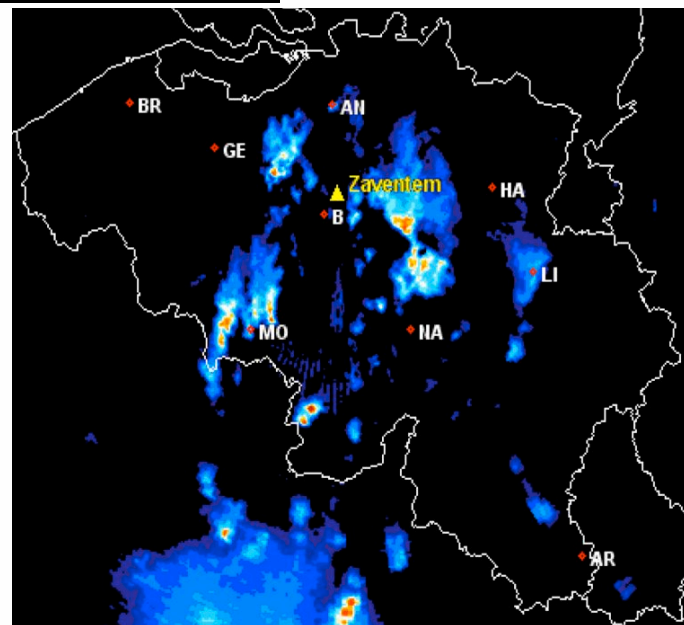
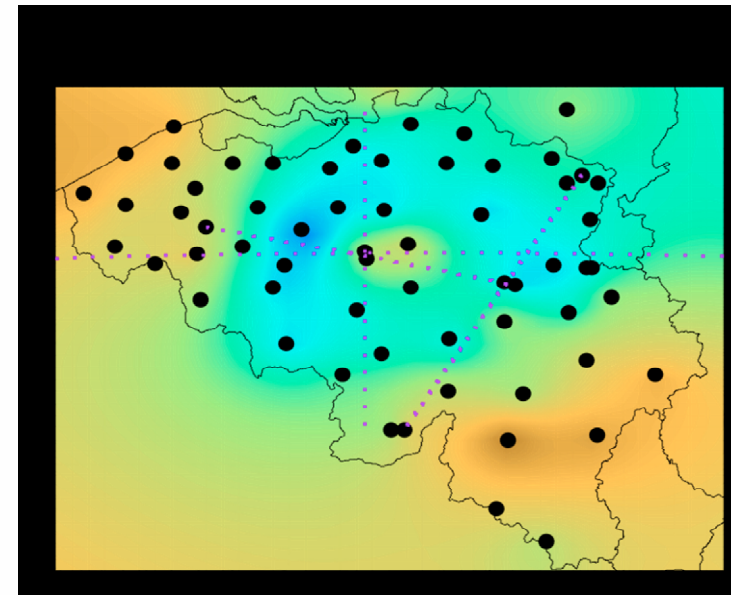
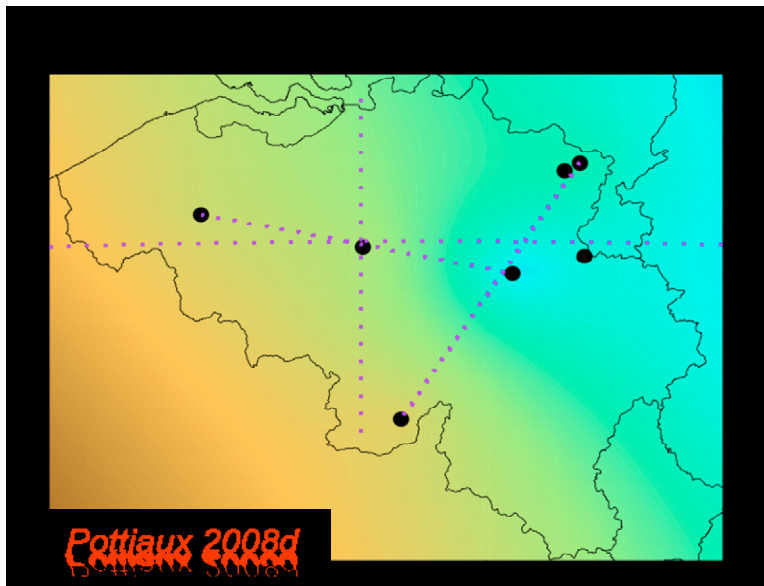


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- E-GVAP analysis center
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# Small-Scale Structures in the Troposphere Using GNSS Dense National Networks





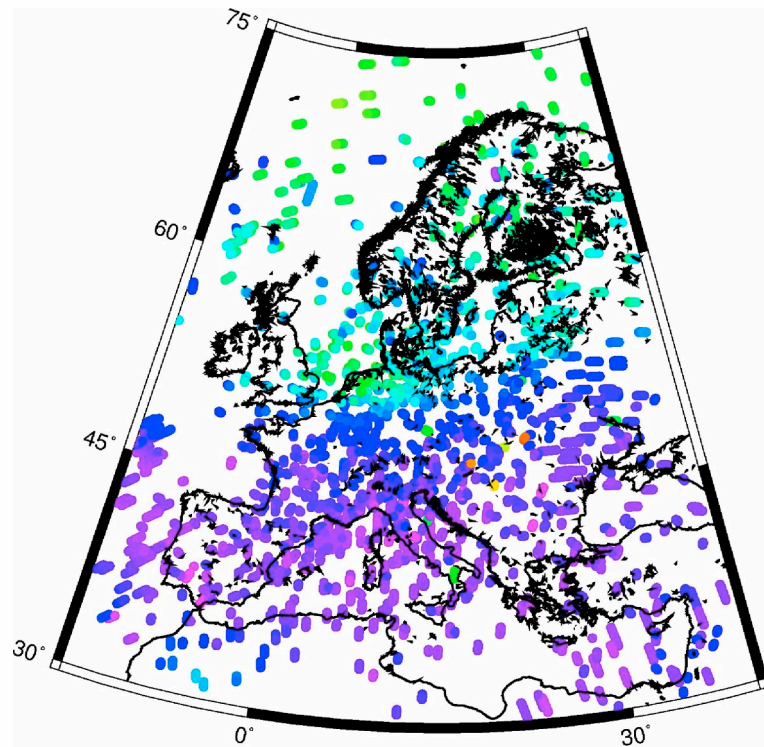
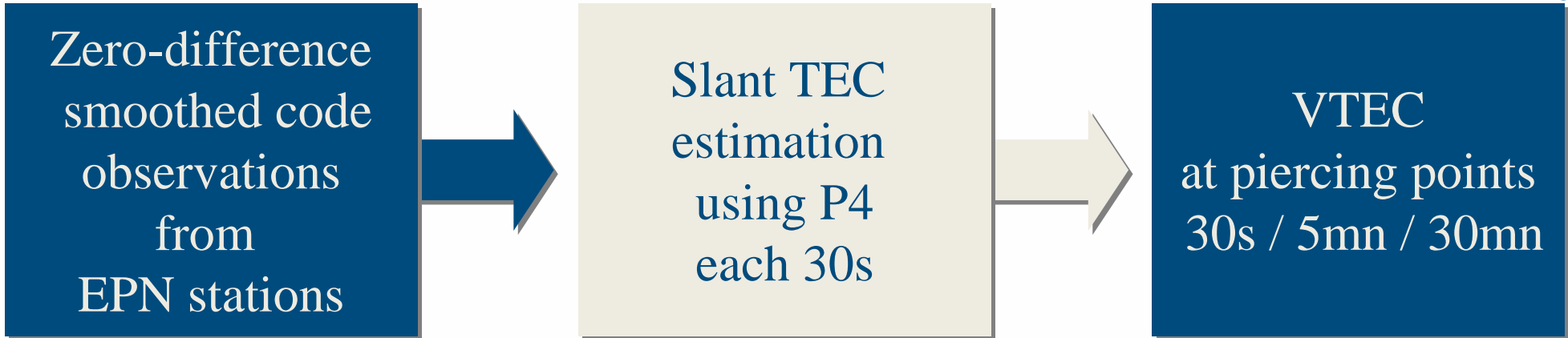
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# Ionospheric monitoring

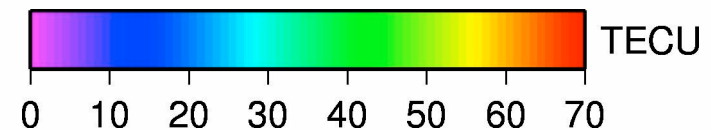


VTEC at piercing points (5mn)

Geomagnetic storm day

2003/10/30

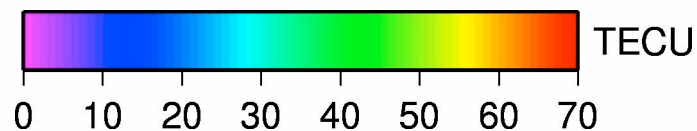
21:20 to 21:25



21:20:0 to 21:24:30 (UT)



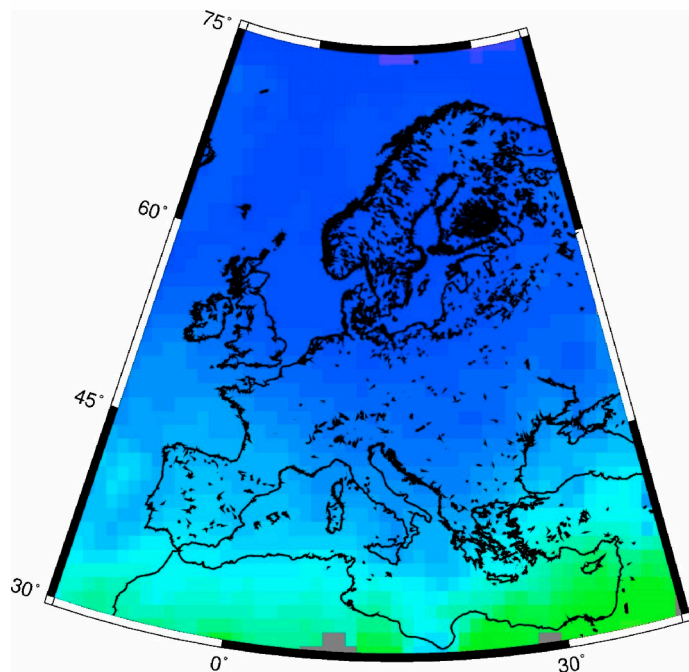
Interpolation to produce  
VTEC 1°/1° grid maps  
over Europe  
each 30mn or 1h



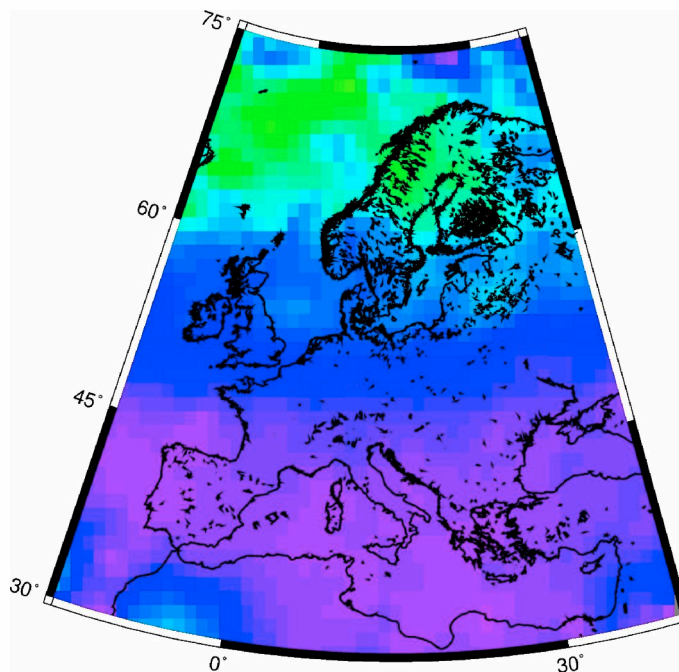
Geomagnetic storm day  
(2003/10/30)

(2003/11/01)

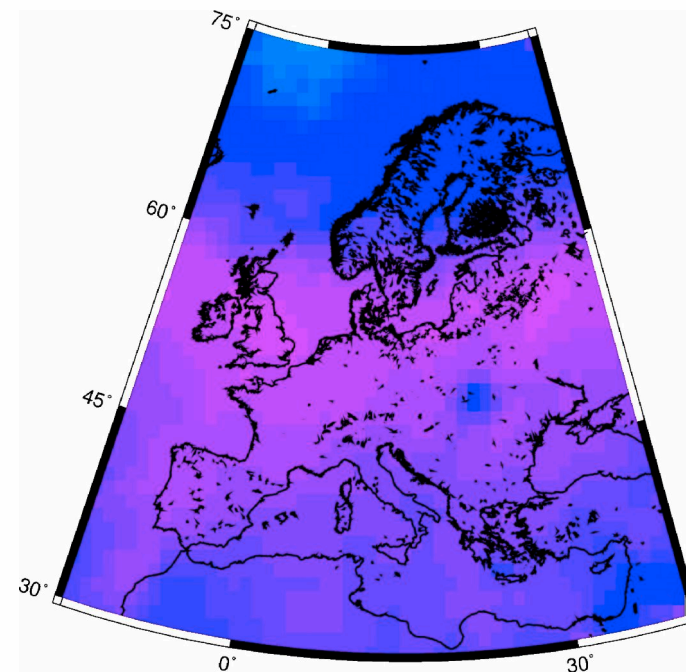
(2003/11/01)



11:0:0 to 11:59:30 (UT)



21:0:0 to 21:59:30 (UT)



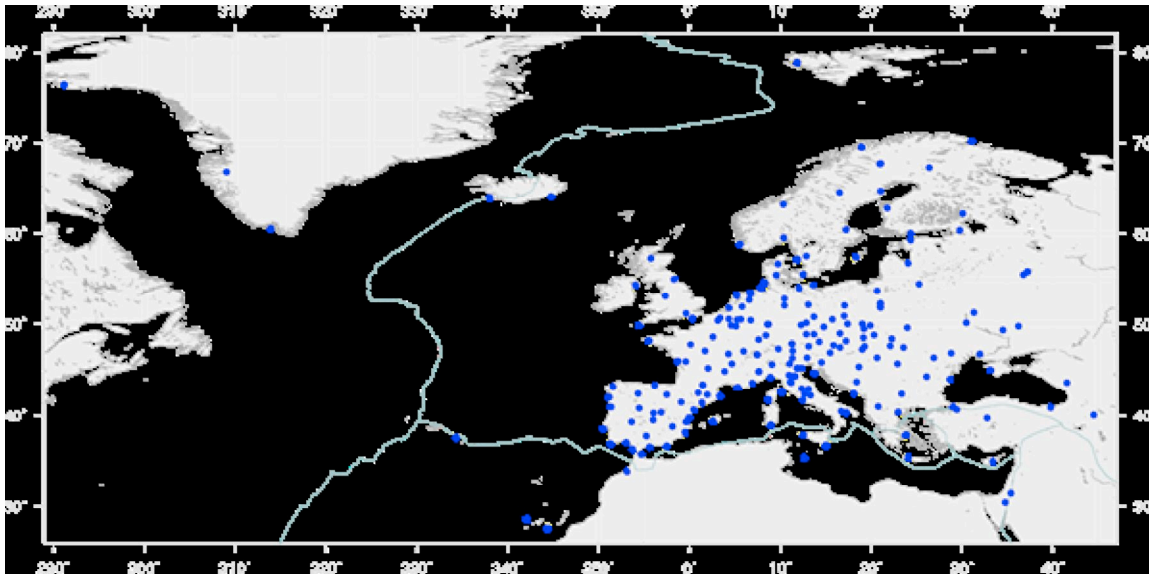
21:0:0 to 21:59:30 (UT)



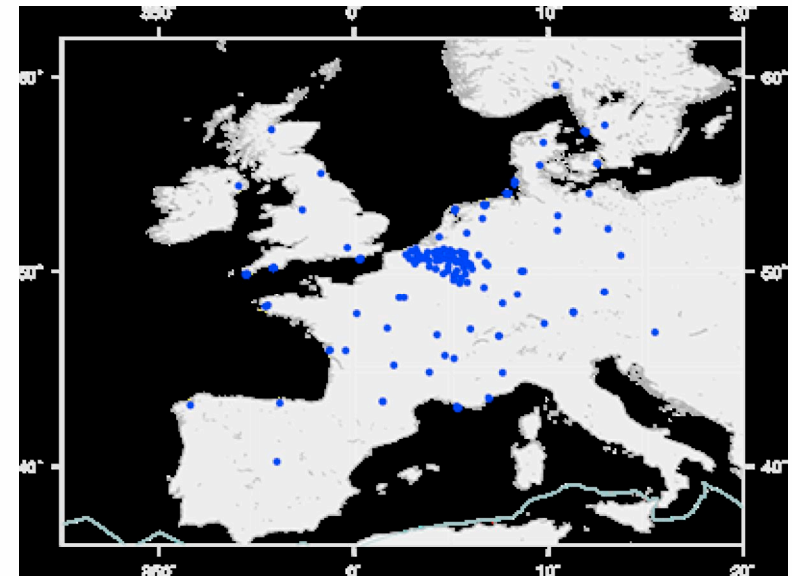
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EPN Reprocessing  
Regional network  
222 EPN stations  
Data span: 1997-present



ROB Reprocessing  
Local network  
134 stations (EPN + Belgian)  
Data span: 1996-present

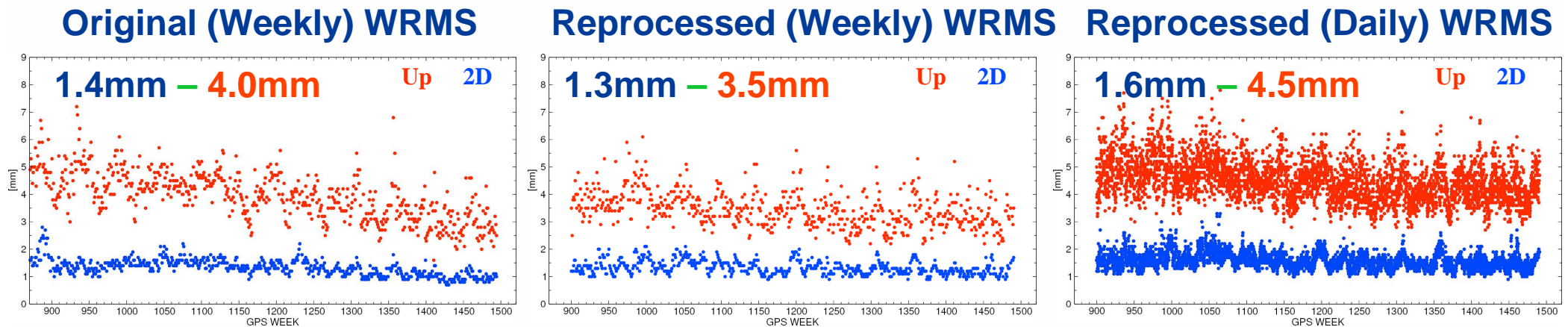
## Data Processing (LAC Guidelines):

- **BERNESE software version 5.0**
- Ionosphere-free double differences in a network approach
- absolute antenna phase center corrections
- IGS final orbits and ERPs
- Troposphere: wet-Niell mapping function

CATREF (Altamimi 2007) is used to:

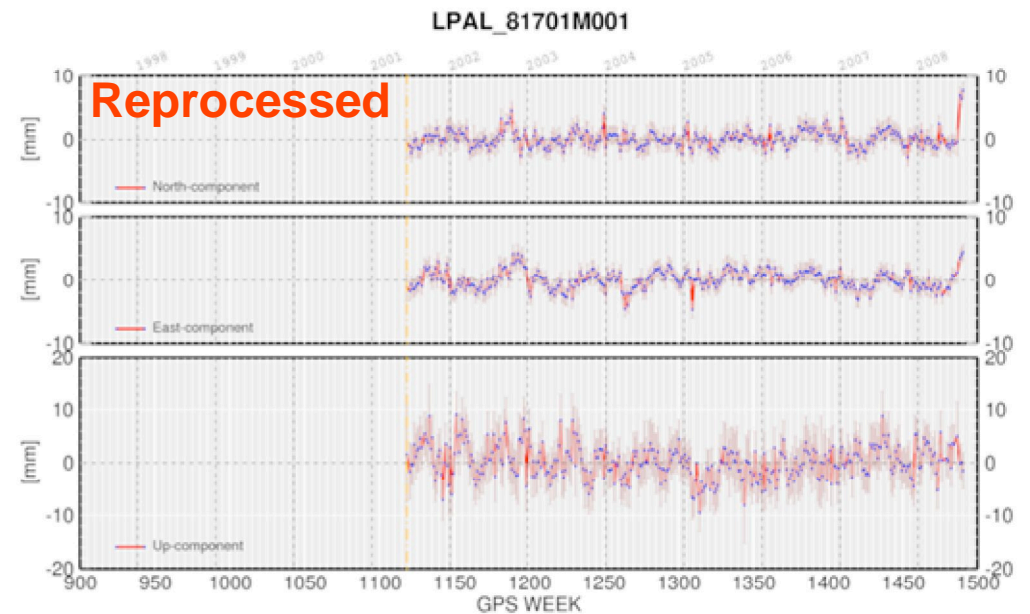
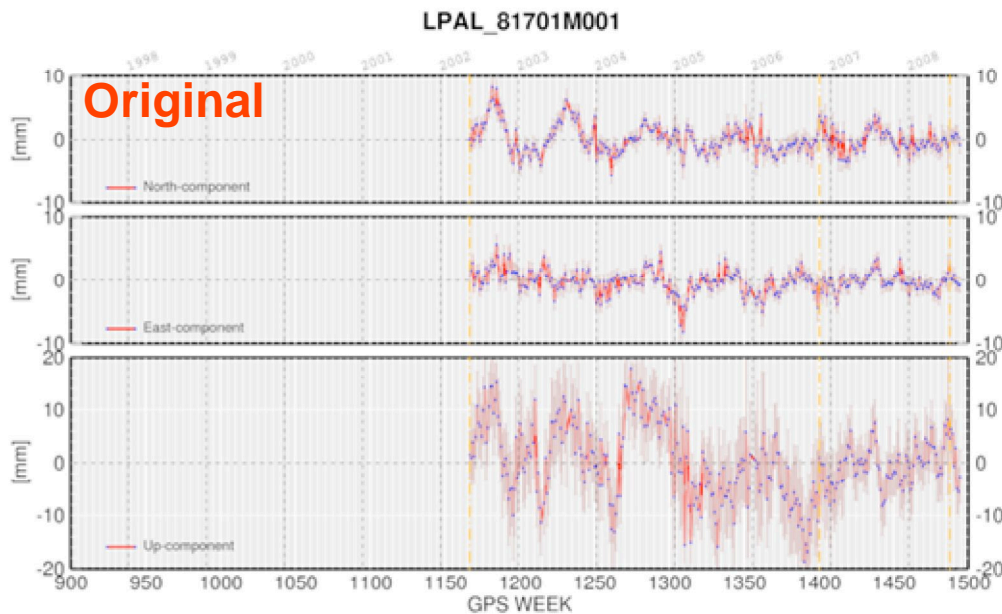
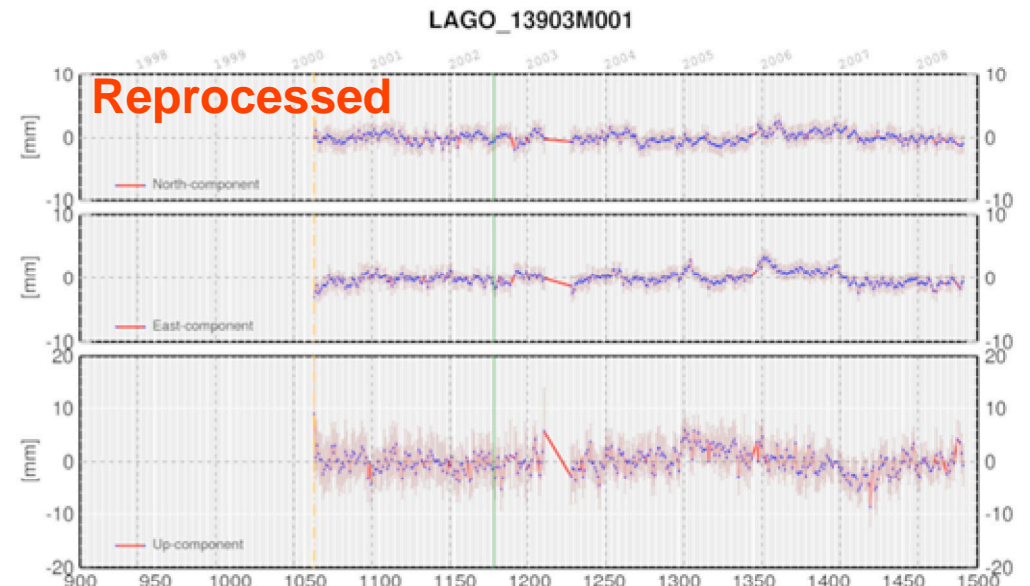
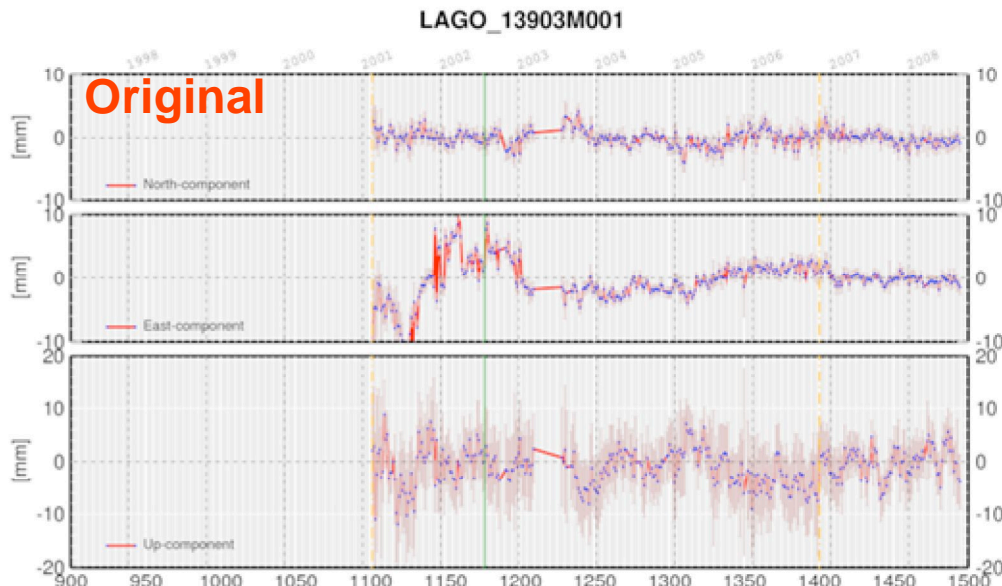
- compute weekly sinex
- combine daily or weekly sinex
- ⇒ Position/Velocity cumulative solution

Residual timeseries cleaning using daily solutions

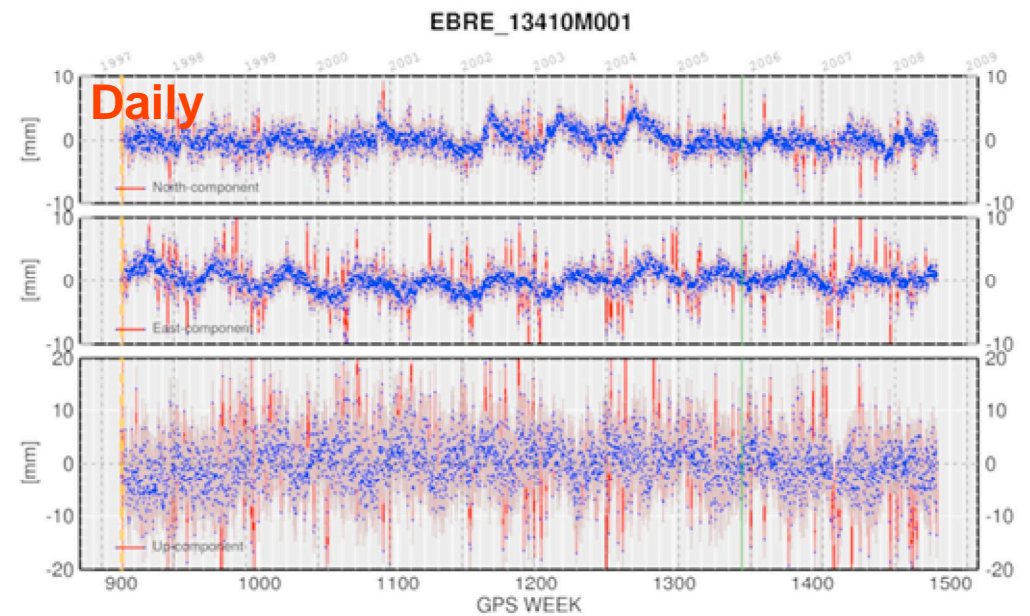
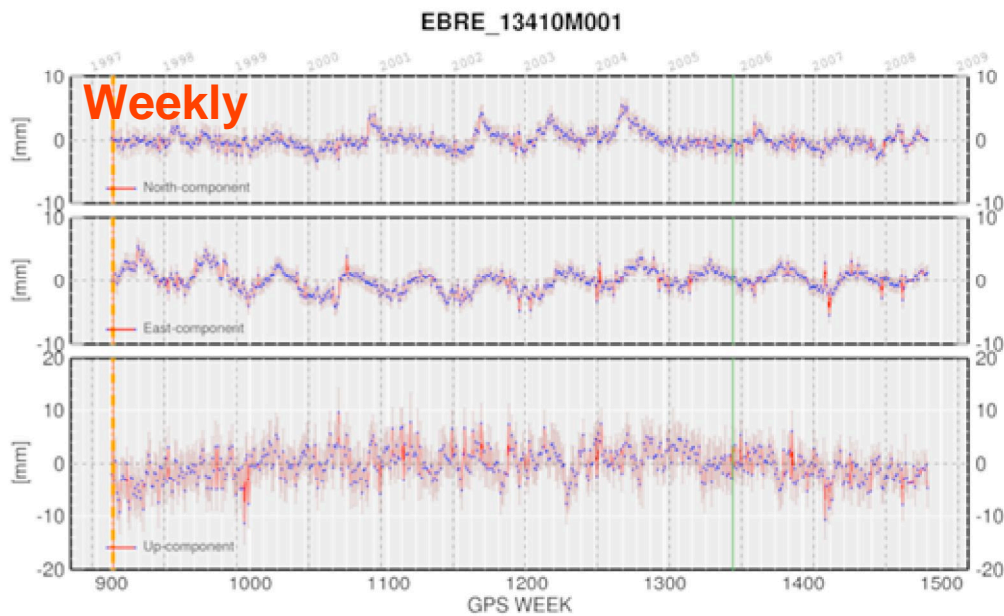
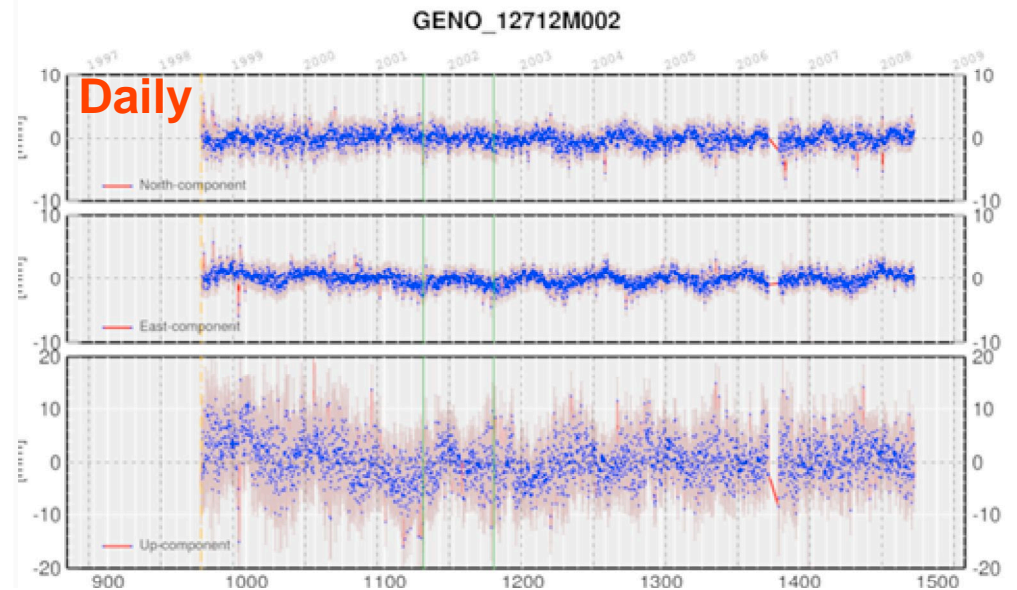
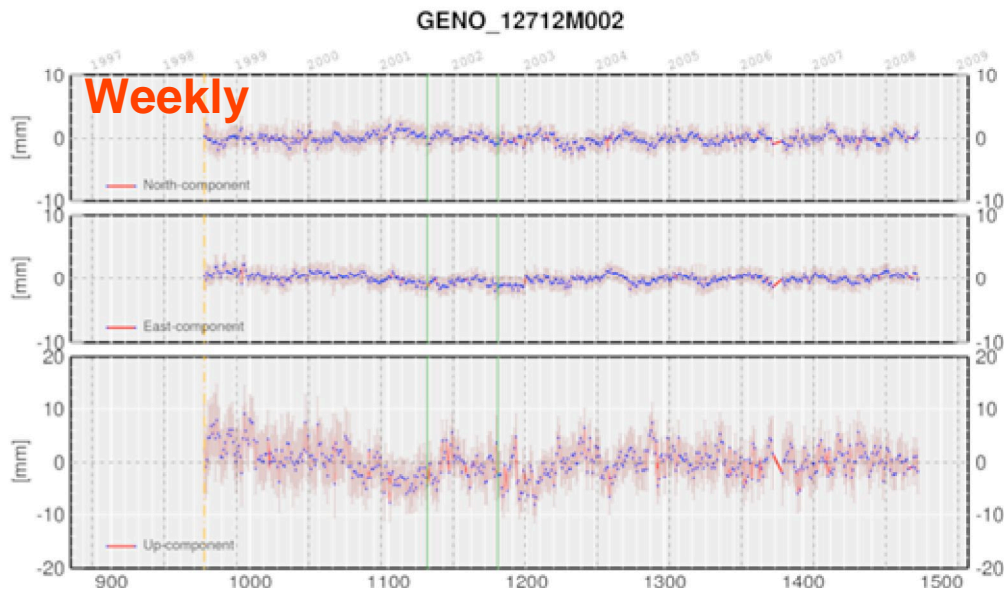


Time series special project (A. Kenyeres)



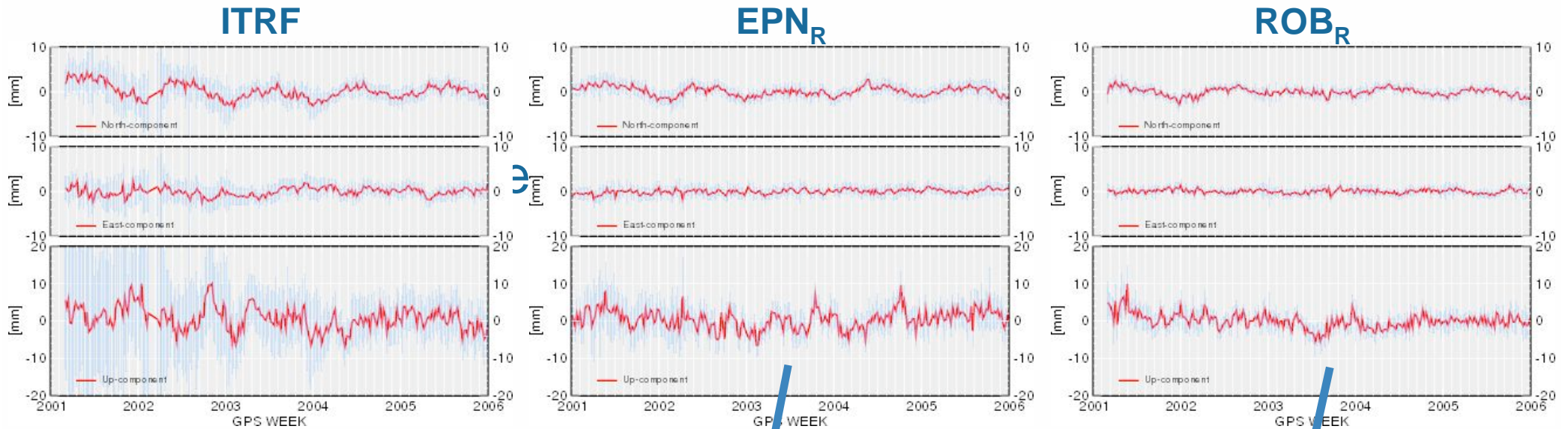


# Benefits from Daily Time Series

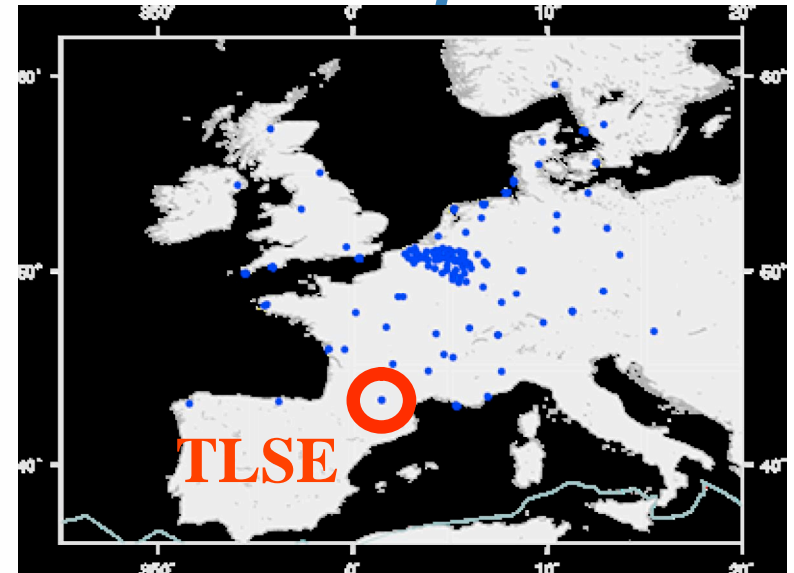
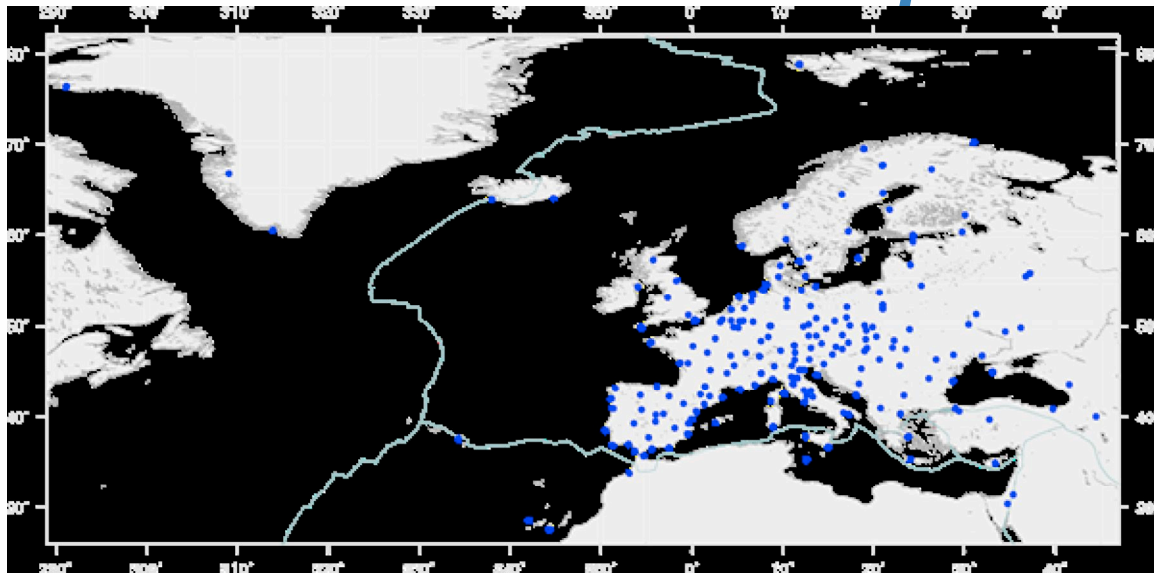


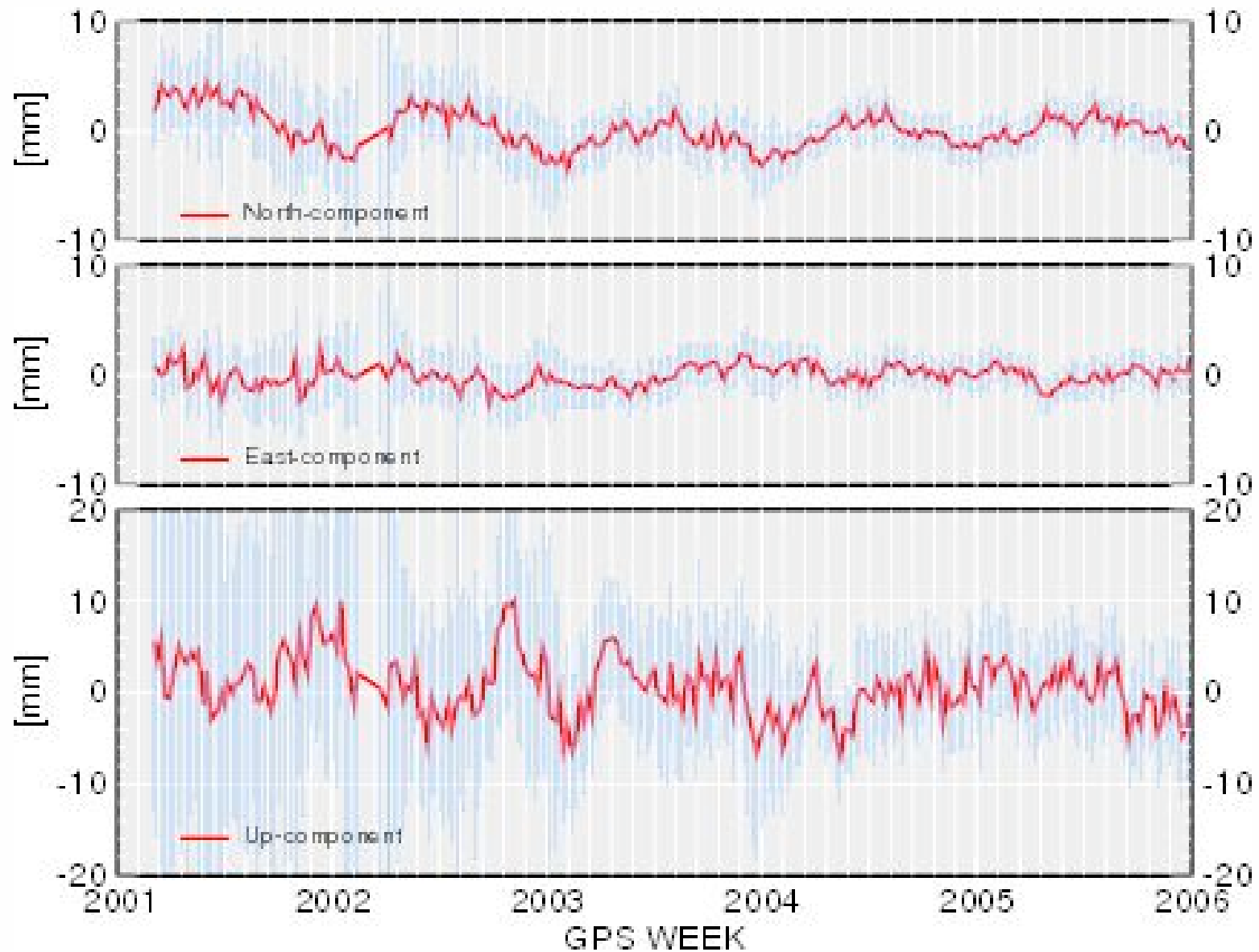


# Comparison of Global/Regional/Local Time Series

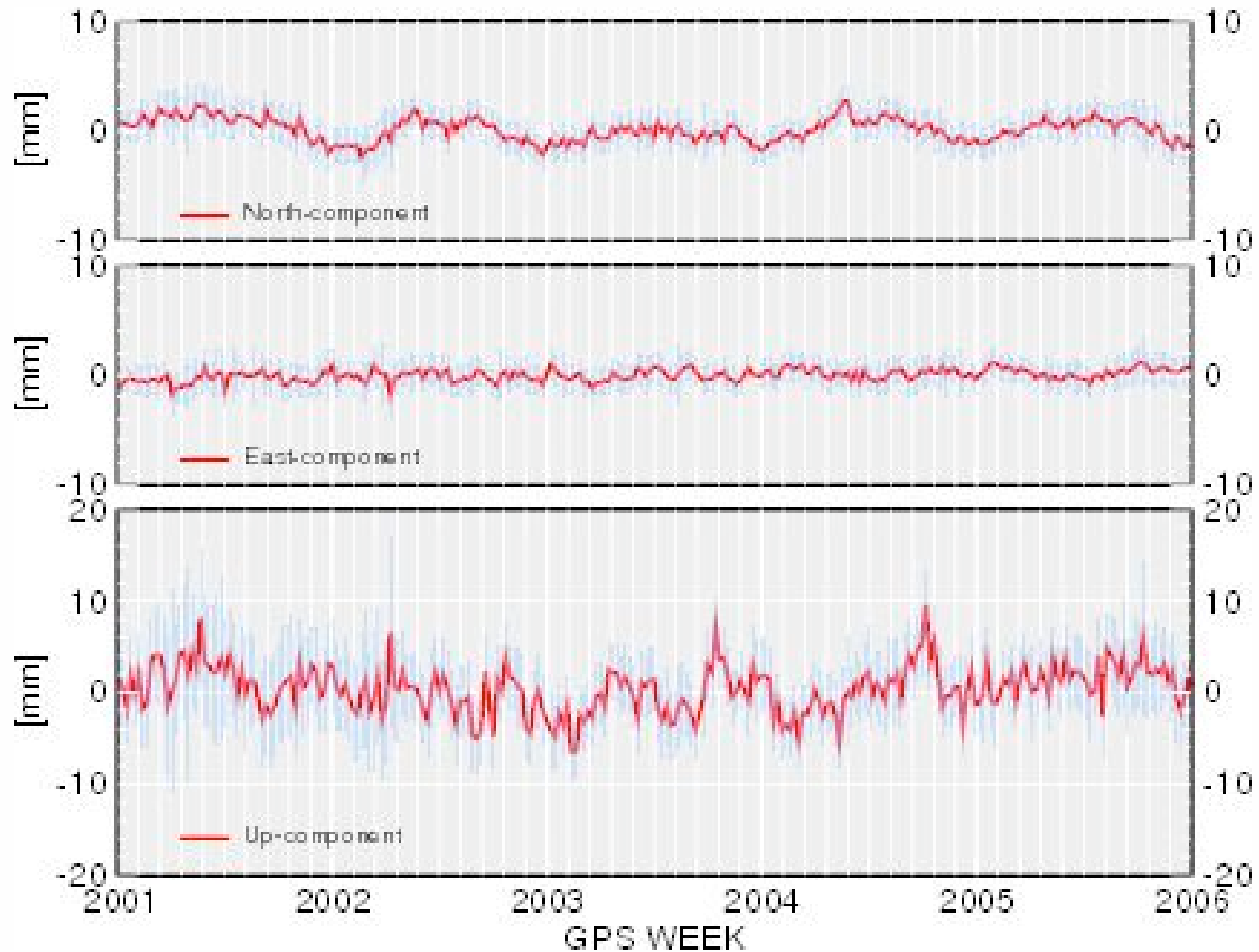


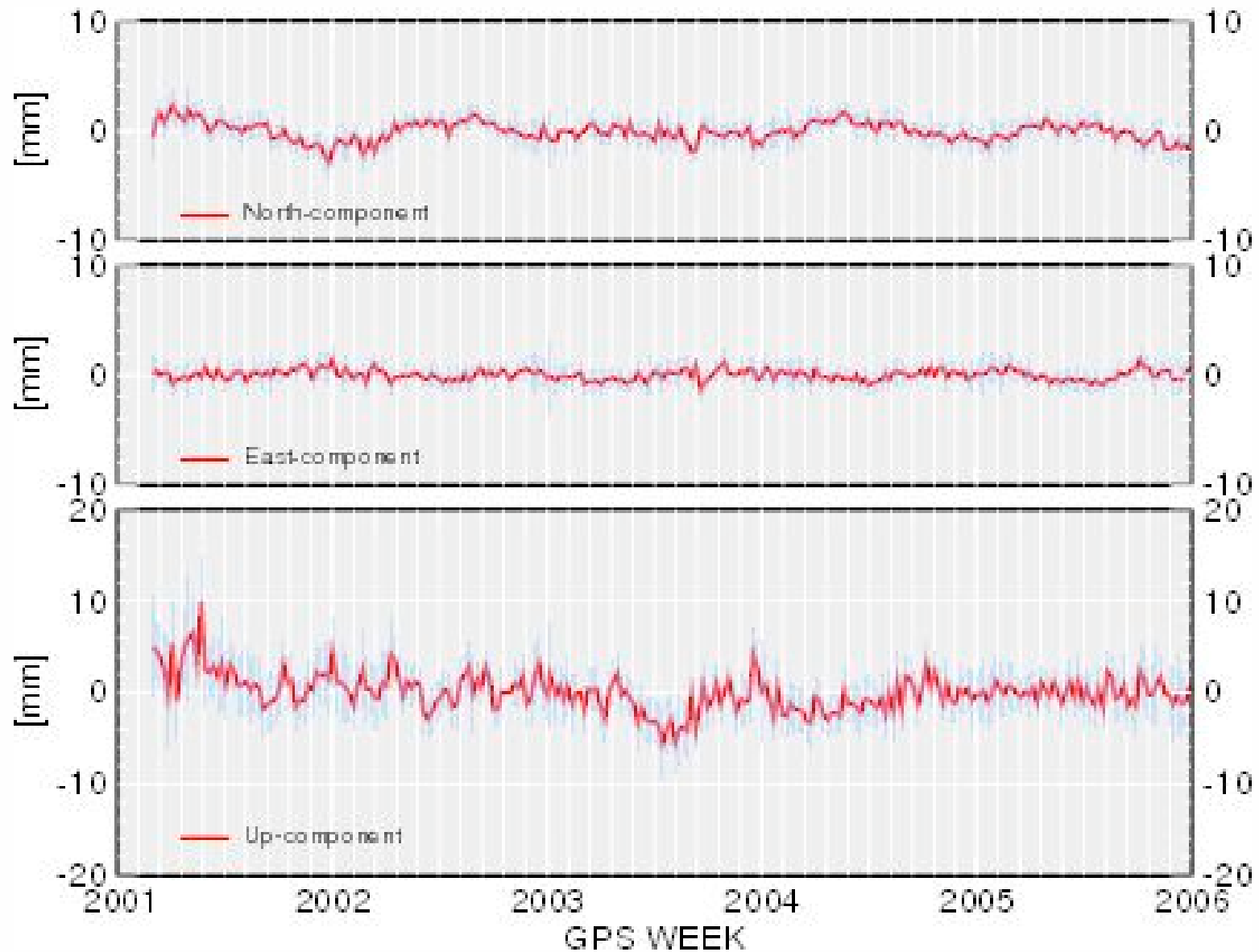
[ITRF Web site](#)













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# Regional vs Global: Positions



- **Regional:**

different regional solutions can show biases (up to the cm-level) with respect to each other

- Outliers in reference stations
- Set of reference stations
- Reference frame: IGS05 / ITRF2005

- **Global:**

stable sub-mm level

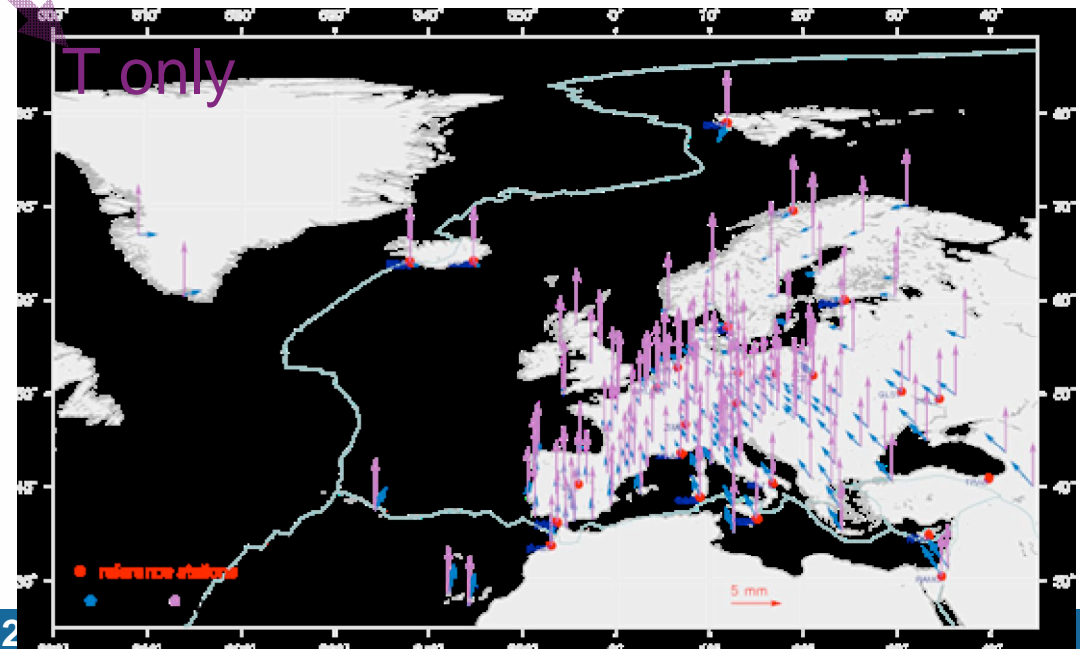
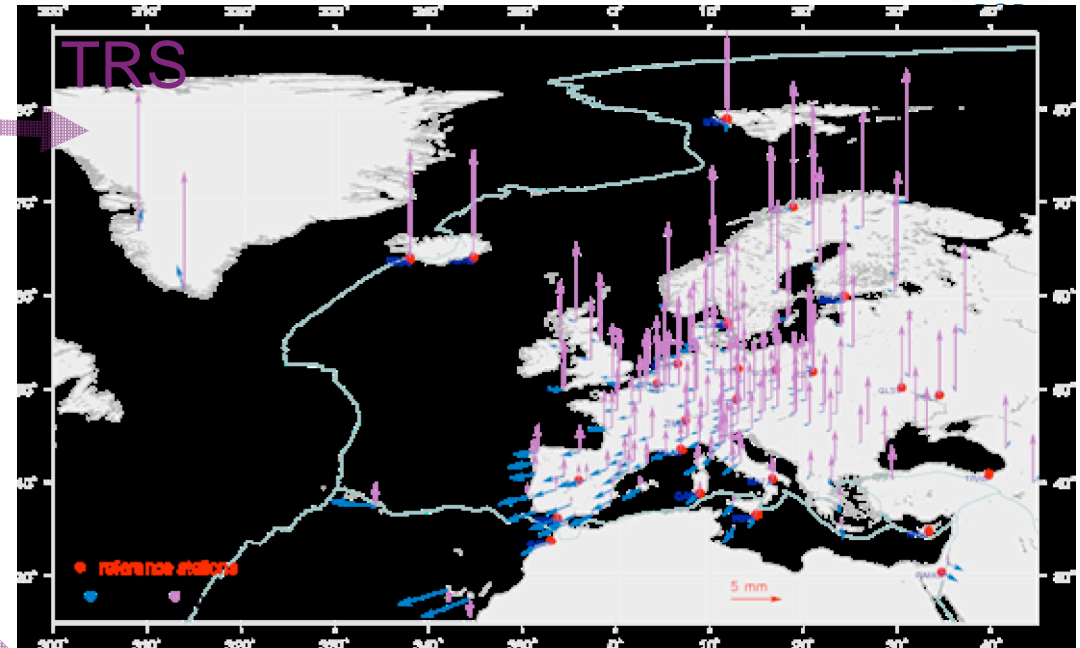
# IGS05 vs ITRF2005: Positions

Minimal constraints on:

- Translation, Rotation, Scale
- Translation only

Reference stations:

Reference stations of the EPN combined solutions

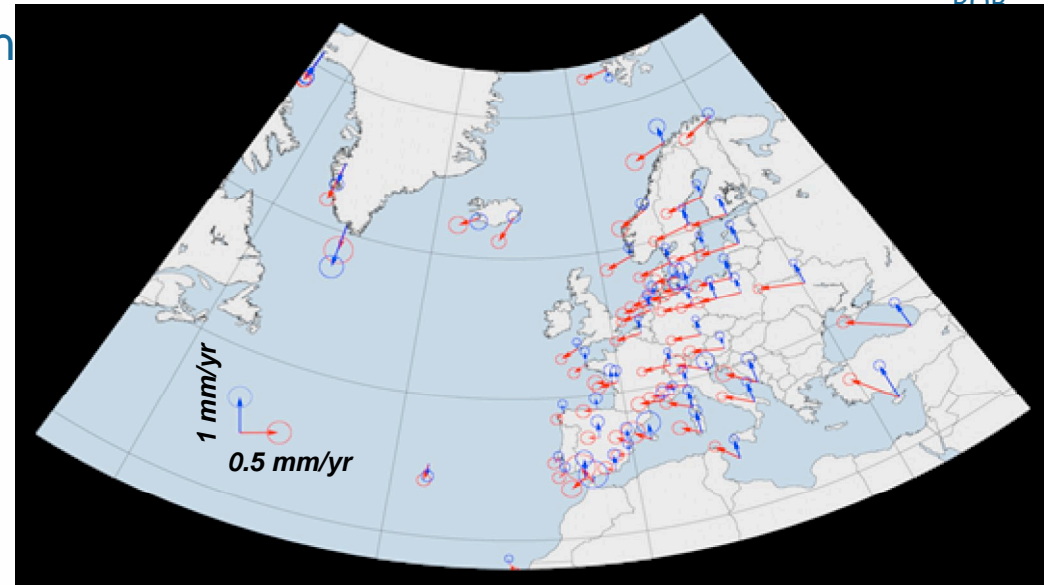
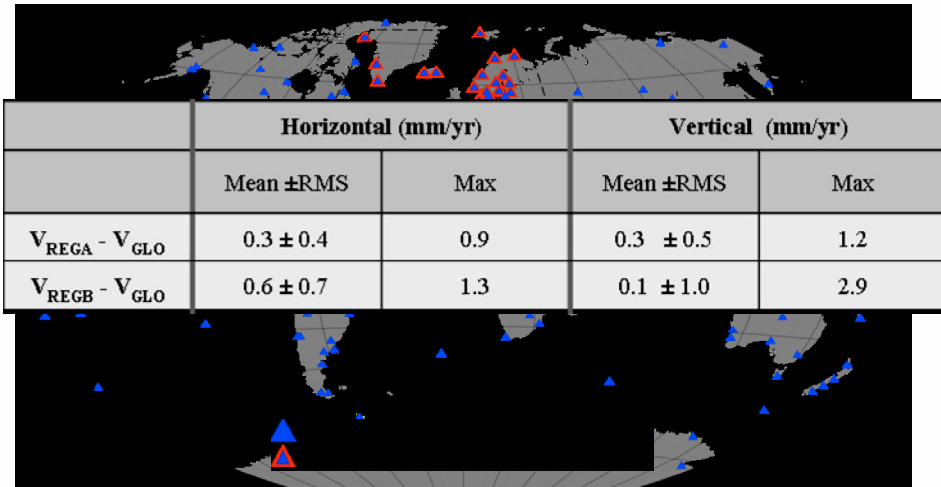


		Mean [mm]	Rms [mm]	Max [mm]
TRS	2D	1.2	0.8	5.1
	Up	5.0	3.2	17.0
T	2D	1.6	0.6	3.5
	Up	5.2	0.2	5.5

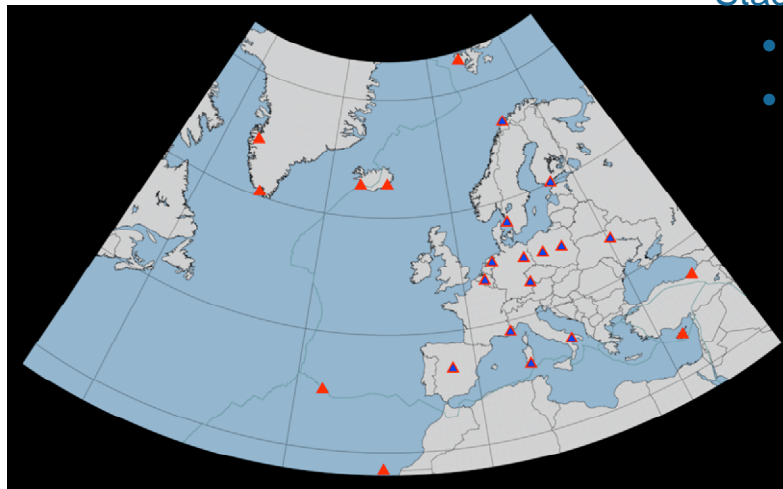
Table: Position differences between a reprocessed weekly solution (week 1404) expressed in IGS05 and in ITRF2005.

# Regional vs Global: Velocities

1997-2006 weekly solutions ULR contribution to TIGA (Wöppelmann et al., 2007)

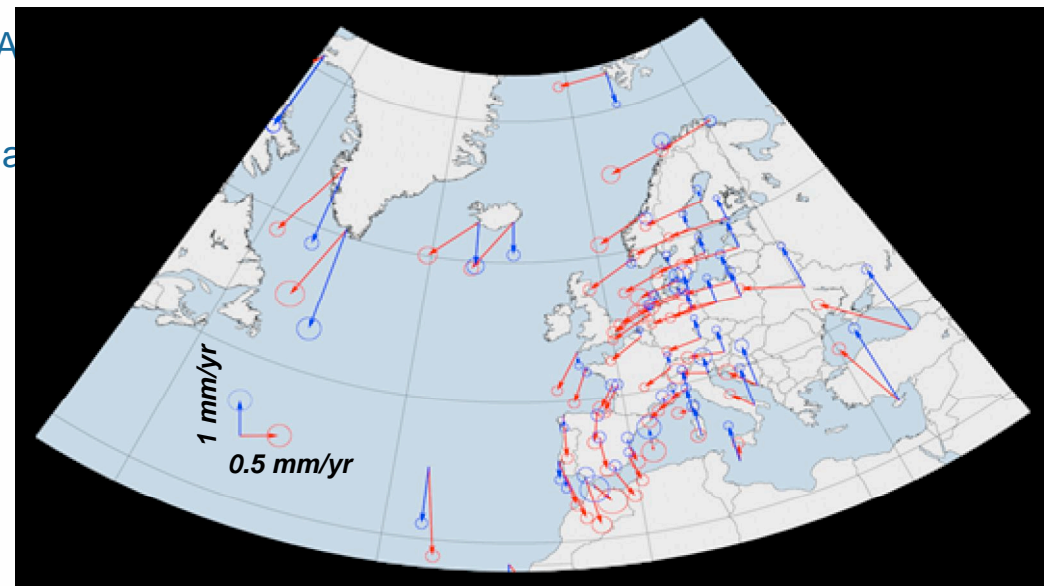


Velocity differences between Global and Regional A



Stacking with CA

- Global
- Regional A a



Velocity differences between Global and Regional B



# Summary



- PPP software ATOMIUM: good agreement with IGS clock solution
- Troposphere: E-GVAP, sensitivity of ZTD and benefits from the Belgian dense network
- Ionosphere: High resolution European ionospheric maps
- Reprocessing ROB/EPN done
- Reference Frame: sensitivity of regional networks