

# What can we expect from the EPN reprocessing?

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EPN LAC workshop 22-23 October 2008, Frankfurt, Germany

# EPN REPROCESSING

- **OFFICIAL**
  - IGS recommendations, models, rules
  - IGS products (orbit, EOP)
  - Not yet scheduled (IGS, ITRF)
- **TEST ( PILOT )**
  - testing the current environment (database, tools, resources)
  - get insight into the expected improvements

# EPN PILOT RE-ANALYSIS

- **MUT** (Military University of Technology, Warsaw)

Figurski M. - Kaminski P. - Kroszczyński K. - Gałuszkiewicz Z.

- **ROB** (Royal Observatory of Belgium)

Legrand J. - Bruyninx C.

- [ BEK, OLG, SGO, .... ]

BERNESE 5.0 using the current EPN analysis standards  
(absolute PCV, 3° cut of angle, tropospheric gradient, JPL  
DE405 ephemeris, troposphere Niell mapping function . . .  
**Datum: MC over the translation parameters**)

# CUMULATIVE SOLUTION

- Weekly combined SINEX files are available
- Multiyear solution: CATREF (Altamimi et al 2004)
- Datum: ITRF2005\_IGS-TRF.SNX

IGS05\_reprocessed.SNX

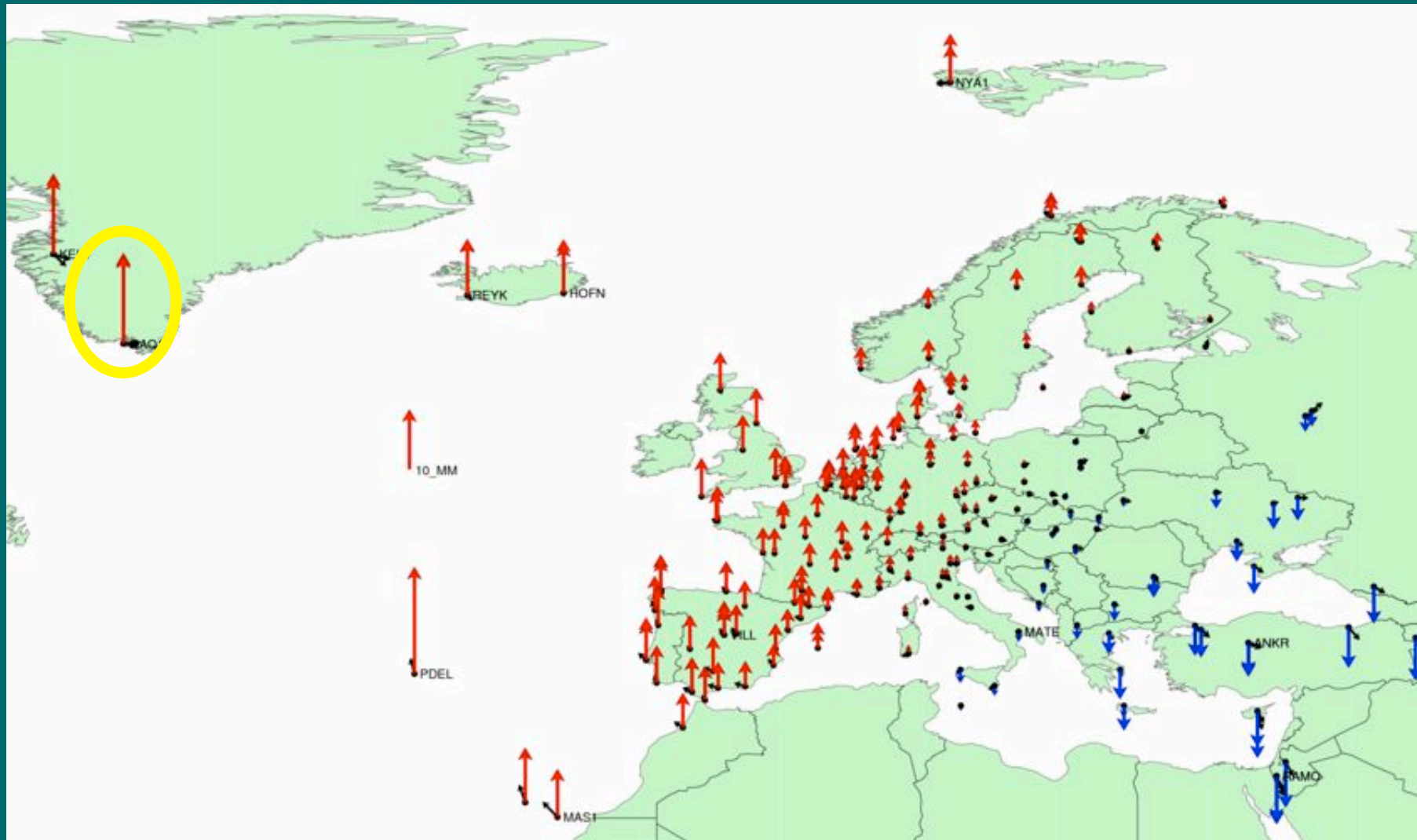
- Minimum Constraint (MC) approach, the frame is defined by 22 ITRF/EPN stations (43 soln)
- Discontinuities harmonized with IGS ('ITRF friendly')

# DATUM DEFINITION with MC

- the reference network, defining the datum must be extended as broad as possible (tending to global), (Bruyninx, Legrand 2008),
- below an 'optimal' site number (about 15 sites) and reference network geometry, the network shows remarkable variability/instability,
- the network keeps its original 'shape',
- No direct constraints to 'imported/foreign' values

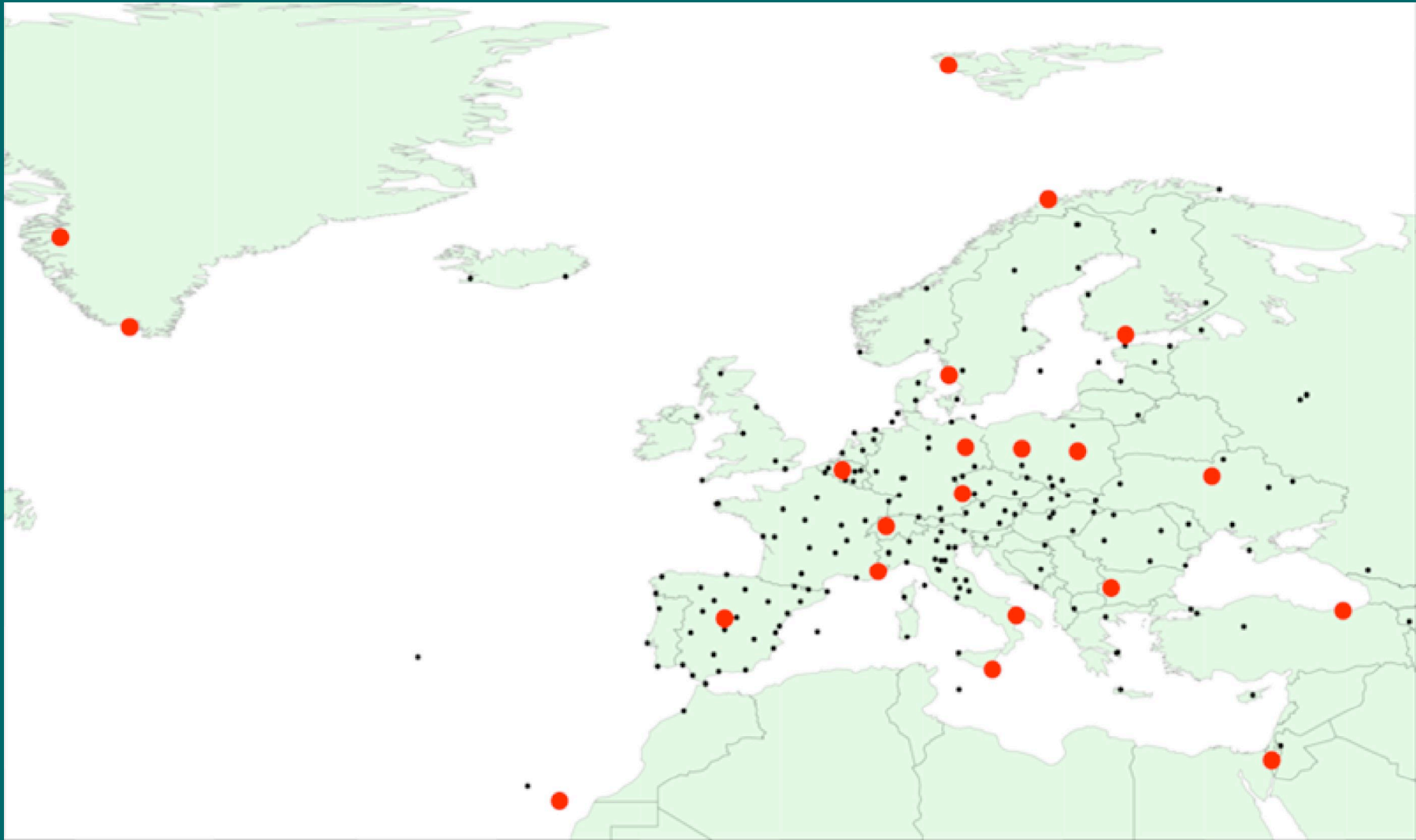
# DATUM DEFINITION

coordinate differences due to different reference station sets used for datum definition



# DATUM DEFINITION

22 sites - 43 solution numbers

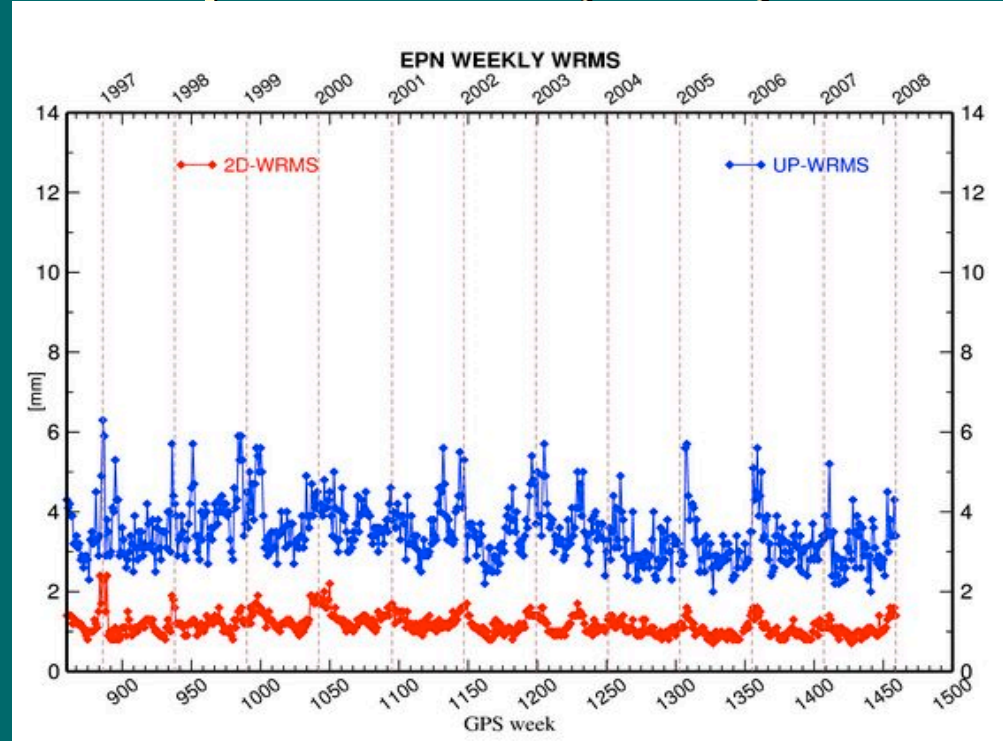
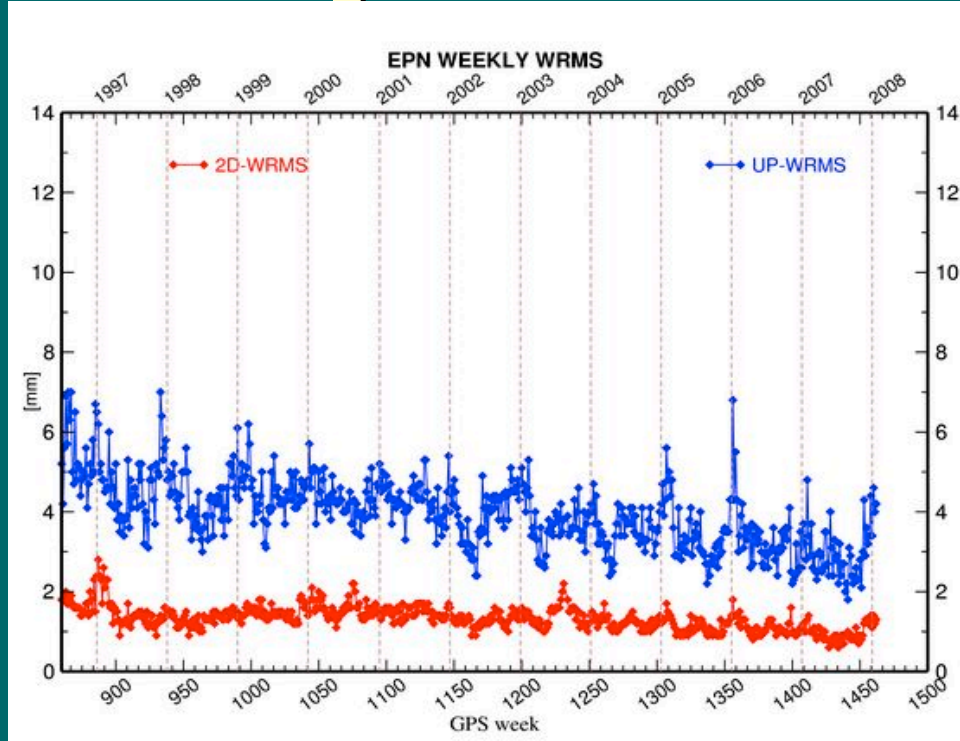


# GENERAL RESULTS I.

## weekly weighted RMS

original EPN

reprocessed (MUT)



weekly solutions are averaged  
over 16 LAC results  
3-5 LAC per station

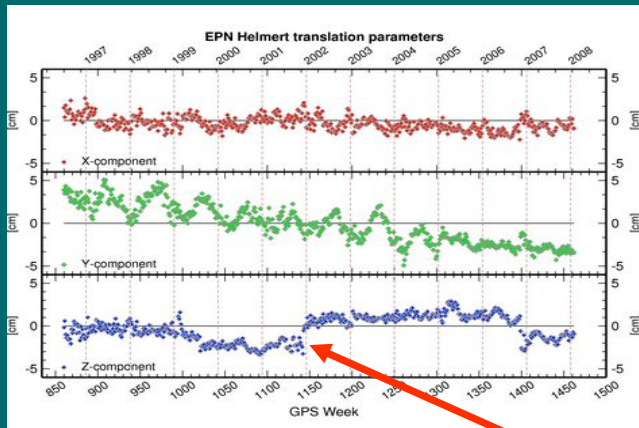
no averaging!  
single LAC solution



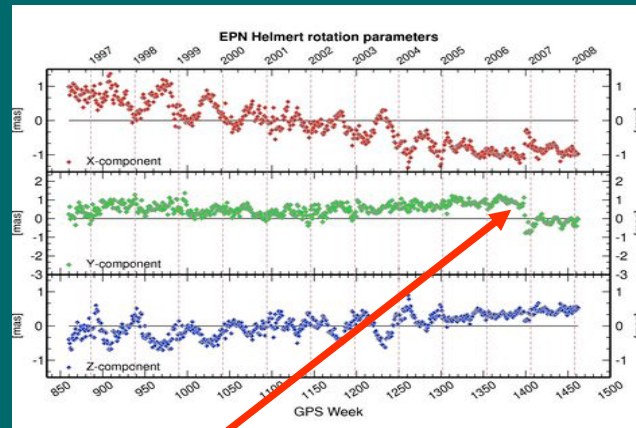
# GENERAL RESULTS II.

## Helmert-transformation parameters between the cumulative and weekly solutions

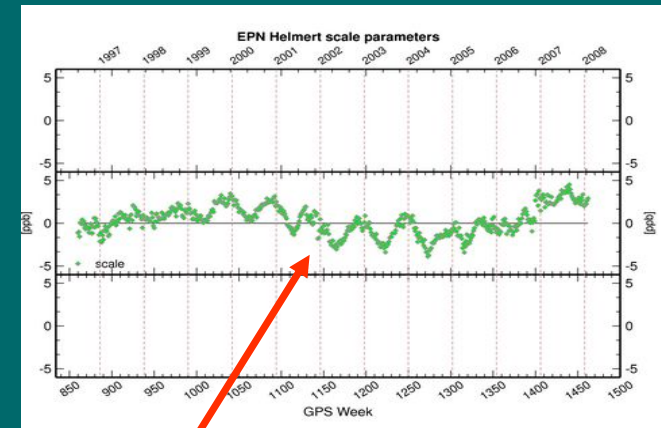
### translation



### rotation



### scale



Reference frame changes,  
Software modeling shortcomings,  
Analysis strategy changes are seen

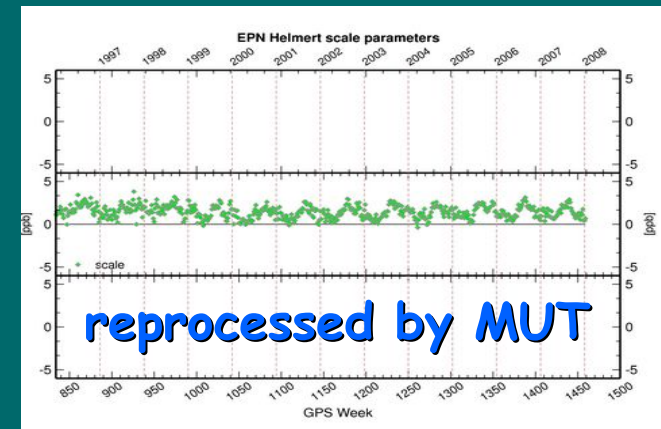
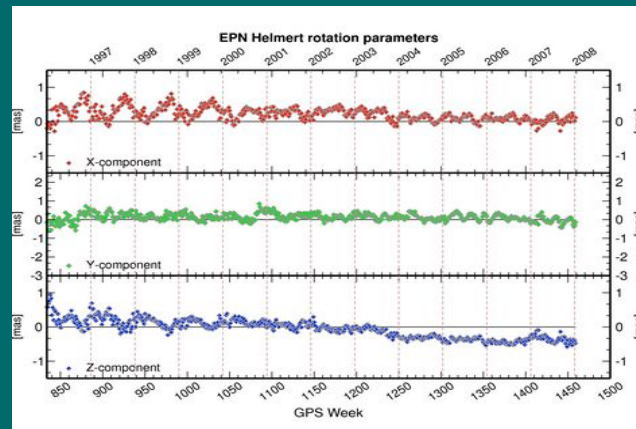
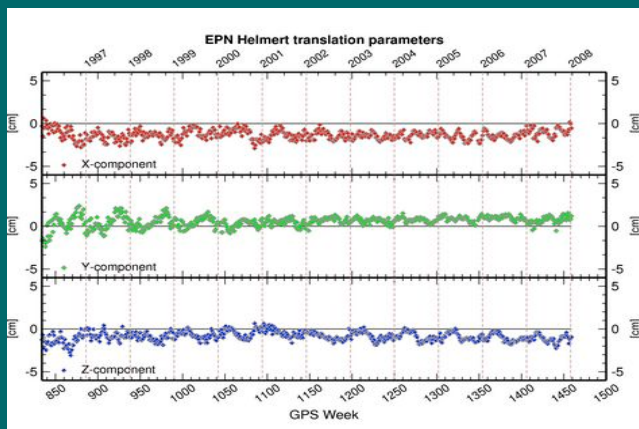
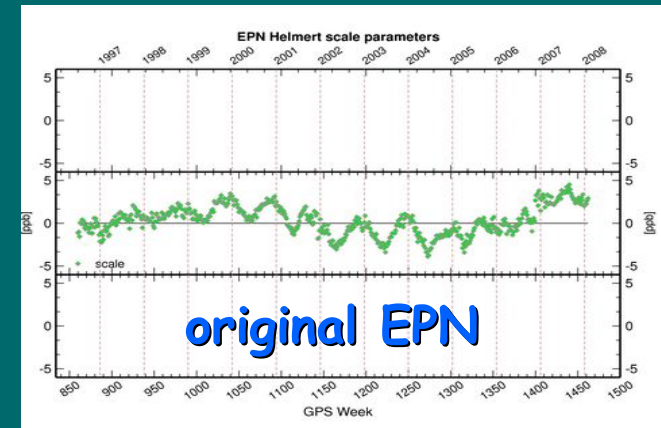
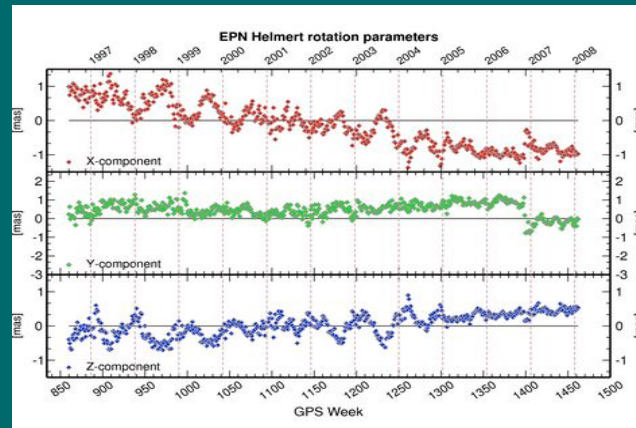
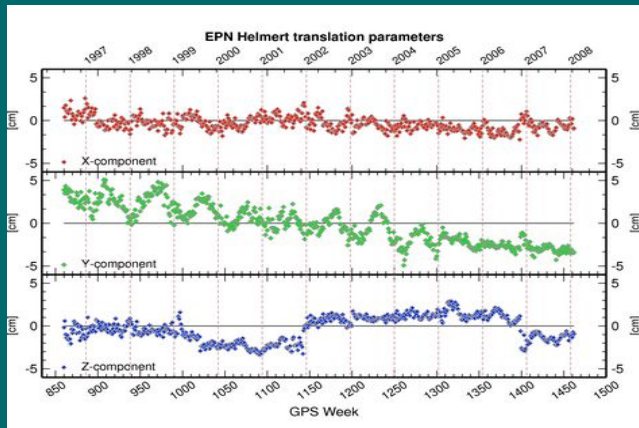
# GENERAL RESULTS II.

## Helmert-transformation parameters between the cumulative and weekly solutions

translation

rotation

scale



# GENERAL RESULTS III.

## HARMONIC ANALYSIS (CATS\_MLE & PSD)

- SEASONAL SIGNAL (amplitude / phase by CATS)

### PRELIMINARY RESULTS:

- AVERAGE 30% REDUCED AMPLITUDE N / E / U  
(ONLY AT HALF OF THE STATIONS (!) )
- PHASE CHANGES: HIGH SCATTER OF DIFFERENCES

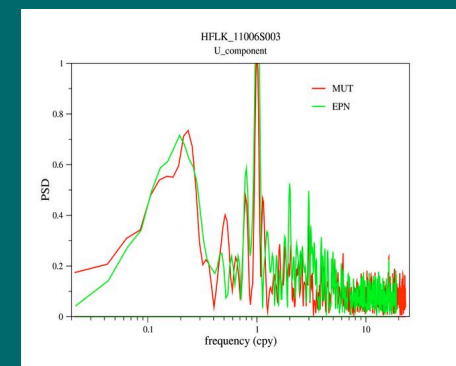
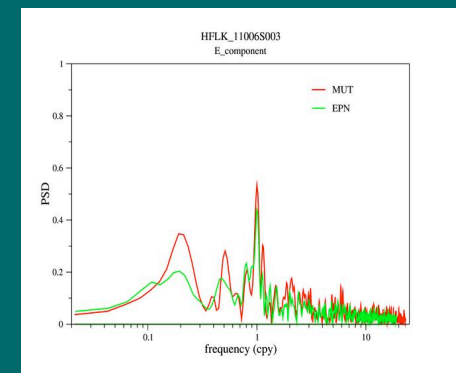
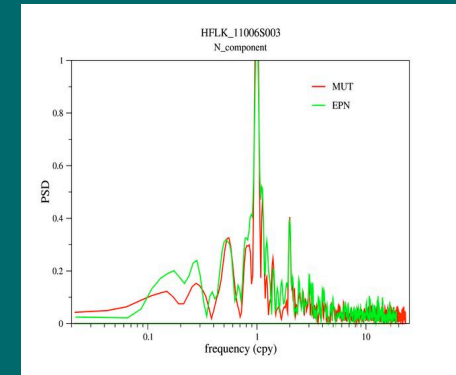
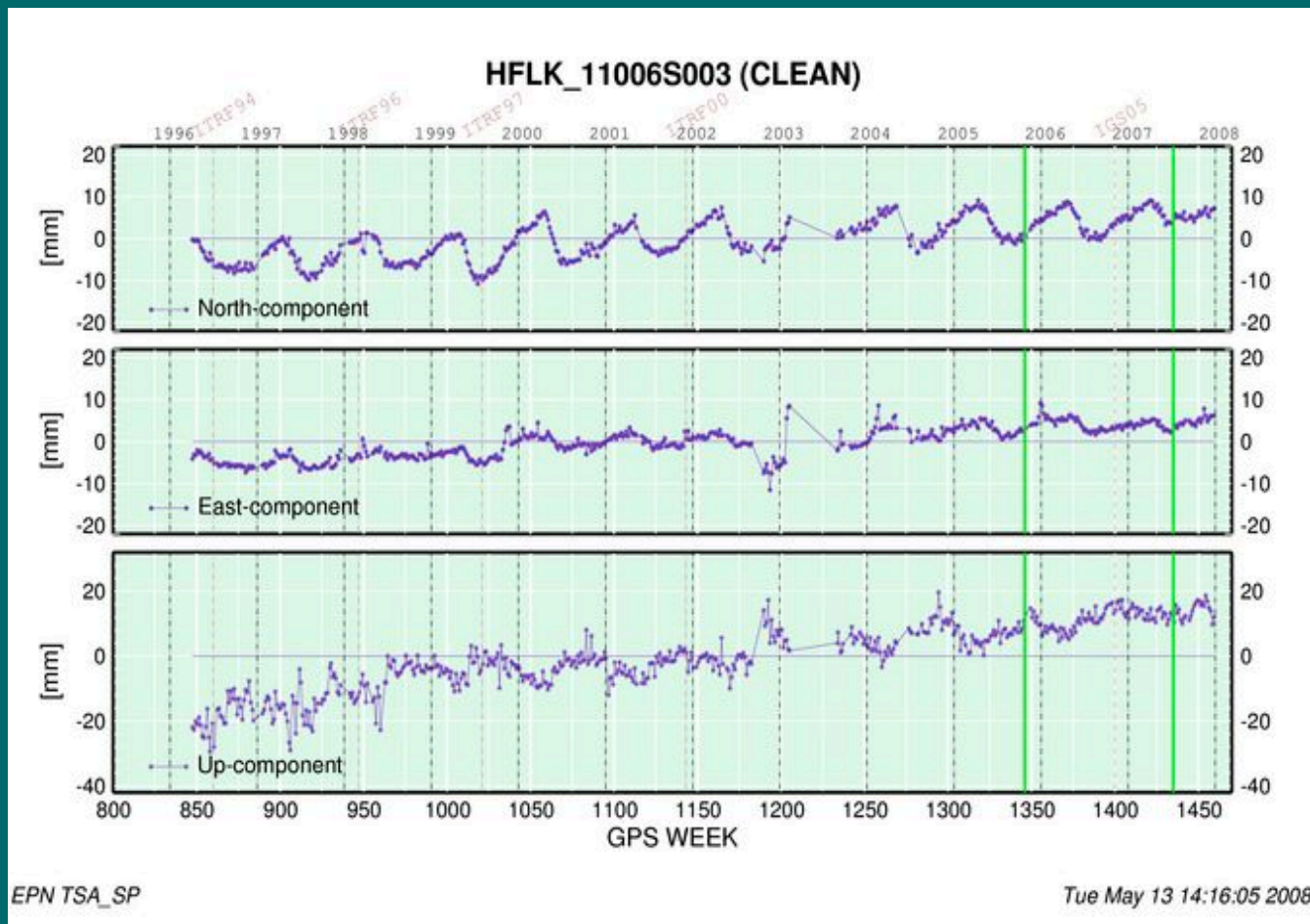
FURTHER DETAILED INVESTIGATIONS (STATISTICAL ANALYSIS, CORRELATIONS - equipment, environment) ARE FORESEEN!

- POWER SPECTRAL DENSITY (Lomb-periodogram)

# LOMB PERIODOGRAM EXAMPLES

## NO CHANGE: UNCALIBRATED ANTENNA/RADOME

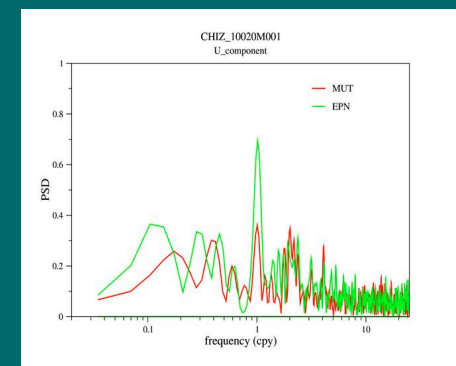
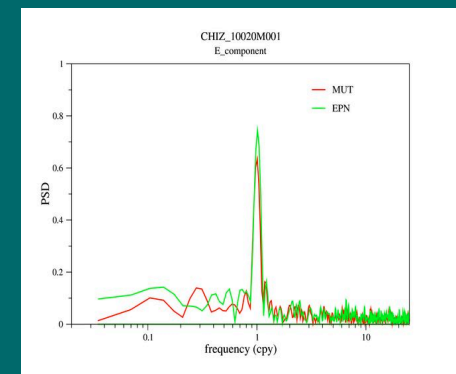
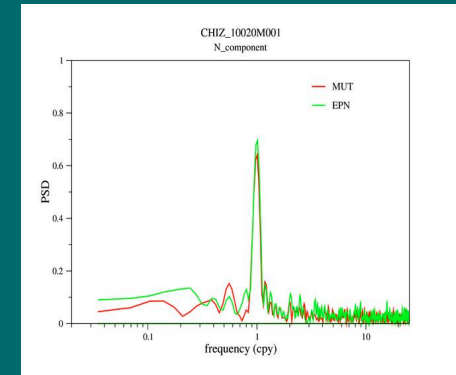
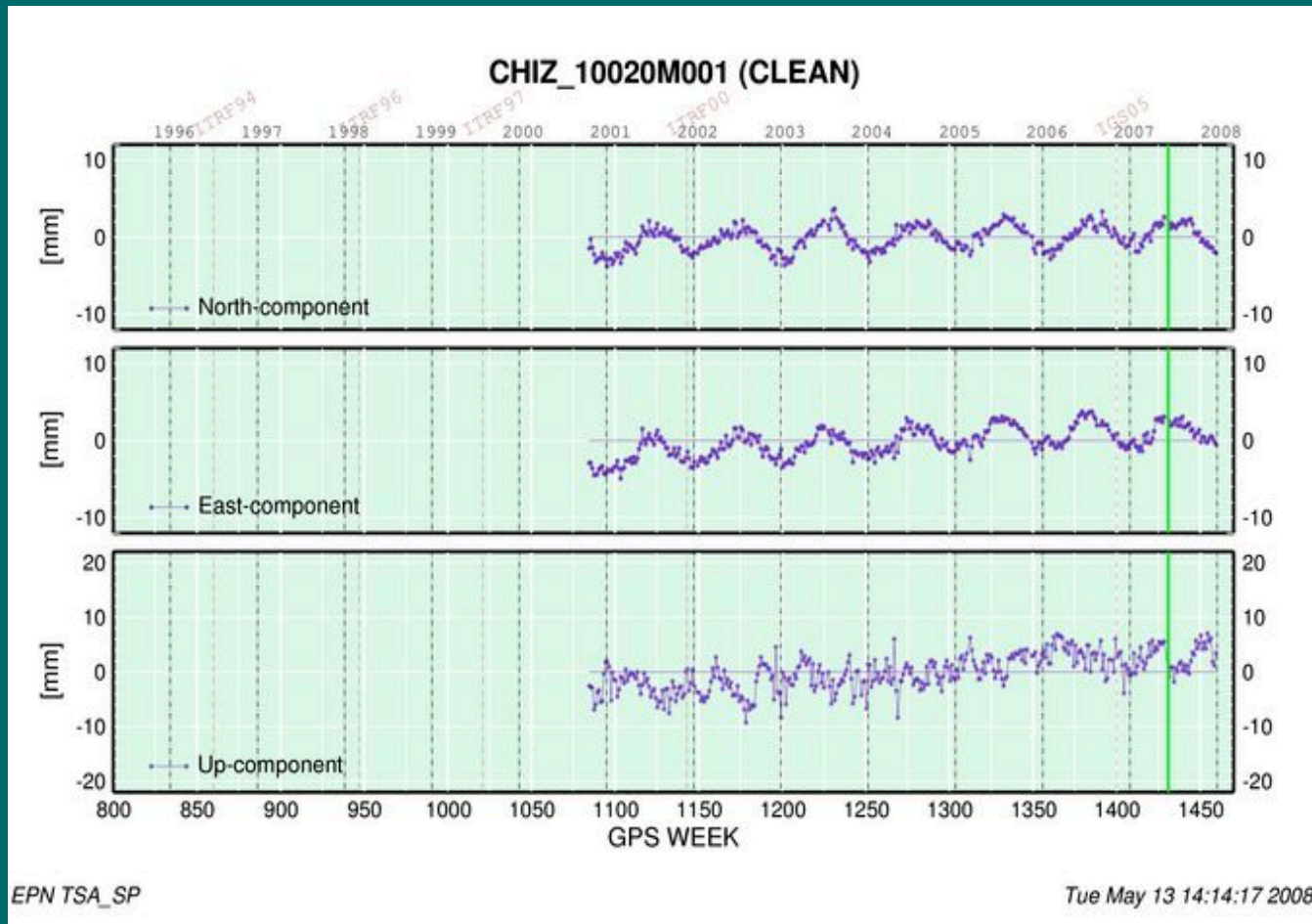
TRM29659.00 **GRAZ**



# LOMB PERIODOGRAM EXAMPLES

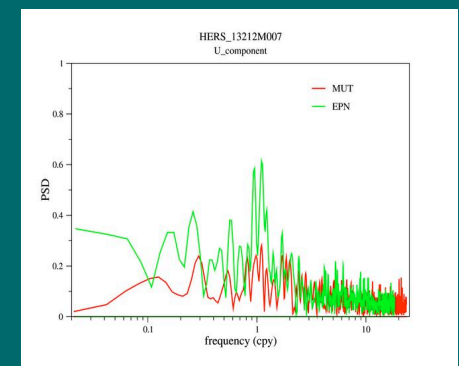
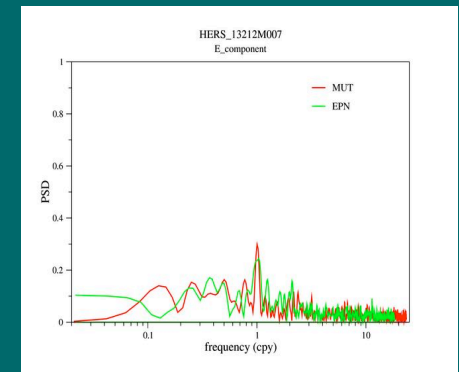
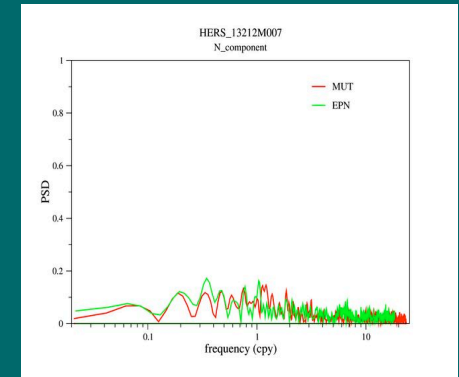
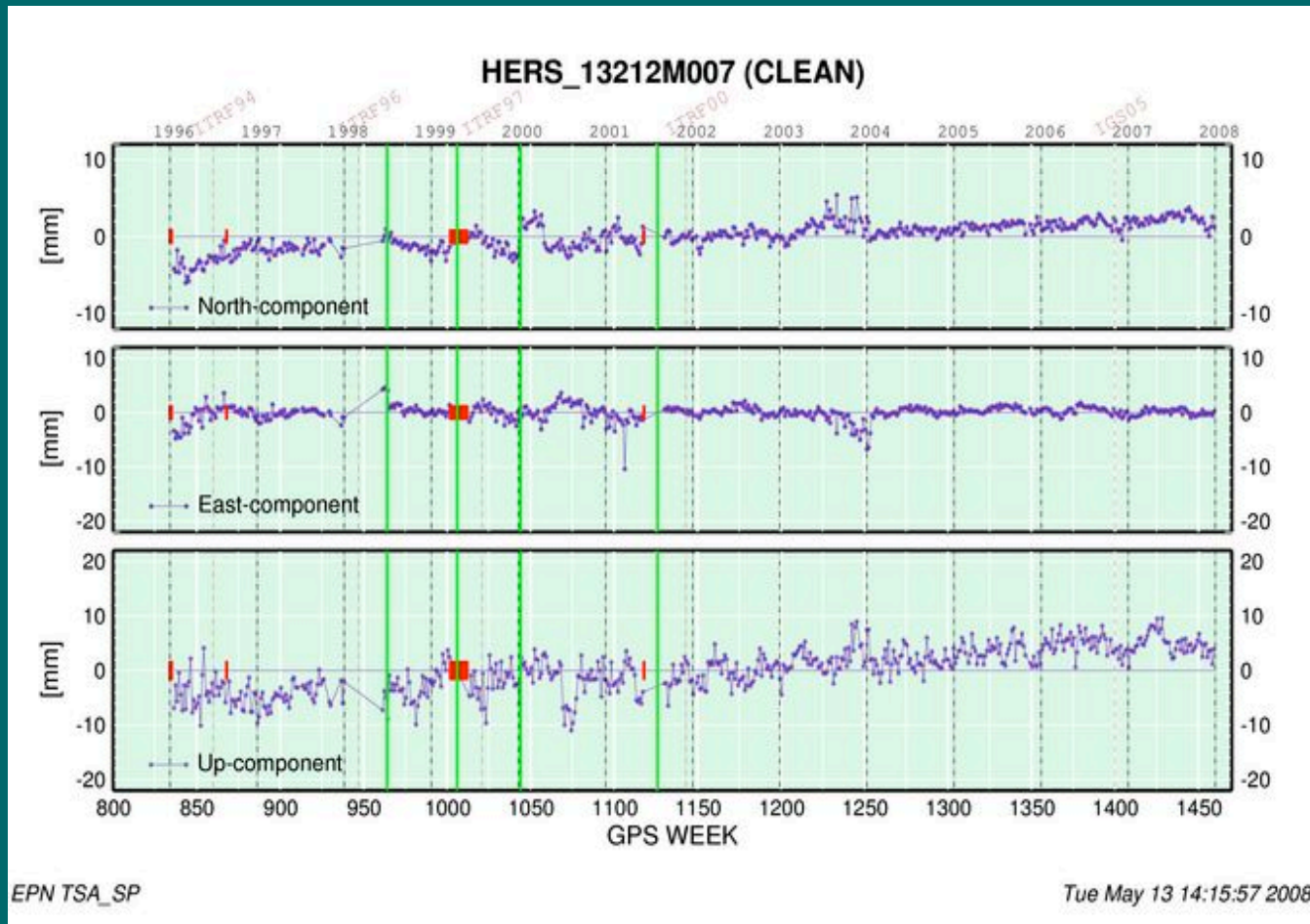
## SEASONAL SIGNAL PARTIALLY REMAINS

CHIZ: concrete bunker of World War II.



# LOMB PERIODOGRAM EXAMPLES

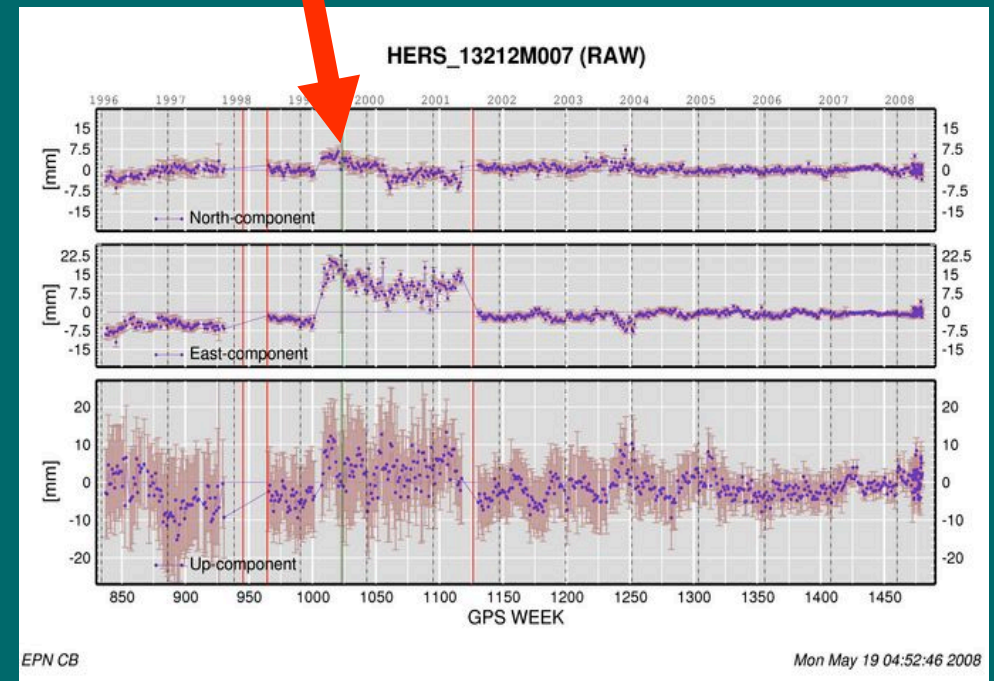
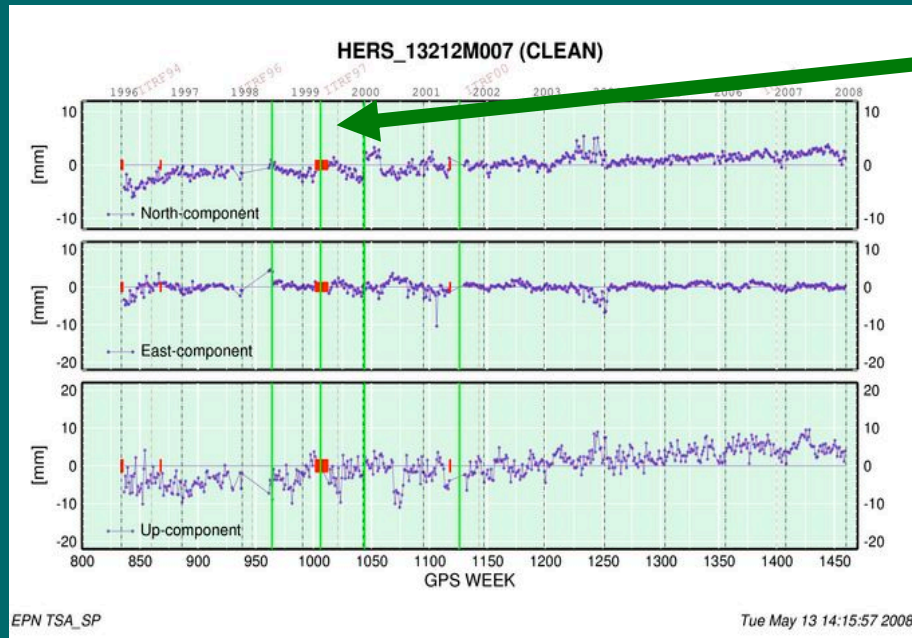
## SEASONAL SIGNAL DECREASED



# UNEXPECTED REPROCESSING RESULT

## DECREASED SENSITIVITY TO ANTENNA PROBLEMS?

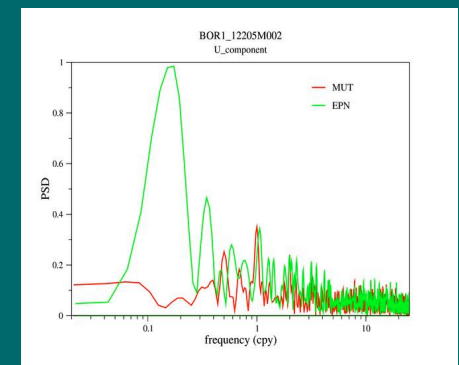
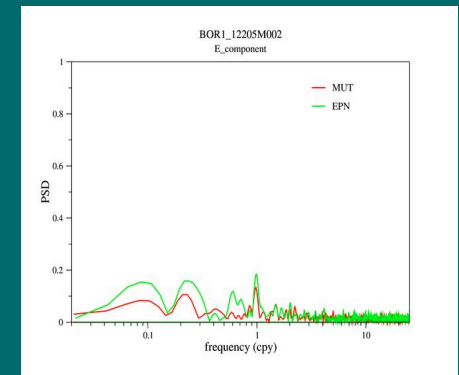
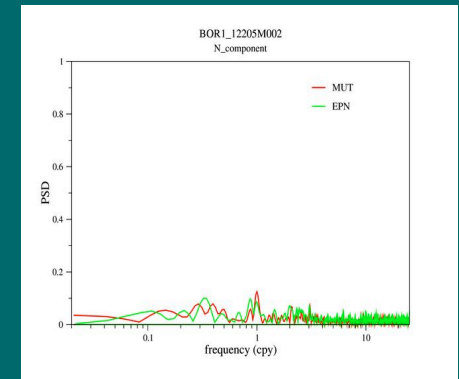
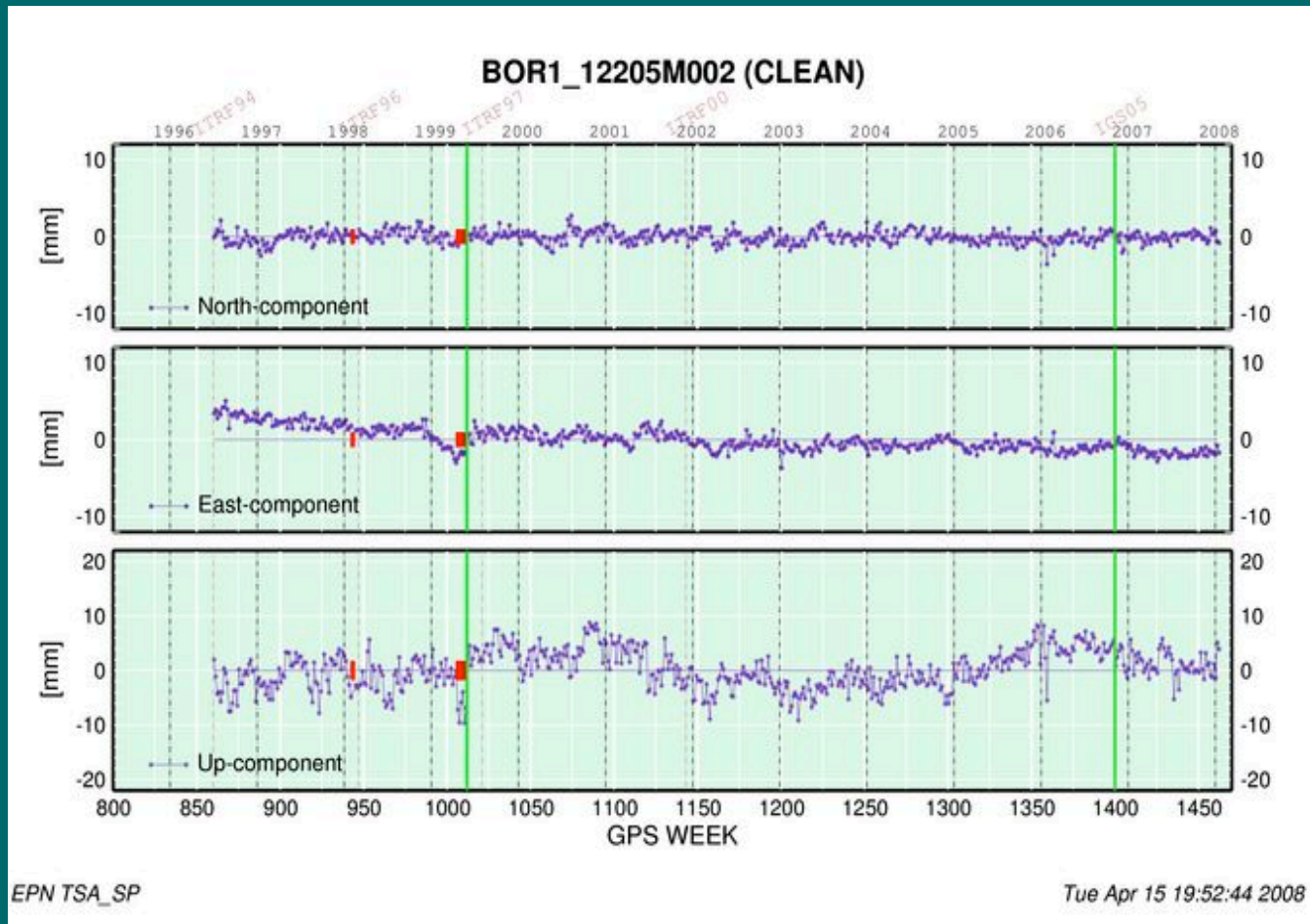
ANTENNA MALFUNCTION  
(ASH700936E)



# LOMB PERIODOGRAM EXAMPLES

## UP COMPONENT LONG TERM SIGNAL DECREASED

### ORIGINAL EPN SERIES

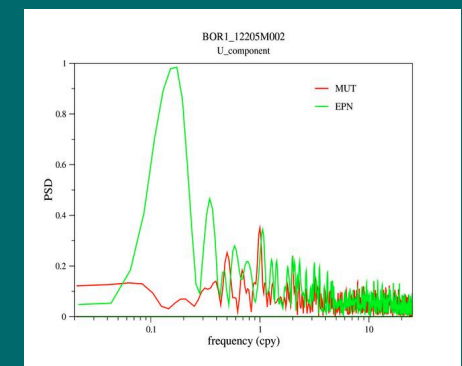
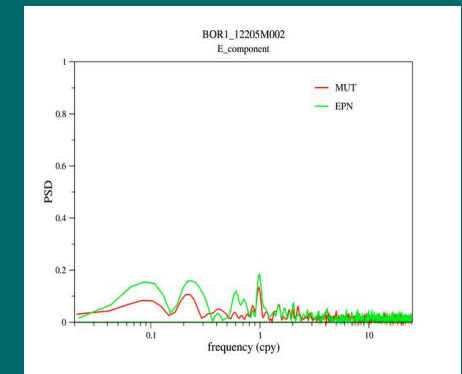
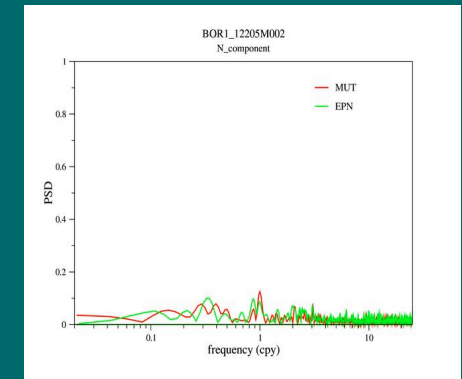
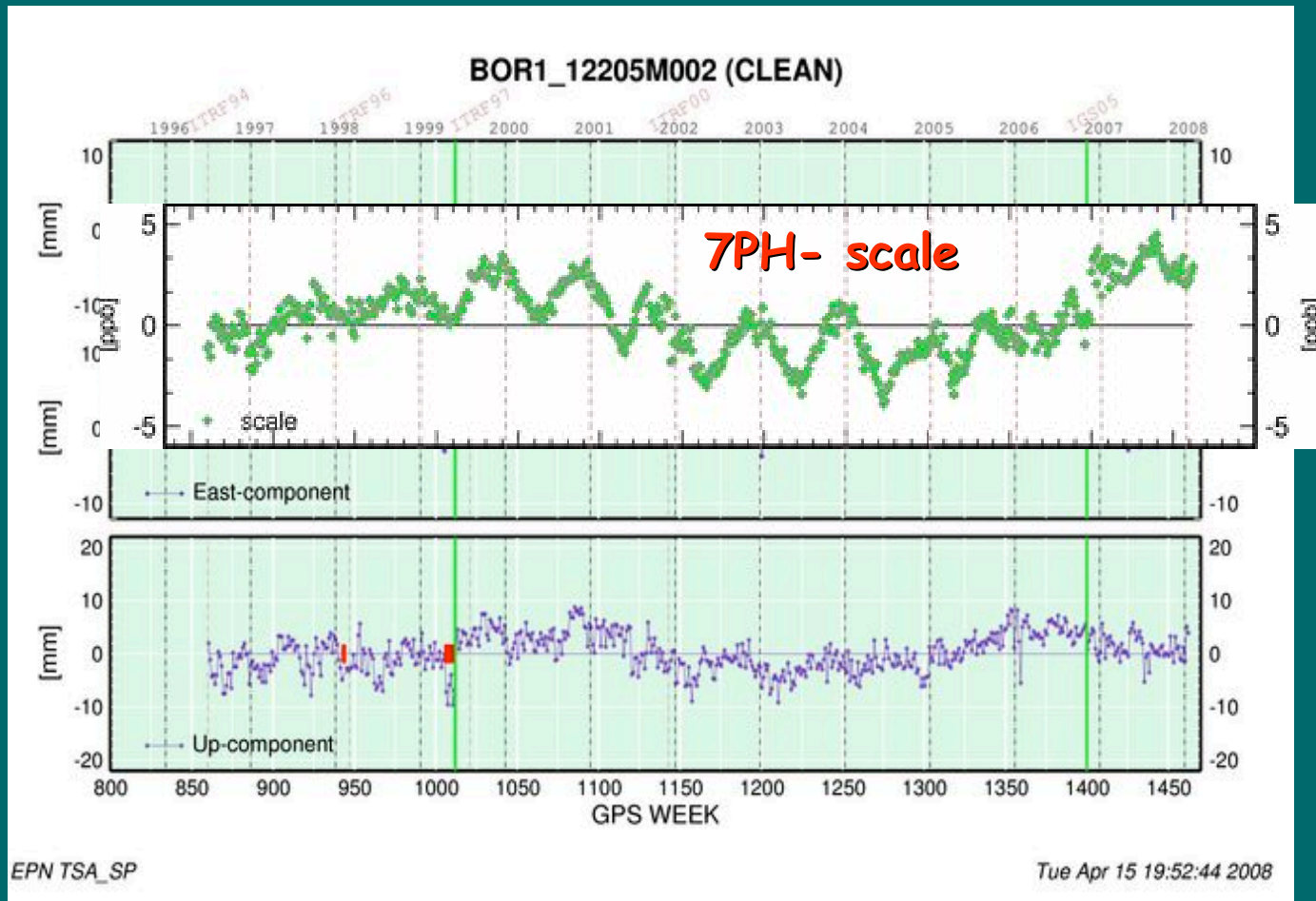




# LOMB PERIODOGRAM EXAMPLES

## UP COMPONENT LONG TERM SIGNAL DECREASED

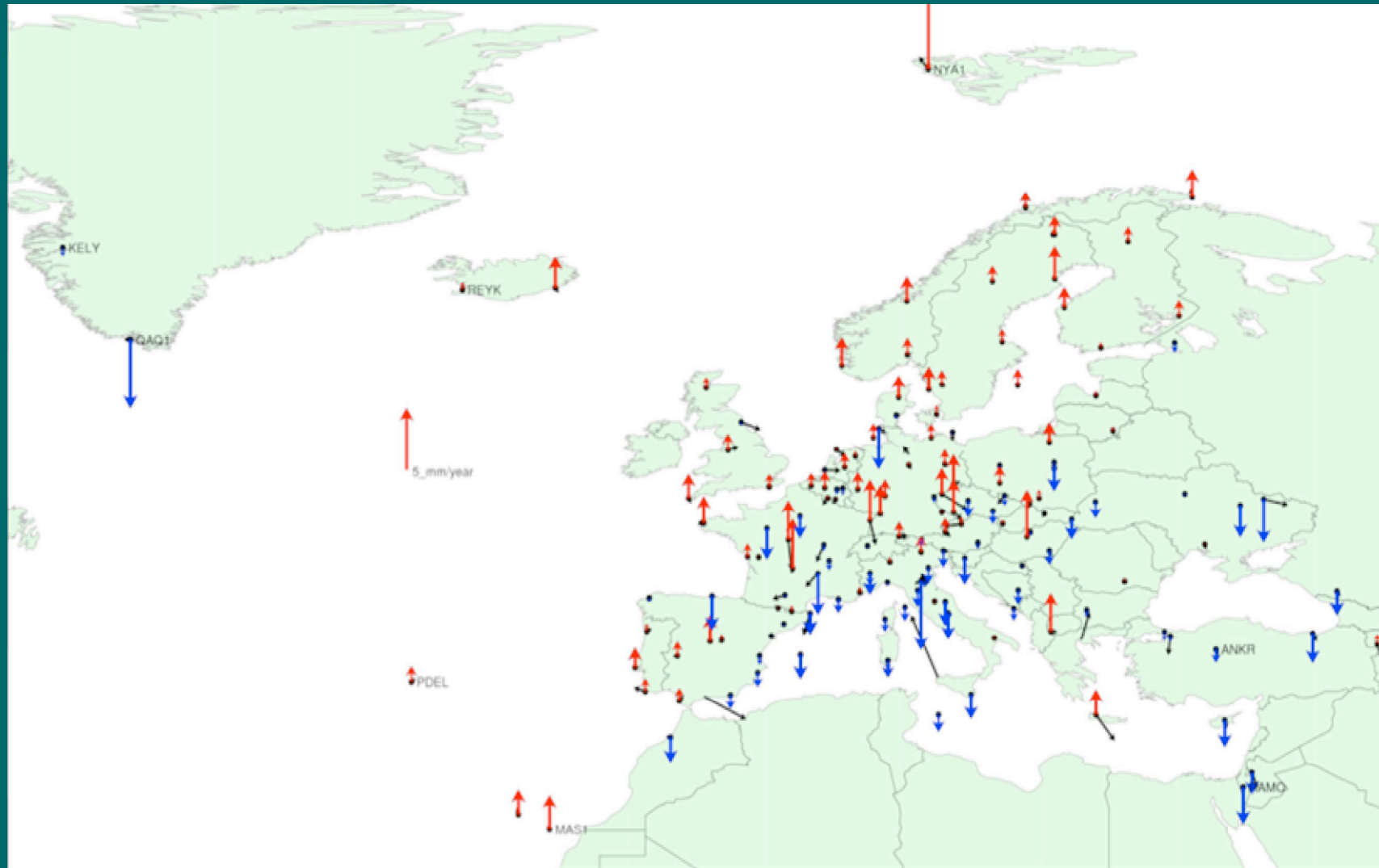
### ORIGINAL EPN SERIES



# DIFFERENCES IN VELOCITY ESTIMATE (UP)

(THE HORIZONTAL DIFFERENCES ARE NEGLIGIBLE!)

EPN STANDARD - REPROCESSED



# CONCLUSIONS

## REPROCESSED CUMULATIVE SOLUTION

😊 REDUCED WRMS

>10% overall ( >30% before week 900 )

😊 '**STABLE**' HELMERT TRANSFORMATION  
PARAMETER SERIES,

😊 NO DISCONTINUITY AT GPSWEEK 1400 !

😊 REFERENCE FRAME: HOMOGENOUS TIME  
SERIES

😊 PERFECT BASE FOR A NEW ITRF SOLUTION

# CONCLUSIONS cont'd

☹️ FLICKER NOISE IS STILL DOMINATING

☹️ SEASONAL SIGNAL: DECREASED AMPLITUDE,  
BUT NON-HOMOGENOUS PHASE CHANGES

FURTHER STATISTICAL ANALYSIS REQUIRED  
(CORRELATIONS, SIGNIFICANCE TESTS)

☹️ CHANGES IN VERTICAL VELOCITY  
ESTIMATES (need to be verified - regional  
network)

# RECOMMENDATIONS - 1

- REAL **ABSOLUTE PCV** FOR ALL ANTENNA TYPES
- STANDARD PRODUCT: **DAILY SINEX**  
SOLUTIONS DUE TO DECREASED NOISE LEVEL
  - BETTER DISCONTINUITY MODELING
  - HIGHER RESOLUTION HARMONIC ANALYSIS
- FULLY HARMONIZED IGS/EPN  
DISCONTINUITY TABLE
- NEW ITRS REALIZATION IN AGREEMENT  
WITH THE ABSOLUTE APCV MODELS

# RECOMMENDATIONS - 2

TO BE DISCUSSED IN DETAIL:

- STRATEGY, MODELS
- DATUM DEFINITION
- PARTICIPATION
- DATABASE ( + AND - )
- SCHEDULE