Report on the EPN Analysis

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Introduction

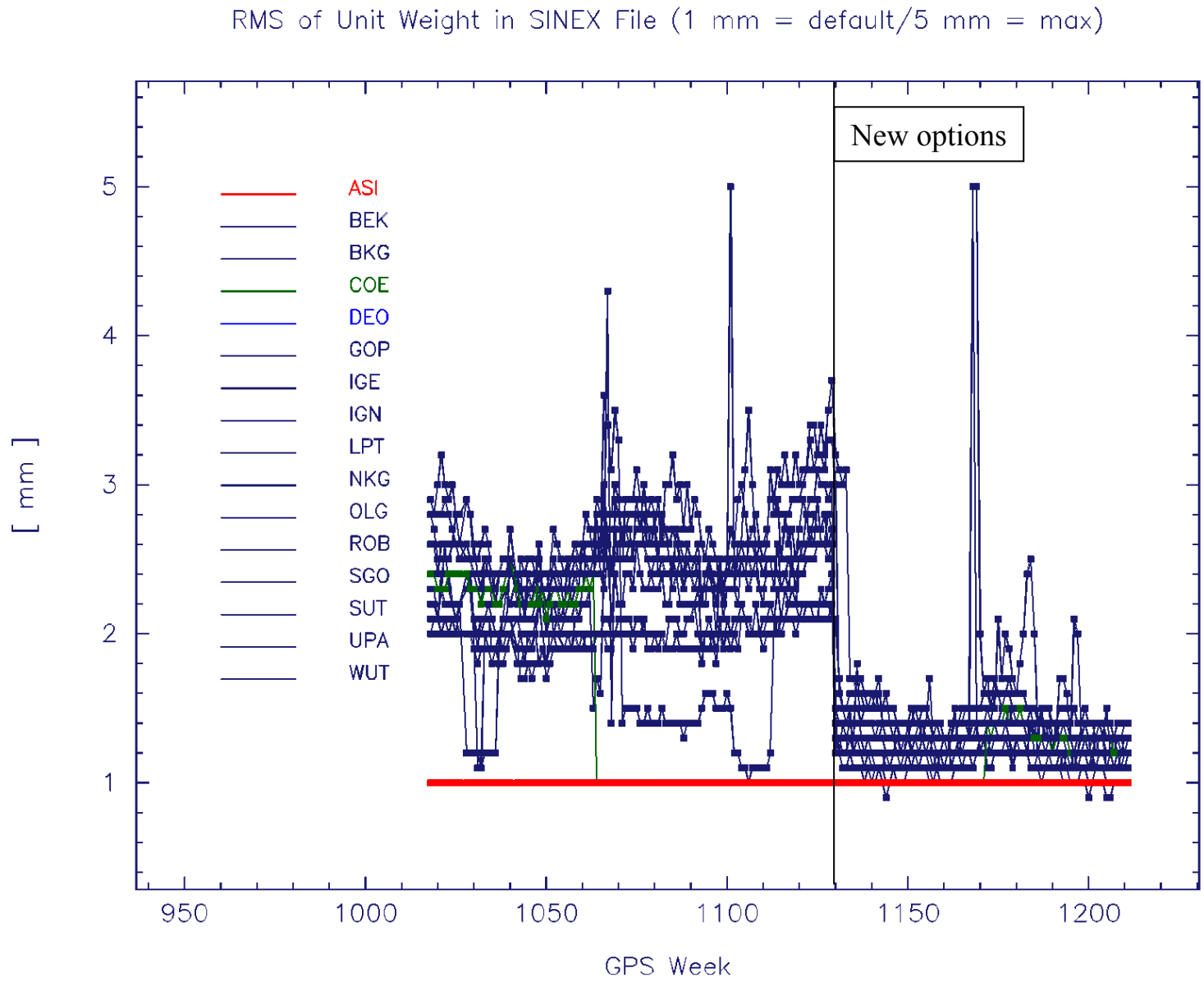
- Changes since 3th LAC Workshop
- EPN Reference Frame Alignment
- Exclusions in the combined solution
- EPN contribution to TIGA Pilot Project

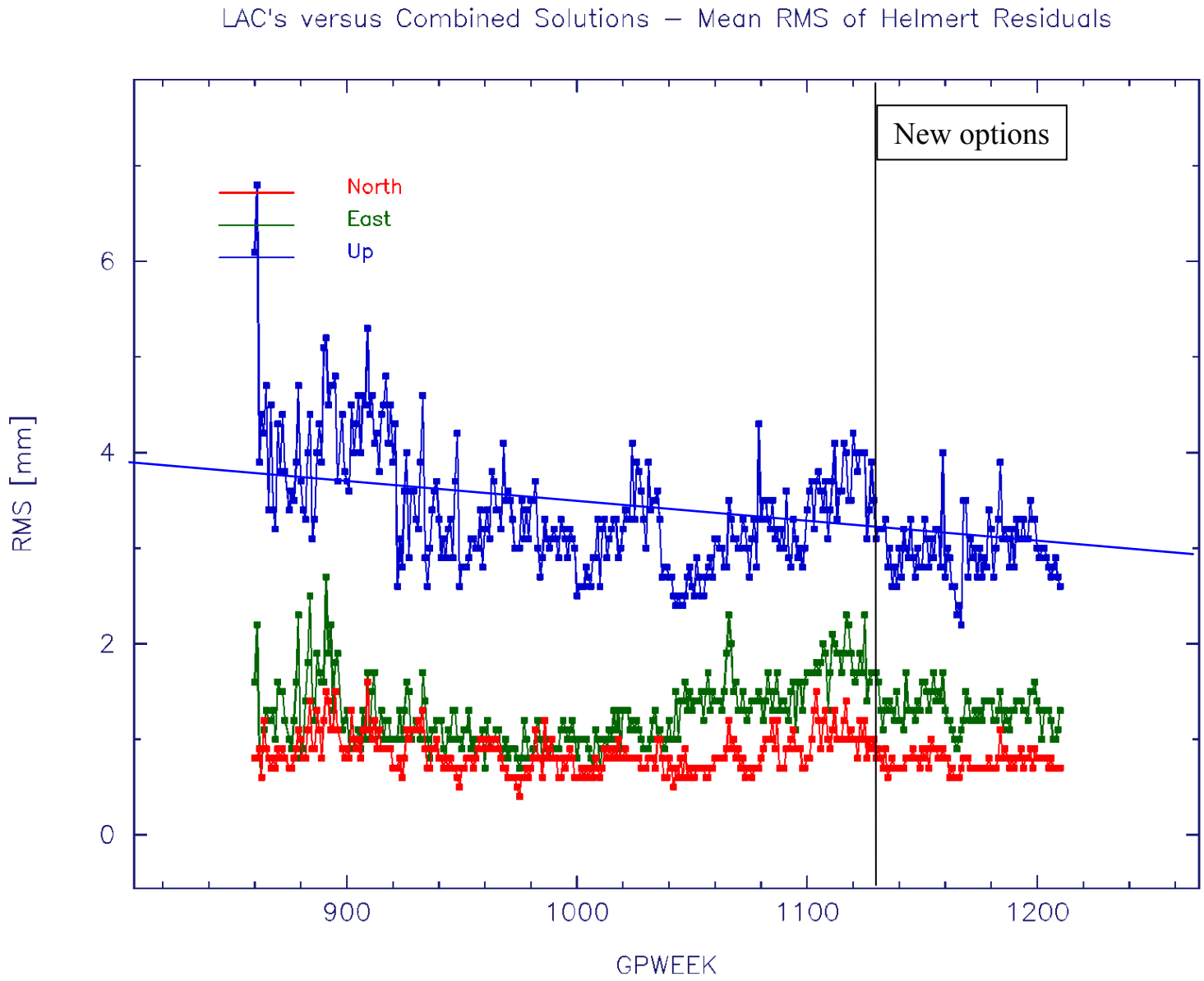
EPN Processing History

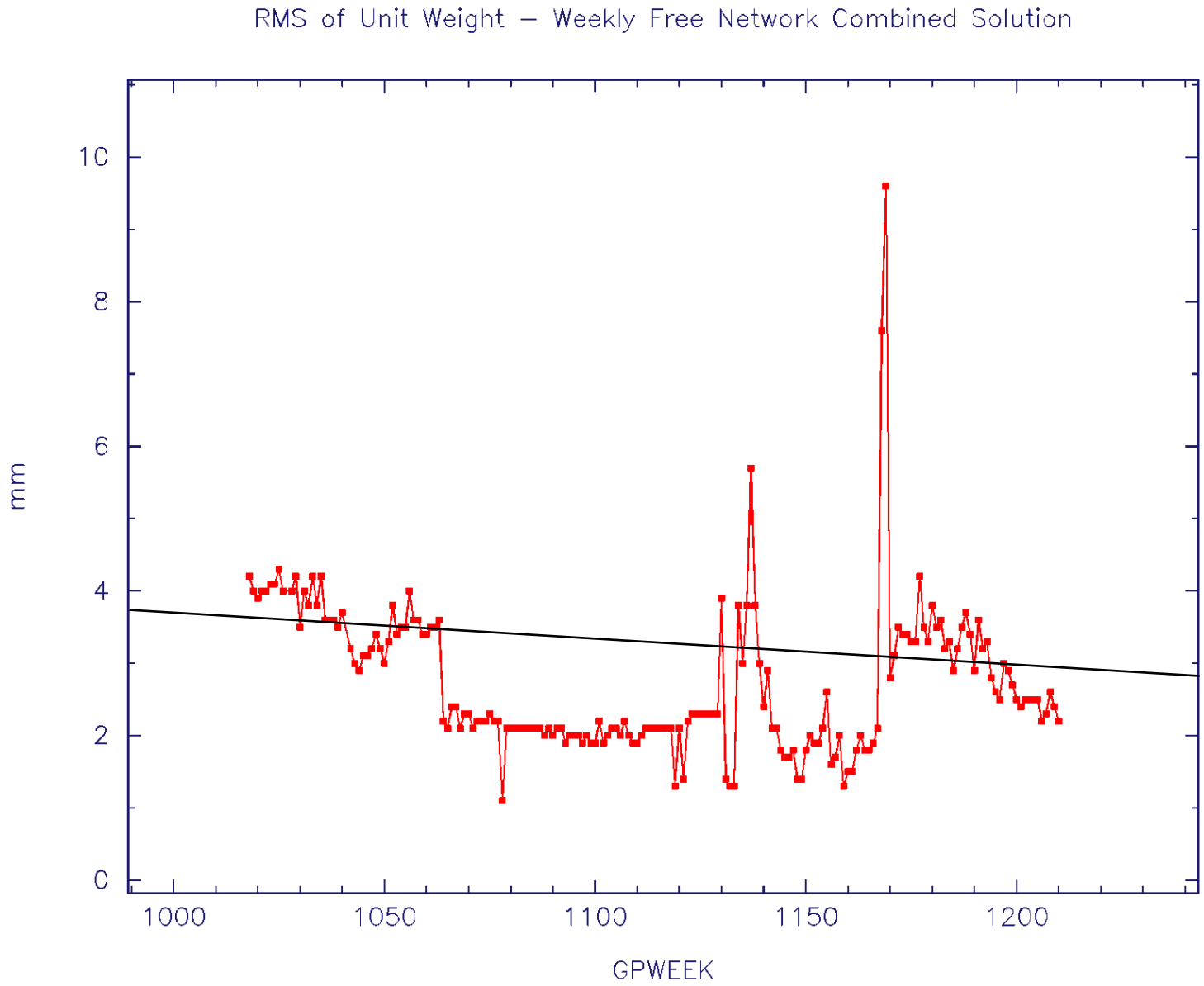
31 May – 01 June 2001	■ 3rd Local Analysis Center Workshop, Warsaw, Poland
2 Sep 2001(week 1130)	■ Introduction of new processing options, following the minutes of the 3rd LAC Workshop, Warsaw ■ Submission of SINEX files from the LACs fixed to the ITRFxx (contribution to Troposphere Special Project) ■ New analysis center IGE introduced into the combined solution
14 Oct 2001 (week 1136)	■ New product generation: Densification of global IGS weekly solution, product not official and not public available ■ New product generation: Transformation of the EUREF fixed solution from ITRF into ETRF, product not official and not public available
November 2001	■ Proceedings of the 3rd Local Analysis Center Workshop published in the Reports on Geodesy No3 (58), 2001, Warsaw University of Technology
2 Dec 2001(week 1143)	■ Change from ITRF97 to ITRF2000 for reference frame realization, fixed solution and troposphere parameter affected ■ New analysis center SGO introduced into the combined solution, Bernese Software used by SGO

EPN Processing History (Cont.)

12 Jan 2002(week 1149)	■ New product generation: Densification of global IGS cumulative solution, product not official and not public available
5 – 8 June 2002	■ EUREF 2002 Symposium, Ponta Delgada, Portugal
1 Sep 2002 (week 1182)	■ New analysis center SUT has been introduced. It uses the Bernese GPS Software.
4 – 7 July 2003	■ EUREF 2003 Symposium, Toledo, Spain


RMS of Unit Weight in SINEX File (1 mm = default/5 mm = max)
New options
ASI
BEK
BKG
COE
DEO
GOP
IGE
IGN
LPT
NKG
OLG
ROB
SGO
SUT
UPA
WUT
[mm]
1
2
3
4
5
950
1000
1050
1100
1150
1200
GPS Week

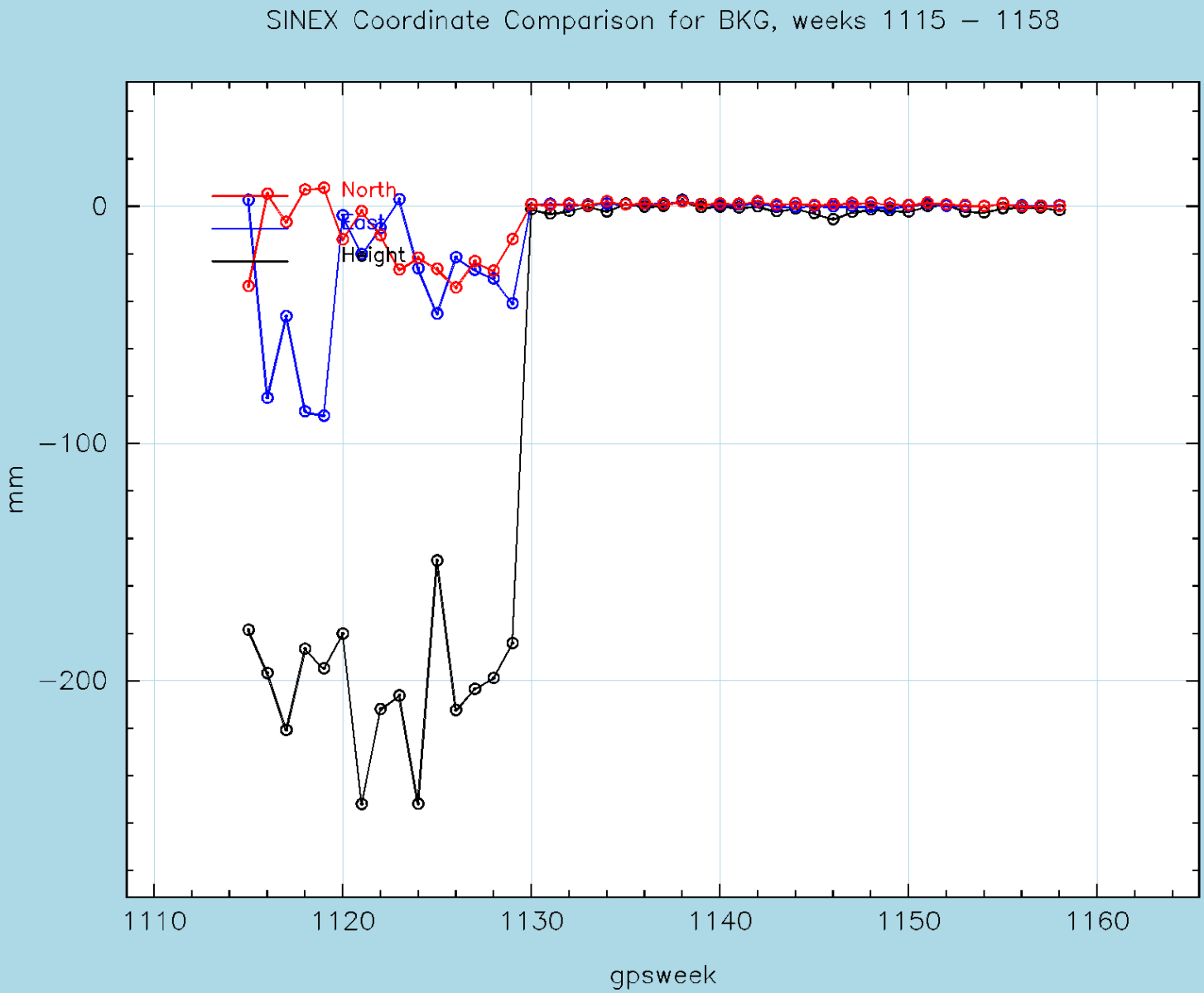

LAC's versus Combined Solutions – Mean RMS of Helmert Residuals
New options
North
East
Up
RMS [mm]
0
2
4
6
900
1000
1100
1200
GPWEEK


RMS of Unit Weight – Weekly Free Network Combined Solution
mm
10
8
6
4
2
0
1000
1050
1100
1150
1200
GPWEEK

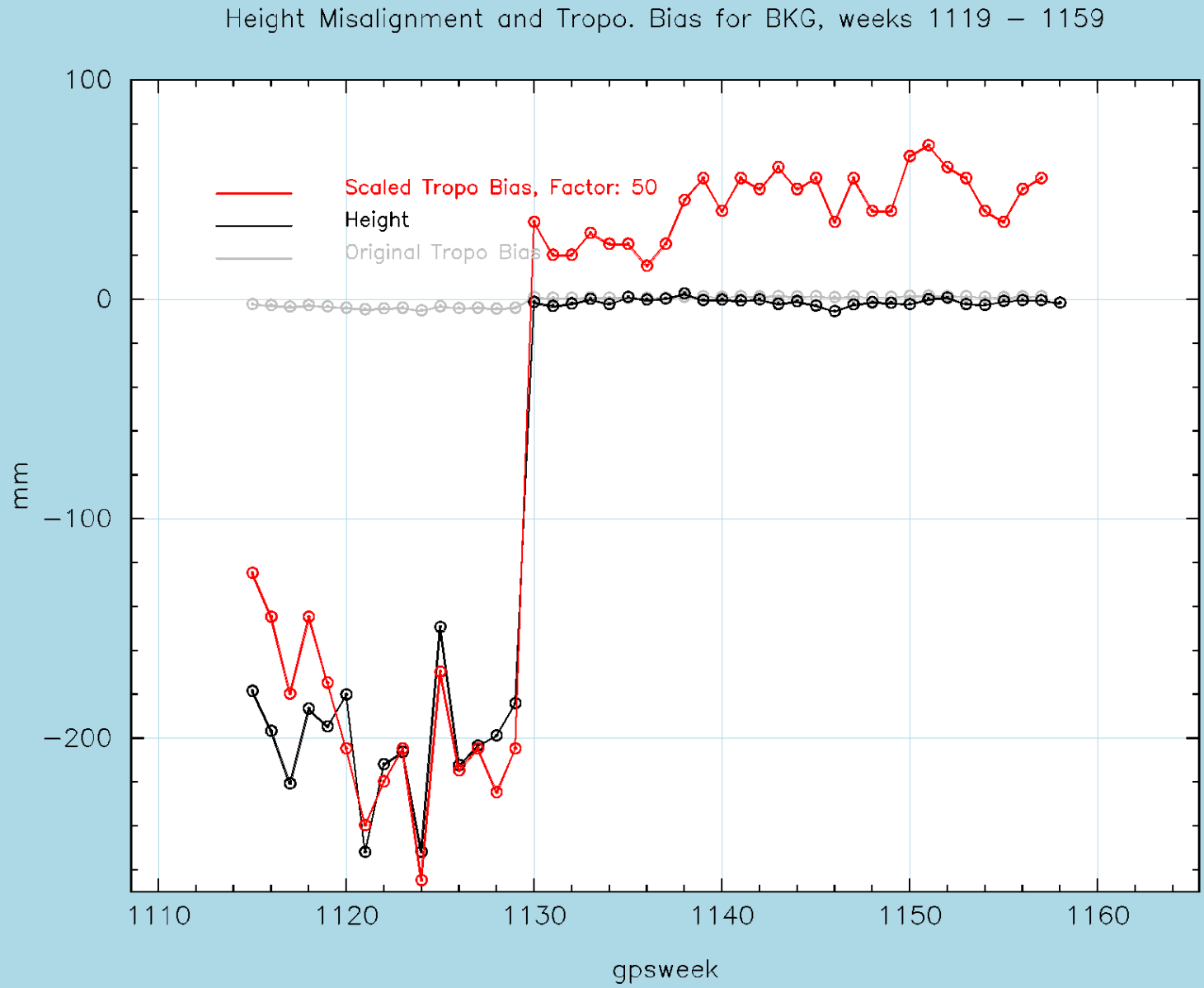
Submission of Constraint SINEX Solutions

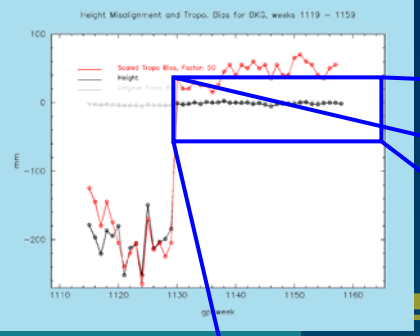
Motivation:

- Alignment of all LAC solutions to a common terrestrial reference frame (realized by submission of solutions, which are constraint to ITRF)
- Reduction of biases in the combination of the station specific troposphere parameters (Troposphere Special Project) through „coordinate re-substitution“
- Constraints will be removed before the combination (no effect on combined coordinate product)
- Realized since week 1130



BKG versus EUREF Combination


Height Misalignment and Tropo. Bias for BKG, weeks 1119 – 1159
Scaled Tropo Bias, Factor: 50
Height
Original Tropo Bias
100
0
−100
−200
mm
1110
1120
1130
1140
1150
1160
gpsweek



Height Misalignment and Tropo. Bias for BKG, weeks 1119 – 1159

Scaled Tropo Bias, Factor: 4
Height
Original Tropo Bias

10
5
0
−5
−10
mm

1130
1135
1140
1145
1150
1155
1160
1165
gpsweek

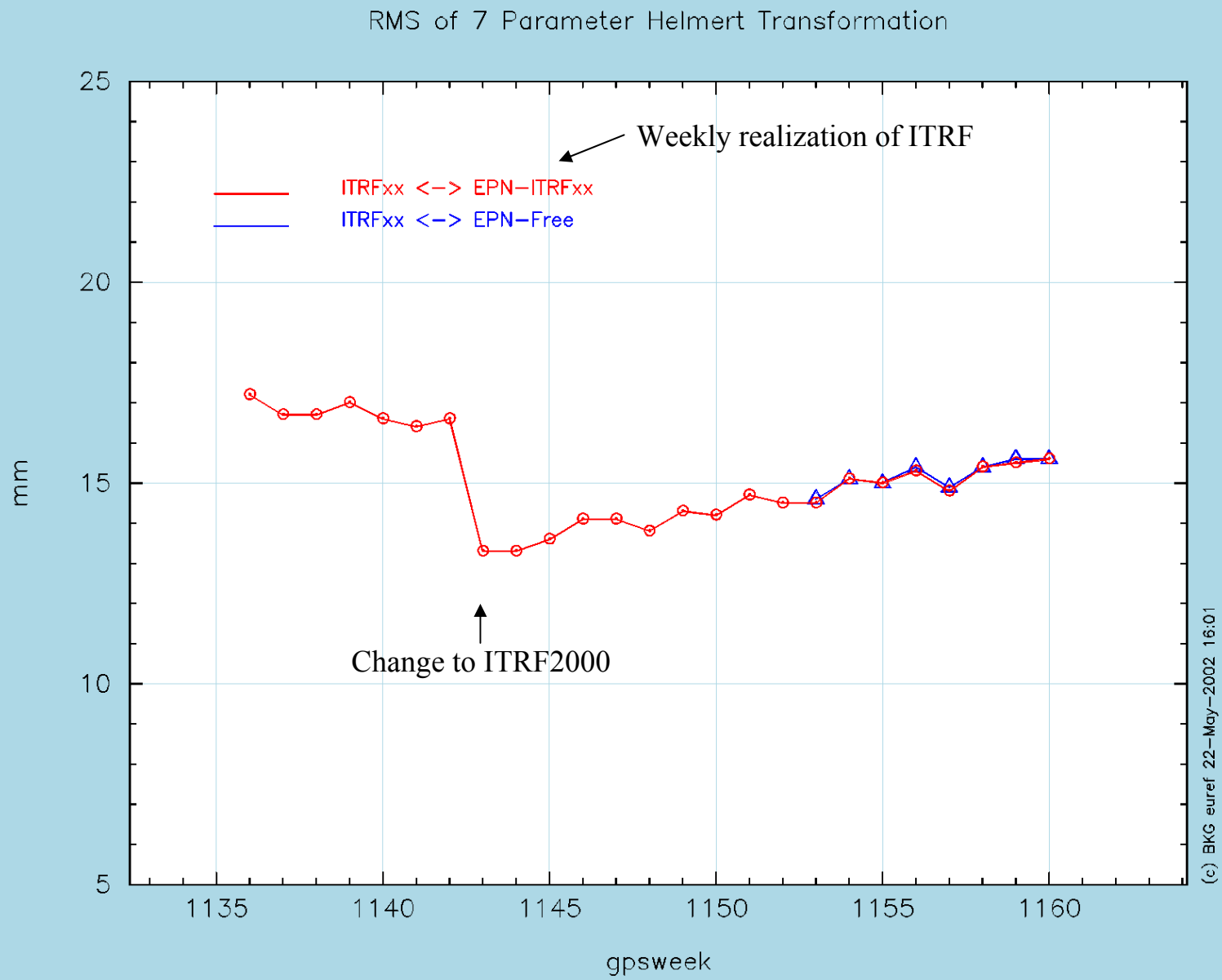
Next Steps for Constraint SINEX Solution

- The variation of the LAC specific trop. biases significantly improved after the coordinate re-substitution in the weekly solutions of each LAC
- Systematic variation of the biases may be reduced, if the combined EPN solution would be used for the coordinate re-substitution.
- Ask the LACs to calculate such a solution for test purpose.
- Detailed study of the scaling factor between trop. parameter and heights.

Change from ITRF97 to ITRF2000

Motivation:

- IGS introduced ITRF2000 in week 1143
- All IGS products (satellite orbits, EOP, station coordinates,..) in the new reference frame
- EPN introduced ITRF2000 at the same week to be consistent to the IGS and to take benefit form the improved reference frame


RMS of 7 Parameter Helmert Transformation
Weekly realization of ITRF
ITRFxx <-> EPN-ITRFxx
ITRFxx <-> EPN-Free
Change to ITRF2000
mm
gpsweek
25
20
15
10
5
1135
1140
1145
1150
1155
1160
(c) BKG euref 22-May-2002 16:01

EPN Reference Frame Alignment

Motivation:

- IGS initiative to realize a dense global reference network; fully consistent to the IGS products (orbits, EOP, reference frame,..)

Idea:

- Alignment of Regional GPS Networks (e.g., EPN) to the global IGS solution
- Regional Densification of the Global IGS Network

IGS 2002 Workshop Contributions

Alignment of regional networks:

- Z. Altamimi: Using the „free network conditions“ for network alignment
- M. Craymer, R. Ferland: Using the Helmert Transformation approach for network alignment
- H. Habrich: Heavily constraining common sites of global and regional solutions for network alignment

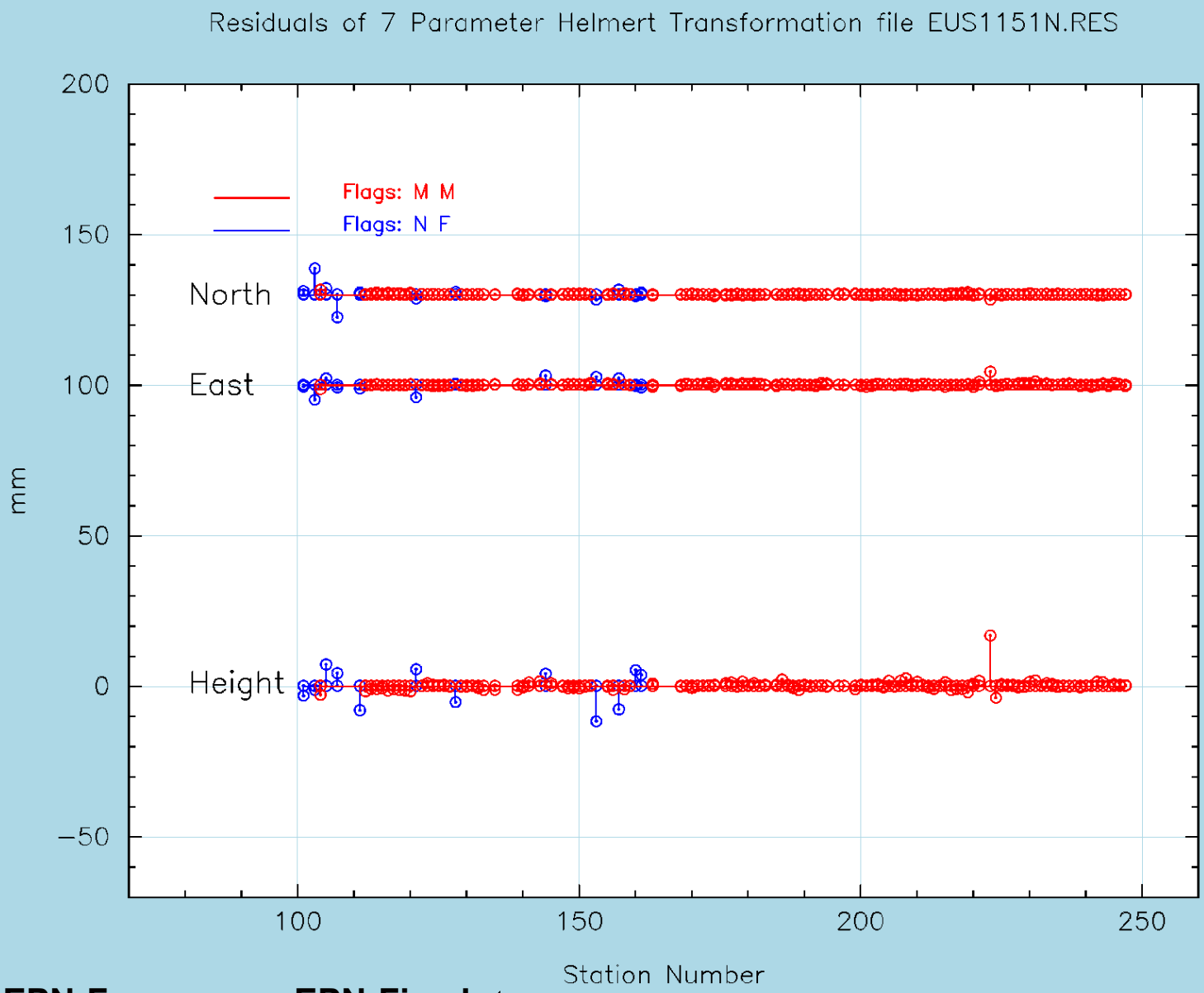
Realization of IGS Polyhedron and Preliminary European Densification

	Weekly	Cumulative
IGS	Coordinates and velocities of 51 high quality global distributed stations aligned to ITRF-2000 ⬇ IGS Polyhedron	
	~ 130 global stations	~ 130 global stations
EUREF	IGS Polyhedron fixed	
	~ 40 European stations	~ 40 European stations
	⬇ EPN Polyhedron	
	~ 130 European stations	~ 130 European stations

Preliminary

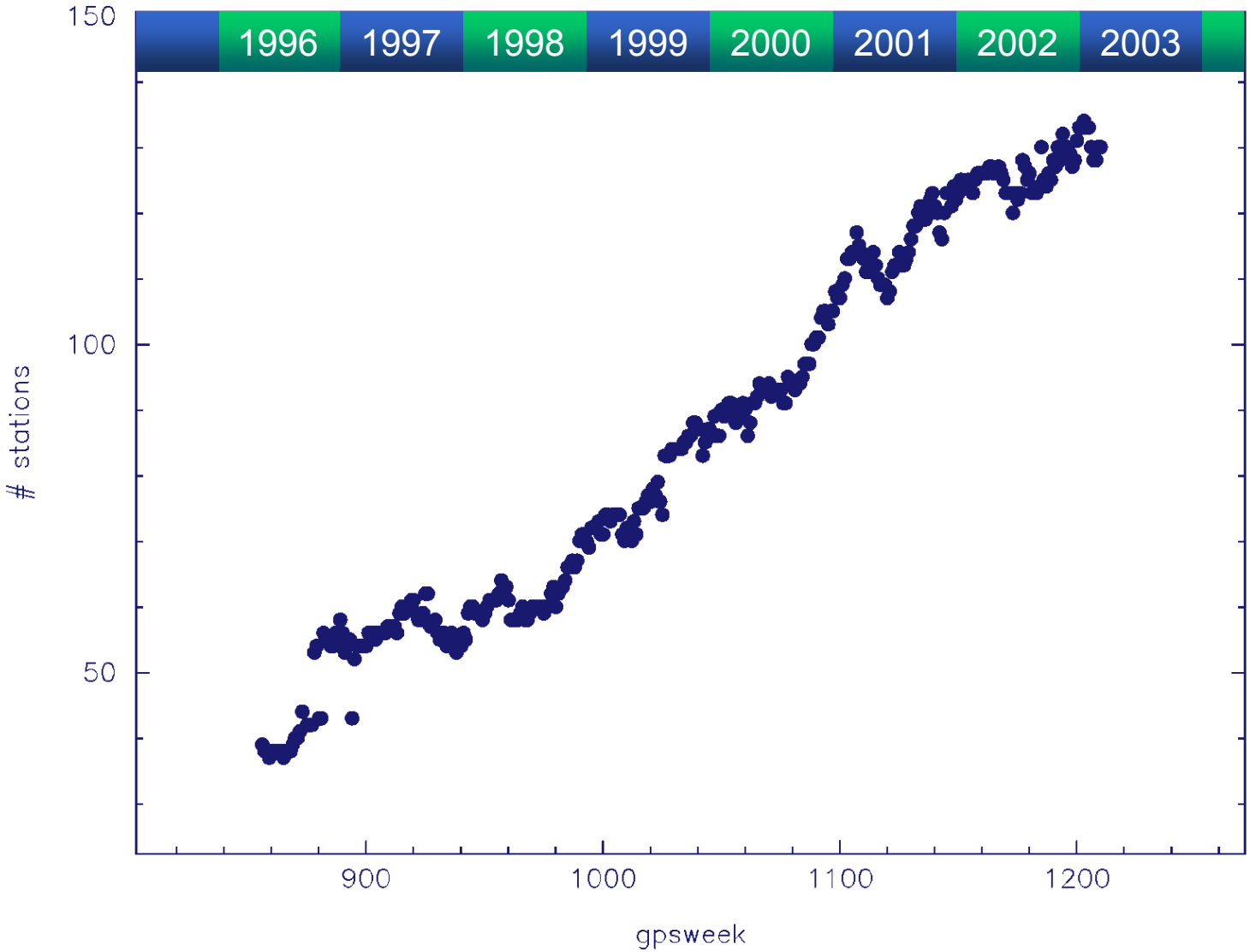
Reference Frame Alignment of Weekly EPN Solutions

- ITRF-2000 coordinates of **12 EPN stations** are hold **fixed** (constrained to sub-millimeter level)
- Generation of weekly SINEX files
- A-priori constraints are included in SINEX files
- Product usage:
  - Direct extraction of coordinates and co-variances
  - Removal of constraints for new reference frame definition ***or*** cumulative solutions generation
- Example for usage:
  - Contribution to ITRF-2000 (cumulative solution)



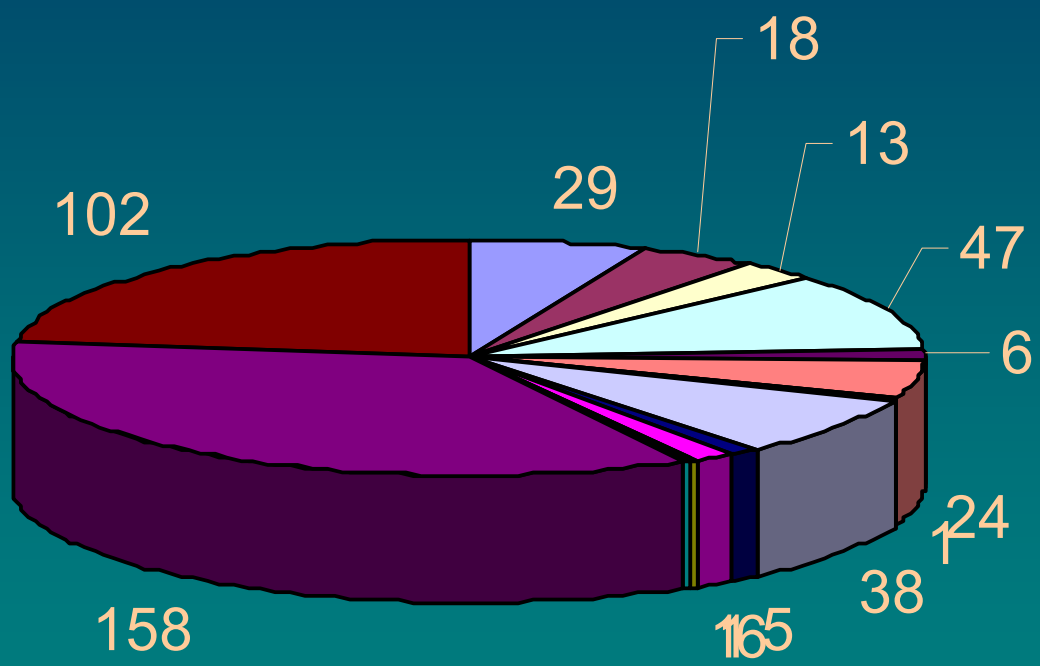
EPN-Free versus EPN-Fixed

Number of Stations in EPN Analysis

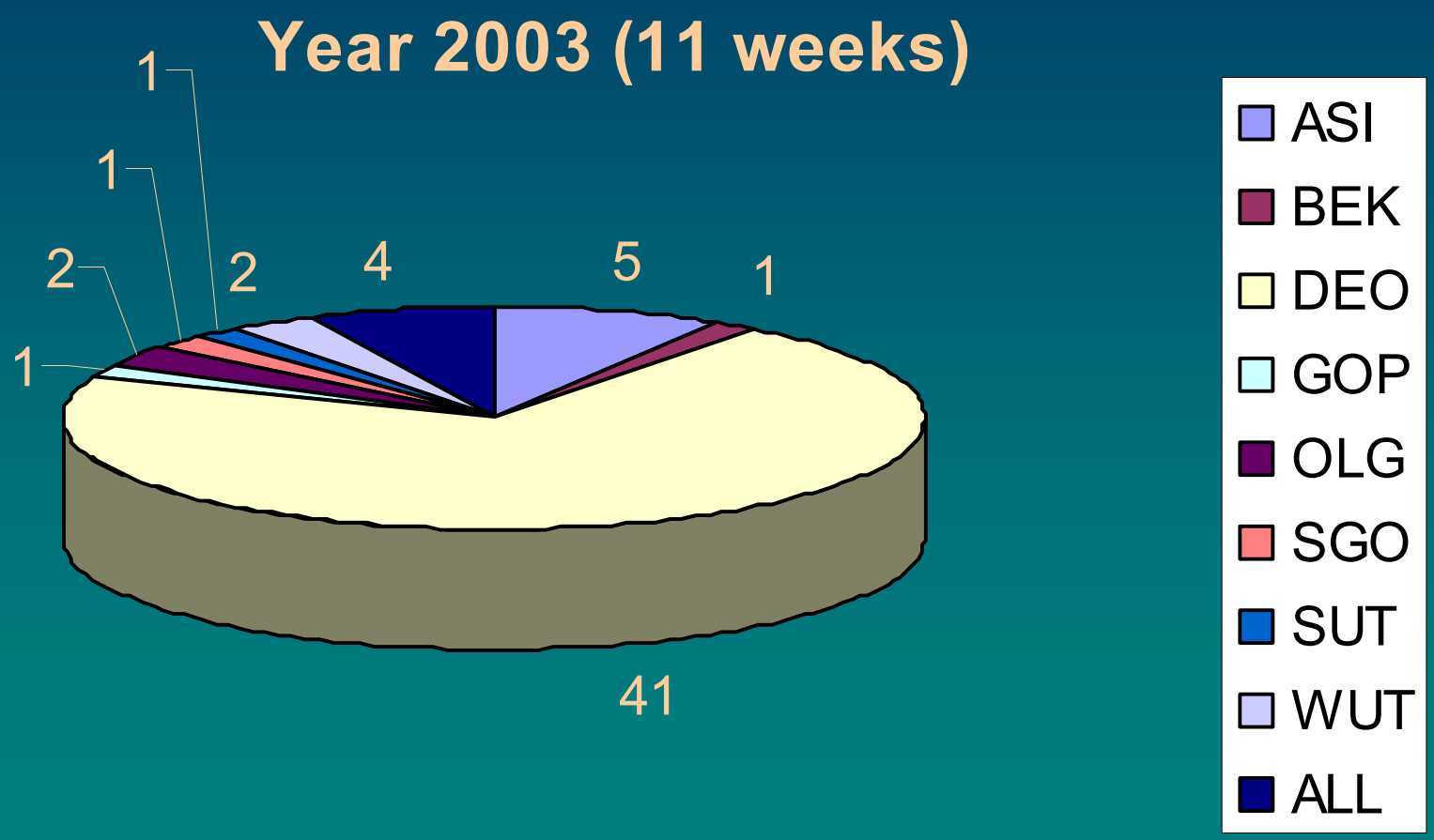


Distribution of Exclusions

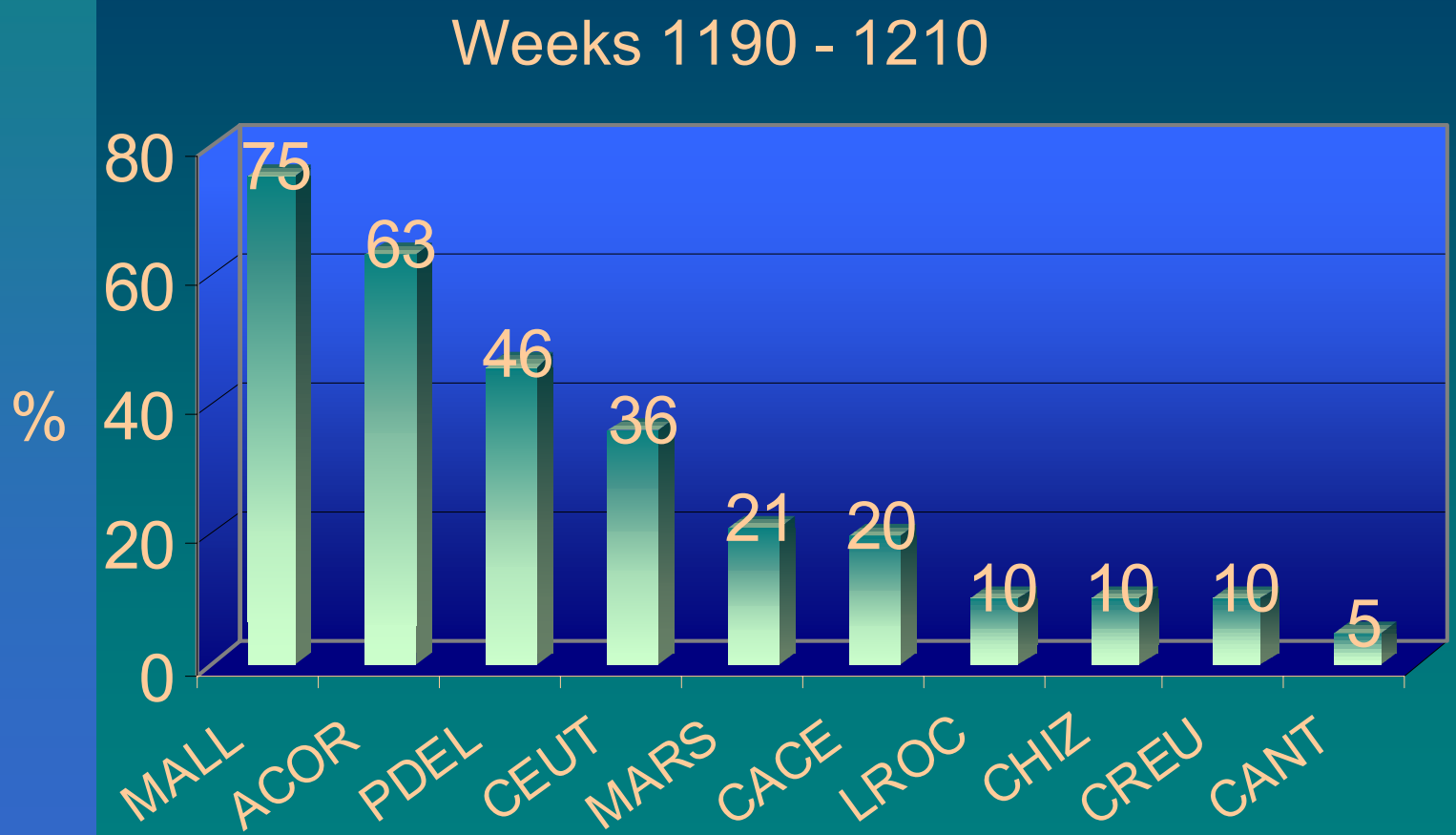
Year 2001



Distribution of Exclusions



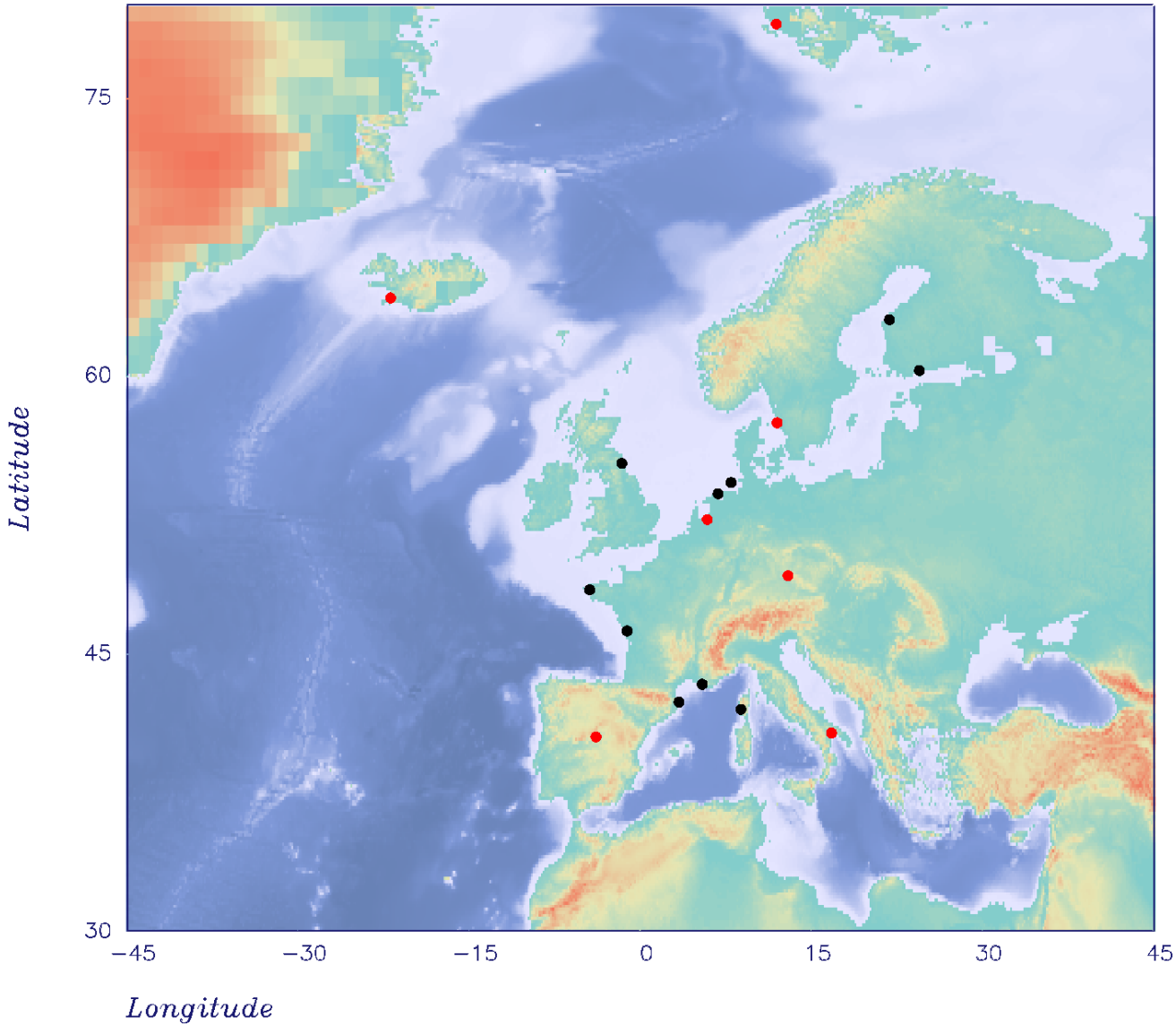
Exclusions in DEO Sub-Network



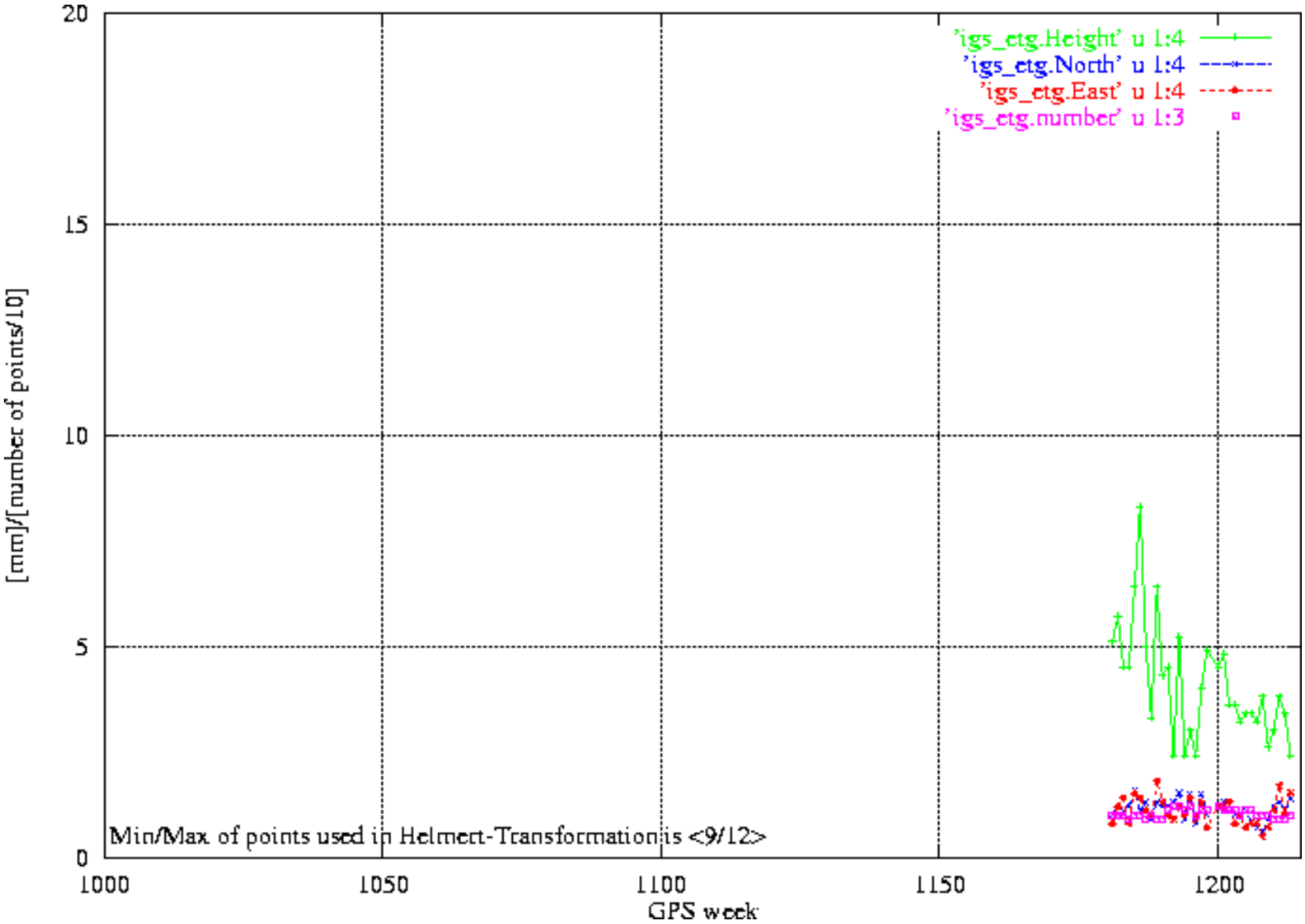
TIGA-Pilot Project

- EUREF proposal for participation in TIGA-PP as Analysis Center accepted
- Generation of a TIGA-PP sub-network from the combined solution
- All EPN stations which meet the TOS (TIGA observing station) standard
- Actually 7 stations for connection to ITRF2000
- „loosely constrained“ solution (1 m a-priori sigma for connection sites)
- SINEX file **ETGwwww7.SNX** submitted to ftp-server at GFZ

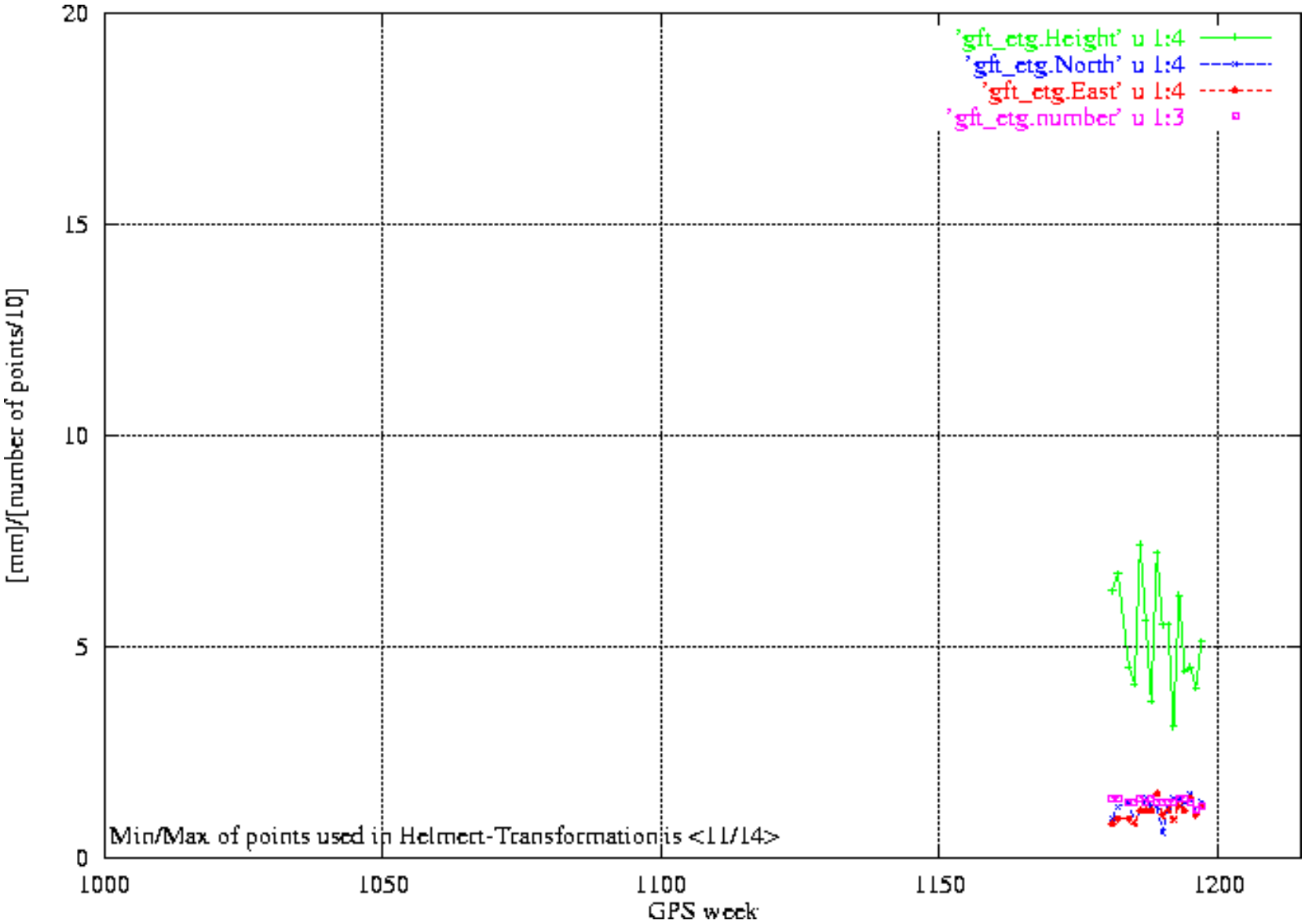
EPN Sub-Network for TIGA-PP, week 1225



Comparison between EPN Sub-Network for TIGA-PP and IGS Network



Comparison between EPN and GFZ Sub-Network for TIGA-PP



Summary

- Continuously improving consistency of all LAC solutions
- Constraining all station coordinates reduces troposphere biases
- Minimum-constraints are a promising alternative for reference frame alignment
- Contribution of EPN to new projects, e.g., TIGA, ESEAS, ECGN

Thank you!