Results from the Reprocessing of the BEK subnetwork



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Background

- Since 1996 the EPN has been processed by the numerous Analysis Centres according to defined standards:
 - Correction models
 - Antenna calibration models (radome neglected), troposphere, solid earth tides, ocean loading etc.
 - Processing strategies
 - Elevation dependent weighting, elevation mask, ambiguity resolution strategy etc.
 - Reference Frame realisation
 - Orbits and coordinates in different realisations of the ITRS
- Result:
 - Coordinates depend on correction models, reference frames, analysis
 - Inconsistent time series of coordinate changes => incorrect velocities



Time Series of Position Changes Station Wettzell



http://www.epncb.oma.be/

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Aim of the Reprocessing

- Compute consistent coordinates and velocities over the entire time (1996-2005, 10 years)
- Procedure
 - Identical analysis strategy
 - The same reference frame realisation (IGb00)
 - The same correction models
 - Absolute PCV, earth tides, ocean loading, etc
 - Software package (BERNESE 5.0)
- Realisation
 - Use reprocessed orbits and EOP's of the group
 Rothacher/Dietrich (GFZ, TU Dresden and TU Munich)



The Reprocessed Network



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Network Characteristics of the BEK Subnetwork

- Over the past 10 years 92 stations were included
- But only 62 stations cover at least 3 years of data
- Daily solutions were processed using BERNESE 5.0
 - Troposphere: one estimate every two hours, one gradient per day
 - Abs. PCV for SV and ground antenna (additions from the GEO++ database)
- Data were processed on three PENTIUM IV computers (OS: Debian Linux)



Achieved repeatabilities of the daily solutions:

North:	2.0 mm
East:	2.2 mm
Height:	5.1 mm

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Time Series after Reprocessing WTZR



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Discontinuities in Times Series (Trend Removed)



This Study: Jump on 18 Aug., 2003 North: -11.9 mm East: -5.7 mm Height: *

EPN Times Series Monitoring:

Jump on 18 Aug., 2003 North: -12 mm East: -4 mm Height: *





Periodicities and Frequent Antenna Changes



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Removal of Jumps and Periodicities with TSVIEW



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Tsview: http://www-gpsg.mit.edu/~tah/GGMatlab



First Results

- Discontinuities due to reference frame changes are not detectable
- Discontinuities caused by antenna changes are mostly still visible
 - Type mean absolute PCV do not describe the antenna behaviour completely
 - Obviously there is more then just the absolute PCV describing the antenna characteristics
 - Estimated coordinates are probably biased by a certain unknown effect ("near field")
- Only some stations show a seasonal behaviour



Estimation of the velocity field

- Coordinates and velocities were estimated applying ADDNEQ2 using the daily solutions (3643 normal equation files)
- Outliers and jumps had to be removed in an iteration (several ADDNEQ2 runs were necessary)
- Coordinates and velocities were constrained using a minimum constrain condition for
 - Translation and rotation
 - BRUS, GRAS, ONSA, VILL, WTZR, ZIMM.



- Velocities have changed only very little for IGb00 sites (< 1 mm/a)
- Outlier detection limit:
 - North: 15 mm
 - East: 15 mm
 - Height: 20 mm
- More then 2500 outliers have been detected and were removed in the final ADDNEQ2 run

Station		A priori	Estimated	Correction	
Station		[mm/a]			
BOR1	Up	-0.9	-0.2	0.7	
	North	13.8	13.2	-0.6	
	East	20.7	20.5	-0.2	
BRUS	Up	1.2	0.1	-1.0	
	North	14.1	14.1	0.0	
	East	18.0	18.0	0.0	
NICO	Up	1.0	0.1	-0.9	
	North	14.1	13.9	-0.2	
	East	18.9	18.8	-0.1	
ONSA	Up	0.6	0.9	0.3	
	North	13.9	13.6	-0.3	
	East	17.2	17.2	0.0	
VILL	Up	-0.3	-0.5	-0.2	
	North	15.5	15.4	-0.1	
	East	19.5	19.5	-0.0	
WTZR	Up	0.3	-1.1	-1.5	
	North	14.5	14.5	0.0	
	East	20.4	20.6	0.2	



Horizontal Velocity Field (ETRS)



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Vertical Velocity Field





Conclusions

- A consistent set of coordinates has been estimated using 10 years of data (not yet final)
- Jumps in the time series are still mainly caused by antenna changes
- Each coordinate set is still biased by unknown sites effects (multipath, near-field effects etc.)
- This work still needs to be continued:
 - New tropospheric models should be applied and tested
 - High frequency effects are still not investigated



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Ref: P. Steigenberger, M. Rothacher, R. Dietrich, M. Fritsche, A. Rülke, S. Vey: Reprocessing of a global GPS network, Journal of Geophysical Research, 2005

- The data centres for keeping data online:
 - Bundesamt für Kartographie und Geodäsie (BKG)
 - Institut Géograhique National (IGN)
 - Space Research Institute, Department of Satellite Geodesy (OLG)
 - Agenzia Spatiale Italiana (ASI)
- The EPN Central Bureau
 - For the data from 1996
 - And a well maintained homepage with plenty of information