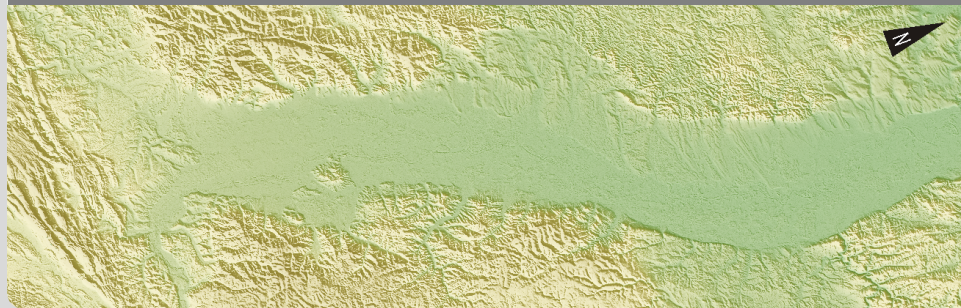


GURN (GNSS Upper Rhine Graben Network) - Status and First Results

A. Knöpfler¹, F. Masson², M. Mayer¹, P. Ulrich², B. Heck¹ | 13 April 2010

¹KIT, GEODETIC INSTITUTE

| ²EOST STRASBOURG



Institutions

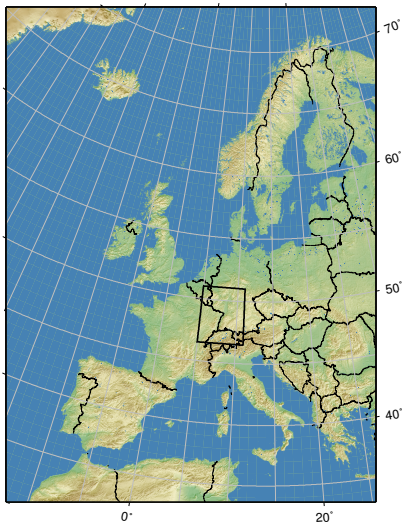
EOST: Ecole et Observatoire des Sciences de la Terre
Frédéric Masson, Patrice Ulrich



GIK: Geodetic Institute Karlsruhe, Karlsruhe Institute of
Technology
Andreas Knöpfler, Michael Mayer, Bernhard Heck



Area of interest



GIK at URG

Motivation

GURN

Station quality

First reprocessing



Work of different fields

- GPS: EUCOR-URGENT
 - Campaign measurements
 - Few sites, few days
 - Only sites very close to the URG
- Precise levellings
- Meteorology: COPS

Actual work in context of

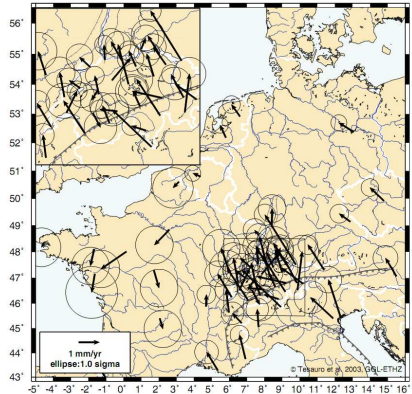
- EUCOR-URGENT
- TOPO-WECEP
- TOPO-EUROPE

Main goal

First all-embracing and consistent scientific processing and analysis of data of permanent operating GNSS sites in the area of the Upper Rhine Graben

Motivation

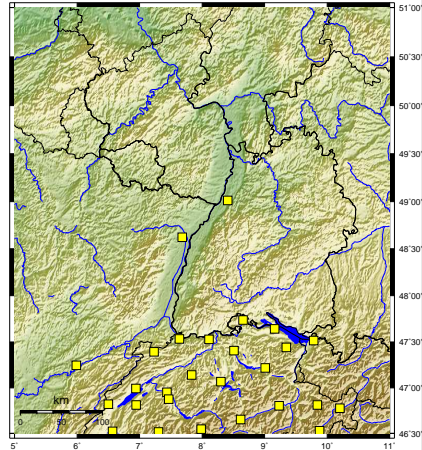
- Velocities/Strain
e.g. based on Tesauro et al. (2005)
- Only 2 sites in URG region
- Sites representative for URG?
- Recent geodetic developments:
 - Growing GNSS networks
 - New techniques



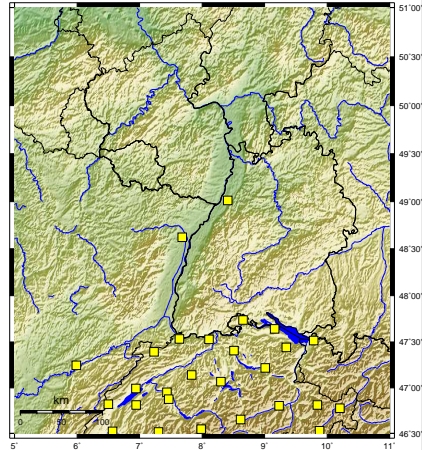
Graphic from Tesauro et al., Continuous GPS and broad-scale deformation across the Rhine Graben and the Alps, International Journal of Earth Sciences, Volume 94, Number 4, 2005

Motivation

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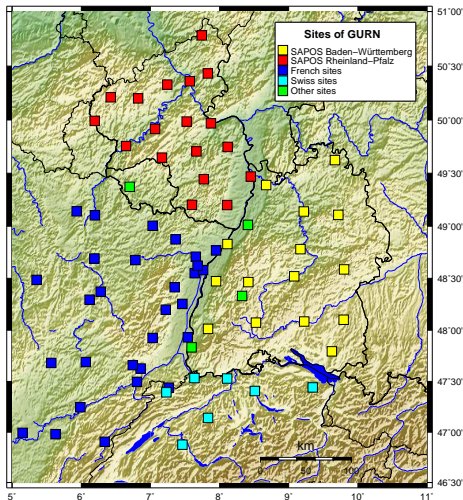


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- Germany
 - SAPOS[®] Baden-Württemberg
 - SAPOS[®] Rheinland-Pfalz
 - BFO, BKG
- France
 - RENAG
 - RGP
 - Teria
 - Orpheon
 - EOST
- Switzerland
 - swisstopo

$\Sigma \approx 75$ sites



Requirements for good GNSS results

- Stable monumentation of site
- Good coupling to ground
- No shadowing
- Professional equipment
- No multipath

- Pillars with good visibility
- Shadowing, multipath
- New buildings
- Old buildings
- ...



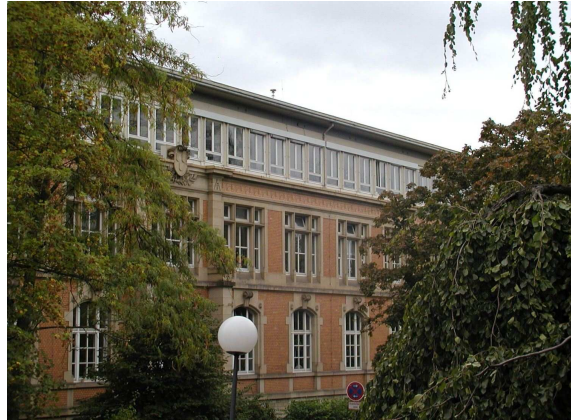
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- Pillars with good visibility
- Shadowing, multipath
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- Old buildings
- ...



- Pillars with good visibility
- Shadowing, multipath
- New buildings
- Old buildings
- ...



Keep in mind

- Detection of the movement of the ground or the building?
- Purpose of sites: cadastre vs. geodynamics
- Aspects for selection of sites:
 - Logistics
 - Security
 - Good conditions for GNSS

Monitoring using tiltmeters

Case study: monitoring of 2 sites

- KARL (old building)
- IFFE (between 2 lock chambers)



Monitoring using tiltmeters

Case study: monitoring of 2 sites

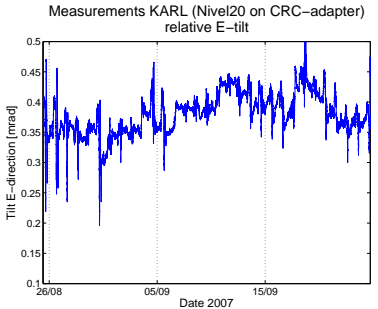
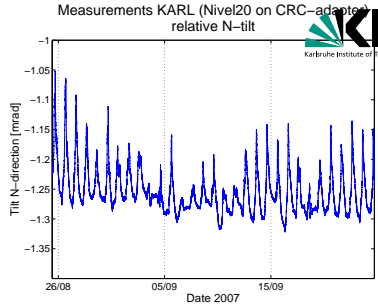
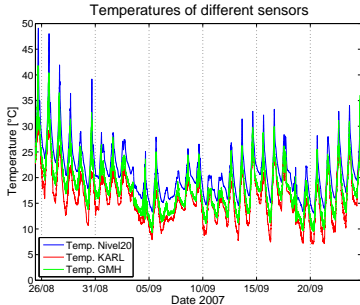
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Monitoring using tiltmeters

Case study: monitoring of 2 sites

- KARL (old building)
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Case study: monitoring of 2 sites

- KARL (old building)
 - IFFE (between 2 lock chambers)
- Variations during the day are obvious
 - Correlation: temperature \Leftrightarrow tilt
 - Main amplitude in N-S direction
 - Max-Min ≈ 0.22 mrad $\hat{=}$ 3.5 mm (N-S)

Monitoring using tiltmeters

Case study: monitoring of 2 sites

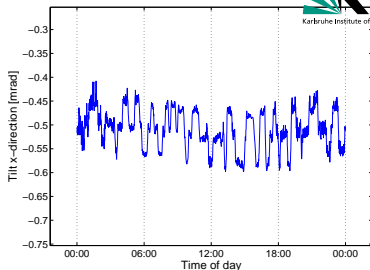
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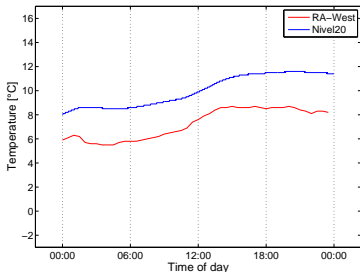
Monitoring using tiltmeters

Case study: monitoring of 2 sites

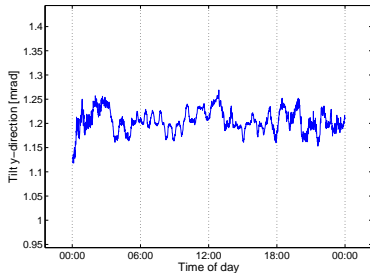
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Measurements Iffezheim
Temperatures



Measurements Iffezheim using Nivel20
relative y-tilt



Case study: monitoring of 2 sites

- KARL (old building)
- IFFE (between 2 lock chambers)
 - Operation of the lock obvious
 - Amplitude based on assumptions ± 1.8 mm

Checks based on data

- Real observed data
- No log-files for some sites
- Processing the data of 2007

Checks based on data

- Real observed data
- No log-files for some sites
- Processing the data of 2007

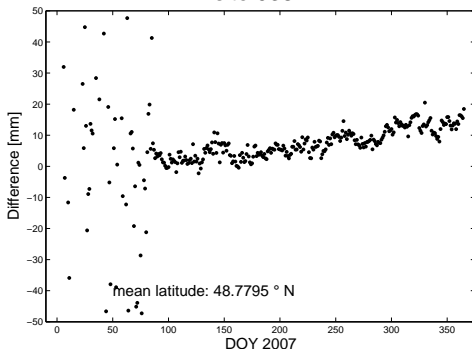
What is PPP?

- PPP = Precise Point Positioning
- Every site separately
- Bernese GPS Software
- Final Products (Orbits, ...)

Coordinate time series out of PPP

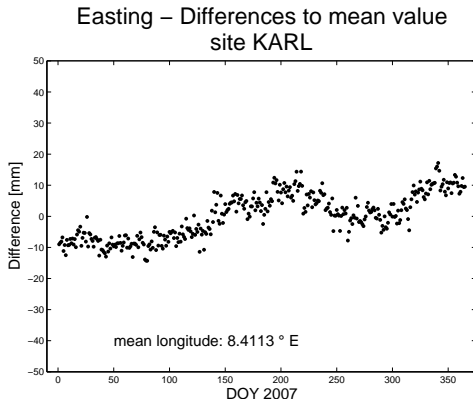
- Problems with equipment on sites
⇒ various data quality
- Seasonal signals
⇒ filtering necessary

Northing – Differences to mean value
site 0384



Coordinate time series out of PPP

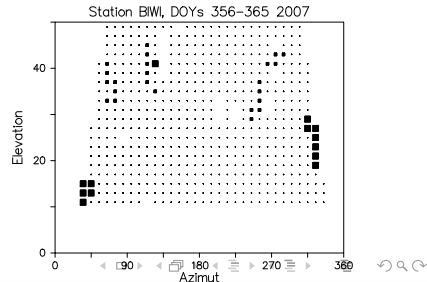
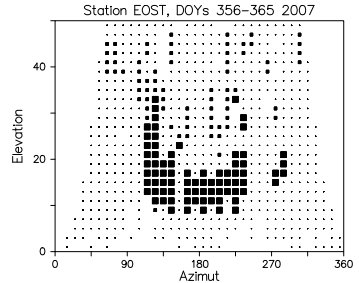
- Problems with equipment on sites
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- Seasonal signals
⇒ filtering necessary



- Software used: WaSoft/Multipath (www.wasoft.de)
- Analysis of phase residuals
- Checks performed in small subnetworks
- Assumption: signals with $e > 50^\circ$ not affected

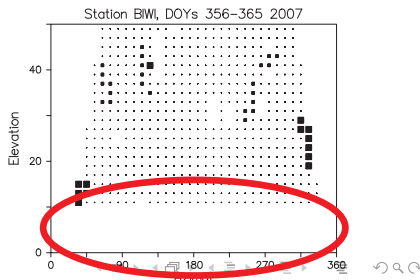
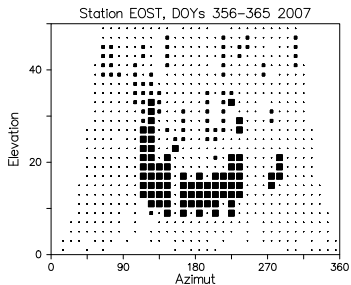
Multipath checks

- Site environment
- Elevation mask
⇒ Change may cause apparent deformations

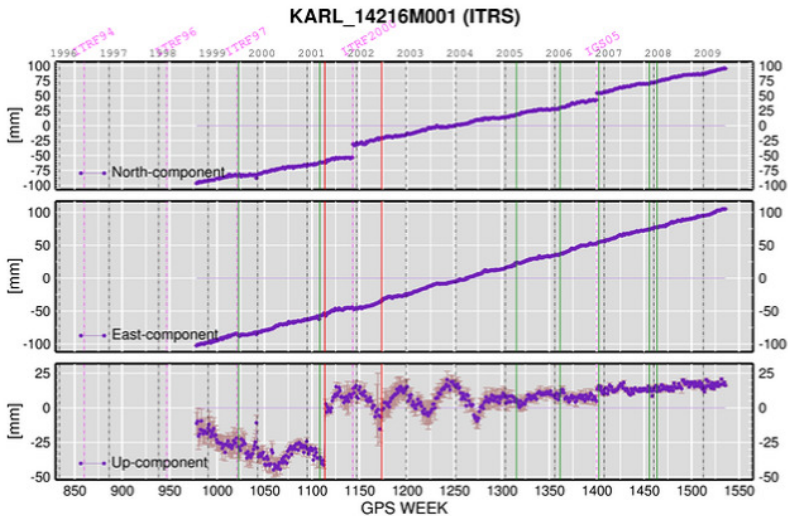


Multipath checks

- Site environment
- Elevation mask
⇒ Change may cause apparent deformations



	EOST	GIK
Software	GAMIT/GLOBK Version 10.34	Bernese GPS Software Version 5.0
Orbits	final IGS	reprocessed CODE final CODE
Antenna model	abs. IGS	abs. individual and abs. IGS
Reference frame	ITRF2005	ITRF2005
	daily solutions	



EPN CB

Fri Oct 23 11:17:16 2009



GIK at URG

Motivation

GURN

Station quality

First reprocessing



Preliminary time series of coordinates

- Calm time series
- Seasonal signals
- Discontinuous time series
- Large variations of daily solutions



Changes on the sites

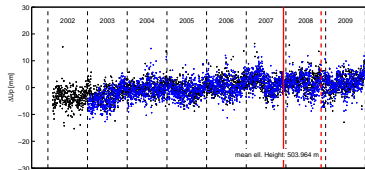
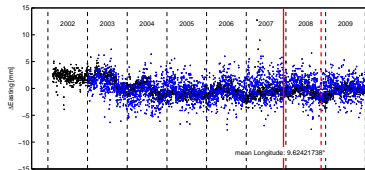
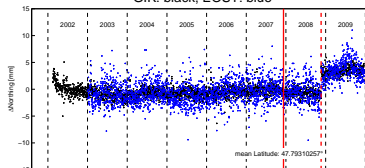
—	only receiver
—	only antenna
—	only antenna height
- -	receiver and antenna
- -	antenna and antenna height
- -	receiver and antenna height
- -	receiver, antenna and antenna height



Preliminary time series of coordinates

- Calm time series
- Seasonal signals
- Discontinuous time series
- Large variations of daily solutions

Site 0395 – Differences to mean value (without eurasian trend)
GIK: black, EOST: blue



Changes on the sites

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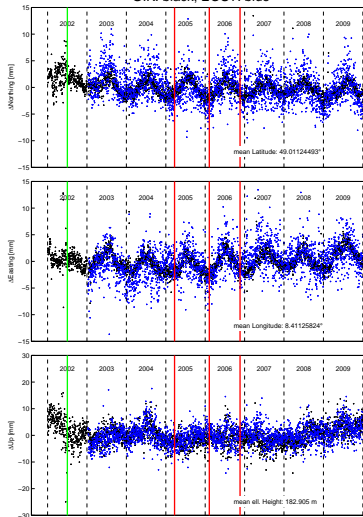
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- - -	antenna and antenna height
- - -	receiver and antenna height
- - -	receiver, antenna and antenna height

Site KARL – Differences to mean value (without eurasian trend)
GIK: black, EOST: blue



Preliminary time series of coordinates

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- Discontinuous time series
- Large variations of daily solutions



Changes on the sites

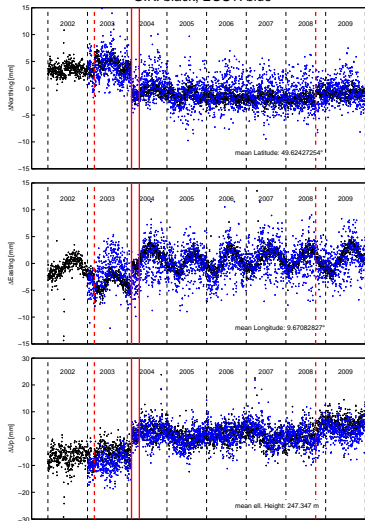
—	only receiver
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- - -	receiver and antenna
- - -	antenna and antenna height
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- - -	receiver, antenna and antenna height



Preliminary time series of coordinates

- Calm time series
- Seasonal signals
- Discontinuous time series
- Large variations of daily solutions

Site 0392 – Differences to mean value (without Eurasian trend)
GIK: black, EOST: blue



Changes on the sites

- only receiver
- only antenna
- only antenna height
- - receiver and antenna
- - antenna and antenna height
- - receiver and antenna height
- - receiver, antenna and antenna height



Preliminary time series of coordinates

- Calm time series
- Seasonal signals
- Discontinuous time series
- Large variations of daily solutions



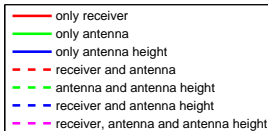
Changes on the sites

—	only receiver
—	only antenna
—	only antenna height
- -	receiver and antenna
- -	antenna and antenna height
- -	receiver and antenna height
- -	receiver, antenna and antenna height

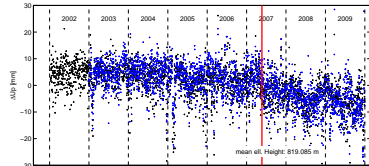
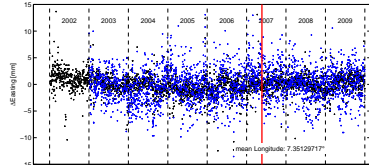
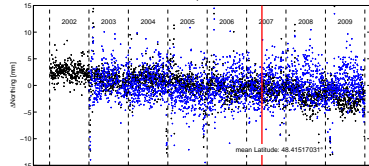
Preliminary time series of coordinates

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- Large variations of daily solutions

Changes on the sites



Site WLBH – Differences to mean value (without eurasian trend)
GIK: black, EOST: blue



Summary

- Dense permanent GNSS-network covering URG region
- Different site checks performed
- First reprocessing and comparison with promising results

Further steps

Short term:

- Detailed comparison of results: EOST vs. GIK
- Cleaning of time series
- Estimation of site velocities

Medium term:

- Estimation of water vapor fields with high resolution
- Hybrid deformation analysis: InSAR, Levelling, GNSS

Main goal:

- Well-founded new geodynamical model for Upper Rhine Graben region

Thank you for your attention

Further details: see paper or

contact: andreas.knoepfler@kit.edu