FOOTPRINT - NETWORK

GPS - Monitoring of the Fundamental Station Wettzell

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Overview

1. Motivation

2. Description of the Footprint - Network

3. Analysis Strategy

4. Discussion of the Results

5. Conclusion
1. Motivation

Monitoring of the local environment of a fundamental station (about 20 km)!

Establish long time series of station coordinates to detect periodical signals, significant local movements, ...

Goal: clear and accurate information about the local stability of fundamental stations
2. The Footprint Network

- Hohenwarth (HOWA)
- Wettzell (WTZZ)
- Prackenbach (PRAC)
- Arber (ARBR)
- Miltach (MILT)

Distances:
- 19.0 km
- 7.0 km
- 8.2 km
- 7.1 km
2. The Footprint Network

Height differences between stations:

<table>
<thead>
<tr>
<th>Station</th>
<th>Station Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARBR</td>
<td>1505 m</td>
</tr>
<tr>
<td>HOWA</td>
<td>562 m</td>
</tr>
<tr>
<td>MILT</td>
<td>488 m</td>
</tr>
<tr>
<td>PRAC</td>
<td>588 m</td>
</tr>
<tr>
<td>WTZZ</td>
<td>665 m</td>
</tr>
</tbody>
</table>

Observation period: 01.01.2001 - 09.08.2003 (2.7 years)
3. Analysis Strategy

Processing goal: station coordinates of highest accuracy

Bernese GPS - Software 5.0:
Scientific GPS - Analysis Tool

- Estimation of many different parameter types
- Automatic Processing (BPE)
- Combination of Normal Equations (ADDNEQ)
3. Analysis Strategy for Daily Solutions

- **RINEX - Raw Data**: Receiver Clock, Baselines, Widelane/Narrowlane, Local Troposphere Model
- **Orbit/EOP - Information**: Cycle Slips, RMS-Dependent Strategy, NEQ Files: Combination

**Preprocessing**

- **L3 Ambiguity-Float Solution**
- **Ambiguity Resolution**
- **L3 Ambiguity-Fixed Solution**
3. Analysis Strategy: Local Troposphere Model

Estimation of the troposphere path delay $\Delta \rho$ as a function of station height ($n = 2$):

$$\Delta \rho(z, h) = f(z) \sum_{i=0}^{n} k_i \cdot (h - h_r)^i$$
4. Results: Repeatability of the North-Component

Station ARBR, RMS = 3.10 mm

Station HOWA, RMS = 1.68 mm

Station MILT, RMS = 1.35 mm

Station PRAC, RMS = 1.59 mm
4. Results: Repeatability of the East - Component

Station ARBR, RMS = 2.48 mm

Station HOWA, RMS = 1.45 mm

Station MILT, RMS = 1.47 mm

Station PRAC, RMS = 1.13 mm
4. Results: Repeatability of the Height-Component

Station ARBR, RMS = 8.06 mm

Station HOWA, RMS = 4.86 mm

Station MILT, RMS = 4.17 mm

Station PRAC, RMS = 3.68 mm
4. Results: Signal in the East-Components (HOWA & MILT)

Is the signal caused by neglecting the absolute zenith troposphere delay (ZTD)?

Scaling of baseline length $l$ (8 km) due to an absolute troposphere error $\Delta \rho$ (20 cm):

$$\Delta l = \frac{\Delta \rho}{R_e \cos(z_{\text{max}})} \approx 1.4 \text{mm}$$
4. Results: Effect of the Absolute Tropospheric Zenit Delay

- ZTD estimated with:
  - absolute ZTD introduced for WTZZ
  - no absolute ZTD for WTZZ
4. Results: Estimation of Velocities

Local System of WTZZ

![Graph showing local system of WTZZ with velocities at various points: HOWA (0.6 mm/y), MILT (0.1 mm/y), PRAC (0.3 mm/y), ARBR (1.1 mm/y).]
5. Conclusion & Outlook

- Repeatability of local network: 1.5 mm in horizontal, 4 mm in vertical position.

- A strong seasonal signal for HOWA and MILT was detected. (reason unclear; deformation of building?)

- Velocity estimation: There is no significant movement in the vicinity of Wettzell.

- A local permanent GPS network is well-suited to monitor the stability of fundamental stations.