The tropospheric delay estimation for EPN/IGS permanent stations located in the Sudety Mountains and in the adjacent areas.

Witold Rohm Jarosław Bosy
Institute of Geodesy and Geoinformatics
Wroclaw University of Environmental and Life Sciences
witold.rohm@kgf.ar.wroc.pl; bosy@kgf.ar.wroc.pl
GPS meteorology: MHES Grant

**Aim:**
- Use of the GPS observation to build the spatio-temporal (4D) troposphere tomography model on the Sudety Mountains.

**Data sources:**
- Meteorological parameters,
- GPS observations.

**Products:**
- GPS observations,
- Spatial and temporal distribution of water vapour in the troposphere over GPS network.
GPS Meteoreology: Stage I

- Meteorological data reliability assessment
- Meteorological GPT model accuracy assessment
- Evaluation of EPN ZTD product as a proper reference for the Sudety subnetwork.
Meteorological parameters

- T temperature [°C, °K]
- p pressure [hPa]
- h humidity [%, hPa]

GPS stations: WROC, SNEC, BISK, GOPE
Meteo stations: Wrocław II, Śnieżka, Cervena, Praha-Kbely
Period: year 2006
Meteorological parameters: Sources

- meteo packs mounted close to GPS antenna
  - pressure: 0.3 – 0.5 hPa
  - temperature: 0.3 – 0.5 °C
  - humidity: 3 - 5%

- Polish Meteorological Service (IMGW) and Czech Hydrometeorological Institute (CHMI)
  - pressure: 0.2 hPa
  - temperature: 0.2 °C
  - humidity: 2%

- GPT model
  - pressure: 5 hPa
  - temperature: 3 °C
Meteorological parameters: data interpolation comparison and calibration

Interpolate to similar resolution (1 h)

Compensate for sensor displacement

24h average

Correcting 1 hour observations with mean day difference

Calculating corrections

Compensate for synop station vertical distance

Calculate GPT model values (p,T)

Plotting

Position of synoptic station

"Mean sea level"

GPS antenna position

Position of pressure sensor

Station | meteo files time resolution [s]
---|---
WROC | 300
GOPE | 60
Meteorological parameters: Results

<table>
<thead>
<tr>
<th>Station</th>
<th>pressure [hPa]</th>
<th>temperature [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>bias</td>
<td>error</td>
</tr>
<tr>
<td>WROC</td>
<td>0.94</td>
<td>0.40</td>
</tr>
<tr>
<td>GOPE</td>
<td>-0.53</td>
<td>5.02</td>
</tr>
<tr>
<td>SNEC</td>
<td>-0.07</td>
<td>0.40</td>
</tr>
<tr>
<td>BISK</td>
<td>24.37</td>
<td>6.14</td>
</tr>
</tbody>
</table>
Meteorological parameters: Problems

- Synoptic stations heights not defined well
- BISK pressure sensor large bias
## Meteorological parameters: GPT accuracy assessment

<table>
<thead>
<tr>
<th>Stations</th>
<th>pressure [hPa]</th>
<th>temperature [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>bias</td>
<td>error</td>
</tr>
<tr>
<td>WROC</td>
<td>-2.64</td>
<td>7.68</td>
</tr>
<tr>
<td>GOPE</td>
<td>0.14</td>
<td>4.02</td>
</tr>
<tr>
<td>SNEC</td>
<td>0.32</td>
<td>6.58</td>
</tr>
<tr>
<td>BISK</td>
<td>-48.88</td>
<td>9.14</td>
</tr>
</tbody>
</table>
Tropospheric Delay: Sources

- Euref product means weekly from all LAC’s:

<table>
<thead>
<tr>
<th>Source</th>
<th>Apriori model</th>
<th>Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>OLG since 1397</td>
<td>Dry Niell + MF</td>
<td>ZTD (each 1h). Wet Niell MF, HG (tilting) for 24 hours</td>
</tr>
<tr>
<td>BKG since 1320</td>
<td>Dry Saastamoinen + dry-Niell MF</td>
<td>ZWD (each 1h) + Wet Niell MF</td>
</tr>
<tr>
<td>BKG since 1400</td>
<td>Dry Niell</td>
<td>Zenith delay corrections (1h each station), wet-Niell MF. HG (tilting) for 24 hours.</td>
</tr>
</tbody>
</table>

- Tropospheric delay - Saastamoinen equations:

\[
ZWD = 0.002277 \cdot \left( \frac{1255}{T_0[°K]} + 0.05 \right) \cdot e_0[hPa]
\]

\[
ZHD = \frac{0.0022767 \cdot \left( \frac{m}{hPa} \right) \cdot P_o}{1 - 0.00266 \cdot \cos 2\varphi - 0.00028 \cdot \left( \frac{1}{km} \right) \cdot h_e}
\]

\[
ZTD = ZWD + ZHD
\]
Tropospheric Delay: Comparison

- **Station WROC**
Conclusion

• BISK station pressure data failure,
• GOPE too few reference data,
• GPT reliable global model,
• ZTD from meteo data shows general agreement with EUREF mean solution.
Thank you for your attention!