The ALPS-GPSQUAKENET project

A permanent GPS network in the Alps

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EUREF 2008
"Alpine Integrated GPS Network: Real-Time Monitoring and Master Model for Continental Deformation and Earthquake Hazard"

Establishment of a geodetic network covering the ALPS (40 CGPS) for the determination:
- Crustal deformation (GPS),
- Landslides (GPS und INSAR) and
- Meteorology (GPS)

Partly funded (50%) by INTERREG IIIb Alpine Space!

Partners from the following countries:
France (2), Italy (7), Germany (2) and Slovenia (1)
Missing: Austria and Switzerland
Alpine Deformation

- Collision of the Eurasian and African plates leads to the formation process of the ALPS.

- **Western Alps:**
  - Low to moderate seismotectonic activity
  - E-W extension in the central part of the mountain belt is observed by GPS studies (1997-2001)
  - Compressional Strain (N-S & NW-SE) is observed in the southern part (Calais et al., 2002)

- **South-Eastern Alps:**
  - Represents one of the seismically active regions in Europe
  - Appearance of active faults
  - Seismic Events: Friuli sequence ($M=6.5$), Western Slovenia (1998 $M=5.7$ and 2004 $M=5.3$)

- Glacier shrinkages lead to vertical uplift (significant signal ?).
Distribution of Earthquakes

Source:
NEIC: National Earthquake Information Centre.

Showing earthquakes since 1986 with $M_s > 3.5$

Concentration:
Friuli, Apennine

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Data Availability

- Frequent data gaps (incomplete).
- Daily access is limited to a few stations.
- Late realisation of the stations leads to rather short time series.
- Of the 40 stations only 29 deliver or delivered data to the Trieste data centre.

=> Collection of additional data:
   - Austria (+ 11 sites)
   - Italy [FReDNet: The Friuli Regional Deformation network] + 13 sites
Complete GPS network
(73 sites processed)

No coverage of Switzerland, yet!!
Daily Data Analysis

Re-processed Orbits/ERP by:
GFZ Potsdam
TU Dresden
TU München

- 1200 daily solutions files
  Spanning data between 2005, 001 - 2008, 099

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Estimation of the velocity field

- **MC-Condition:**
  - Translation and rotation (Vel/Pos)
  - Stations used: BRUS, GRAS, MATE, POTS, WTZR, ZIMM.

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Time Series
(linear Trend removed)

WART

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Annual and Semi-Annual Signals

RMS of TS

Station

Amplitude Annual Signals

Amplitude Semi-Annual Signals

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Time Series “Patscherkofel”
(linear Trend removed)

After Removal of periodic signals for selected sites:
Coordinate Repeatabilities are
North=1.3, East=1.3 mm, Height=3.8 mm
Horizontal Velocities in ETRS

Selected Stations only (>2a)

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Deformation across the Eastern Alps

Deformation Zone:

\[ \Phi = 46.5-48.3^\circ \text{ N} \]
\[ \Lambda = 12.0-14.0^\circ \text{ E} \]
Profile across the Alps

Northward Motion
Eastern Alps

Friuli
Austria
HKBL
German Stations

[mm/a]

[km] from BASO

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18.6.2008
Conclusions

• Time series of the stations are still very short.
  - Stations with a history of close to 3 years show [(FReDNET), Austria+ EPN] significant horizontal deformations.
  - Access to the data of the GAIN network needs to be improved!
  - Due to the shortness of the time series vertical velocities are still critical (no discussion at the moment).
  - Some sites show clear seasonal dependence, origin is still unknown and needs to be evaluated (Snow and others).

• Western ALPS and Eastern Alps show different behaviour:
  - West: partly extension, but still very noisy!
  - East: shortening across the ALPS is clearly visible
    • Deformation zone in the Eastern Alps shows compression between 2.5 – 1 mm/a.

• Extend analysis over several years.
# Annual and Semiannual Signals

<table>
<thead>
<tr>
<th>Station</th>
<th>RMS (new)</th>
<th>North</th>
<th>East</th>
<th>Height</th>
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<td></td>
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<td>East</td>
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<td>sin</td>
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<td>4,50</td>
<td>2,79</td>
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</table>

**After Removal of periodic signals for selected sites:**

**Coordinate Repeatabilities are**

North=1.3, East=1.3 mm, Height=3.8mm
Improved Velocities by Removal of annual and semiannual signals

Velocity Changes
(removal annual + semi-annual)

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