Using ground-based GPS to quantify Soil Moisture

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Limiting Factors of GPS

- satellite-specific effects
  - orbit, clock, antenna model
- atmospheric effects
  - ionosphere, neutrosphere
- site-specific effects
  - clock, multipath, antenna model
- other limiting factors
  - relativistic effects, reference frame, ...

Principle of the Experiment

Mitigation of multipath by means of:
- appropriate location
- hardware
- software
- observation duration

Correlation between penetration depth of GPS signals and soil moisture

Measure? S/NIR!
**Preliminary Tests**

- test of total shielding
- line of sight: south
- shielding of direct signals
- different ground reflector

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**MESMERISE**

**Meteorological Soil Moisture Experiment Series**

Wednesday, 27th April 2005: Poster Area Hall Z 188 (5:30 -)
Mayer, M., Hauk, C., Hauk, B., Kothmann, C., "A ground-based GPS able to measure Soil Moisture?"

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**MESMERISE**

- reference antenna (not tilted): Trimble 5800
- tilted antenna - soil moisture sensor: Trimble 5800
- S/NR-analysis

- Trimble raw data
- Trimble Total Control
- RINEX including S/NRL1 and S/NRL2
- TEQC
- daily "sky plot" analysis

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**MESMERISE**

- sampling: 5 s
- analysis of 3 days
- analysis of 2700 epochs (3:45 h)
- no consideration of reference antenna till now

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**MESMERISE - „Sidereal“ Differencing**

- GPS observations of day 188
- GPS observations of day 189
- GPS observations of day 190

time scale
transition to „sidereal“ differencing (ca. 3° 56')

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Conclusion and Outlook

- the assumption GPS has the ability to determine soil moisture could not be rejected / some first hints on the detectability of soil moisture variations from GPS measurements could be found
- comparison with other sensors
- satellite-specific analysis
- improvement of the functional modelling, e.g. with respect to correct satellite positions
- long-term experiment under controlled meteorological conditions
- normalization of the S/NR-values
- determination of absolute soil moisture values