United Nations/Latvia Workshop on the Applications of Global Navigation Satellite Systems

Riga, Latvia, 14 - 18 May 2012

SINGLE-FREQUENCY GPS POSITIONING PERFORMANCE IN NORTHERN ADRIATIC REGION DURING GEOMAGNETIC STORM ON 22 - 24 JANUARY 2012

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Single-frequency GPS positioning performance in Northern Adriatic region during geomagnetic storm on 22 - 24 January 2012

- Content of presentation
  - Introduction
  - Previous research
  - Geomagnetic storm development in observed period
  - Single-frequency GPS positioning performance in observed period
  - Discussion
  - Conclusion

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- Introduction
  - Core GNSS market projected to create US$ 112 billion this year (Glen Gibbons, in InsideGNSS, Jan/Feb 2012)
  - Space weather and ionospheric disturbances as the major source of GNSS positioning performance deteriorations
  - Understanding space weather and ionospheric effects on GNSS leads to sustained provision of quality of PNT service
  - Case-study analyses grow the knowledge base and contribute to understanding of extremely complex positioning environment

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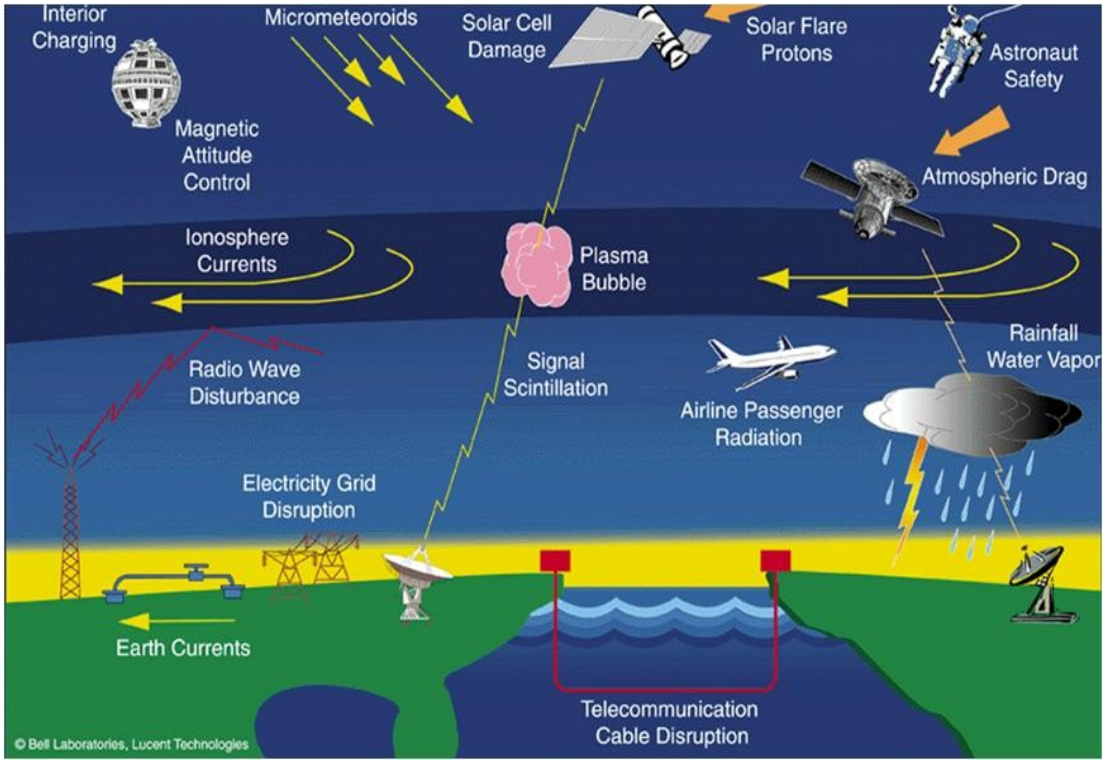
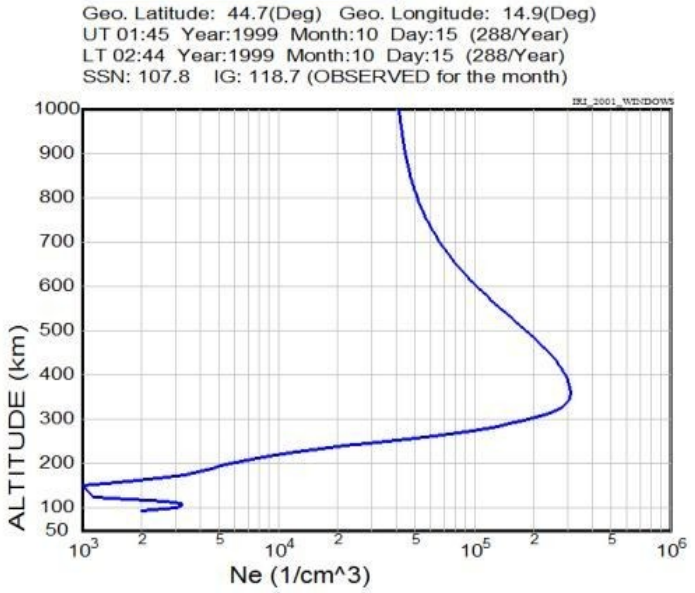
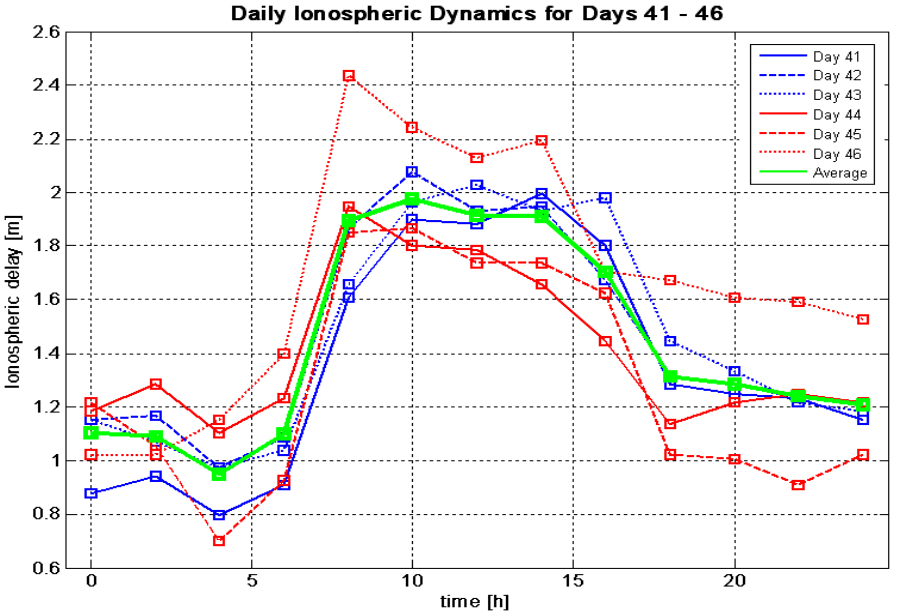
- Previous research

$$t_{iono} = \frac{40.3}{c \cdot f^2} \cdot \int_0^{h_{max}} N(h) \cdot dh$$







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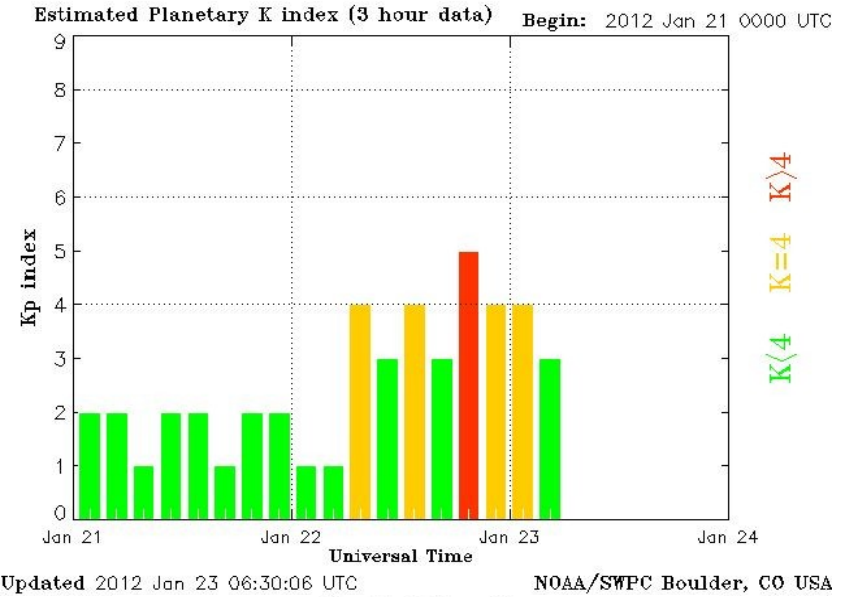
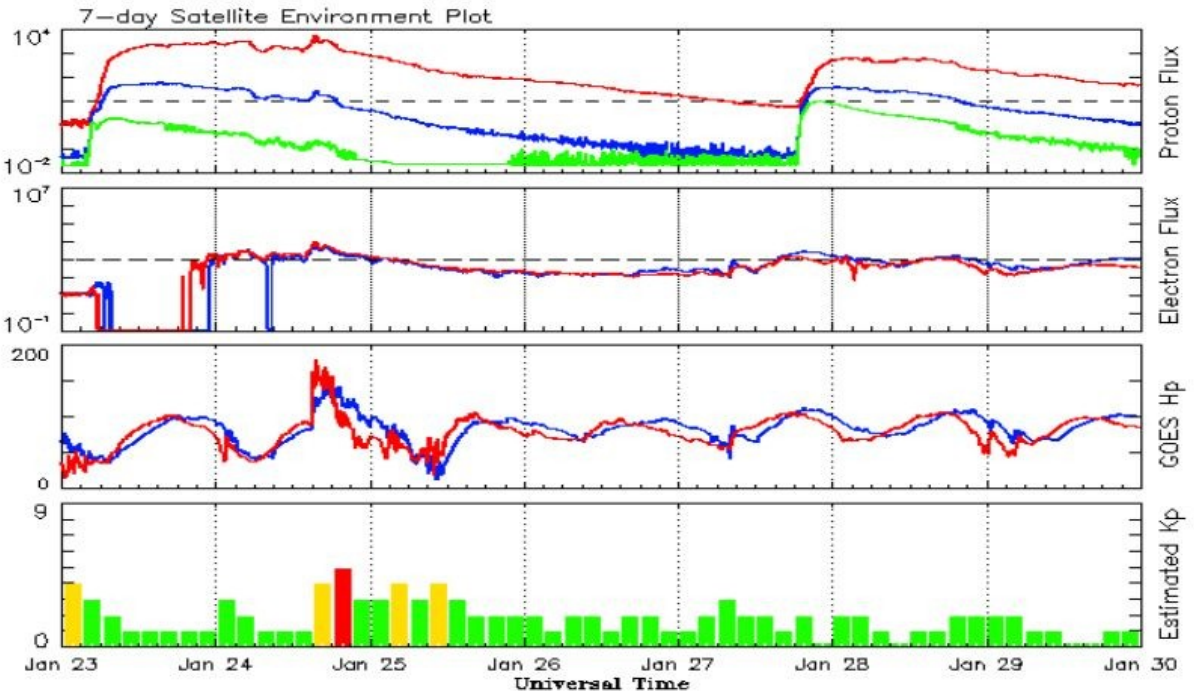
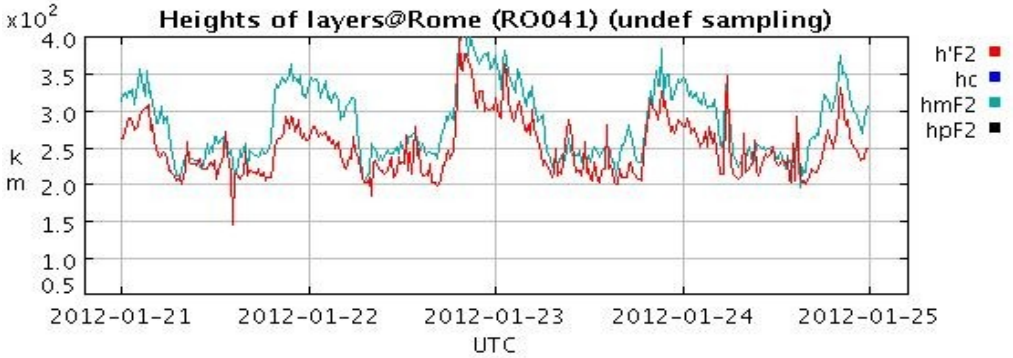
- Geomagnetic storm development in observed period







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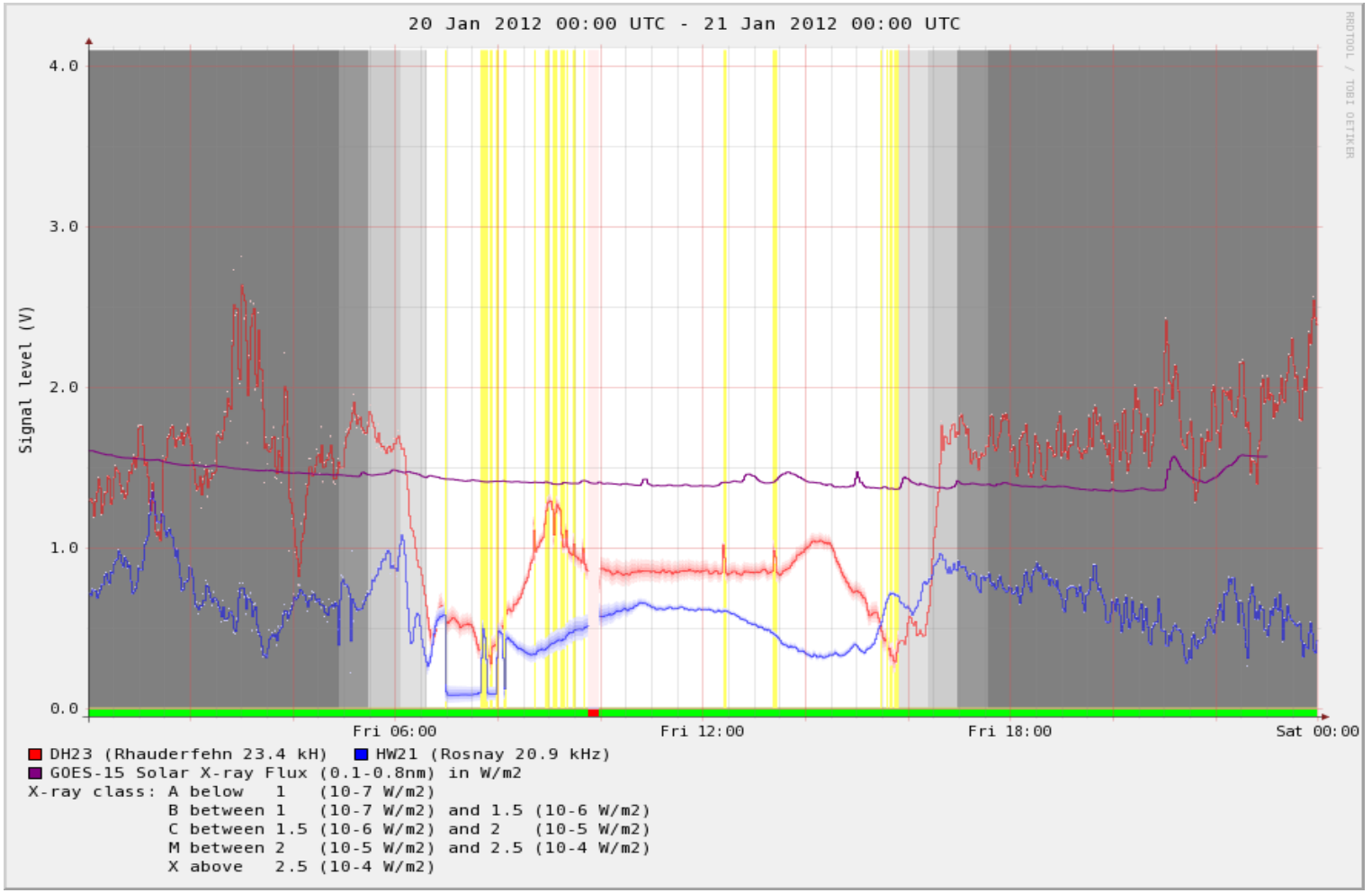

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- Single-frequency GPS positoning performance in observed period – methodology
- Single-frequency GPS performance: reconstructed from the archived RINEX files using single-frequency (L1) pseudoranges, ionospheric corrections modelled using the broadcast coefficients of Klobuchar model
- SID monitor data: observed VLF signals strength, reference stations: Rosnay, France and Rhauderfehn, Germany

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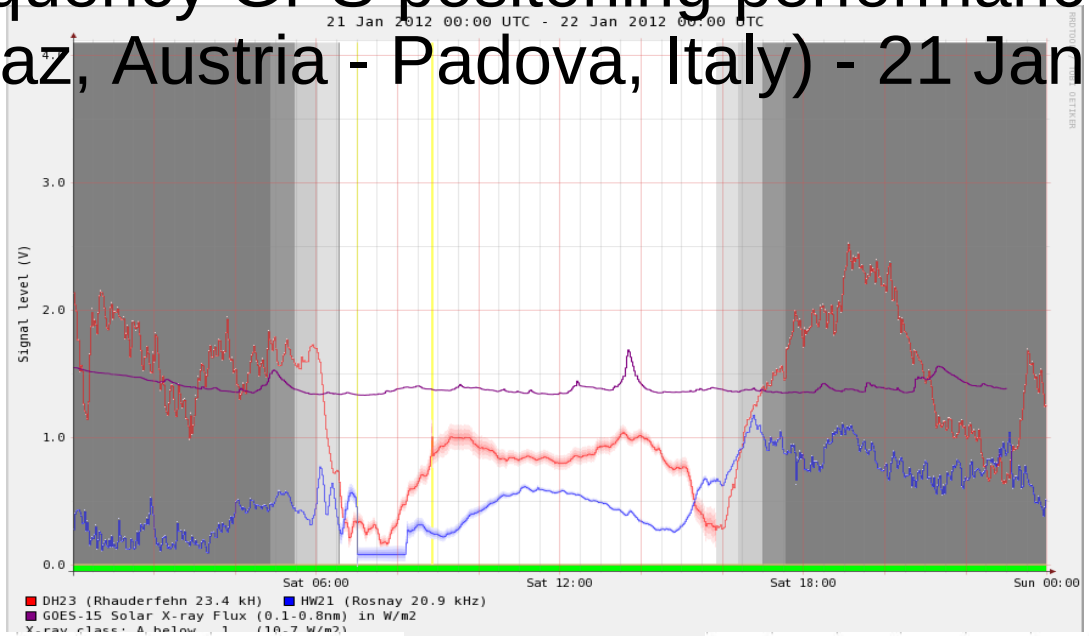
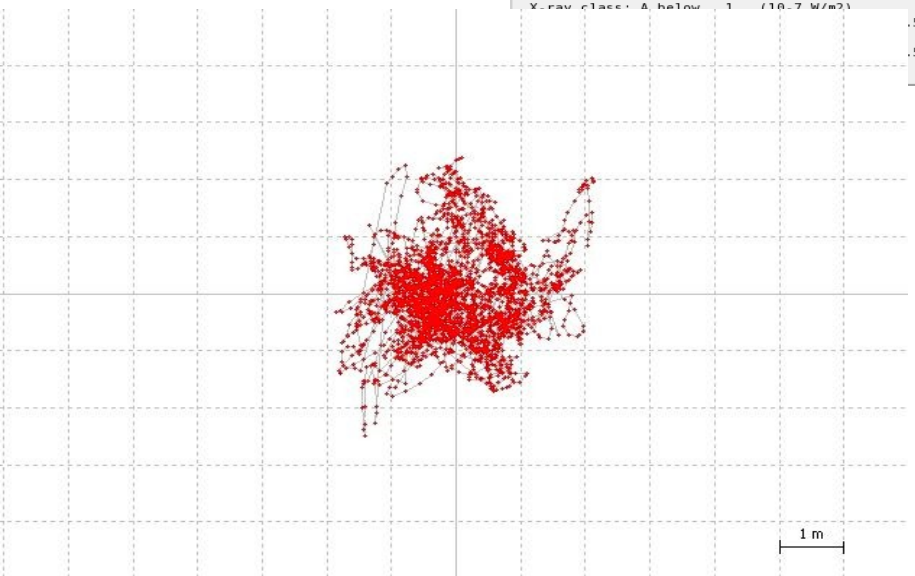
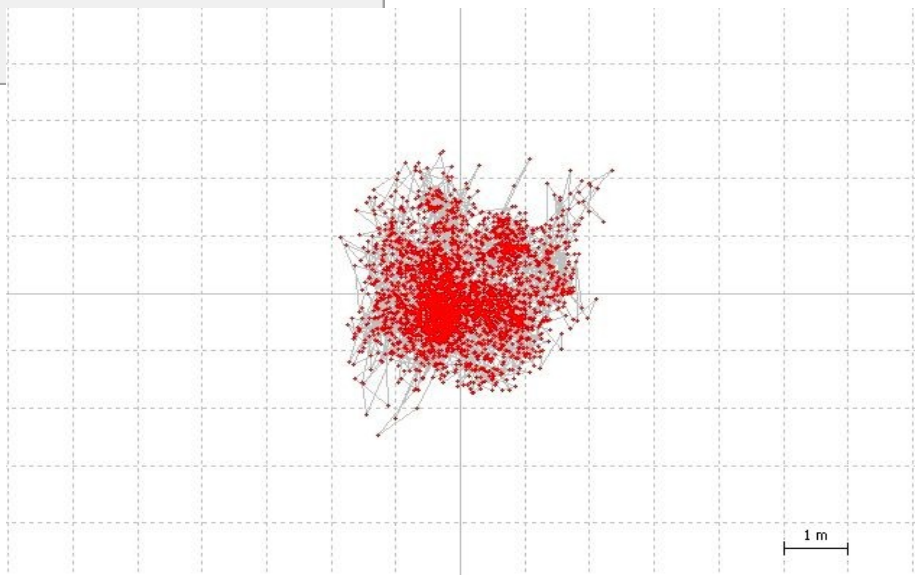
- Single-frequency GPS positoning performance in observed period (Graz, Austria - Padova, Italy) - 21 January 2012







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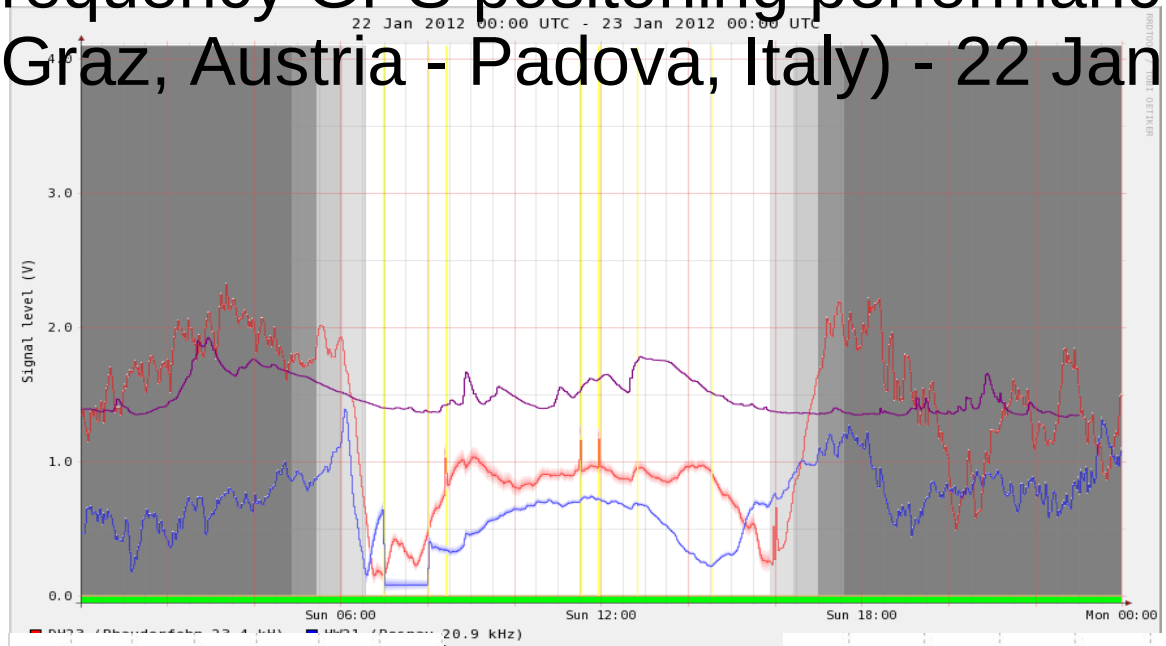
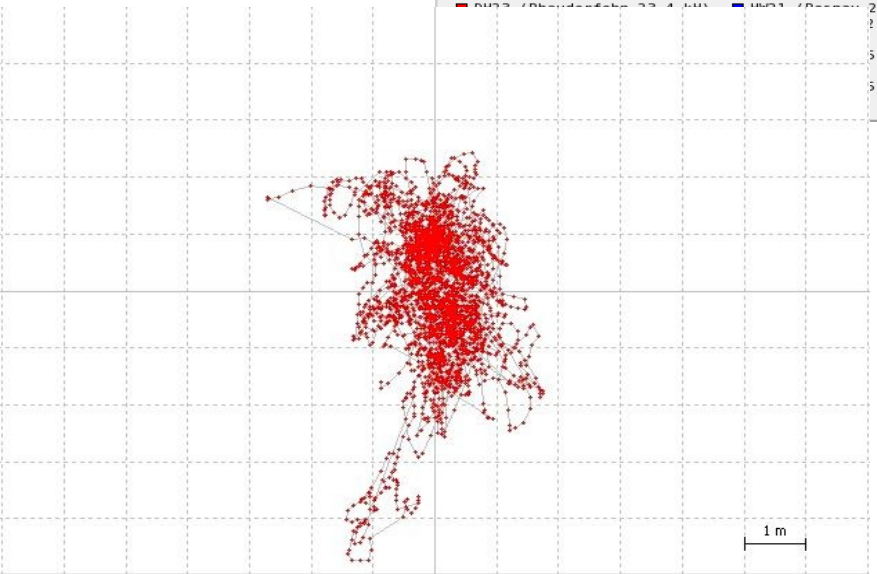
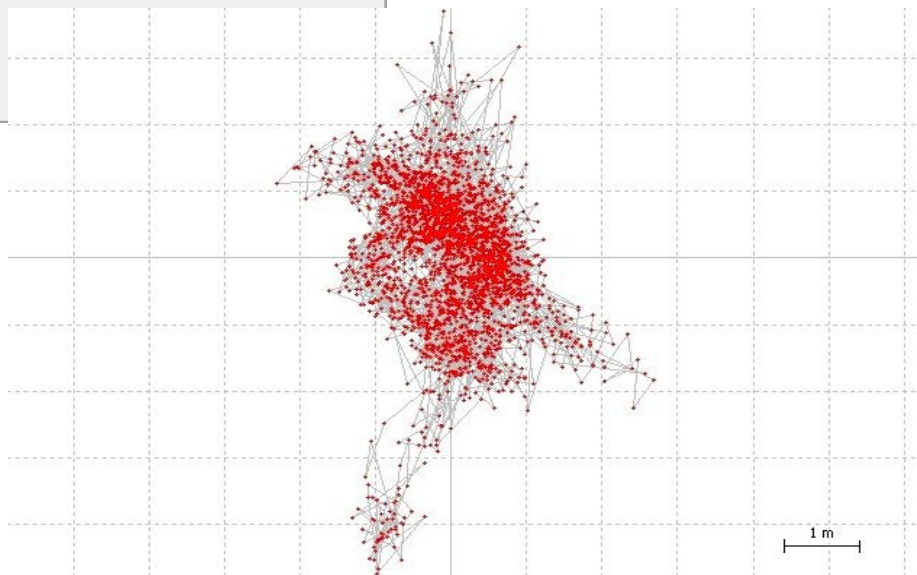
- Single-frequency GPS positoning performance in observed period (Graz, Austria - Padova, Italy) - 22 January 2012







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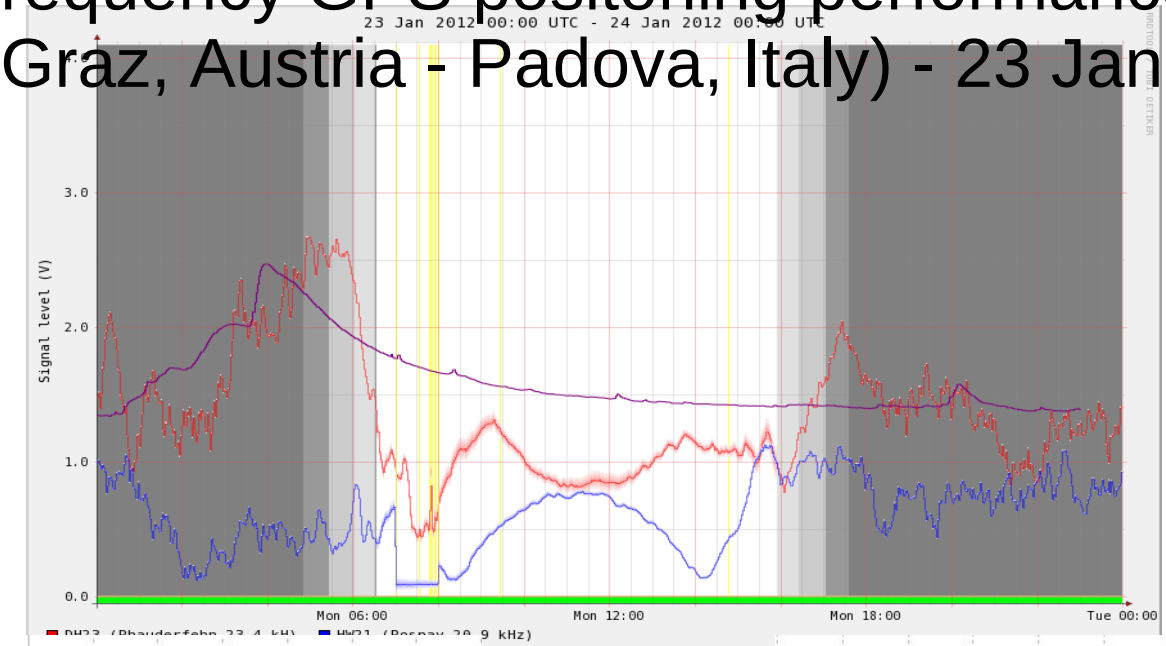
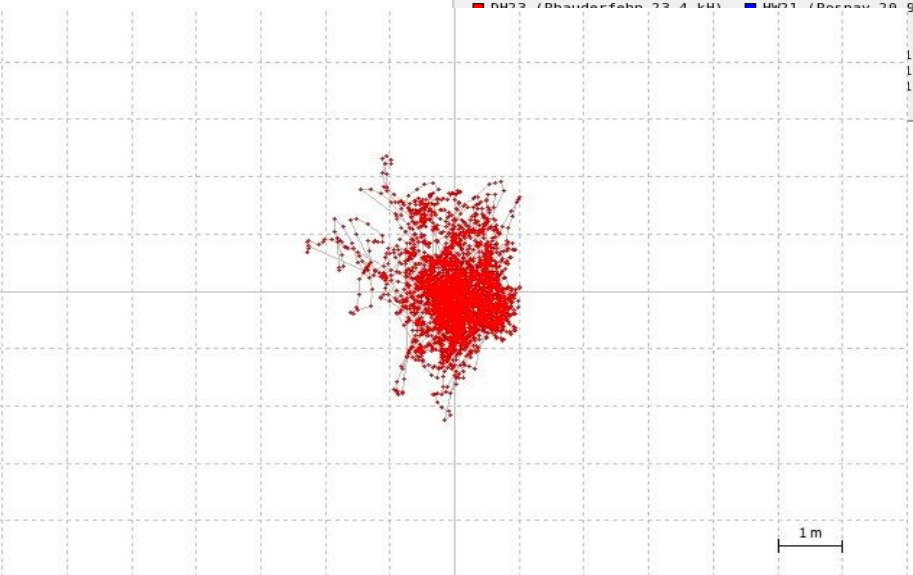
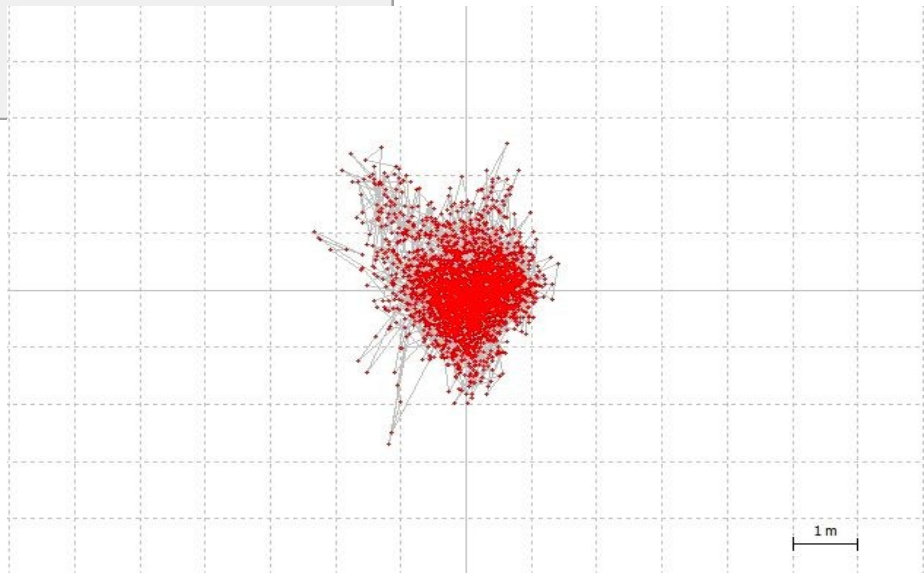
- Single-frequency GPS positoning performance in observed period (Graz, Austria - Padova, Italy) - 23 January 2012







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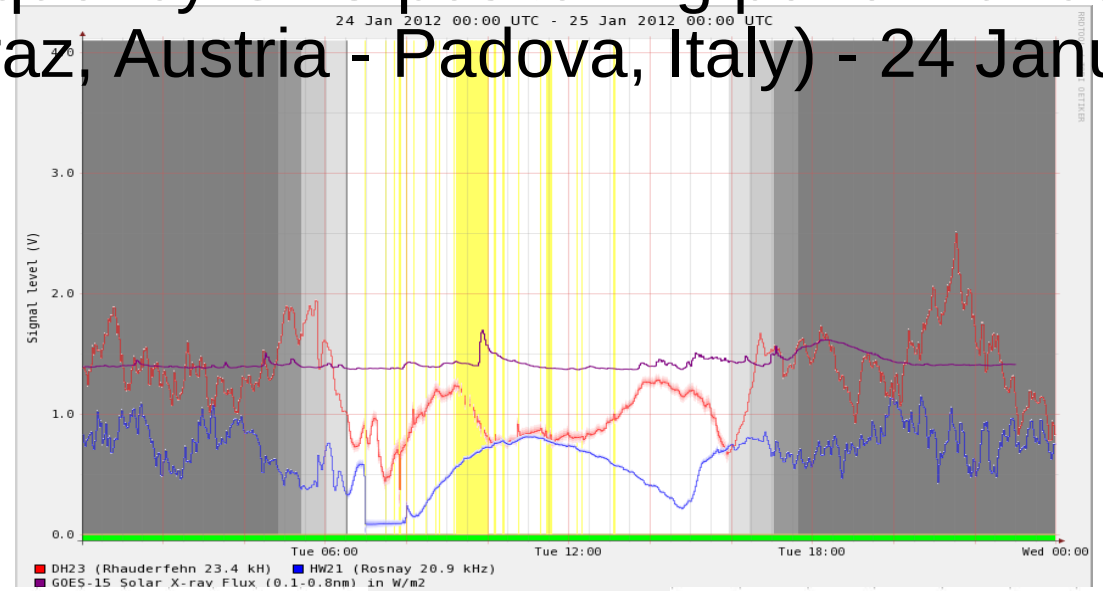
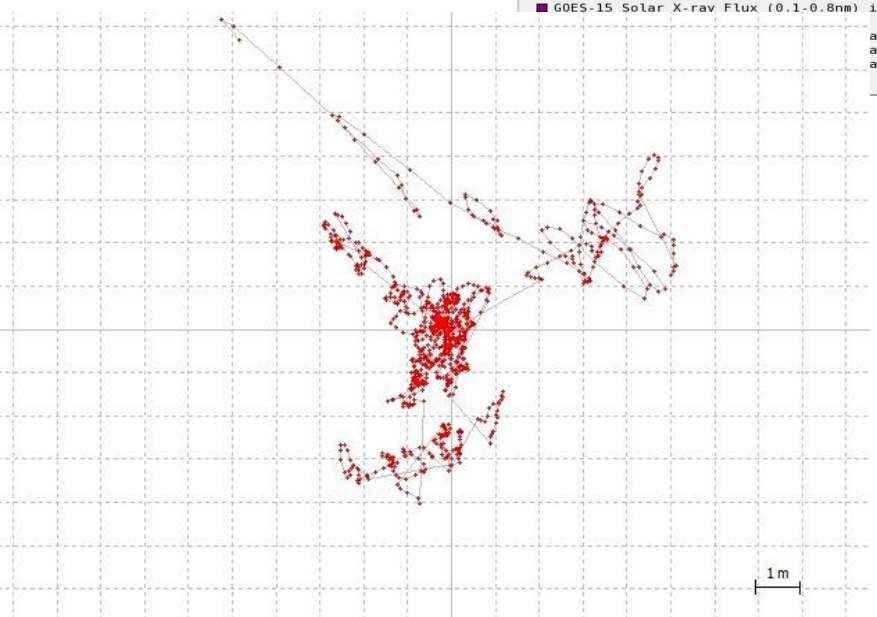
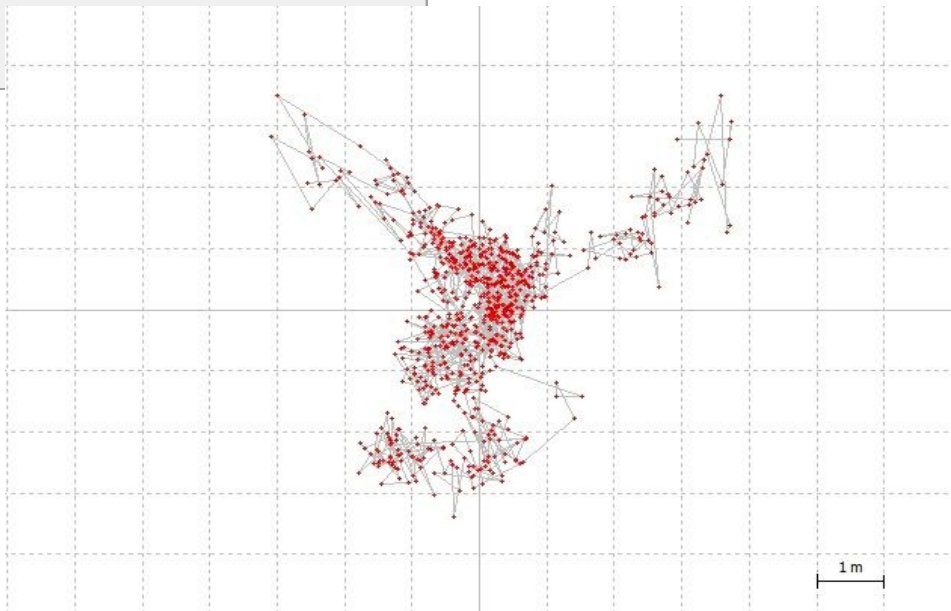
- Single-frequency GPS positoning performance in observed period (Graz, Austria - Padova, Italy) - 24 January 2012







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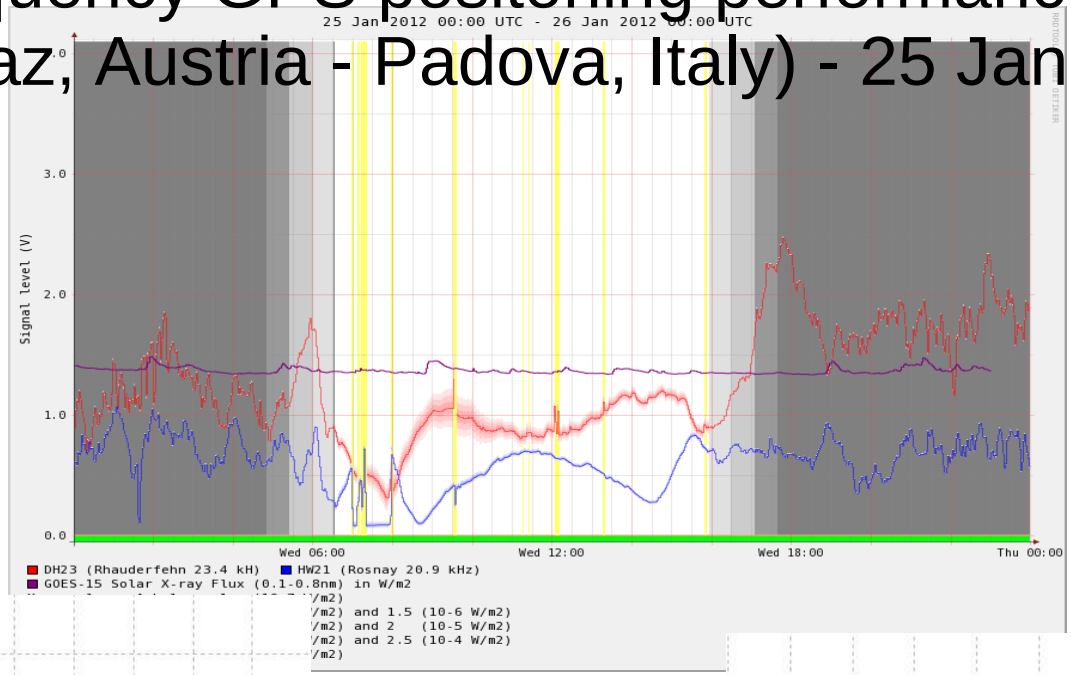
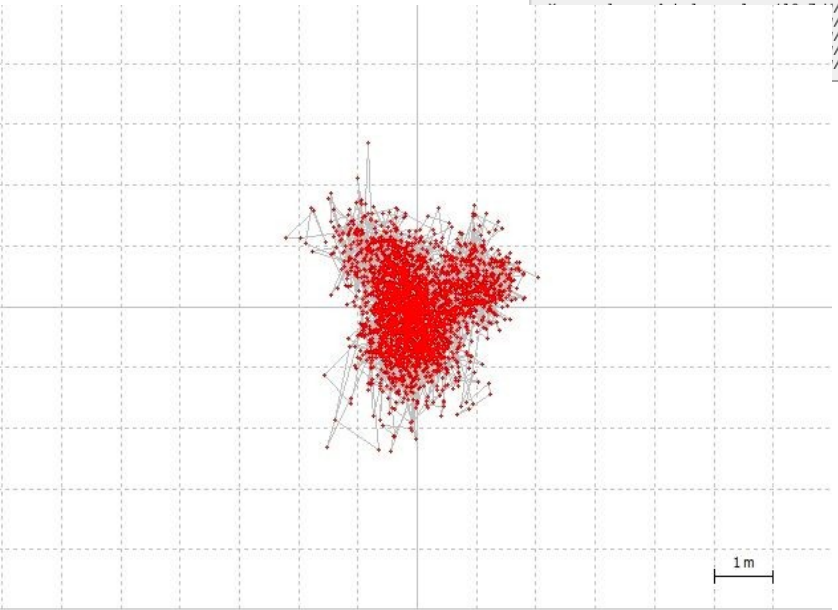
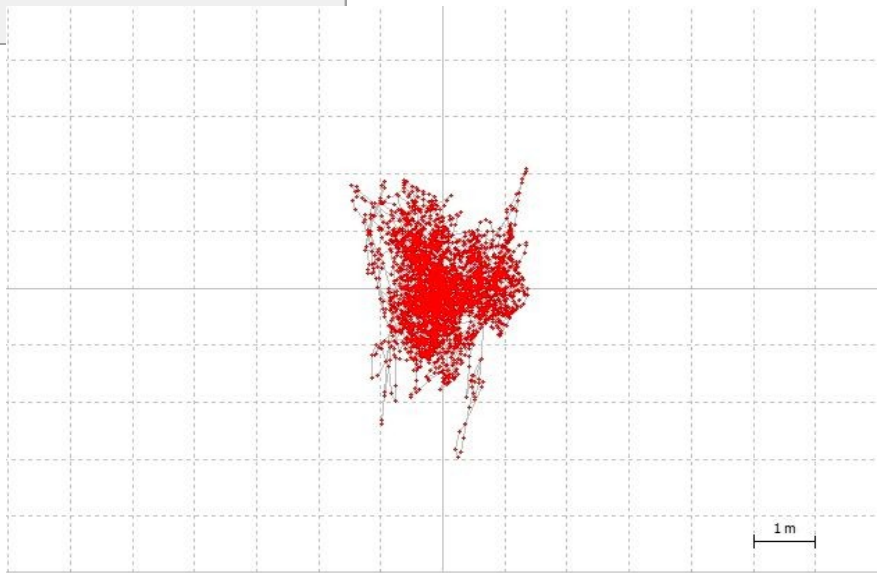
- Single-frequency GPS positoning performance in observed period (Graz, Austria - Padova, Italy) - 25 January 2012







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- Discussion
  - Geomagnetic storm on 22 – 24 Jan 2012 caused increased scattering of estimated positions of a stationary reference GPS receiver
  - GPS positioning effects of the geomagnetic storm in correlation with modifications of SID monitor data waveform
  - Geomagnetic storm caused deep ionospheric effects, affecting lower layers

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- Conclusion
  - Importance of sustained quality of GNSS PNT services
  - Space weather disturbances cause deteriorations of GNSS PNT services
  - Strong geomagnetic storm can cause low-ionosphere effects, correlated with GNSS performance deterioration

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- Reference

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THANK YOU FOR YOUR ATTENTION!

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