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Institute of Geodesy and Photogrammetry

Low-cost and smartphone GNSS: Current capabilities and perspectives for seismic and tropospheric applications

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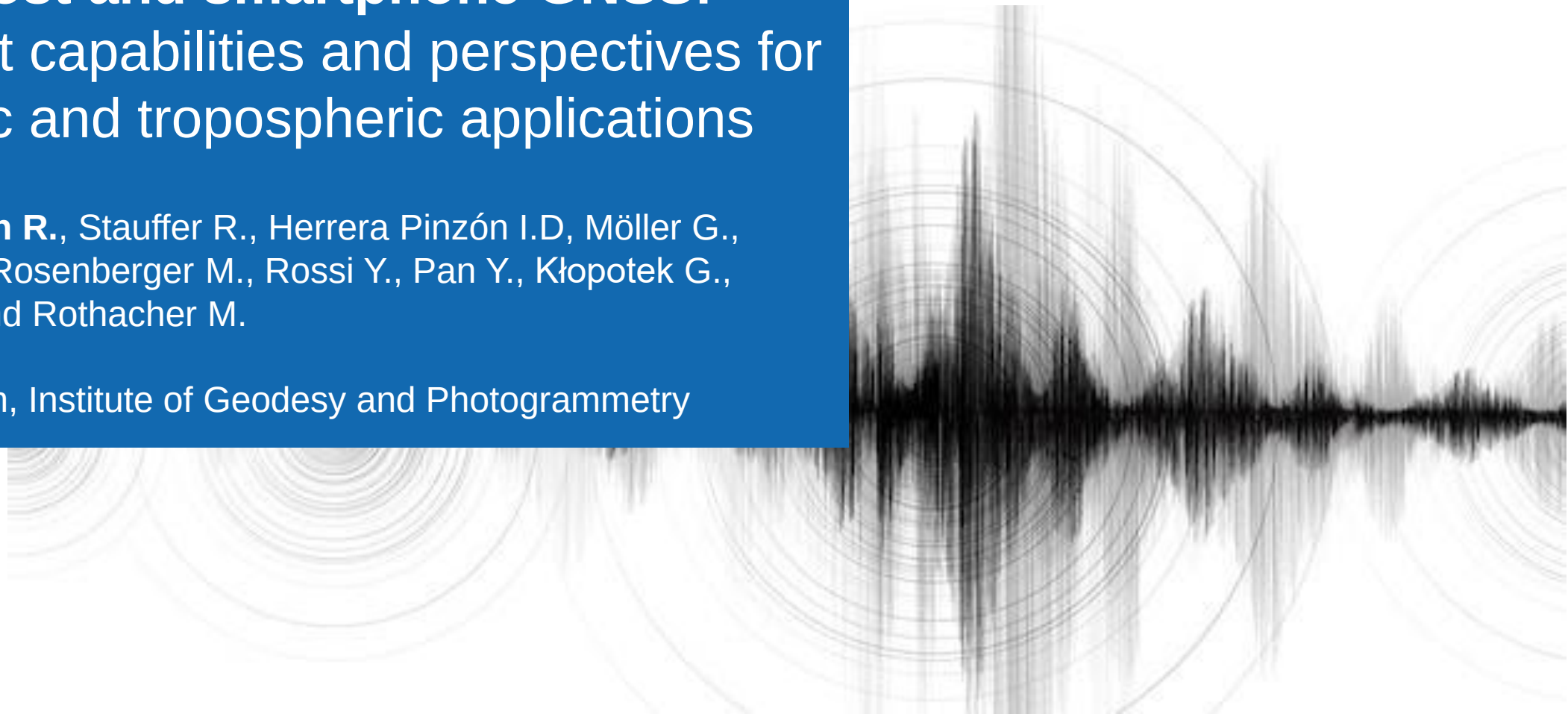


Low-cost, dual-frequency GNSS devices

- Dual-frequency and real-time GNSS became a standard for mass-market applications

~ 100 $

~ 60 $

ublox F9P chip and ANN-MB multi-band antenna

PointPerfect: u-blox correction service provides PPP-RTK

~ 500 $

Google Pixel 4 XL dual-frequency smartphone

~ 300 $

In-house developed ublox F9P logger

~90 $

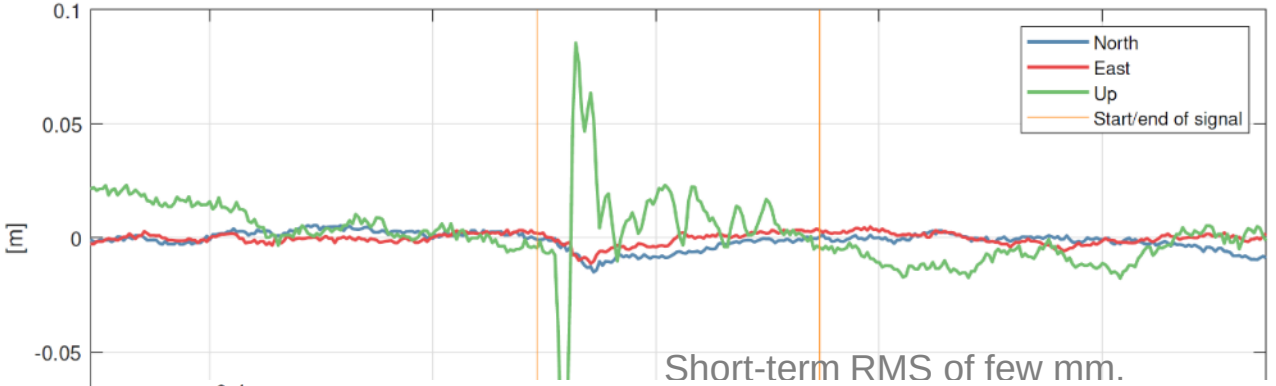
simpleANT2B multiband antenna

What is its value for geomonitoring applications?

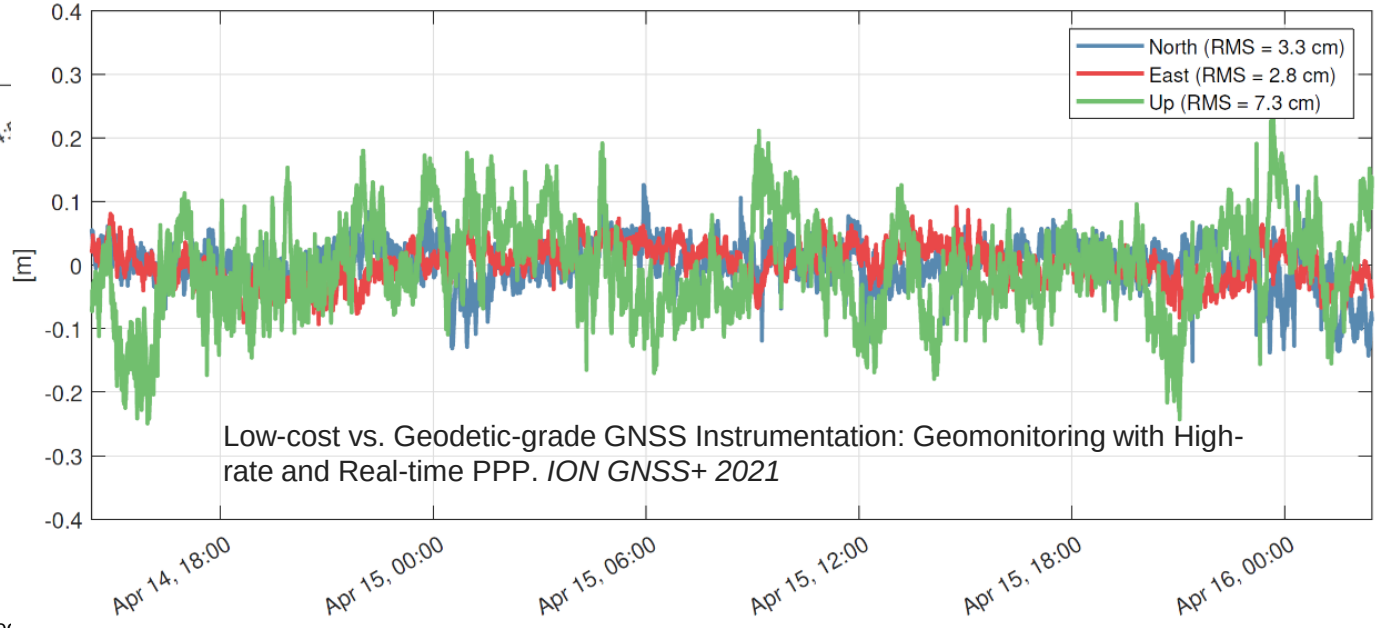
***current prices as found in Switzerland**

Seismic Monitoring with Low-cost Equipment

- GNSS-enabled earthquake-early-warning needs to resolve centimeter-level displacements



Short-term RMS of few mm.



Low-cost vs. Geodetic-grade GNSS Instrumentation: Geomonitoring with High-rate and Real-time PPP. *ION GNSS+ 2021*

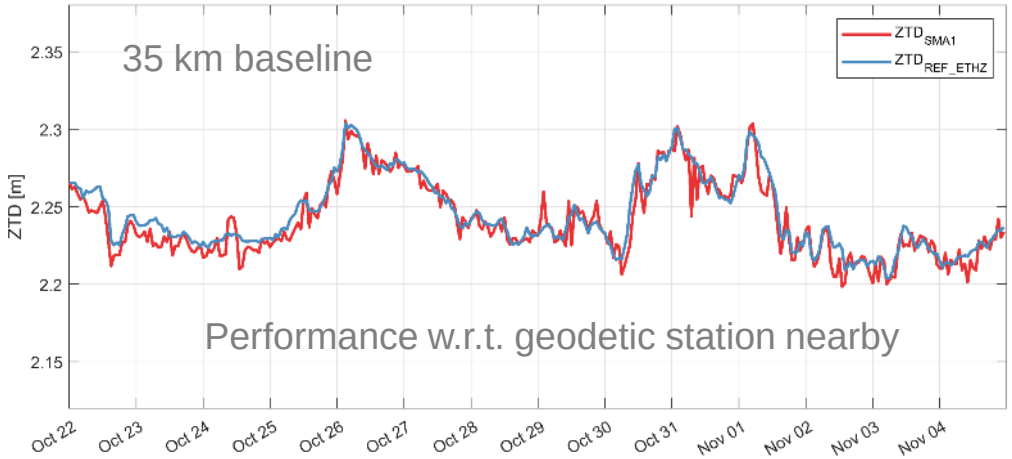
Experiment with robot, Real-time PPP, CNES-demonstrator software

Precision at the few cm-level is possible, even for real-time PPP

Tropospheric Monitoring with Low-cost Equipment

- Densify regional tropospheric observations with smartphone and low-cost GNSS (near real-time)

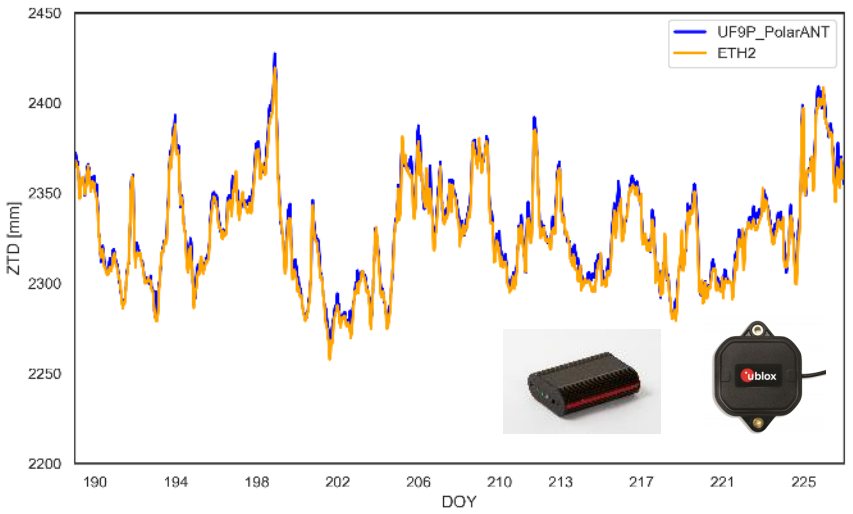
Attach differential ZTD to CORS station ZTD



Red:
Smartphone ZTD

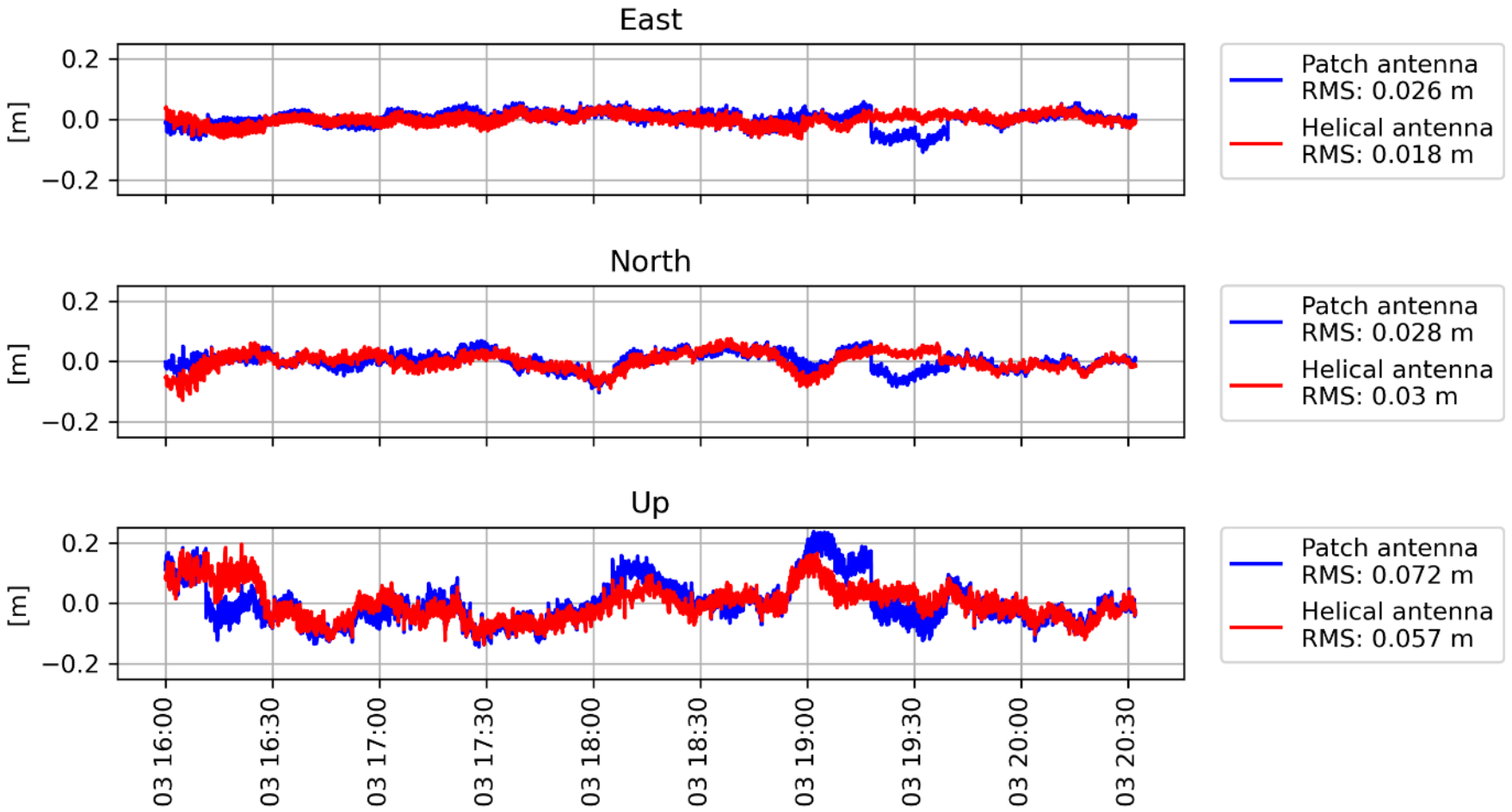
Blue:
Reference ZTD

Zenith total delays (ZTDs) obtained for our autonomous low-cost GNSS stations



Commercial-of-the-shelf PPP-RTK with Ambiguity Resolution

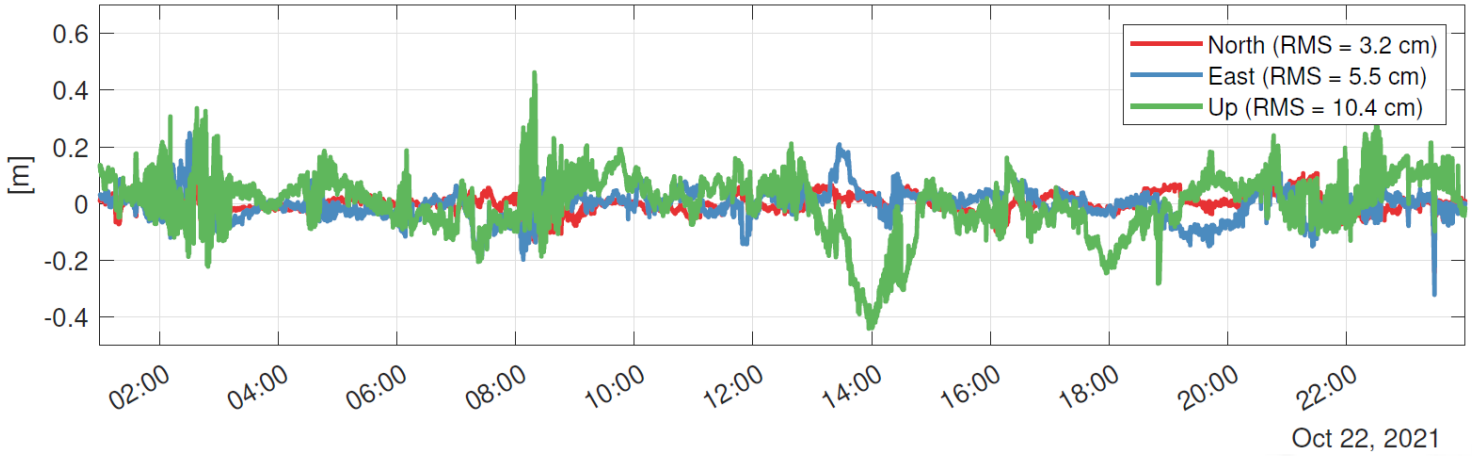
- “PointPerfect” -- u-blox recently launched an PPP-RTK correction service



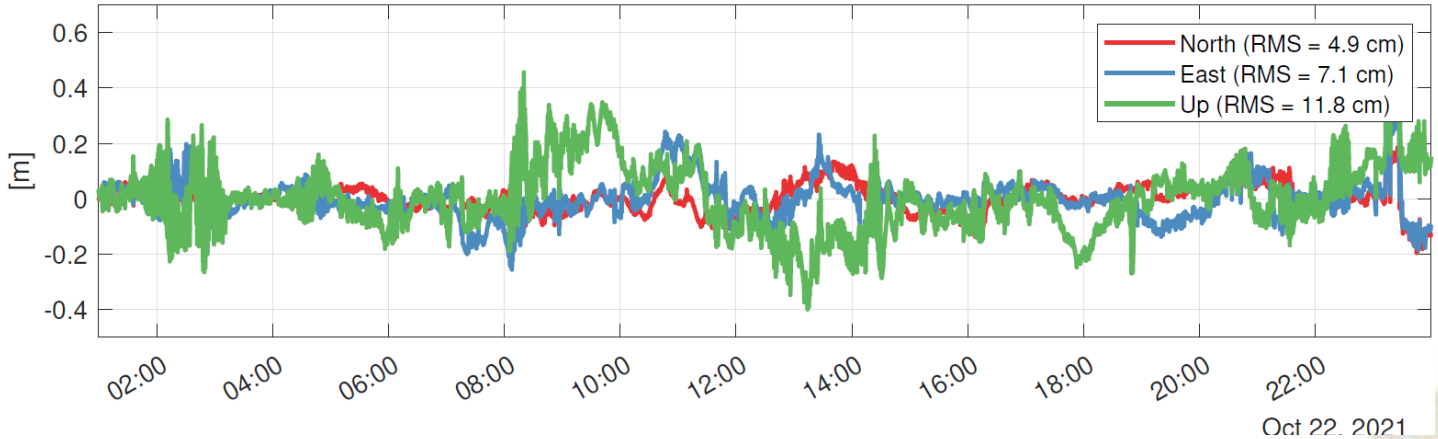
Smartphones for Dynamic Monitoring Applications

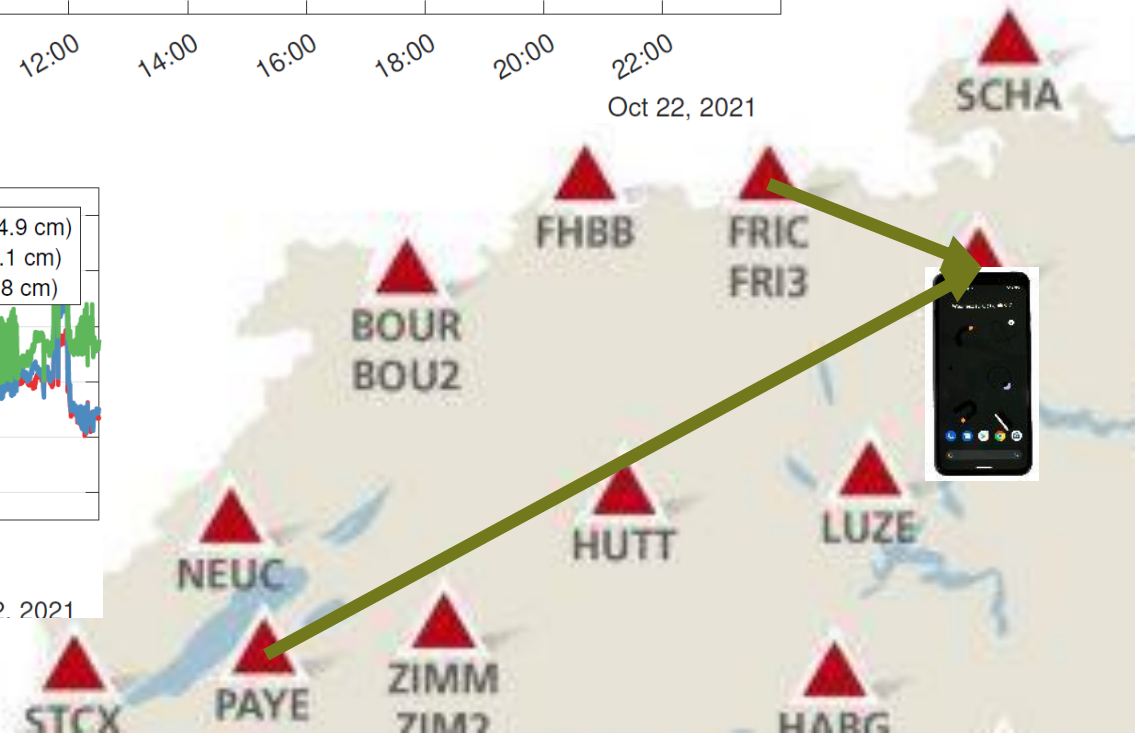
- Assessing kinematic smartphone solutions for different baseline lengths (L1, GPS, ambiguity-fixed)

35 km baseline (top plot)



140 km baseline (bottom plot)





Conclusion and Outlook

- Low-cost GNSS enables cm-level geomonitoring
- Antennas play a crucial role
- Low-cost GNSS as “signals-of-opportunity” for geomonitoring → crowdsourcing potential
- Antenna calibrations and multi-sensor fusion will become even more important
- Machine learning methods enable detection of smallest signals in noise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Recent advances and perspectives for positioning and applications with smartphone GNSS observations

Jacek Paziewski[1]

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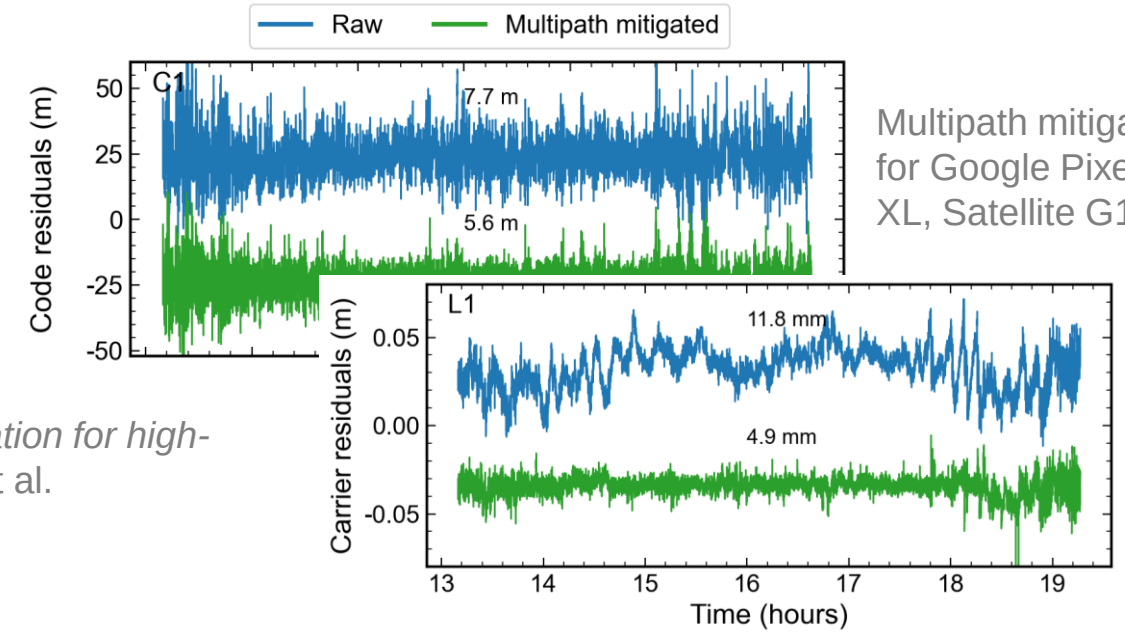
Measure

Citation

Open Access Article

A Field Calibration Solution to Achieve High-Grade-Level Performance for Low-Cost Dual-Frequency GNSS Receiver and Antennas

by Andreas Krietemeyer [1,2,*], Hans van der Marel [1], Nick van de Giesen [1] and Marie-Claire ten Veldhuis [1]



Multipath mitigation for Google Pixel 4 XL, Satellite G13

Machine learning based multipath mitigation for high-precision GNSS data processing, Pan et al.
Fr., May 27, 8:57 a.m., Room -2.16