

Machine learning based multipath mitigation for high-precision GNSS data processing

Yuanxin Pan, Gregor Moeller, Roland Hohensinn, Benedikt Soja

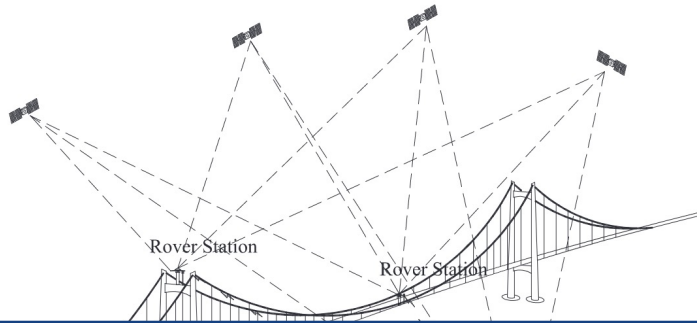
Institute of Geodesy and Photogrammetry, ETH Zürich

EGU 2022

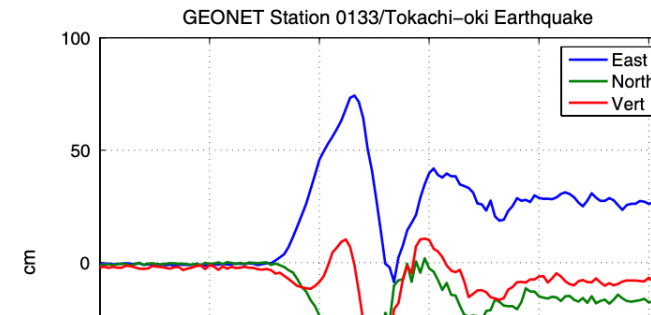
Background

□ GNSS is actively used in many fields:

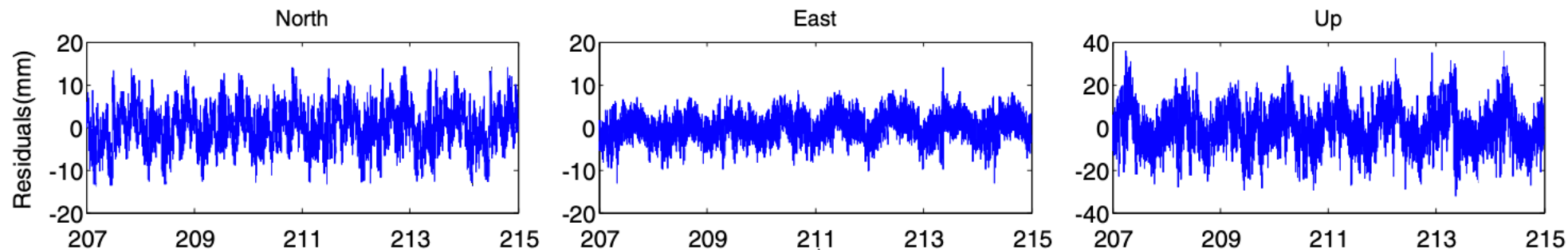
- Structure Health Monitoring



- Seismology



Multipath (MP) is the main unmodelled error source hindering high-precision GNSS positioning

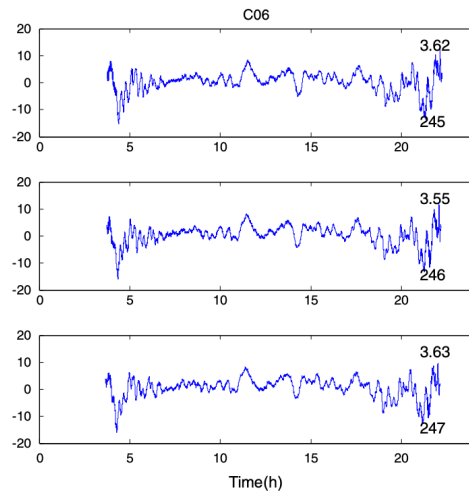


(Ye et al., 2015)

Background

❑ Classic multipath mitigation methods:

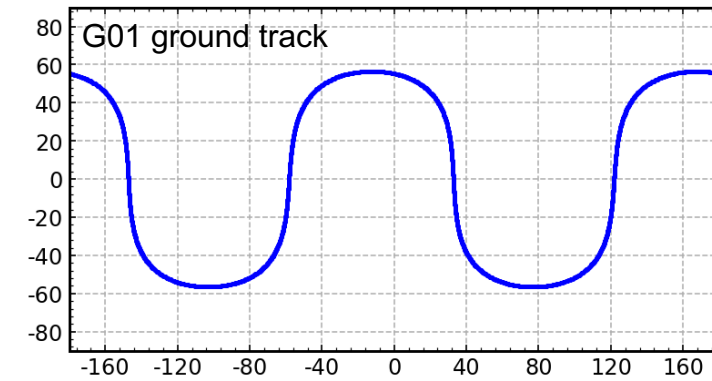
1. Sidereal filtering (SF)



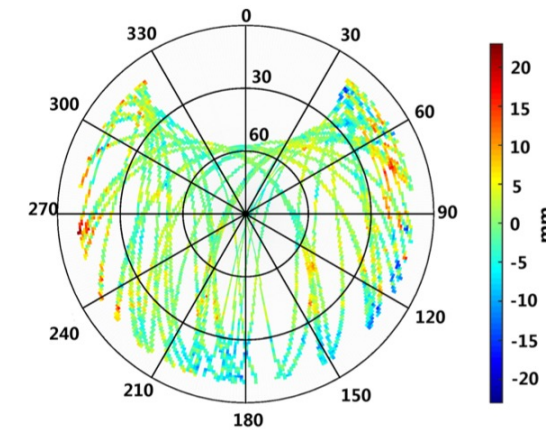
(Ye et al., 2015)

Look up MP corrections in time domain

- **Advantage:** good MP mitigation effect
- **Drawback:** cumbersome to implement



2. Multipath Hemispherical Map (MHM)



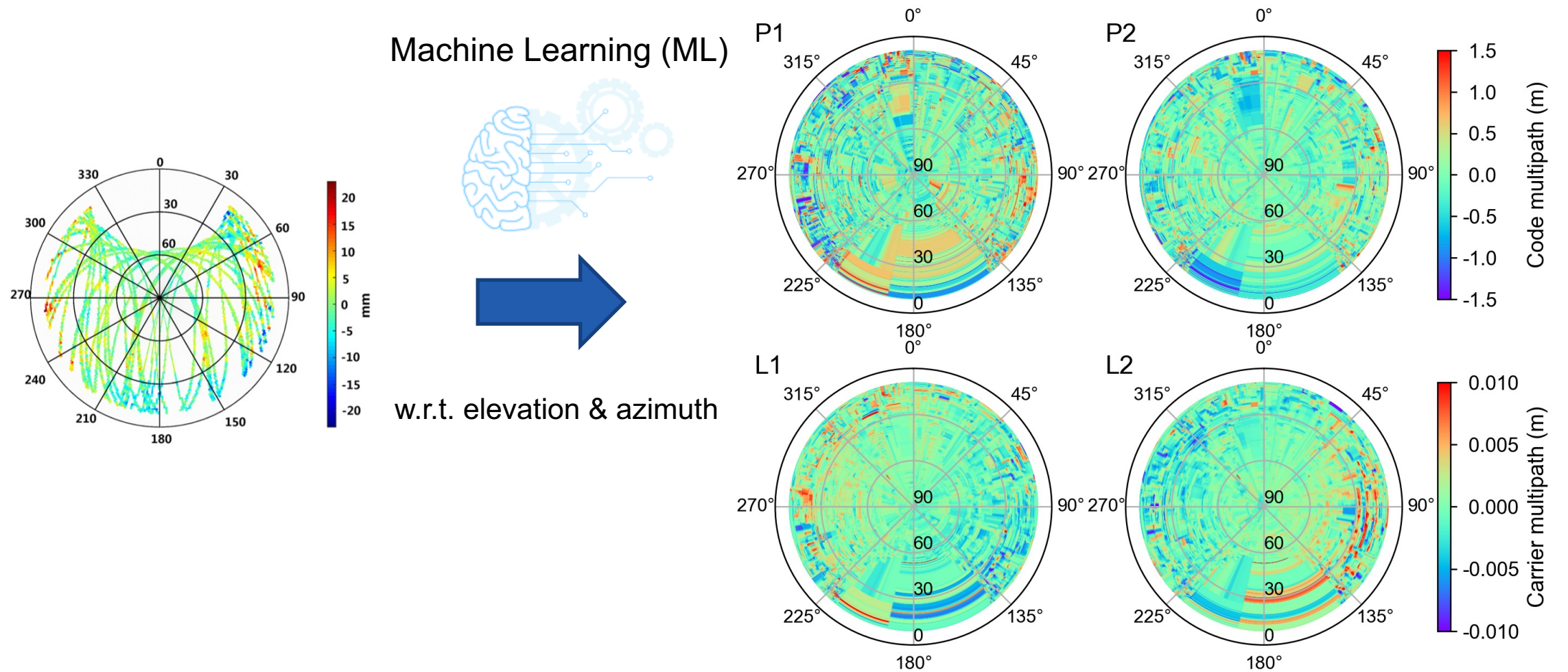
(Dong et al., 2016)

Look up MP corrections in coordinate domain

- **Advantage:** easy to implement
- **Drawback:** not effective for high-frequency MP

Method

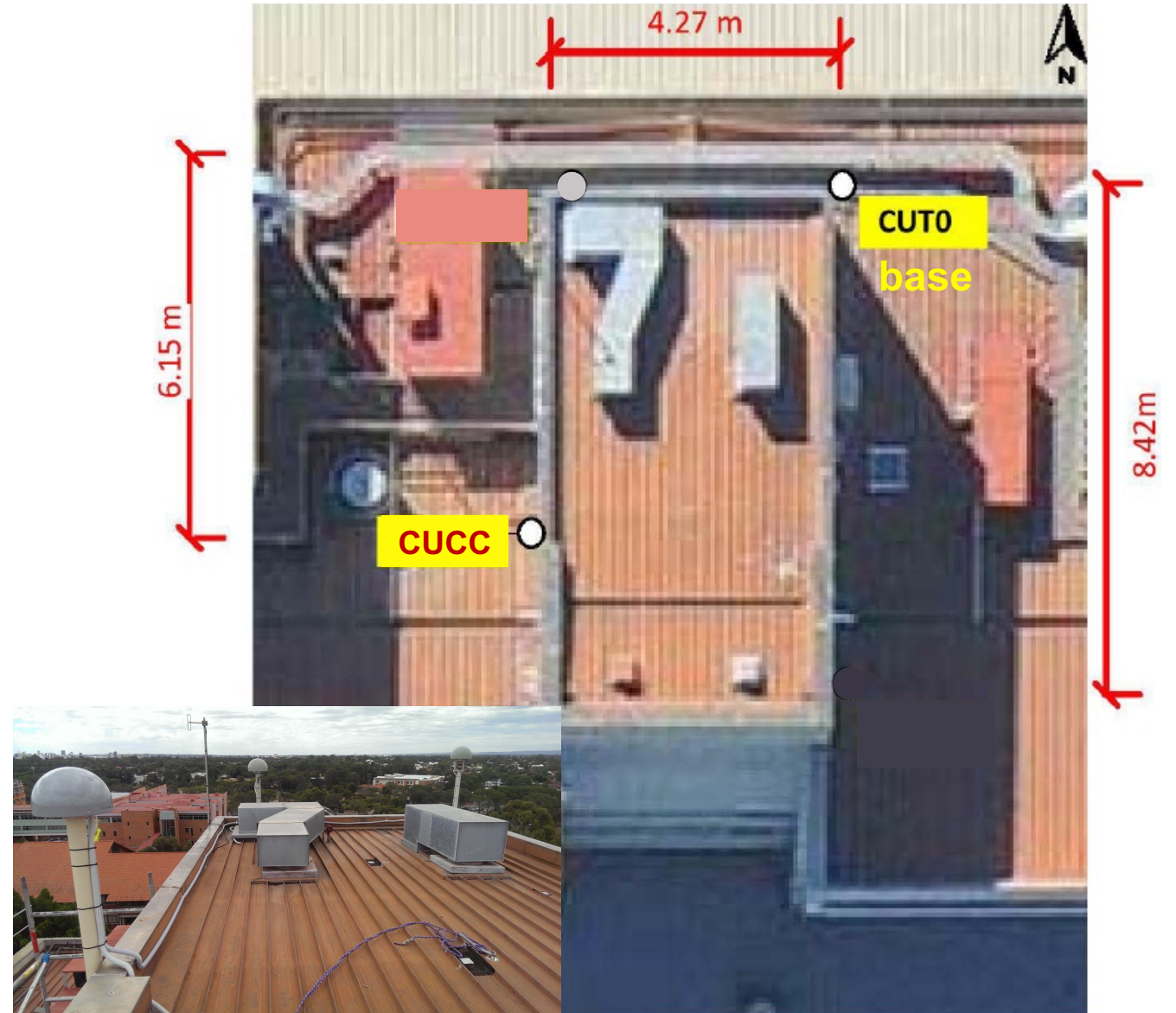
❑ ML-based spatial interpolation



Data

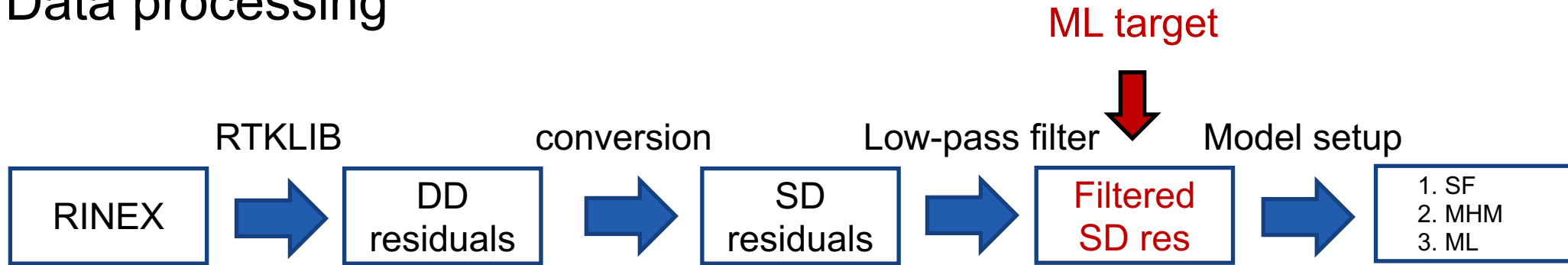
❑ Short baseline from Curtin University

1. 2021 244-273 (30 days)
2. 1 Hz sample rate
3. GPS dual-frequency

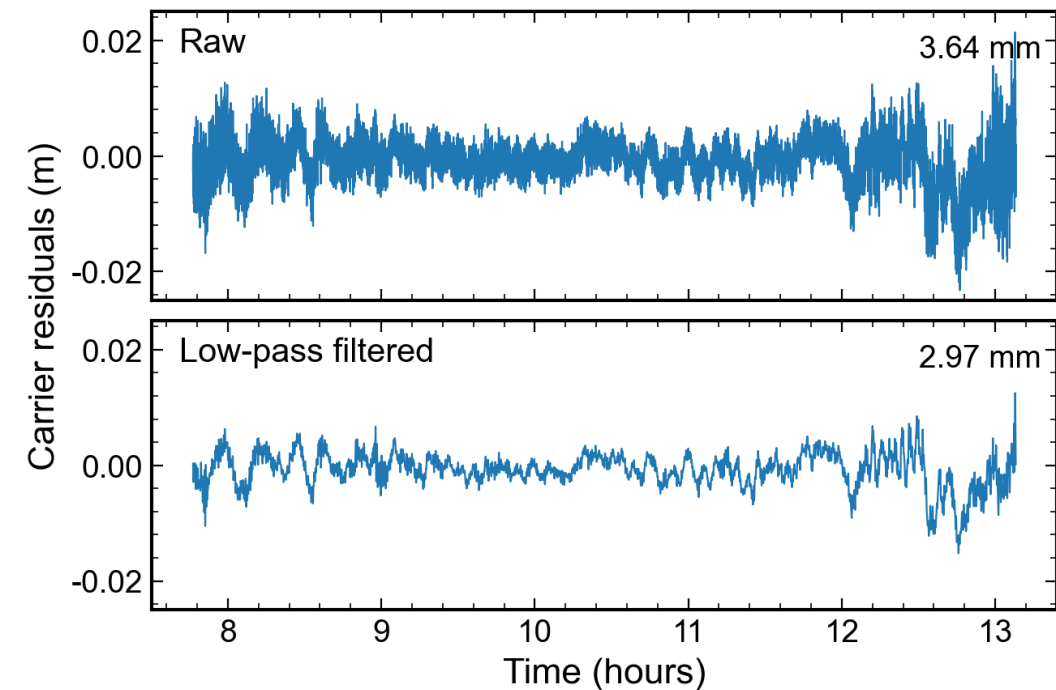


(All photo copyrights are reserved by Curtin GNSS-SPAN Group)

Data processing

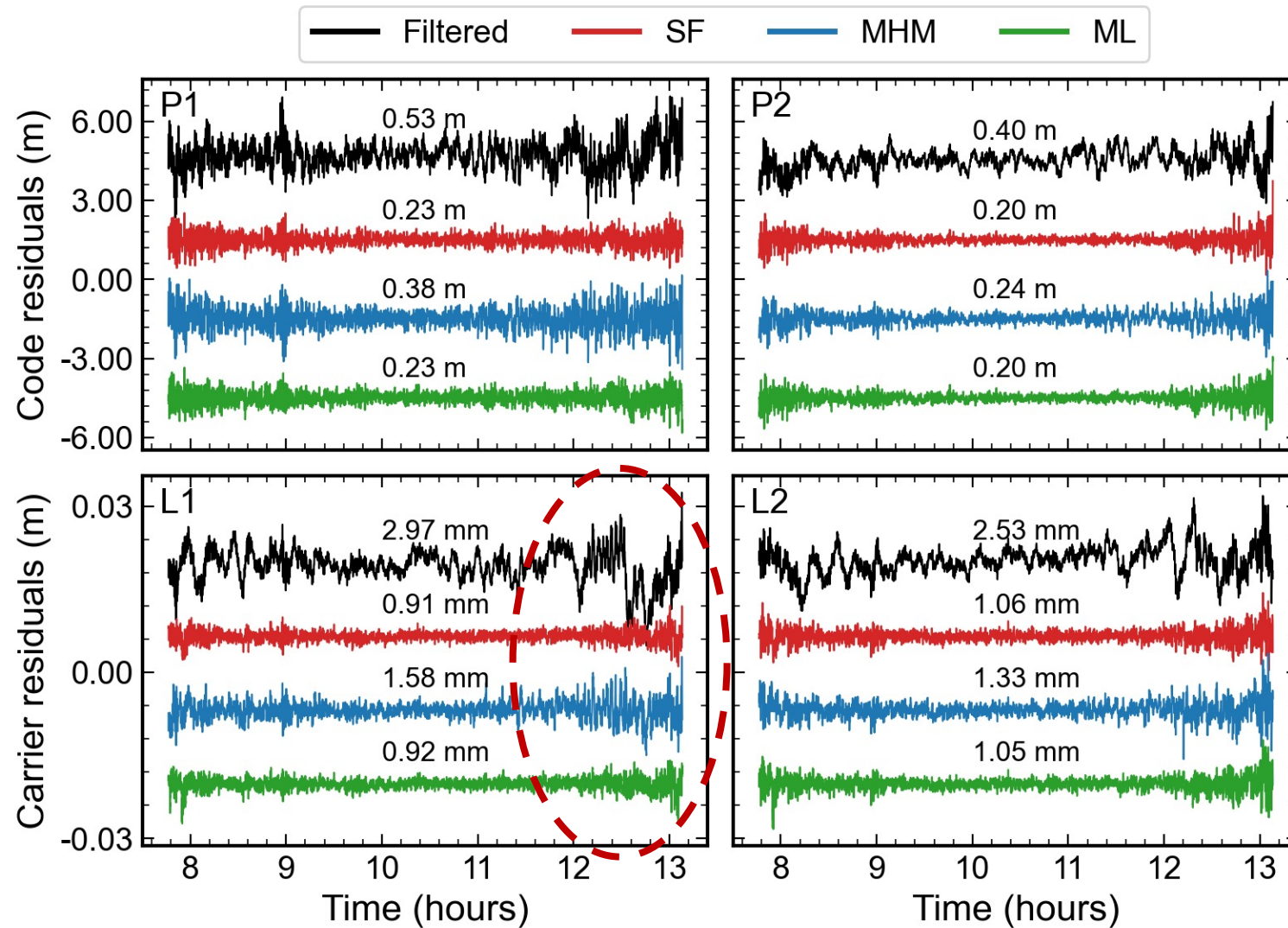


1. 5 days' residuals before the target day are used for MP modelling (Dong et al., 2016)
2. P1, P2, L1 and L2 MPs are all modelled
3. Residual reduction & positioning are compared among SF, MHM and ML methods



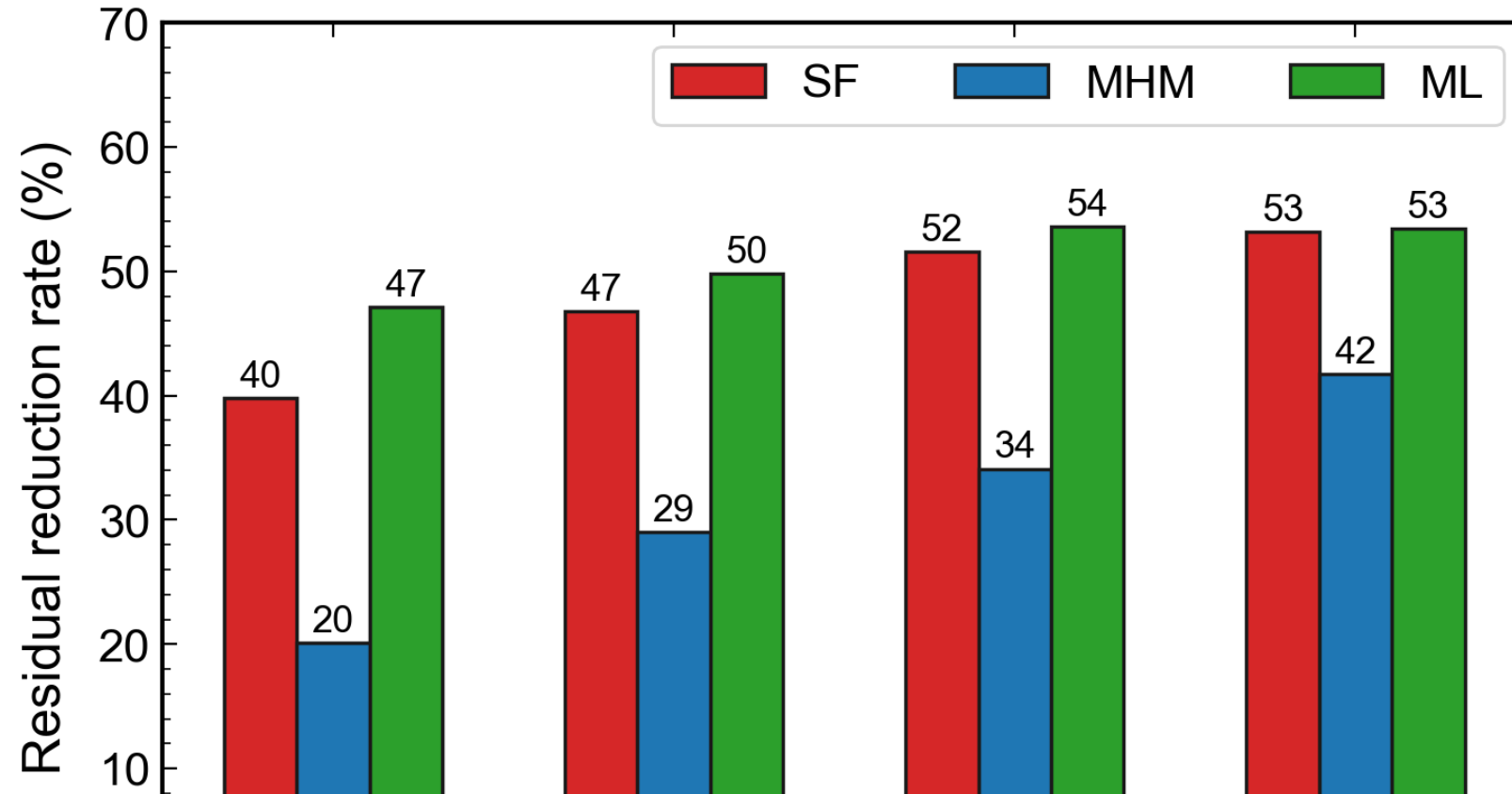
Multipath mitigation

Residuals of satellite G23 on DOY 273 (CUCC)



Multipath mitigation

Residual reduction rate over all days



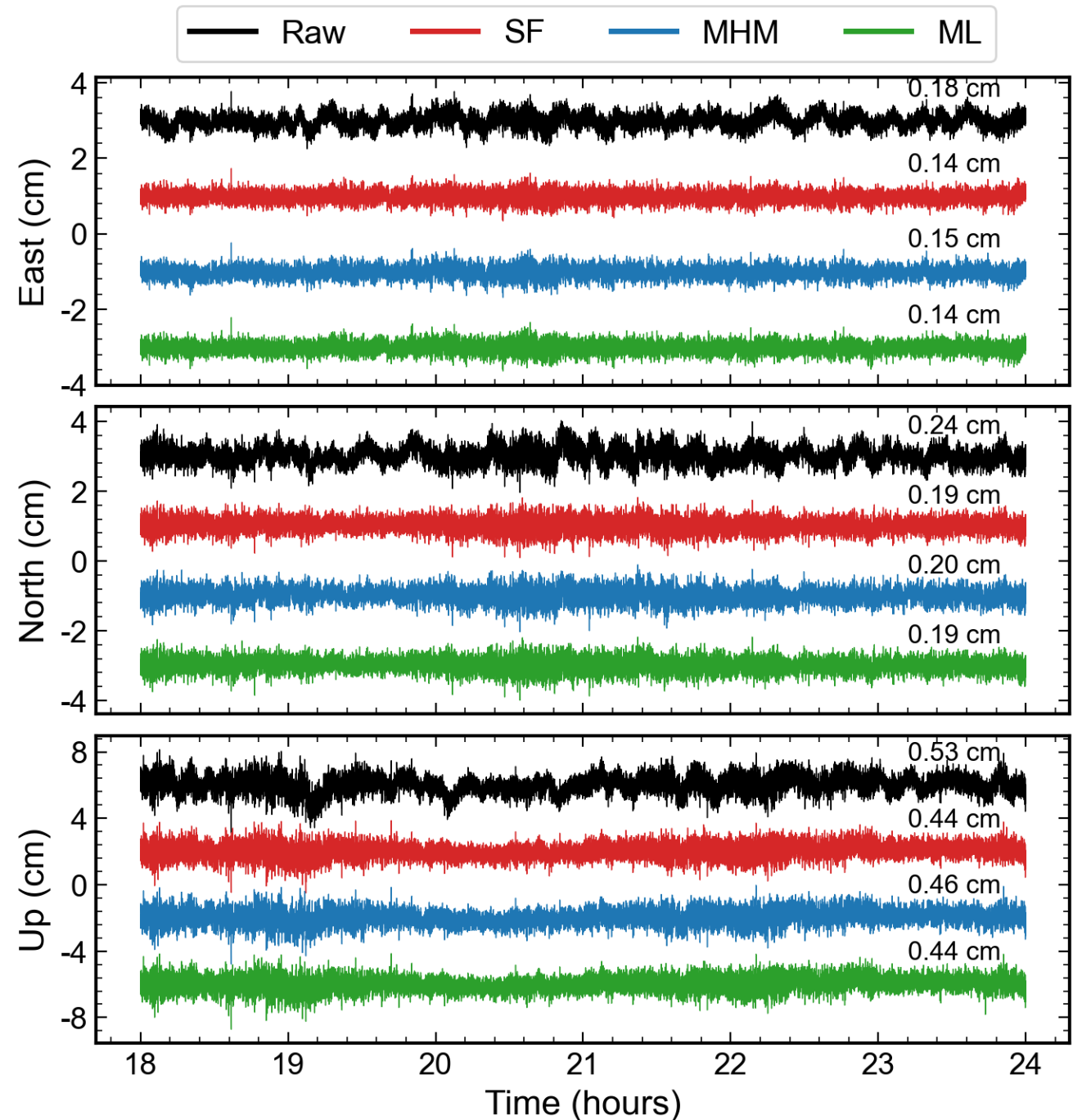
ML method performs best regarding residual reduction.

Positioning test

❑ 6h positioning results of CUCC on DOY 273

(MP models are applied to data processing)

1. MP induced errors are effectively mitigated with ML-based method
2. Positioning precision improves ~20%



Conclusion

1. We proposed a ML-based spatial interpolation method for MP mitigation
2. It can achieve ~50% residual reduction rate for all observables
3. It can effectively mitigate the MP errors in positioning results with an improvement of ~20%

Yuanxin Pan
PhD student
yxpan@ethz.ch

ETH Zürich
Institute of Geodesy and Photogrammetry
Robert-Gnehm-Weg 15
8093 Zurich

www.space.igp.ethz.ch

QR code for our EGU22 abstract

