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Low-cost GNSS for InSAR Atmospheric Correction: Assessing Zenith Tropospheric Delay Accuracy

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- Solution: GNSS provides continuous Zenith Tropospheric Delay (ZTD).
- Method: By interpolating ZTD from a GNSS network, we can correct InSAR images.
- The Barrier: Geodetic-grade GNSS stations cost \$10k-20k+ each.
- Consequence: Sparse networks → poor interpolation → residual errors.



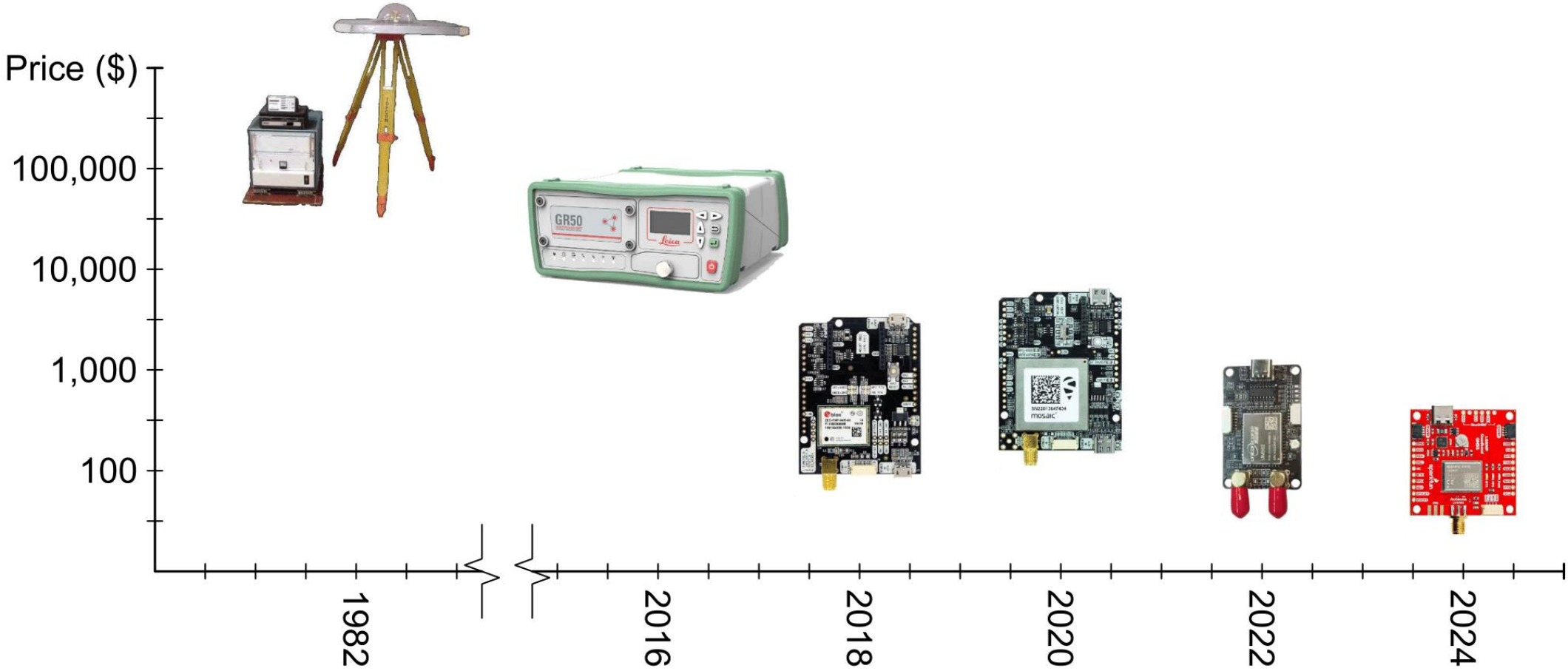
Problem statement



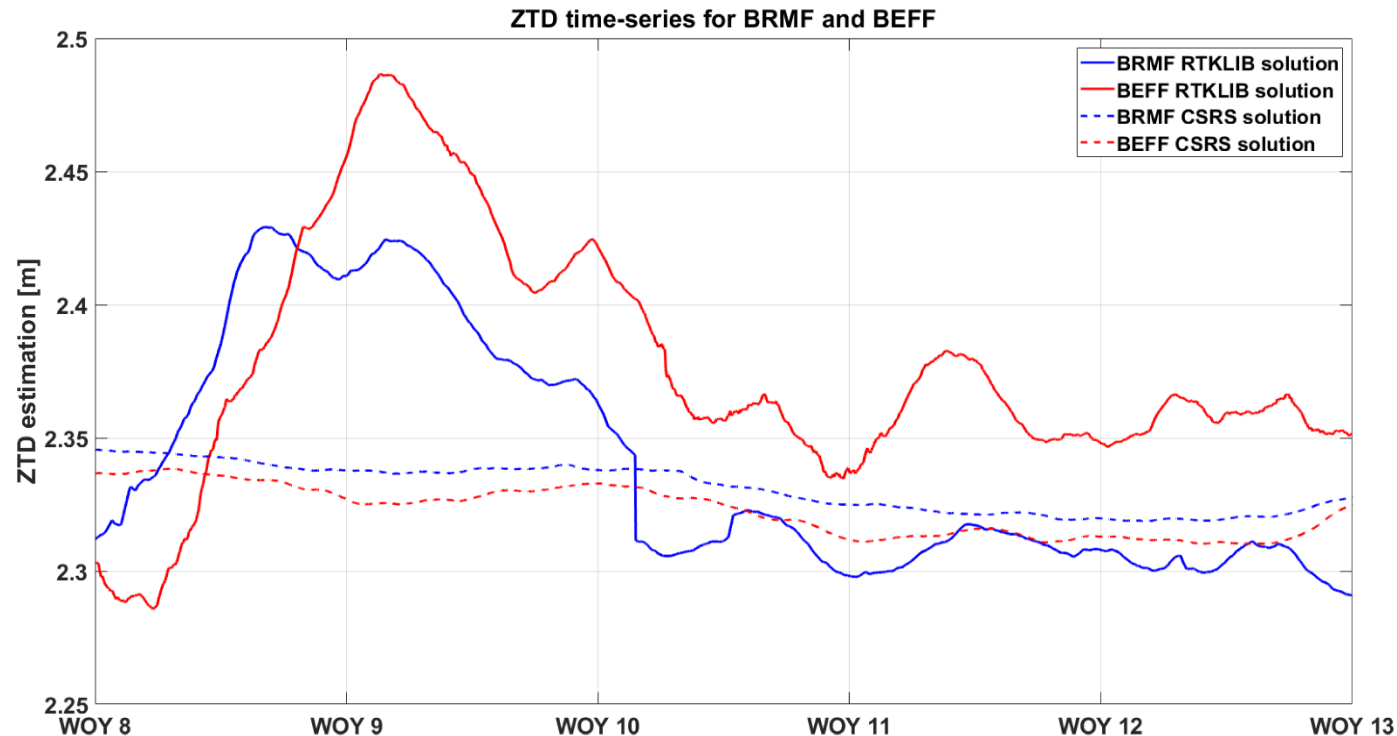
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Dabove and Bagheri (2024) demonstrated that low-cost GNSS networks can estimate ZTD to within a few centimeters, achieving accuracy comparable to that of geodetic-grade infrastructure.



Materials and methods



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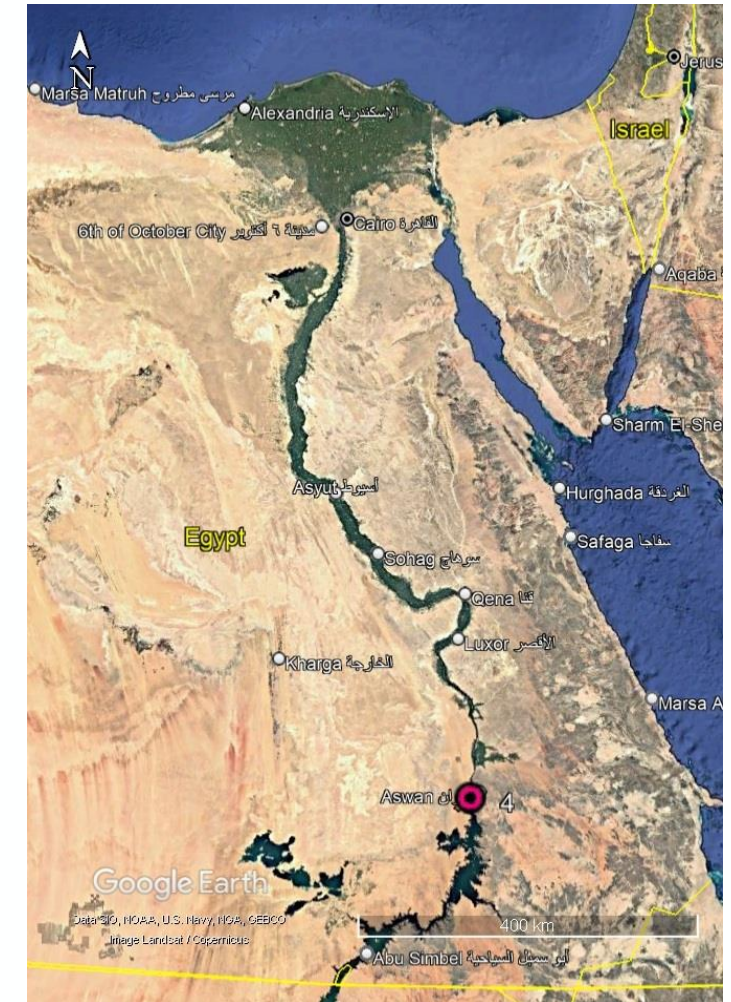


Three low-cost CORS stations from the Centipede-RTK network, in addition to a station in Aswan city, were utilized in this study.

Duration: 3 consecutive days.

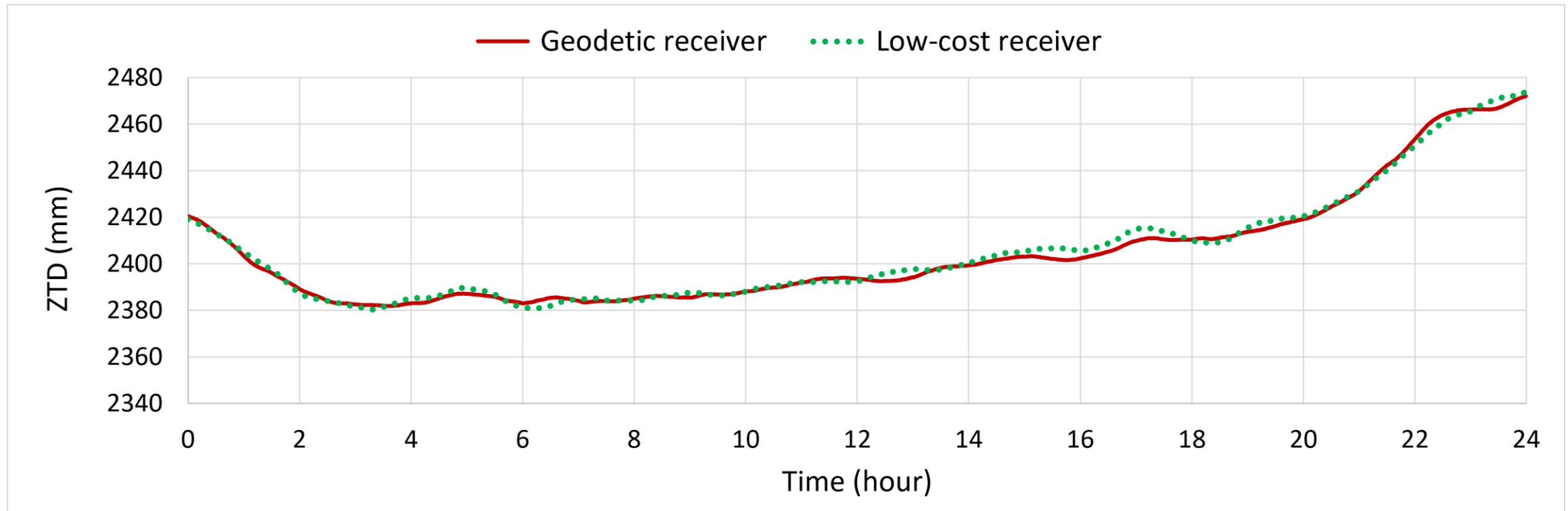
Session length: 24 hours.

Sampling: 30 seconds.

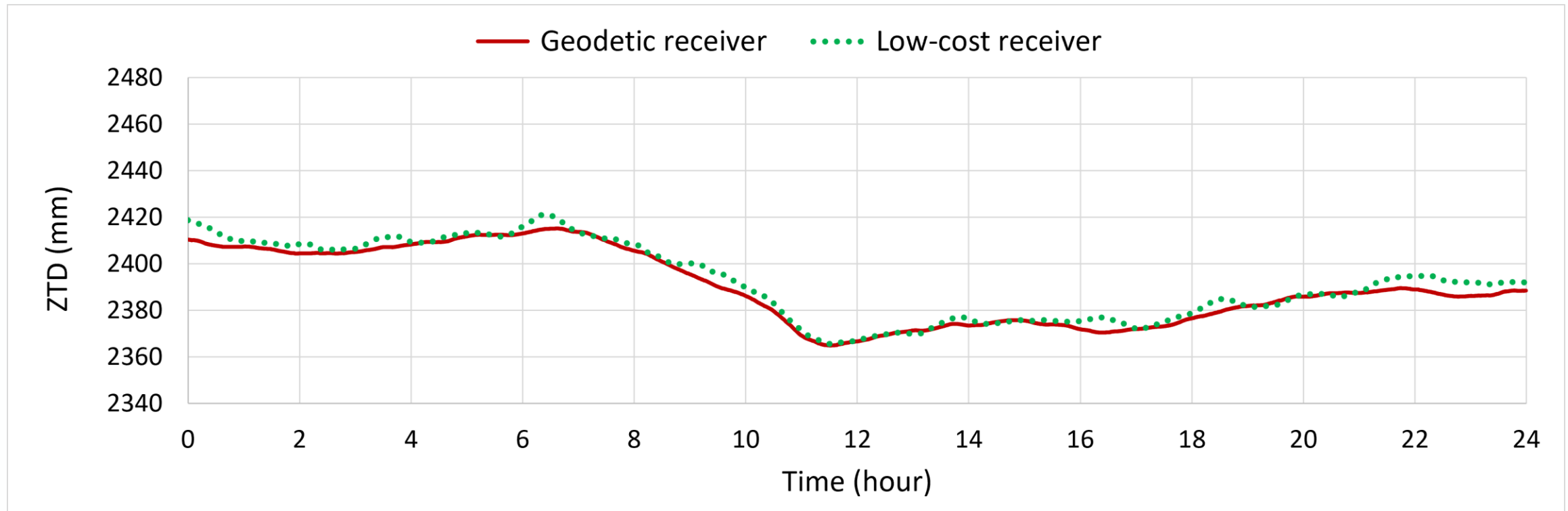


A photograph showing two surveying tripods set up on a sandy, open field. Each tripod is equipped with a GNSS receiver mounted on top. The tripod on the left has a white receiver, while the one on the right has a yellow receiver. Both tripods are white with red and black components. In the background, there is a large, multi-story white building with many arched windows and a central tower-like structure. The sky is clear and blue.

Station	Day 1	Day 2	Day 3	Fixed Solution
1 (A96500FRA - BRST)	3	2	3	70%
2 (B04300FRA - DUNQ)	3	3	3	94%
3 (B34900FRA - TLSG)	8	9	9	89%
4 (ASWN)	3	5	5	86%



Comparison of the ZTD estimated by the geodetic receiver and the low-cost receiver at station 1.



Comparison of the ZTD estimated by the geodetic receiver and the low-cost receiver at station 2.





- The low-cost GNSS receivers successfully achieved fixed ambiguity solutions for a substantial portion of the observation period.
- When compared with geodetic-grade reference systems, the Zenith Tropospheric Delay (ZTD) values obtained from the low-cost receivers agreed closely, with root mean square errors ranging from 2 to 9 mm.
- Integrating low-cost GNSS into InSAR workflows enables dense, cost-effective monitoring networks.



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Questions?

Thank you for your attention.

