

Slovakia

Geodesy, Cartography and Cadastre Authority of the Slovak Republic

Collaborating to expand Slovakia's cutting-edge satellite radar data monitoring capabilities

"For strengthening sustainability in the field of geodesy, geoinformatics, cartography and cadastre our Authority actively cooperates with the Slovak University of Technology in Bratislava in solving tasks of technical development and research. One of the current tasks concerns the construction of collocation stations for the use of InSAR technology on the territory of Slovakia."

Juraj Celler

Head, Geodesy, Cartography and Cadastre Authority of the Slovak Republic

Slovakia's Geodesy, Cartography and Cadastre Authority is collaborating with the Slovak University of Technology to construct a network of collocation stations to ensure the precise integration of radar and GNSS data.

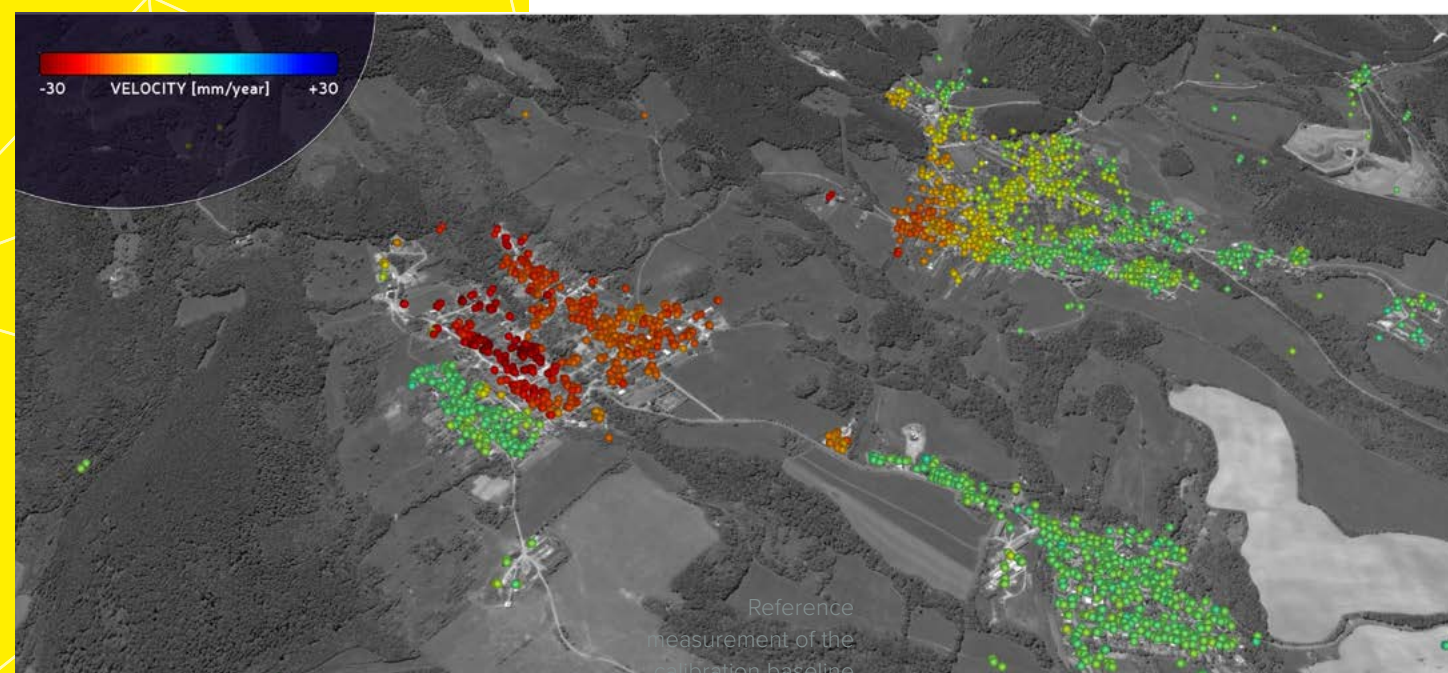
The stations provide valuable insights for monitoring landslides and critical infrastructure. For example, they have been deployed in landslide-prone regions, such as Upper Nitra and Košice Basin where the combination of satellite and ground-based data, enabling the monitoring of displacement trends with seasonal and event-specific accuracy. Collocation stations have also been used to track subsidence and deformation near water management structures, providing essential data for safety evaluations and risk mitigation.

Interferometric Synthetic Aperture Radar (InSAR) is a cutting-edge geodetic technique that leverages satellite radar data, such as from Copernicus Sentinel-1, to precisely measure Earth's surface deformation. With millimetre-level precision and the ability to cover extensive areas, InSAR is widely used for monitoring infrastructure, geohazards, earthquakes, and water management structures.

Unlike traditional methods, it requires no on-site personnel or installations.

InSAR is a relative geodetic method, akin to GNSS, that measures spatial and temporal changes in the positions of numerous natural radar reflectors relative to a stable reference point. While relative measurements are sufficient for many applications, absolute motion tracking requires connecting InSAR to terrestrial reference systems, such as ETRS89. This is achieved by collocating InSAR with GNSS at specially designed stations, where artificial radar reflectors (corner reflectors or transponders) and GNSS antennas are mounted together on stable pillar.

Slovakia's network of collocation stations ensures precise integration of radar and GNSS data. Parameters such as Radar Cross Section (RCS) and Signal-to-Clutter Ratio (SCR) are analysed to maintain data quality. Slovakia continues to expand its InSAR-based monitoring capabilities by improving collocation methodologies, integrating data from other satellite missions, and further enhancing the accuracy and scalability of national monitoring networks.



Example of InSAR displacement monitoring over a landslide-prone area.



Collocation station with GNSS and artificial corner reflectors.

Benefits

- **Efficiency:** Enables monitoring of large areas without extensive fieldwork or sensor installations.
- **Precision:** Provides millimetre-level displacement measurements and links to absolute geodetic reference frames.
- **Versatility:** Effective for diverse applications, from geohazard assessments to infrastructure monitoring.