GNSS and InSAR collocation
(new experience from Slovakia)

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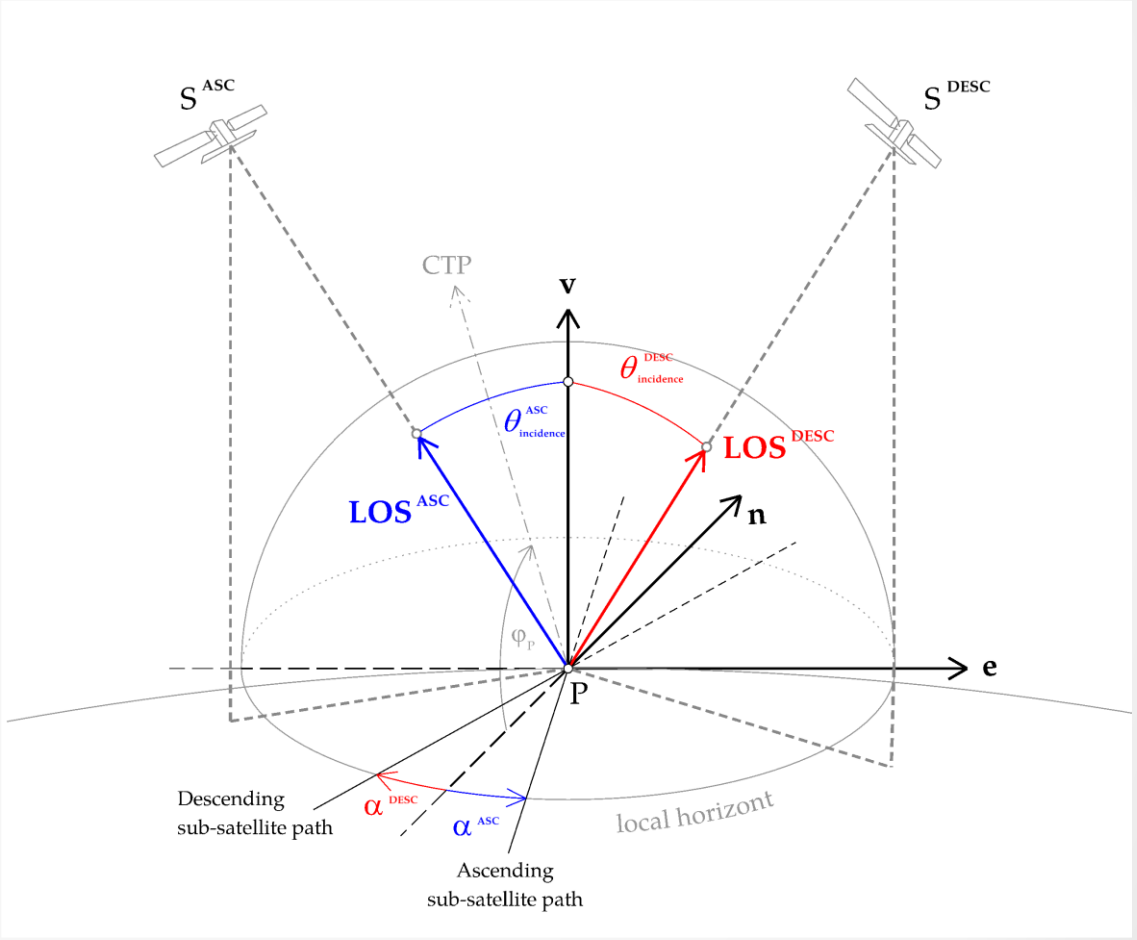
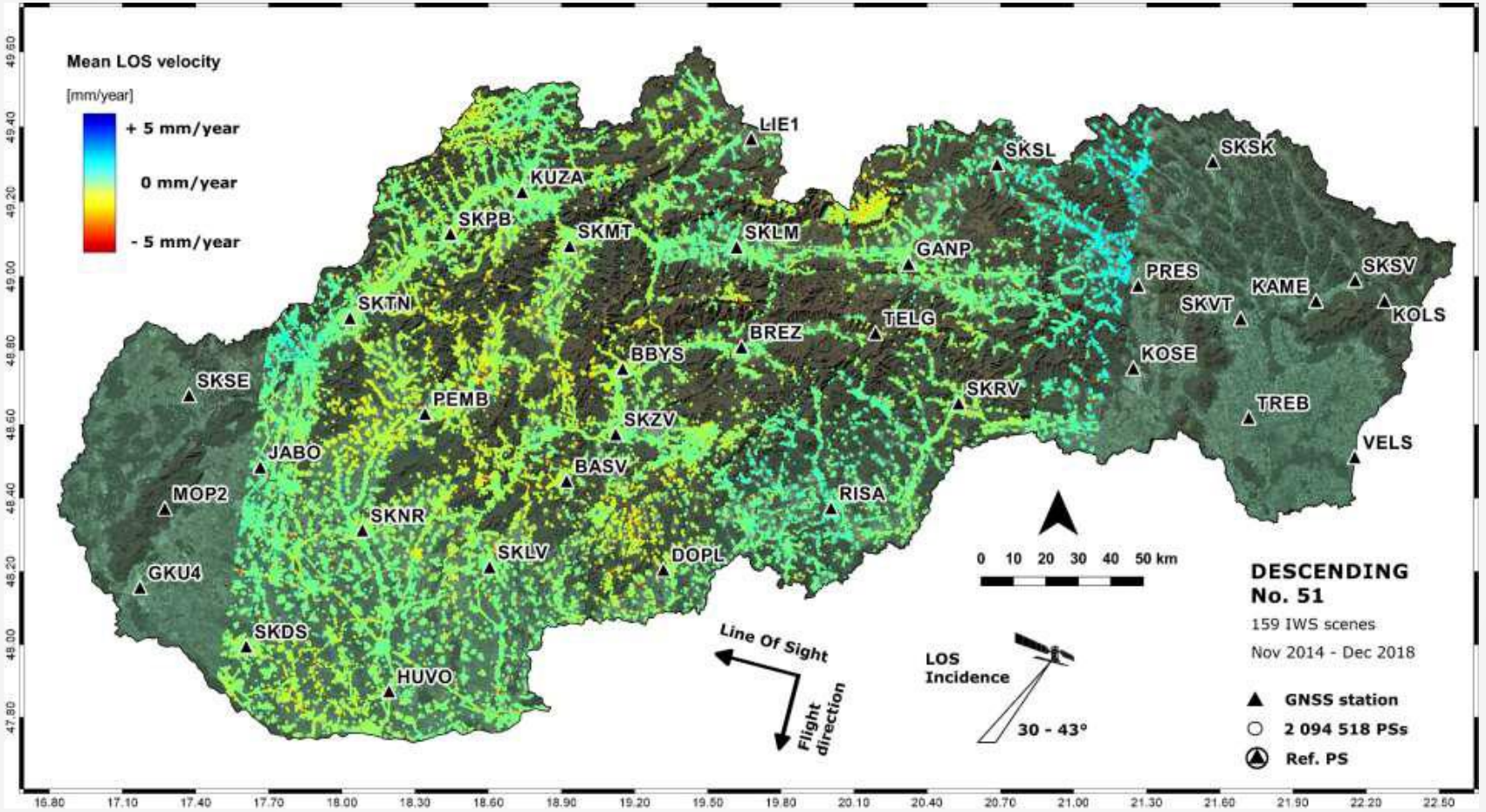
Slovakia idea: Establishment of „National InSAR reflector network“ to reference InSAR results

- **InSAR** (Interferometric Synthetic Aperture radar) vs „Conventional“ geodetic techniques:
  - **Differenet** datum (ref. frame)
  - **Different** geometry
  - **Different** benchmarks
  - **Different** observation time
- **„National InSAR reflector network“**
  - consist of set of artificial reflectors with precise ETRS89 coordinates of its phase centers

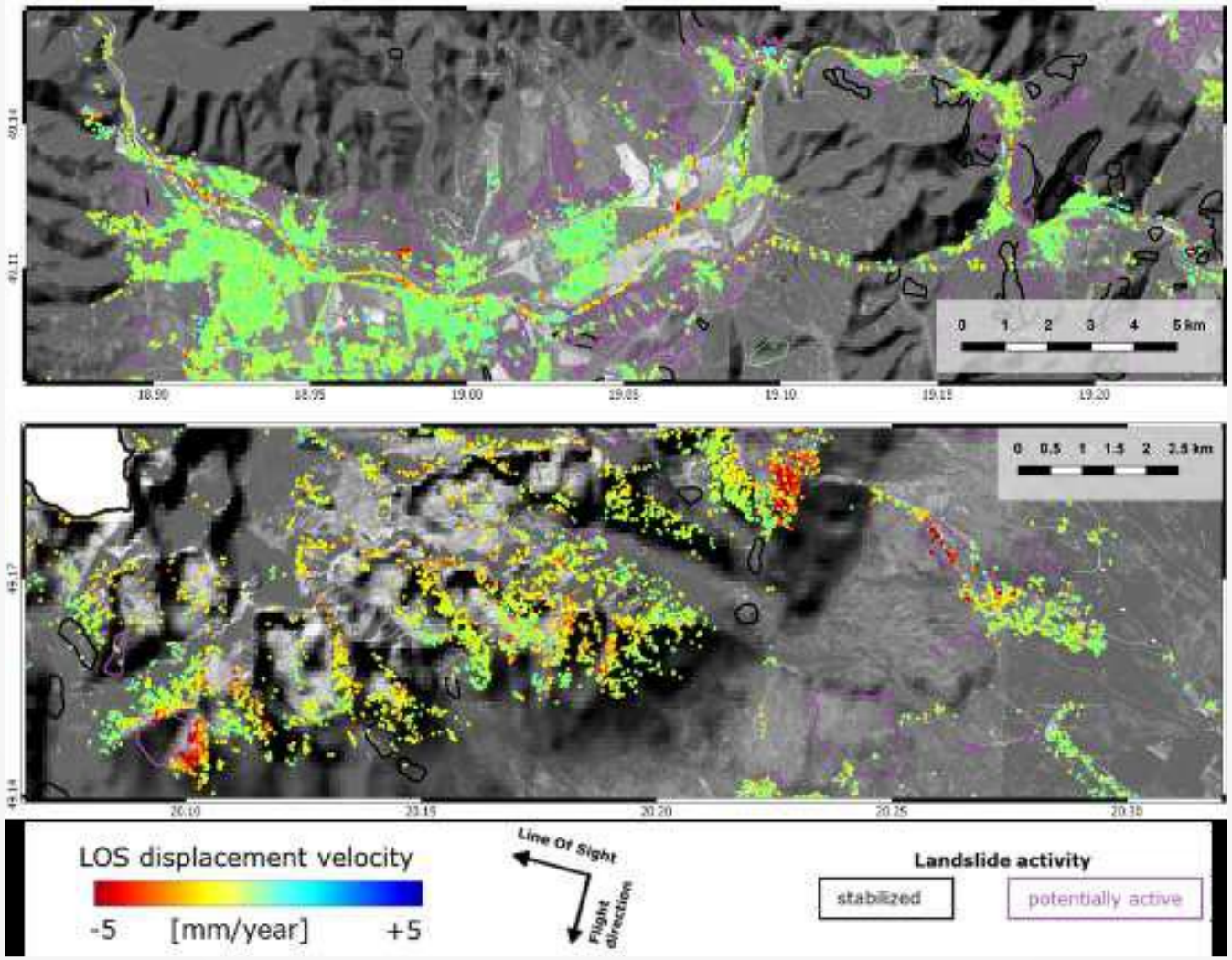


„National InSAR reflector network“ will serve for state wide vertical monitoring = doing levelling only where it will be needed



„National InSAR reflector network“ will serve for regional monitoring

= suitable e.g. for geologists

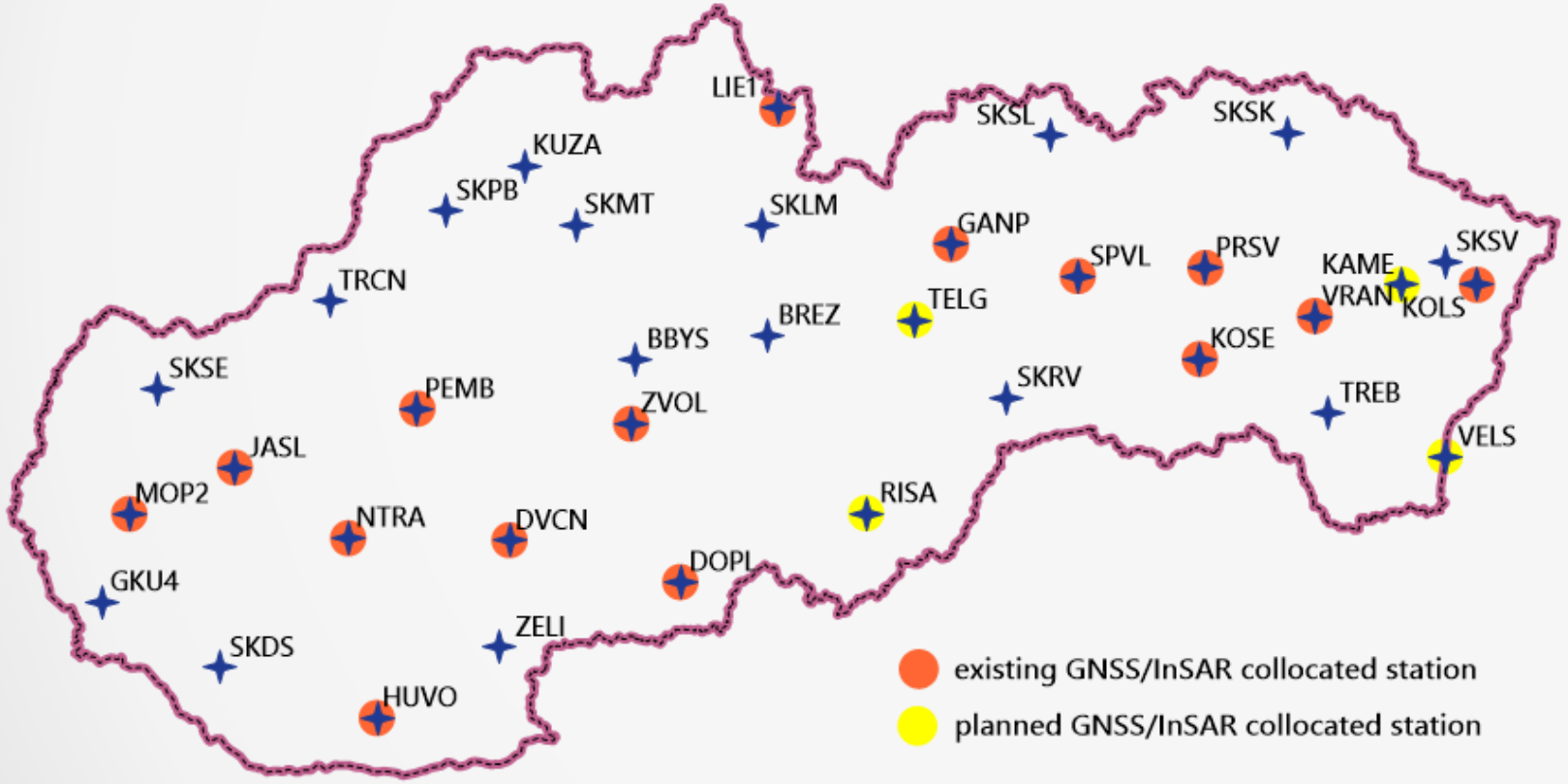


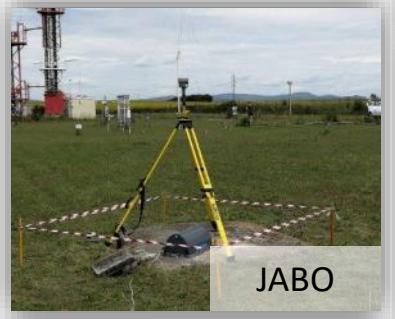
Collocation with GNSS on SKPOS CORS

- via artificial SAR reflector (known phase center)
  - Passive: corner reflector
  - Active: radar transponder

- collocation ensure:
  - linking of InSAR networks from individual Sentinel-1 satellite tracks
  - InSAR measurements to the national ETRS89 reference frame
  - absolute (deformation) time series
  - calibration of systematic effects

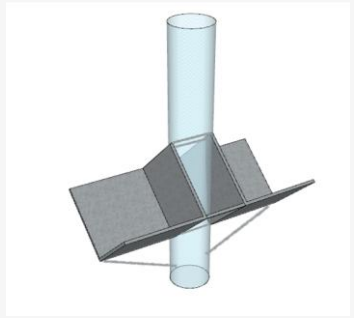
SKPOS GNSS/InSAR collocation sites
15 sites (status in November 2024)

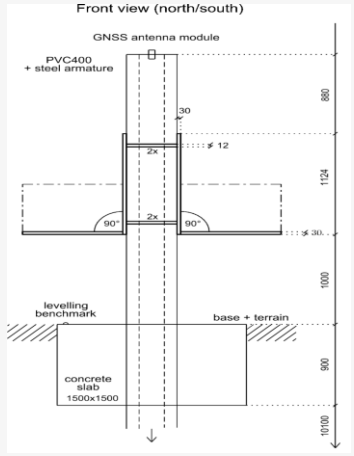


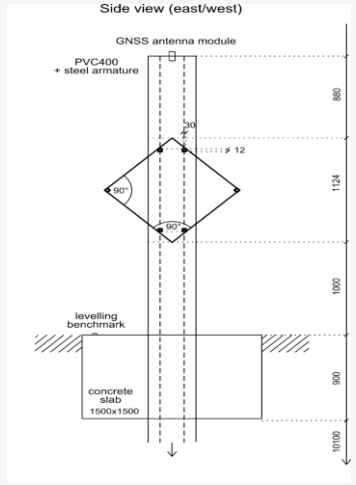


Slovakian design of GNSS/InSAR collocation site with passive reflector

- InSAR:
  - no secundary refflection
  - > 1 m over terrain
  - > 20 dB SCR
- GNSS
  - no effect multipath
  - > 1.3 m over InSAR reflector
- robust construction
- precise position of the phase center





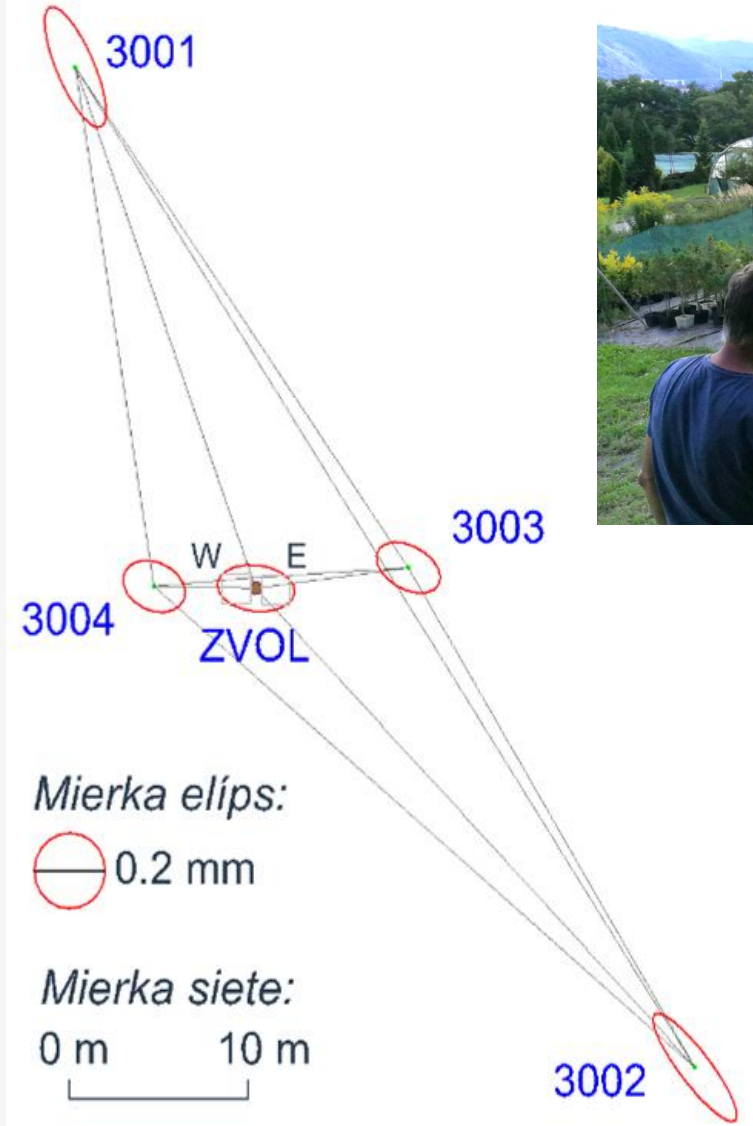


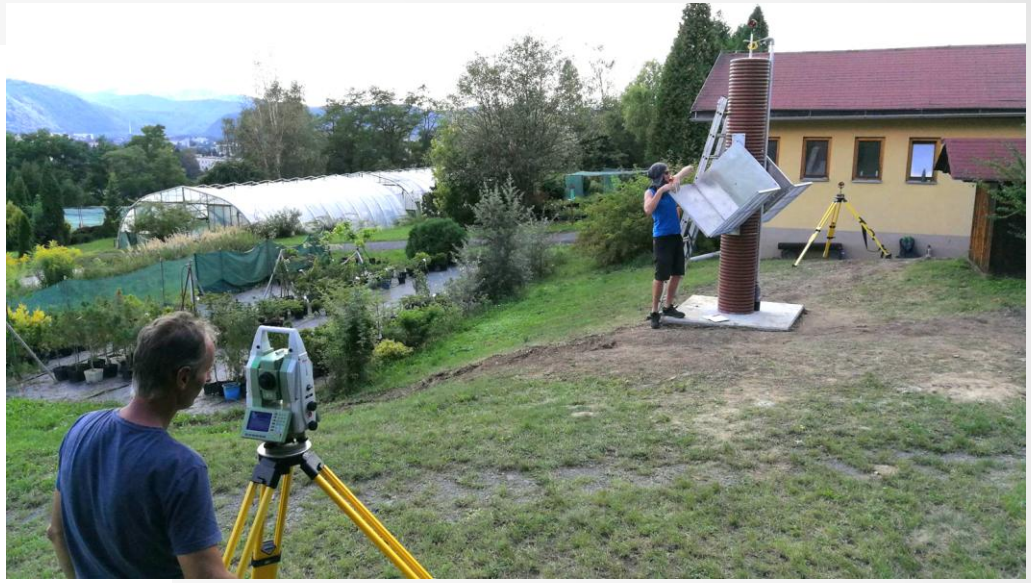
GNSS/InSAR collocation site with passive reflector
Instalation on the new SKPOS CORS (new pillar)

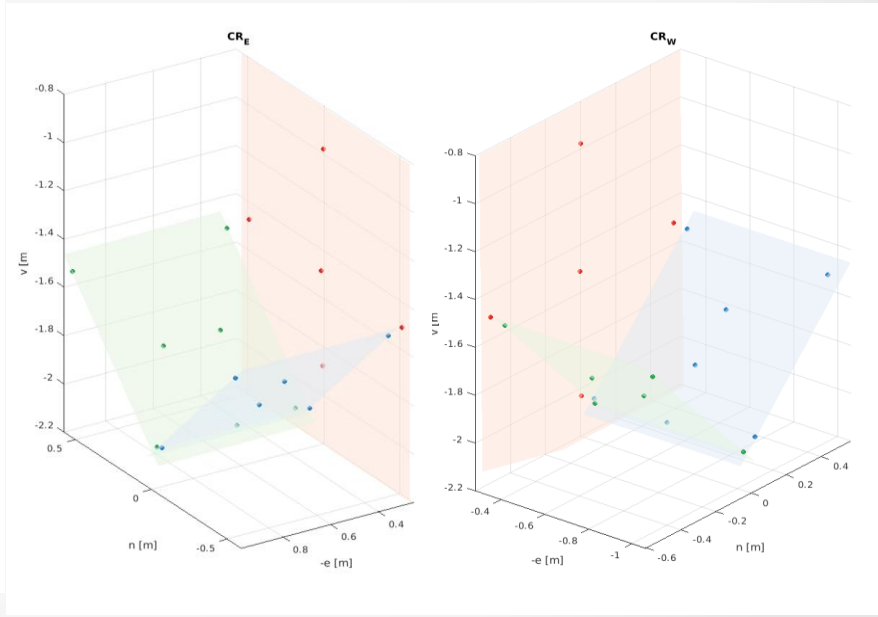
GNSS/InSAR collocation site with passive reflector
Instalation on the existing SKPOS pillar

Active transponder (electricity needed)
Eccentric placement = not very comparable with GNSS

Determination of passive InSAR reflector phase center coordinates is very important







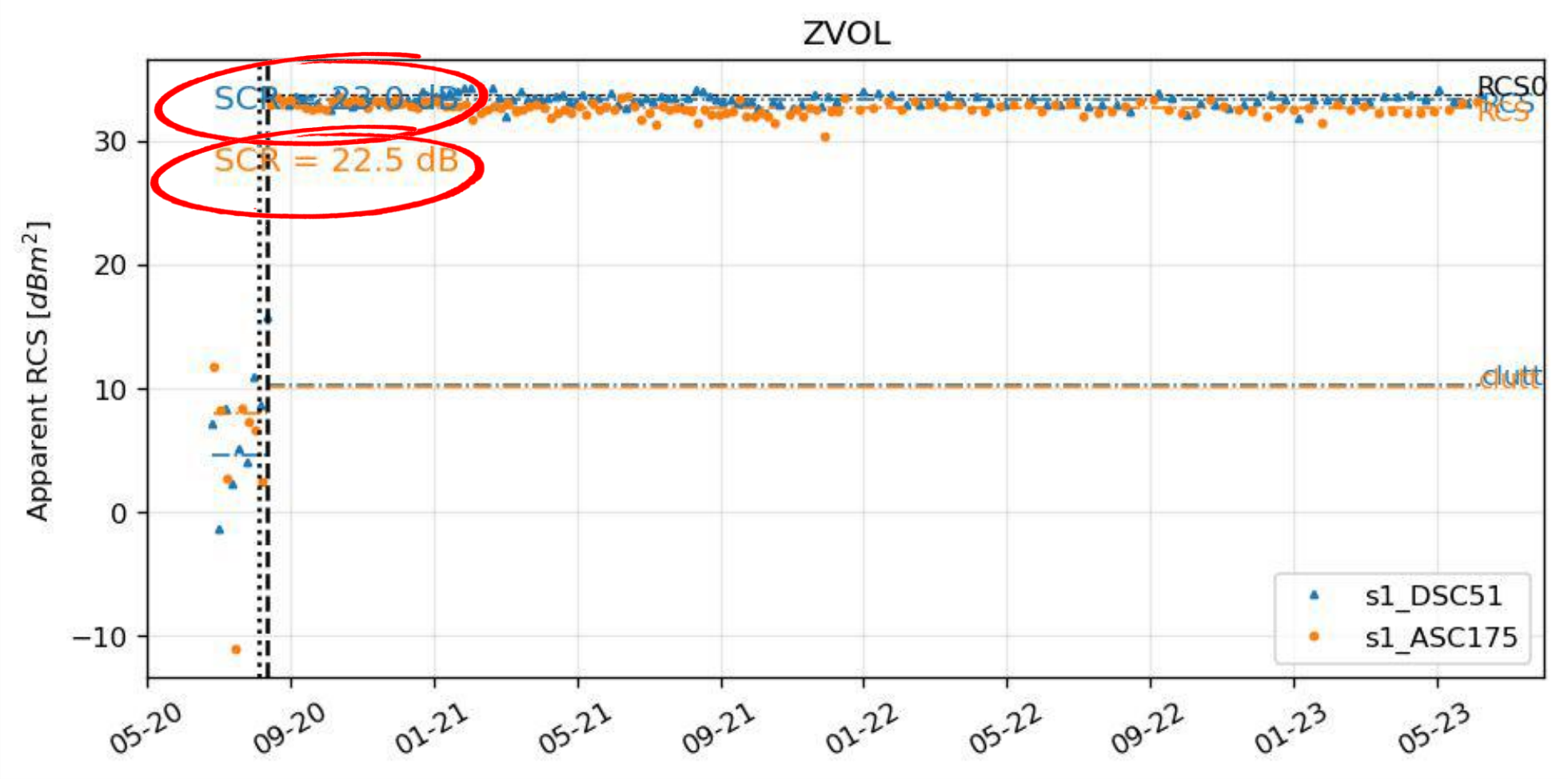
ZVOL (Zvolen, SR)

SKPOS®

Determination of passive InSAR reflector phase center coordinates is very important

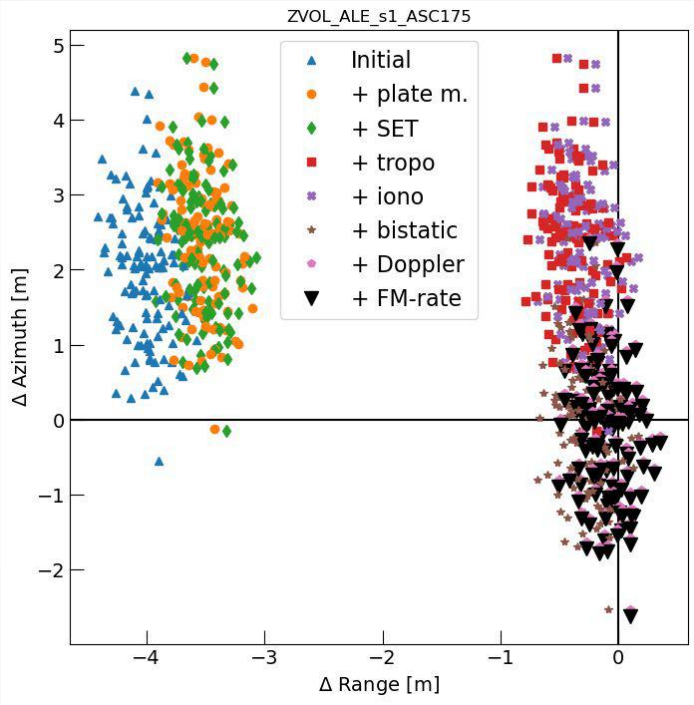
Collocation station sutability check (SCR value)

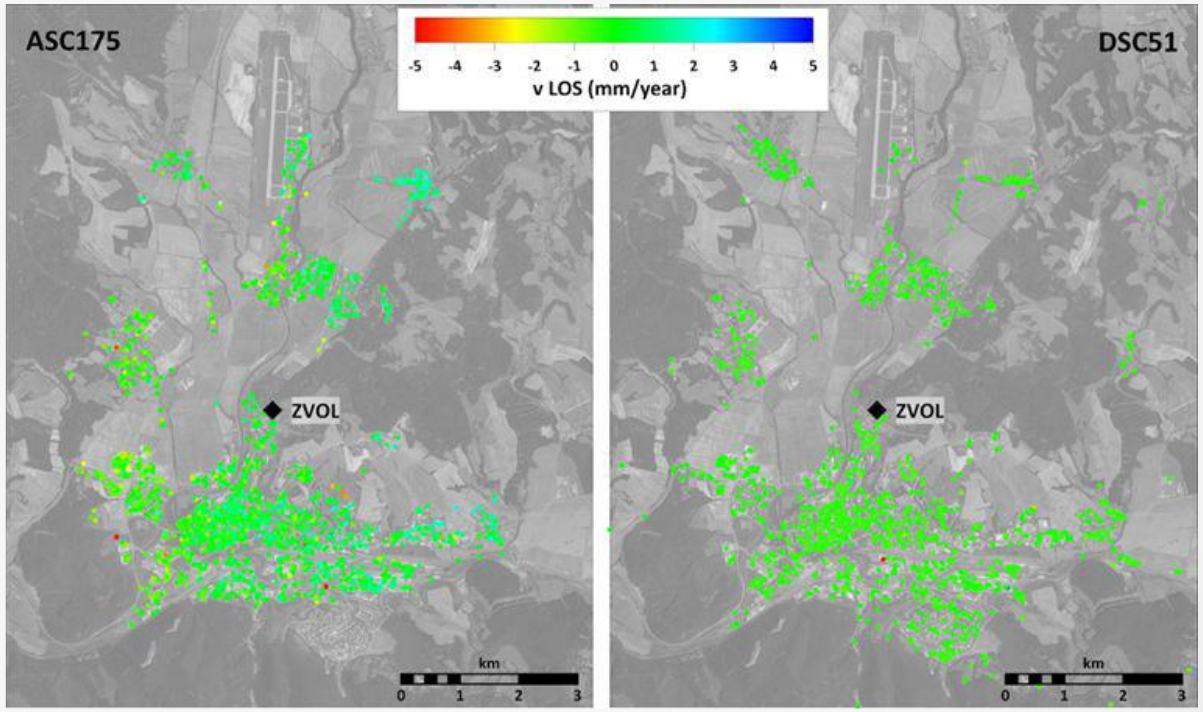
before vs after instalation



Absolute positioning errors and SW used for InSAR processing

- **InSAR data processing (cooperation with Slovak university of technology):**
  - SW Gecoris (Czikhardt et al. 2021)
  - procesing as local network
- **InSAR reflector coordionates differences – very important**
  - true coordinates = coordinates from GNSS/InSAR collocation sites
  - observed coordinates = from Sentinel-1 epoch measurements

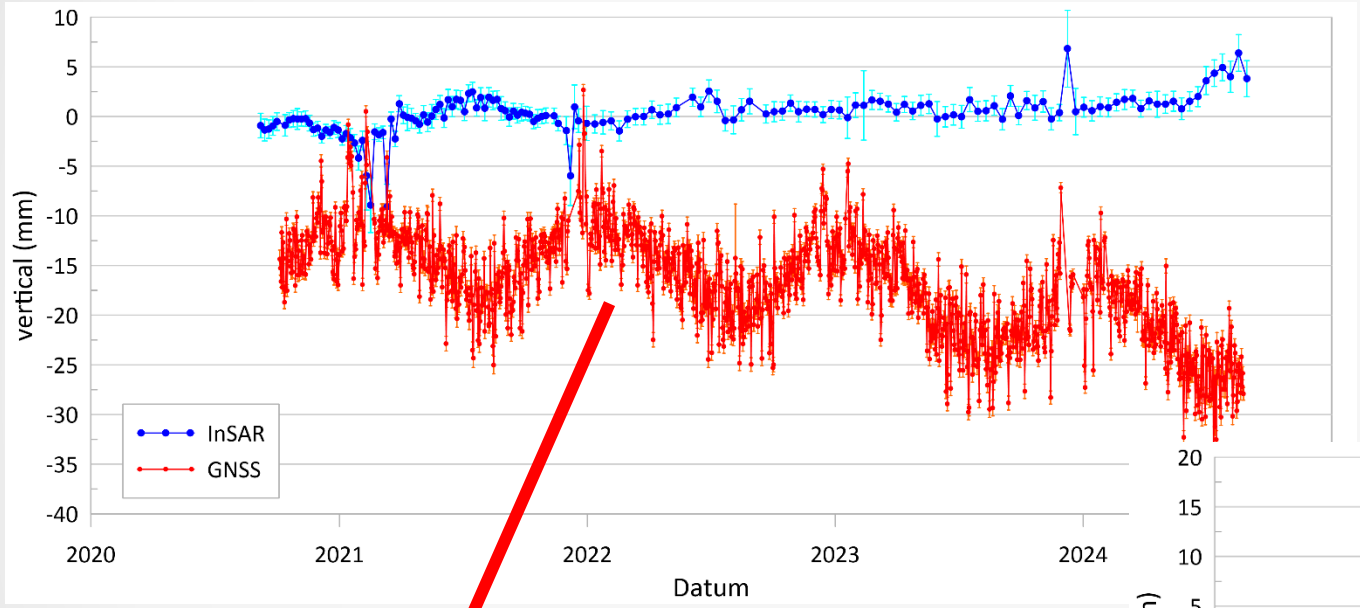




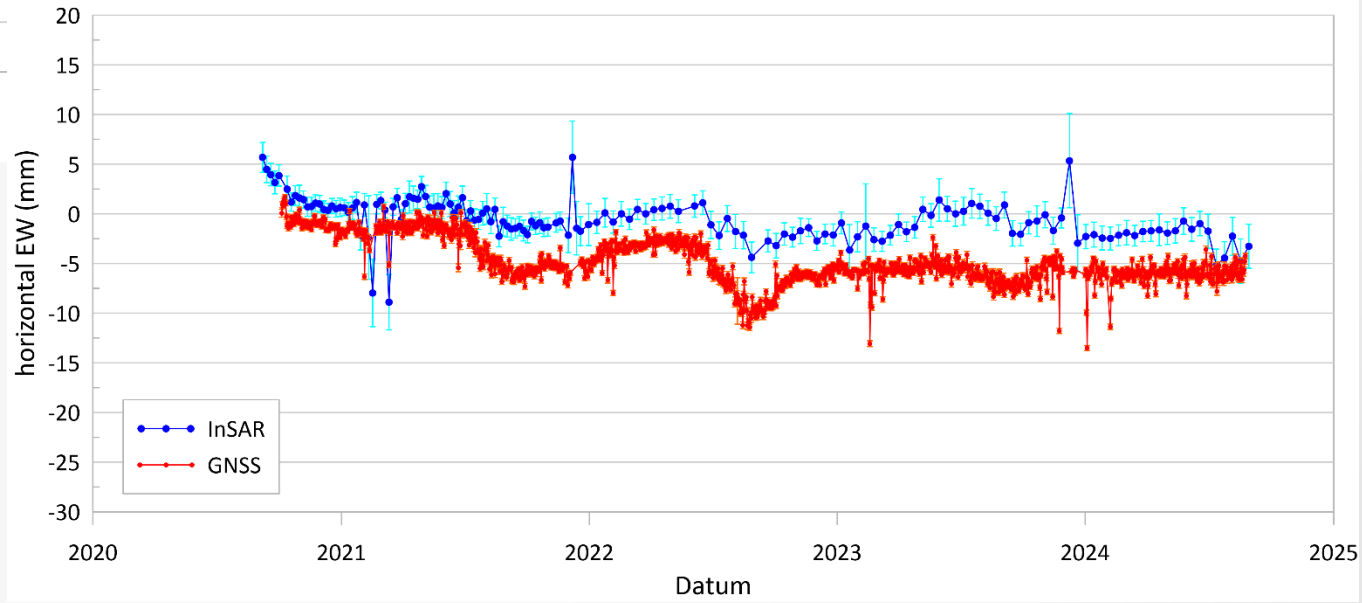
Czikhardt et al. (2021): Gecoris: An open-source toolbox for analyzing time series of corner reflectors in insar geodesy, DOI: 10.3390/rs13050926

- GNSS and InSAR comparison on collocation sites

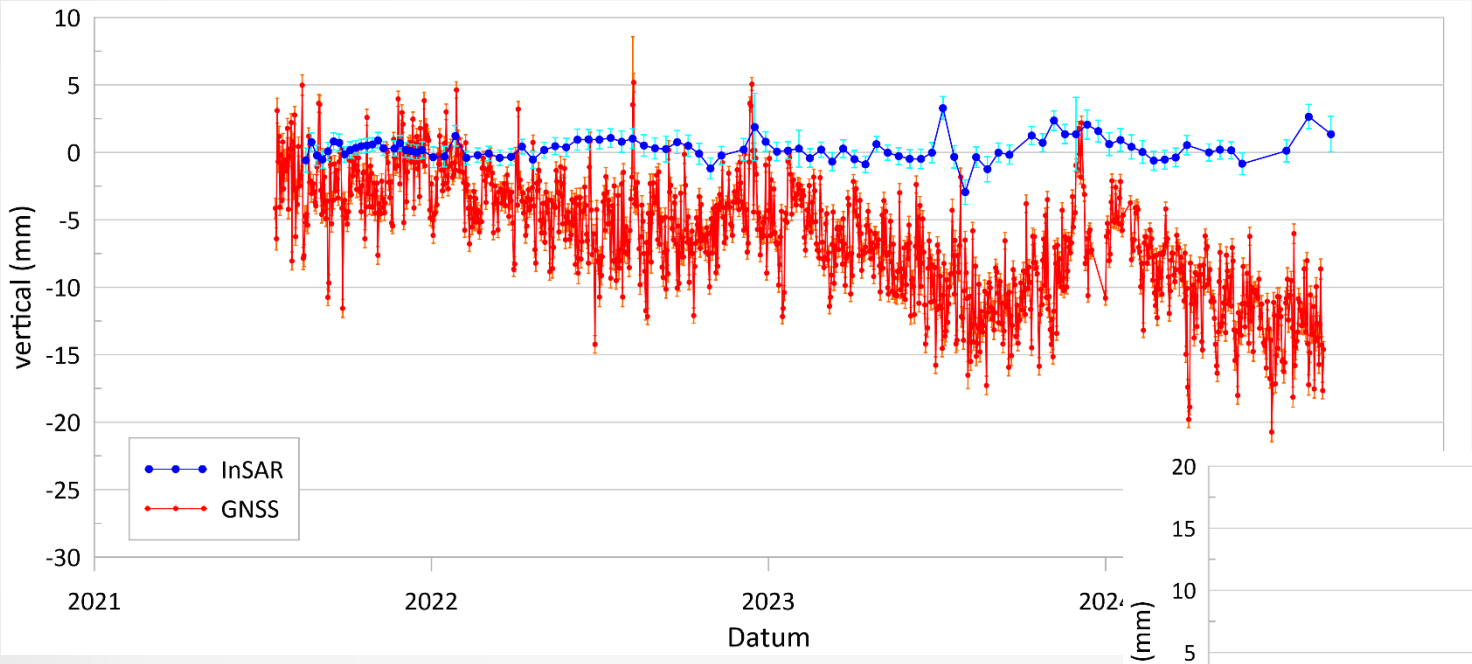
InSAR vs GNSS displacement comparison - local InSAR network vs GNSS (station ZVOL)

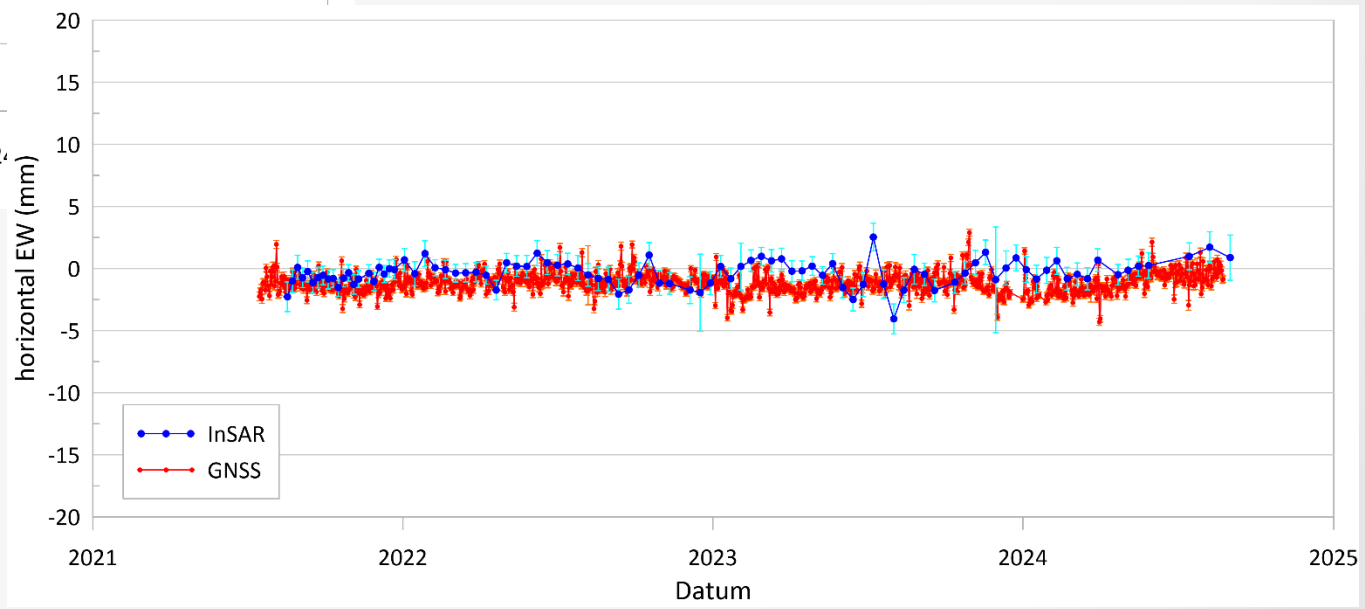


Probably GNSS antenna thermal phase center variation

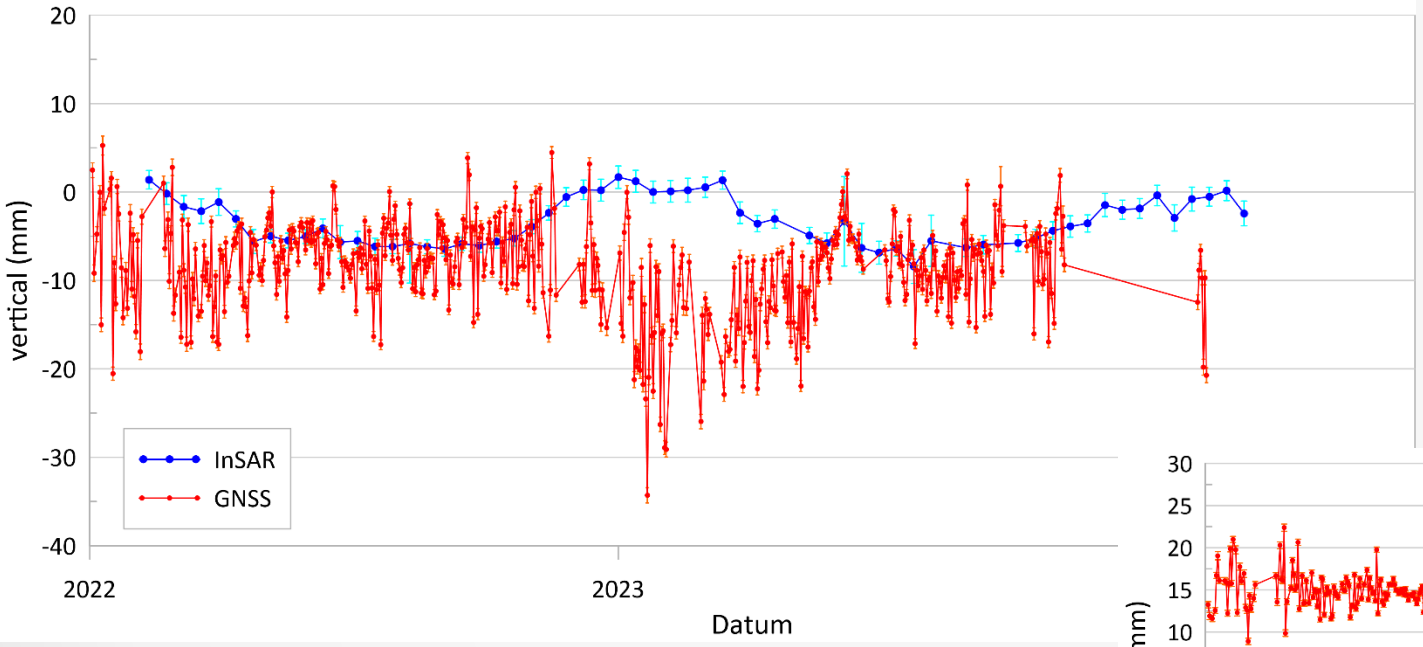


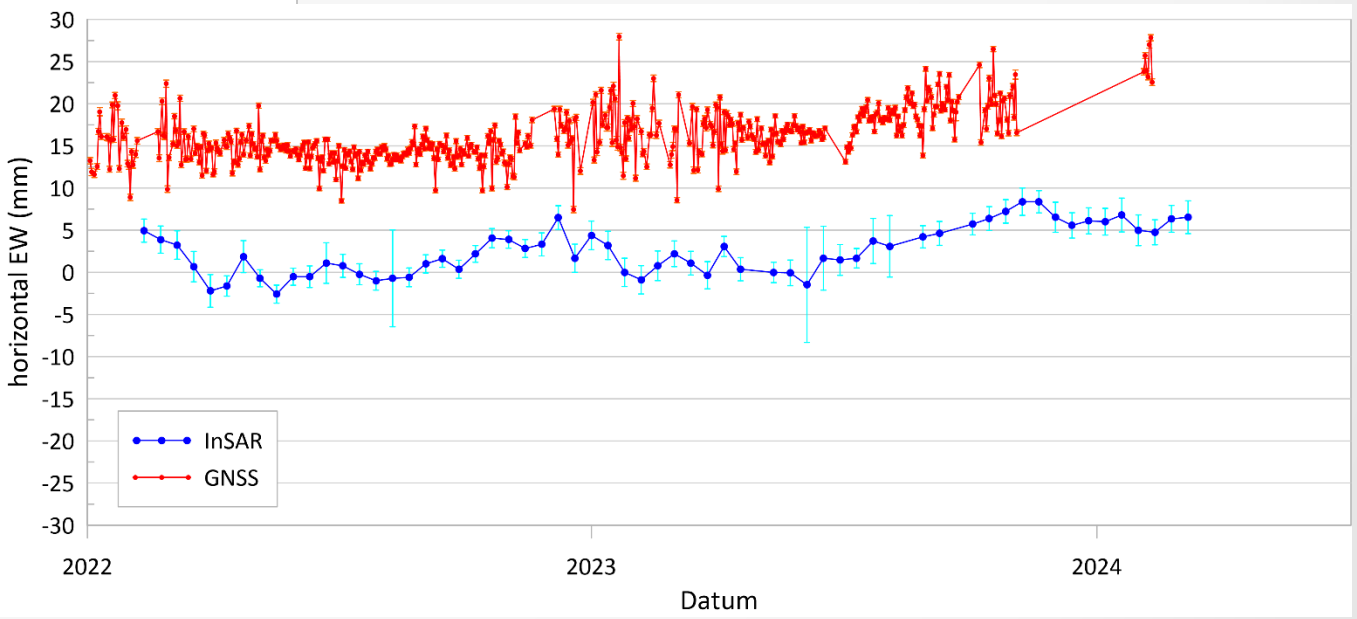
InSAR vs GNSS displacement comparison - local InSAR network vs GNSS (station ZVOL)





InSAR vs GNSS displacement comparison - local
InSAR network vs GNSS (station KOLS)



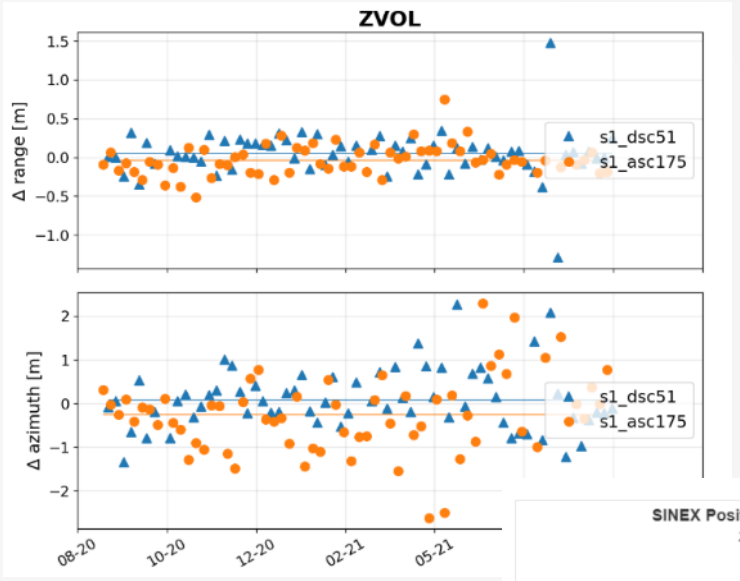


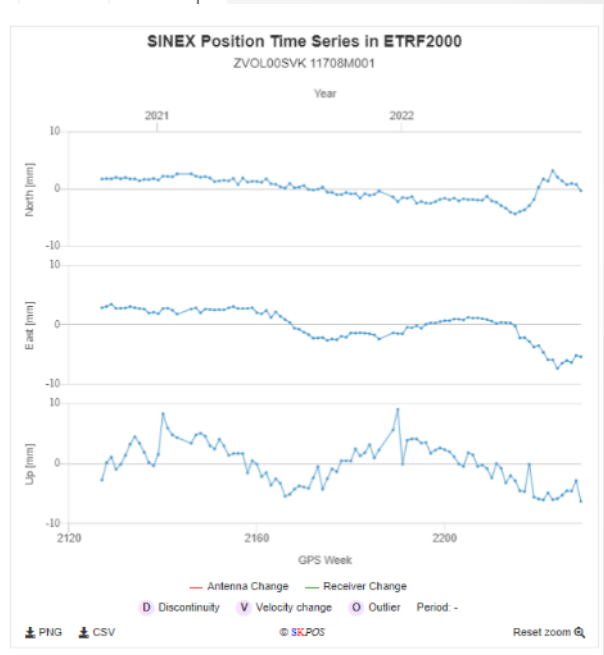
Conclusion

- comparison of GNSS / InSAR displacements on horizontal East - West component time series is very promising
- comparison of GNSS / InSAR displacements on vertical component time series is not very satisfying
- big differences in behavior is probably caused by GNSS antennas phase center variation

Next steps

- finishing of „National InSAR reflector network“
- measurement of all InSAR reflector phase center coordinates (need for providing for referencing)
- analysing of displacement computeted on all GNSS/InSAR SKPOS collocation sites
- creation of the state wide referenced displacement maps from InSAR





Thank you for your attention

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