GNSS and InSAR collocation
(experience from Slovakia)

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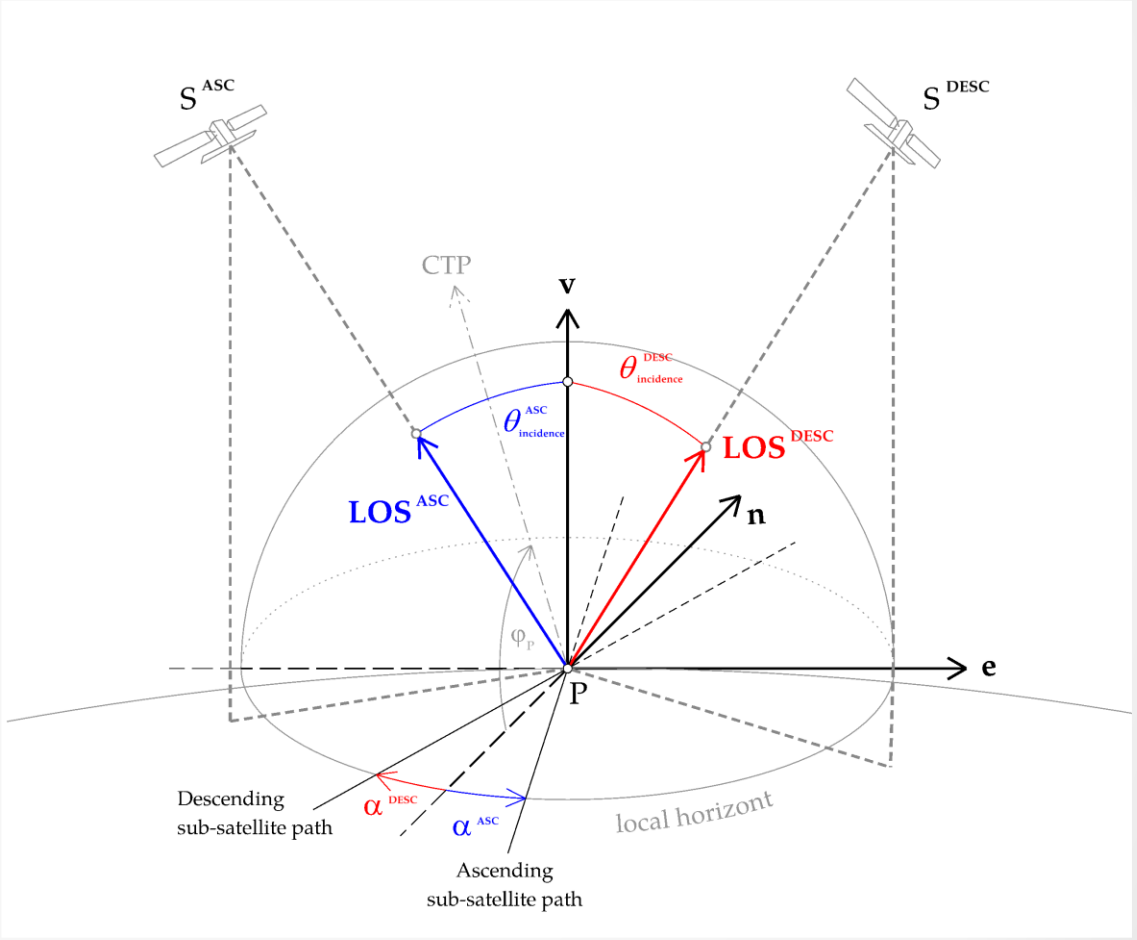
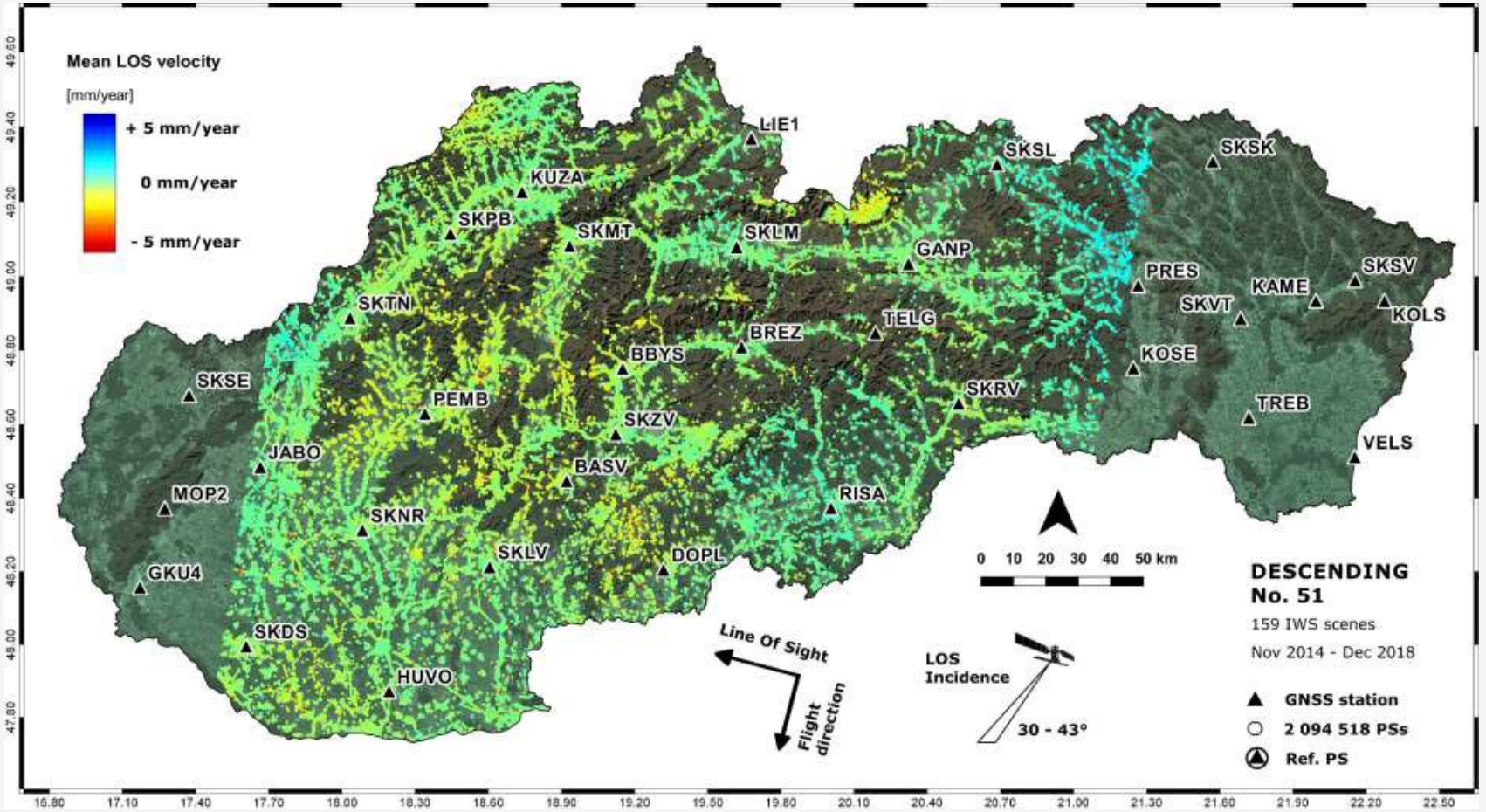
Establishment of „National InSAR reflector network“ to reference InSAR results

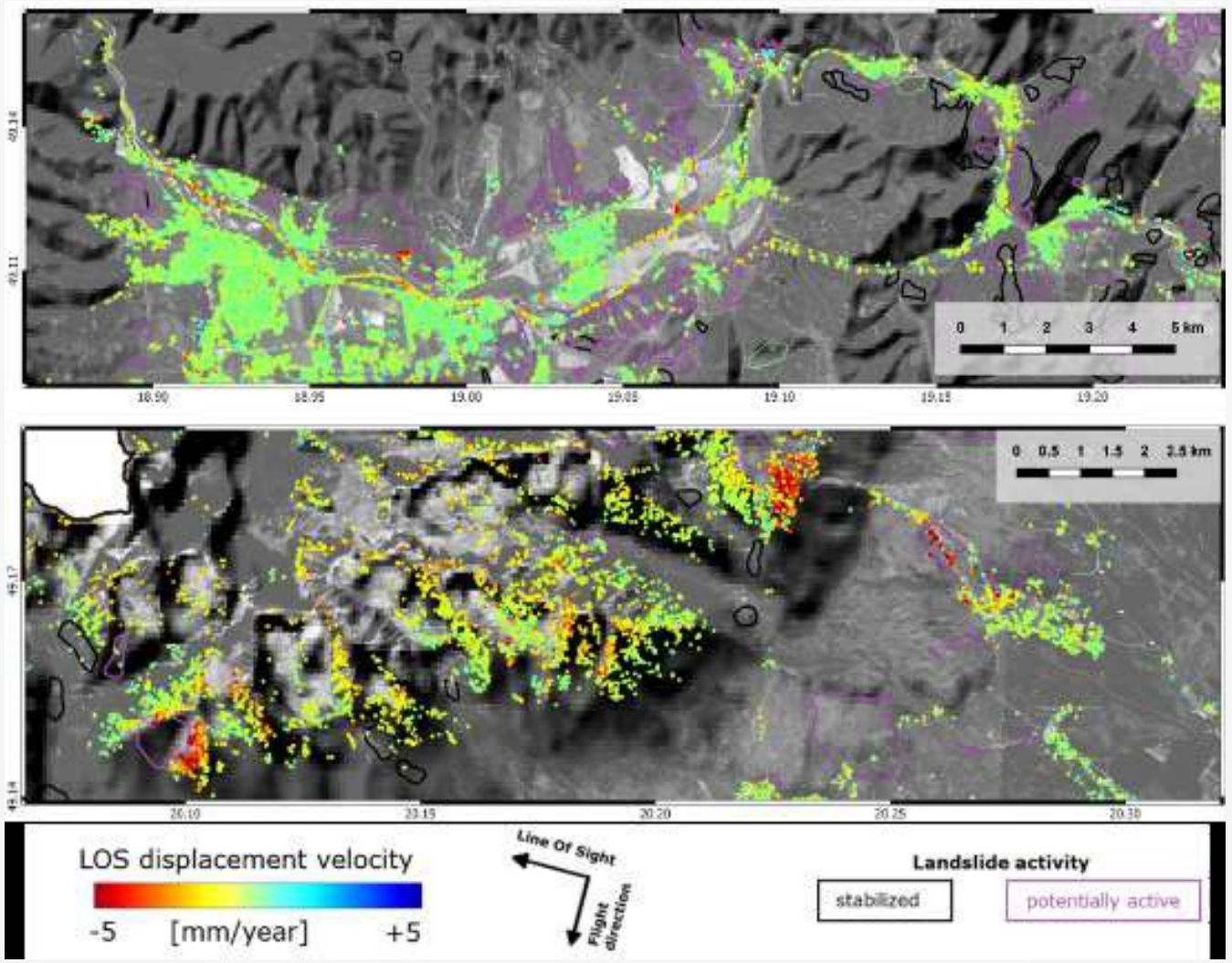
- **InSAR** (Interferometric Synthetic Aperture radar) vs „Conventional“ geodetic techniques:
  - **Differenet** datum (ref. frame)
  - **Different** geometry
  - **Different** benchmarks
  - **Different** observation time
- **National InSAR reflector network**
  - consist of set of artificial reflectors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

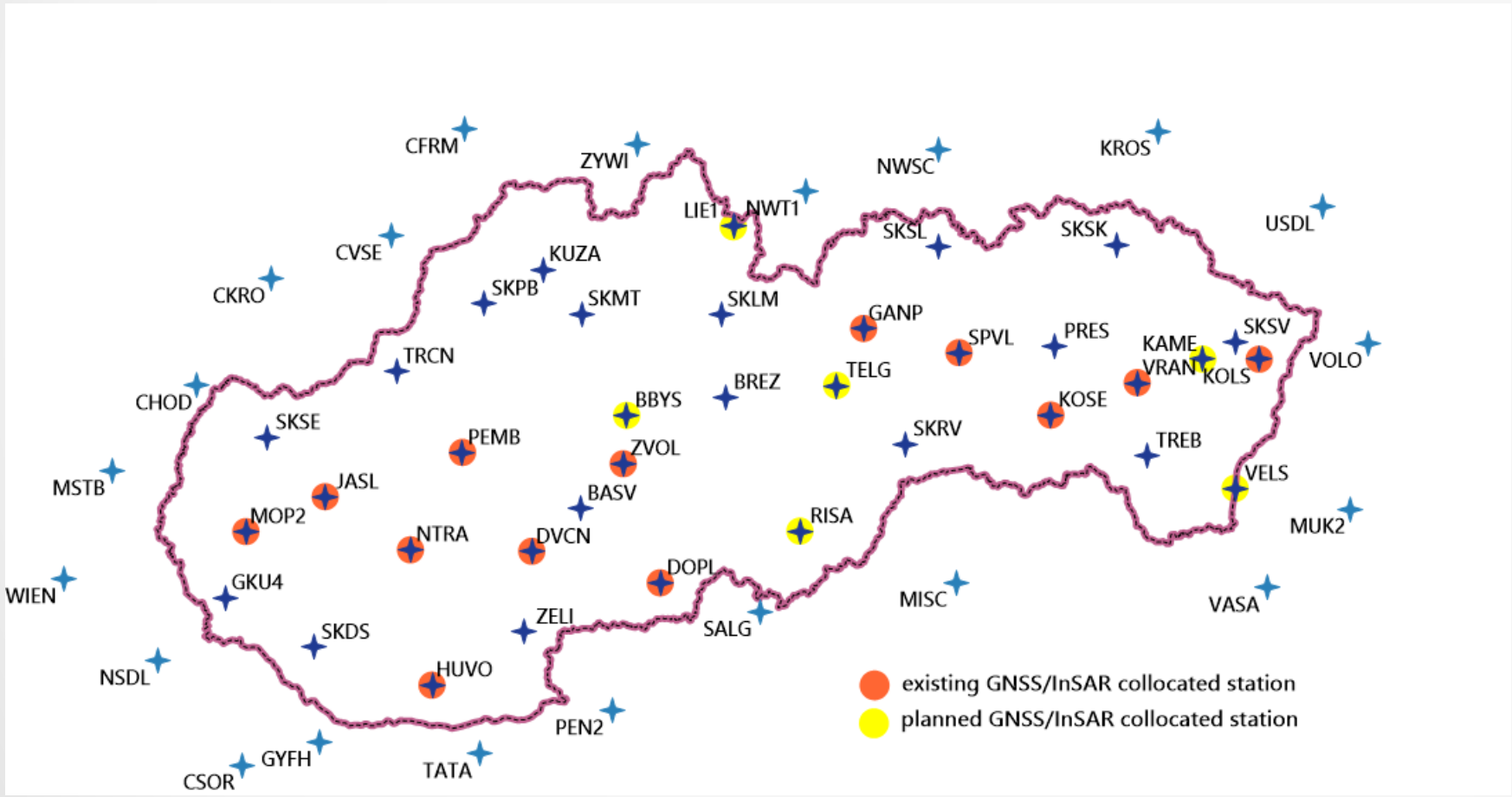


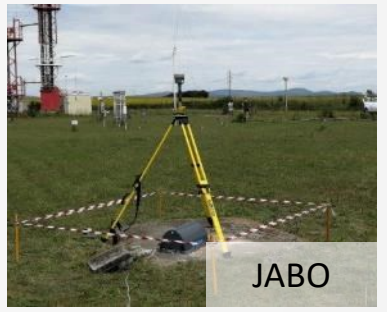
Collocation with GNSS on SKPOS CORS

- 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 realization of ETRS89
  - absolute deformation time series
  - calibration of systematic effects

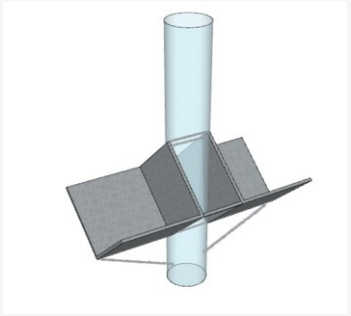
SKPOS GNSS/InSAR collocation sites (status in November 2023 = 13 sites)

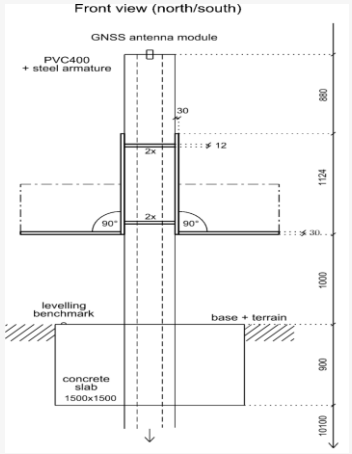


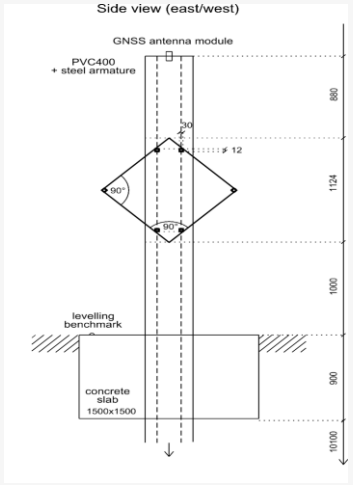


GNSS/InSAR collocation site with passive reflector – slovakian design

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





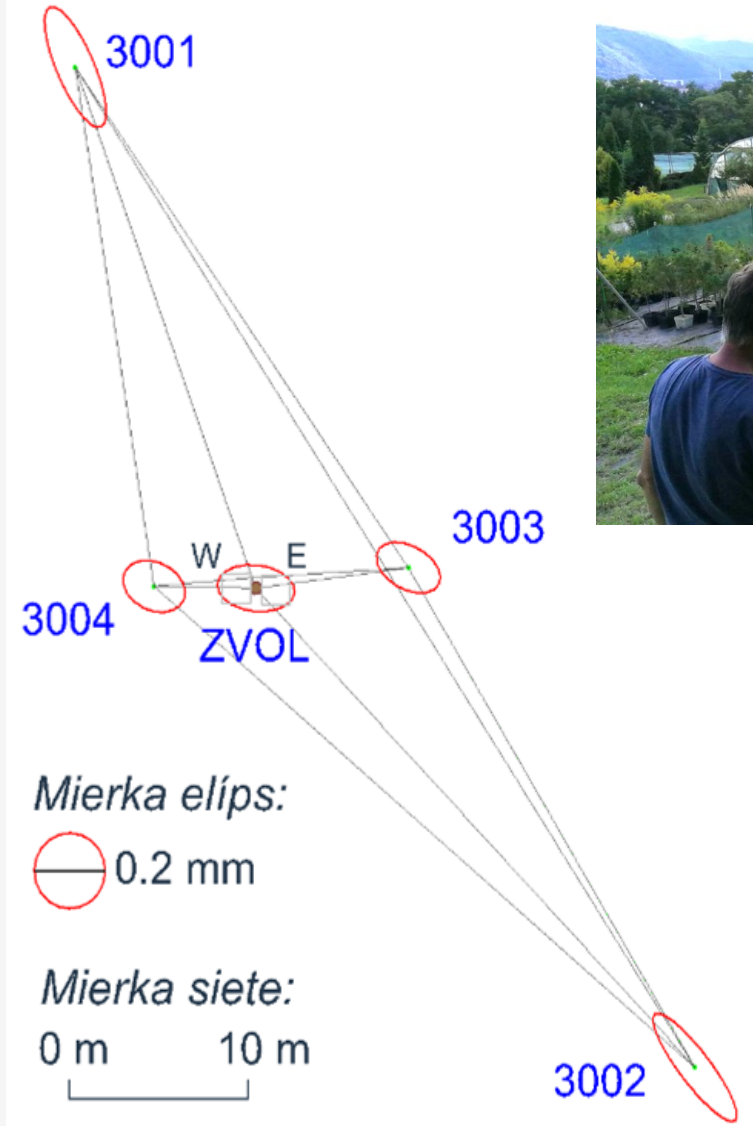


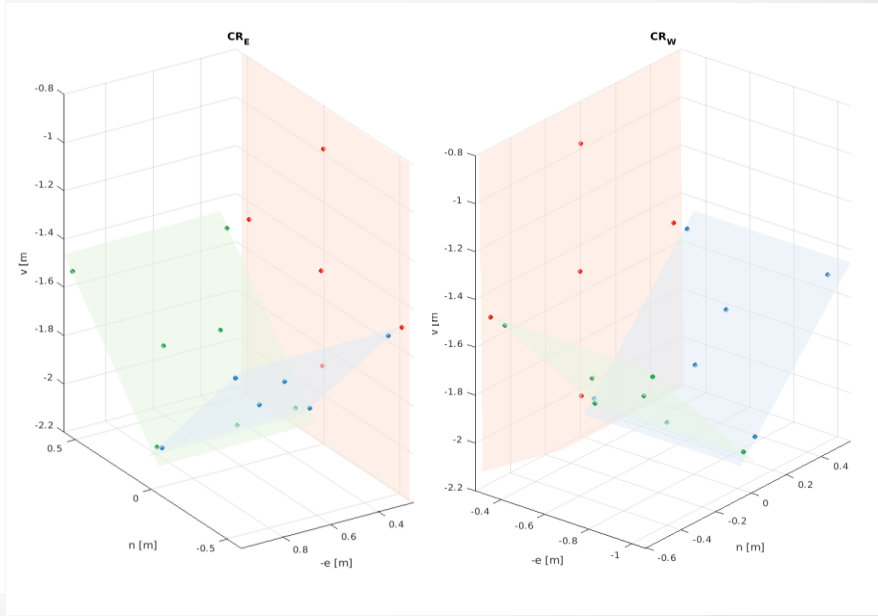
GNSS/InSAR collocation site with passive reflector
Instalation on the new SKPOS CORS (new pillar)

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)

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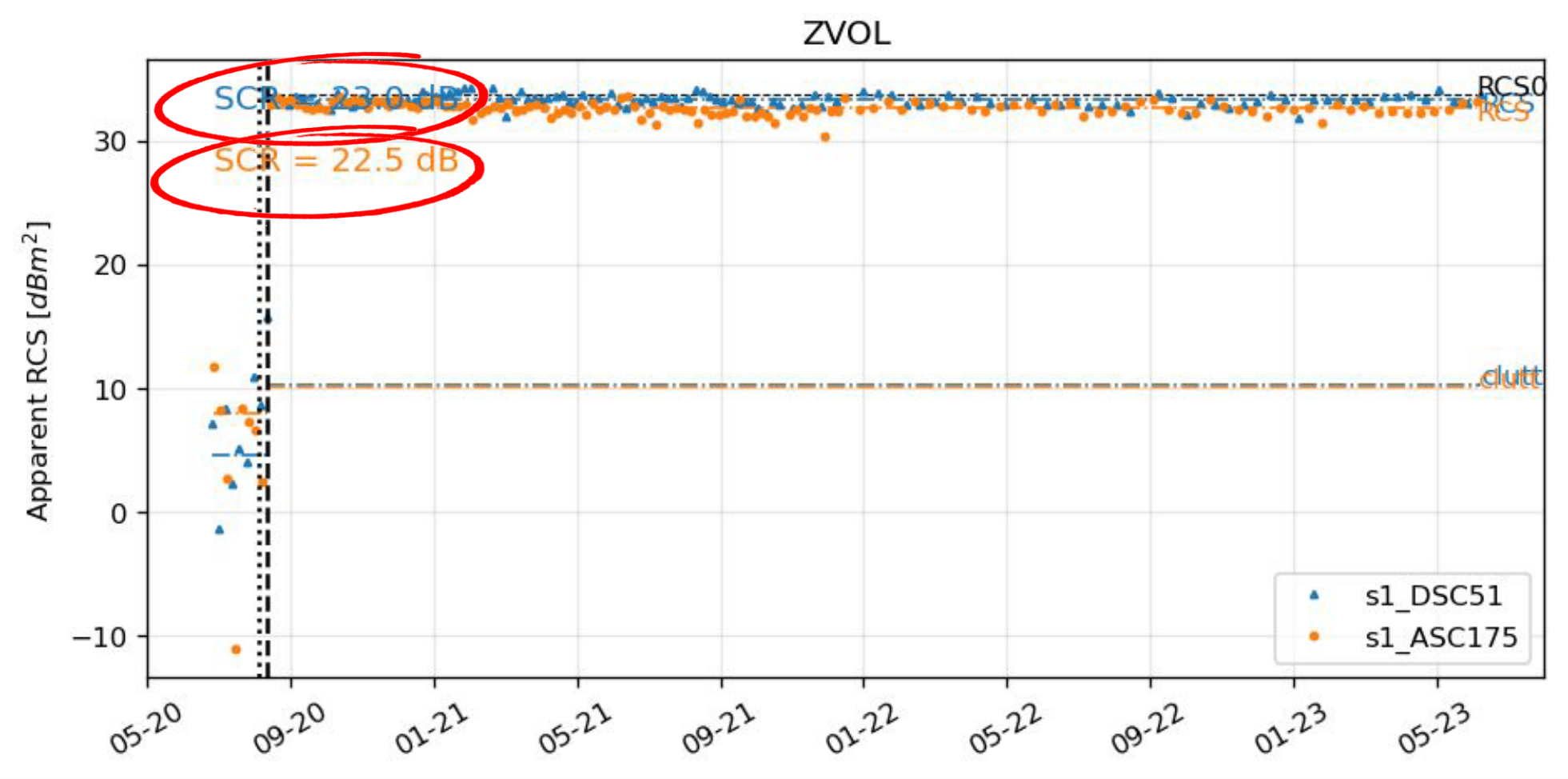
Determination of passive InSAR reflector phase center coordinates is very important

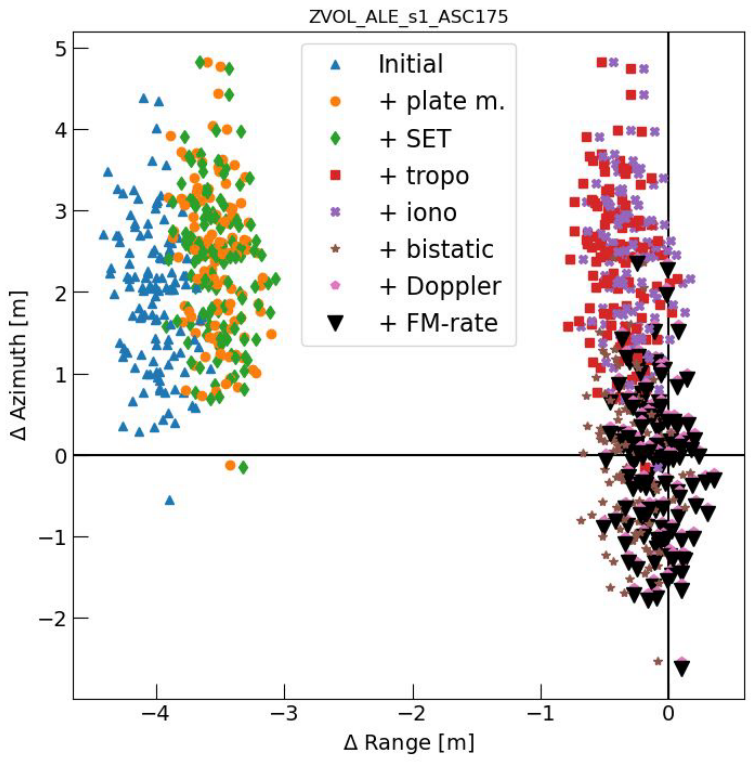
Collocation station sutability check (SCR value)

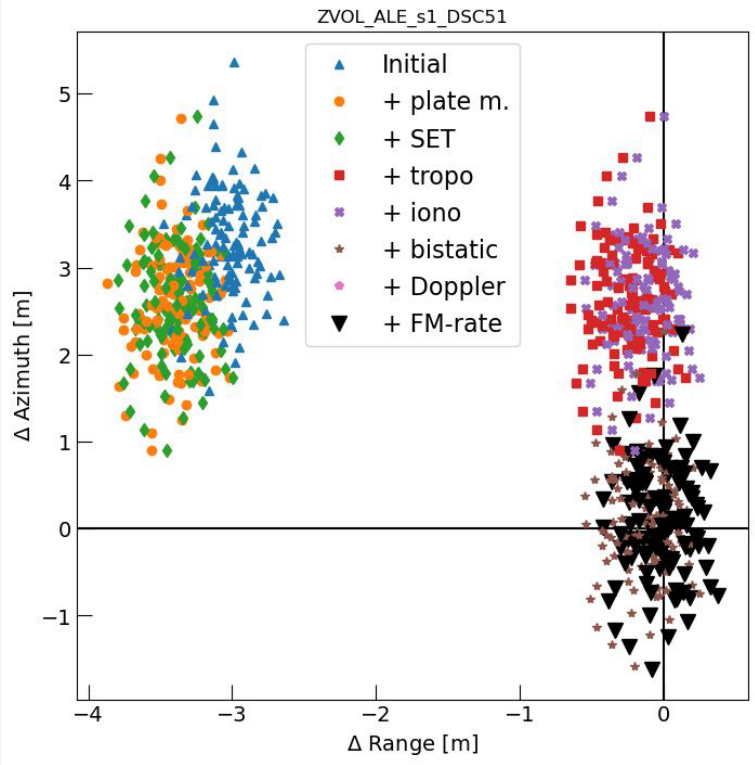
before vs after instalation



Absolute positioning errors

- **InSAR reflector coordionates differences:**
  - true coordinates = coordinates from GNSS/InSAR collocation sites
  - observed coordinates = from Sentinel-1 epoch measurements

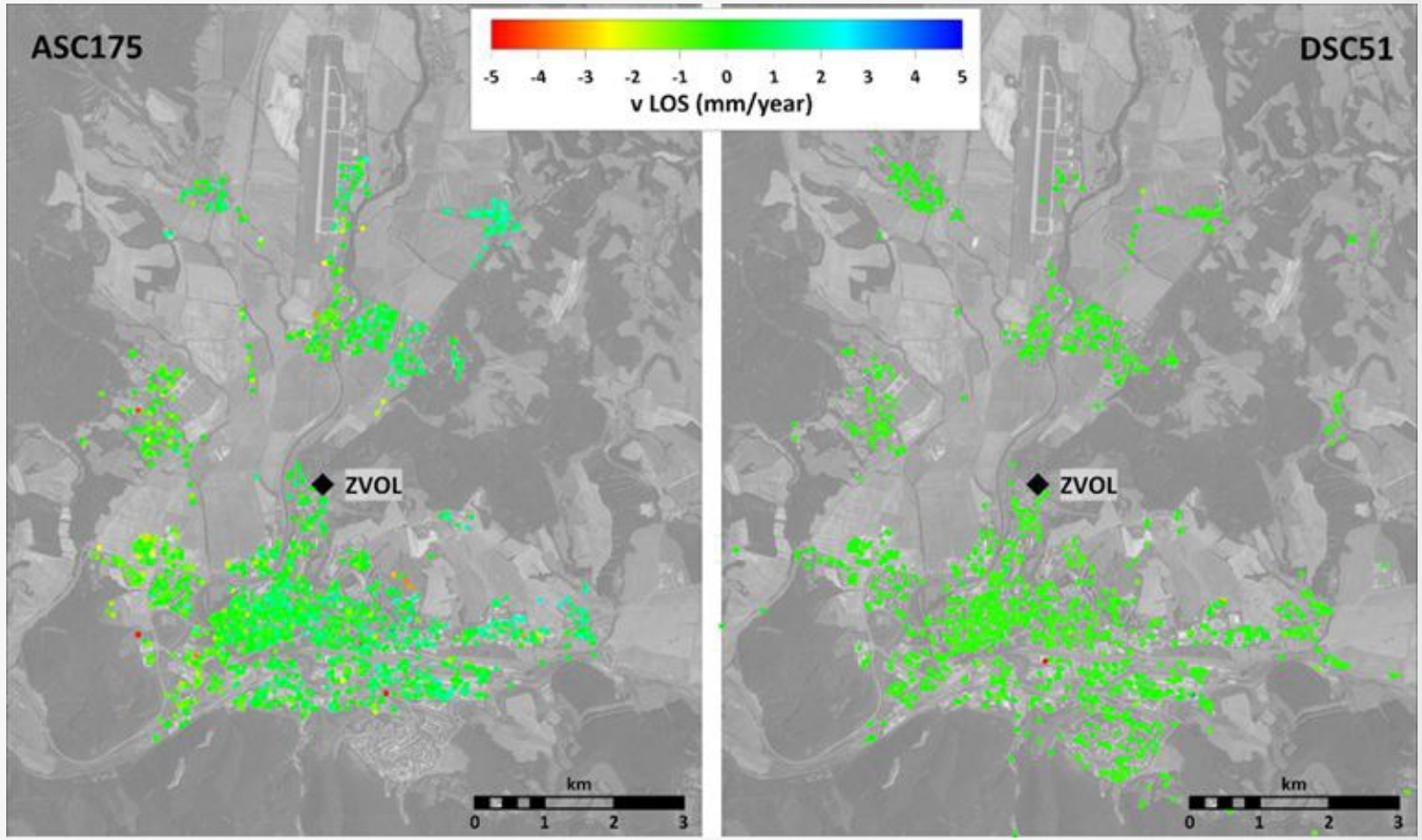




Local InSAR processing results (station ZVOL)

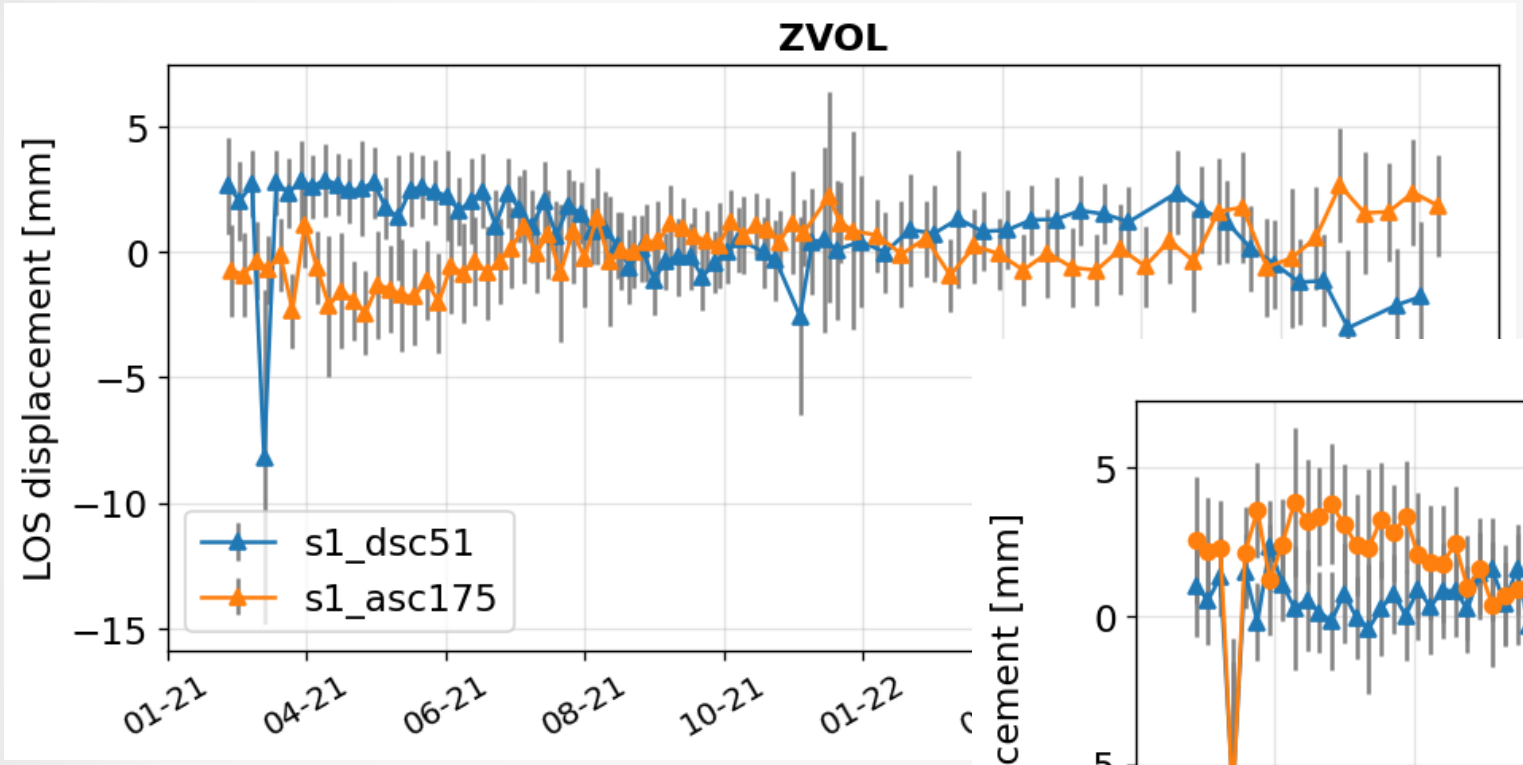
- GECORIS (Czikhardt et al. 2021)

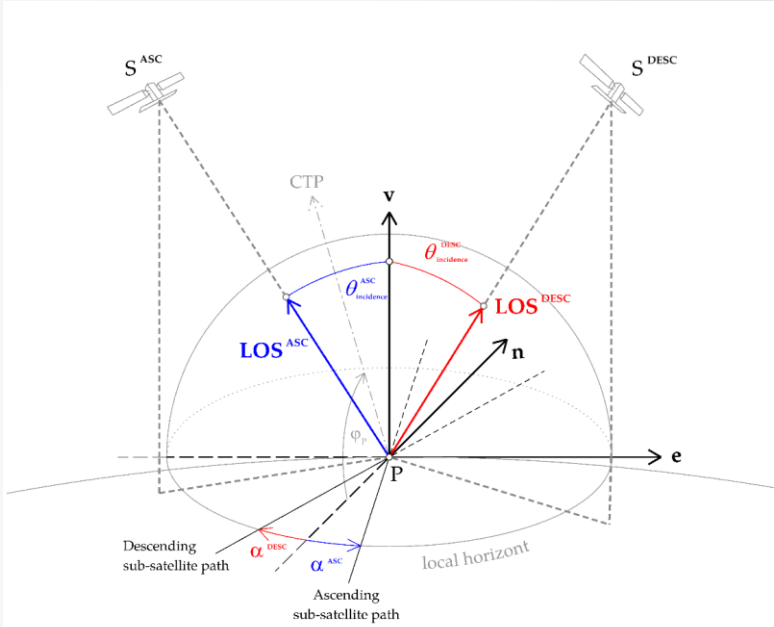
- SNT1 ASC175/DSC51
- 2021/02 - 2022/10

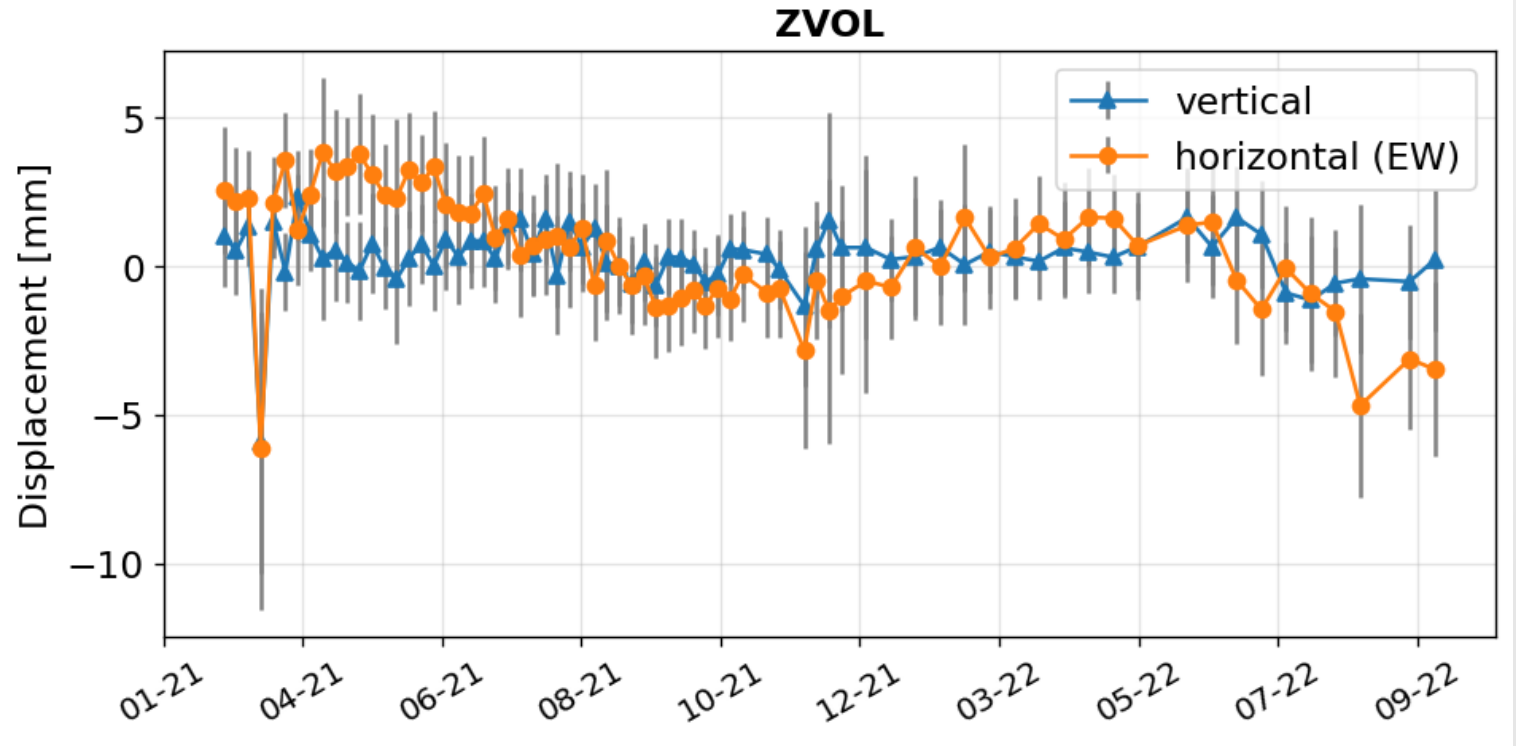


Czikhardt et al. (2021): Gecoris: An open-source toolbox for analyzing time series of corner reflectors in insar geodesy, DOI: 10.3390/rs13050926

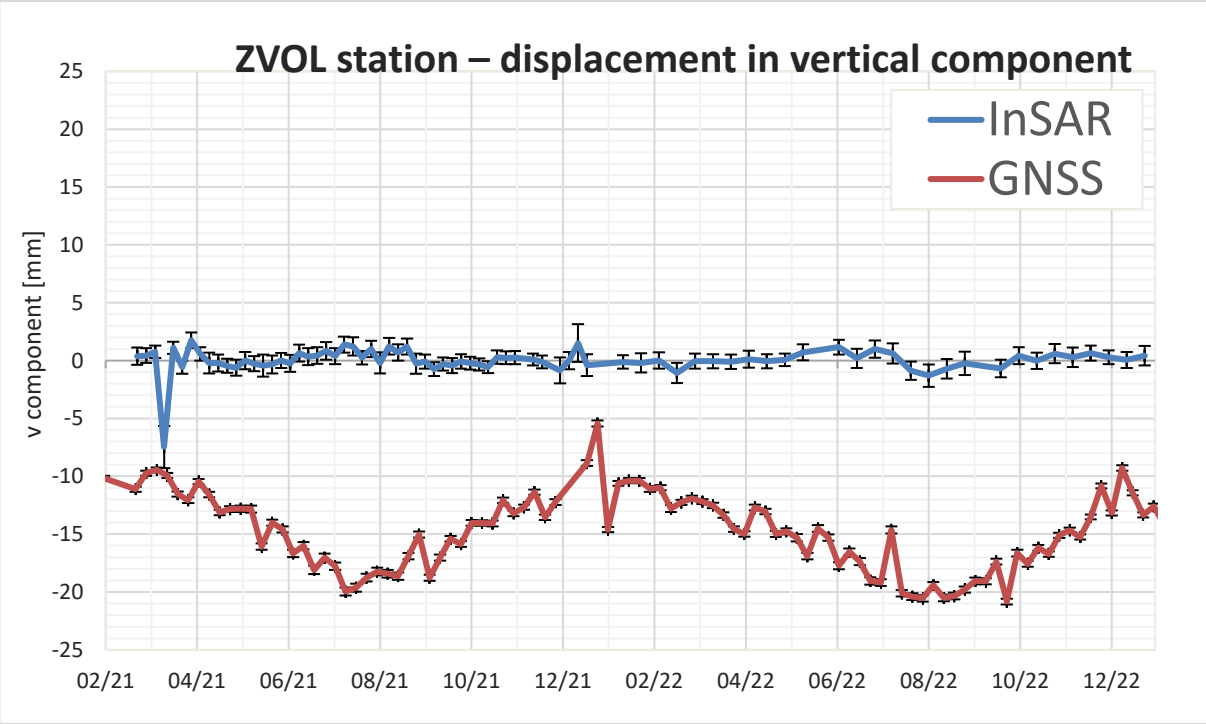
InSAR – LOS displacement and decomposition (station ZVOL)

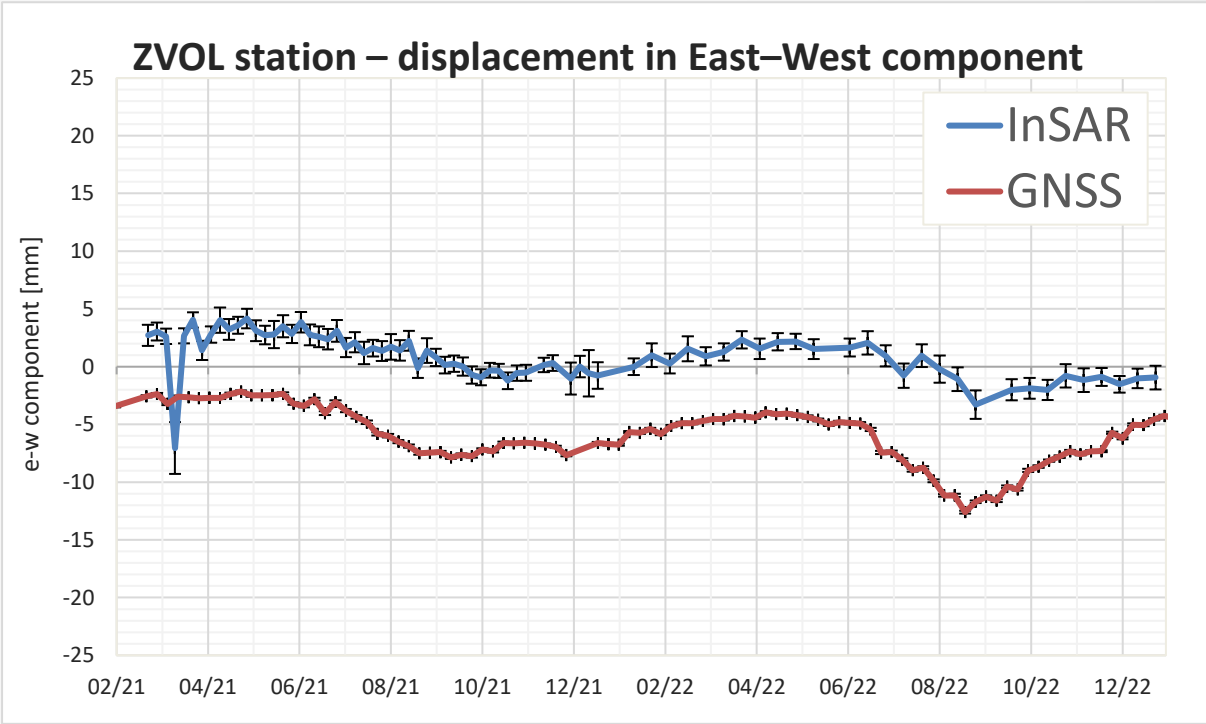




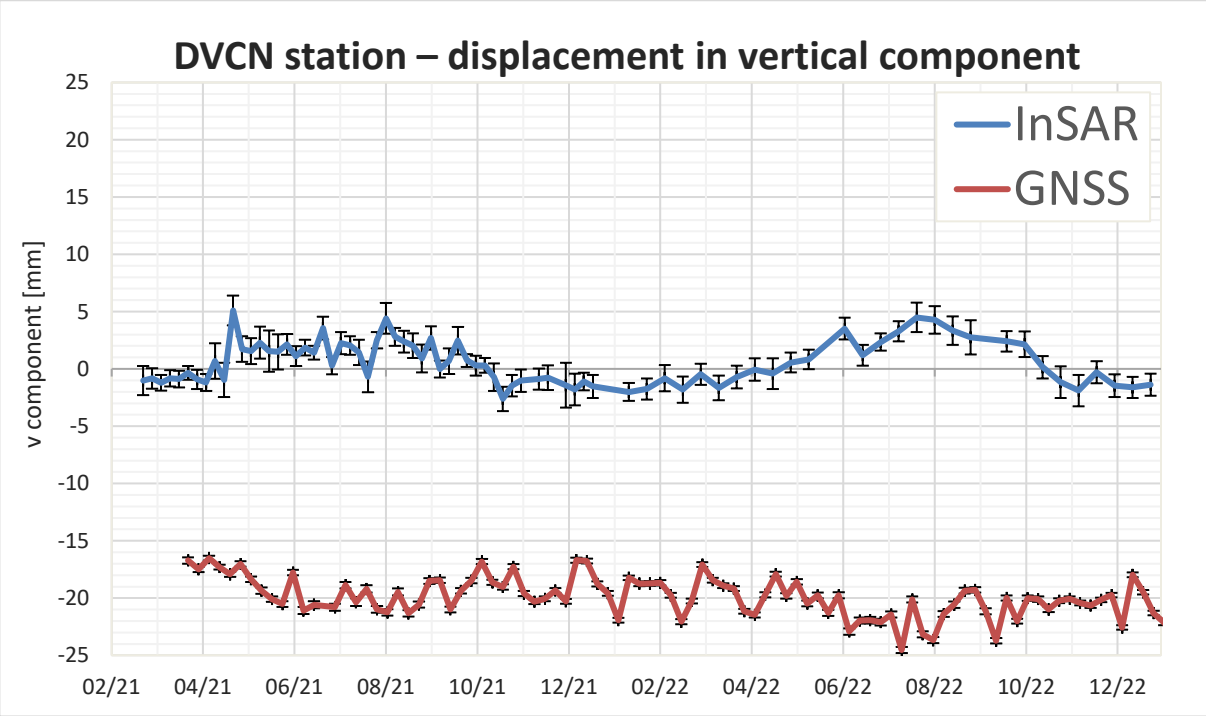


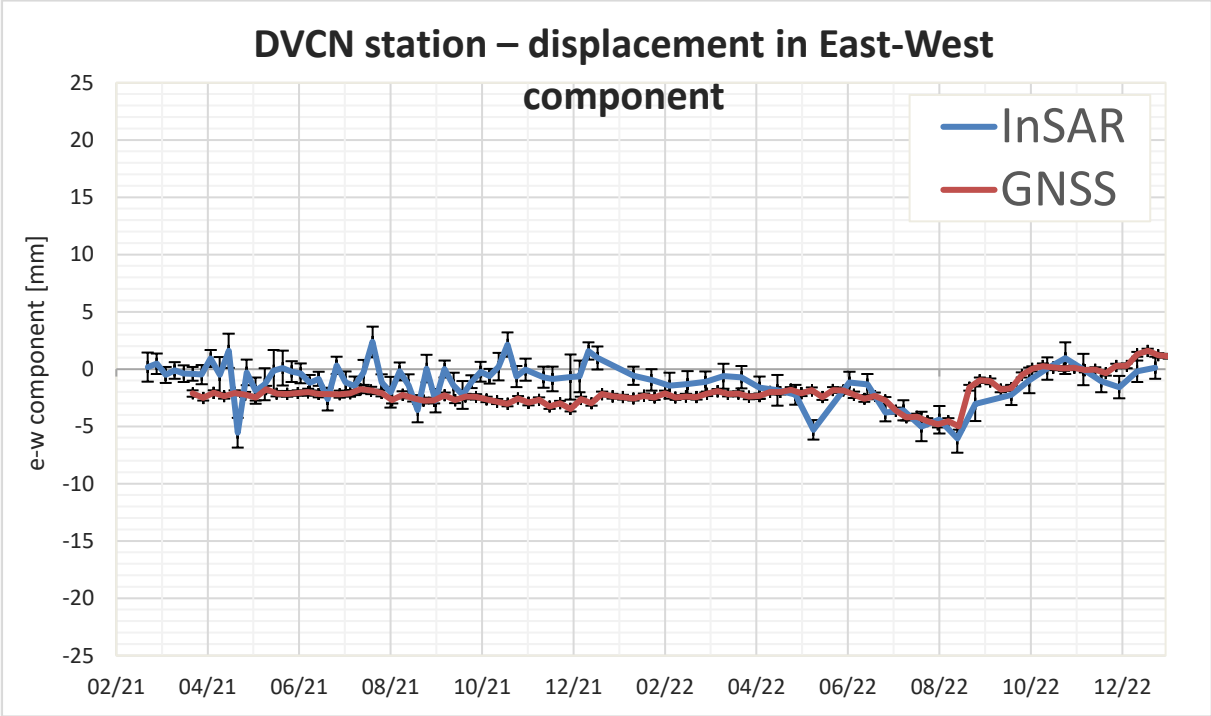
InSAR vs GNSS displacement comparison - local InSAR network vs GNSS (station ZVOL)





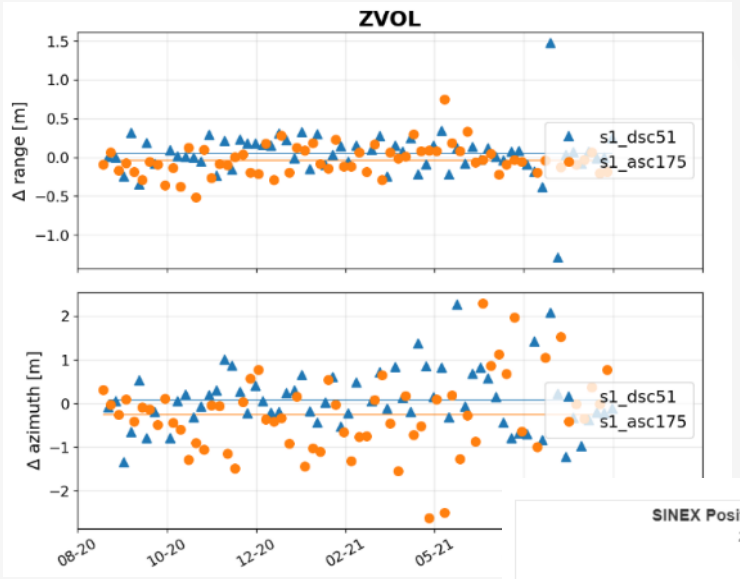
InSAR vs GNSS displacement comparison - local InSAR network vs GNSS (station DVCN)

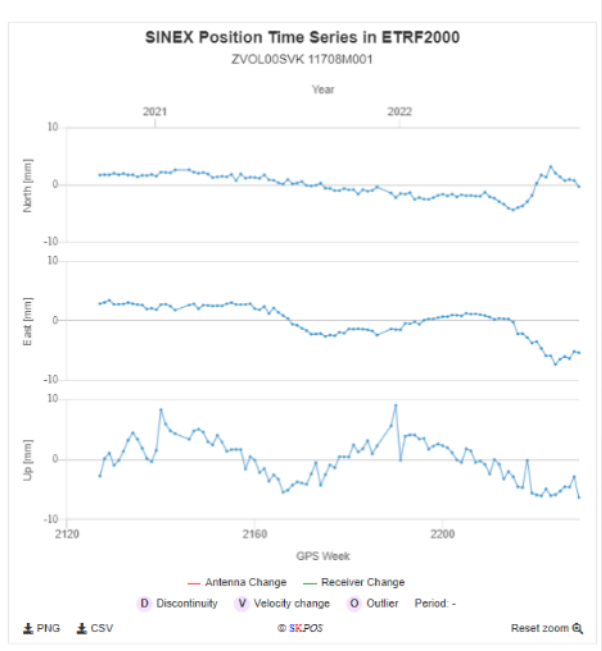




Plans and next steps

- to finish „National InSAR reflector network“ and start providing of the reflector phase center coordinates for referencing
- to compute displacement and do comparison on all GNSS/InSAR SKPOS collocation sites
- to check some stations with different behaviour in time series
- to create the state wide referenced displacement maps from InSAR
- to set (vertical) monitoring of whole Slovakia





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Thank you for your attention

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EUPOS
European Position Determination System

9th EUPOS Technical meeting

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