GNSS – InSAR collocation in Slovakia

(Building up of the National reflector network)

Branislav Droščák[1], Juraj Papčo[2]

branislav.droscak@skgeodesy.sk, juraj.papco@stuba.sk

[1]Geodetic and Cartographic Institute Bratislava

[2]Slovak university of Technology in Bratislava

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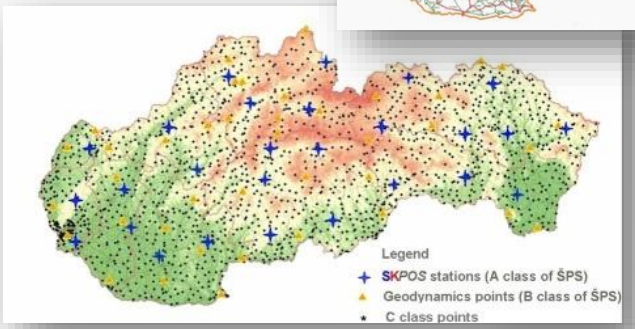
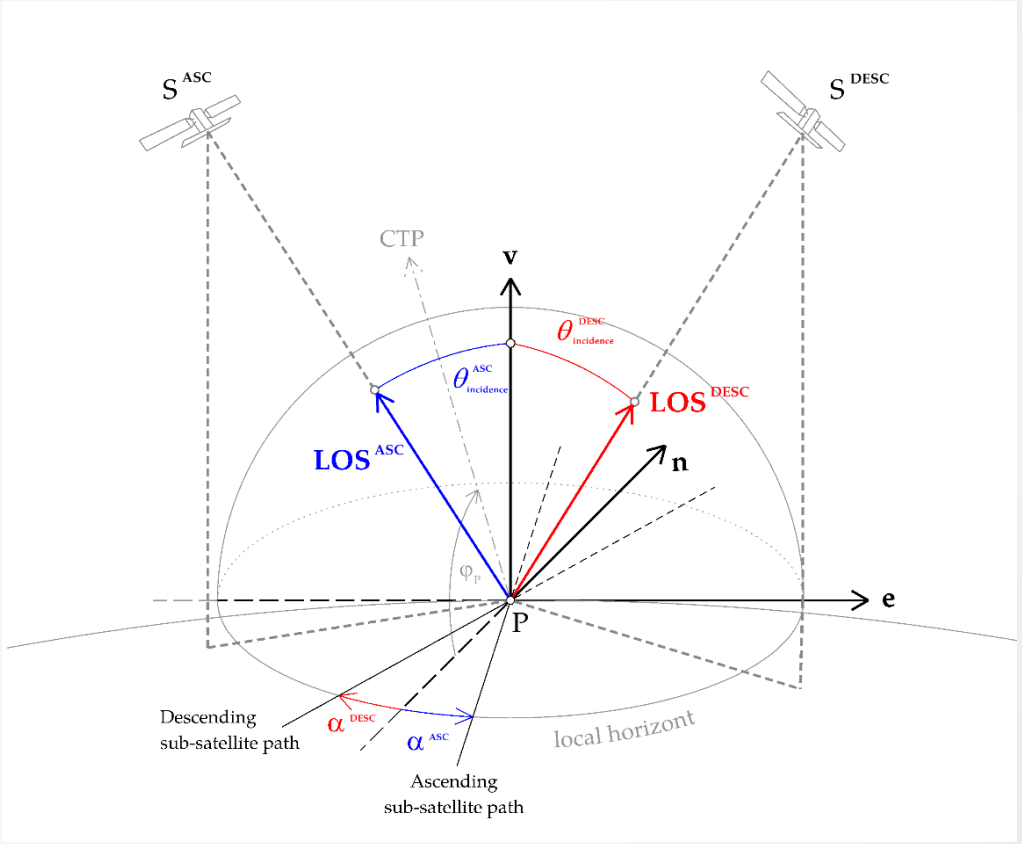
Geodetic networks in Slovakia

Network	Geodetic reference system representation
National spatial network	ETRS89
National trigonometric network	S-JTSK (national positioning system)
National levelling network	Baltic after adjustment (1957) EVRS
National gravimetric network	S-Gr95
„National InSAR reflector network“	ETRS89 (means referencing of InSAR images to ETRS89)



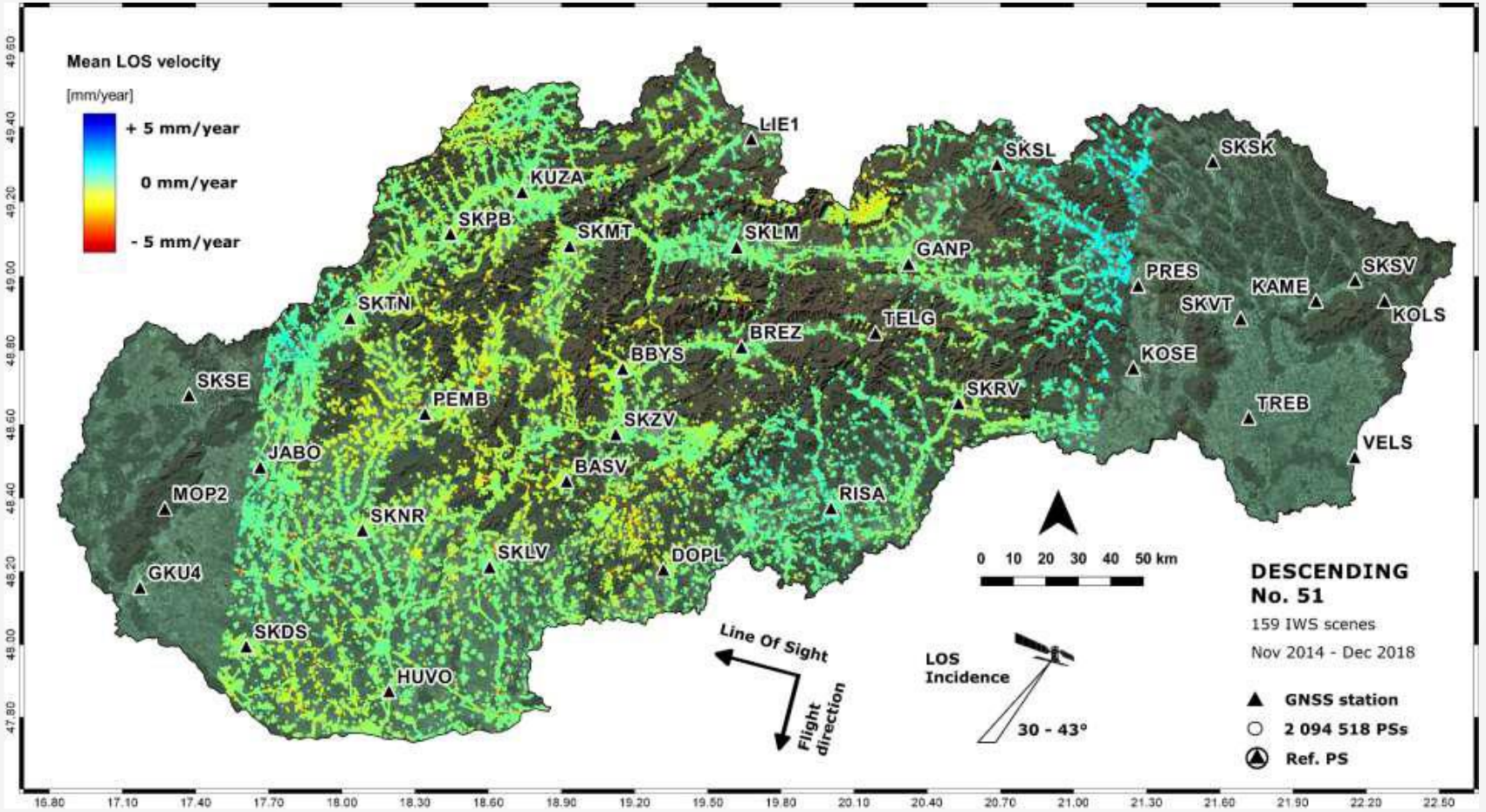
Why „National InSAR reflector network“?

- **InSAR** (Interferometric Synthetic Aperture radar) is:
  - a new geodetic technique
  - as a technique has ability to detect and provide submillimeter information about HZ and V changes of natural or artificial reflectors (in LOS geometry)
  - „relative“ technique - needs geodetic referencing to provide changes in absolute values
  - accurate coordinates of artificial InSAR reflector will enable to do correct absolute referencing of InSAR images to ETRS89
- **National InSAR reflector network**
  - will consist of set of artificial reflectors with precise coordinates of its phase centers
  - results from referenced InSAR images processing will be used e.g. for detailed vertical monitoring of whole Slovakia

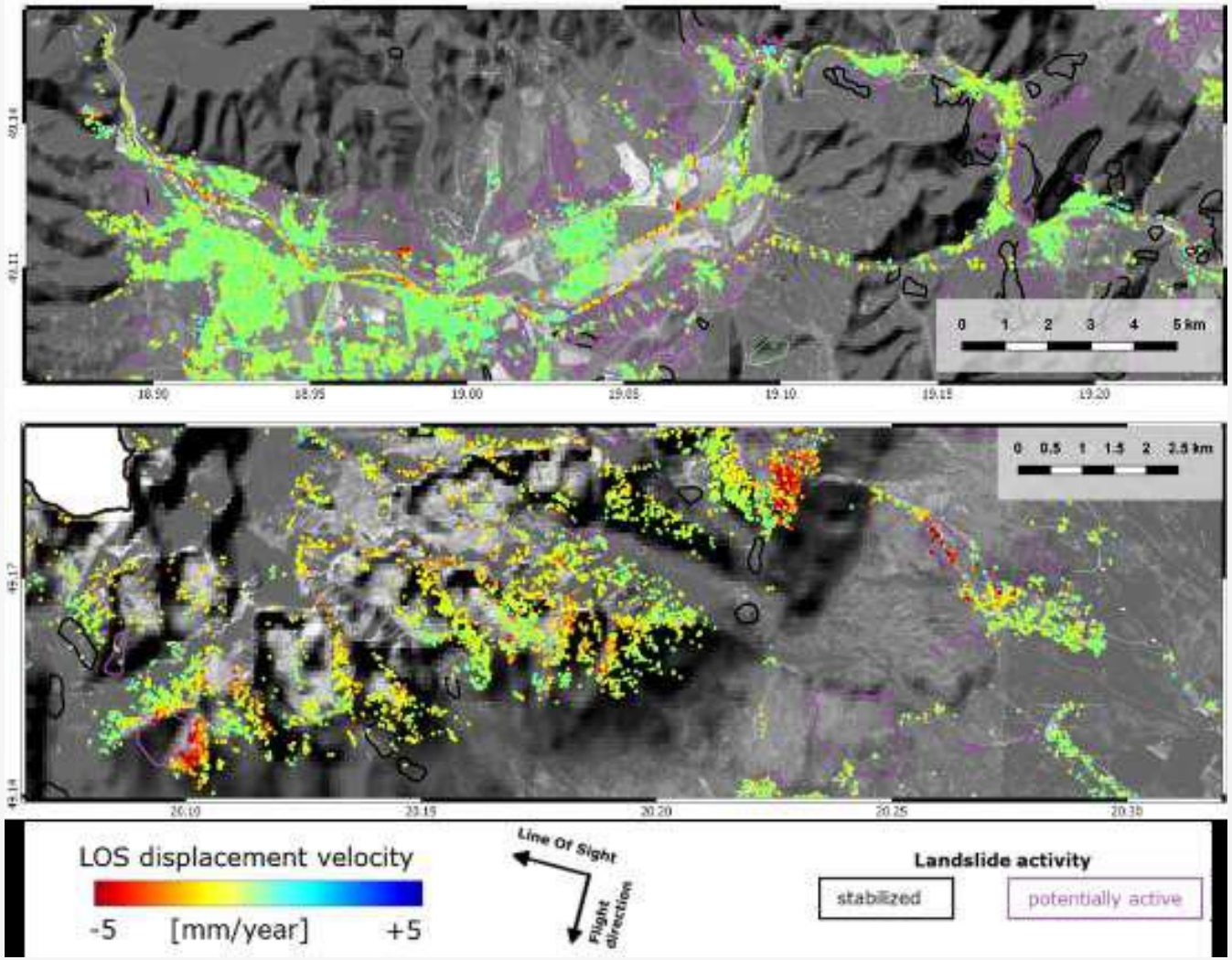


Why „National InSAR reflector network“?

State wide vertical monitoring = doing levelling only where it will be needed



Why „National InSAR reflector network“?
Regional monitoring = suitable also for geologists



Decision in Slovakia:
To collocate InSAR with GNSS on SKPOS CORS

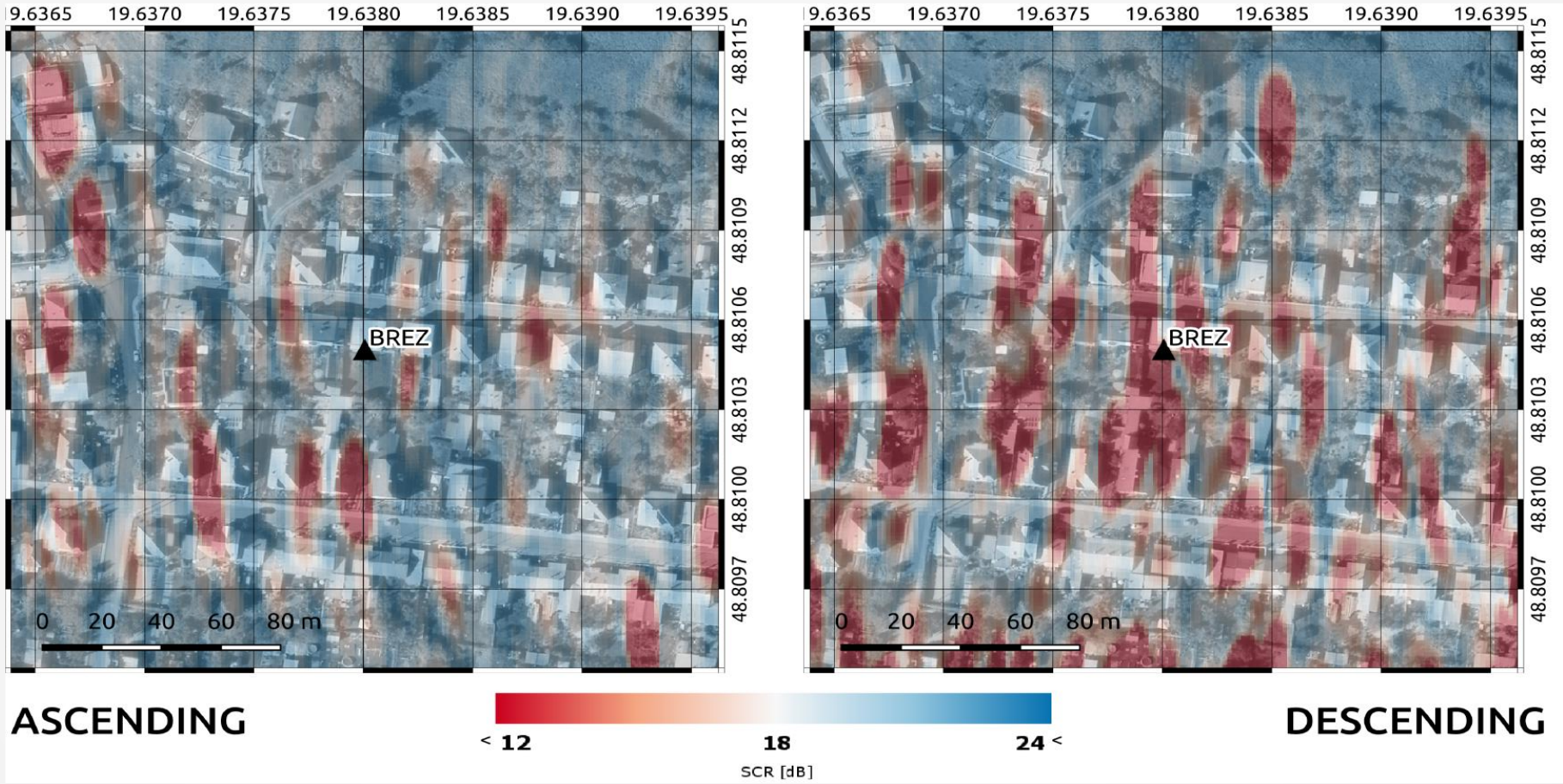
- Why?
  - there are enough and well distributed SKPOS CORS across whole country
  - we can compare precise (mm) HZ or V changes got from both techniques (GNSS and InSAR)

- Final decision:
  - to built up InSAR network in collocation with SKPOS CORS (not all)
  - station design - inspiration was taken from Netherlands (EUREF symposium Amstredam 2018)
  - study first: Slovak university of technology checked suitability of all SKPOS CORS for InSAR reflectors installation

Checking of SKPOS CORS suitability for InSAR reflector installation via SCR (signal to clutter ratio)

- example of „**BAD**“ station (less than 20 dB)

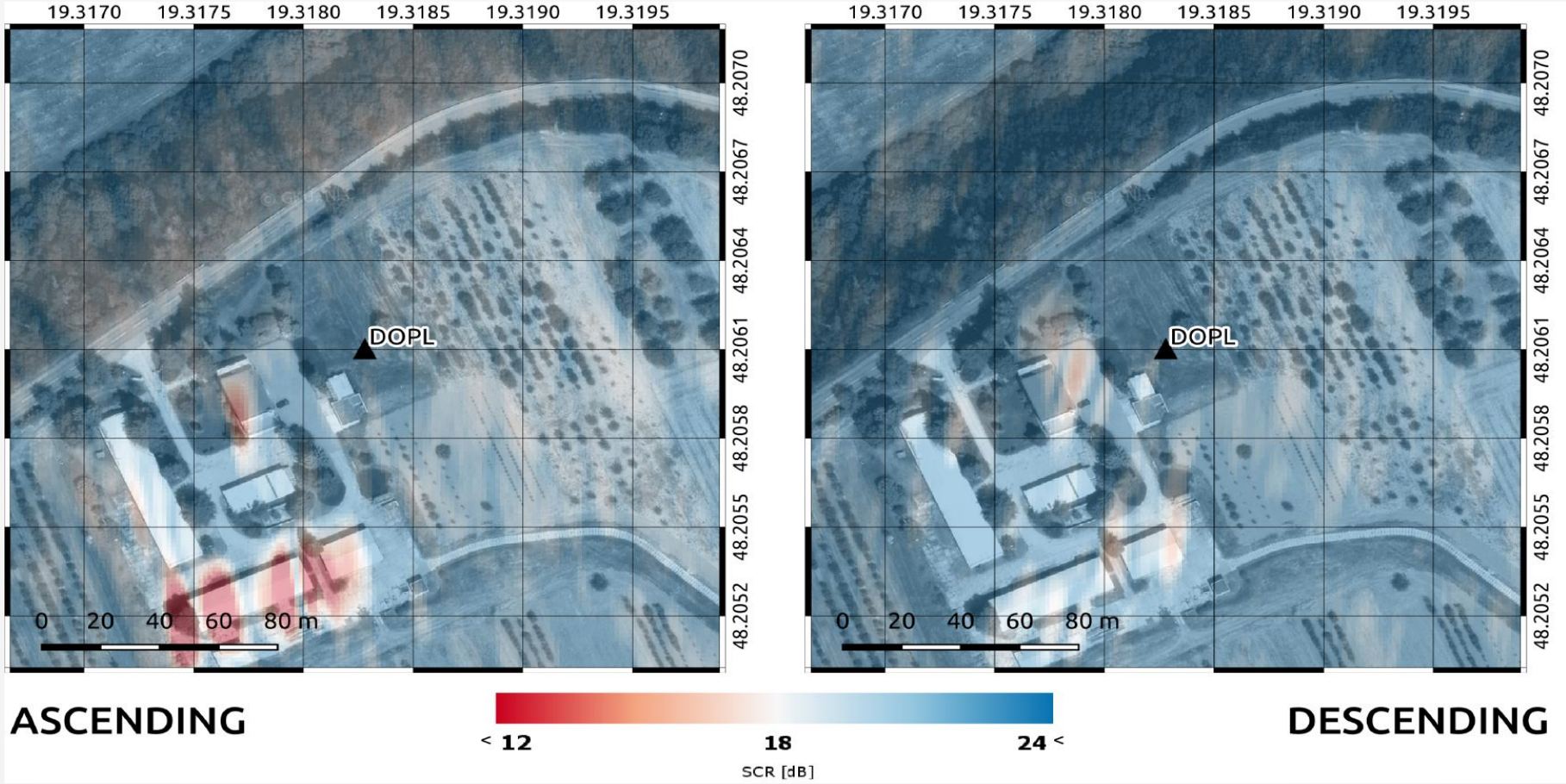
$$\sigma_{LOS} < 0.5\ mm \Longrightarrow SCR > 20\ dB$$



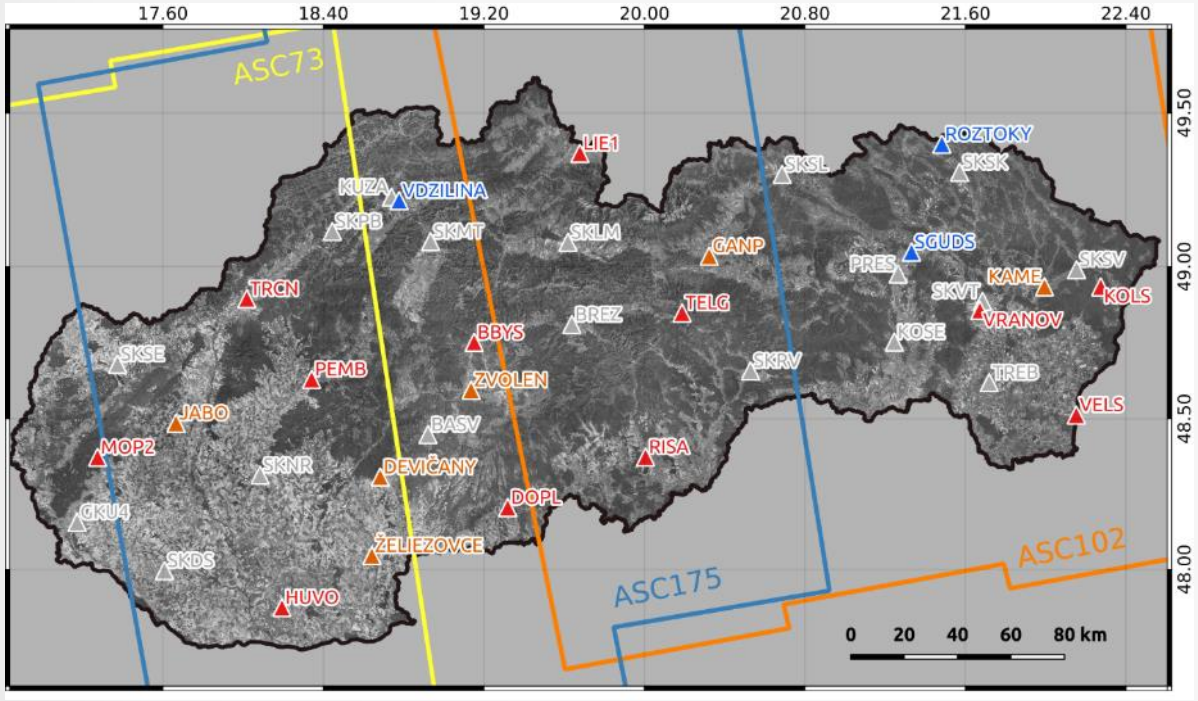
Checking of SKPOS CORS suitability for InSAR reflector installation via SCR (signal to clutter ratio)

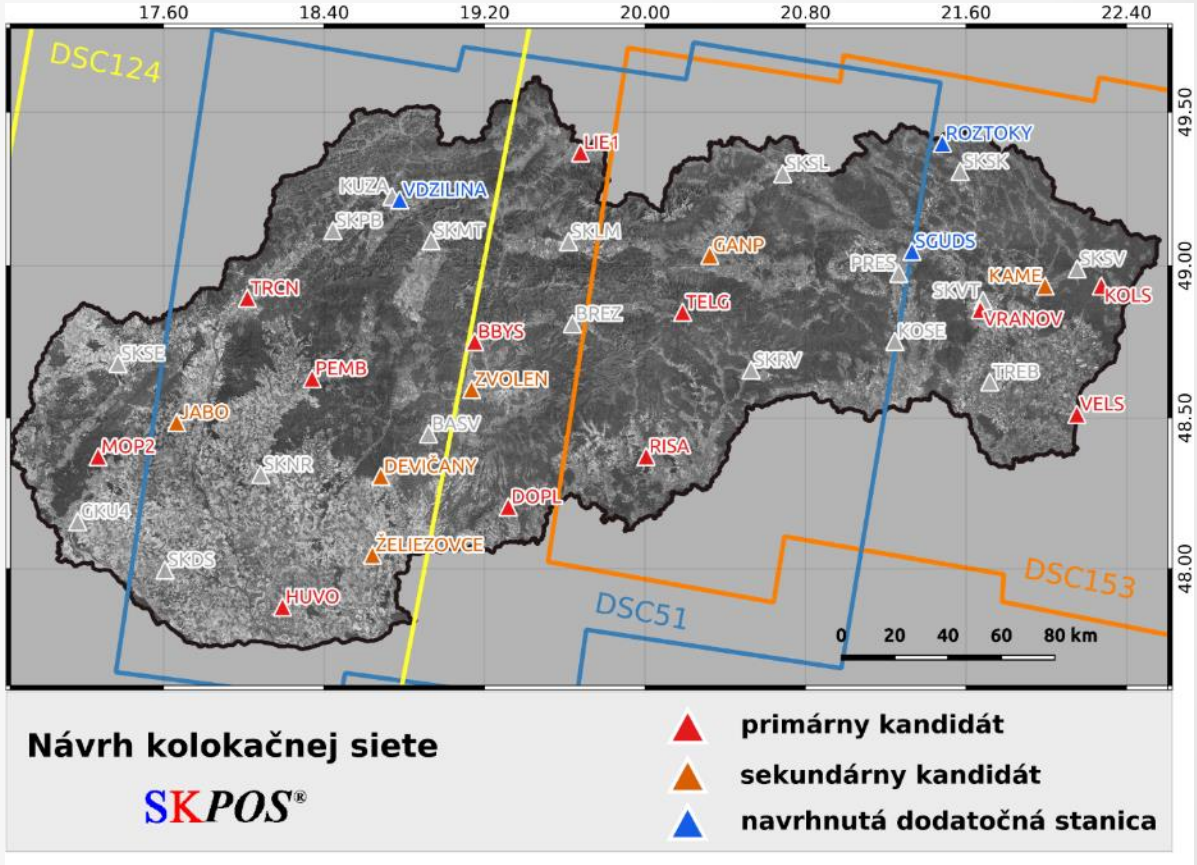
- example of „**GOOD**“ station (more than 20 dB)

$$\sigma_{LOS} < 0.5\ mm \Longrightarrow SCR > 20\ dB$$

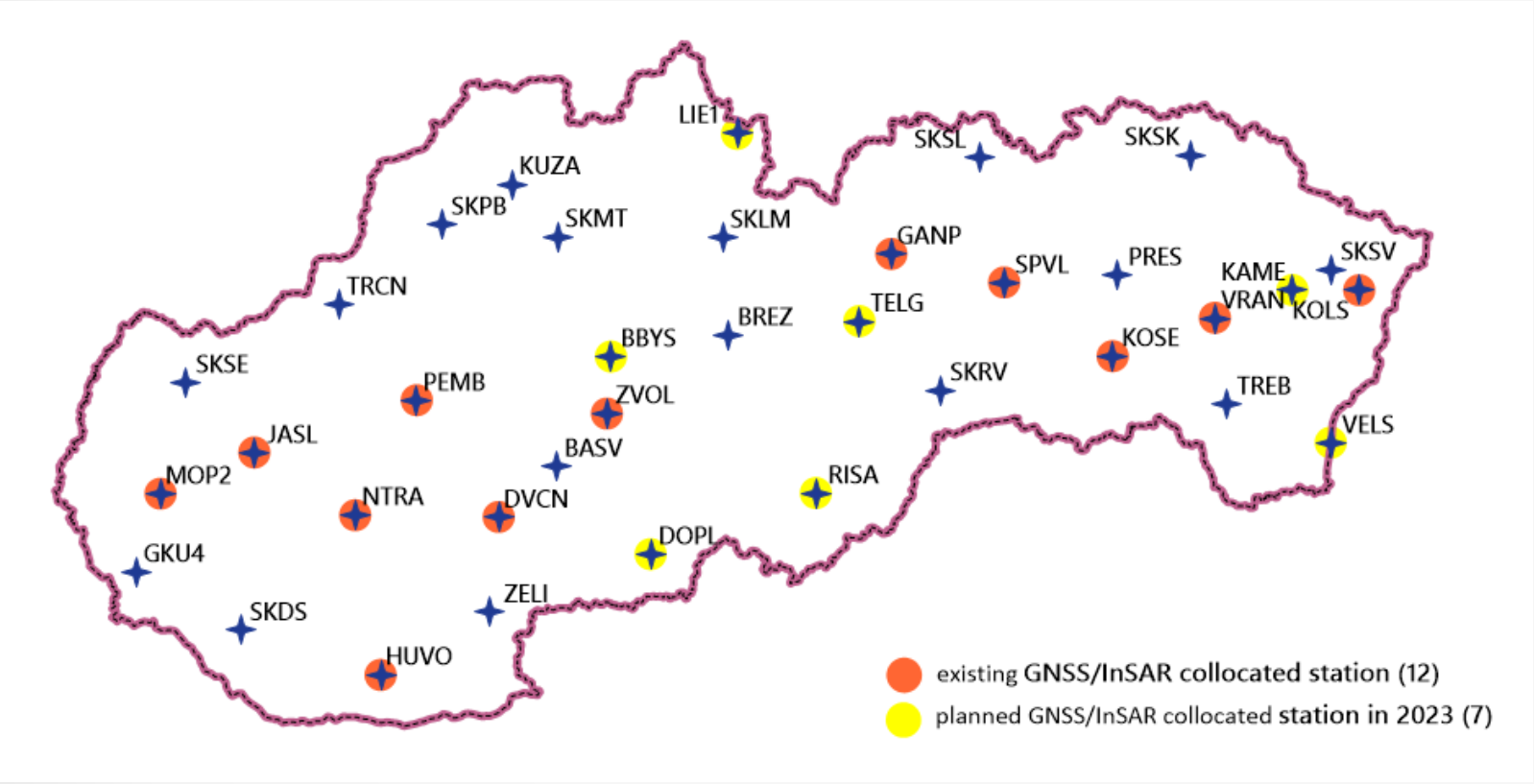


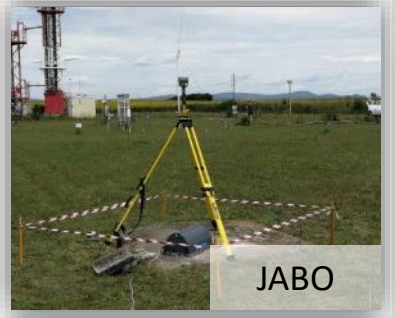
Final proposal for SKPOS - GNSS / InSAR collocation sites





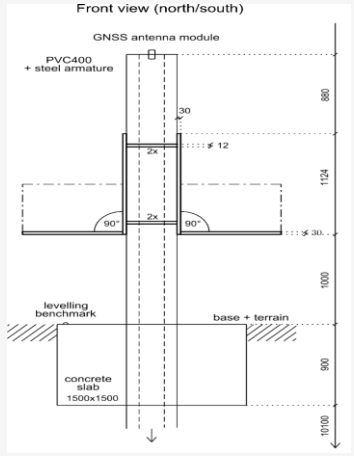
SKPOS GNSS/InSAR collocation sites (status in May 2023 = 12 sites)

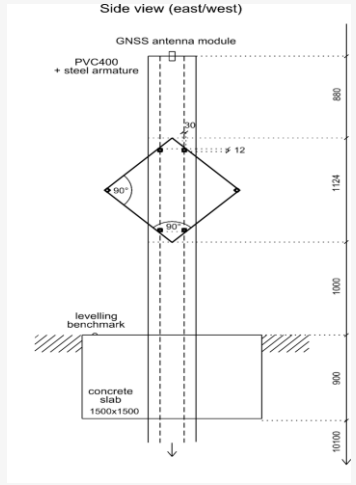


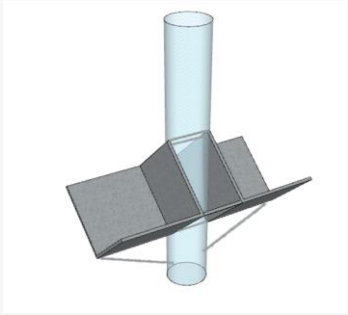


GNSS/InSAR collocation site with passive reflector – slovakian design

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





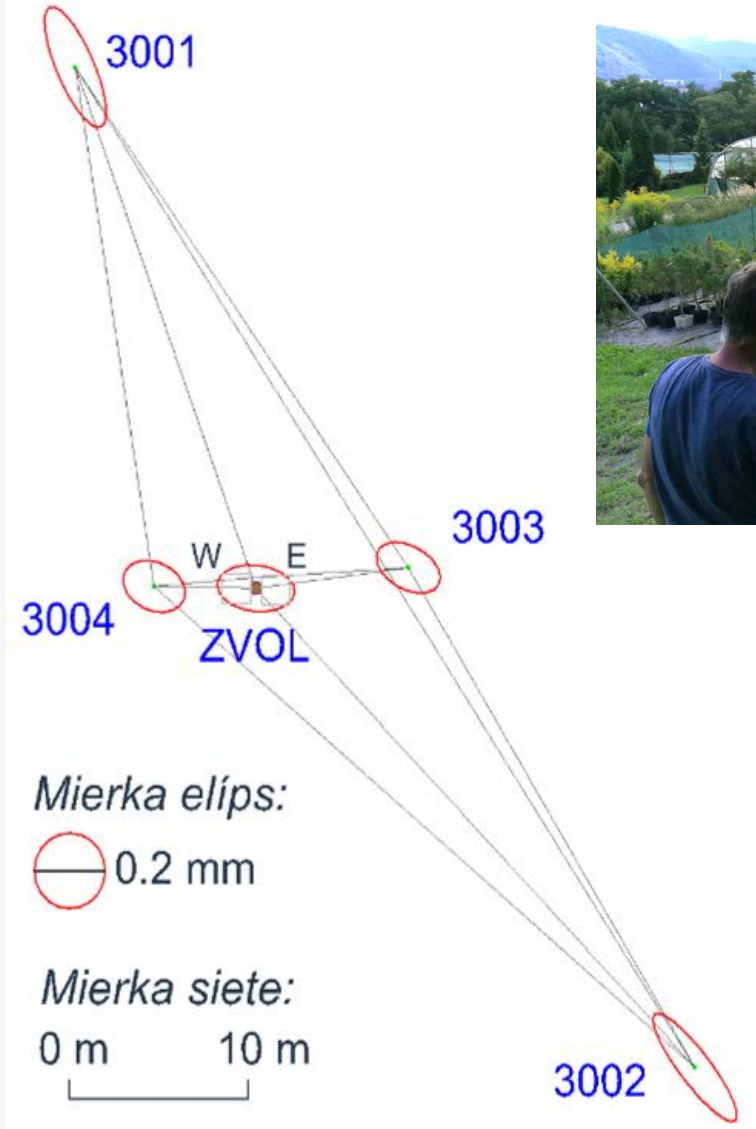


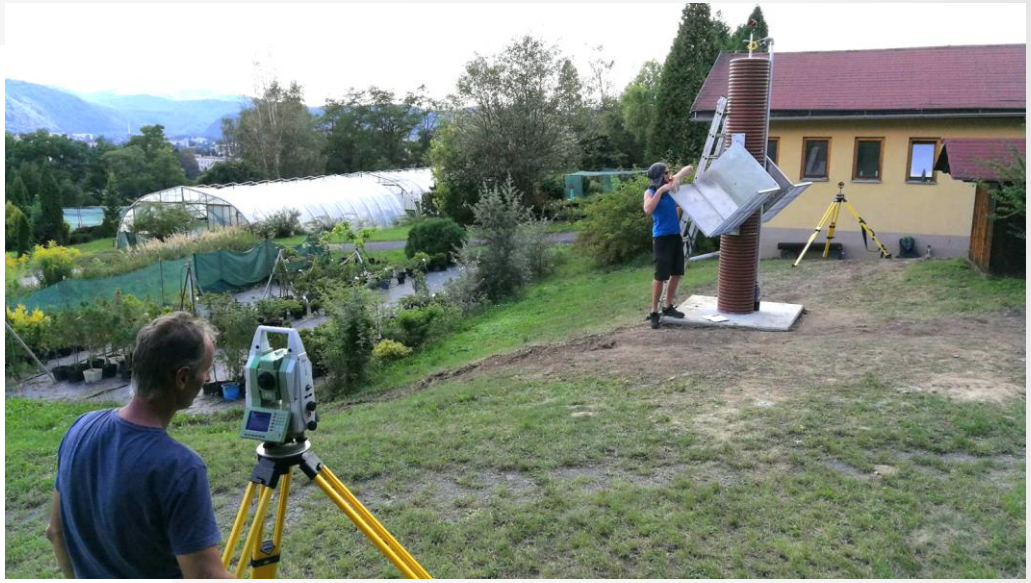
GNSS/InSAR collocation site with passive reflector
Instalation on the new SKPOS CORS (new pillar)

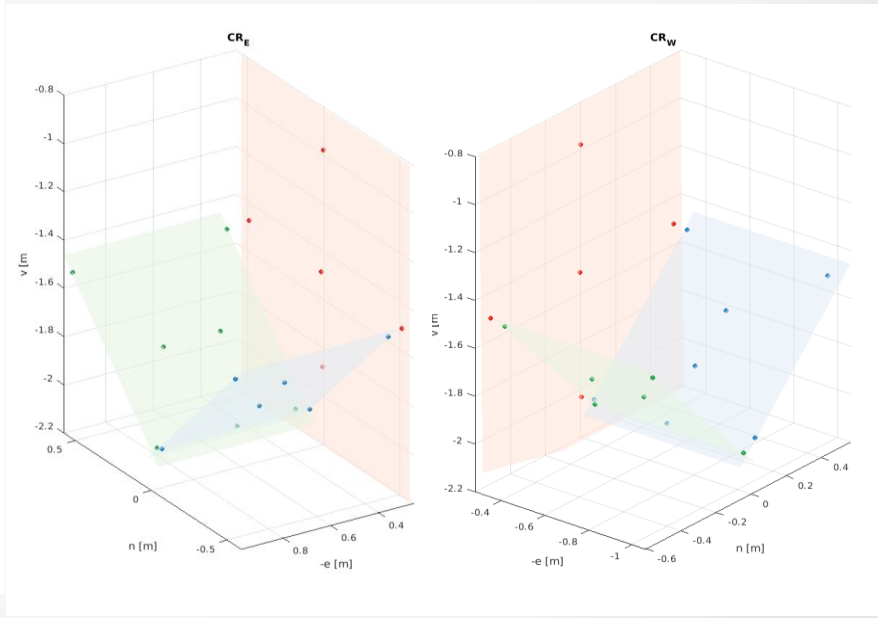
GNSS/InSAR collocation site with passive reflector
Instalation on the existing SKPOS pillar

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

Determination of passive InSAR reflector phase center coordinates is very important





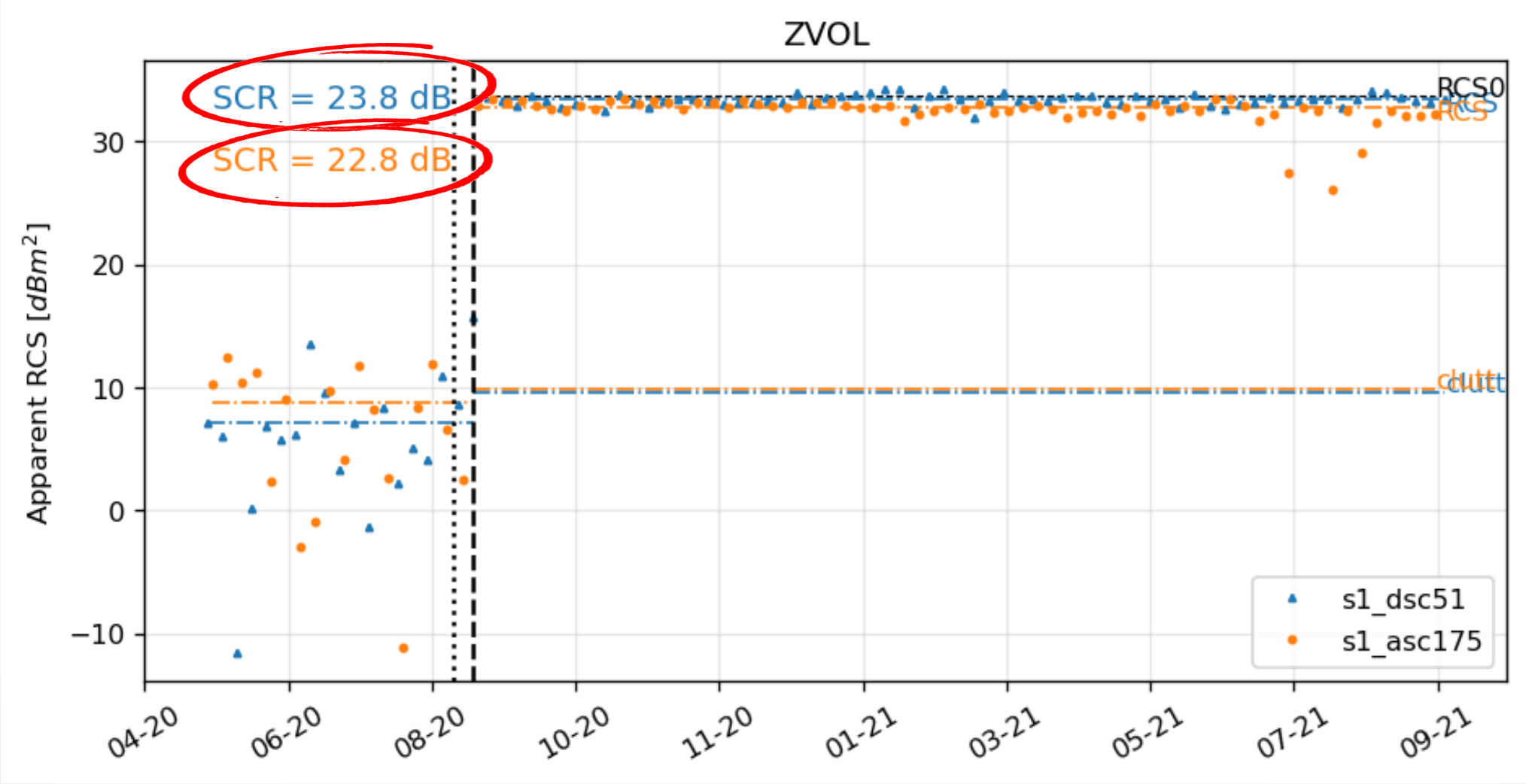


ZVOL (Zvolen, SR)

SKPOS®

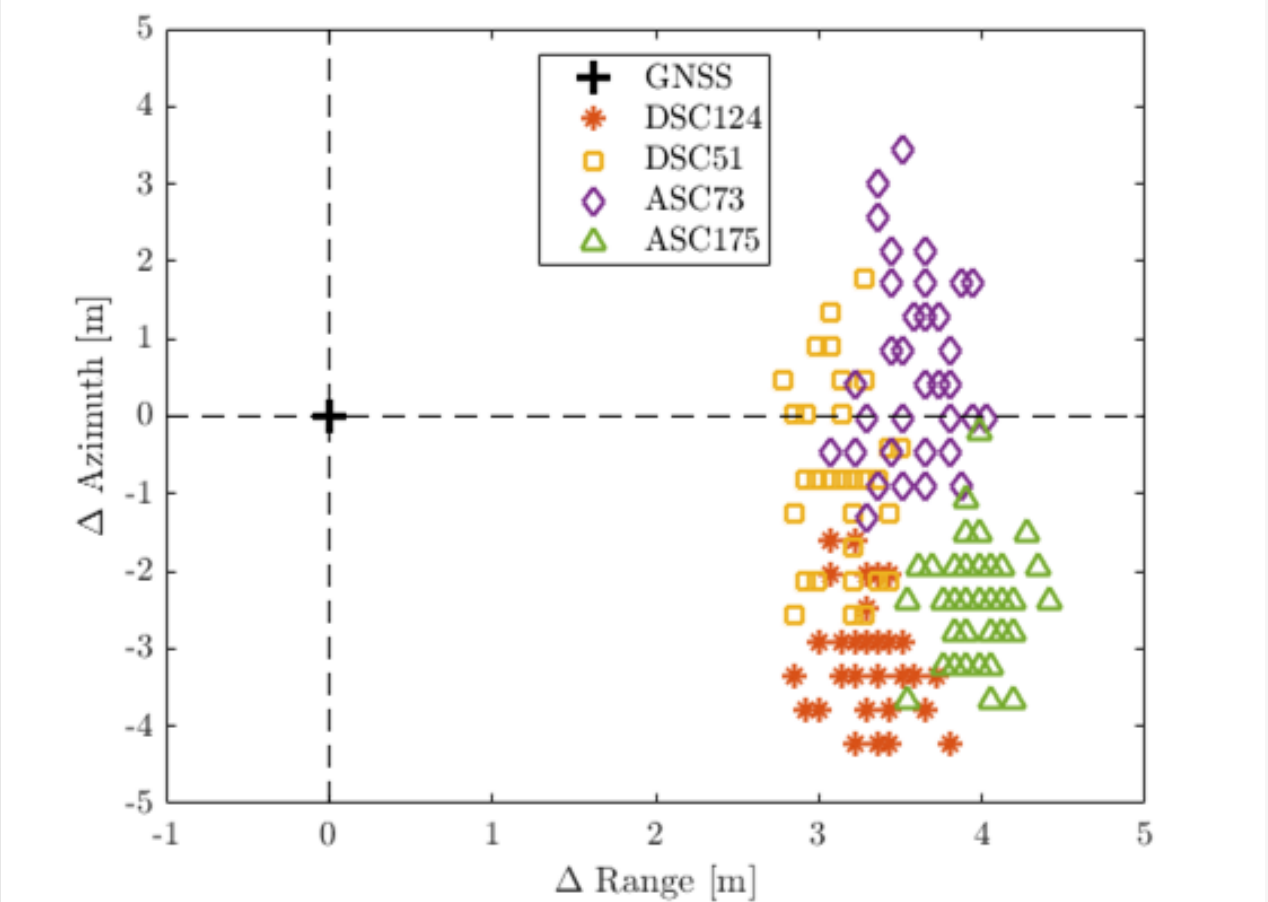
Determination of passive InSAR reflector phase center coordinates is very important

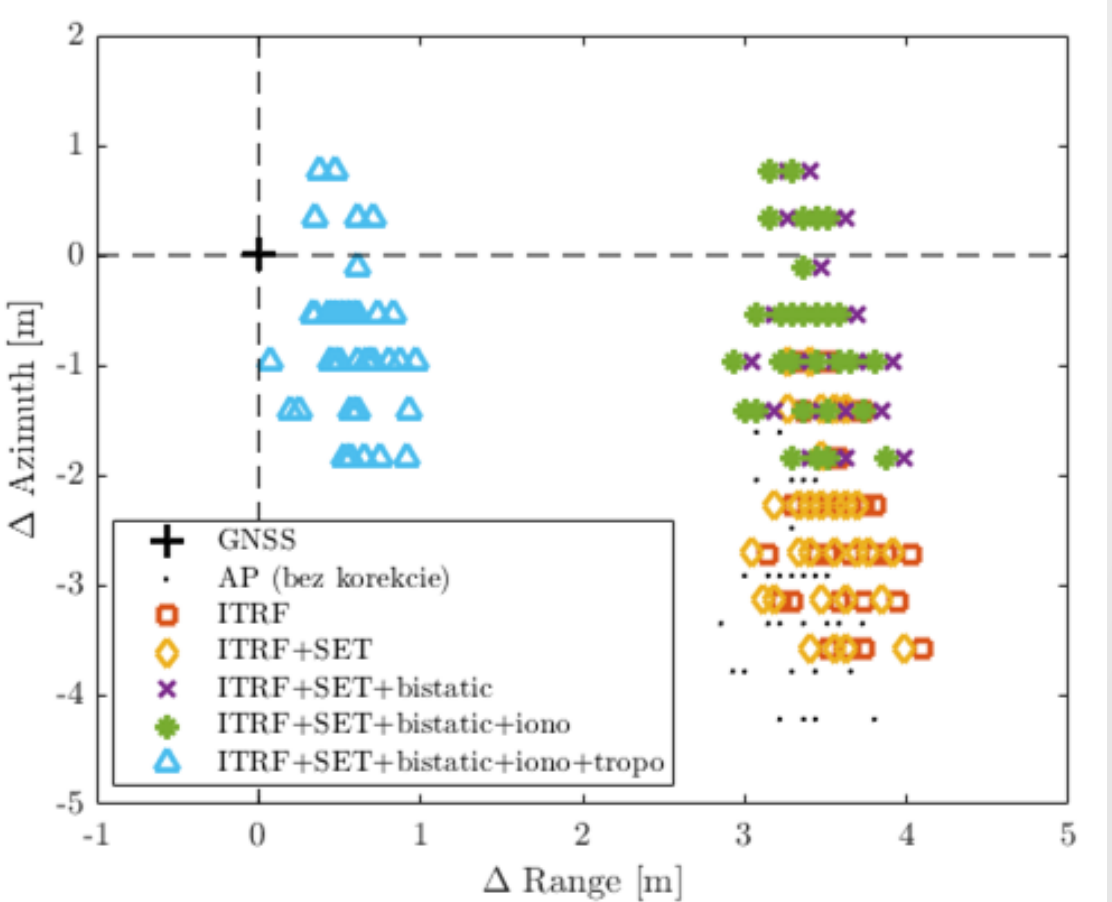
Quality check of collocation stattion after instalation (SCR value)



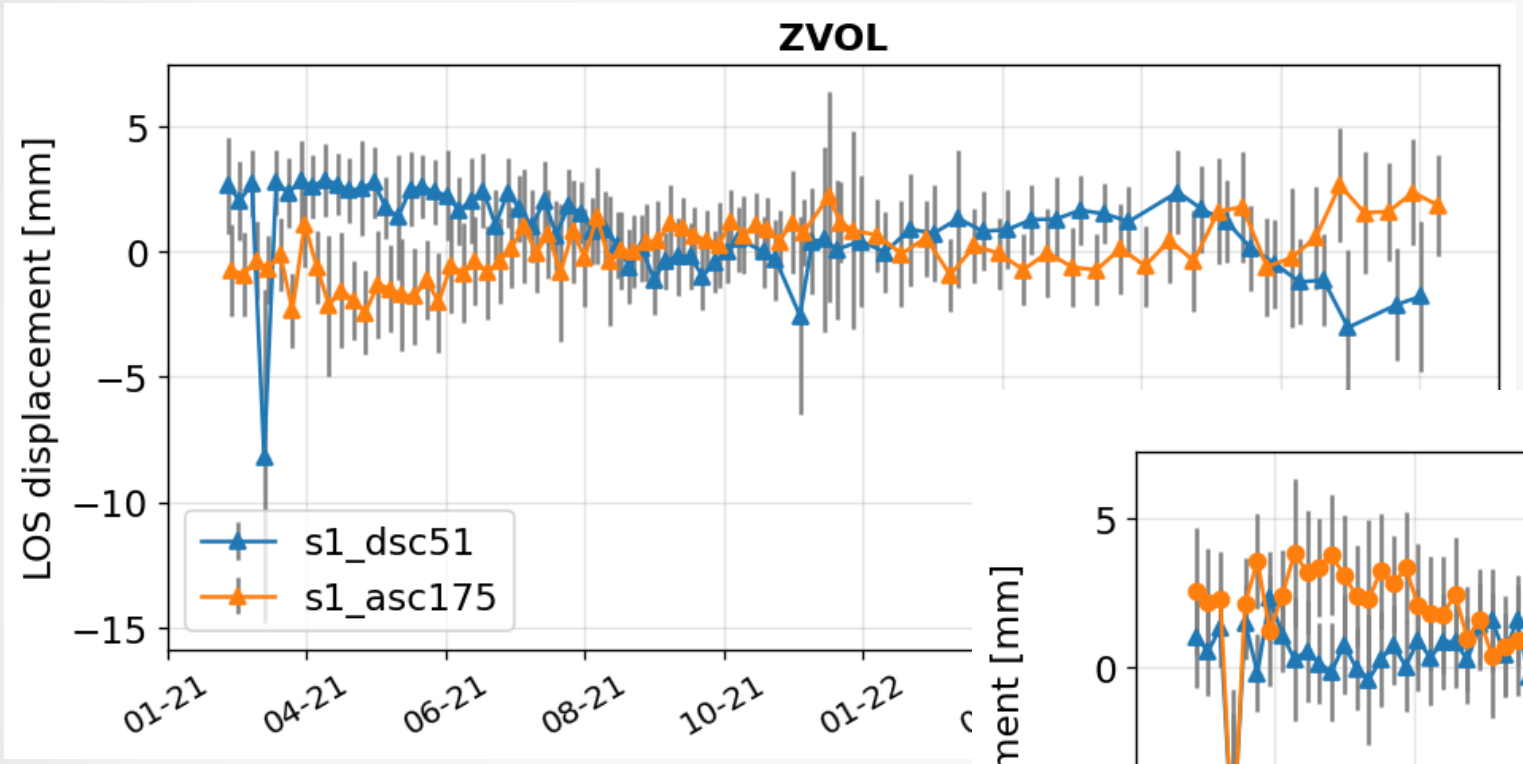
InSAR coordinates corections

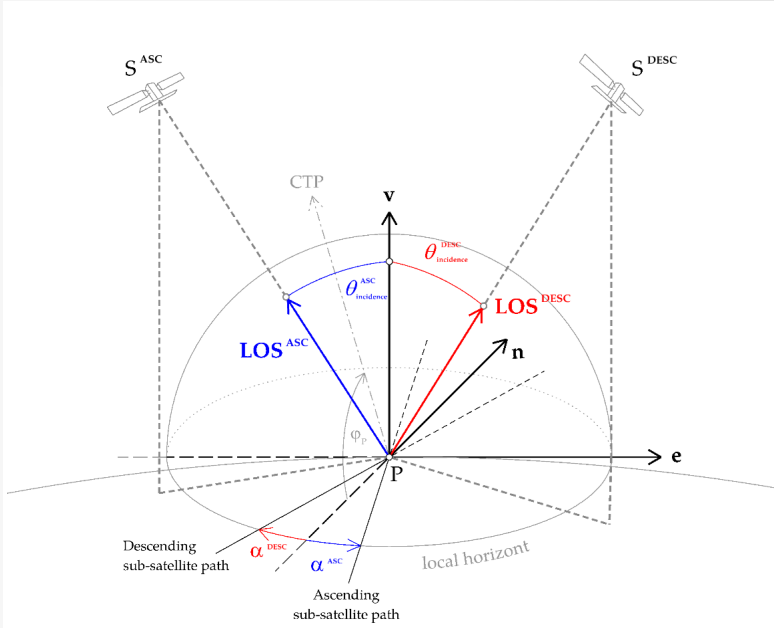
- **InSAR reflector coordionates differences:**
  - true coordinates = coordinates from GNSS/InSAR collocation sites
  - observed coordinates = from Sentinel-1 epoch measurements

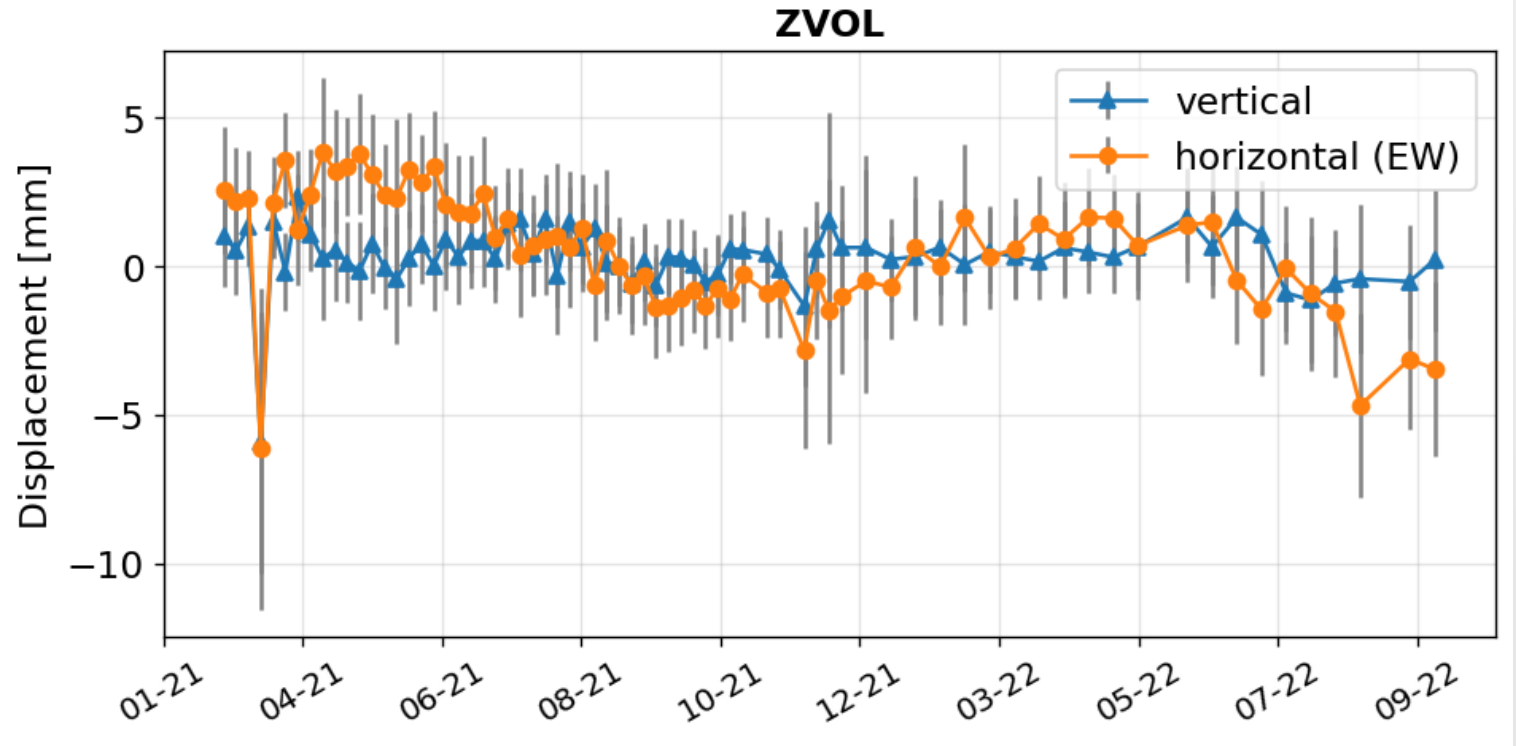




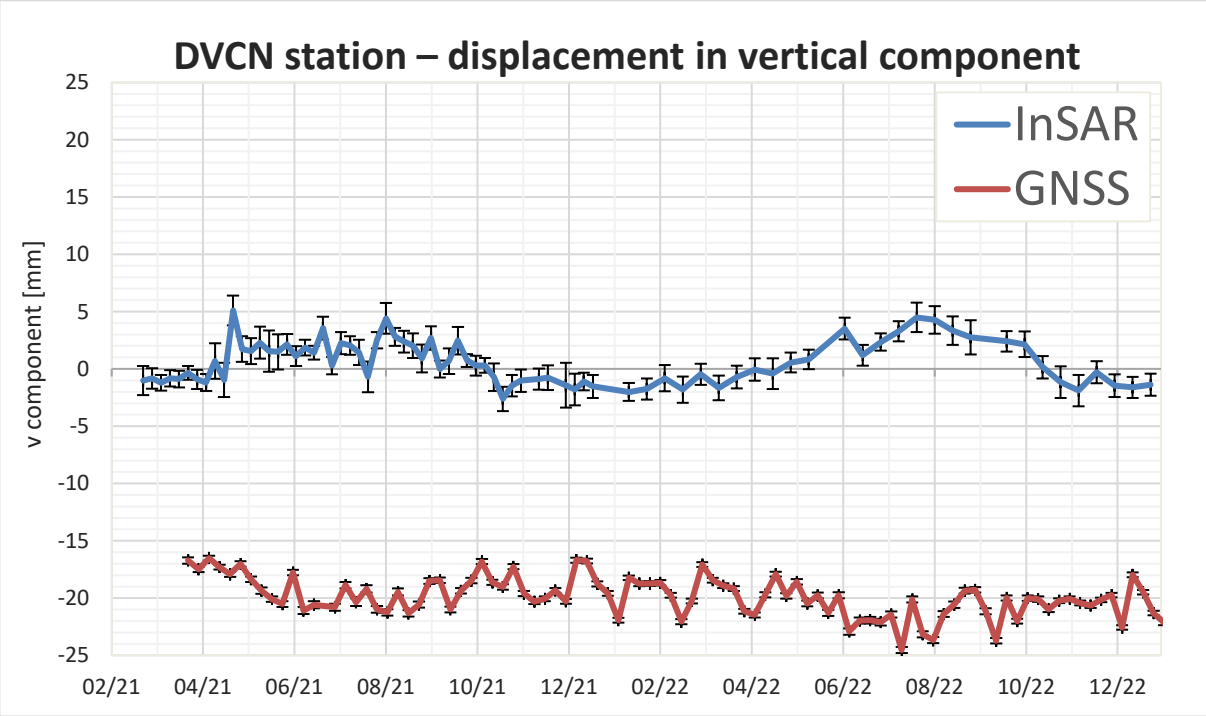
InSAR displacement processing

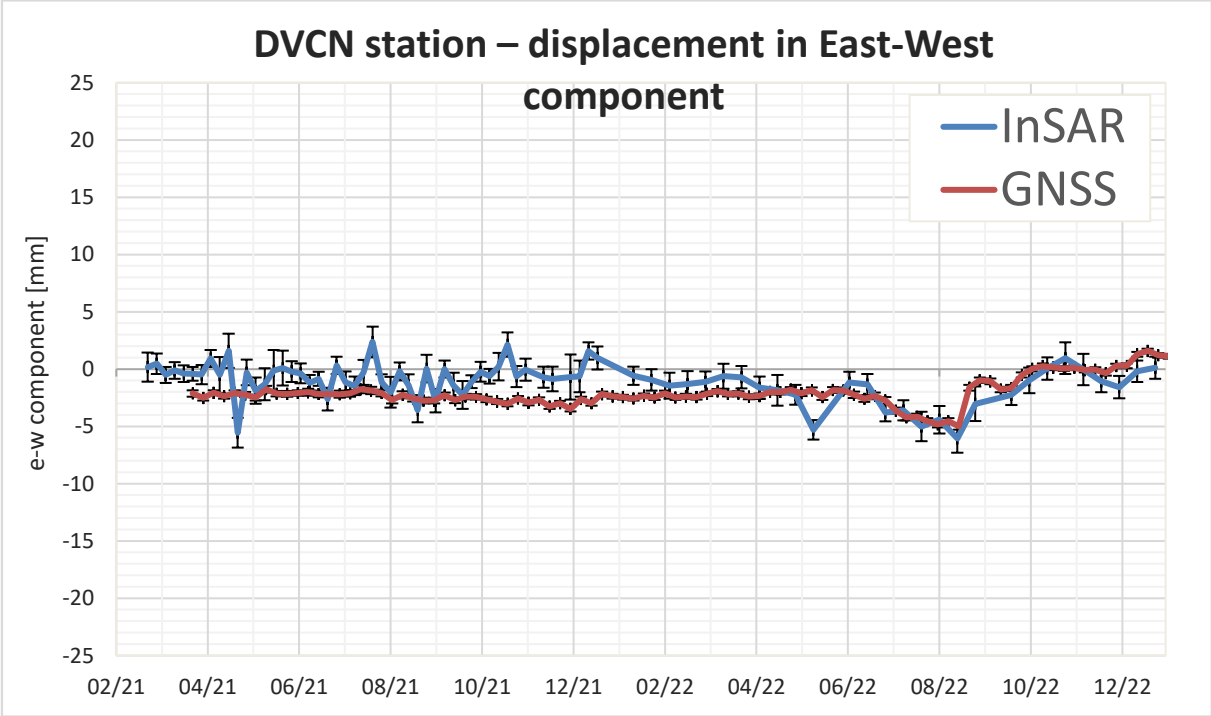






InSAR vs GNSS displacement comparison (local InSAR network vs GNSS)





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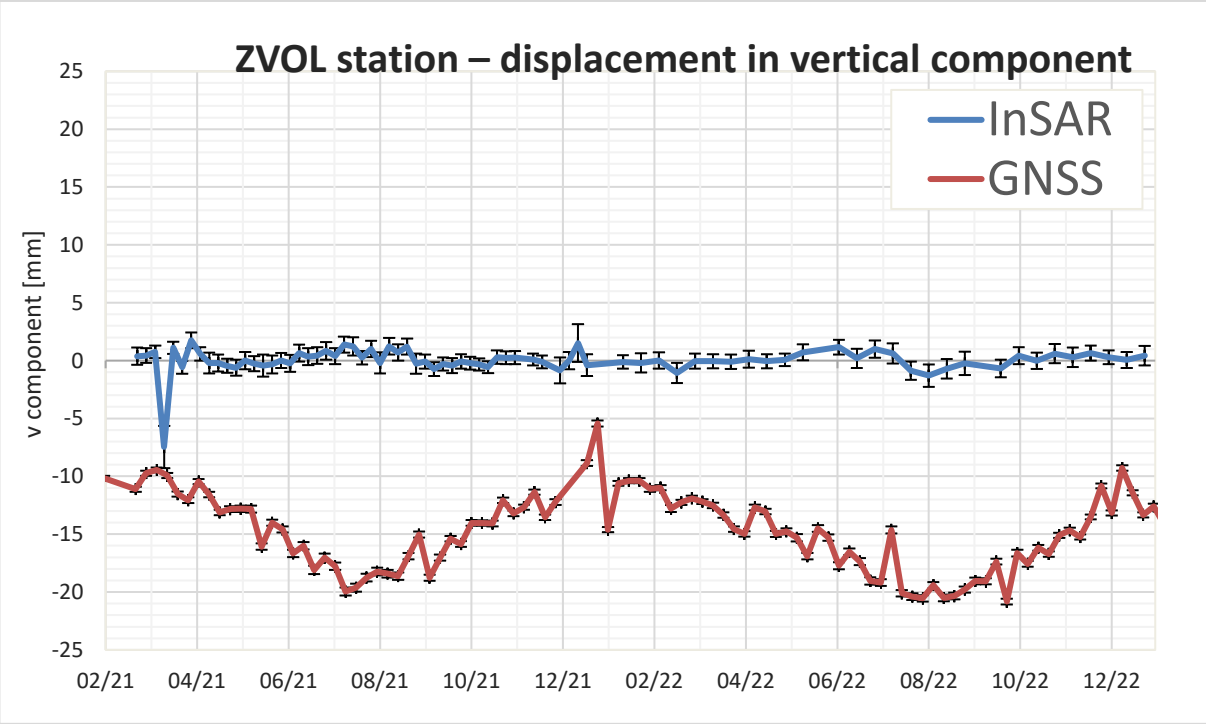
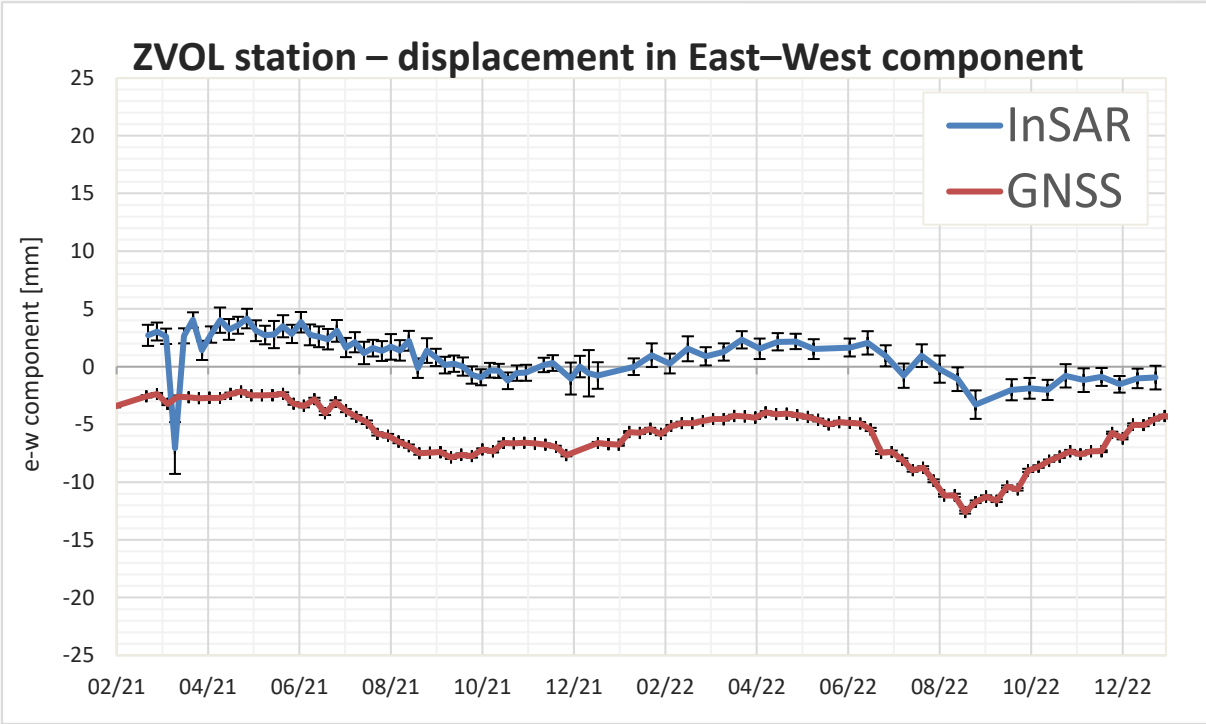
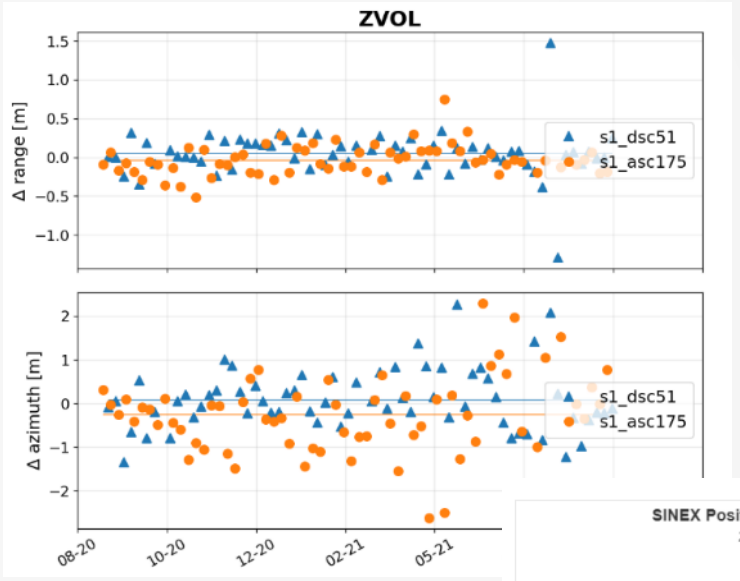
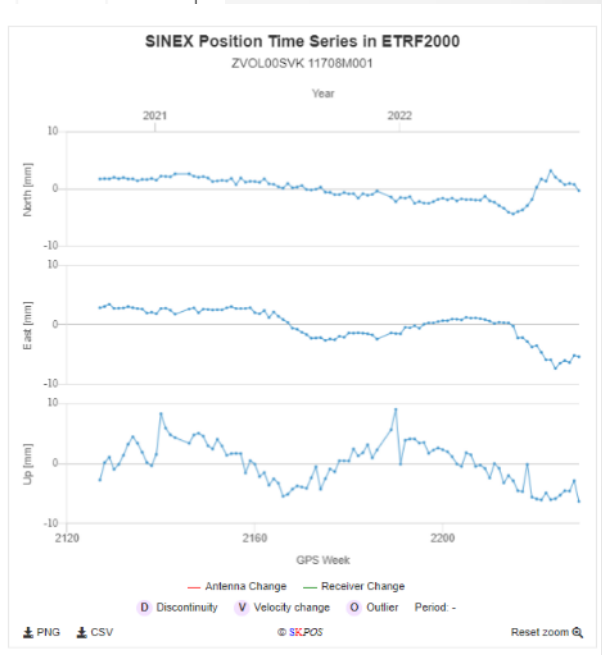




Plans and next steps

- finish „National InSAR reflector network“ and start providing of the reflector phase center coordinates for referencing
- displacement comparison from all GNSS/InSAR collocation sites
- creation of the state wide referenced displacement maps from InSAR
- set (vertical) monitoring of whole Slovakia





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Thank you for your attention

Branislav Droščák

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