COMPLEMENTING THE SWEDISH GEODETIC INFRASTRUCTURE WITH ACTIVE AND PASSIVE REFLECTORS FOR INSAR
- EXPERIENCES AND RESULTS SO FAR -

EUREF SYMPOSIUM, 24-26 MAY 2023

FARAMARZ NILFOUROUSHAN[1,2], NURELDIN AHMED ADAM GIDO[1], CHRISHAN PUWAKPITIYA GEDARA[1], PER-ANDERS OLSSON[1],

1) LANTMÄTERIET, GÄVLE, SWEDEN, 2) UNIVERSITY OF GÄVLE, SWEDEN

LANTMÄTERIET

OUTLINE

- Introduction/background
- Types of reflectors and installation
- Effects on GNSS-coordinates?
- Data analysis and results
- Snow effect
- Summary and outlook

BACKGROUND

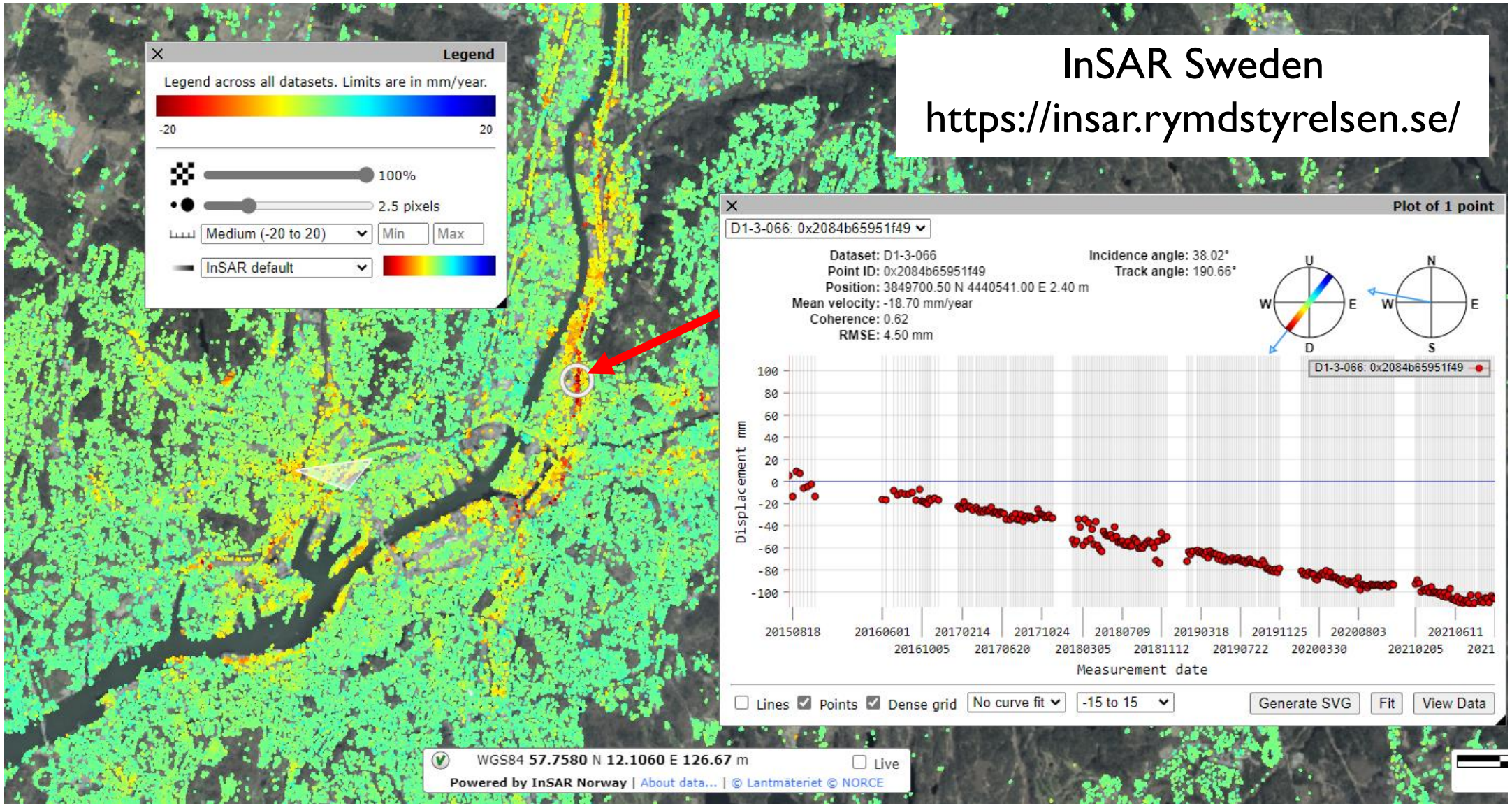
- 2019-2021, Geodetic SAR project
  - Geodetic SAR for Baltic Height System Unification and Baltic Sea Level Research
- 2020-2022, InSAR Sweden
  - Swedish ground motion service based on InSAR Norway
  - Plan to install 20 passive CRs co-located with GNSS
- 2022, Release of European Ground Motion Service (EGMS)
- 2023 Finalize installation of 20 CR
  - Start time series
  - Learn and follow developement
  - Evaluate

GEODETIC SAR

- Active transponders/Electronic Corner Reflectors (ECR)
- Absolut positioning with ECRs
- Combination of techniques
- Height system unification

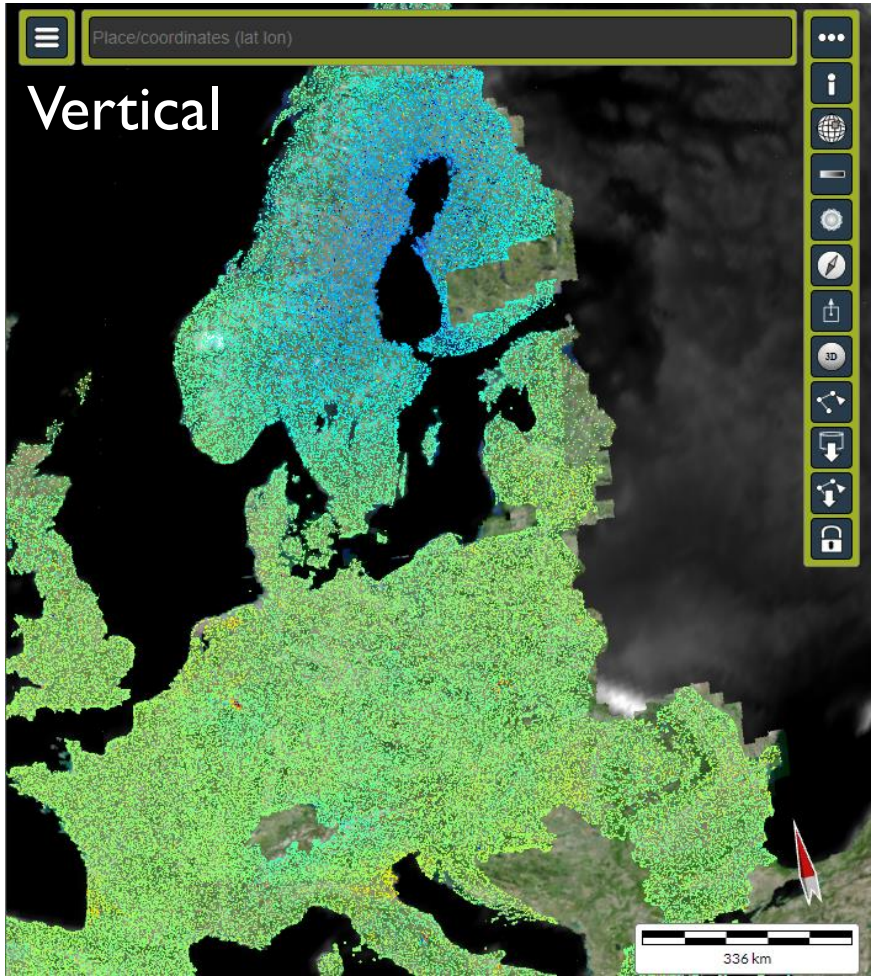
Reference: *Gruber, T. et al.Geodetic SAR for Height System Unification and Sea Level Research—Results in the Baltic Sea Test Network. Remote Sens.* ***2022****, 14, 3250. https://doi.org/10.3390/rs14143250*

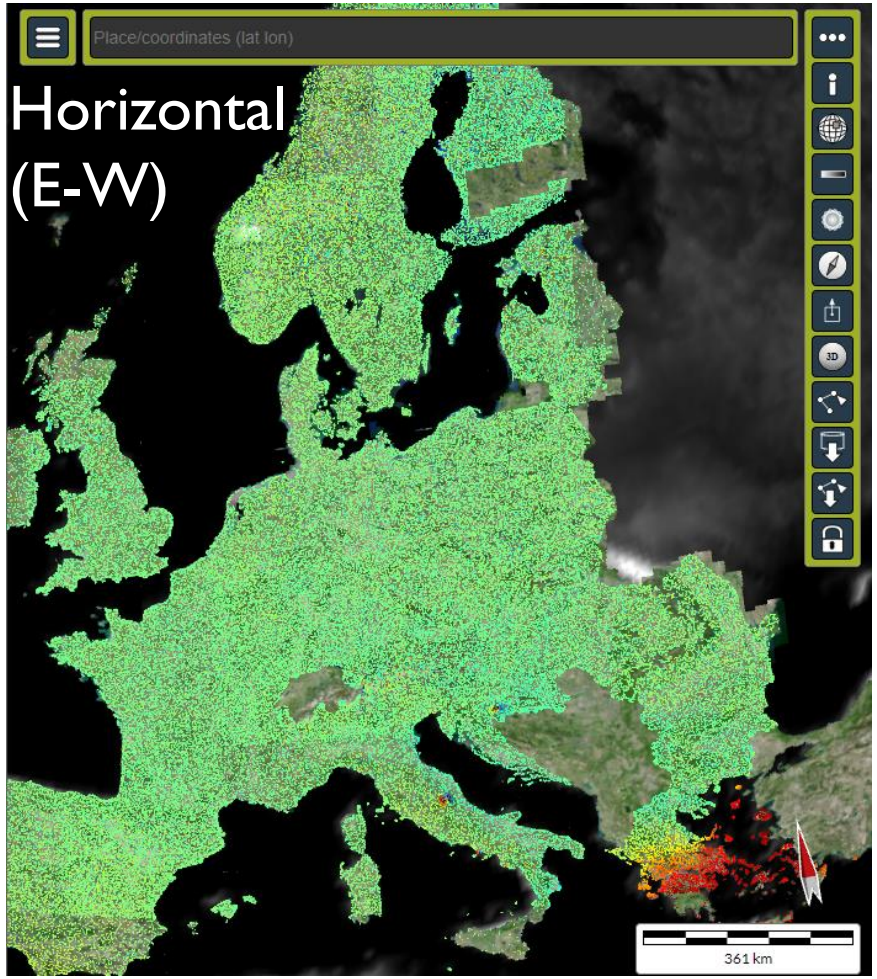
INSAR SWEDEN



EGMS

European Ground Motion Service





https://egms.land.copernicus.eu/

WHY ARTIFICIAL REFLECTORS?

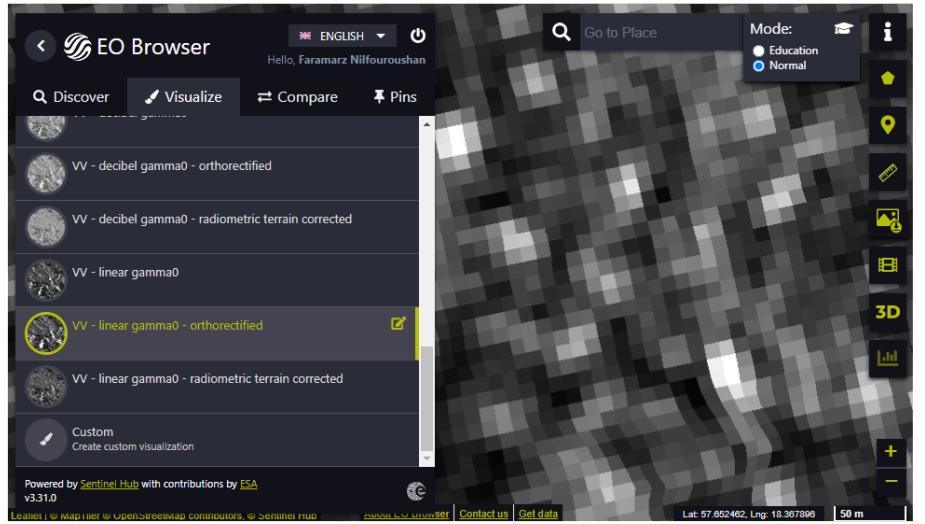
General

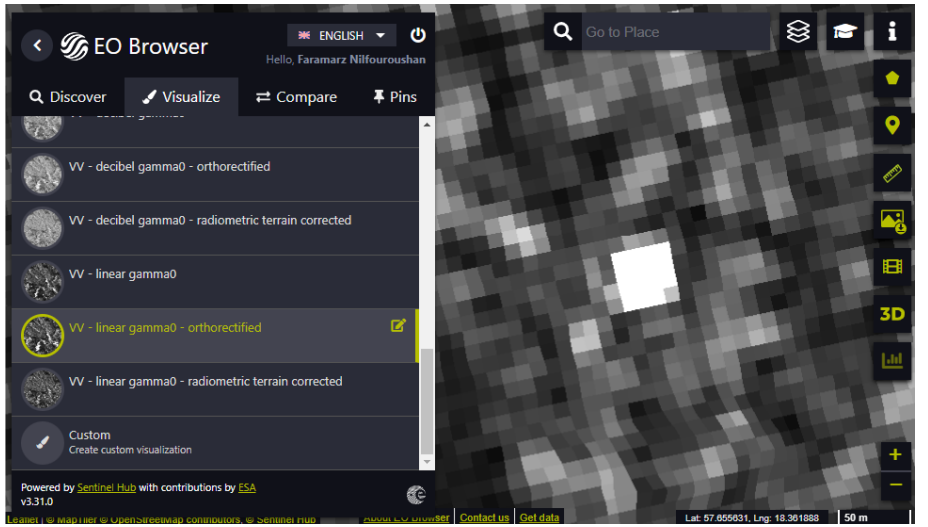
- Add (known) stable points in areas with few natural PS-points

Co-located with GNSS

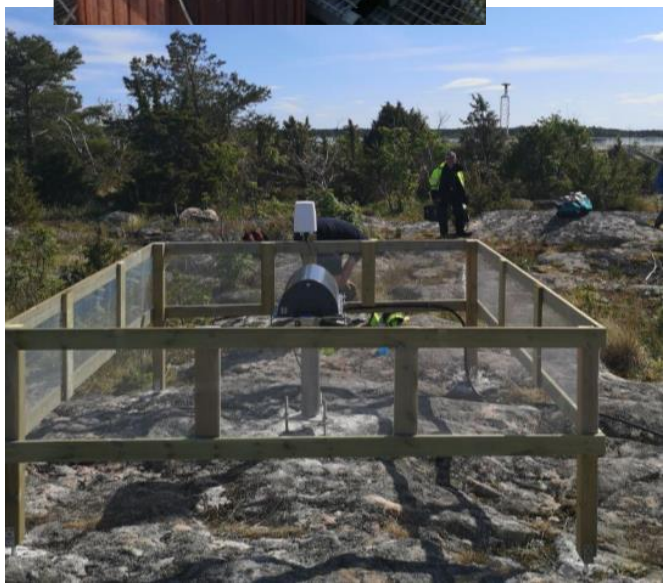
- Help to validate och develope e.g. ground motion services
- Absolute motion in geodetic reference frame

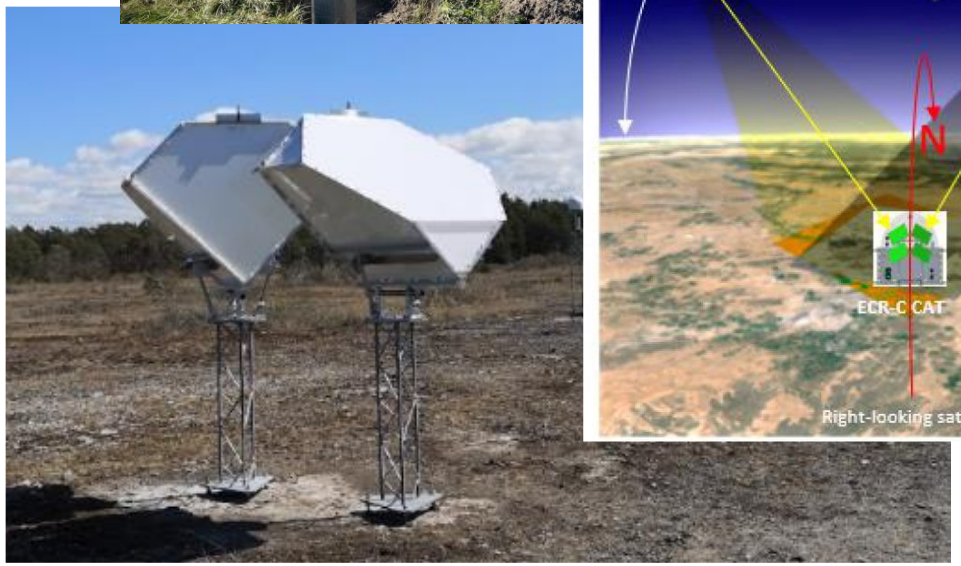
Note that stable installations of artificial CRs (and/or GNSS) might not show the same signal as the surrounding ground motion…

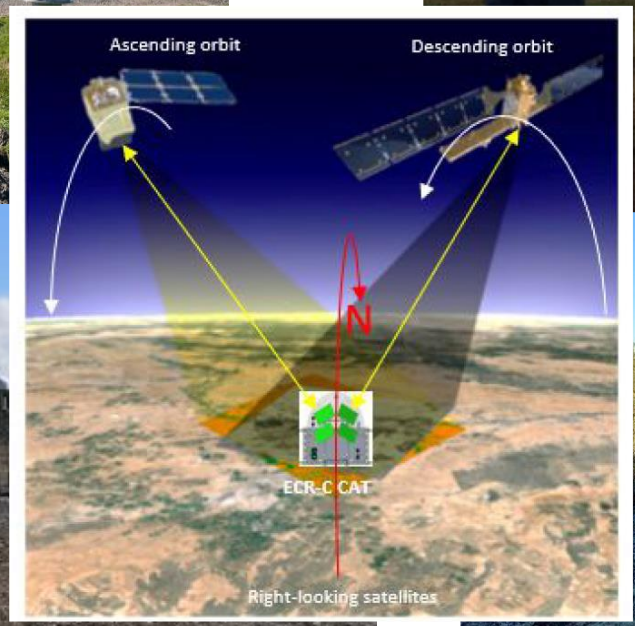




DIFFERENT TYPES OF CORNER REFLECTORS

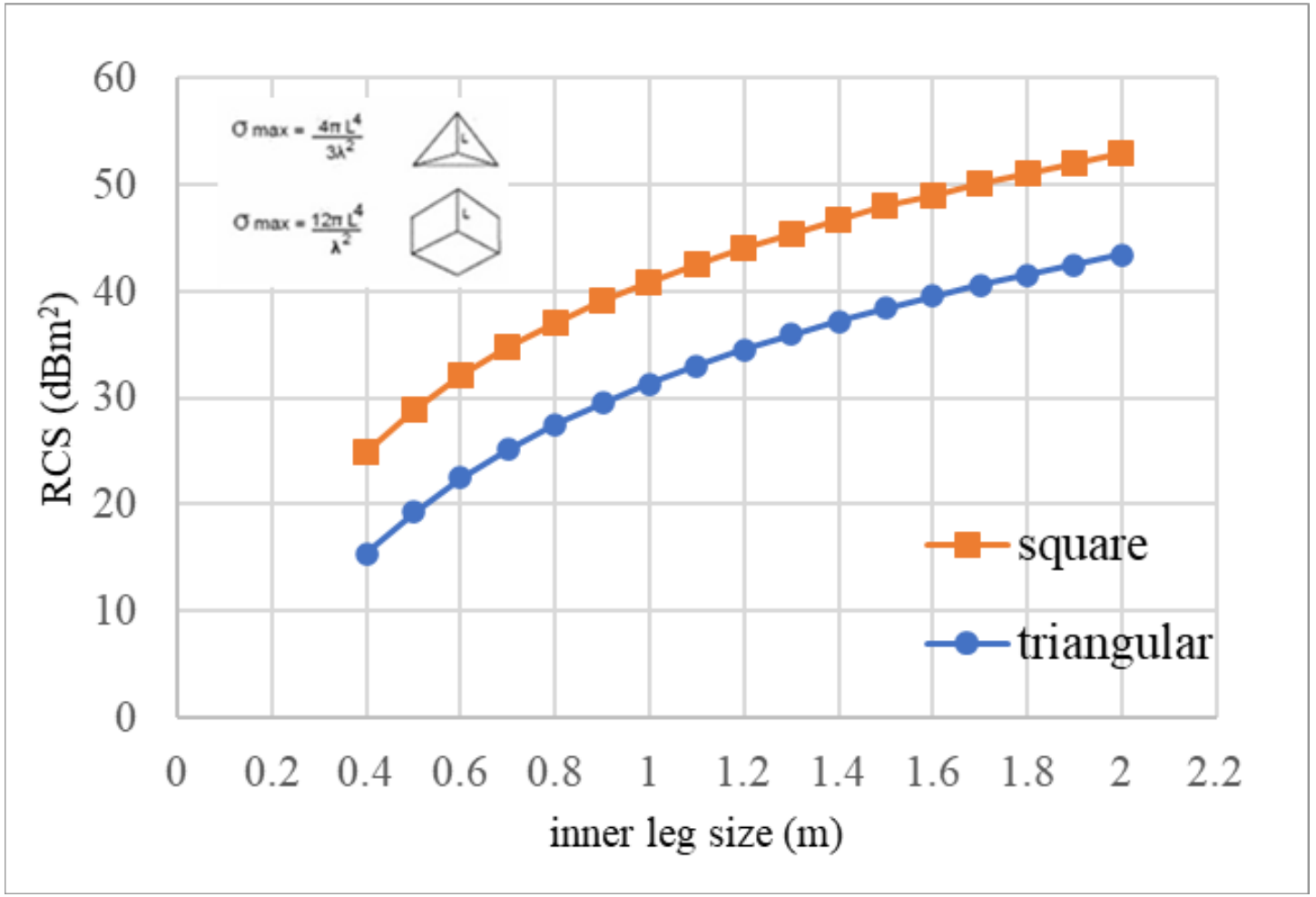






SIZE AND SHAPE OF THE CR

Radar Cross Section (RCS) is a measure of the size of that target as seen by the imaging radar.

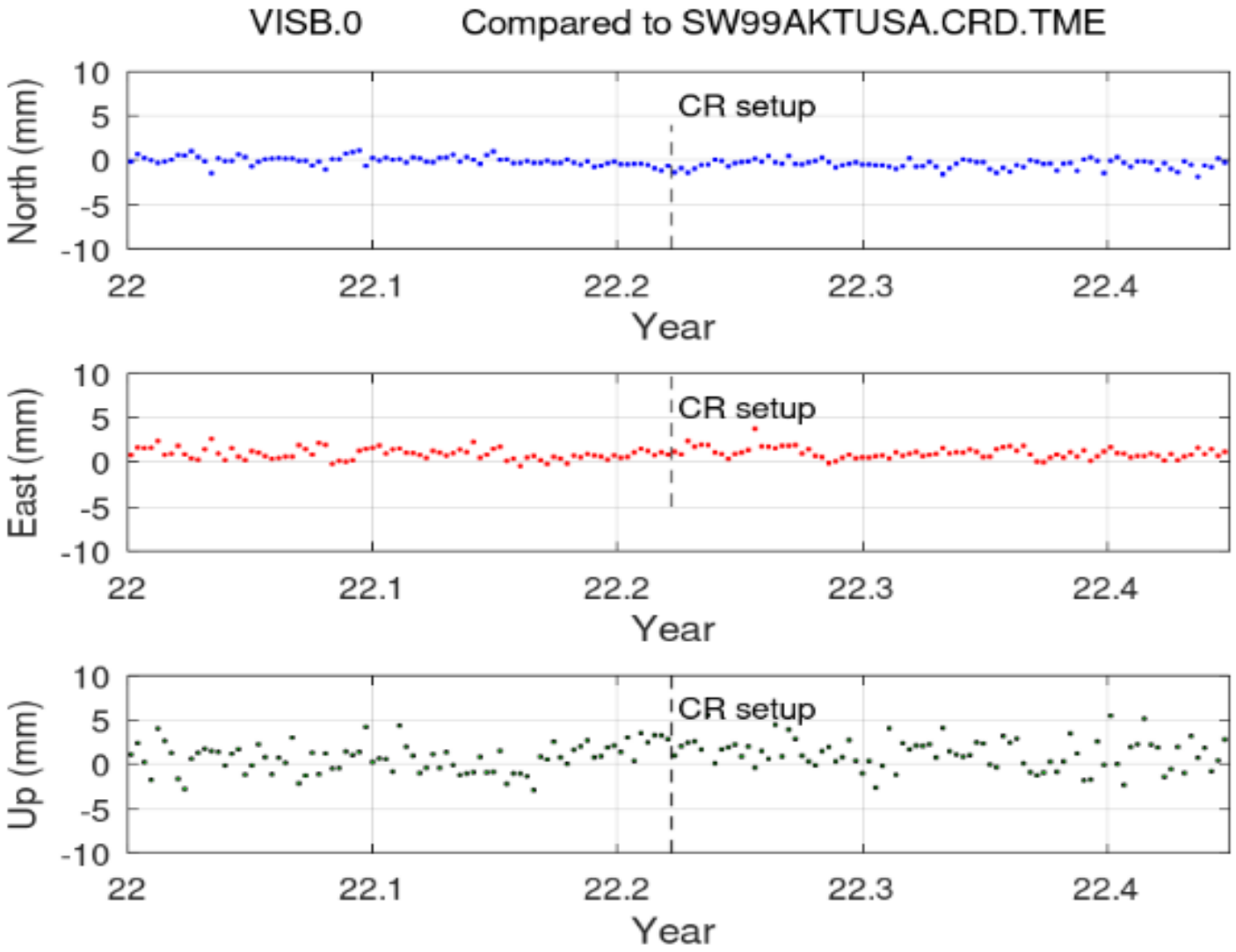


INSTALLATION

First: find suitable locations with respect to e.g.:

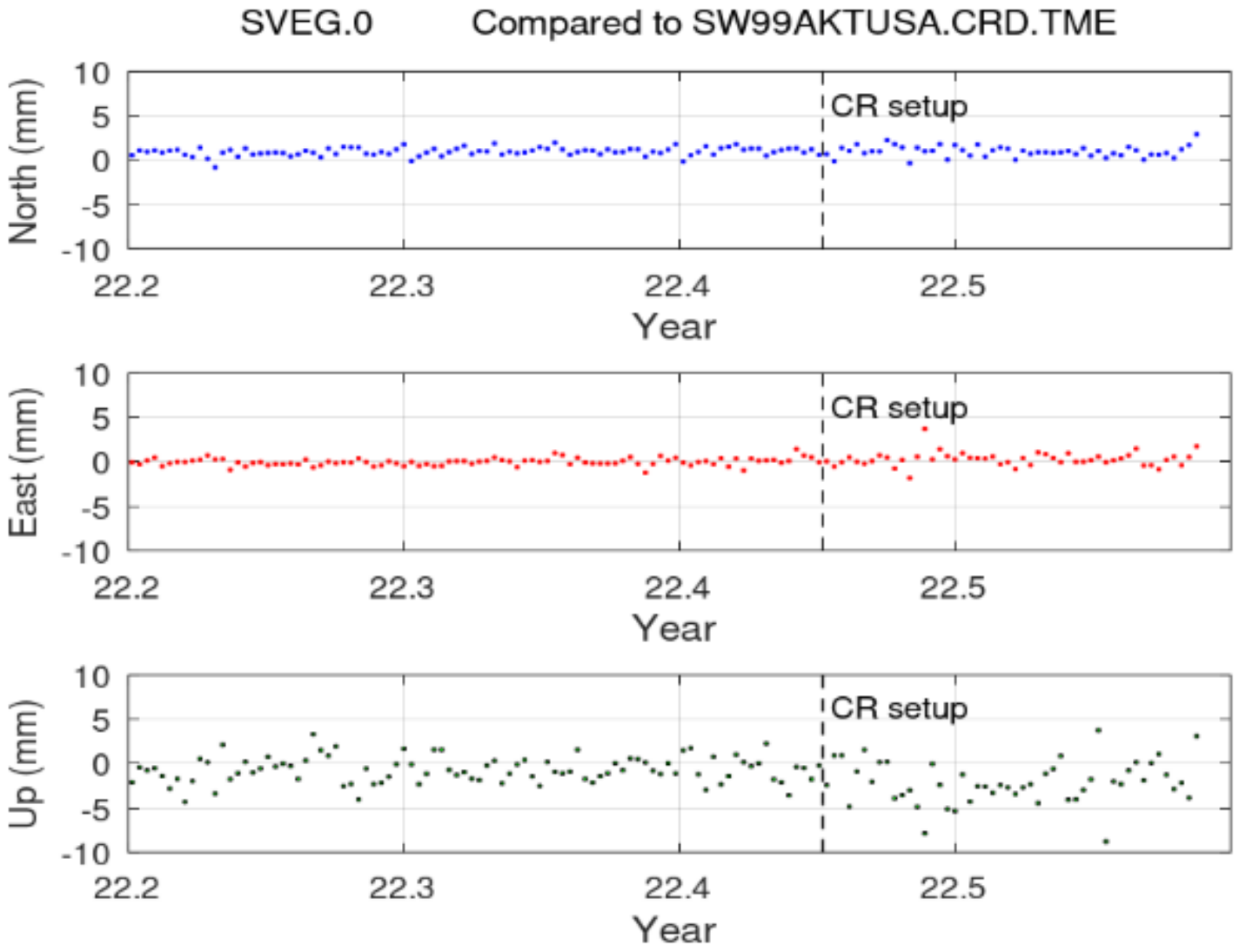
- Bedrock (stable ground)
- Clear sky (over time)
- Signal to Clutter Ratio (SCR)
- Permission from land owner

EFFECT ON NEARBY GNSS STATIONS?



Visby

EFFECT ON NEARBY GNSS STATIONS?



Sveg

STATUES RIGHT NOW

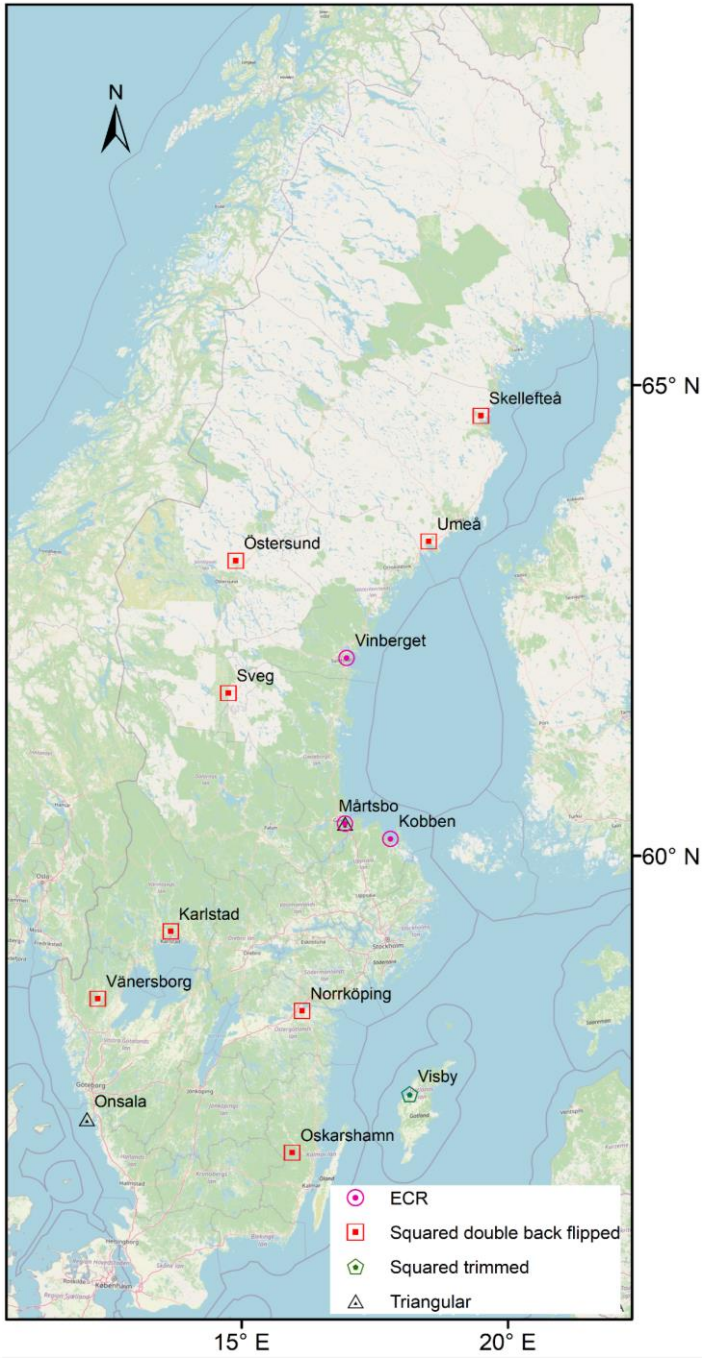
Site	Passive/ Active	Date of Installation	Type	Orientation
Kobben	Active	2020-06-01	Electronic transponder	Asc and Desc
Vinberget	Active	2020-10-01		Asc and Desc
Mårtsbo	Activ			sc and Desc
Mårtsbo	Passiv			sc
Onsala	Passive			sc
Onsala	Passive			esc
Norrköping	Passive			c and Desc
Visby	Passive			sc
Visby	Passive			
Sveg	Passive			and Desc
Östersund	Passive		Squared double back flipped	Asc and Desc
Umeå	Passive	2022-10-21	Squared double back flipped	Asc and Desc
Skellefteå	Passive	2022-10-23	Squared double back flipped	Asc and Desc
Karlstad	Passive	2023-05-10	Squared double back flipped	Asc and Desc
Vänersborg	Passive	2023-05-12	Squared double back flipped	Asc and Desc
Oskarshamn	Passive	2023-05-13	Squared double back flipped	Asc and Desc

3 active transponders,

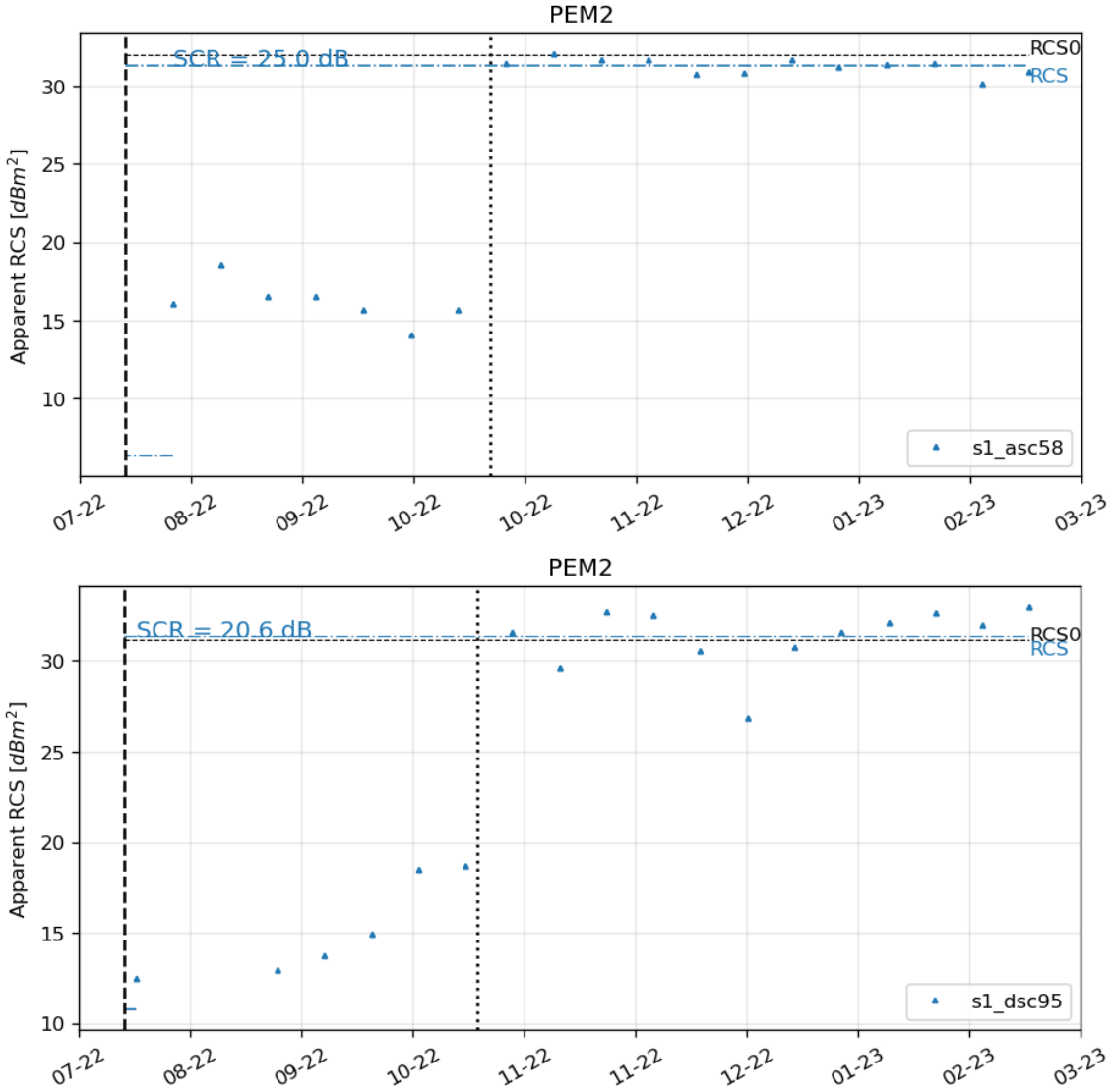
13 passive corner reflectors

at 13 different GNSS stations.

Some 7 stations still to go.



DATA ANALYSIS AND RESULTS



- Sentinel-1 data
- GECORIS toolbox (Czikhardt et al., 2021)
- SNAP Sentinel Application Platform v9.0.0

Skellefteå

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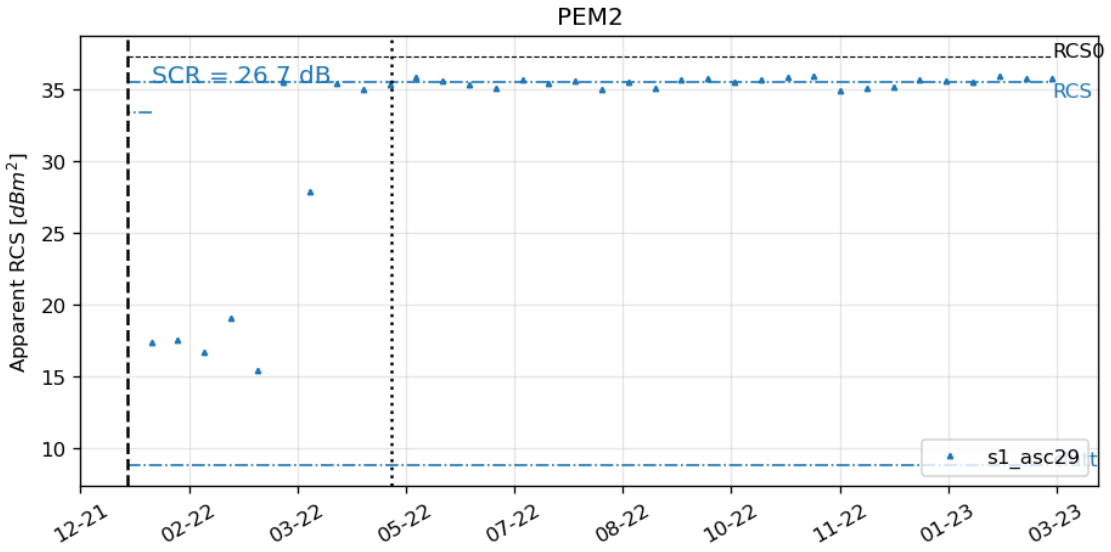
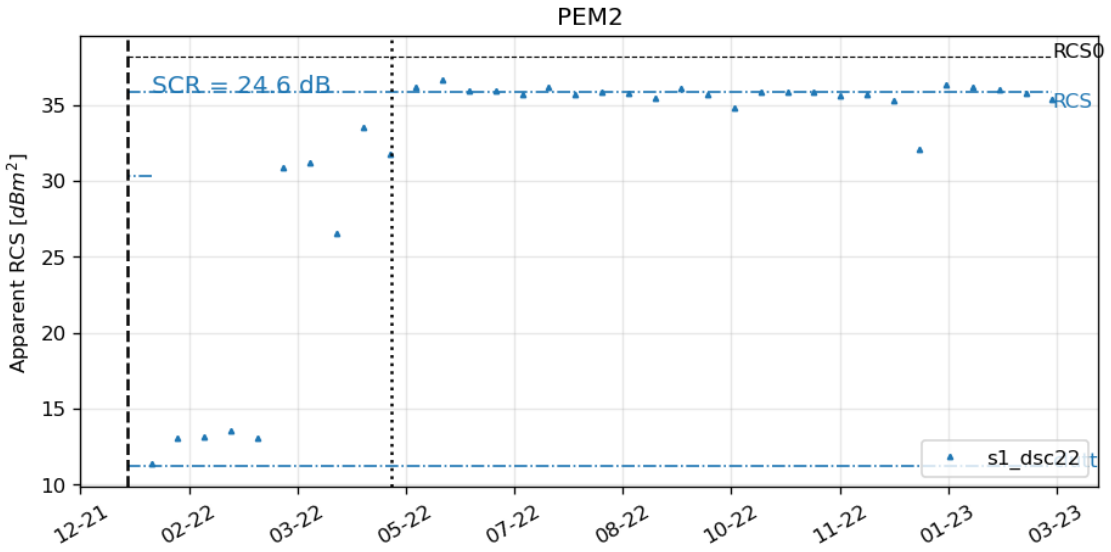
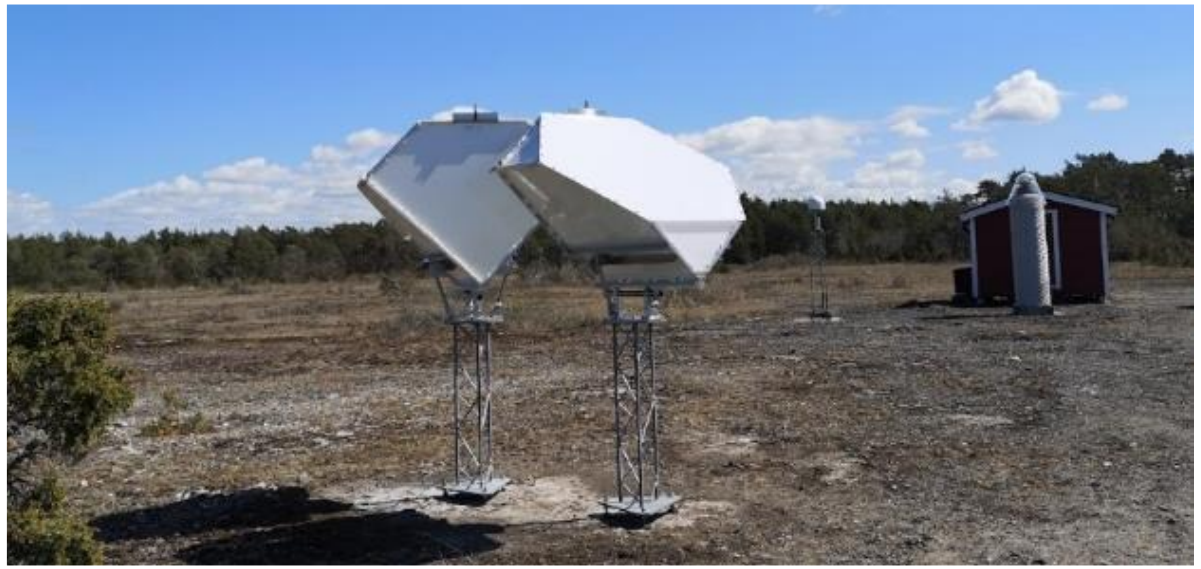




Visby



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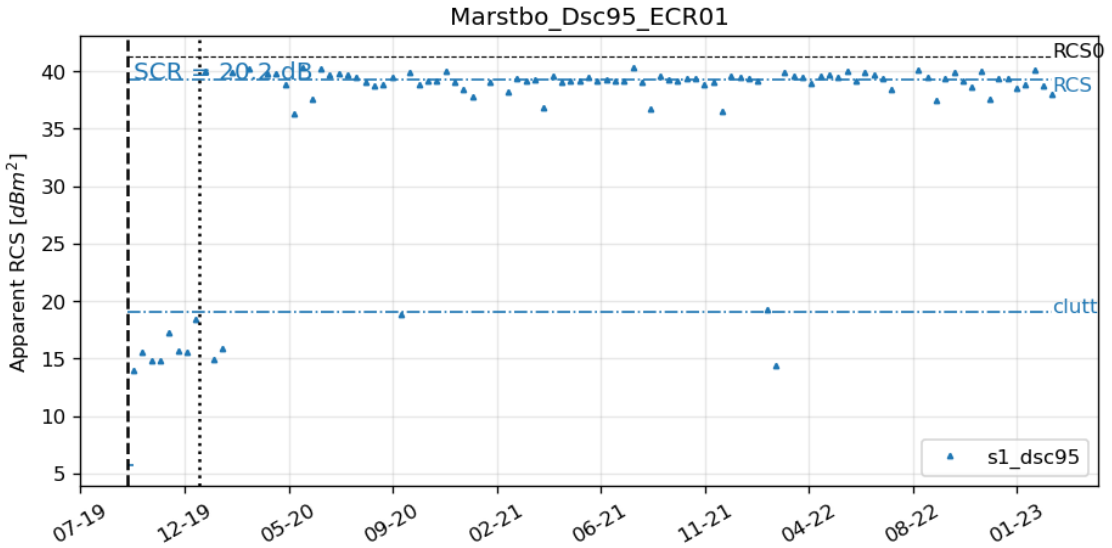

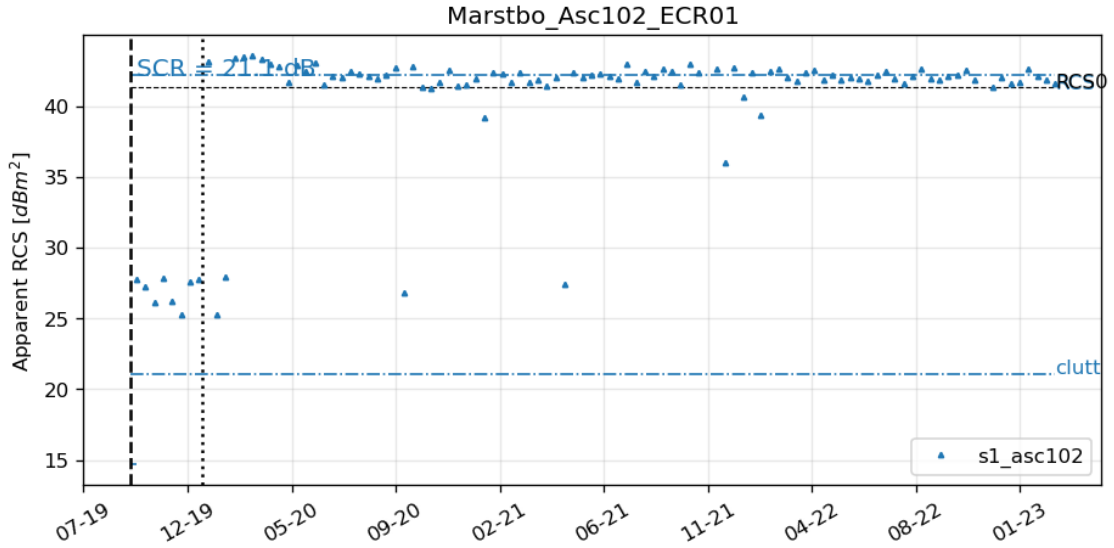

Mårtsbo

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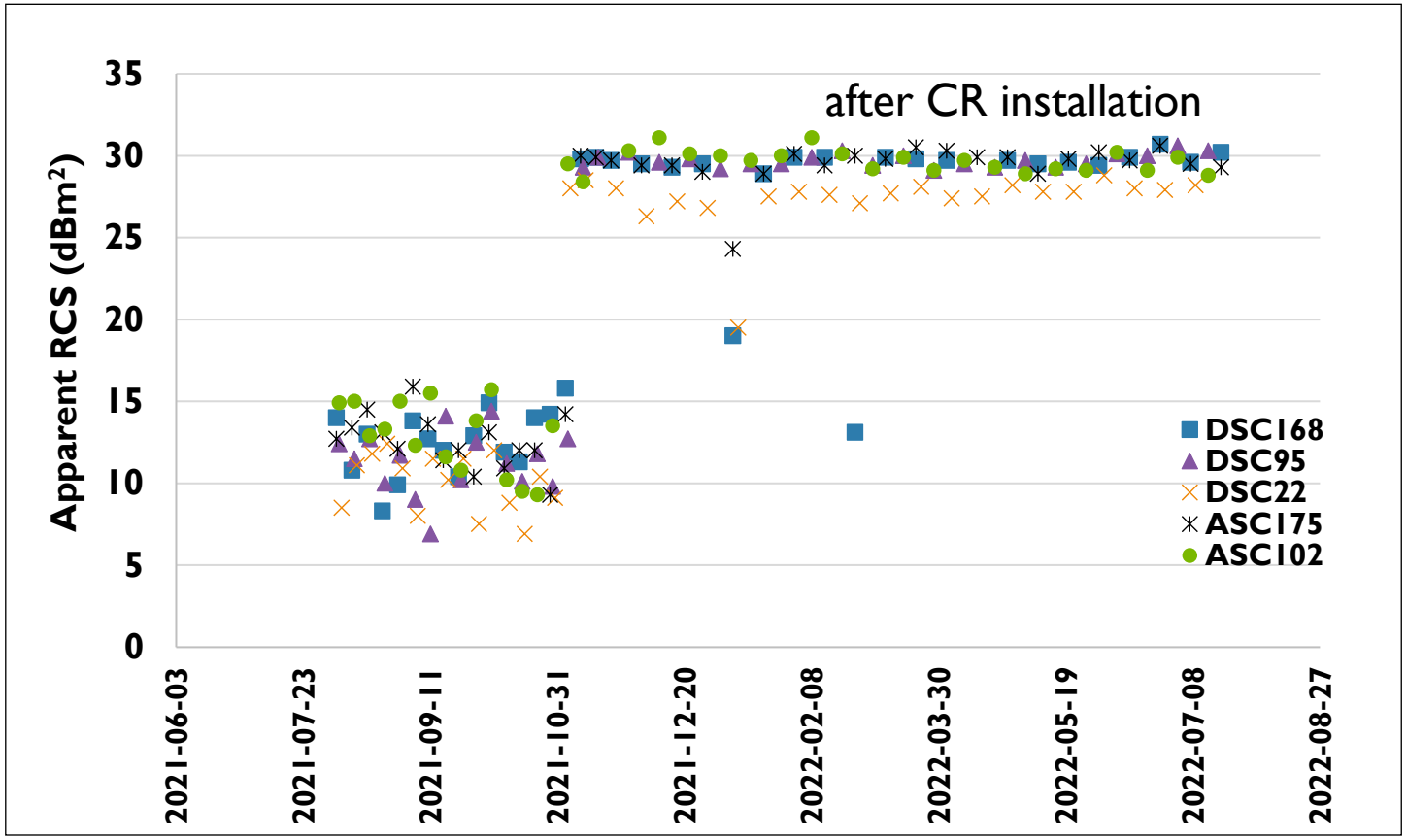
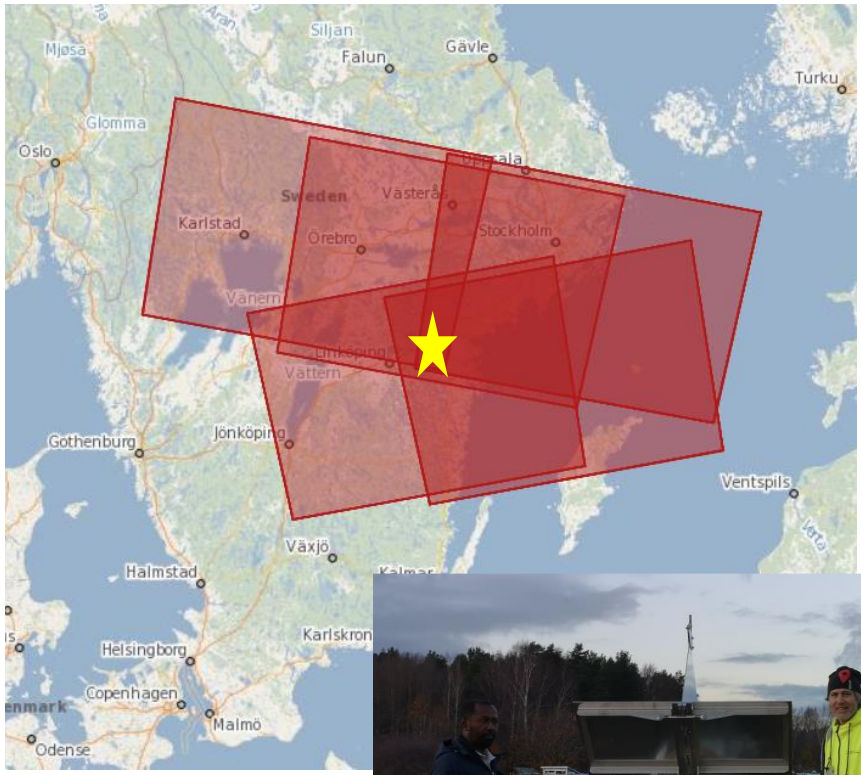


Norrköping



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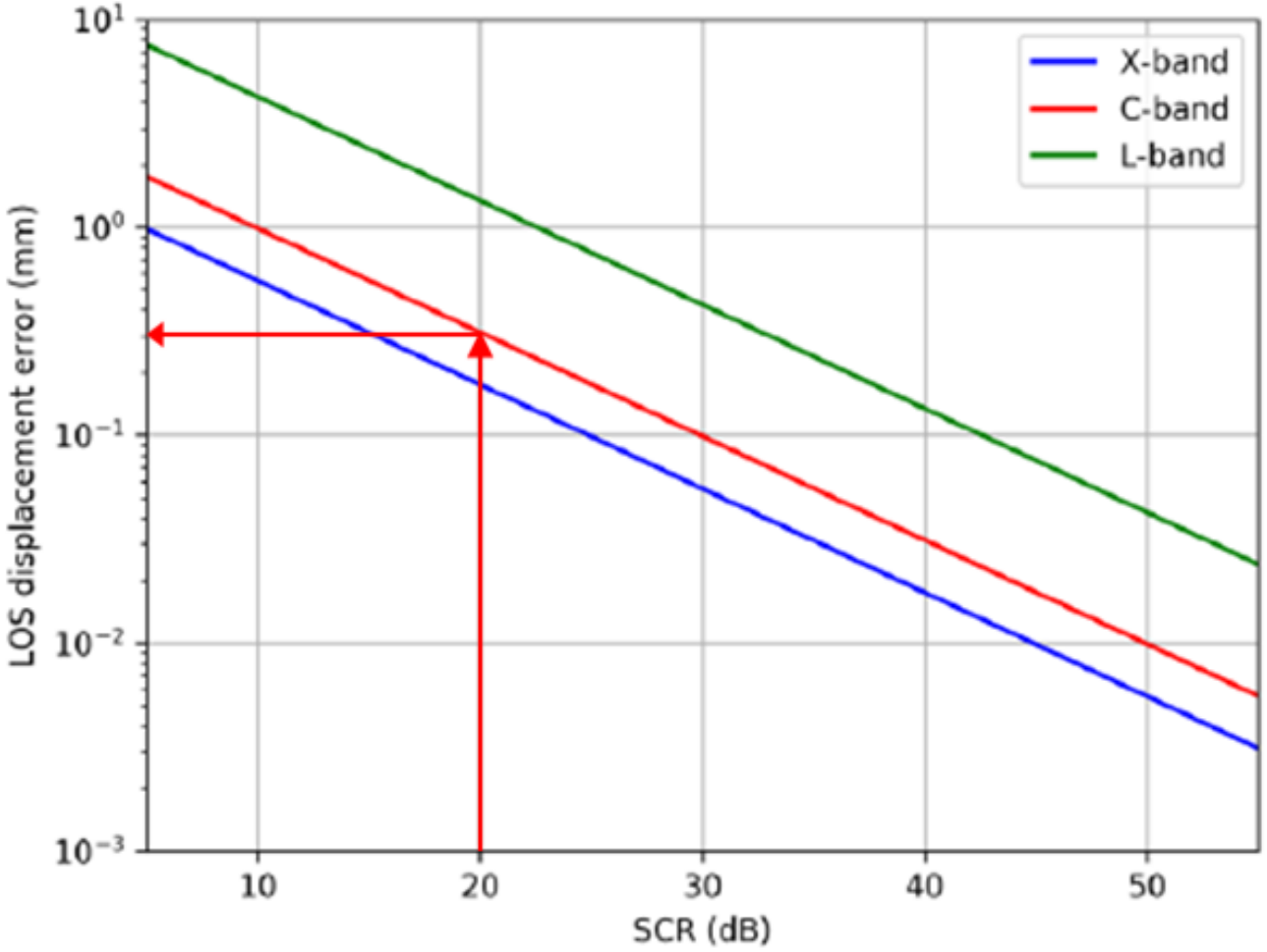
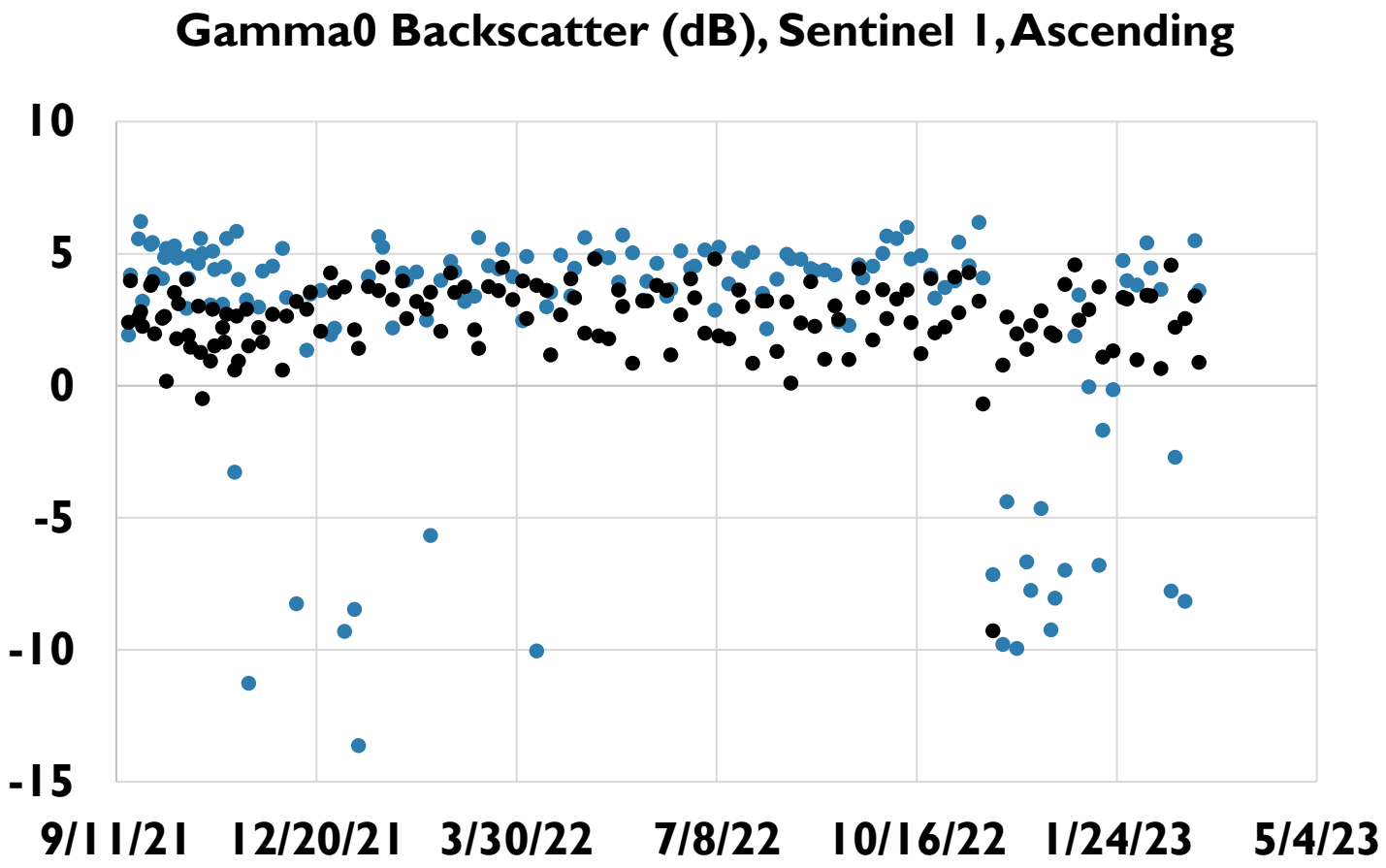


SNOW EFFECT ON BACKSCATTERING



SUMMARY AND OUTLOOK

- Started with two projects with external founding (Geodetic SAR and InSAR Sweden)
- Right now in a process where focus is on installation of CR:s
  - 3 active
  - 13 passive
  - 13 sites
  - Some 7 stations to go
- Time series started
- Gained a lot of experience and contacts
- Time for evaluation
- And then decision on how to proceed…

THANKS FOR YOUR ATTENTION!

Read more:

Activity Report: Contributions from Lantmäteriet to the InSAR-Sweden Project:
https://www.lantmateriet.se/globalassets/geodata/gps-och-geodetisk-matning/rapporter/lantmaterirapport_2023-1.pdf

Geodetic SAR for Height System Unification and Sea Level Research—Results in the Baltic Sea Test Network:
https://doi.org/10.3390/rs14143250

CONTACT geodesi@lm.se PHONE +46 (0)26 633932

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