EVALUATING THE POTENTIAL OF ACTIVE AND PASSIVE SAR CORNER REFLECTORS AS COMPLEMENTARY GEODETIC INFRASTRUCTURE IN SWEDEN

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Abstract

In Sweden, three compact active transponders (CATs) and 18 passive corner reflectors (CRs) near twin fundamental class A SWEPOS GNSS stations have been installed complementing the geodetic infrastructure. Utilizing the PS-InSAR, a powerful Remote Sensing technique with these CATs and CRs shows promising millimeter-scale ground movement monitoring results compared to GNSS coordinates. Preliminary results reveal that displacement time series from CRs align within 2-3 mm accuracy with GNSS measurements, confirming the efficacy of integrating CRs in geodetic monitoring. Multi-year data analysis from CATs demonstrates good performance and comparable efficacy to CRs, validating their use in long-term geodetic studies.

Background

The study utilizes Sentinel-1A SLC products with an approximate one-week revisit frequency for each path over Sweden.

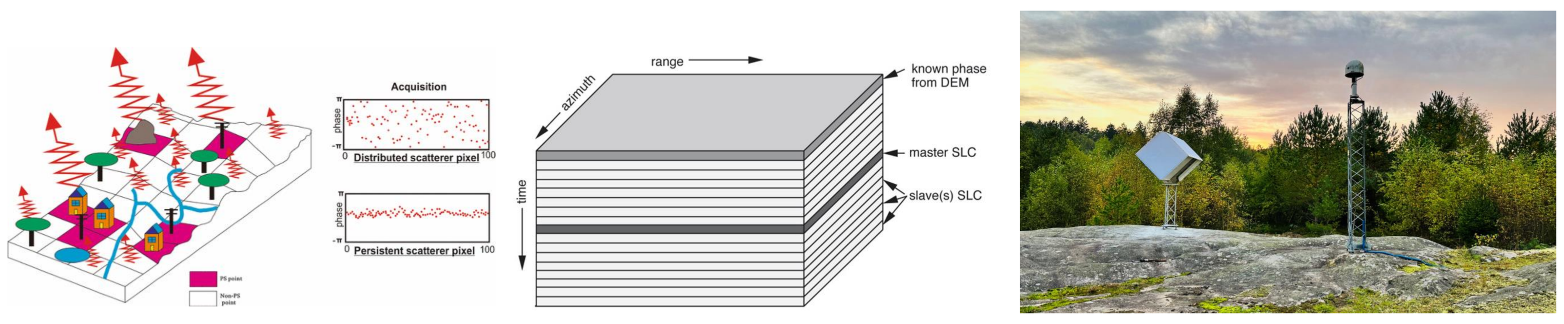

***Figure 1**: The working principle of PS-InSAR, which is spatially and temporally relative. Our CRs are installed on the same bedrock as the GNSS antennas.*

CATs and CRs installation

***Table 1**:The CATs and CRs installation history.*

CR ID	City	Installation Date	Type	Orientation
ECR01	Mårtsbo	2020-01-07	CAT	ASC + DSC
ECR02	Kobben	2020-06-01	CAT	ASC + DSC
ECR03	Vinberget	2020-10-01	CAT	ASC + DSC
CR02	Onsala	2021-06-18	Triangular	ASC
CRTEMP	Mårtsbo	2021-08-07	Triangular	ASC
CR01	Onsala	2021-09-13	Triangular	DSC
CR03	Mårtsbo	2021-09-14	Triangular	ASC
CR04	Norrköping	2021-11-04	Squared double back flipped	ASC + DSC
CR05	Visby	2022-05-11	Squared trimmed	DSC
CR06	Visby	2022-05-11	Squared trimmed	ASC
CR07	Sveg	2022-06-14	Squared double back flipped	ASC + DSC
CR08	Östersund	2022-09-01	Squared double back flipped	ASC + DSC
CR09	Umeå	2022-10-21	Squared double back flipped	ASC + DSC
CR10	Skellefteå	2022-10-23	Squared double back flipped	ASC + DSC
CR11	Karlstad	2023-05-10	Squared double back flipped	ASC + DSC
CR12	Vänersborg	2023-05-12	Squared double back flipped	ASC + DSC
CR13	Oskershamn	2023-05-13	Squared double back flipped	ASC + DSC
CR14	Kramfors	2023-06-21	Squared double back flipped	ASC + DSC
CR15	Överkalix	2023-08-10	Squared double back flipped	ASC + DSC
CR16	Hässleholm	2023-09-27	Squared double back flipped	ASC + DSC
CR17	Leksand	2024-05-14	Squared double back flipped	ASC + DSC
CR18	Lovö	2024-05-17	Squared double back flipped	ASC + DSC

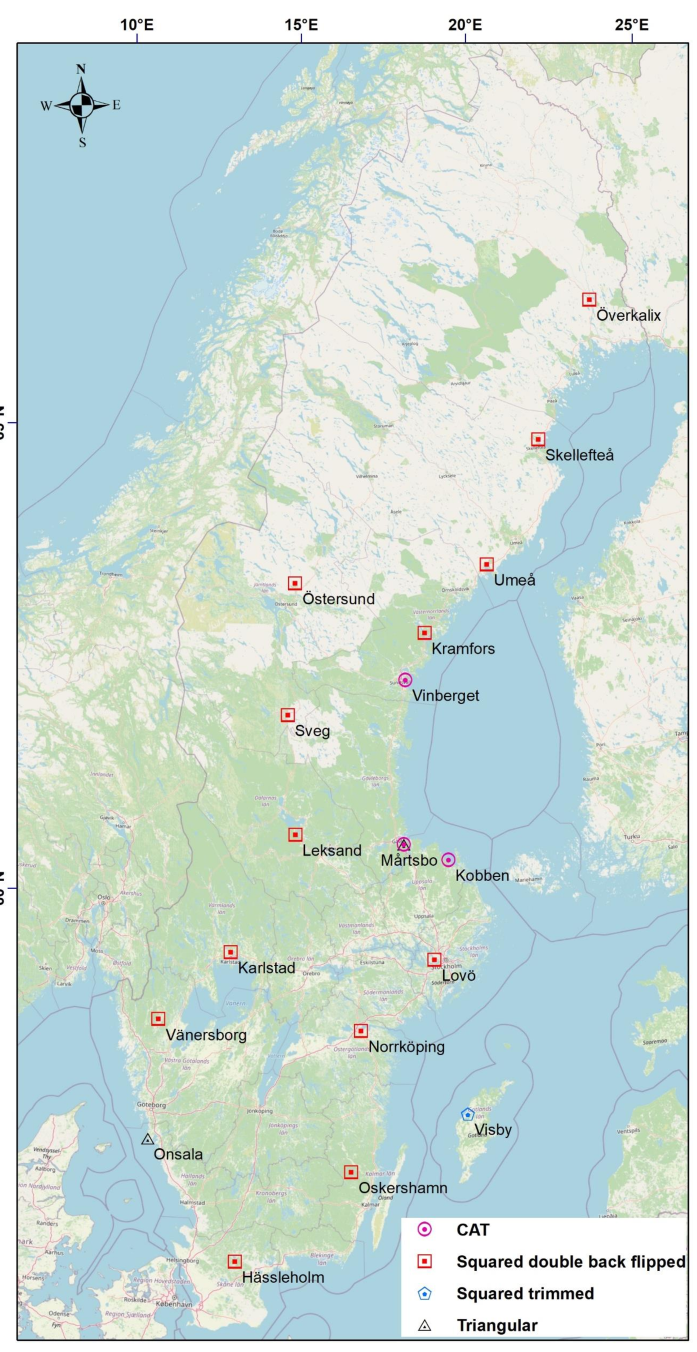

***Figure 3**: Spatial distributions of CATs and CRs in Sweden.*

Methodology

The CAT and CR PSI analysis are done using the GECORIS toolbox and ESA-SNAP.

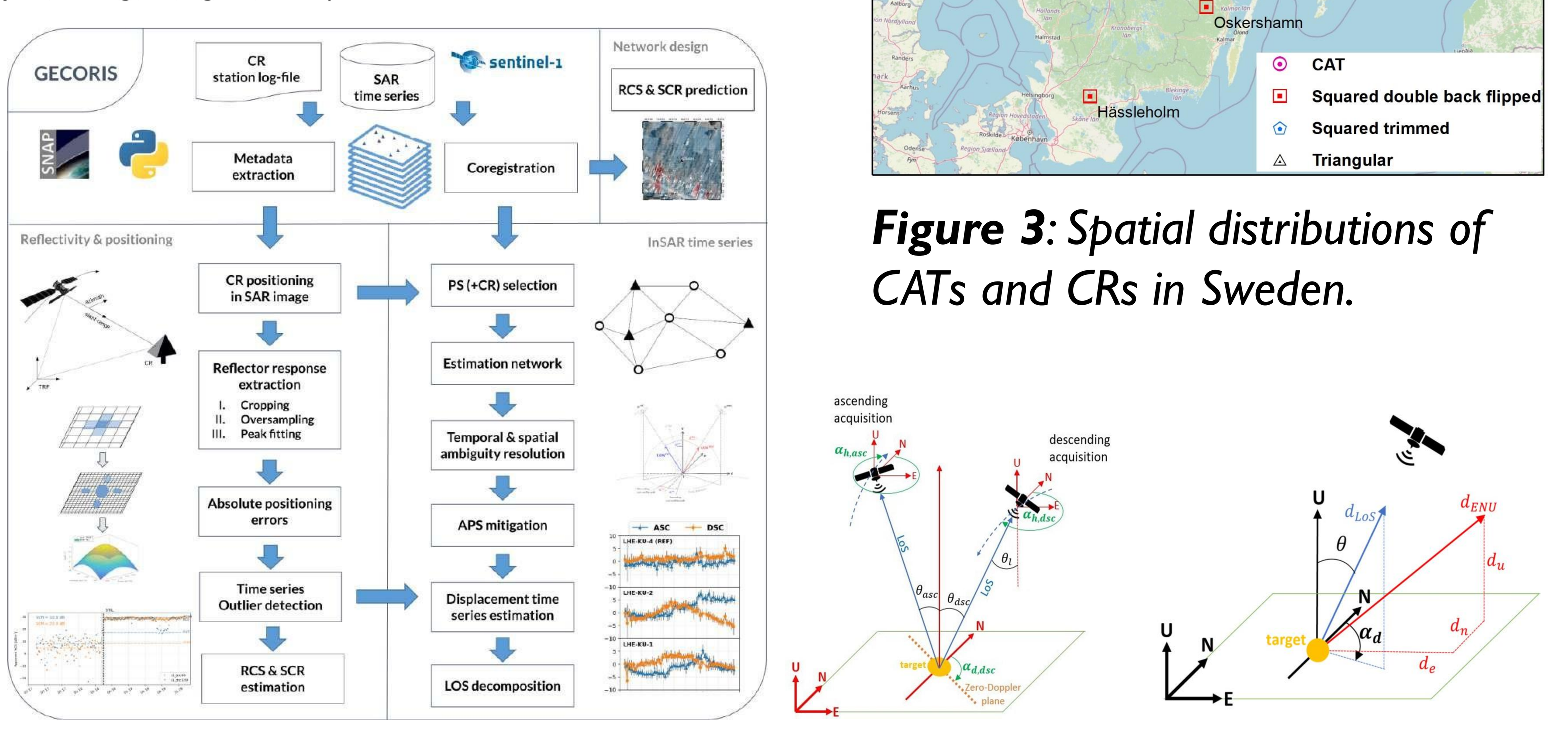

***Figure 2**: Workflow of the GECORIS toolbox and the vector decomposition and the composition for InSAR LOS and GNSS LOS(Reference:https://doi.org/10.3390/rs13050926 and https://doi.org/10.1109/IGARSS47720.2021.9554216).*

Compact active transponders

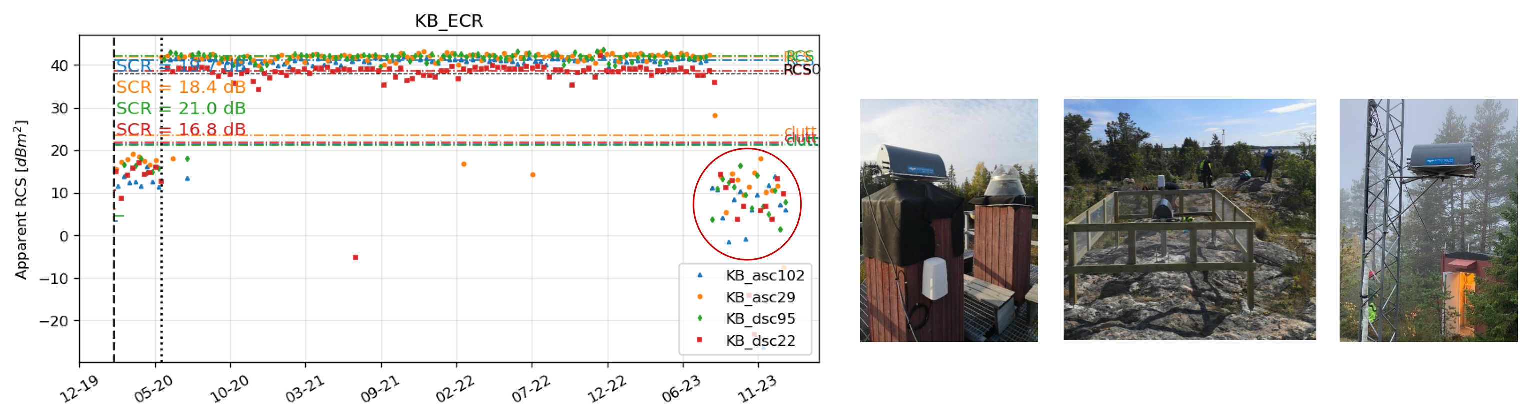

***Figure 7**: SCR and RCS of the Kobben CAT.*

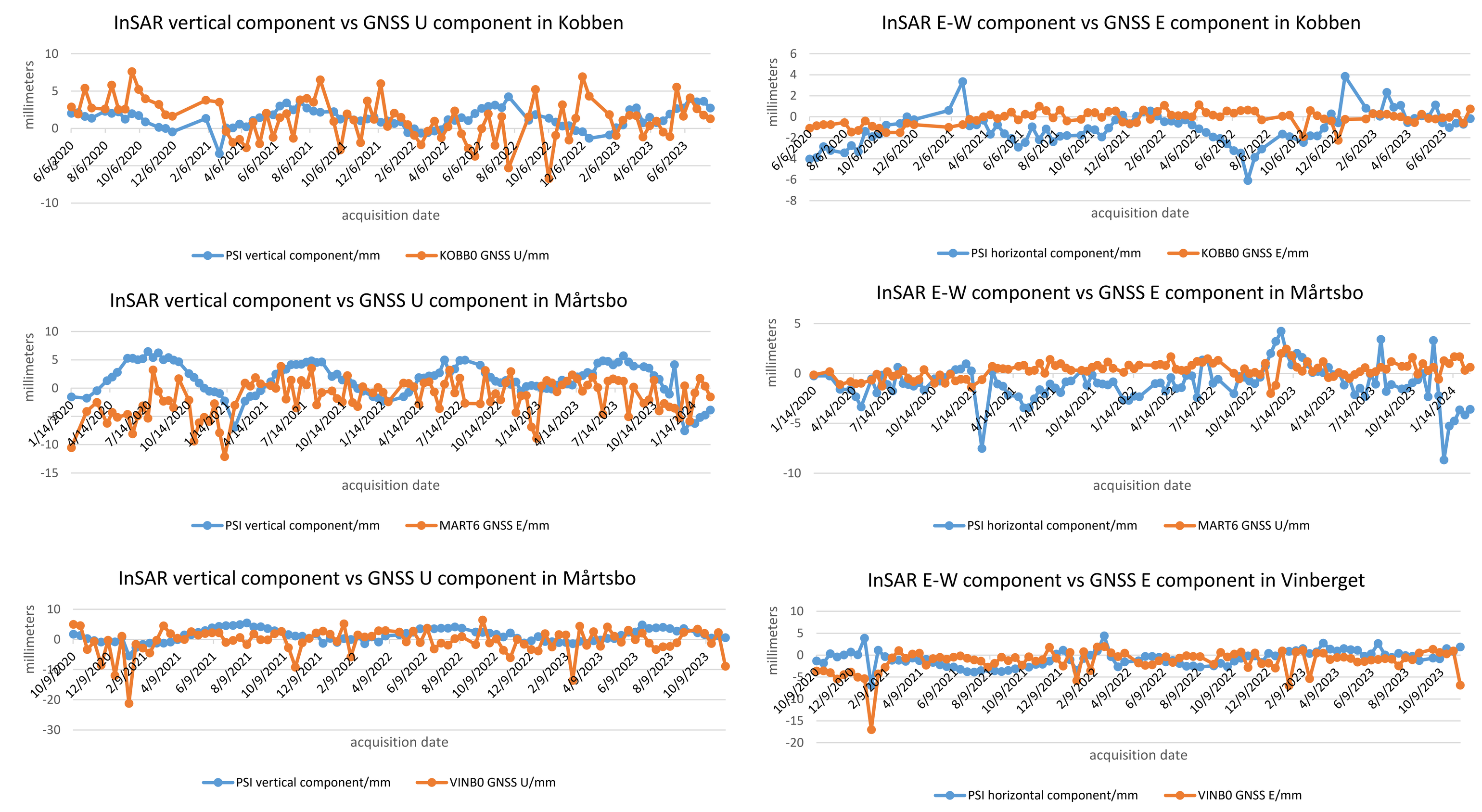

***Figure 8**: The displacement time series captured by the CATs compared to respective nearby GNSS stations.*

Mårtsbo CAT and CR

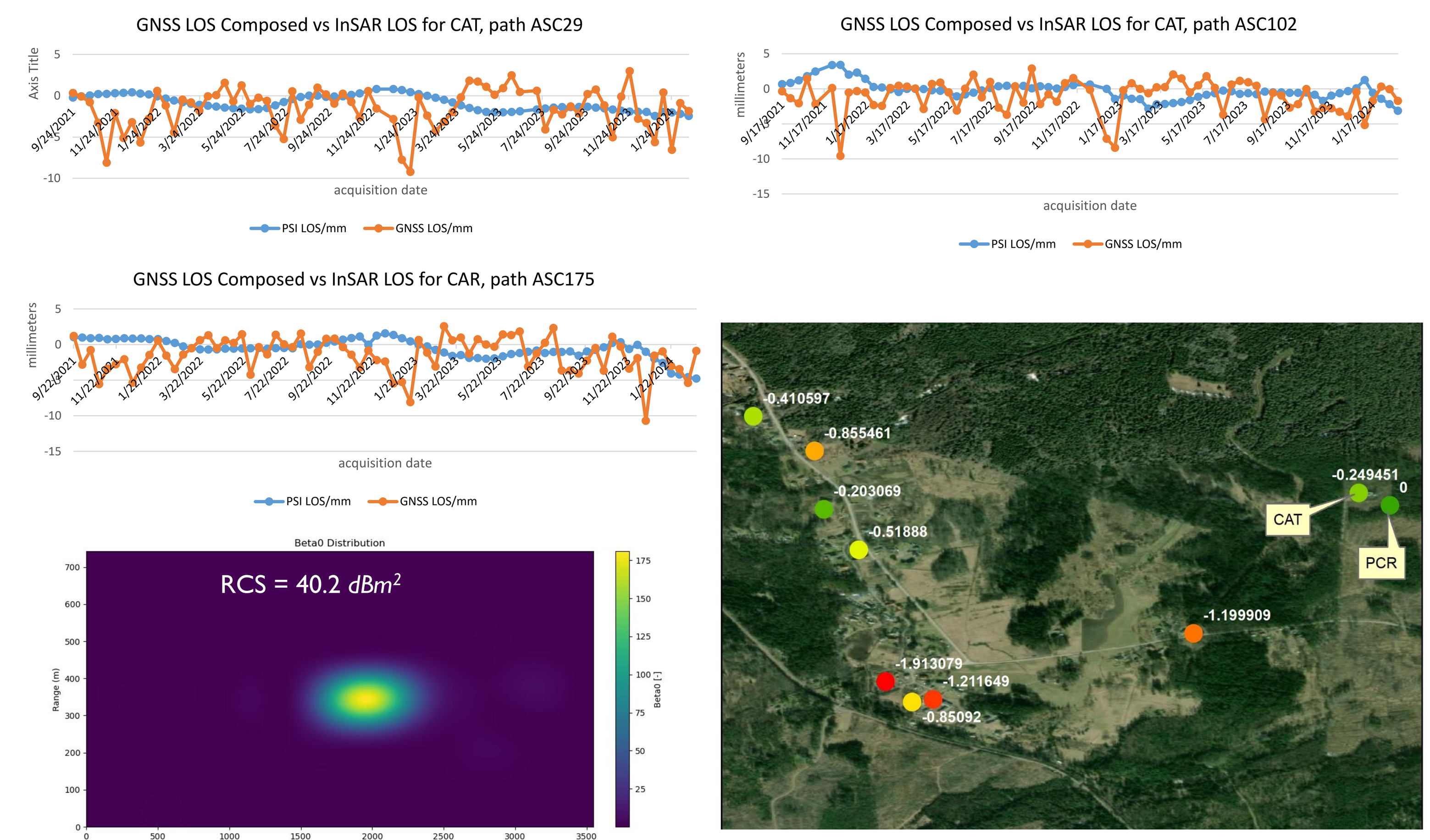

***Figure 6**: The performance of the CAT in Mårtsbo compared to projected GNSS LOS and the PS network for path ascending 29 having the PCR as the reference.*

VISBY CR Performance

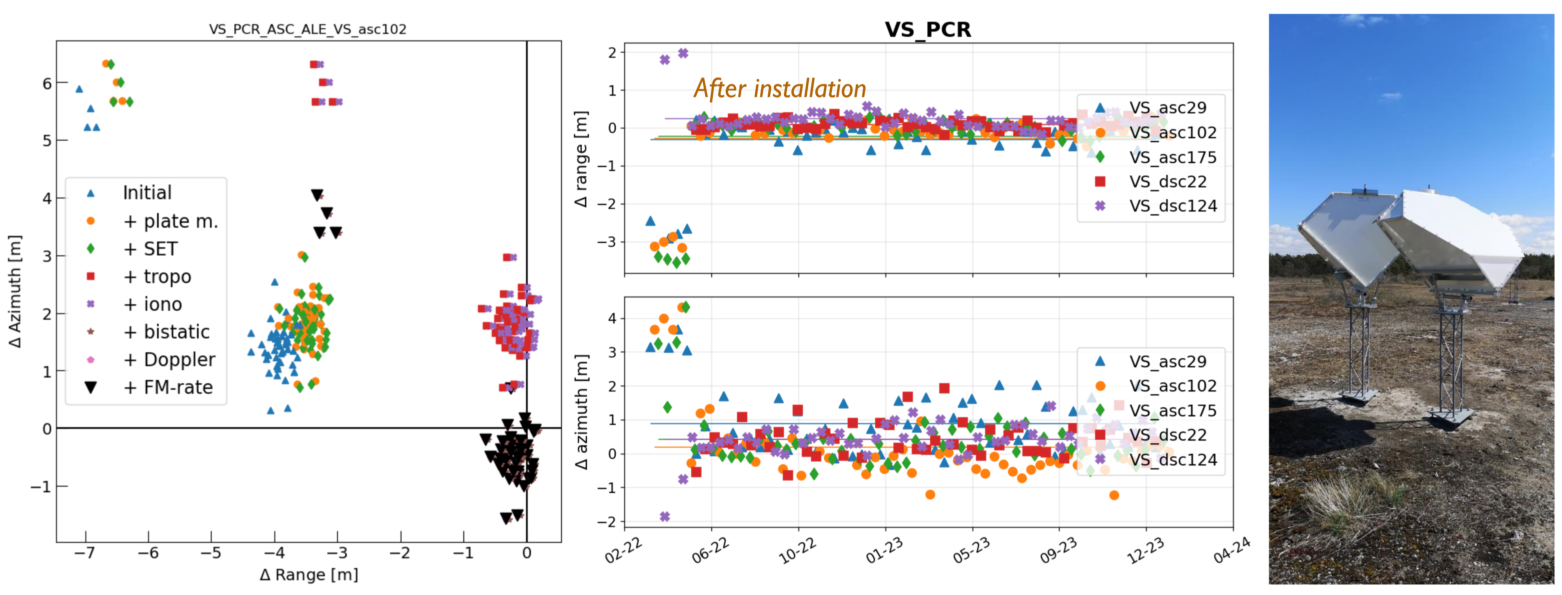

***Figure 4**: Individual SAR positioning corrections on the Azimuth and Range of the VISBY CR.*

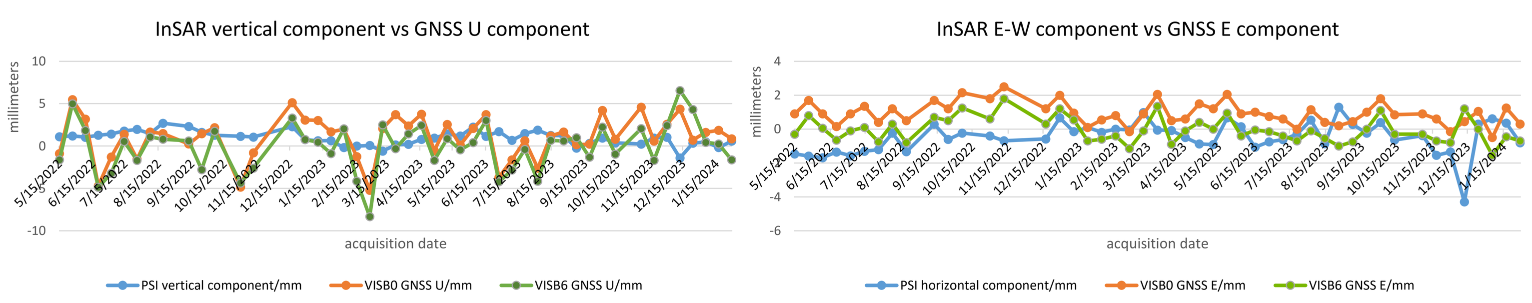

***Figure 5**: The displacement time series captured by the CR and compared to two nearby GNSS station's (VISB0 and VISB6) E and U.*