Satellite Radar Interferometry on corner reflectors in the area of mining region in Poland

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The EPOS-PL project is the Polish realization of the European Plate Observing System (EPOS) initiative, which aims at the integration of existing and newly created research infrastructures to facilitate the use of multidisciplinary data and products in the field of Earth sciences in Europe. Within the EPOS, one of the tasks aims at SAR data utilization for deformation monitoring in the area of Rydultowy mine. The Rydultowy mine is the oldest active mining in the Upper Silesia Coal Basin in Poland. In the area of this mine, five Corner Reflectors (CRs) have been deployed in the framework of the EPOS-PL. Additionally, in the area of interest one high-frequency GNSS receiver working permanently has been placed. This GNSS permanent station (RES100POL) enables estimating of deformation time-series based on multi-GNSS observation in post-processing.

In this study, we use Sentinel-1A/B TOPSAR images acquired between 25 June 2018 and 14 July 2019 in one ascending and two descending geometries with revisiting time of 6-days. Additionally, we use ground truths of two leveling and GNSS measurement campaigns carried out to precisely estimate deformations on five CRs (2nd-4th of July 2018 and 28th-30th of June 2019). GNSS static measurements were carried out via three independent measurement sessions. Coordinates of the station RES100POL and static GNSS and leveling measurements were used for validation of SAR measurements.

SAR data has been processed by means of classical consecutive Differential Interferometry (DInSAR) as well as Persistent Scattering (PSInSAR) approach. During SAR data processing, snow coverage accumulated on the CRs caused that some Sentinel-1 images from the winter season have been removed from DInSAR as well as PSInSAR processing. Results from ascending and descending orbits allow the estimation of vertical as well as east-west deformation components. Root Mean Square Error (RMSE) between CRs measured by conventional geodetic techniques and DInSAR was estimated as 31mm and 38mm for east-west and vertical deformation components, respectively. RMSE measured between PSInSAR and GNSS was estimated as 5mm and 7mm for east-west and vertical components, respectively. RMSE of 15mm and 3mm was estimated for DInSAR with respect to GNSS from RES100POL station for east-west and vertical components, respectively. Subsequently, RMSE of 4mm and 5mm was estimated as deformation time variations between PSInSAR and GNSS from RES1 station for east-west and vertical components, respectively. These measures indicate clearly the advantage of the PSInSAR method. However, the
PSInSAR approach was able to estimate deformations only for three CRs due to the fast and non-linear deformation pattern observed on other two CRs.