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InSAR techniques to determine mining-related deformations using Sentinel-1 data: the case study of Rydułtowy mine in Poland.

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Since launching Sentinel 1 satellites, the European Space Agency has been providing a huge amount of repeated SAR data. Thanks to 6-days revisiting time, it creates a perfect possibility for the monitoring of ground deformation, caused by underground mining activity, by using Differential SAR interferometry (DInSAR).

Because, DInSAR exploits single interferometric SAR pairs, the accuracy of this technique is limited by spatial and temporal decorrelation and atmospheric artifacts. To minimize the atmospheric influence on DInSAR results, we investigated precipitation and relative humidity data acquired from the Institute of Meteorology and Water Management (IMGW). Theoretically, the summed atmospheric LOS errors due to relative humidity for 106 ascending and 112 descending images are -3.5 cm and 7,5 cm, respectively. In fact, we observed that there is a moderate correlation between precipitation/relative humidity and "bad" acquisition in relatively small study area. Nevertheless, we were able to remove 33 ascending and 15 descending images from the queue of consecutive DInSAR. Finally, it allowed to estimate up to 1m subsidence in the period of 1 Jan 2017–8 Oct 2018 in the Rydułtowy mine located in the southwest part of the Upper Silesian Coal Basin (USCB), Poland.

To evaluate our DInSAR accuracy due to atmospheric artefacts, we decided to compare the results with "atmospheric-free" results acquired by SBAS technique. SBAS separates diverse interferometric components that correspond to deformation, topographic error, atmospheric error, and orbital errors.

The Root-Mean-Square Error (RMSE) has been calculated between SBAS and DInSAR for selected subsidence profiles. The maximal RMSE was found to be 3.6 cm and 4.1cm for ascending and descending LOS displacements, respectively. This shows that DInSAR cannot be used for monitoring millimeter-level deformation. On the contrary, it can be effectively used to assess quick nonlinear deformations reaching several decimeters /year such as in the presented study case.