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Analysis of Clay-Induced Land Subsidence in Uppsala City Using Sentinel-1 SAR Data and Precise Leveling

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Land subsidence and its subsequent hazardous effects on buildings and urban infrastructure are important issues in many cities around the world. The city of Uppsala in Sweden is undergoing significant subsidence in areas that are located on clay. Underlying clay units in parts of Uppsala act as mechanically weak layers, which for instance, cause sinking of the ground surface and tilting buildings. In this study, a Persistent Scatterer InSAR (PSI) analysis was performed to map the ongoing ground deformation in Uppsala. The subsidence rate measured with PSI was validated with precise leveling data at different locations. Two ascending and descending data sets were analyzed using SARPROZ software, with Sentinel-1 data from the period March 2015 to April 2019. After the PSI analyses, comparative permanent scatterer (PS) points and metal pegs (measured with precise leveling) were identified creating validation pairs. According to the PSI analyses, Uppsala was undergoing significant subsidence in some areas, with an annual rate of about 6 mm/year in the line-of-sight direction. Interestingly, the areas of great deformation were exclusively found on postglacial clay.