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Sentinel-1 Constellation for nationwide deformation mapping with InSAR – From science to operations

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For more than a decade, InSAR has been used in Norway study landslides and subsidence. Initial studies concentrated on understanding and validating the technique in various settings. During the last five years, however, we have moved towards using InSAR in operational settings. Of all the challenges we have faced, the largest has been regular access to SAR imagery. The Sentinel-1 constellation will bring a paradigm shift to the field with its operational characteristics: mission configuration, acquisition planning, and data distribution policy. For the first time, we will have nationwide acquisitions with an unprecedented temporal spacing. By the end of this year, we will have a sufficiently long time series of data to produce an initial version of a national deformation map. Within the ESA SEOM InSARap project, we have developed the necessary updates of interferometric processing tools necessary to handle the novel TOPS mode, and successfully demonstrated the performance of S1 InSAR in a number of scientific applications. However, to fully exploit the key advantages of the Sentinel-1 mission, we still face a number of scientific and operational challenges, due to the new and unique characteristics of the mission. Specifically, the large coverage and dense temporal sampling results in very large data sets with a vastly increased information content, which still needs new algorithmic development to extract. In the context of national mapping, optimal harmonization of deformation maps based on overlapping individual S1 stacks is the most prominent challenge.

Urban areas in Norway face much the same problems as many other cities throughout the world; subsidence due to soil compaction and groundwater changes or excavation, and resulting damage to infrastructure. More unique to Norway is the threat to lives caused by large unstable rock slopes along the steep fjords. In the 20th century alone, catastrophic rock slope failures leading to tsunamis in fjords and large lakes, caused the deaths of nearly 200 people. Each of these failures was preceded by years of slow deformation. Through systematic mapping, including the use of InSAR, we have now identified more than 70 unstable rock slopes that are deforming and have the potential to collapse. In order to meet the needs of the local communities living under the threat of these landslides, as well as the urban areas dealing with subsidence problems, we are developing an automatically updated, nationwide InSAR service based upon the Sentinel-1 constellation. The proposed map product will be periodically updated and will be of a different resolution for urban and non-urban areas. Deformation data will be fed directly into the decision-support tools of various local, regional and national authorities via appropriate web GIS protocols. The data will also be made available to the public via a web map interface with simple tools to query and visualize the information.