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TerraFirma and SubCoast: using satellite data for flood related issues and ground subsidence

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Subsidence is a typical geohazard for coastal lowland areas and river basins. Subsidence, when combined with sea level rise and extreme weather events (windstorms, heavy rainfall and related river discharges) aggravates flood risk, increasing the hazard by deteriorating the flood defence and increasing the exposure as a result of the subsiding terrain. Therefore, subsidence and flood risk are closely related.
Coastal lowland areas are often densely populated with varied land use including industry, agriculture and infrastructure. If flood defence systems are not in place or fail to function, a flooding event will result in substantial economic damage and possible loss of life.
The probability of a flood event increases for a subsiding flood defence structure, by an increase in the probability of overtopping. Additionally, with a subsiding hinterland the difference in height between the extreme water level and the exposed terrain increases, destabilising the flood defence structures. Secondly, the impact of a flood will be larger for subsided terrain by an increase in inundated area both in depth and in extent. This means that terrain movement is a relevant parameter for all flood prone areas, whether protected by flood defence structures or not.
The shallow subsurface in lowland areas frequently contains compressible soils which are vulnerable to subsidence. Furthermore, these deposits have a substantial spatial variability due to sedimentation and erosion processes, introducing a spatial component in the vulnerability to subsidence. In addition to natural processes of ripening, compaction and peat oxidation, human factors also influence the terrain level: The extraction of natural resources like groundwater, salt, oil or gas in deeper layers (ranging from tens of metres up to thousands of metres) may cause subsidence at the surface.
Knowing the magnitude of changes in terrain level over the past decades and understanding the processes behind it is key for predicting terrain movement in the future. Within the TerraFirma programme several pilots have been performed in which PSI data (Persistent Scatterer Interferometry data from satellites) have been used to assess terrain motion over the last 10 years for both wide areas (typically 100 x 100 km2) and stretches of flood defence structures. Combining these data with detailed (geological) information allows to link the measured motion to (local) geological processes and/or human interference. This workflow is further developed within the FP7 framework project SubCoast, where PSI, existing digital elevation models and geological information are used to develop dynamic models to predict the terrain elevation in the future for both local and regional areas in coastal lowlands.