



## **Geohazard monitoring and modelling using Persistent Scatterer Interferometry in the framework of the European project Terrafirma**

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Increasingly, geohazard risk managers are looking to satellite observations as a promising option for supporting their risk management and mitigation strategies. The Terrafirma project, aimed at supporting civil protection agencies, local authorities in charge of risk assessment and mitigation is a pan-European ground motion information service funded by the European Space Agency's Global Monitoring for Environment and Security initiative. Over 100 services were delivered to organizations over the last ten years.

Terrafirma promotes the use of Synthetic Aperture Radar Interferometry (InSAR) and Persistent Scatterer InSAR (PSI) within three thematic areas for terrain motion analysis: Tectonics, Flooding and Hydrogeology (ground water, landslides and inactive mines), as well as the innovative Wide Area mapping service, aimed at measuring land deformation over very large areas.

Terrafirma's thematic services are based on advanced satellite interferometry products; however they exploit additional data sources, including non-EO, coupled with expert interpretation specific to each thematic line. Based on the combination of satellite-derived ground-motion information products with expert motion interpretation, a portfolio of services addressing geo-hazard land motion issues was made available to users.

Although not a thematic in itself, the Wide Area mapping product constitutes the fourth quarter of the Terrafirma activities. The wide area processing chain is nearly fully automatic and requires only a little operator interaction. The service offers an operational PSI processing for wide-area mapping with mm accuracy of ground-deformation measurement at a scale of 1:250,000 (i.e. one cm in the map corresponds to 2.5 Km on the ground) on a country or continent level. The WAP was demonstrated using stripmap ERS data however it is foreseen to be a standard for the upcoming Sentinel-1 mission that will be operated in Terrain Observation by Progressive Scan (TOPS) mode.

Within each theme, a series of products are offered. The Hydrogeology service delivers geo-information for hydrogeological hazards affecting urban areas, mountainous zones and infra-structures. Areas where ground-water has been severely exploited often experience subsidence as a result. Likewise, many European towns and cities built above abandoned and inactive mines experience strong ground deformation. The hydrogeology theme products study these phenomenon as well as slope instability in mountainous areas.

The Tectonics service presents information on seismic hazards. The crustal block boundaries service provides users with information on terrain motion related to major and local faults, earthquake cycles, and vertical deformation sources. The vulnerability map service combines radar satellite data with in situ measurements to identify regions that may be vulnerable in the case of an earthquake.

Within the Coastal Lowland and Flood Risk service, the flood plain hazard product assesses flood risk in coastal lowland areas and flood-prone river basins. The advanced subsidence mapping service combines PSI with levelling data and GPS to enable users to interpret subsidence maps within their geodetic reference systems. The flood defence monitoring service focuses on flood protection systems such as dykes and dams.

Between 2003 and 2013, Terrafirma delivered services to 51 user organizations in over 25 countries. The archive of datasets is available to organisations involved in geohazard risk management and mitigation.

**Keywords:** Persistent Scatterer Interferometry, Synthetic Aperture Radar, ground motion monitoring, Terrafirma project, multi-hazard analysis

