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Towards monitoring of geohazards with ESA's Sentinel-1 C-band SAR data: nationwide feasibility mapping over Great Britain calibrated using ERS-1/2 and ENVISAT PSI data

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Following the success of its predecessors ERS-1/2 and ENVISAT, ESA's Sentinel-1 constellation will provide routine, free of charge and globally-available Synthetic Aperture Radar (SAR) observations of the Earth's surface starting in 2013, with 12day repeat cycle and up to 5m spatial resolution. The upcoming availability of this unprecedented and long-term radar-based observation capacity is stimulating new scientific and operational perspectives within the geohazards and land monitoring community, who initiated and is being working on target preparatory studies to exploit this attractive and rich reservoir of SAR data for, among others, interferometric applications.

The Earth and Planetary Observation and Monitoring, and the Shallow Geohazards and Risks Teams of the British Geological Survey (BGS) are routinely assessing new technologies for geohazard mapping, and carrying out innovative research to improve the understanding of landslide processes and their dynamics. Building upon the successful achievements of recent applications of Persistent Scatterer Interferometry (PSI) to geohazards mapping and monitoring in Europe, and with the aim of enhancing further the research on radar EO for landslide management in Britain, since the beginning of 2012 the BGS has been carrying out a research project funded by internal NERC grants aimed at evaluating the potential of these techniques to better understand landslide processes over Great Britain.

We mapped the PSI feasibility over the entire landmass, based on the combination of topographic and landuse effects which were modelled by using medium to high resolution DEMs, land cover information from the EEA CORINE Land Cover map 2006, and six PSI datasets over London, Stoke-on-Trent, Bristol/Bath, and the Northumberland-Durham region, made available to BGS through the projects ESA-GMES Terrafirma and EC-FP7 PanGeo. The feasibility maps for the ERS-1/2 and ENVISAT ascending and descending modes showed that topography is not the major limitation over most of Britain, and areas of layover and shadow for each satellite mode do not exceed 1% of the entire landmass. Although the results from the landuse feasibility mapping confirm that landcover has stronger control on the potential of these technologies over Britain, the overall number of monitoring targets that might be identified over the entire landmass for each acquisition mode exceeds 12.8M. Based on the results of the feasibility mapping, we identified three categories of landsliding in Britain, over which we will carry out SAR-based ground motions studies with ERS-1/2 SAR and ENVISAT ASAR data covering the past 20 years, based on combination of change detection, SAR Interferometry (InSAR), PSI and Small Baseline (SBAS) approaches. Selected test sites include South Wales Coalfield, the Cotswold Escarpment, the Pennines, the North York Moors, as well as landsliding affecting transport/infrastructure and coastal sites in eastern and southern England.

The results of our study act as milestones for future SAR applications and operational uses for a wide range of geohazards in Britain, including landslides, land subsidence/uplift due to groundwater abstraction/recharge, shrink-swell clays, as well as structural deformation of critical infrastructure, and show the potential of future nationwide monitoring of the entire landmass with the new Earth explorers of the Sentinel-1 constellation.

Reference:
Cigna F., Bateson L., Jordan C., Dashwood C. (2012), Feasibility of InSAR technologies for nationwide monitoring of geohazards in Great Britain. Remote Sensing and Photogrammetry Society Annual Conference, RSPSoc 2012, Greenwich (UK), 12-14 September 2012. Available at: http://nora.nerc.ac.uk/19876/