

# New land motion map shows the human impact on the UK landscape

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Credit: University of Nottingham

Researchers at the University of Nottingham who developed groundbreaking technology which was used to create the first country-wide land motion map of Scotland, have scored another first by creating a new UK-wide ground motion map.

Using thousands of satellite radar images, the technology was applied under license by Geomatic Ventures Limited (GVL), an innovative University spin-out company, to create a complete land motion map of the UK as a natural progression from [the first country-wide map of ground motion in Scotland](#).

The new UK-wide map covers a two-year period from 2015 to 2017 and was created using an Intermittent Small Baseline Subset (ISBAS) analysis, a novel satellite remote sensing data processing algorithm. It offers the most detailed look ever at the UK's shifting topography and

highlights areas of hazards due to [coal mining](#), soil compaction, landslides, coastal erosion, landfill subsidence and tunnelling for the London Underground.

This unique ground motion surveying system offers a host of advantages. It can obtain measurements over all urban and rural areas and therefore provides a full picture of the moving UK land surface, which is of significant interest to policymakers and a wide range of industries. These include onshore oil and gas, civil engineering, insurance, mining and carbon trading.

Dr. Stephen Grebby, Assistant Professor in Earth Observation, explained, "With the new map we are able to better understand how the entire UK landscape is being affected by various natural and anthropogenic processes. Whilst providing us with detailed information to study the individual mechanisms of these processes, the technique also offers a means of identifying and mitigating any potential risk that these may also pose to infrastructure, society and the environment."

Dr. John Kupiec, Innovation Manager at the Environment Agency commented, "The Environment Agency has supported GVL in this innovative development and is delighted to see the product released as an online interactive map. The Environment Agency and other government and public sector organisations will be able to make use of the rich information for a variety of applications in monitoring both the natural and built environments for the benefit of people and to promote sustainable development."

Large civil engineering projects such as the works at Kennington Park, London, part of the Northern Line Extension, lie at the heart of a large subsidence bowl (red/brown on the map) measuring more than 500m across, just east of the Oval. This is most likely due to the sinking of a shaft which was completed in November 2017. The map also shows that

parts of the proposed HS2 route go through some of the most dynamic areas of coal mining subsidence in England.

Coal mining areas contain large regions of surface rebound (uplift – blue on the map) which is a common occurrence as the underground workings flood after closure, but there are also many instances of collapsing mines deep underground that may still lead to surface subsidence (red/brown on the map) decades after closure. The examples of such effects can be seen extensively over former coalfields such as Leigh, Greater Manchester; North Nottinghamshire; South Yorkshire; Stoke-on-Trent; and Midlothian. Even though the map shows ground movement in these and other areas, there is very little cause for concern, as the rates are typically very low (only a few millimetres per year) and would be barely noticeable in most cases.

The new map easily identifies subsiding areas (in red/brown) in Scotland's Flow Country, which is the largest blanket bog in Europe and the largest single terrestrial carbon store in the UK, thus ensuring that the extent of the damage can be assessed. This key information can contribute towards international reports on emissions which are submitted to the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and the European Union. It also provides useful evidence on the success of restoration campaigns which are important for reporting on carbon sequestration.

Dr. Andy Sowter, Chief Technical Officer of GVL said, "This is truly the first of its kind. No one has ever mapped land motion across the whole of the UK quite like this before, encompassing the complete rural and urban landscape, and all from a satellite orbiting 800km above us. This unique image has revealed a dynamic, shifting, collapsing landscape dominated by unnatural, man-made activities such as our heritage in coal mining, agricultural practices and peatland management. It has implications for a whole range of industrial and governmental bodies

including those in energy, infrastructure, environmental management and climate change but also demonstrates that a low-cost, operational solution to the monitoring of land surface dynamics at this scale is possible."

## **About the UK-wide land motion map**

The map was produced from over 8TB of radar data (more than 2000 images) acquired over two years by the Sentinel-1 satellite mission, which is part of the European Union's Copernicus programme. Sentinel-1 data was downloaded for free from the European Space Agency website. The data was analysed using the novel (patent pending) ISBAS Interferometric SAR (InSAR) method developed by the University of Nottingham and exclusively licensed to GVL, which is uniquely able to survey both rural and urban areas. The images were processed by GVL.

## **About the ISBAS method**

The Intermittent Small Baseline Subset (ISBAS) method was first tested in 2012 in collaboration with the British Geological Survey. In 2014, it was the overall winner of the prestigious Copernicus Masters Competition, also known as the 'Space Oscars,' awarded by the European Union and the European Space Agency. Since then it has been fully validated and is the subject of a growing number of high-ranking peer-reviewed journals. It is also the subject of a patent application by the University of Nottingham.

Provided by University of Nottingham

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