

MEASURES OF SURFACE MOVEMENTS IN CATALONIA USING SENTINEL-1 DATA

A complete monitoring of surface movements at regional scale has been implemented as a decision support tool on risk management.

The challenge

Surface movements can be caused by various phenomena, both anthropic and natural ones, such as groundwater extraction, landslides, infrastructure construction, mining or tunnelling. The techniques developed by the Cartographic and Geological Institute of Catalonia (ICGC) allow the measurement of movements with millimetre accuracy.

Using these techniques, the ICGC has generated a map of ground motion measures for the Catalan territory, using SENTINEL-1A/B radar satellites at C band throughout 2016 and 2017.

The space based solution

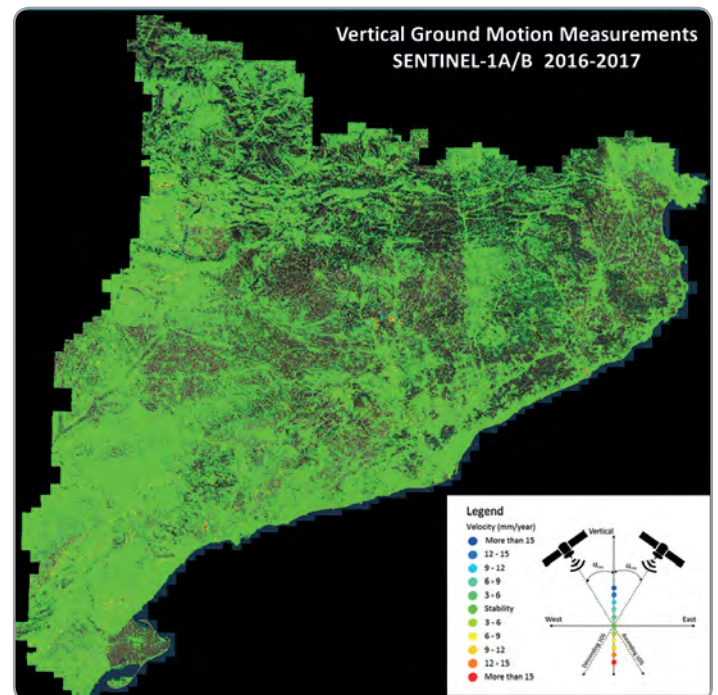
ICGC has created the first complete map of measures of land movement for the entire territory of Catalonia. The measurements have been obtained from radar images of the SENTINEL-1A and B satellites on ascending and descending modes. These satellites offer a maximum 6-day image acquisition frequency, and the images are free to download.

In recent months ICGC has been developing Persistent Scatterer Interferometry (PSI) methodology for processing large quantities of SENTINEL-1 images.

With regards to SENTINEL-1A/B images, the measurement points are shown on the maps with a spatial resolution of 20 x 20 metres. The points that can be measured must be surface elements that do not undergo major changes during the monitoring period, and are usually found with a high density in urban areas, infrastructures and zones with low vegetation.

Benefits to Citizens

The different incidence angles of the satellite in the ascending and descending orbits allow the measurement of the components of the movement corresponding to the vertical and horizontal direction (East-West).



Measurements of vertical movement (2016-2017) in the entire territory of Catalonia obtained with ICGC's PSI processing chain using SENTINEL-1A/B data.

This translates into a very detailed knowledge of the characteristics of the motion, and this information combined with geological studies and in situ measurements, is transformed into a great tool to evaluate the causes and to apply solutions, for better management and monitoring of the territory.

Thematic Area



**TERRITORIAL
MANAGEMENT
AND URBAN
PLANNING**

Region of Application



CATALONIA

Sentinel mission used



S1

Copernicus Service used



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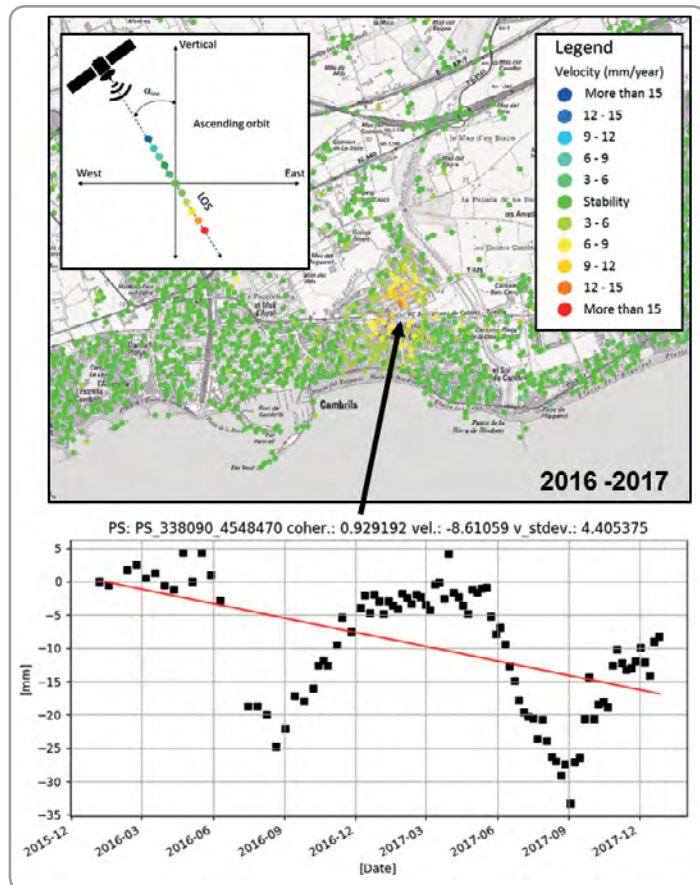
Usage Maturity Level



4

The images that illustrate this article show motion measurements generated with a set of SENTINEL-1A/B images during 2016 and 2017, corresponding to the motion in the vertical direction and Line Of Sight (LOS) respectively. A colour scale indicating the intensity of the velocity represents the points that can be measured.

Stable points are shown in green. In these measures, which cover the entire Catalan territory, several areas affected by surface movements can be distinguished.



Example of measured subsidence in Cambrils urban area due to periods of groundwater extraction. During summer (2016 and 2017) groundwater is extracted and subsidence accelerates (more than 3 cm accumulated in 2017). Note that surface level does not recover fully during the winter.

“Copernicus Sentinel-1 data allow us to transform data into information and knowledge in a cross-fertilisation action between geologist and remote sensing professionals.”

*Sr. Jordi Marturia,
ICGC-Geological Prevention Risks*

The mentioned ICGC SENTINEL 1 added value chain has been also used in the LIFE EBRO-ADMICLIM project (ENV / ES / 001182), in the Ebro Delta (Catalonia, a zone that is very vulnerable to the rise of sea level and ground subsidence). Therefore, the interferometric SENTINEL-1 data on the current rates of subsidence of the Delta are of major importance.

Outlook to the future

Starting from the measure corresponding to 2016, the ICGC proposes to create periodic updates, generating a historical database of surface motion throughout the territory of Catalonia.

Acknowledgements

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ABOUT COPERNICUS4REGIONS

This Copernicus User Story is extracted from the publication “**The Ever Growing use of Copernicus across Europe's Regions: a selection of 99 user stories by local and regional authorities**”, 2018, Edited by NEREUS, the European Space Agency and the European Commission.

The model cases focus on local and regional authorities who successfully applied Copernicus data in 8 major public policy domains. The views expressed in the Copernicus User Stories are those of the Authors and can in no way be taken to reflect the official opinion of the European Space Agency or of the European Commission.

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