

## PROTECTION OF EUROPEAN CULTURAL HERITAGE FROM GEOHAZARDS

*Application of innovative EO techniques for geohazards assessment in the Derwent Valley Mills (WHS).*

### The challenge

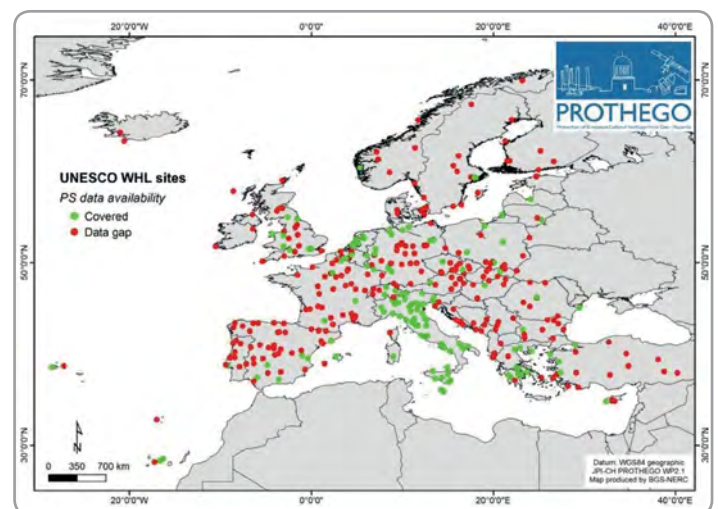
Tangible cultural heritage includes various categories of monuments and sites, from individual architecture to cultural landscapes, and from archaeological complexes to historic centres. Many of these sites are affected by a variety of factors, with rapid or slow onset. They include natural hazards, such as landslides, settlement, subsidence, earthquakes or extreme meteorological events, which could be worsened by climate change and/or human interaction. A comprehensive picture of cultural sites affected by geohazards is not yet available. The PROTECTION of European Cultural HERitage from GeOHazards, (PROTHEGO) project provides an overview of remote sensing capabilities for monitoring these threats by focusing on properties on the UNESCO World Heritage List (WHL) in Europe. These properties will serve as a reference case for all EU heritage properties.

### The space based solution

PROTHEGO applies novel space technologies based on radar interferometry (InSAR) to monitor monuments and sites in Europe which are potentially unstable due to geohazards. These technologies can play a crucial role in developing site management strategies sustainable for the preservation of cultural heritage and landscape. Remotely sensed information on ground stability conditions is combined with In order to assess observed motions and understand geological processes, an analysis of remotely sensed data in conjunction with local-scale geological analysis was implemented for each test site. Advanced modelling and field surveying were also carried out. At least one site for each partner country (i.e. Italy, United Kingdom, Cyprus and Spain) was chosen to validate and calibrate the methodology.

The Derwent Valley Mills World Heritage Site (DVMWHS), managed by the Derwent Valley Mills Partnership, is one of the PROTHEGO

case study sites selected for local scale monitoring, investigation and advanced modelling. The Derwent Valley, with its associated mill complexes, industrial housing and infrastructure, was inscribed on the UNESCO World Heritage List in 2001 in recognition of its importance as the birthplace of the modern factory system. In order to monitor the current state of activity of the identified geohazards, Sentinel-1 space-borne imagery acquired between 2015 and 2017 was processed using the InSAR technique. The project identified fluvial and groundwater flooding and landslides as key threats to the Valley's cultural heritage resource, for example, at Belper, where radar data identified damage possibly connected to a recent flooding event.



UNESCO WHL sites of Europe covered by PS ground motion data, derived by satellite radar interferometry. Base map data © ESRI. World Heritage Site data Credit © 1992 - [2016] UNESCO/World Heritage Centre. All rights reserved. Map produced by BGS, © NERC/UKRI. Green dots indicate PS data available for site, red dots indicate PS data not available.

### Benefits to Citizens

PROTHEGO's goal is to enhance cultural heritage management practices at the national level, reinforcing institutional support

Thematic Area



CULTURAL HERITAGE, TOURISM AND LEISURE

Region of Application



ITALY  
CYPRUS  
SPAIN

Sentinel mission used



S1

Copernicus Service used



-

Usage Maturity Level



3

and governance through knowledge and innovation. The project identifies, assesses and monitors risks with the aim of strengthening disaster preparedness for heritage properties in the future. The project promoted interdisciplinary and collaborative R&D activities, transferring the highest level of knowledge, quality and standards from space and earth sciences to cultural heritage conservation sciences.

## Outlook to the future

An agreement amongst EU institutions (e.g. member states, EU Commission, ESA, EEA etc.) on the use of satellite services for monitoring geohazards affecting cultural heritage would help define best practice guidelines and standard methodologies for adoption by practitioners in this field.



InSAR data identified damage in the East Mill possibly connected to the Winter 2016-17 flooding event in Belper. Sentinel-1 data were sourced from the European Space Agency. Imagery supplied through ESRI's World Imagery layer under ESRI's Master license Agreement ©ESRI.

*Credit: Contains modified Copernicus Sentinel data 2015-2017*

“The data and methods developed by PROTHEGO will contribute significantly to the development of mitigation strategies aiming to preserve the Derwent Valley’s globally important cultural heritage.”

*David Knight, DVM's Partnership*

## Acknowledgements

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