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EDITED AND REVIEWED BY
Alexander Kokhanovsky,
German Research Centre for Geosciences, Germany

*CORRESPONDENCE
Massimo Fabris,
massimo.fabris@unipd.it

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Editorial: Management and monitoring of natural disasters using remote sensing and ground-based data

Massimo Fabris[1]*, Djamil Al-Halbouni[2], Michele Monego[1], Arianna Pesci[3] and Giordano Teza[4]

[1]Department of Civil, Environmental and Architectural Engineering, University of Padua, Padua, Italy, [2]Institute for Earth System Science and Remote Sensing, Leipzig University, Leipzig, Germany, [3]National Institute of Geophysics and Volcanology (INGV), Roma, Italy, [4]University of Bologna, Bologna, Italy

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Editorial on the Research Topic
Management and monitoring of natural disasters using remote sensing and ground-based data

Introduction

Intensity and frequency of the natural disasters are increasing worldwide, above all also because of human activity and related effects on climate changes. In this context, ground deformation generated by catastrophic events represents a growing problem that affects hundreds of millions of people worldwide. The surface changes due to natural events, i.e., landslides, sinkholes, coastal erosion, volcanic activities, earthquakes, land subsidence, etc., can lead to structural damage of buildings and infrastructures, loss of extensive agricultural and/or natural areas, damage to tourist sites and cultural heritage, rise of salt wedges, regression of coastlines, and can have a significant economic and social impact. This negative impact can be further aggravated by climate change (e.g., sea level rise, modifications of rainfall intensity and period) and by climate change driven increased anthropogenic influence (e.g., groundwater withdrawal) in particular in low-lying coastal areas and unstable slopes.

Ground deformation monitoring before (when possible), during and after a natural disaster plays a key role in the management of such natural hazards by providing cost-effective solutions for implementing risk mitigation strategies.

Management and monitoring of natural events can be performed using different data: they can be acquired at various scales based on remote sensing techniques (in particular, but not limited to, InSAR–Interferometric Synthetic Aperture Radar) complemented with ground-based surveys (e.g., GNSS–Global Navigation Satellite System, precise leveling, Structure from Motion photogrammetry, Terrestrial Laser Scanning), including measurements from airplanes, helicopters, UAV (Unmanned Aerial Vehicle) as well as USVs (Unmanned Surface Vehicles) or also UUVs (Unmanned Underwater Vehicles). As each technique is characterized by advantages and disadvantages, when remote sensing data are used in conjunction with data provided by other techniques the quality of the final results improves (in terms of accuracy, costs and times of survey and data processing). In this way, the integration of data obtained from different sources play a fundamental role to improve the information that must be available for every risk mitigation activity.

Overview of contributions

The accepted works are briefly presented here in order of publishing.

Sun et al. derived the surface deformation of landslides in Shuicheng District, located in Guizhou Province, China. The authors used multi-source SAR dataset from Sentinel-1A and ALOS/PALSAR-2 satellites, atmospheric error correction by quadratic tree image segmentation method, and phase-stacking method to obtain the surface deformation: with this procedure, they identified 42 potential landslides. Thus, the authors analyzed in detail Pingdi landslide: combining DS-InSAR (Distributed Scatterer InSAR) (that acquire the deformation along the LOS–Line Of Sight) and MSBAS (Multidimensional Small Baseline Subsets) method (to retrieve the east-west and vertical deformation time series), using ground surface deformation result, optical remote sensing images and geomorphological information they studied the surface deformation. From the obtained data and according to the spatial-temporal deformation characteristics and field investigation, the authors conducted a comprehensive analysis of triggering factors and failure process. The results indicated that the mining activity was the main cause of the Pingdi slope deformation and the precipitation was the driving factor of the landslide instability.

Wang et al. studied the deformation of the steep terrain and dense vegetation in southwest China, the landslide in Xinmo Village, Mao County, Aba Prefecture Sichuan Province, China. The authors used 9 vegetation indexes based on 4 Landsat 8 Operational Land Imager (OLI) images. The index with the highest correlation and better dispersion with vegetation coverage was used as the indicator of landslide change to estimate the vegetation coverage. They analyzed the relationship between the vegetation anomalies and the landslide creep, superimposing vegetation spatial variation characteristics and slope structure. The results showed that from May 2015 to May 2017 as the time of landslide was approaching, portion of the vegetation in the study area was affected by the landslide deformation. Finally, the authors highlighted a clear correlation between vegetation changes and landslide deformation during the landslide creep phase that provide the evolution process of landslide destabilization: for this reason the proposed method can be used for the early identification of landslides in high vegetation coverage areas.

Intrieri et al. proposed a procedure based on the detection of ground displacements obtained by a Ground-Based Interferometric radar (GBInSAR) and on the generation of a risk zonation map to reduce the risk represented by sinkholes. The authors analyzed 11 years of ground displacements data to search for sinkhole precursors. The test site was around Camaiore (Italy) where a catastrophic 30 m wide sinkhole occurred in 1995. They analyzed averaged displacement time series retrieved from high-coherence scattered pixels. In this way, the authors generate a sinkhole risk map evaluating the susceptibility map obtained from: i) a set of predisposing environmental parameters; ii) the vulnerability derived from the thickness of the sedimentary cover; iii) the value of the elements at risk obtained from the Italian Real Estate Market Observatory that was integrated with land cover information for the non-built up areas. Results provided a few centimeters of vertical displacements, well correlated with water table oscillations. In this way, the event of 1995 could have likely been detected before its final collapse. Finally, from the sinkhole risk map the authors identified some specific areas that should be monitored integrating *in situ* and remote sensing measurements.

Ni et al. proposed a method to reduce number of images, computational load and hardware characteristics normally required by the traditional time series InSAR processing for geohazard identification. The authors used less than 7 SAR images of Sentinel-1 satellite (acquired from April to June 2021) to quickly find the deformation related to a geological hazard-prone area in the Jinsha River basin, China. They used a linear model to correct the results and remove the correlation between the rate values and the elevation information. From the corrected rates the authors identified a total of 13 areas where deformation occurred. They analyzed in detail 2 slopes characterized by large deformations and identified the maximum line of sight deformation rate of 115 mm/year between July 2020 and July 2022, certifying the poor overall stability of the studied areas.

Author contributions

MF: Writing–original draft, Writing–review and editing. DA-H: Writing–review and editing. MM: Writing–review and editing. AP: Writing–review and editing. GT: Writing–review and editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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