Title: Development of a web-platform for monitoring infrastructure networks affected by ground instabilities

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In recent years, big data and artificial intelligence have provided new methods and opportunities for many applications in the field of engineering geology. Examples are the implementation of detailed 3D geological models, precision geolocation with GNSS, the development of artificial neural networks associated with the evaluation of landslide susceptibility, 3D seismic tomographs useful for the identification and estimation of georesources, etc. Although very useful, big data and data mining operations require specific methodological refinements in order to consolidate objectives and results, making them suitable for applications in the field of natural risk management. In the presence of mass movements, real-time monitoring of infrastructures is of extreme relevance for risk management, especially in the presence of large amounts of data resulting from the integration of traditional and innovative monitoring systems. The implementation of an integrated data management system capable of managing data deriving from traditional monitoring techniques (inclinometers, topographic systems, etc.) with those deriving from innovative sensors (laser scanners, proximity photogrammetry, interferometry, etc.) is one of the technological challenges that the managers of large works and/or networks at the national level have been pursuing for several years. However, the management and integration of large databases and their interpretation for the purpose of landslide risk management is a complex operation that requires specialised tools capable of integrating process-based data management protocols. The integrated data management systems represent the technological solution to these needs and allow, through a system of acquisition and programmed data transmission, the control of wide areas, identifying in a rapid and at the same time accurate manner the priorities on which to subsequently concentrate detailed studies and interventions. The strand within which the proposed research is framed is that of the integration of data deriving from traditional and innovative monitoring techniques of deformation phenomena of the earth's surface, characterised by slow and/or intermittent kinematisms. The objective is to develop a platform and an associated data integration and management procedure capable of supporting risk management operations for infrastructure networks starting from the knowledge of the boundary conditions of the reference sites. The proposing research group is that of Engineering Geology, which will collaborate with DiSTAR colleagues from the fields of Geotechnics, Applied Geophysics and Structural Geology, among others. Examples of such platforms, developed by the proposing research group are: (i) EOSAR (Earth Observation Services for Risk Assessment), a geoinformative service for monitoring the evolution of the Earth's surface; (ii) ASTERISK (Analysis of Stability of Exposed Element to Risk Reduction), a product that uses satellite data, non-invasive structural surveys and numerical modelling in an integrated manner for the structural analysis of the stability conditions of buildings, cultural heritage and infrastructures (hydraulic barrages) in general; I-PROMONALISA (Integrated Procedure for Monitoring and Assessment of Linear Infrastructure Safety), a service designed for monitoring linear infrastructure such as road networks, railway networks, water and sewage networks.

The research will be developed in a series of different phases with a specific methodological connotation: (i) study of the existing literature; (ii) characterisation through field surveys of the site under experimentation, (iii) acquisition and processing

of the available data also through the application of existing procedures suitably improved through the implementation of machine learning algorithms, (iv) development of a new platform for the dissemination and management of the specific data, (v) validation of the proposed procedure. The literature study (i) will focus on the in-depth study of the interaction of slow landslides and linear infrastructures, as well as on the monitoring techniques of these systems and the methodologies useful for data processing and their use for risk management purposes. At the same time, field surveys will be initiated to identify the most suitable experimental sites and their detailed characterisation (ii). Site and remote data (iii) will be acquired, also on the basis of the experiences of the industrial partner, in order to select case studies characterised also by different phenomena (slope instability, criticality at works of art, etc.). These data will be processed through procedural schemes derived from existing ones appropriately implemented through the integration of machine learning techniques and algorithms, which will allow to analyse in detail the relationships between the different data sources, in order to objectively identify the specific problems for a proper management of the actions to be undertaken for risk mitigation. A web-based data management and dissemination platform will then be implemented (iv), useful to the industrial partner for the correct management of its networks, finally completing the methodological process with the validation of the implemented procedure (v).