Geophysical Research Abstracts
Vol. 20, EGU2018-4809, 2018
EGU General Assembly 2018

Application of Infrared Thermography (IRT) for landslide hazard and risk scenarios assessment: suggestions for a methodological approach from some case studies

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Geo-hydrological hazards are a major threat to human life, property, cultural heritage, natural and built environments. Landslides in particular, play an important role in the evolution of landscapes, representing a major cause of loss of life and injuries, property damage, environmental degradation and natural disasters around the world. In this context, the availability of new remote sensing technologies, based primarily on satellite, aerial and terrestrial remote sensing platforms, can allow systematic and easily updatable acquisitions of data over wide areas, therefore improving the production of landslide hazard maps and hazard assessment, reducing costs and optimize field work.
Infrared thermography (IRT), or thermal imaging, is a remote sensing technique capable of mapping the surface temperature pattern evolution, to be used as an alternative or complementary tool in a wide variety of technical and scientific applications. In recent years IRT, thanks to the technological development of portable high resolution and cost-effective thermal imaging cameras, and to the improved quality of the thermographic data collection and processing, represents a versatile and innovative tool, capable of providing non-contact mapping of surface temperature over wide areas. Rapid thermal mapping can lead to the detection of thermal anomalies within the investigated scenario, therefore permitting the measurement of hazardous areas safely, under almast all-weather and enviromental conditions. Nevertheless, in the field of landslide hazards and risk studies, IRT is still not a well-established technique and it has been only rarely and experimentally applied.
In this work the potential of IRT as an innovative operational tool for landslide surveying, 2D-3D rapid mapping and characterization is explored by analyzing various case studies, characterized by different types of landslide hazard scenarios and risk management contexts. In particular, IRT was applied both from terrestrial and airborne platforms, in an integrated methodology with geomatics methods such as terrestrial laser scanning (TLS) and Global Positiong Systems (GPS), for the detection and mapping of landslides' potentially hazardous structural and morphological features (rock mass discontinuities and open fractures, seepage and moisture zones, ledges/niches systems, landslide drainage network and ponds). The work objective is to improve the investigative capacity of IRT and to extend its fields of application in landslide hazard and risk management studies, to provide an effective and reliable tool to be used for the fast evaluation of hazard scenarios during the emergency management, and, during the post-disaster recovery phase, for the planning of the proper risk reduction measures. The challenge of this work is to go beyond the current state of the art of IRT in landslide studies, with the aim of improving and extending the investigative capacity of the analyzed technique, in the framework of a growing demand for effective Civil Protection procedures in landslide geo-hydrological disaster managing activities, when it is often necessary to gather all the required information in dangerous environments as fast as possible. Advantages and limitations of the proposed method in the field of the explored applications are evaluated, as well as general operative recommendations and future perspectives.