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## **Analysis of potential urban unstable areas and landslide-induced damages on Volterra historical site through a remote sensing approach**

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Multisystem remote sensing techniques were exploited to provide a comprehensive overview of Volterra (Italy) site stability with regards to its landscape, urban fabric and cultural heritage. Interferometric Synthetic Aperture Radar (InSAR) techniques allow precise measurements of Earth surface displacement, as well as the detection of building deformations on large urban areas. In the field of cultural heritage conservation Infrared thermography (IRT) provides surface temperature mapping and therefore detects various potential criticalities, such as moisture, seepage areas, cracks and structural anomalies.

Between winter 2014 and spring 2015 the historical center and south-western sectors of Volterra (Tuscany region, central Italy) were affected by instability phenomena. The spatial distribution, typology and effect on the urban fabrics of the landslide phenomena were investigated by analyzing the geological and geomorphological settings, traditional geotechnical monitoring and advanced remote sensing data such as Persistent Scatterers Interferometry (PSI). The ground deformation rates and the maximum settlement values derived from SAR acquisitions of historical ENVISAT and recent COSMO-SkyMed sensors, in 2003-2009 and 2010-2015 respectively, were compared with background geological data, constructive features, in situ evidences and detailed field inspections in order to classify landslide-damaged buildings. In this way, the detected movements and their potential correspondences with recognized damages were investigated in order to perform an assessment of the built-up areas deformations and damages on Volterra. The IRT technique was applied in order to survey the surface temperature of the historical Volterra wall-enclosure, and allowed highlighting thermal anomalies on this cultural heritage element of the site.

The obtained results permitted to better correlate the landslide effects of the recognized deformations in the urban fabric, in order to provide useful information for future risk mitigation strategies to be planned by the local authorities and the involved technicians and conservators.