

## **The Serra de Tramuntana World Heritage Site (Mallorca, Spain). Landslide activity valuation by means of Persistent Scatterers Interferometry**

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The Serra de Tramuntana, which forms the backbone of the north-west of Mallorca (Spain), was declared in 2011 World Heritage Site by UNESCO under the cultural landscape category. The particular landscape of this range is the fruit of the exchange of knowledge between cultures, with small-scale works performed collectively for a productive aim, conditioned by the limitations imposed by the physical medium. The steep topography of the chain, highly related to its geological complexity, and the Mediterranean climate, influence intense slope dynamics with the consequent multiple types of slope failures: rock slides, earth landslides and rockfalls, which cause significant damage and specifically to the road network (Mateos, 2013a). The human landscape marked by agricultural terraces (dry stone constructions) has significantly contributed to the slope stability in the range for centuries. In the present work, a landslide inventory map with 918 events has been updated and the landslides state of activity was analyzed exploiting 14 ALOS PALSAR satellite SAR (Synthetic Aperture Radar) images acquired during the period 2007-2010. Landslide activity maps were elaborated through the use of PSI (Persistent Scatterers Interferometry) technique (Bianchini et al., 2013). Besides assessing the PS visibility of the study area according to the relief, land use and satellite acquisition parameters, these maps evaluate, for every monitored landslide, the average velocities along the satellite Line Of Sight (VLOS) and along the maximum local steepest slope (VSLOPE), providing an estimate of their state of activity and their potential to cause damages. Additionally, a ground motion activity map is also generated, based on active PS clusters not included within any mapped landslide phenomenon. A confidence degree evaluation is carried out to attest the reliability of measured displacements to represent landslide dynamics. Results show that 42 landslides were identified as active ( $VSLOPE < -5\text{mm/yr}$ ) and seven of them with a potential to produce moderate damage ( $VSLOPE < -10\text{mm/yr}$ ). One of the largest landslides in the range is the Bàltx landslide (50 million m<sup>3</sup> in volume), located on the steep coastal side (Mateos et al., 2013b). Within the landslide body, Roman cistern and old terrace walls have been identified. Numerous geomorphological features identified in its displaced mass (cracks, shallow slides and rockfalls) reveal that the landslide has not yet reached a state of equilibrium. Additionally, field observations determine that the northeastern sector of Bàltx shows major activity signs. DInSAR results reveal that the rate of movement for the Bàltx landslide is extremely low ( $-5\text{mm/yr}$  on average) that could be interpreted as the residual displacement of the deep-seated rockslide. A major activity has also been detected in the northeastern sector of Bàltx with the PSI technique, where velocities rates are slightly over  $-5\text{mm/yr}$ . The outcomes of this work reveal the usefulness of landslide activity maps for environmental planning activities in cultural heritage sites.

### References:

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