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Rapid physical and economic vulnerability assessment of the elements affected by Active Deformation Areas (ADA) detected by radar interferometry in the central Pyrenees of Catalonia (Spain)

Ivan Fabregat¹, Jordi Marturià¹, Pere Buxó¹, and Carlos López-Quintanilla²

¹Institut Cartogràfic i Geològic de Catalunya, Prevenció de Riscos Geològics, Barcelona, Spain (ivan.fabregat@icgc.cat)

²PSIG, Implementació, gestió i formació SIG, Corbera de Llobregat, Spain

Geological hazard caused by ground movements (landslides, subsidence...) are difficult to assess at regional scale due to the large number of potential vulnerable elements.

The paper shows an innovative methodology for a quickly quantify of principal infrastructures (buildings, roads, and railways) structural vulnerability in urban settlements affected by ground movements detected by the Active Deformation Areas (ADA) obtained by medium and high-resolution radar satellites interferometry (Sentinel-1A / B and Cosmo-SkyMed, respectively).

The methodology, tested in the Pyrenean counties of La Cerdanya and Alt Urgell (Catalunya, NE Spain) in the framework of the MOMPA project, has served as the basis for a preliminary estimation a long-term of physical and economic vulnerability. Open information from Cadastral and topographic data (such us, OpenStreetMap®) have been used to calculate vulnerability to buildings, roads, and the railways.

Physical building vulnerability has been calculated from the expected damages according to the type of building, based on this case on the age of the construction. For economic vulnerability, has been used the average of second-hand sale price. The physical vulnerability in roads has determined from the expected damage according to the categories (typology) of existing roads and, the economic one, on the basis the linear average construction price. In the same way, have been calculated the railways vulnerabilities. The vulnerability ranges have been determined based on the expected damage classes based on our experience and existing works. The hazard, an essential variable for the calculation of vulnerability, has been determined by the intensity of the phenomenon derived by the ADA intensity. This intensity allows obtaining a direct estimate of the magnitude of the ground movement. Thus, the hazard is determined by the strain rate (mm / year) of the satellite monitoring data.

This methodology provides a first vulnerability assessment of the vulnerable elements detected by that ADA that allows optimizing and prioritizing efforts in works related to geological risk management and making a rapid assessment of loss at the vulnerable elements.

The clustering of scattering points of the Sentinel 1 A / B data gave a result of 361 ADA, and 59

ADA from the Cosmo-SkyMed satellite (over an area of around 2,000 km²). Between the two satellites, 80 ADA have detected buildings with a category of superficial damage for deformation rates <16 mm / year and an average loss of 5% of their value. 135 ADA affect some category of roads, causing superficial damage (20% of losses) in 96% and structural damage (80% of losses) in the remaining. No railways were affected by the Active Deformation Area (ADA) in Alt Urgell and La Cerdanya counties.

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