SAR interferometry monitoring along the ancient Rome City Walls –the PROTHEGO project case study

Cristina Carta (1), Maria gabriella Cimino (1), Gabriele Leoni (2), Marina Marcelli (1), Claudio Margottini (2), and Daniele Spizzichino (2)

(1) Roma Capitale - Sovrintendenza Capitolina ai Beni Culturali, U.O. Monumenti di Roma, Progetto Osservatori, via Ostiense 109, 00154 Roma, (2) ISPRA, Institute for Environmental Protection and Research, Geological Survey of Italy, Via Vitaliano Brancati 48, 00144 Rome, Italy; daniele.spizzichino@isprambiente.it

Led by the Italian Institute for Environmental Protection and Research, in collaboration with NERC British Geological Survey, Geological and Mining Institute of Spain, University of Milano-Bicocca and Cyprus University of Technology, the PROTHEGO project, co-funded in the framework of JPI on Cultural Heritage EU program (2015-2018), brings an innovative contribution towards the analysis of geo-hazards in areas of cultural heritage in Europe. The project apply InSAR techniques to monitor monuments and sites that are potentially unstable due to natural geo-hazard. After the remote sensing investigation, detailed geological interpretation, hazard analysis, local-scale monitoring, advanced modeling and field surveying for some case studies is implemented. The selected case studies are: the Alhambra in Granada (ES); the Choirokoitia village (CY); the Derwent Valley Mills (UK); the Pompei archaeological site and Historical centre of Rome (IT). In this work, in particular, we will focus on ground deformation measurements (obtained by satellite SAR Interferometry) and on their interpretation with respect to the ancient Rome City Walls. The research activities carried out jointly with the Superintendence's technicians, foresee the implementation of a dedicated web GIS platform as a final repository for data storage and spatial data elaboration. The entire circuit of the ancient city walls (both Mura Aureliane and Mura Gianicolensi), was digitalized and georeferenced. All the elements (towers, gates and wall segments) were drawn and collected in order to produce a map of elements at risk. A detailed historical analysis (during the last twenty years) of the ground and structural deformations were performed. A specific data sheet of ruptures was created and fulfilled in order to produce a geographic inventory of past damage. This data sheet contains the following attributes: triggering data; typology of damage; dimension, triggering mechanism; presence of restoration works. More than thirty events were collected. The most frequent damages refers to human impacts, detachment of brick outer surface and wall collapse. The resulting damage layer was compared with different local hazard maps (e.g. landslide; subsidence; seismic) and also with the PS (monitored point) coming from the satellite analysis. The satellite monitoring data and analysis was based on the processing of COSMO-SkyMed image data (from 2011 to 2014). The data were obtained from the Extraordinary Monitoring Project Plan, implemented by the Italian Environmental Ministry. The preliminary analysis did not show large areas affected by deformations. A wide area affected by subsidence phenomena was detected in the south portion of the walls (close to the Ostiense district). While smaller and localized detachments were detected in the northern sector. Starting from these firsts results, COSMO-SkyMed SAR interferometry analysis seems to be very efficient due to its capability of providing a large number of deformation measurements over the whole site and structures with relatively small cost and without any impact. Cross analysis between interferometric results, natural hazard and historical data of the site (e.g. collapses, works) is still in progress in order to define a forecasting model aiming at an early identification of areas subjected to potential instability or sudden collapse