Geophysical Research Abstracts
Vol. 15, EGU2013-12460, 2013
EGU General Assembly 2013

Archaeological prospection of cultural heritage in the Nasca region, Peru, by coupling ENVISAT ASAR 2003-2007 and optical-VHR time series

Deodato Tapete (1), Francesca Cigna (2), Nicola Masini (3,5), Rosa Lasaponara (4,5)

(1) University of Florence, Italy (deodato.tapete@gmail.com), (2) British Geological Survey, Natural Environment Research Council, United Kingdom, (3) Institute for Archaeological and Monumental Heritage, National Research Council, Italy, (4) Institute of Methodologies for Environmental Analysis, National Research Council, Italy, (5) Italian mission of heritage Conservation and Archaeogeophysics (ITACA) in Peru

We present the radar-interpretation of a 4year-long stack of ENVISAT ASAR imagery, integrated and cross-validated with optical-Very High Resolution (VHR) data from QuickBird2, GeoEye and WorldView-1/2, and carried out over the cultural and natural heritage of the Nasca region in Southern Peru. This research is performed thanks to the provision of free-access archive SAR data from the European Space Agency (ESA) through the Cat-1 project 11073, and is supporting the activities of the Italian mission of heritage Conservation and Archaeogeophysics (ITACA), which directly involve researchers from the Institute for Archaeological and Monumental Heritage (IBAM) and the Institute of Methodologies for Environmental Analysis (IMAA), National Research Council (CNR) of Italy.

The whole ENVISAT ASAR imagery archive, consisting of 8 ASAR IS2 scenes acquired in descending mode between 04/02/2003 and 15/11/2005 and 5 images in ascending mode between 24/07/2005 and 11/11/2007, was processed by exploiting and analyzing SAR amplitude information and change detection to reconstruct the temporal evolution of radar signatures and related backscattering coefficient ($\sigma 0$) of the targets on the ground in the monitoring period 2003-2007. The selection of a SAR amplitude-based change detection method was made to explore its actual potentials for archaeological prospection and monitoring purposes, complementarily to approaches of interferometric coherence used by other scholars over the same region of investigation.

The novel contribution to heritage studies over Nasca includes remote sensing insights into the renowned UNESCO-WHL Nasca geoglyphs and archaeological mounds of the adobe Ceremonial Centre of Cahuachi, as well as the ancient puquios within the Rio Grande drainage basin. The latter are prehispanic underground aqueducts, and nowadays represent not only important cultural features to preserve, but also a potential driver to revitalize waterways and oases in such a dry region.

Advantages and shortcomings of the SAR signature-based recognition of archaeological features on the ground are discussed through the test sites of the geoglyphs groups belonging to the Nasca Lines and the puquios along Rio Taruga, with specific reference to the medium spatial resolution offered by ENVISAT ASAR scenes and the supporting comparison with the VHR-optical imagery.

Amplitude change detection demonstrates high suitability to highlight temporal differences from which we can infer: (i) modifications due to human activity (e.g., looting in Cahuachi); (ii) surface alteration of the exposed archaeological structures (i.e. site conservation issues); (iii) variations of soil water content and vegetation in agricultural areas where puquios are built; and (iv) land surface processes which can trigger natural hazards potentially damaging cultural and natural heritage, as also demonstrated by past and recent mudslides in Cahuachi and the Andean foot-hills.

References

Lasaponara R., Masini N. 2012. Investigating satellite Landsat TM and ASTER multitemporal data set to discover ancient canals and acqueduct systems, in Lecture Notes in Computer Science, Vol. 7335, Issue 3, 2012, Pages 497-511, 12th International Conference on Computational Science and Its Applications, ICCSA 2012, doi: 10.1007/978-3-642-31137-6_38.

Masini N., Lasaponara R., Rizzo E., Orefici G. 2012. Integrated Remote Sensing Approach in Cahuachi (Peru): Studies and Results of the ITACA Mission (2007–2010), In: Lasaponara R., Masini N. (Eds) 2012, Satellite Remote Sensing: a new tool for Archaeology, Springer, Verlag Berlin Heidelberg, ISBN 978-90-481-8800-0, doi: 10.1007/978-90-481-8801-7_14; pp. 307-344.