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Multitemporal satellite data analyses for archaeological mark detection: preliminary results in Italy and Argentina

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The current availability of very high resolution satellite data provides an excellent tool to detect and monitor archaeological marks, namely spectral and spatial anomalies linked to the presence of buried archaeological remains from a landscape view down to local scale (single site) investigations.
Since the end of the nineteenth century, aerial photography has been the remote sensing tool most widely used in archaeology for surveying both surface and sub-surface archaeological remains. Aerial photography was a real “revolution” in archaeology being an excellent tool for investigations addressed at detecting underground archaeological structures through the reconnaissance of the so-called “archaeological marks” generally grouped and named as "soil","crop marks" “snow marks”, and also recently “weed marks” (Lasaponara and Masini).
Such marks are generally visible only from an aerial view (see detail in Lasaponara and Masini 2009, Ciminale et al. 2009, Masini and Lasaponara 2006 Lasaponara et al 2011) . In particular, soil marks are changes in soil colour or texture due to the presence of surface and shallow remains.
Crop marks are changes in crop texture linked to as differences in height or colour of crops which are under stress due to lack of water or deficiencies in other nutrients caused by the presence of masonry structures in the subsoil. Crop marks can also be formed above damp and nutritious soil of buried pits and ditches. Such marks are generally visible only from an aerial view, especially during the spring season.
In the context of the Project “Remote sensing technologies applied to the management of natural and cultural heritage in sites located in Italy and Argentina: from risk monitoring to mitigatin startegies (P@an_sat)”, funded by the Italian Ministry of Foreign Affair, we tested the capability of multitemporal data, from active and passive satellite sensors, in the detection of “archaeological marks”. The areas of interested were selected from within Basilicata and Puglia Region, southern Patagonia and Payunia-Campo Volcanicos Liancanelo e PayunMatru respectively, in Italy and Argentina.
We focused our attention on diverse surfaces and soil types in different periods of the year in order to assess the capabilities of both optical and radar data to detect archaeological marks in different ecosystems and seasons.
We investigated not only crop culture during the “favourable vegetative period” to enhance the presence of subsurface remains but also the “spectral response” of spontaneous, sparse herbaceous covers during periods considered and expected to be less favourable (as for example summer and winter) for this type of investigation.
The main interesting results were the capability of radar (cosmoskymed) and multispectral optical data satellite data (Pleiades, Quickbird, Geoeye) to highlight the presence of structures below the surface even (i) in during period of years generally considered not “suitable for crop mark investigations” and even (ii) in areas only covered by sparse, spontaneous herbaceous plants in several test sites investigate din both Argentine and Italian areas of interest.
Preliminary results conducted in both Italian and Argentina sites pointed out that Earth Observation (EO) technology can be successfully used for extracting useful information on traces the past human activities still fossilized in the modern landscape in different ecosystems and seasons. Moreover the multitemporal analyses of satellite data can fruitfully applied to: (i) improve knowledge, (ii) support monitoring of natural and cultural site, (iii) assess natural and man-made risks including emerging threats to the heritage sites.

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