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A multidisciplinary approach to reveal floodplain palaeohydrography in the surrounding of ancient Luna archaeological site (lower Magra River valley, NW Italy)

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The Magra floodplain (NW Italy) is a coastal plain that was created during the last 2.5 millennia by the River Magra itself and by minor streams draining the southern slope of the Apuan Alps. The coastline progressively migrated from the mountain foothills to its present position, 2.5 km seaward. Available stratigraphical data suggest that the marine gulf that occupied the area before Bronze age gradually changed into a lagoon; this was finally separated from the open sea and became a complex of marshes that were finally silted up. All these environments provided opportunities for settlement and land use: early settlement is accounted for in the Iron Age by Ligurian people that were finally defeated by the Romans. In the 2nd century bC the roman colony of Luna (today Luni) was founded in the area. After the Imperial Age Luni gradually decayed and was finally abandoned in 1204. Post-Roman alluviation is thought to be partly responsible for the city decline and the survival of only scattered farmsteads in its surroundings. Settlement and land use history from Iron Age onward are thus tightly dependant from drainage network evolution in the area. Although historical maps provide some chronological constraints about the advance of the Magra floodplain it is still unknown how and when precisely the transformation of a lagoon environment into a dry land occurred. In particular no data are available about the position of the mouths of the Magra River and of the minor streams at Roman Times and little is known about channel migration since the Early Middle Ages and information about land reclamation are difficult to find because dispersed.
In order to identify abandoned fluvial channels, a series of digital elaborations were applied to different types of Remotely-Sensed Images. In detail, the used data consist of satellite images (Landsat 7 – ETM) and airborne orthophotos (AIMA) covering a temporal interval of five years (from 1998 to 2002) and characterized by a spatial resolution of 30 and 1 m, respectively.
The elaboration techniques chosen for our investigation include the classic visualisation in gray level mode, colour composition of different bands (natural and false), contrast enhancement, density slicing and filtering. These procedures allowed to improve the visual discrimination of buried fluvial features basing on the assumption that palaeo-river elements show unique characteristics in their spectral responses represented by image elements as tone/colour, brightness, shadow, shape, pattern and size.
Using satellite images, the best results are obtained working with the infrared channels that are very sensitive to moisture content and with the panchromatic channel where the better spatial resolution (15 meters) combined to its spectral characteristics (visible and near infrared) enhances the detection of fluvial elements with sizes in width mayor than 15 meter. In this way it was possible recognize a palaeo-channel system of primary rank.
Using orthophotos, signs of palaeo-river courses were recognized in natural or man-made features (e.g. forested areas or roads) characterized by a marked meandering pattern, in the presence of unjustified directional changes of cultivated terrains and, finally, in contiguous and narrow shadows that result well visible in the gray-tones images. Besides, the higher spatial resolution of these images (1 m) permitted to distinguish in detail palaeo-fluvial features that can represent a palaeo-drainage system of secondary rank.
All detected elements were mapped and organized in a Geographic Information System (GIS).
The consistence of highlighted features with plaeo-river channels was validated by means of historical maps and available stratigraphical and geophysical data. Our research provided valuable information useful to investigate the relationship between river channel migration and human settlement through time in the study area.