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Integration of remote sensing and geophysical techniques for coastal monitoring

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Coastal areas are of great environmental, economic, social, cultural and recreational relevance; therefore, the implementation of suitable monitoring and protection actions is fundamental for their preservation and for assuring future use of this resource. Such actions have to be based on an ecosystem perspective for preserving coastal environment integrity and functioning and for planning sustainable resource management of both the marine and terrestrial components (ICZM-EU initiative).
We implemented an integrated study based on remote sensing and geophysical techniques for monitoring a coastal area located along the Ionian side of Basilicata region (Southern Italy). This area, between the Bradano and Basento river mouths, is mainly characterized by a narrow shore (10-30 m) of fine sandy formations and by a pine forest planted in the first decade of 50's in order to preserve the coast and the inland cultivated areas. Due to drought and fire events and saltwater intrusion phenomena, such a forest is affected by a strong decline with consequent environmental problems.
Multispectral satellite data were adopted for evaluating the spatio-temporal features of coastal vegetation and the structure of forested patterns. The increase or decrease in vegetation activity was analyzed from trends estimated on a time series of NDVI (Normalized Difference Vegetation Index) maps. The fragmentation/connection levels of vegetated patterns was assessed form a set of landscape ecology metrics elaborated at different structure scales (patch, class and landscape) on satellite cover classifications. Information on shoreline changes were derived form a multi-source data set (satellite data, field-GPS surveys and Aerial Laser Scanner acquisitions) by taking also into account tidal effects.
Geophysical campaigns were performed for characterizing soil features and limits of salty water infiltrations. Form vertical resistivity soundings (VES), soil resistivity maps at different a deeps (0.5-1.0-1.5m) were obtained; in addition electrical resistivity tomographies (ERT) were acquired with different orientations and lengths.
The analysis of vegetation activity from satellite data identified large patches affected by vegetation decline and fragmentation processes, where geophysical measurements highlighted a salt water infiltration. Moreover, they showed that such a phenomenon has not only a horizontal distribution, but also a vertical diffusion interesting the layer active for plant roots. Since a severe shoreline regression (up to 90m) was observed along the investigated coast, erosional process could have increased the saltwater intrusion process during the last 20 years. On the whole, the obtained results suggest that the integration of remote sensing peculiarities (synoptic view, multi-temporal availability) with those of geophysical techniques (local details, non-invasive soundings) can be a suitable support tool for planning and management activities in coastal areas (e.g., the identification of the most appropriated sites for ecological interventions or for barrage and earthen block construction).