The application of spectral radiometry for sediments characterization

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Introduction The use of remote sensing for environmental characterization of coastal areas is broadly expanding. Different studies show that some sediments characteristics can be spectrally distinguishable on the basis of reflectance features: spectral signature of sediment samples are influenced by variations in moisture content, mineralogy composition and grain size distribution.

Methods: We discussed the possibilities and open questions concerning laboratory reflectance spectroscopy, field spectroscopic measurements, optical remote sensing data and integration of multiscale data with a special focus on coastal sediment characterization. Open questions are: (1) to investigate the capacity of spectroradiometry to determine the different characteristics of sediments, like grain size distribution and moisture content, studying the influence of different variables on the reflectance spectra; (2) to define criteria for laboratory and field spectra classification, as a tool for (3) end-member selection for image data classification using Spectral Mixture Analysis (SMA).
In situ and laboratory tests were conducted on north Adriatic Italian area. From each in situ characterization point spectral signatures and samples for laboratory analysis (radiometric and physical properties) were collected. The in situ and laboratory hyperspectral data were obtained by a spectroradiometer, FieldSpec®3 manufactured by Analytical Spectral Devices Inc., in order to obtain spectral measurements between 0.35 and 2.5 μm.

Results: Results show that the application of these indirect surveys methods provide a good qualitative and semi-quantitative characterization of coastal areas and it could be a cost-effective alternative approach to direct sampling and laboratory analysis, supporting decision makers in the environmental management.

Discussion: Spectroscopy at various scales is used here to mean spectroscopic measurements in experimental conditions characterized by different observational distances. According to the instantaneous field of view (IFOV), the increase of sensor-target distance results in the degradation of ground resolution and spectral responses, and increases the probability of spectral inhomogeneity within the surface and the ambiguity in the interpretation. Surface complexity manifests on different scales. Considering radiometric measurements, the sediments complexity occurs at subarea scale, including surface texture. The reflectance of a mixed pixel is generally assumed to result in a linear combination of the spectral properties, proportionally to their areal distribution within the pixel. Optical remote-data analysis using SMA and the spectral lab anaylsis was applied to identify nature and to map spatial distribution of sediments properties.
Even if it is a work in progress the identified spectral library represented suitable end-members collection for classification of specific properties. Thus the spectral linear combinations resulted suitable to classify mixed pixels and to approximate the classification of different sediment characteristics in coastal areas.

References: [1] Sgavetti, et al., (2006), *Annals of Geophysics*, **49**, 1; [2] Small et al., (2009), *Remote Sensing of Environment,* **113**: 342–361; [3] Van der Meer et al. (2012), *International Journal of Applied Earth Observation and Geoinformation,* **14**: 112–128; [4] Manzo et al. (2015), *International Journal of Applied Earth Observation and Geoinformation,* **36**: 54–68.