Application of ECOSTRESS multispectral LWIR images to assess topsoil properties: preliminary results on agricultural test sites in Central Italy

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Ecosystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) is a thermal infrared sensor, developed by NASA-JPL, launched in June 2018. ECOSTRESS acquires five LWIR spectral channels between 8 and 12 μm, with 70 m of spatial resolution at different times of the day and night.

The availability of multispectral TIR bands allows the retrieval of Land Surface Temperature (LST) and Land Surface Emissivity (LSE) by using well known procedures, like Temperature and Emissivity Separation (TES). The availability of LSE images in the LWIR atmospheric window at a medium resolution allows to estimate some topsoil/rock properties, for example those related to quartz diagnostic absorption features.

Furthermore, recent studies have shown that multispectral data in the LWIR region allows to retrieve quantitative information on topsoil properties, such as texture, carbon and nitrogen content, especially when applying multivariate statistical models [1] [2]. This study intends to verify the potential of night and day ECOSTRESS images for topsoil properties estimation.

To this aim, on specific experimental fields in Central Italy, soil sampling campaigns have been conducted to assess the topsoil properties like soil texture (clay, silt, sand) and soil organic carbon (SOC).

First, on these experimental fields, ECOSTRESS archive images were explored to identify the images in which the sampled fields are ploughed (i.e. bare soil conditions). Second, the ECO2LSTE products [3], containing the land surface temperature and emissivity, were downloaded from the USGS web site (https://ecostress.jpl.nasa.gov/data) and atmospherically corrected. Third, the TES algorithm was applied providing emissivity images at a spatial resolution of 70 m.
Last, the emissivity images were used to define a prediction model (calibration and validation) by using both Partial Least Squares Regression (PLSR) and Random Forest (RF).

The preliminary results seem to confirm: i) the potential of ECOSTRESS LWIR data to retrieve topsoil properties valuable for agronomical purposes at the regional scale, ii) the preliminary result of the multivariate analysis like PLSR and RF to derive model for topsoil properties (mainly clay and organic content) prediction at a medium resolution scale.

References