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POTENTIAL OF SPACEBORNE IMAGING SPECTROSCOPY FOR SOIL PROPERTIES MAPPING AND EXPECTED ACCURACY

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ABSTRACT:

Soil spectroscopy based on laboratory, field, and airborne data has been shown to be a proven method for the quantitative prediction of key soil surface properties in local areas when soils are exposed at the surface and under certain surface conditions such as reduced vegetation cover, homogeneous roughness and water content. With the upcoming launch of the next generation of hyperspectral satellite sensors (e.g. EnMAP, HISUI, HyspIRI, HypXIM, PRISMA, SHALOM), a great capability for the production of high quality mapping of soil properties over spatially extensive areas is appearing. In particular, three central questions are at the forefront of research: a) methodological developments toward improved algorithms and operational tools for the extraction of soil properties, b) up scaling from the laboratory into space domain, and c) demonstration of the potential of upcoming satellite systems and expected accuracy of soil maps.
In this paper, airborne imaging spectroscopy data from several test sites are used to simulate EnMAP satellite images at 30 m scale. Then, different soil algorithms are examined such as basic spectral classification (Spectral Angle Mapper SAM), extraction of chemical-physical features from the soil spectral reflectance (Hyperspectral Soil Mapper HYSOMA), multivariate techniques (Partial-Least Squares PLS, Support-Vector Machine SVM), to determine parameters of interest: soil organic carbon (SOC), clay and iron oxide content, general mapping of soil erosional stages. Finally, the derived soil maps are compared with ground-truth data. The results show variable outcomes with soil prediction model accuracy varying from very good (R^2 ~0.85-0.90) to medium-poor (R^2< 0.4) depending on algorithms used, soil property in question, and the test site. In general, the results show the high potential of upcoming spaceborne hyperspectral missions for soil science studies. Nevertheless, high care must be used and further studies are needed to fulfil the entire potential of soil spectroscopy for orbital utilization.

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