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Physical Characterization and Spectral Response of Mediterranean Soil Surface Crusts

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Soil surface crusting and sealing are unfavorable processes. It impedes infiltration and stimulates runoff, incision and erosion. It hampers germinisation of seeds and settlement of plants. Soil surface crusts and seals develop during severe rainfall events when the soil surface is bare and exposed to the hammering effects of the raindrops. The soil aggregates fall apart into individual soil particles of clay, silt and sand. These individual particles fill up the pores and spaces at the soil surface and the crusts and seals slowly develop. When the rain ceases, the crusts often develop into a hard, impenetrable layer. The use of hyperspectral remote sensing (400 to 2500 nm) may be useful to map the spatial distribution of the crusts and to develop and apply land management to reduce crusting.

In this study we investigated the occurrence of crusts in the Salagou area, a Mediterranean part of Southern France. The study area has a large variety of soil types at short distances developed in different geological substrates such as limestone, marls, basalts and flysch. The soils vary from fairly well developed Leptosols and Cambisols to poorly developed Lithosols almost without any soil profile development. The proneness of the soils to crusting significantly varies, making this area a suitable test area. Furthermore, hyperspectral airborne HyMap images are available from this area allowing the upscaling of soil crust mapping.

The study aimed at 1) characterizing the physical properties of the crusts versus the

non-crusted soil such as physical strength (Torvain, penetration strength), infiltration capacity, thickness of the crust, crack development after drying and aggregate stability, and 2) to identify the spectral characteristics of the crusted soil surface and non-crusted soil surface by measuring their spectral behavior using a portable handheld spectrometer (ASD FieldSpec), and 3) to use the detailed spectral field measurements to analyze HyMap images to investigate mapping possibilities of crust occurrence in the area.

Results show that the differences in physical properties are significant. Infiltration capacity and crust strength greatly vary between the soil types and between crusted versus non-crusted soil surfaces. The spectral differences however proof to be small. Crusted versus non-crusted spectra differ mainly in albedo values i.e. overall reflectance. In the visible and near infrared region some cross over of the spectral curves is found enabling the use of band ratioing to map soil surface crusts. Some of the crusts show stronger absorption features in the clay mineral absorption bands located around 2200 nm.

During the presentation the soil types, their physical characterization, their spectra and our mapping results of crusted versus non-crusted soil surfaces will be presented and discussed.