Using an Vis-NIR hyperspectral image to map topsoil properties over bare soil surfaces of the Lebna catchment in Tunisia (300 km^2)

C. Gomez (1), P. Lagacherie (2), and S. Bacha (3)

(1) IRD, Laboratoire d'étude des Interactions Sol Agrosystème Hydrosystème (UMR LISAH), Montpellier, France (gomez@supagro.inra.fr), (2) INRA, Laboratoire d'étude des Interactions Sol Agrosystème Hydrosystème (UMR LISAH), Montpellier, France., (3) Centre National de Cartographie et de Télédétection (CNCT), Tunis, Tunisia.

The aim of this work was to evaluate the potential of Vis-NIR hyperspectral airborne data for mapping topsoil properties in North African cultivated landscape that includes contrasted pedological patterns and a large proportion of bare soil surfaces. We examined whether Vis-NIR airborne spectroscopy could be used for mapping eight common soil properties, including clay, sand, silt, calcium carbonate, free iron, cation-exchange capacity, organic carbon and pH, with good precision both for estimating local value and capturing the spatial structures.

This work employed AISA-Dual Vis-NIR hyperspectral airborne data recently acquired in the Mediterranean region over a 300 km^2 area (Lebna catchment, Cap Bon region, Tunisia) with a fine spatial resolution (5 m) and fine spectral resolution (260 spectral bands from 450 to 2500nm). Soil properties predicted maps were computed for these eight soil properties using the partial least squares regression.

The results showed that four out of the eight soil properties (clay, sand, iron, and cation-exchange capacity) were suitable for mapping using these hyperspectral data over our studied area. Both accurate local predictions and good representations of spatial structures were observed for these four predicted soils properties maps. For example, the clay prediction map of a 6,67 km^2 sub-catchment showed a strong variation in the soil pattern on a small scale, with a close succession of clay-rich areas and clay-poor areas, corresponding to marl and sandstone outcrops, respectively. The clay prediction map of the entire study area showed a complex regional soil pattern with clear difference between the Pliocene area located in the southeast corner of the image, and the Miocene area covering the rest of the image.

This study highlight the complexity of the North African soil patterns and opens up the possibility of more extensive use of hyperspectral data for digital soil mapping of the successfully predicted soil properties.