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Monitoring and mapping soil organic carbon with airborne VNIR spectroscopy

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Efficient and accurate method to assess Soil Organic Carbon (SOC) stocks and stock changes are needed at various scales: plot/local ($< 10^3$ km^2), regional/national (10^3-10^6 km^2) and continental/global scales ($> 10^6$ km^2). Increasingly, inventories of SOC stocks and CO_2 fluxes are requested at the regional/national level for the Kyoto protocol commitment and as input in biogeochemical and regional climate models. Furthermore, the depletion of organic matter is mentioned as one of the major threats to the soil resource within the EU soil thematic strategy. Countries are required to monitor the decline of soil organic matter in order to delineate risk areas and are invited to set up operational measures to mitigate and prevent further problems.

Due to its large spatial variability, regional estimates of SOC changes can only be obtained by analysing very large number of samples. Current methods of soil analysis are too expensive and time consuming to meet the amount of data required for statistical inference in soil monitoring. Visible and Near InfraRed (VNIR) reflectance spectroscopy provides an alternative to chemical analyses. The benefits of this technique include a reduction of the sampling processing time and hence an increase of the number of samples that can be analysed within time and budget constraints. To this regard, airborne imaging spectroscopy is able to retrieve a SOC value pixel-by-pixel, provided that the soil is bare.

We present here the results obtained after 3 flight campaigns in 2003, 2005, and 2007 with the CASI and AHS hyperspectral sensors. Imaging Spectroscopy fails, for the time being, to reach an acceptable precision for the determination of SOC content in

each pixel. However, even with somewhat lower precision levels, such technique can enhance the estimation of changes in SOC stocks at the field and regional scales, since the bias is low.

Spatial patterns of SOC content at a very fine resolution were distinguished. It suggests that intra- and inter-field SOC variability can be detected according to the spectral response of the soil. In one field, a sharp and geometrical pattern of SOC contents corresponding to old field boundaries were observed.