



Using Multispectral and Elevation Data to Predict Soil Properties for a Better Management of Fertilizers at Field Scale

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This project aims at developing and validating an operational integrated management and localized approach at field scale using remote sensing data. It is realized in order to support the competitiveness of agricultural businesses, to ensure soil productivity in the long term and prevent diffuse contamination of surface waters. Our intention is to help agrienvironmental advisors and farmers in the consideration of spatial variability of soil properties in the management of fields.

The proposed approach of soil properties recognition is based on the combination of elevation data and multispectral satellite imagery (Landsat) within statistical models. The method is based on the use of the largest possible number of satellite images to cover the widest range of soil moisture variability. Several spectral indices are calculated for each image (normalized brightness index, soil color index, organic matter index, etc.). The assignation of soils is based on a calibration procedure making use of the spatial soil database available in Canada. It includes soil profile point data associated to a database containing the information collected in the field. Three soil properties are predicted and mapped: A horizon texture, B horizon texture and drainage class. All the spectral indices, elevation data and soil data are combined in a discriminant analysis that produces discriminant functions. These are then used to produce maps of soil properties. In addition, from mapping soil properties, management zones are delineated within the field. The delineation of management zones with relatively similar soil properties is created to enable farmers to manage their fertilizers by taking greater account of their soils. This localized or precision management aims to adjust the application of fertilizer according to the real needs of soils and to reduce costs for farmers and the exports of nutrients to the stream.

Mapping of soil properties will be validated in three agricultural regions in Quebec through an experimental field protocol (spatial sampling by management zones). Soils will be sampled, but crop yields under different nitrogen rates will also be assessed. Specifically, in each of the management areas defined, five different doses of nitrogen were applied (0, 50, 100, 150, 200 kg N / ha) on corn fields. In fall, the corn is harvested to assess differences in yields between the management areas and also in terms of doses of nitrogen.

Ultimately, on the basis of well-established management areas, showing contrasting soil properties, the farmer will be able to ensure optimal correction of soil acidity, nitrogen fertilization, richness of soil in P and K, and improve soil drainage and physical properties. Environmentally, the principles of integrated and localized management carries significant benefits, particularly in terms of reduction of diffuse nutrient pollution.