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SPATIO-TEMPORAL VARIABILITY OF SOIL MOISTURE AT THE FIELD SCALE USING REMOTE AND PROXIMAL SENSING

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ABSTRACT The spatio-temporal variability of soil moisture is an important factor to consider in agriculture. It helps understand the conditions of water and air availability, two elements essential to plant growth and environmental risk assessment. Previous studies have shown that soil electrical conductivity (EC) and remote sensing techniques are helpful as ancillary variables in digital soil mapping at various scales. This study objective is the soil drainage mapping at the field scale using remotely sensed images (RADARSAT-1 and IKONOS) and proximal sensing technologies (VERIS 3100 soil EC meter and handheld CS-620 HydroSense soil moisture sensor). The study has been conducted on three adjacent fields (15.6 ha) in an experimental microwatershed (3 km²) of the Bras d'Henri catchment (167 km²), located on south shore of the St. Lawrence River, nearby St. Narcisse municipality. This highly intensive agricultural area has been mapped by the Pedology and Precision Agriculture Laboratories, Agriculture and Agri-Food Canada, in 2004 and 2005 for updating and upgrading soil survey information at different scales (1 :40 000, 1 :20 000 and 1 :10 000). Five out of the seven soil drainage classes defined in the Canadian system of soil classification have been observed in the watershed (well drained to very poorly drained soils). In May 2007 and 2008, RADARSAT-1 images (HH polarization) have been collected in the Fine acquisition mode (8m x 8m). A multispectral IKONOS image (4 bands: blue, green, red and near-infrared) has been also collected in May 2008. The soil EC data have been measured with the VERIS 3100 sensor at 0-30 and 0-100 cm. A spatial and temporal characterization of the topsoil (0-10cm) soil moisture content (CS-620 HydroSense) has been realized in Spring 2007 and 2008 (8 dates) for 164 georeferenced points distributed in the three fields along a unaligned sampling grid (30m x 30m). Soil moisture and EC maps were produced by kriging and cokriging using the Geostatistical Analyst extension of ArcGIS 9.2 software. The geostatistical analysis shows that soil surface moisture, measured with the CS-620 HydroSense, presents spatial patterns closely related to the drainage map derived from the conventional soil map and consequently can be used as soil drainage indicators in digital soil mapping. Moreover, good correlation ($r=0.76$) has been found

between the IKONOS near-infrared spectral band, soil EC data measured with VERIS 3100 at 0-30cm and the soil moisture dataset, particularly in fields #1 and #2. These preliminary results show that remote and proximal sensing can be use jointly for digital mapping of soil drainage at the field scale.

Keywords: soil moisture; RADARSAT-1; IKONOS; soil electrical conductivity