TERRASAR-X AND RADARSAT-2 FOR CROP CLASSIFICATION AND ACREAGE ESTIMATION

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Mapping crops and estimating crop acreages, particularly when these data are tied to the landscape, supports numerous information requirements for agriculture. For example, this information can be used to assess the impacts of government policies and programs on agriculture, such as the impact of bio-fuel policies on cropping practices. Annual updates are required and thus the approach to gathering this information must be both effective and efficient. Although optical satellite data are very well suited to classify crops, cloud and haze can impact the reliability of operational crop monitoring. For the most part, SAR data have been unable to match the accuracies achieved with optical data, primarily because access to multi-dimensional SAR data has been limited. Attempts to separate crops using single frequency and single polarization radar data have been met with limited success even when the temporal changes in crop phenology are exploited. The availability of multiple polarizations does improve classification accuracies, but Agriculture and Agri-Food Canada found that to reach target accuracies of 85%, multi-polarization SAR data were needed at multiple frequencies. This was demonstrated using C-Band (RADARSAT-1, ASAR) and L-Band (ALOS PALSAR) data. Penetration of L-Band into the crop canopy was an issue for some smaller biomass crops and consequently, higher frequency X-Band data may assist in classification of these crops.

This paper will present recent crop classification results using data from Canada's RADARSAT-2 satellite, integrated with data from the German TerraSAR-X satellite. The test site was located east of Ottawa (Canada), where the cropping system consists of pasture-forage, small grains (wheat, barley), corn and soybeans. Four RADARSAT-2 fine quad-pol images and six TerraSAR-X dual-pol (VV, VH) images were acquired, along with cropping information on 274 fields. The RADARSAT-2 data were polarimetric and to date, the linear polarizations (HH, VV, VH) have been synthesized and integrated into the classification. A decision tree supervised classifier was used and overall, users and producers accuracies were computed.

Accuracies were low when only single dates of RADARSAT-2 (52% - 66%) and TerraSAR-X (58% - 74%) were used, confirming the need for multi-temporal data. With four dates of RADARSAT-2 (22 June, 16 July, 9 August, 2 September) an accuracy of 75.4% was reached. Although RADARSAT-2 was able to accurately identify soybean (approximately 82% accuracy) and corn (approximately 75%), cereals and pasture-forage were not well classified. Six dates of TerraSAR-X (from mid-July to early September) produced an overall accuracy of 84.9% and all crop classes reached accuracies above 80%. Of particular interest, a C- and X-Band multi-polarization data set classified crops to an overall accuracy of 87.3%. Small grains, often the most problematic to identify, had high users (96%) and producers (86%) accuracies. The X-Band data were very helpful in improving the identification of both small grains and pasture-forage.

This research confirms the significant improvement in accuracy achieved when multiple frequencies of SAR data are integrated for the purpose of crop classification. Both this study, and Agriculture and Agri-Food Canada's work with C- and L-Band data, are demonstrating that a SAR-only approach to crop classification is feasible. The research will next integrate polarimetric information from the RADARSAT-2 data into the decision tree classifier.