Crop type mapping and growth monitoring thanks to a synergistic use of SAR and optical remote sensing

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ABSTRACT

Agriculture applications were most often separately developed from Synthetic Aperture Radar (SAR) and optical sensors. Optical imagery provides great information content for crop mapping and monitoring but only daily observation by 1-km large scan angle sensor (typically SPOT-VEGETATION) can systematically deliver the expected information on regular basis. SAR sensor has the major advantage to measure a well calibrated signal whatever the atmospheric conditions and the cloud coverage are. The research challenge is to develop methods combining only the advantages of both sources. For crop type mapping research was completed in operational context in Belgium and France and, proposed approach was successfully adopted by the Ministry of Agriculture (Region Wallonne).

Reflectance in red and near-infrared bands is directly related to the green biomass and vegetation indices are widely used for crop monitoring. On the other hand SAR backscattering is a function of various biophysical properties including crop biomass and moisture, crop structure and seed row but also land slope, soil surface moisture and roughness. This is the reason why advanced strategies are required to combine both sources of information. At local scale the coherence images derived by interferometry from ERS Tandem mission was found the most reliable information on crop status. At regional scale the coupling of hydrological and biophysical parameters through a crop growth model enhanced by a spatially distributed hydrological model aims to assimilate SAR and optical information. The roadmap for such development includes several steps which have been successfully completed including soil roughness characterisation and related uncertainty modelling, valid regional sampling strategy and radiative transfer model inversion. In spite of major issue related to ENVISAT ASAR and MERIS acquisition multi-annual data set combining simultaneous satellite and field observations are used for this research. Finally a unique field measurement campaign dedicated to most advanced radiative transfer model allowed to validate simulated backscattering coefficient and to determine new cross-polarised indices for crop monitoring.