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# Monitoring agricultural landscapes dynamics using the complementarities of optical, microwave and thermal remote sensing data

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**Abstract:** The goal of this study is to establish links between crop trajectories (governed by environmental conditions and agricultural practices) and the ability of optical, radar and thermal imagery to inform water budget, crop phenology and biomass characteristics. The perspective of this study is to take advantage of the three main domains of wavelength to sequentially constrain static (parameters) and dynamic variables of agrometeorological and SVAT (Soil Vegetation Atmosphere Transfers) models for water budget and biomass simulation. As of now, only the association of microwave or thermal infrared with visible optical data are considered to instantaneously estimate information of the surface (tillage properties, water status, stress index, evapotranspiration maps, row orientation, classification maps etc). The combination microwave and thermal infrared domains is uncommon due to the lack of suitable dataset, with high resolution images acquired at a high enough frequency over the same area. There is thus an ongoing challenge for a better use of the actual and future images acquired by Sentinel-1/2/3, Landat-8, RCM... international satellite missions. The dataset used in this study comes from the MCM'10 experiment conducted by the CESBIO in 2010, over an area located in the South-West of France, near Toulouse. Microwave images have been acquired by Terrasar X, Radarsat2 and ALOS whereas optical and thermal data come from SPOT 4/5, Formosat 2 and LANDSAT 5/7 respectively. The dataset also includes a comprehensive monitoring of 37 fields with soil and vegetation parameters such as LAI, biomass, crop height, soil water profiles and transects, at each satellite overpass. Our methodology consists in establishing multi-dates and multi-crops (corn, sunflower, wheat, soybean...) diagrams of relative differences of backscatter coefficient (from Terrasar X, and Radarsat2) versus surface temperature (from LANDSAT5/7). The patterns identified are then analyzed thanks to the spatial variability of in situ observations. First results from multi-dates combinations based on microwave backscatter coefficient and surface temperature differences are presented for different crop classes and highlight the temporal behaviors and the spatial intra and inter crop variability.

**Keywords:** optical; thermal; microwave; remote sensing; crop