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AgriSAR 2006 - Airborne SAR and Optics campaigns for an improved monitoring of agricultural processes and practices

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Food security is among the most important global future challenges. Effective and sustainable agricultural production requires an advanced monitoring of agricultural processes and practices, which can be provided by means of remote sensing imagery acquired at high spectral, spatial and temporal resolution. The multi-platform 'Sentinel Missions' are currently developed by ESA in the framework of GMES (Global Monitoring for Environment and Security). They will include SAR and optical satellites with new imaging configurations and spectral bands, and much improved capabilities for high repetition.

In order to support the development of this earth observation system, an intense airborne and ground campaign was designed and performed in the consolidated long-term testsite DEMMIN (approx. 150 km north of Berlin in Mecklenburg-Western Pomerania, Germany). The conjoint research efforts involved 16 European research institutions and universities and covered the main local agricultural growing season (April-August 2006).

The major goal of the investigation was to generate an image and ground data base for the examination and validation of bio-/geo-physical parameter retrievals, obtained at different radar frequencies and polarisations (X-, C- and L-Band) and at hyperspectral optical bands. Manifold ground measurements were acquired for various crop types and non-vegetated agricultural fields and include gravimetric and volumetric soil

moisture and soil surface roughness (photogrammetric, Laser profiling), plant phenology and height, LAI, wet/dry biomass, reflectance or chlorophyll content. Several continuous recording stations were also installed on different crop types, monitoring soil moisture, soil temperature and surface-energy-budget (Bowen-Ratio Station and Scintillometer).

The study, unique in scope and scale, was initiated and led by the Microwaves and Radar Institute of the German Aerospace Center, contributing their own airborne radar system (E-SAR) and collecting radar data over the testsite at a weekly time step (16 data takes in 14 weeks, each covering an 10 x 3 km^2 flight-stripe area). The ground sampling strategy comprised a reduced weekly component, conducted for selected fields in parallel to each E-SAR data take and three intensive in-situ measurement campaigns with large areal coverage, two of which supplemented by optical airborne instruments (using AHS from INTA and CASI from ITRES Research).

The paper presents the mission objectives, explains the adjusted conductance of airborne and field campaigns, and highlights the current state of data examination and the retrieval of soil and vegetation parameters from multi-parametric SAR and hyperspectral imagery. First results of Sentinel-1 and -2 simulations are presented. In addition to the obvious scientific relevance of high repetition, multifrequency airborne data synergy for agricultural surveys, the suitability for a simulation of Sentinel-1 and Sentinel-2 sensor and mission characteristics and their respective potential for land applications will be discussed.