Supporting ESA SMOS Cal/Val 2010 Activities With Airborne HUT-2D Interferometric Radiometer

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An extensive campaign with the airborne HUT-2D radiometer system was carried out in the frame of ESA SMOS calibration and validation activities from late April through late June 2010. Radiometer data were acquired over selected soil moisture test sites (Denmark and Central / Southern Germany); all recognized as major soil moisture calibration and validation sites for the SMOS mission. In this paper we describe the main characteristics of the data sets acquired with the HUT-2D instrument over these test sites and discuss the performance of the instrument and preliminary results.

The goal of the ESA SMOS (Soil Moisture and Ocean Salinity) mission is to provide accurate global soil moisture and ocean salinity data on a regular basis. The satellite was launched in November 2009 and its only instrument is the MIRAS (Microwave Imaging Radiometer by Aperture Synthesis) sensor. It operates at 1.4 GHz (L-band) and employs interferometry to produce two-dimensional brightness temperature images of the Earth with a spatial resolution of 30 to 50 km. These images are transformed into soil moisture and ocean salinity maps using recently developed algorithms. In order to support the SMOS mission, an airborne 1.4 GHz interferometric radiometer HUT-2D was developed by the Helsinki University of Technology (presently part of Aalto University). The HUT-2D sensor is accommodated onboard the University's remote sensing aircraft. The main technical parameters of HUT-2D are similar to those of MIRAS; hence, HUT-2D can be used to produce multi-angular dual-polarized data sets needed for the development and validation of SMOS algorithms.

The first test site, Upper Danube catchment (77,000 km^2), is a temperate agricultural area situated mostly in Southern Germany with no open water bodies or large urban areas affecting passive microwave signature. The terrain as well as the soil is fairly homogeneous. The second test site encompasses the catchment basins of the Rur and Erft Rivers and is located in the Belgian-Dutch-German border region. Forest and grassland characterize the southern part, whereas in the north fertile agricultural land predominates. Multiple sensor systems have been installed in the Rur catchment. The third test site is situated within the Skjern River catchment in Western Denmark (ca. 2500 km^2), close to the coast line. The predominant soil type is podsol. Most of the land is under intensive agricultural practice with patches of forest plantations, grassland, heath, shrub and wetlands. An area corresponding to SMOS ground resolution (diameter ~44 km) was validated by means of (a) measurements of a soil moisture network with 30 stations distributed throughout the area, and (b) the airborne campaign with snapshots concurrent with ground measurements in three selected patches of different land cover types.