

## Participation of Finnish radiometer HUT-2D in calibration and validation campaigns of European Space Agency's SMOS mission

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SMOS is the European Space Agency's next Earth Explorer satellite due for launch. It aims for global monitoring soil moisture and ocean salinity. Earth Explorer satellites are a set of missions, in which new technology is developed for the purpose of remote sensing while also providing valuable input to Earth Observation Sciences.

SMOS houses a state-of-the-art instrument called MIRAS – Microwave Imaging Radiometer by Aperture Synthesis [1]. It is a radiometer that uses 72 individual receivers at 1.4 GHz to measure the spectral power density, i.e. brightness temperature, of the Earth by means of interferometry. Accordingly, by correlating each signal with the ones from the other receivers, a two-dimensional brightness temperature image is obtained.

Helsinki University of Technology (TKK) has participated in the development of the MIRAS instrument from the mid 1990's through several projects. These include preliminary studies of the instrument's calibration methods, the testing and manufacturing of demonstrator of subsystems of MIRAS, the definition and execution of test campaigns of the MIRAS Calibration Subsystem Flight Model, and development of the instrument's signal processing methods. Also, complex scientific instruments onboard – six Noise Injection Radiometers – have been designed and tested by TKK.

In addition to the projects related directly to MIRAS itself, TKK has designed, manufactured and tested an airborne instrument with characteristics similar to MIRAS,

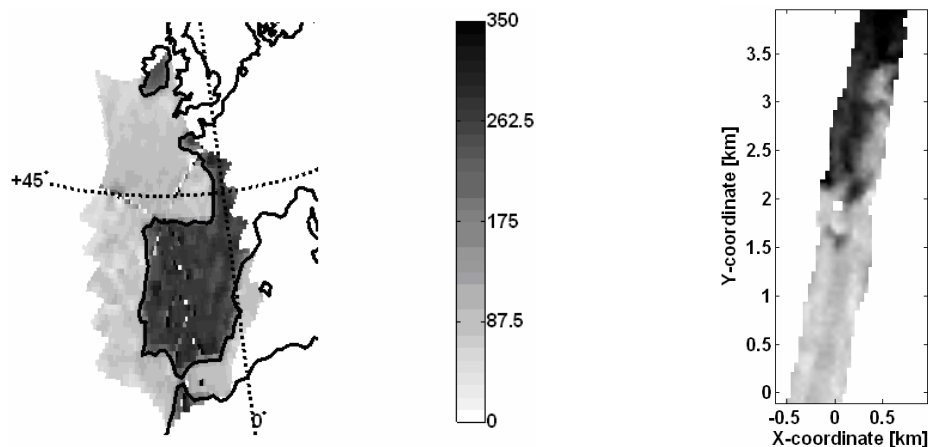


Figure 1. Left: simulated response of MIRAS to the brightness temperature of western Europe. Right: A measurement of the HUT-2D radiometer over the Finnish coastal area.

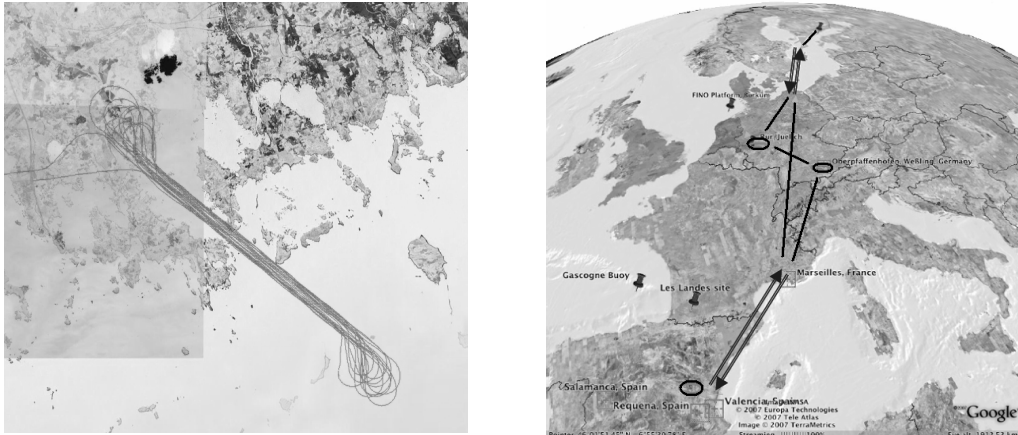


Figure 2. Left: Flight trajectory of the sea salinity test line measured with HUT-2D during CoSMOS-2007. Right: Measurement sites of Ruhr, Danube (in Germany), and Valencia (in Spain), and flight plan of the Rehearsal Campaign in spring 2008.

to be used on board the Department of Radio Science and Engineering research aircraft. The radiometer is called HUT-2D and is described in detail in [2]. The instrument was completed in spring 2006, followed by successful first measurement flights. ESA's interest to get L-band multi-angular datasets similar to the SMOS product before the launch has guaranteed a role for HUT-2D in the SMOS in-orbit calibration and validation plans – in addition to a Spanish MIRAS demonstrator, HUT-2D is the only European instrument able to provide SMOS-like measurement data (Figure 1).

During the autumn of 2007 HUT-2D participated in the CoSMOS-2007 campaign, in which a dataset from the Finnish coastal area was measured in order to demonstrate sea salinity retrieval. The campaign consisted of three two-hour measurement flights with HUT-2D and the Danish conventional radiometer EMIRAD. The systems were accommodated in the department's research aircraft. During the same autumn, HUT-2D was used to measure a dataset in northern Finland for SMOS Soil Moisture data product validation purposes. The flight consisted of one measurement flight over a test area in Sodankylä, and long transects of ~800 km from southern to northern Finland.

The most significant measurement campaign of HUT-2D for SMOS validation is supposed to be carried out once SMOS is in orbit, during autumn 2009 or 2010. This campaign consists of measurements of soil moisture test areas in Germany and Spain (Figure 2). The campaign was carried out during spring 2008 in a smaller scale, as a "rehearsal" for the final campaign. Data processing from the campaign is currently ongoing.

## REFERENCES

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