

SEA SURFACE SALINITY RETRIEVAL DEMONSTRATION USING DATASETS OF SYNTHETIC APERTURE RADIOMETER HUT-2D

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1. ABSTRACT

SMOS is the European Space Agency's Earth Explorer satellite due for launch in autumn 2009. It aims for global monitoring of soil moisture and ocean salinity. The satellite utilizes a state-of-the-art instrument called MIRAS – Microwave Imaging Radiometer by Aperture Synthesis [1], which is a passive L-band instrument applying the method of interferometry for 2-dimensional imaging of the Earth.

SMOS calibration and validation activities include e.g. collection of radiometric datasets from selected test areas using instrumentation that provide measurements with the same 1.4 GHz frequency band as MIRAS. HUT-2D is an airborne interferometric radiometer system with the main characteristics similar to MIRAS [2]. It was designed, manufactured and tested by Helsinki University of Technology and it can be mounted on the university's research aircraft. Building of 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.

This paper describes the test campaign carried out with the HUT-2D radiometer in autumn 2007 in order to demonstrate the capability of an interferometric radiometer to measure one of the main geophysical parameters to be measured by SMOS: sea surface salinity.

During the autumn of 2007 HUT-2D participated in the CoSMOS-2007 campaign, in which datasets from the Finnish coastal

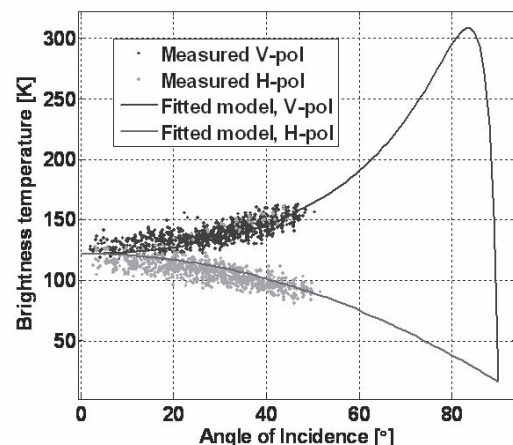
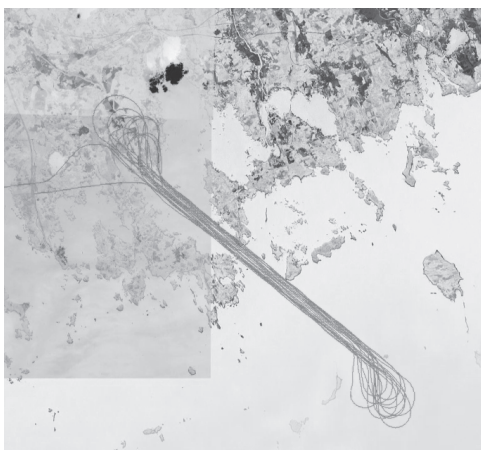


Figure 1. Left: Flight trajectory of the sea salinity test line measured with HUT-2D during CoSMOS-2007. Right: Measured brightness temperature samples as a function of incidence angle, and a brightness temperature signature provided by an emissivity model [3].

area were measured in order to demonstrate sea salinity retrieval. The campaign consisted of three two-hour measurement flights with HUT-2D accommodated in the university's research aircraft. Two of the flights were aimed to measure a salinity gradient occurring in the Finnish coastal area (Figure 1). Reference data was collected along the test line for the true sea salinity and sea temperature. The forward modeling of the sea brightness temperature was done using an emissivity model [3] and radiometric measurements were compared with the model.

Reference measurements from the test site show that there was a change of salinity from 0.6 psu (practical salinity units) to 4.0 psu along the test line including the transit from the bay to the open sea area. According to the emissivity model, this causes a change of approximately 0.35 K between the two ends of the test line. Detection of this small scale change requires good stability from a radiometer system, and also requires careful analysis in terms of disturbing phenomena, e.g. changes in the reflection of the cosmic background radiation.

This study includes analysis of the sea surface salinity retrieval demonstration made during autumn 2007 using the datasets measured with the HUT-2D radiometer. The HUT-2D datasets are assessed in terms of the instrument's sensitivity, radiometric resolution and accuracy. Applicability of HUT-2D for retrieval purposes is discussed.

2. REFERENCES

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