SMOS a summary of the most significant findings after two years and a half in orbit

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1. INTRODUCTION

The SMOS (Soil Moisture and Ocean Salinity) satellite was successfully launched in November 2009. This ESA led mission for Earth Observation is dedicated to provide soil moisture over continental surface (with an accuracy goal of 0.04 m3/m3) and ocean salinity. These two geophysical features are important as they control the energy balance between the surface and the atmosphere. Their knowledge at a global scale is of interest for climatic and weather researches in particular in improving models forecasts.

2. OBJECTIVE

The purpose of this communication is to present the mission results after more than two years in orbit as well as some outstanding results already obtained. A special attention will be devoted to level 2 products.

3. METHODOLOGY

3.1 SMOS data

The SMOS instrument measures the passive microwave emission of the Earth surface at a frequency of 1,4 GHz (L-band). It has been demonstrated that this frequency is well adapted to monitor surface soil moisture (first 5 cm) and sea surface salinity. The instrument is an interferometer and provides brightness temperatures with an average resolution of 40 km, at several angle and dual polarizations. It means that a point at the surface is seen several times with different incidence angles. Data are acquired at two times in a day at 6 am and 18 pm (local time) and insure a complete coverage of the Earth surface in 3 days.

3.2 Modeled Brightness temperature and soil moisture retrievals

Modeling multi-angular brightness temperatures is not straightforward. The radiative model transfer model L-MEB (L-band Microwave Emission) is used over land while different models with different approaches as to the modeling of sea surface roughness are used over ocean surfaces. Over land the approach is based on semi-empirical relationships, adapted to different type of surface. The model computes a dielectric constant leading to surface emissivity. Surface features (roughness, vegetation) are also considered in the models. However, considering SMOS spatial resolution a wide area is seen by the instrument with strong heterogeneity. The L2 soil moisture retrieval scheme takes this into account. For each node, a wide area is defined (~ 123 km) referred to as a working area. A complete knowledge of the surface is necessary (soil texture, surface classification of the vegetation). The surface types are gathered in 10 main classes: Nominal surface, Forest, Wetlands, Pure Water, Saline Water, Barren ground, Urban, Ice, Frozen soil, Snow. The soil moisture retrieval is run over the nominal surface, which is a scene covered by low vegetation. Forest areas are also of interest if they are not too opaque (in terms of radiative penetration).

For each of these classes a decision tree determines the dielectric model to be used and its configuration (parameterization) according to the surface. For the nominal and forest, Dobson's law is used to get a dielectric constant.

Brightness temperatures are computed for every classes composing a working area. A weighted function is applied for the incidence angle and the antenna beam. Once the brightness temperature is computed for the entire working area, the minimizing process starts Different cases are then possible. The retrieval process succeeds a soil moisture is derived along with vegetation optical thickness, and effective surface temperature. If no soil moisture is derived (not attempted or process failed) a dielectric constant is still derived from an simplified modeled (the cardioid model).

3.3 Sea Surface salinity and sea Ice

SMOS data enabled very quickly to infer Sea surface salinity fields. As salinity retrieval is quite challenging, retrieving it enable to assess very finely the characteristics of the complete system in terms of stability, drift etc. Some anomalies such as the ascending descending temperature differences, temporal drifts or land sea contamination were used to infer issues and improve data quality. The modeling has to account for several perturbing factors 'galactic reflection, sea state, atmospheric path and faraday rotation etc…as the useful signal is quite small when compared to the perturbing factors impact as well as the instrument sensitivity.

Over sea ice several studies showed that it was possible to infer thin ice (first year ice, 50 cm or less) from SMOS measurements. Other studies focused on the Antarctic plateau with also very interesting new results.

3.4 RFI

SMOS is affected by RFI. Careful analysis of the perturbations enabled to start legal activities against unlawful emitters as well as finding methods to quantify them. Several approaches were tested and implemented in the algorithms to flag such data.

4. CONCLUSION AND PERSPECTIVES

This presentation shows in detail the first SMOS in flight results. The retrieval schemes have been developed to reach science requirements, that is to derive the surface soil moisture over continental surface with an accuracy better than 0,04m3/m3. Over the ocean the goals are not yet satisfied but results are already getting close to the requirements

The first results obtained as of today are thus very encouraging as can be seen on figure 1. It is expected to have an even more significant yield in July.

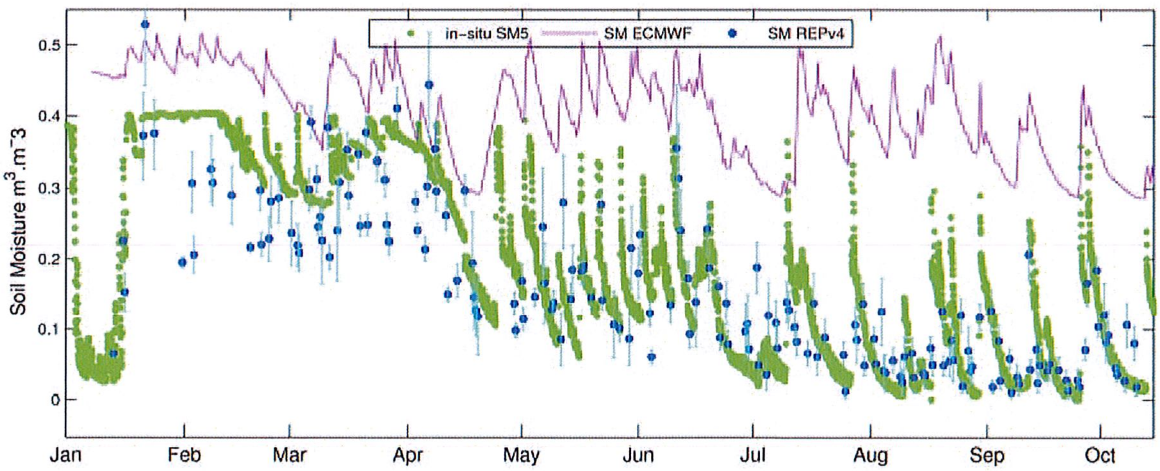

Figure 1 SMOS Soil moisture retrieval example

During the presentation we will show SMOS results and present detailed analysis of retrieval quality together with main issues encountered.

5. REFERENCES

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