SMOS FIRST RESULTS OF THE LEVEL 2 SOIL MOISTURE ALGORITHMS

Y;H. Kerr[1], A. Mialon[1], P. Waldteufel[2], F. Cabot[1], P. Richaume[1], A. AlBitar[1], E. Jacquette[1], A. Mahmoodi[3], S. Delwart[4], P. Ferrazoli[5], J.-P. Wigneron[6]

[1] CESBIO(CNES CNRS UPS IRD), Toulouse France
[2] IPSL, Verrieres le Buisson France
3 Array Systems, Toronto Canada
[4]ESA ESTEC, Noordwijk, The Netherlands
[5]Tor Vergata University, Roma, Italy
[6]INRA EPHYSE, Bordeaux, France

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 better than 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 algorithm to derive the soil moisture over continental surface from SMOS measurements, known as SMOS Level 2 products. The principle of the retrieval is based on comparing the measured brightness temperatures (V and H polarizations) acquired by the SMOS instrument with brightness temperatures simulated from semi-empirical models. Minimizing the differences (cost-function) allows to set the best-suited soil moisture and vegetation features.

2. METHODOLOGY

2.1 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). The instrument is an interferometer and provides brightness temperatures with an average resolution of 40 km, at several angle and dual polarizations (H and V). 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.

2.2 Modeled Brightness temperature

Modeling multi-angular brightness temperatures is not straightforward. The radiative model transfer model L-MEB (L-band Microwave Emission) is used. It is based on semi-empirical relationships, adapted to different type of surface. It 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).

2.3 Auxiliary data

The complete algorithm needs auxiliary dataset to initialize and run the retrieval. We will make a review of all the inputs necessary, as weather data (from ECMWF), LAI (Leaf Area Index), Ecoclimap for surface classification).

3. CONCLUSION AND PERSPECTIVES

This presentation shows in detail the algorithm used to derive soil moisture from SMOS data and the first in flight results. The retrieval scheme has 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.

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

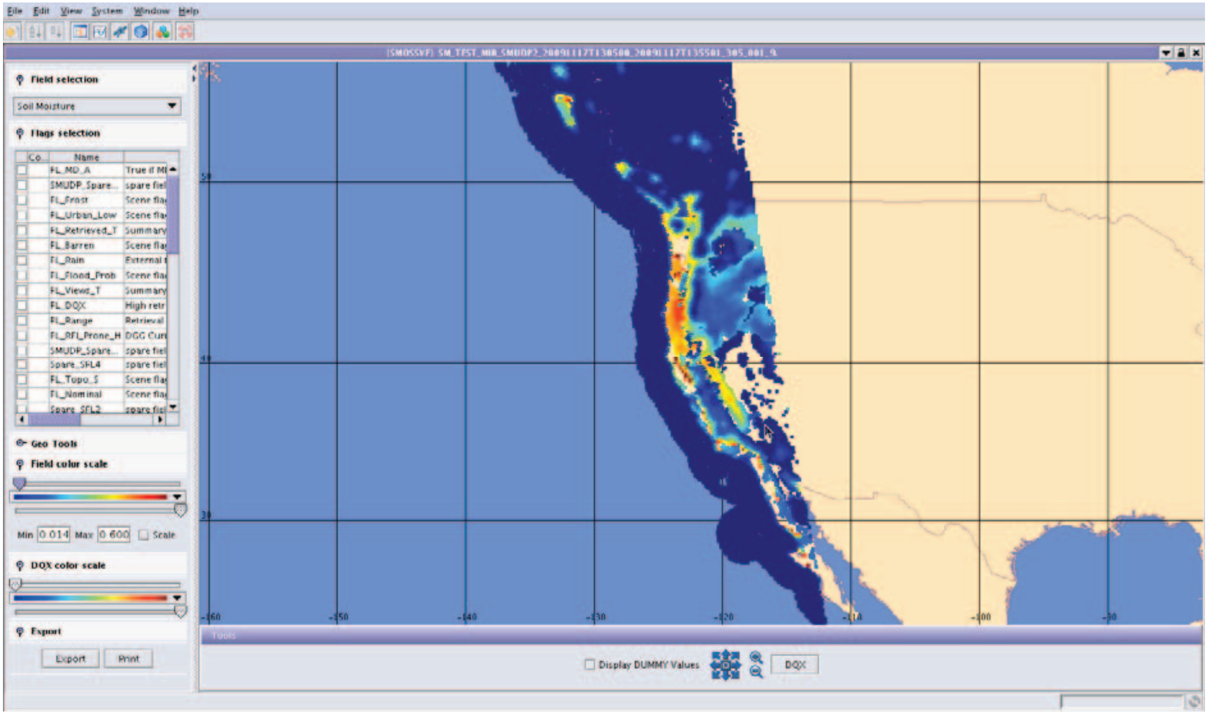

Figure 1 First SMOS Soil moisture retrieval

The algorithm is based on semi-empirical models to simulate brightness temperatures of an heterogeneous surface.

Some dielectric models are still to be improved (snow, ice...), to extend the area of application of the current algorithm.

4. REFERENCES

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