OVERVIEW OF SMOS CATDS LEVEL 3 SOIL MOISTURE PRODUCTS

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1. INTRODUCTION

The Soil Moisture and Ocean Salinity (SMOS) satellite, successfully launched on November 2nd 2009, will provide soil moisture over continental surfaces and surface salinity over ocean [1]. It is a joint programme between ESA (European Space Agency), CNES (Centre National d'Etudes Spatiales) and CDTI (Centro para el Desarrollo Tecnologico Industrial). SMOS payload is a 2D interferometer in L-band at 1,4 GHz frequency. This wavelength permit to probe the earth surface emissivity, which can be related to soil moisture in the first centimeter of soil, without be troubled by the atmosphere which is almost transparent at this frequency. SMOS will provide global soil moisture maps, with a precision better than 4% and with an average spatial resolution of 40km. SMOS satellite has a sun-synchronous orbit, it's local time is around 6am or pm, and the revisit time is between 1 and 3 days.

2. CNES SMOS GROUND SEGMENT

CNES is developing a ground segment (CATDS: Centre Aval de Traitement des Données SMOS) to produce higher level SMOS products at level 3 and 4. The CATDS infrastructure consists of two scientific expert centers at CESBIO Toulouse and IFREMER Brest, and one production center at IFREMER. C-PDC takes in charge the production and dissemination of data in a systematic basis. Products will be controlled, verified and distributed by C-PDC. CESBIO, an expert support laboratory, is in charge of defining the level 3 and 4 processing for soil moisture.

ESA's ground segment (DPGS) will provide CATDS with level 1b products and ancillary data. Level 1b are Fourier components of the acquired snapshots, these are used to produce internal global L1c brightness temperatures (BT) at the desired gridding system. Soil Moisture along with other geophysical products (such as optical thickness or dielectric constant) will be derived from the CATDS L1c multi-angular BT. The retrieval algorithm is based on the level 2 soil moisture prototype. The retrieval is done by iteratively minimizing the quadratic difference between the observed BT and a model one taking into consideration the uncertainties. The major enhancement of the prototype at CATDS concerns the use of multi-orbit inversion. The products obtained at level 3 after the retrieval are global maps. From these global maps, a filtering and an aggregation of the data is made to obtain temporal synthesis products.

3. TEMPORAL SYNTHESIS PRODUCTS

The temporal synthesis products consist in using the temporal information in order to produce global soil moisture maps. These products will include event detection flags obtained from time series analysis of SMOS data and ancillary data. These flags are also used to filter data in the monthly products aggregation. Event detection consists in detecting a particular state of the observed surface by using temporal information. An “event” can be a case of freezing, dew, snow or flood for example. They can be detected only if the characteristic time of the event is upper than revisit time of SMOS.

The event detection will be a based on a two stage detection algorithm. First the probability of occurrence of the event is assessed. This probability depends on spatio-temporal constraints, on climatic constraints from ancillary data, and from values of geophysical retrieved parameters. A list of thresholds is defined for each constraint taking into account their uncertainties. An event is declared as probable if all tests are positive. For example freezing conditions occur in certain regions and need low temperatures. The second stage, which is the essential one, consists in testing the temporal evolution of a list of selected geophysical parameters for each event over a 7 days period. The 7 days period ensures a minimum of 2 revisits per grid point. The event is confirmed if the parameters evolutions coincide with the expected evolution for the tested event and that for all parameters. For the freeze example, soil dielectric constant decreases drastically [2] and can be detected. At first stage, this algorithm will be tested using a synthetic database over 7 days. The synthetic database is created by simulating brightness temperature emitted by a surface with controlled surface parameters (such as soil moisture, LAI, temperature, soil texture) over homogeneous and heterogeneous areas. Surface parameters vary in time in order to simulate the events to be detected. With the real SMOS data, this algorithm would be tested on selected calibration and validation sites.

Level 3 SMOS products for continental surfaces are temporal synthesizes over different step of time. First, 1 day global product is produced for each day. It contains many geophysical parameters such as soil moisture, vegetation optical thickness, albedo, dielectric constant or surface temperature. It contains also event flags coming from event detection to characterize the confidence level on the data. 1 day global maps are aggregated in

3 days global products every day. One decadal product and one monthly product are also produced for their temporal period. Figures below show the results of soil moisture aggregation with simulations over Europe.

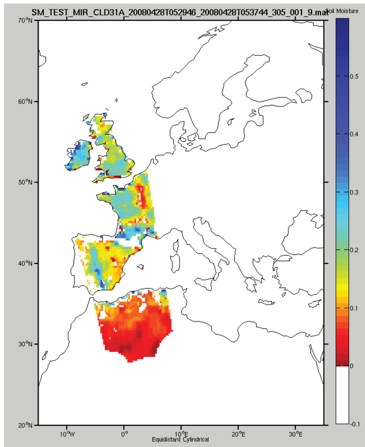

Figure 1 : 1 day soil moisture product

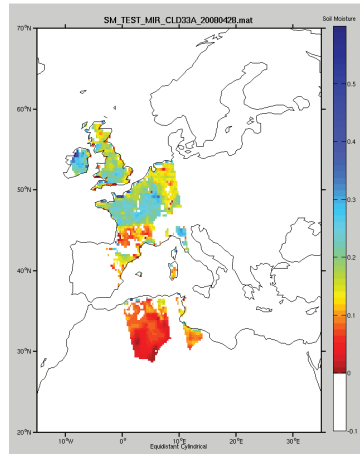

Figure 2 : 3 days soil moisture product

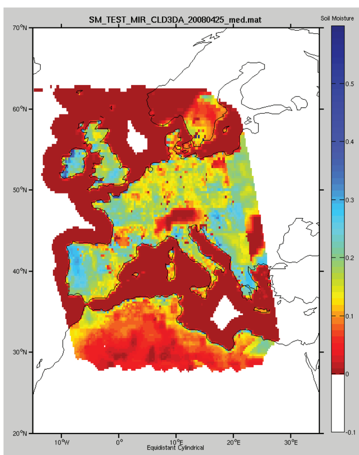

Figure 3 : Decadal soil moisture median product

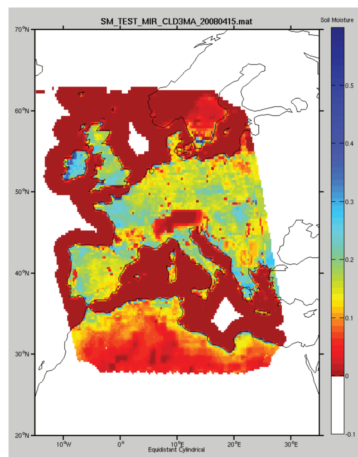

Figure 4 : Monthly soil moisture product

4. REFERENCES

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