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The SMOS project: current status

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It is now well understood that soil moisture and sea surface salinity are required to improve meteorological and climatic predictions. There are also key elements for assessing and forecasting extreme events (floods, droughts) and, obviously for improving water resources management. These two quantities are not yet available globally and with an adequate temporal sampling. So as to cover this data gap, it has been recognized that, provided it is possible to accommodate a suitable antenna on board a satellite, L Band radiometry was most probably the most promising way to fulfil this gap ....()..... It is within this framework that the European Space Agency (ESA)'s selected the second Earth Explorer Opportunity Mission, namely the Soil Moisture and Ocean Salinity (SMOS) mission. SMOS carries a single payload, an L band 2D interferometric radiometer in the 1400-1427 MHz h protected band. This wavelength penetrates well through the vegetation and the atmosphere is almost transparent. Consequently, the instrument probes the Earth surface emissivity without much hindrance. Surface emissivity can then be related to the moisture content in the first few centimetres of soil over land, and, after some surface roughness and temperature corrections, spatio-temporal aggregation, to the sea surface salinity over oceans. It must be noted that the design of the instrument is so that either Dual polarisation of full polarisation modes can be operated. But most striking feature of SMOS is it capacity to retrieve the angular brightness temperature signatures of the target, enabling hence to separate the different contributions to the signal (Soil and vegetation layer).

The mission requirements are to retrieve soil moisture globally for all the nominal surfaces with an accuracy of 4% (vol.) every 3 days at most and with a spatial resolution better than 50 km, Vegetation water content with same spatial resolution but every 7 day and sea surface salinity with a 200 km spatial resolution every 10 to 30 days and an accuracy of 0.1 psu. It is also expected to soon be able to infer root zone soil moisture using assimilation schemes.

The mission is new by several aspects: i) measurements (L band emission from space) does not have a long track record to say the least and, ii) there are no real measurements of surface soil moisture or sea surface salinity to date to infer or test algorithms and assumptions; moreover, iii) the technique used here to break the spatial resolution frontier is very novel and relies on a almost never tested from space technique: the 2D interferometry. So the wealth of scientific studies and related technological challenges are very high. On the Science part the different teams (from all over Europe, from the US, Canada, Japan, China, India, Australia, South America and Africa (and even Antarctica!) are addressing the different issues still to be tackled so as to provide the most appropriate and efficient set of retrieval algorithms from the current state of the art. The activities are several folds. Intensive basic research work is still currently underway, while the Cal Val programme has started being implemented. To address all these, a number of collaborative studies are underway. For instance, so as to cover the gap linked to the novelty of the approach and of the measurements, simulations and generation of synthetic data sets to build test data sets a performed. Large field campaigns either on the long time scale or very intensive over specific targets have been carried out over Land and sea to address the specific issues related to retrieval with perturbing factors. In parallel intensive efforts are devoted to the basics of interferometry, be it the optimization of image reconstruction or devising the most efficient calibration scheme.

The second fold of the research activities is in the direction of the step forward. To be even more useful for hydrology and water resources, a higher spatial resolution is sought for. A number of studies show now the possibility to dis-aggregate SMOS data to a few kilometres using external data and models. Over the ocean Neural networks start giving very promising results.

Obviously, as with any very innovative approach, we are all anxious to get the first real data to touch and feel the real brightness temperature sat L Band. It is expected that with actual data we will be able to significantly improve our understanding of the processes and hence our science, leading to better applications and notably improved weather forecast and inputs for climate studies.