First evaluation of the SMOS observations over the VAS site: comparing different retrieval approaches

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Abstract

The SMOS (Soil Moisture and Ocean Salinity) mission was launched on November 2, 2009. Over the land surfaces, simultaneous retrievals of surface soil moisture (SM) and vegetation characteristics are made from the multi-angular and dual polarization SMOS observations by inverting the L-MEB (L-band Microwave Emission of the Biosphere) model [1-2]. Preliminary analyses evaluating the SMOS observations in terms of Brightness Temperatures (TB) and Level-2 products (SM and vegetation optical depth TAU) were carried out over several sites of all continents.

Here, the study is based on SMOS observations and in situ measurements carried out in 2010 over one of the main SMOS calibration/validation sites in Europe: the VAS (Valencia Anchor Station) site in the region of Utiel–Requena, close to Valencia, Spain. The main vegetation types in the region are vineyards (cover fraction ~60%), natural Mediterranean vegetation (pine trees and shrubs ~30%) and orchards. The SMOS observations were analysed in conjunction with those carried out by the L-band ELBARA II radiometer over a vineyard which is representative of the main land use of the VAS site [3]. Retrievals of SM and TAU based on the SMOS observations (Level-2 products) and the ELBARA II instrument were compared and evaluated against in situ measurements and simulations of SM by atmospheric models.

Even though there is a very large difference in the spatial scale of the observations made from ELBARA II (a plot within a vineyard field) and SMOS (~a circle with a 40 km diameter), a good agreement was found between the TB observations ($R2 > 0.88$) at both polarizations.

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A good agreement was found too between the retrieved time variations in SM over the site computed from both the SMOS and ELBARA II observations. Retrievals computed from the SMOS observations were obtained a) from the official ESA SM products computed with the Level 2 algorithm and b) from a simplified retrieval process based on the L1C Tb products and assuming homogeneous soil/vegetation conditions over the SMOS pixel and neglecting the effects due to the SMOS synthetic lobe patterns (referred to as the WEF function).

It was found the SMOS Level-2 SM products underestimated the SM values retrieved from ELBARA II by a bias of about -0.20% (Fig. 1a). Conversely, retrievals computed from the SMOS data using a simplified L-MEB approach, that did not consider the pixel heterogeneity, produced very satisfying results (Fig. 1b) with a much lower bias (Bias ~ -0.06 m3/m3, R2=0.76) when compared to retrievals computed from the ELBARA II observations. Current studies investigate this result which could provide interesting hints to explain the dry bias which is obtained with the Level- 2 products over some specific geographical areas.

The time variations in the retrieved TAU computed from the ELBARA II observations could be closely related to the time variations in the NDVI vegetation index, obtained from the MODIS observations in the optical domain (TAU = 0.61. NDVI -0.11, with R^2 = 0.61). Conversely, the time variations in the SMOS Level-2 TAU product did not provide clear patterns that could be related to the vegetation dynamics and seemed to be strongly affected by the effects of the microwave interferences (RFI) over the VAS site.

The comparison between the SM and TAU retrievals obtained from (i) the Level-2 algorithm and (ii) the simplified L-MEB approach allowed making recommendations about potential future improvements of the Level-2 algorithms.

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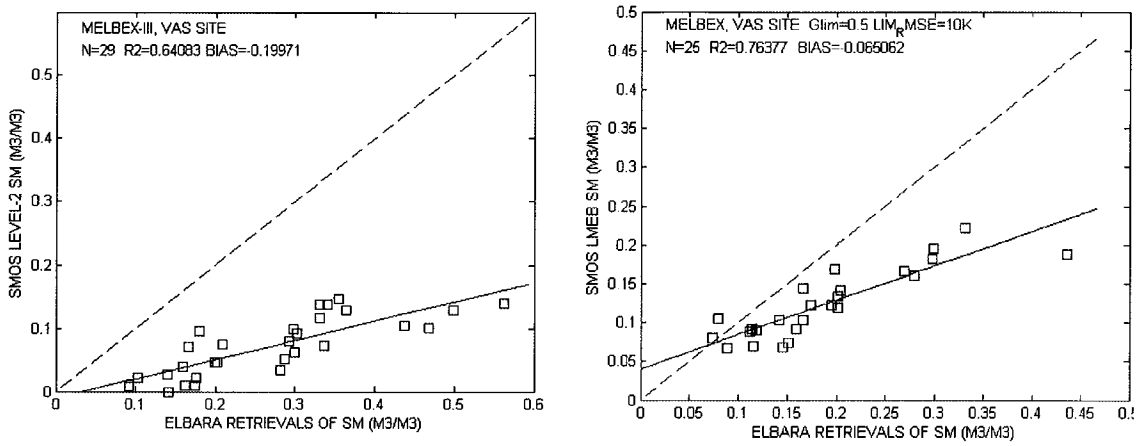
Figures



a) b)

Fig. 1 ab Comparison between retrieved Soil Moisture (SM) values obtained from the *in situ* ELBARA-II TB observations with SM values retrieved from the SMOS observations over the VAS site in 2010. These latter were obtained a) using official ESA SM products computed with the Level 2 algorithm b) using a simplified retrieval process based on the L1C TB products assuming homogeneous soil/vegetation conditions over the SMOS pixel.