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Analysis of SMOS signatures over forests and application of L2 algorithm

Paolo Ferrazzoli (1), Rachid Rahmoune (1), Yann Kerr (2), and Philippe Richaume (2)
(1) Tor Vergata University, Ingegneria - DISP, Roma, Italy (ferrazzoli@disp.uniroma2.it), (2) CESBIO, Toulouse, France

A significant percentage of SMOS pixels is affected by fractional forest. Whereas the effect of low vegetation can be corrected using a simple radiative transfer model, in case of dense forests the wave penetration is limited and the sensitivity to variations of soil moisture is poor. However, most of the pixels are mixed, and a reliable estimate of forest emissivity can allow us to retrieve their soil moisture. Moreover, there are many forests with moderate density, where the sensitivity to variations of soil moisture can be still significant. In these cases, the correction of vegetation effects requires a detailed knowledge of the variables which affect the overall emissivity. This is generally difficult, at the scale of spaceborne radiometers.

The retrieval algorithm described in the ATBD (Algorithm Theoretical Basis Document) is based on a forward model and a retrieval process. For all vegetated areas, the forward model adopts a simple radiative transfer approach. For the specific case of forests, the albedo and the optical depth are computed by fitting the outputs generated by the physical model developed at Tor Vergata University, and refined by empirical fitting. The procedure assumes to know the forest kind (broadleaf, or coniferous) and the maximum yearly value of Leaf Area Index, made available by ECOCLIMAP.

This presentation summarizes the basic modelling procedure, describes the refinements and the recent tests. Comparisons between the forward model and SMOS signatures collected in 2010 are presented. To this aim, some wide forest areas have been selected. The areas are flat, homogeneous, and free from water bodies or urbanization. These properties have been verified by ECOCLIMAP maps and Landsat images. The forests have different values of Leaf Area Index. The emissivity and the polarization ratio predicted by the model are compared against multitemporal series of the same variables for a range of incidence angles.

Over deep and dense forests, such as Amazonia, the obtained results confirm the expected properties. The Polarization Ratio is close to zero, the temporal trend is stable and variations of soil properties cannot be detected. However, different features are observed in less dense forests, such as Argentinian Chaco, border areas of Central African region, and some Boreal forests. In these areas, SMOS signatures show an appreciable increase of Polarization Ratio with angle. Moreover, there are temporal variations of emissivity, related to the occurrence of rain events or snow melting in early spring. The refined forward model generally reproduces the experimental properties. Also tests of soil moisture retrieval algorithm are in progress.