ON THE PROBLEM OF MODELLING AND CORRECTING THE INFLUENCE OF THE RELIEF ON THE OBSERVATIONS OF MICROWAVE RADIOMETERS

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Microwave radiometry of land should carefully account for large-scale relief effects, when applied to mountainous areas. Variations in topography influence the upwelling brightness temperature (TB) measured by a satellite radiometer in several ways. The optical depth of the atmosphere is modified since it changes with the elevation of the terrain. The radiometer observation angle becomes a function of the surface slope, and this implies variations of the soil emissivity. Parts of the scene may be shadowed, radiation can be reflected from one tilted surface to another and a depolarization effect occurs, due to a rotation of the linear polarization plane. In the presence of vegetation, also the pathlength through the latter changes with slope angle, so that the vegetation optical depth is modified too.

The effects listed above should be accounted for and, possibly, corrected or at least mitigated in order to remotely sensing bio-geophysical parameters, such as soil moisture. Indeed, algorithms for retrieving soil moisture assume a flat topography.

In previous studies, we developed a simulator of satellite microwave radiometric observations of mountainous scenes, able to operate at different frequencies and observation angles. This simulator allowed us to carry out an analysis aiming at quantifying the errors in satellite microwave radiometric imaging of a terrain with a complex relief for instruments working at relatively low frequencies (L- and C-bands) devoted to land applications. In this work, we extend the simulation at higher frequencies too, which are mainly used for atmosphere monitoring, where the surface acts as a disturbance effect that must be corrected.

In addition, the work aims at modelling the errors induced by relief in order to yield an approach to correct them, or, at least, to account for the topography effects in an error budget when retrieving soil moisture or correcting the surface background. To do this, the trends of the difference between the antenna temperature calculated for a mountainous scene and that computed for a flat terrain versus parameters representing the topography, such as local observation angle, slope and height standard deviation are analyzed. From this analysis, an attempt to establish a relationship between the TB variations due to relief and the parameters mentioned above is performed.

We focus our study on an Alpine region in Northern Italy and we use a digital elevation model (DEM), characterized by a spatial resolution of 250x250 m, to extract the information about the height, as well as the slope and the aspect angles. Two radiometer configurations, both characterized by a conical scan, are assumed. For the first one, we take as reference the Advanced Microwave Scanning Radiometer for the Earth Observing System (AMSR-E), supposing a sensor observing the Earth at 55° from an altitude of 705 Km. For the second configuration, we consider an instrument operating at L-band, with an observation angle of 40° and orbiting at 670 km of altitude, similar to that conceived for the radiometer aboard the future Soil Moisture Active-Passive (SMAP) mission.

The results of our work will be presented at the conference, discussing both the achievements and the aspects that remain critical for modelling and correcting the influence of the relief on the observations of microwave radiometers.