Experimental and Model Investigation about Forest Emission at L Band

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In the near future important projects, aimed at monitoring soil moisture and land properties by L band spaceborne radiometers, are foreseen. In particular, technological efforts are being done for the development and launch of SMOS and HYDROS. Since these systems will collect microwave signatures at large scale, the contribution of surfaces covered by forests must be investigated. In fact, forests cover a large fraction of land, so that several pixels will be affected, partially or even totally, by their presence.

Up to now, most of theoretical and experimental studies about microwave interaction with forests have been based on active systems. Therefore, presently available results about emissivity are rather limited and sparse. New efforts are required to estimate the emission due to forest components and attenuation introduced over soil emission, which are important to fully exploit the potential of future L band radiometers.

In this work, results of model simulations and recent experiments are described and compared against each other. The model is based on routines, developed at Tor Vergata University in recent years, representing electromagnetic effects of trunks, branches, leaves, and soil. Single effects are then combined in order to simulate the emission of the whole medium. This basic electromagnetic software has recently been joined with a set of basic allometric relationships, available in the literature for several forest categories. This allows us to estimate forest emission without need of very detailed ground truth.

Experimental data were collected during the autumn 2004 in the Research Centre Jülich (Germany). The L-Band 1.4 GHz radiometer ELBARA, as well the X-Band 11.4 GHz radiometer MORA, were installed looking in the upward direction in a mixed hardwood forest. The average height of trees was about 20 meters, and the leaf fall process was monitored. Measurements with ELBARA allow distinguishing the horizontal and the vertical polarisation, and the antenna beamwidth is 12 degrees. In November 2004, the ELBARA radiometer was located above the same forest, looking downward from a 100 m tower. The experiment was repeated after covering the soil with a metallic foil.

The theoretical model has been adapted to the structural and geometrical properties of the forest. It was run in order to simulate the cases of upward looking radiometer and downward looking radiometer in absence and presence of the metallic foil. Comparisons between simulated and measured data are shown. The model represents several basic properties of experimental data. Some critical points, requiring further work, are identified.