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Coupling the Tor Vergata microwave scattering model with a plant architectural model

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Obtaining biophysical parameters of complex vegetated environments from remote sensing data is still a challenging field of research. When SAR data are considered, good knowledge of the backscattering processes which affect the signal is required, in order to understand and explain its local or temporal variations. It is through this knowledge that accurate quantification of the desired parameters can be obtained; therefore the contribution of theoretical microwave scattering models is needed. Since the early 90s empirical relationships are mainly used, which are in general limited. On the other hand, the assumptions used in the theoretical models usually dissuade their further use for applications where the environmental conditions are by definition complex (e.g. post-fire environment).

The use of microwave scattering models requires accurate parametrization and usually the inputs needed are many, leading scientists to rely on assumptions. In particular, the characterization of vegetation canopy structure is challenging due to its intrinsic complexity. Many different approaches have been proposed in the past to describe canopy in a proper way for feeding theoretical models. Detailed sampling of canopy material is intensive and difficult, especially in the case of forests. Often allometric equations are used, which can provide a generic description of the diameters of the canopy dielectric material (e.g. branches, needles, leaves). However, tree species show impressive variability of canopy architecture, mirroring the effects of genetically imposed expressions and the limitations introduced by the environmental conditions as light availability, site quality, soil and water competition etc. Terrestrial laser scanning is also another alternative to derive accurate description of the scanned canopy. Recently, 3D computer models of trees have been also used to mimic canopies of various species. The only condition which is required is the calibration of the 3D computer models, with the plants existing in a particular landscape. Plant growth models offer a good solution, since they mimic growth conditions and plant architecture based on observations made on the field.

Here we present the theoretical approach and first results on the coupling of an architectural plant model with the electromagnetic model developed in the University of Rome “Tor Vergata”. The experiment aims to simulate backscattering time-series over a particular post-fire pine environment on a Mediterranean landscape. The plant architectural model AMAP has been calibrated in order to ’grow’ Pinus halepensis mock-ups for the area of interest. AMAP has been kindly provided by the Center for International Cooperation in Agronomic Research for Development (CIRAD). The 3D pine architecture has been translated into cylindrical shapes, which are used to mimic the burned canopy layer. Needles and small branches (diameter < 0.6 cm) are excluded, considering field observations made on burned pines. Dead fuel moisture content has been estimated from meteorological data, using the Nelson dead fuel moisture model. Also, soil moisture variations through time have been approximated using meteorological data from the area of interest. First results of the modelling of C-band backscattering over burned pine forests are presented and compared with ASAR WS time-series.