GLOBAL MONITORING OF SOIL MOISTURE, SNOW COVER AND VEGETATION BIOMASS BY USING MULTI-FREQUENCY AMSR-E DATA

S.Paloscia, E.Santi, S.Pettinato
IFAC-CNR

ABSTRACT

Due to the increasing relevance of global changes in the Earth's system, the contribution of microwave sensors in better understanding the ongoing phenomena can be essential, especially for the monitoring of snow/ice melting, desertification and flooding processes. This research, carried out within the framework of the G-COM/JAXA project with the GLAMOUR proposal (GLobal Algorithms for the MOnitoring of sURface parameters), aims at evaluating the applicability of microwave radiometers in the study of global scale geophysical processes over land. We intend to investigate the spatial and temporal variations of microwave emission from natural targets and, in particular, to evaluate the ability of multifrequency dual-polarized radiometers in detecting the variations of vegetation cover, soil moisture and snow cover and depth over global scale at different latitudes, from equator to polar regions. The final goal of this study is the production of multi-temporal maps of geophysical parameters involved in the land component of the hydrological cycle.

The approach followed in this research work consists in testing, on a worldwide scale, some physical models and experimental relations which have been found in past research using ground based, airborne and satellite sensors (SSM/I, AMSR, AMSR-E).

Suitable inversion algorithms (mainly based on Artificial Neural Networks-ANN), able to estimate the main soil, vegetation and snow parameters (i.e., soil moisture, vegetation biomass and snow depth), have been selected. These algorithms were first tested at a local scale on some Italian test areas, already used for similar experiments: the first one is dedicated to soil moisture and biomass investigations and is located in Northern Italy in a flat agricultural area, the second one, dedicated to the snow research, is located in the Italian Alps in the Cordevole watershed. In the meantime, a method already tested on some areas for improving the ground resolution at C-band was improved and validated on the Alessandria area in Italy.

The algorithm for the estimate of soil moisture (SMC) and vegetation biomass, through the ω–τ model, uses brightness temperatures (Tb) at C, X and Ku band for computing ω and τ, and Tb in V pol. at Ka band for estimating the surface temperature. The model is then inverted by using an ANN. Vegetation maps were obtained through the relationship between the Polarization Index (PI) at X band and NDVI. The algorithm for the estimate of snow depth (SD) is based on the direct relationship between the Frequency/Polarization Index (FPI) at Ku and Ka band and the SD.

Afterward the algorithms were validated on a more global scale by means of microwave AMSR-E satellite data in areas where on ground features was available, as well as cartographic, optical and meteorological data used as a comparison. Maps of SMC in Northern Italy and SD maps in Scandinavia. were obtained. Since the results were considered satisfactory, the algorithms were used for generating global maps of vegetation biomass, SMC and SD, by obtaining maps with 4-5 levels of vegetation biomass, soil moisture and snow depth.