ON THE POTENTIAL OF THE AMSR-E BASED POLARIZATION RATIO VARIATION INDEX (PRVI) FOR SOIL WETNESS VARIATIONS MONITORING

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EXTENTED ABSTRACT

Soil moisture is one of the key variable involved in the hydrological cycle, playing a fundamental role when an attempt of flood forecast has to be done in presence of adverse weather forecasts associated to different precipitation regimes. Depending on pre-existing soil conditions, in fact, the same raining event can result or not in a disastrous flooding event. Mainly for this reason, particular importance is given to the estimates or, if possible, to the direct measurement, of soil water content in order to formulate suitable flood forecast models at the basin scale. The sole ground-based measurements of soil moisture are not able to assure sufficient information because of the extreme spatial variability of point measurements and the impracticality of obtaining a sufficient dense network of points to provide spatially continuous information. Satellite data, on the other side, could just help to fill these gaps. Their useful value in such a contest is demonstrated by the launch, on last November of an European space mission, ESA-SMOS (European Space Agency – Soil Moisture and Salinity Mission), specifically dedicated to the soil moisture retrieval [1]. Additionally, a NASA mission (SMAP – Soil Moisture Active & Passive), is planned with same aims for 2012 [2].

Nowadays, among microwave radiometers which could be used for a soil moisture retrieval actually useful for hydrological applications, thanks to their capability of assuring a spatial resolution of 25-50 km and a nearly daily revisit time, the Advanced Microwave Scanning Radiometer on Earth Observing System (AMSR-E), is the one that, thanks to its spectral/spatial/temporal resolutions, has been used with promising results [3] – [9]. Unfortunately, after its launch (AMSR-E is flying aboard EOS-AQUA satellite since 2002) diffuse C-band Radio-Frequency Interferences (RFI) were discovered contaminating AMSR-E radiances over many areas in the world [7]; [10]; [11]; [12]. For this reason, C-band data have not more used and X-band (less RFI affected) based retrieval algorithms, instead of the original based on C-band, have been preferred [13] - [18]. As a consequence, the sensitivity of such measurements is decreased, because of the lower penetrating capability of the X band wavelengths than C-band, as well as for their greater noisiness, due to their high sensitivity to the presence of vegetation and/or precipitation in the sensor field of view [3]; [10].

In order to face all these problems, a new Polarization Ratio Variation Index (PRVI) has been recently proposed [19] – [21]. It is based on a general methodology for multi-temporal satellite data analysis (Robust Satellite Techniques, RST – [22]; [23]), already successfully applied in the framework of hydro-meteorological risk mitigation [24] – [28]; [20]; [29]. PRVI has been computed through a multi-temporal analysis of long-term historical series of AMSR-E C-band data. In particular, the investigated signal is the Polarization Ratio (PR=Tbv-Tbh/Tbv+Tbh, where Tb stands for brightness temperature and the subscripts v and h indicate, respectively, vertical and horizontal polarization) useful to obtain information about soil moisture and vegetation effects [7]. Polarization ratio, in fact, normalizes out the surface temperature, leaving a quantity that is primarily dependent on soil moisture and vegetation.

Preliminary achievements have demonstrated the potential of such an index in: i) separating soil moisture contribute from the vegetation ones; ii) reducing the impact of RFI on the measured signal and iii) reducing the consequences of every kind of site effects (known or not-known). An example of the obtained results is shown in figure 1, where two PRVI maps computed for different regions of interest as well as for different months of the year are plotted.

In order to better assess the potential of such an index for soil wetness variation measurements at global scale and to assess its possible contribute in the hydrometeorological risk management, in this work we analyzed some past flooding events occurred in different part of the world, comparing PRVI with other standard AMSR-E SM products, such that daily provided by NASA [10], as well as that computed and distributed by Vrije University of Amsterdam [17]. Results of such a comparison will be analyzed and discussed in detail, also by using in-situ soil moisture measurements, looking for possible further improvements that may increase the potential of such indicators in furnishing reliable hydrological information.

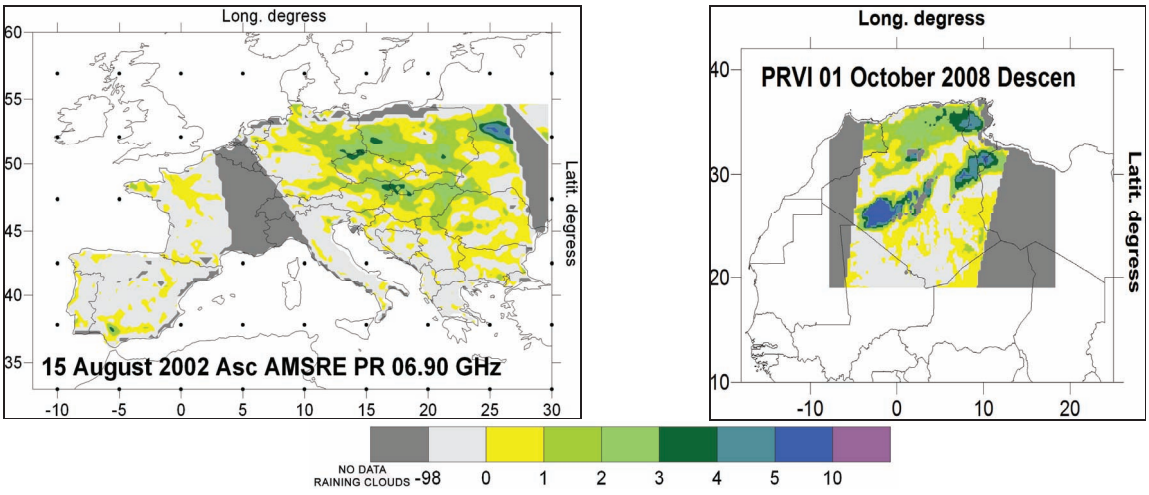

Figure 1: Two PRVI maps computed for the AMSR-E data of: left) 15 August 2002, ascending pass and right) 1 October 2008, descending pass. The colour bar shows the whole range of fluctuation of PRVI

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