General methodology for surface moisture estimation from multi-incidence radar data: application with ASAR-ENVISAT

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In the last years, the importance of soil surface conditions, particularly characterized by moisture and roughness in hydrology and climatic studies, has been shown. Many methodologies have been developed in active microwave remote sensing research in order to understand the backscattering response from natural surfaces and particularly to monitor soil moisture. An important part of these studies, link one-incidence radar signals with surface soil moistures by a simple linear relationship. First, this approach don't consider the effect of roughness on radar signal. Second, it show a very unstable parameters that change from one experimental study to another.In this study, our objective is to propose a new methodology to monitor surface moisture using ASAR-ENVISAT multi-incidence data.First, the stability of the relationship between moisture and radar is studied as a function of different parameters (roughness, texture and scale). It is shown that roughness and scale effects are very important. A new approach is proposed to have a robust and stable relationship. It eliminates the effect of roughness on the processed radar signal.Second, an approach is developed to normalize different incidence angle radar data to one chosen incidence. This approach is based on the roughness distribution over the studied site. Each data is normalized on one angle using numerical backscattering model simulations.These methodologies are applied for a large experimental data base in the Beauce agricultural region in France with eight dates. For each date, ASAR data are taken in horizontal (HH) polarization with one different incidence angle. Simultaneously to radar measurements, soil surface moisture and roughness have been measured for more than 15 bare soil test fields. The results of the new approach illustrate a high correlation between moisture measurements and processed radar signal. An empirical inversion relationship is proposed for multi-incidence data. This study shows the high potential of ASAR-ENVISAT for surface moisture monitoring with a high repetition frequency (about 5 days).