Inferring Soil Moisture And Vegetation Parameters From Airborne And Spaceborne Radar Data

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Radar scattering from bare rough surfaces is influenced by both the surface geometrical properties, such as the surface roughness, and the electrical properties, such as the surface dielectric constant. The surface roughness is usually characterized by an r.m.s. height variation, (commonly called the roughness) and some function describing how the micro-topography at one point on the surface is related to that at any other point (commonly called the correlation function). The dielectric constant of the surface is a strong function of the surface soil moisture. It is therefore clear that in order to infer surface soil moisture from radar measurements, one has to find a way to separate the effects of the surface geometric properties from those of the electrical properties.

Several algorithms have been proposed in the literature to invert radar measurements to infer surface soil moisture. In all cases, multiple radar channels, usually multiple polarizations, are required to separate the effects of surface roughness and surface dielectric constant in order to extract information about the surface moisture. While these algorithms have been demonstrated to yield accuracies on the order of 4% when inferring surface soil moisture, all these algorithms were developed for low frequency radars imaging bare surfaces.

Most of the emphasis in active remote sensing of soil moisture has focused on higher resolution SAR data. In June 1999, the dual polarization SeaWinds instrument was launched on QuikSCAT satellite. SeaWinds is a low-resolution Ku-Band scatterometer that has a very large swath of 1800 km for the vertical polarization and a swath of 1400 km for the horizontal polarization. This size swath can cover 92% of the globe in one day and twice per day for latitude higher than 40°, with a resolution of 7 km by 25 km (Level 1B slice data). Such temporal resolution allow wetness events to be captured at the time scale of a day to track the wetness occurrence frequency through seasonal, annual, and interannual time scales. Recent results from year-long records of QuikSCAT backscatter data show excellent correlations with precipitation events measured by weather stations, and directly with in-situ surface soil moisture measured by the Soil Climate Analysis Network.

In this paper we critically examine the existing soil moisture algorithms, and compare the performance of the different algorithms when the same input data set is used for all algorithms. We will also show examples of the QuikSCAT data, and show how shorter term meteorological events can be separated from the longer term seasonal signals. The meteorological events derived from the QuikSCAT data will be compared with in-situ precipitation data.

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