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Investigating Differences in SMOS Morning and Evening Measurements

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Some concern has been expressed as to the influence of dew on the measurements made by SMOS, however no comparisons between 6pm and 6am (CST) passes of the SMOS satellite have been made. This study examines the difference between the 6pm and 6am passes for the L1 Browse data (at an interpolated incidence angle) and the L1 data at varying incidence angles, as well as the L2 soil moisture product.

Brightness temperature outputs of the SMOS data were examined for both the passes at 6pm and 6am the following morning, to determine if changes in measurement exist for days when there is no rainfall. Passes at both 6pm and 6am are not a daily occurrence, but provide unique opportunity for investigation. Changes in the brightness temperature can result from: changes in internal water content of the crop, which we currently do not have the ability to accurately determine; presence of external water on the canopy, which in this study will be limited to dew; changes in canopy and soil temperature, and changes in soil moisture. Land and airborne L-band radiometers have shown that dew on a crop canopy provides a source of error in the measurements of surface soil moisture. The magnitude and sign of the error appears to be crop dependent. The first step taken in this project was to investigating changes between the 6am and 6pm measurements, using the L 1 Browse data for an interpolated incidence angle, and normalizing the brightness temperatures using the polarization index to account for and eliminate the need for data on canopy and soil surface temperature. As such, changes in the brightness temperature can be attributed to changes in the water content of the crop canopy or the presence of dew. The second approach was to look at the various incidence angles to determine if the presence of dew has a stronger effect on a larger incidence angle.

The empirical model of RH>90% has been used extensively to simulate dew duration. At the Iowa Validation site in Ames, Iowa, relative humidity was measured above the crop canopy, in both corn and soybeans, and within the crop canopy. Comparisons were made between the relative humidity measured above the canopy to that measured within the canopy at 3 locations within the field. These values were also compared to relative humidity measured at a standard weather station near the field site. These measurements were used to define a more appropriate relative humidity threshold for the central Midwest, specifically where agriculture is a dominant land use. It is important that relative humidity data utilized from a source outside of an agricultural field is representative of the conditions occurring within the crop canopy, which is generally higher.

SMOS pixels were chosen for regions where > 75% of the land area was comprised of agriculture. Days were chosen where there was a satellite pass both at 6pm and 6am the following day, on days when no rainfall occurred during the calendar day of the 6pm pass or during the hours prior to 8am the following day. As such, changes in soil moisture would be minimal.

Identifying changes in the signal between morning and evening passes will aid in determining if the presence of dew on crop canopy is an important source of error in soil moisture measurements at L-band, and more importantly, if 6am measurements appear to be viable for soil moisture retrieval, as NASA's SMAP mission plans to use data from 6am passes, only.