Soil moisture estimation in the Hunshandake Sandy Land from polarimetric SAR data

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The Hunshandake Sandy Land is a 52000 km$^2$ region in the central part of Inner Mongolia, China. It is in a temperate semi-arid continental monsoon climate zone, cold, dry and windy in the winter, hot and rainy in the summer. Known as a “Garden Desert”, the region is principally grassland, but is more vegetated in the east, and sandy desert in the west. It is ecologically and economically important, but is under severe threat of desertification. Previous efforts to monitor this process through remote sensing have used multi-spectral VNIR imagery with some success, but, given the uncertainties of consistent acquisition of these images, we are attempting to use polarimetric SAR imagery to estimate soil moisture throughout the region.

We acquired one Radarsat-2 fine quad-pol image (FQ23D) in September 2013, and simultaneously some field measurements of soil moisture. The measured data spanned a soil moisture range of 2-35%. Comparison of these field data with soil moisture estimated by our implementation of the standard Dubois model was not promising, with an RMSE of 19.5% and a correlation coefficient of -0.03. To improve the soil moisture estimation, we developed an empirical model, modifying the Dubois model, but combining it with an AIEM simulation of the natural surface backscattering. The model does not require surface roughness measurements, using only the VV and HH polarization backscattering coefficients to retrieve soil moisture. The RMSE of the comparison of the new model to the field data was 10.5%, with a correlation coefficient of 0.5, showing significant improvement over the Dubois model.

Further experiments are being planned to continue validation and assessment of the new model.