Machine Learning-Based Prediction of C-Band Synthetic Aperture RADAR (SAR) Backscatter over Snow-Covered Terrain

JONGMIN PARK[1] AND BARTON A. FORMAN

ABSTRACT

Snow cover and snow mass exert a significant influence on the Earth's water and energy budgets as well as on climate variability across regional and continental scales. Satellite-based observations have the advantage of capturing the spatio-temporal dynamics of snowpack information as the snow cover extent changes or snowpack deepens and/or ripens. Space-based synthetic aperture radar (SAR) backscatter observations are an attractive means of estimating snowpack information based on the variations of snow dielectric. SAR imagery also has advantages in providing multi-polarization observations at a relatively fine spatial resolution.

This study utilized support vector machine (SVM) regression to predict C-band SAR backscatter over snow-covered terrain in Western Colorado. Training targets included the co-polarized ($\sigma\sigma VVVV$) and cross- polarized ($\sigma\sigma VVVV$) backscatter coefficients as well as the ratio of those two backscatter coefficients. Inputs to the SVM were derived from the NASA Land Information System (LIS) using the NOAH-Multiparameterization (NOAH-MP) land surface model with Modern-Era Retrospective analysis for Research and Application, Version 2 (MERRA2) meteorological boundary conditions. Training periods were selected as September 2015 to August 2018 excluding the validation period selected as September 2016 to August 2017. This study particularly focuses on the influence of training period length on prediction accuracy in conjunction with the effects of data sparsity on SVM efficacy. The results highlight the strengths and weakness of machine learning in the estimation of C-band SAR backscatter over snow-covered land. A discussion on the future use of C-band SAR machine learning within an ensemble-based data assimilation framework is also presented.

[1] Department of Civil and Environmental Engineering, University of Maryland, College Park, MD, USA