Evaluation of Three Different Machine Learning Algorithms for Snow Mass Estimation over the Colorado Rockies using Space-Based Passive Microwave Brightness Temperatures

BINCHENG YU[1] AND BARTON FORMAN[1]

ABSTRACT

This study compares the performance of three different machine learning algorithms used for snow water equivalent (SWE) estimation. Inputs to these algorithms include passive microwave (PMW) brightness temperature (Tb) observations at 10.65 GHz, 18.7 GHz, and 36.5 GHz at both vertical and horizontal polarization as collected by the Advanced Microwave Scanning Radiometer (AMSR-2). The three algorithms include: 1) support vector machine (SVM) regression; 2) long short-term memory (LSTM) networks; and 3) Gaussian process (GP) regression. *In situ* SWE measurements from the SNOTEL network collected across western Colorado are used as the training "targets" during the training procedure. The performance of the algorithms is evaluated using a number of different metrics including, but not limited to, root mean square error (RMSE), correlation coefficient, mean square error (MSE), and bias. The evaluation is conducted over a range of different elevations and different land cover classifications in order to assess algorithm performance across a broad range of snowpack conditions. Preliminary results suggest the LSTM algorithm is computationally more efficient during the training process as compared to the other algorithms yet yields a similar level of performance. However, some limitations have been found in the study, including poor performance during deep snow conditions, which is likely related to signal "saturation" within the PMW Tb's used during the supervised training process. Additionally, algorithm performance is strongly dependent on the amount of training data such that too little training data results in poor performance by the algorithm at successfully reproducing inter-annual variability. The strengths and limitations of these different machine learning algorithms for snow mass estimation will be discussed.

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