Snow Estimation in Complex Terrain using the NASA Land Information System

JAWAIRIA A. AHMAD[1], BARTON A. FORMAN[1], SUJAY KUMAR[2], AND EDWARD BAIR[3]

ABSTRACT

Snow estimation in complex terrain at continental scales has remained as yet, an unsolved problem due to the high spatial variability in elevation, relatively coarse resolution of available satellite data, presence of clouds, and a general lack of ground observations for validation and evaluation purposes. In this study, a machine learning integrated data assimilation framework is utilized to estimate snow in high mountain Asia. The NASA Land Information System (LIS) is the software framework used here to simulate the hydrologic cycle and to assimilate brightness temperature spectral difference observations using an ensemble Kalman filter. Trained support vector machines act as the observation operator within the assimilation framework and map the LIS simulated geophysical states into brightness temperature spectral difference space. Snow estimates (with and without assimilation) are compared to ground-based observations for performance evaluation. Recently acquired *in situ* snow depth measurements are translated to snow water equivalent values using downscaled meteorological forcings and the SNOWPACK model. The assimilation framework exhibits potential in improving the land surface model-based snow estimates. However, machine learning pitfalls such as controllability and under-determined systems do exist at certain locations in time and highlight some of the challenges of utilizing machine learning algorithms as observation operators within a data assimilation framework.

[1] Department of Civil and Environmental Engineering, University of Maryland, College Park, MD, USA
[2] Hydrological Sciences Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD, USA
[3] Earth Research Institute, University of California, Santa Barbara, CA, USA