Towards the Assimilation of C-band Synthetic Aperture Radar (SAR) Backscatter Observations over Snow-covered Terrain

JONGMIN PARK[1] AND BARTON A. FORMAN[1]

ABSTRACT

Estimating snow mass using space-based synthetic aperture radar (SAR) as part of a data assimilation framework holds many challenges. However, the all-weather capability of C-band SAR (as opposed to optical or thermal channels) coupled with the fine spatial resolution of the active microwave system (as opposed to passive microwave systems) make space-based SAR an attractive option.

This study explores the relationship between terrestrial snow depth, snow water equivalent, and Sentinel-1 C-band backscatter. Sentinel-1 is a constellation of two satellites with a 180-degree phase difference (Sentinel-1A and Sentinel-1B) that is operated by the European Space Agency. Among the different acquisition modes and product types, the Sentinel-1 interferometric wide swath (IW) ground range detected (GRD) dataset was used in this research. The observations were preprocessed through a series of steps accounting for sensor orbit, thermal and speckle noise, radiometric calibration, and terrain correction using ESA's Sentinel Application Platform (SNAP) software package. Preprocessed backscatter coefficients were then compared against snow depth measurements from the Global Surface Summary of the Day (GSOD) and Snow Telemetry (SNOTEL) stations within our study area near Grand Mesa, Colorado. Grand Mesa was selected in this study to leverage existing measurement networks as well as to better harness on-going NASA Snow Experiment (SnowEx) Campaign activities in and around the region. Comparison of Sentinel-1 backscatters with ground-based observations is an essential first step that will help characterize the uncertainty (and error) of Sentinel-1 observations, which is an important precursor for backscatter assimilation within an ensemble-based, multi-variate data assimilation framework.

[1] University of Maryland, College Park, MD, USA