On the Complementary Value of Space-Based Snow Observations for Snow Mass Estimation within an Observing Simulation System Experiment

LIZHAO WANG[1], BARTON A. FORMAN[1], SUJAY V. KUMAR[2], YONGHWAN KWON[2,3], PAUL GROGAN[4], RHAE SUNG KIM[2,5], MELISSA L. WRZESIEN[2,5], AND YEOSANG YOON[2,6]

ABSTRACT

Snow plays a key role in the freshwater supply of many watersheds located at high elevations or high latitudes. However, despite this importance, we do not know exactly how much snow exists in the world. One challenge in quantifying snow mass using space-based sensors is that no single sensor can accurately measure all types of snow during all times of the year. That is, each type of sensor has its own strengths (and limitations) that must be considered as part of a suite of sensors in order to accurately measure global snow mass.

In this study, we develop an observing simulation system experiment (OSSE) in order to explore the individual contribution of a complementary suite of space-borne sensors. In the experiment, we first generate a "synthetic truth" of SWE and snow depth using the NoahMP-4.0.1 land surface model within the NASA Land Information System (LIS). Afterwards, synthetic SWE and snow depth retrievals from one PMW radiometer and one LiDAR, respectively, are generated by applying a space-time subsampler that provides an accurate representation of what each sensor can "see" at any point of time on Earth. Next, a realistic amount of observation error as a function of dense/sparse forest, deep/shallow snow, and dry/wet snow is then added to the synthetic retrievals. The synthetic retrievals are then assimilated into NoahMP-4.0.1 in order to help quantify the added value that each type of snow retrieval has on the land surface model performance. The results from this OSSE help reveal the complementary nature of PMW radiometer and LiDAR sensors, and in turn, can help aid mission planners in determining how to get the most observational "bang for the buck" in the selection of a future snow mission.

[1] Civil and Environmental Engineering, University of Maryland, College Park, MD, USA
[2] Hydrological Sciences Laboratory, NASA Goddard Space Flight Center, MD, USA
[3] Earth System Science Interdisciplinary Center, University of Maryland, College Park, MD, USA
[4] Stevens Institute of Technology, School of Systems and Enterprises, Hoboken, NJ, USA
[5] Universities Space Research Association (USRA), Columbia, MD, USA
[6] Science Applications International Corporation, McLean, VA, USA