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Towards Improved Snow Water Equivalent Estimation Via GRACE Assimilation

Bart Forman (1), Rolf Reichle (2), and Matt Rodell (3)

(1) NASA GSFC, Global Modeling and Assimilation Office, United States (barton.a.forman@nasa.gov), (2) NASA GSFC, Global Modeling and Assimilation Office, United States (rolf.h.reichle@nasa.gov), (3) NASA GSFC, Hydrological Sciences Branch, United States (matthew.rodell@nasa.gov)

Passive microwave (e.g. AMSR-E) and visible spectrum (e.g. MODIS) measurements of snow states have been used in conjunction with land surface models to better characterize snow pack states, most notably snow water equivalent (SWE). However, both types of measurements have limitations. AMSR-E, for example, suffers a loss of information in deep/wet snow packs. Similarly, MODIS suffers a loss of temporal correlation information beyond the initial accumulation and final ablation phases of the snow season. Gravimetric measurements, on the other hand, do not suffer from these limitations. In this study, gravimetric measurements from the Gravity Recovery and Climate Experiment (GRACE) mission are used in a land surface model data assimilation (DA) framework to better characterize SWE in the Mackenzie River basin located in northern Canada. Comparisons are made against independent, ground-based SWE observations, state-of-the-art modeled SWE estimates, and independent, ground-based river discharge observations. Preliminary results suggest improved SWE estimates, including improved timing of the subsequent ablation and runoff of the snow pack. Additionally, use of the DA procedure can add vertical and horizontal resolution to the coarse-scale GRACE measurements as well as effectively downscale the measurements in time. Such findings offer the potential for better understanding of the hydrologic cycle in snow-dominated basins located in remote regions of the globe where ground-based observation collection if difficult, if not impossible. This information could ultimately lead to improved freshwater resource management in communities dependent on snow melt as well as a reduction in the uncertainty of river discharge into the Arctic Ocean.