

Impact of Passive Microwave Radiometry and LiDAR Assimilation on Hydrologic Cycle Estimation

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ABSTRACT

Enabling accurate estimation of hydrologic states and fluxes enhances the ability to monitor changes in the terrestrial hydrologic cycle and freshwater storage in general. Although land surface models aim to provide details on land atmosphere interactions, the lack of physical representation in these models limits their accuracy. Assimilation of satellite observations, on the other hand, is one way to reduce the errors and uncertainties in those model estimates.

This study investigates the added value associated with assimilating snow observations from passive microwave (PMW) and LiDAR sensors into the NoahMP-4.0.1 land surface model and their subsequent cascading effect on portions of the hydrologic cycle other than snow such as soil moisture and vegetation. In order to do this, a realistic representation of the satellite measurements (a.k.a., synthetic observations) for a given type of sensor is first derived by applying a space time subsampler that accounts for differences in sensor swath width, platform inclination angle, and platform altitude. These synthetic observations – with an emphasis on terrestrial snow – obtained from a variety of different sensor types and different sensor error characteristics are then assimilated into the NoahMP-4.0.1 model using an Ensemble Kalman Filters. Results from these data assimilation (DA) experiments reveal the extent of improvement in terms of the estimation of various hydrologic states and fluxes such as soil moisture, vegetation growth, surface runoff, and terrestrial water storage relative to model output when such observations are not assimilated. Results presented will quantify how observations related to terrestrial snow eventually cascade down into other components of the hydrologic cycle thereby providing benefits to other hydrologic states and fluxes of interest to hydrologists and water resource managers.

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