Assimilation of Freeze-Thaw Observations into the NASA Catchment Land Surface Model

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The land surface freeze-thaw (F/T) state controls hydrological and carbon cycling and thus affects water and energy exchanges at land surface. In this research an Observing System Simulation Experiment is conducted using synthetically generated measurements of the F/T state for a region in North America (90-110^{o}W longitude, 45-55^{o}N latitude). The synthetic "truth" is generated using the NASA Catchment land surface model forced with surface meteorological fields from the Modern-Era Retrospective Reanalysis for Research and Applications (MERRA). To generate synthetic measurements, the true categorical F/T state is corrupted with a prescribed amount of F/T classification error. The assimilation experiment employs the same Catchment model except that forcing errors (relative to truth) are introduced via the application of meteorological forcing fields from the Global Land Data Assimilation System (GLDAS). A rule-based approach that incorporates model and observational errors is developed and used for assimilating the categorical F/T measurements into the land surface model (F/T analysis). The effect of the F/T analysis on land surface temperature, soil temperature and soil moisture is examined. In a real-world experiment, the synthetic F/T observations are replaced with F/T observations from the Advanced Microwave Scanning Radiometer Enhanced (AMSR-E). The ultimate goal of this project is to provide a framework for the assimilation of SMAP (Soil Moisture Active Passive) F/T observations into the NASA Catchment land surface model.