Geophysical Research Abstracts,
Vol. 11, EGU2009-13899, 2009
EGU General Assembly 2009

Land surface modeling using optimally merged precipitation data from multiple sources

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Precipitation plays a primary role in driving the terrestrial branch of water and energy cycles and is arguably the most significant forcing to affect land surface conditions. However our observational knowledge of precipitation is limited. Ground and satellite based observations have limited spatial and temporal coverage, and numerical model simulations are limited by various physical and dynamic simplifications such as inadequate cloud and convection processes. Given the availability of multiple precipitation products with various shortcomings, an attractive prospect to improve land surface model skill is to merge these precipitation data to benefit from the strengths of each product with avoiding their limitations. We merge precipitation data based on improving terrestrial water and energy cycle simulation skill unlike most common methods where the merging skills are determined by comparing the results with gauge data or a selected reference data. The optimal merging method developed in this study minimizes the simulated soil moisture errors using the Noah land surface model with the Nelder-Mead (Downhill Simplex) method. Improving the simulation skills, this method also prevents from the adverse impact of limitation in precipitation data from a certain source. Further analysis has indicated that, the results from optimally merged precipitation product have less errors in other land surface states and fluxes such as evapotranspiration, discharge and skin temperature than simulation results from each precipitation product alone.