Geophysical Research Abstracts
Vol. 17, EGU2015-1838, 2015
EGU General Assembly 2015

Precipitation and global land surface hydrology in the MERRA-Land and MERRA-2 reanalysis datasets

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Multi-decadal reanalysis datasets have been widely used to study the global terrestrial water cycle. Examples include atmospheric reanalysis datasets (e.g., MERRA and ERA-Interim), coupled atmosphere-ocean reanalysis datasets (e.g., CFSR), and land-surface only reanalysis datasets (e.g., MERRA-Land and ERA-Interim/Land). The driving component of the land surface water budget is the incoming precipitation forcing. Traditionally, e.g. in ERA-Interim and MERRA, the reanalysis precipitation over land is generated by the atmospheric general circulation model component of the reanalysis system. By contrast, MERRA-Land, ERA-Interim/Land, CSFR, and the forthcoming MERRA-2 atmospheric reanalysis essentially use precipitation observations from satellites and/or gauges to force the land surface, which typically results in improved estimates of large-scale hydrological conditions.

This presentation first reviews the approach by which the precipitation observations are introduced in MERRA-Land and MERRA-2. Precipitation in MERRA-Land relies on a global, daily, 0.5 degree gauge product from the NOAA Climate Prediction Center (CPC). But this product is based on a very limited number of measurements at high latitudes and over Africa. Therefore, MERRA-2 relies on a mix of (i) model-generated precipitation at high-latitudes, (ii) a pentad, 2.5 degree satellite product from CPC over Africa, and (iii) the daily, 0.5 degree gauge-based precipitation product elsewhere. Next, the precipitation climatologies and the resulting land surface hydrological conditions are compared regionally and for the reanalysis time period (1980-present). The more sophisticated approach of MERRA-2 precipitation results in generally improved land surface conditions. But MERRA-2 also suffers from adverse spin-up effects in soil moisture conditions at high latitudes.