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Enhancing global land surface hydrology estimates from the NASA MERRA reanalysis using precipitation observations and model parameter adjustments

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The Modern-Era Retrospective analysis for Research and Applications (MERRA) is a state-of-the-art reanalysis that provides, in addition to atmospheric fields, global estimates of soil moisture, latent heat flux, snow, and runoff for 1979-present. This study introduces a supplemental and improved set of land surface hydrological fields ('MERRA-Land') generated by replaying a revised version of the land component of the MERRA system. Specifically, the MERRA-Land estimates benefit from corrections to the precipitation forcing with the Global Precipitation Climatology Project pentad product (version 2.1) and from revised parameters in the rainfall interception model, changes that effectively correct for known limitations in the MERRA land surface meteorological forcings. The skill (defined as the correlation coefficient of the anomaly time series) in land surface hydrological fields from MERRA and MERRA-Land is assessed here against observations and compared to the skill of the state-of-the-art ERA-Interim reanalysis. MERRA-Land and ERA-Interim root zone soil moisture skills (against in situ observations at 85 US stations) are comparable and significantly greater than that of MERRA. Throughout the northern hemisphere, MERRA and MERRA-Land agree reasonably well with in situ snow depth measurements (from 583 stations) and with snow water equivalent from an independent analysis. Runoff skill (against naturalized stream flow observations from 15 basins in the western US) of MERRA and MERRA-Land is typically higher than that of ERA-Interim. With a few exceptions, the MERRA-Land data appear more accurate than the original MERRA estimates and are thus recommended for those interested in using MERRA output for land surface hydrological studies.