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# Global Energy and Water Balances in the Latest Reanalyses

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The recently released Japanese 55-year Reanalysis (JRA-55) data are evaluated and compared with three other global reanalyses, namely Interim version of the next European Centre for Medium-Range Weather Forecasts (ECMWF) Re-Analysis (ERRA-Interim), Modern Era Retrospective-Analysis for Research and Applications (MERRA) and Climate Forecast System Reanalysis (CFSR), in terms of global energy and water balances. All four reanalyses show an energy imbalance at TOA and surface. Especially, clouds in JRA-55 are optically weaker than those in the three other reanalyses, leading to excessive outgoing longwave radiation, which in turn causes negative net energy flux at TOA. Moreover, JRA-55 has a negative imbalance at surface and at TOA, which is attributed to systematic positive biases in latent heat flux over the ocean. As for the global water balance, all reanalyses present a similar spatial pattern of the difference between evaporation and precipitation (E-P). However, JRA-55 has a relatively strong negative (positive) E-P in the Intertropical Convergence Zone and South Pacific Convergence Zone (extratropical regions) due to overestimated precipitation (evaporation), in spite of the global net being close to zero. In time series analysis, especially in E-P, significant stepwise changes occur in MERRA, CFSR and ERA-Interim due to the changes occur in MERRA, CFRS and ERA-Interim due to the changes in the satellite observing system used in the data assimilation. Both MERRA and CFSR show a strong downward E-P shift in 1998, simultaneously with the start of the assimilation of AMSU-A sounding radiances. ERA-Interim exhibits an upward E-P shift in 1992 due to changes in observations from the SSM/I of new DMSP satellites. On the contrary, JRA-55 exhibits less trends and remains stable over time, which may be caused by newly available, homogenized observations and advances in data assimilation technique.

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References
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