



## **Monitoring satellite observations and model simulations of changes in the atmospheric hydrological cycle since 1979**

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Satellite observations of water vapour, clear-sky radiation and precipitation are combined with reanalysis data to evaluate the simulated response of the atmospheric hydrological cycle since 1979. The rise in water vapour and the robust response of clear-sky surface net longwave radiation to these changes in the observations and models explains the reduced clear-sky longwave cooling of the surface as temperatures rise. However, increases in clear-sky outgoing longwave radiation (OLR<sub>c</sub>) with surface temperature show more scatter when comparing different model experiments, reanalyses and satellite observations. This relates to different forcings applied to the models, that directly influence OLR<sub>c</sub>, changes in the observing system applied to the reanalyses and satellite calibration issues. Nevertheless, a robust increase in the clear-sky longwave cooling of the atmosphere with warming is detected in all datasets, implying enhanced precipitation. While models appear to underestimate the trends in precipitation changes when considering the ascending and descending branches of the tropical circulation, the sensitivity of precipitation to interannual changes in surface temperature and water vapour appear broadly consistent with the satellite datasets. The sensitivity of the results to the satellite dataset used is discussed.