Geophysical Research Abstracts
Vol. 20, EGU2018-2067, 2018
EGU General Assembly 2018

Diagnosing present day and future ENSO precipitation shifts using surface relative humidity and temperature

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Large uncertainty remains in future projections of tropical precipitation change under global warming. A simplified method for diagnosing tropical precipitation change is tested here on present day and future ENSO precipitation shifts. This method, based on the weak temperature gradient (WTG) approximation, assumes tropical precipitation is a function of the tropical quantiles of surface relative humidity (RH) and air temperature (SAT). Observed and simulated changes in RH and SAT are subsequently used to diagnose precipitation changes. This study builds upon previous work by developing a novel Gaussian process framework in order to estimate confidence intervals to represent uncertainty based on the WTG assumption. Present day tropical precipitation shifts for composites of different ENSO flavours are successfully diagnosed using observations, reanalyses and climate model simulations. Examining inter-model diversity in diagnosis performance for future mean state and ENSO precipitation shifts, we demonstrate how future simulated precipitation changes are largely characterised by changes in RH and SAT. Hence, this diagnosis method demonstrates a plausible mechanism which relate changes in precipitation, RH and SAT under differing climate perturbations. Therefore, uncertainty in future ENSO tropical precipitation changes may be linked with uncertainty in future RH and SAT changes.