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Water vapor stable isotope observations from tropical Australia

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The response of the tropical hydrological cycle to anthropogenically induced changes in radiative forcing is one of the largest discrepancies between climate models. Paleoclimate archives of the stable isotopic composition of precipitation in the tropics indicate a relationship with precipitation amount that could be exploited to study past hydroclimate and improve our knowledge of how this region responds to changes in climate forcing. Recently modelling studies of convective parameterizations fitted with water isotopes and remote sensing of water vapor isotopes in the tropics have illustrated uncertainty in the assumed relationship with rainfall amount. Therefore there is a need to collect water isotope data in the tropics that can be used to evaluate these models and help identify the relationships between the isotopic composition of meteoric waters and rainfall intensity. However, data in this region is almost non-existent. Here we present in-situ water vapor isotopic measurements and the HDO retrievals from the co-located Total Column Carbon Observing Network (TCCON) site at Darwin in Tropical Australia. The Darwin site is interestingly placed within the tropical western pacific region and is impacted upon by a clear monsoonal climate, and key climate cycles including ENSO and Madden Julian Oscillations. The analysis of the data illustrated relationships between water vapor isotopes and humidity which demonstrated the role of precipitation processes in the wet season and air mass mixing during the dry season. Further the wet season observations show complex relationships between humidity and isotopes. A simple Rayleigh distillation model was not obeyed, instead the importance of rainfall re-evaporation in generating the highly depleted signatures was demonstrated. These data potentially provide a useful tool for evaluating model parameterizations in monsoonal regions as they demonstrate relationships with precipitation processes that cannot be observed with more traditional observations.