Evaluation of Climate Models Using Radio Occultation Observations – Tropical Convection Regimes in the HadGEM Model

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The evaluation of Global Climate Models (GCMs) requires high-quality observational data sets. Global Positioning System (GPS) Radio Occultation (RO) measurements provide a global and continuous data record of key climate variables for the upper troposphere and lower stratosphere (UTLS) since 2001. RO qualifies as climate benchmark data type due to characteristics including long-term stability, homogeneity, and high accuracy and vertical resolution, features which are favorable for the purpose of model evaluation. In this study we focus on physical processes relevant to tropical water vapor/lapse rate feedback. Water vapor and lapse rate responses are closely coupled in the upper troposphere and models with larger negative lapse rate feedback also have a larger positive water vapor feedback. We show first results on the representation of UTLS temperature profiles as well as lapse rates and refractivity gradients in RO observations and in Met Office Hadley Centre HadGEM model data. To allow a consistent and process-oriented approach, we classify moist and dry tropical regimes through distinction between dynamical up- and downdraft regions. The pressure vertical velocity at 500 hPa (ω500) and surface temperature (*T*s) are used for the classification of these regimes (from HadGEM for the model data, from ERA-Interim for the RO profiles). RO data and co-located HadGEM model profiles are sorted and sampled into ω500 and *T*s classes and a systematic comparison is performed. Initial results indicate a systematic deviation of the HadGEM2 model from RO in the UTLS, depending on height and atmospheric conditions. HadGEM2 is warm biased around the tropopause and cold biased above and below. This may partly be due to the coarse vertical HadGEM2 resolution and will be investigated further with better resolved data. A better insight into observation and model behavior in tropical convection regimes will contribute to the development of improved model parameterizations.

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