

## **Tropical free-tropospheric humidity differences in global storm-resolving models**

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Tropical free-tropospheric humidity (FTH) plays a key role in controlling the Earth's outgoing longwave radiation (OLR), but it is poorly simulated by conventional climate models. We investigate whether global storm-resolving models (GSRMs) simulate FTH more accurately, by quantifying inter-model differences in the multi-model ensemble DYAMOND. We find that the model spread in FTH is approximately halved compared to conventional climate models. However, the differences still cause a considerable spread of 1.2 Wm<sup>2</sup> in tropical mean clear-sky OLR. To reduce this spread a reduction of humidity biases would be most beneficial in the lower and mid free troposphere. In the horizontal, FTH biases in two moisture regimes have a particularly strong impact: Dry subsidence regimes and moist regions adjacent to deep convection. In the most critical regions FTH biases are related to parameterized processes (e.g. microphysics, turbulence), so a better understanding of how they affect FTH is needed.