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What drives water vapor trends in CCMs?

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Models of the climate system predict that the humidity of air entering the tropical stratosphere will increase as the climate warms over the 21st century. Despite the importance of this conclusion, the cause of this increase has not been rigorously investigated. We examine this trend in two state-of-the-art chemistry-climate models: the Goddard Earth Observing System Chemistry Climate Model (GEOSCCM) and the Whole Atmosphere Community Climate Model (WACCM). The models predict that air entering the stratosphere will increase by 0.87 and 1.08 parts per million by volume (ppmv) over the 21st century in the GEOSCCM and WACCM, respectively. Using trajectory simulations driven by model met fields, we find that 50-80% of this is due to warming of the TTL. We find strong evidence that the rest of the is due to trends in evaporation of convective ice lofted into the TTL, a process decoupled from TTL temperatures. The models are consistent, however, with previous research showing that TTL temperature variations are the primary regulator of humidity on short time scales (i.e, a decade).