



Why do climate models lack variability in tropical stratospheric water vapour?

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The limited observations available indicate large ($\pm 15\%$) year-to-year variability in the concentration of water vapour entering into the tropical lower stratosphere. Water vapour concentrations in this region are controlled by a range of complex processes which determine the dehydration of air as it is transported through the tropical tropopause layer. We show that state-of-the-art coupled climate models from the CMIP5 archive do not capture the magnitude of interannual variability in tropical stratospheric water vapour (SWV) indicated by the observations. For example, the models never simulate events comparable to the post-2000 SWV decrease, which has been shown to be important for decadal trends in surface climate and stratospheric temperatures. The reasons for this fundamental lack of variability are investigated using a simple regression model to establish whether the large-scale climate phenomena which drive SWV variability and/or the simulated response to a particular climate phenomenon can explain the behaviour of the models.