

Stratospheric water vapor: an important climate feedback

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The importance of stratospheric water vapor (SWV) as a climate feedback remains highly uncertain. Here, we calculate the climate feedback of SWV under abrupt quadrupling of CO₂ for 24 CMIP5 models. All models robustly show a moistening of the stratosphere. This is associated with a multi-model, global mean net stratospheric adjusted radiative response of $0.89 \pm 0.26 \text{ Wm}^{-2}$, with the stratospheric temperature adjustment being an important part of the response. We calculate a corresponding climate feedback of $0.18 \pm 0.04 \text{ Wm}^{-2}\text{K}^{-1}$, with a considerable inter-model range of 0.12 to $0.28 \text{ Wm}^{-2}\text{K}^{-1}$. These effects are important for climate: the calculated feedback is on the same order of magnitude as the surface albedo and cloud feedbacks. Increases in SWV in the extratropical lowermost stratosphere drive mid-latitude peaks in the radiative response and cause the majority (~70%) of the global mean feedback. So, we suggest a future concentration in efforts in understanding drivers of water vapor variability in the extratropical lowermost stratosphere rather than in the tropical tropopause region.

Key words: stratospheric water vapor, climate feedback, stratosphere, radiation