

The response of the tropospheric circulation to water vapor-like forcings in the stratosphere

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An idealized, dry general circulation model is used to examine the response of the tropospheric circulation to thermal forcings that mimic changes in stratospheric water vapor (SWV). It is found that SWV-like cooling in the stratosphere produces a poleward-shifted, strengthened jet and an expanded, weakened Hadley Cell. This response is shown to be almost entirely driven by cooling located in the extratropical lower stratosphere; when cooling is limited to the tropical stratosphere, it generates a much weaker and qualitatively opposite response. It is demonstrated that these circulation changes arise independently of any changes in tropopause height, are insensitive to the detailed structure of the forcing function, and are robust to model resolution. The responses are quantitatively of the same order as those due to increased well-mixed greenhouse gases, suggesting a potentially significant contribution of SWV to past and future changes in the tropospheric circulation.