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Stratospheric Water Vapor Affecting Atmospheric Circulation

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Water vapor plays an important role in many aspects of the climate system, by affecting radiation, cloud formation, atmospheric chemistry and dynamics. Even the low water vapor content of the stratosphere provides an important climate feedback, but current climate models have a substantial moist bias in the lowermost stratosphere. Here we present strong sensitivity of the atmospheric circulation in the stratosphere and troposphere to the abundance of water vapor in the lowermost stratosphere. We show from a mechanistic climate model experiment and inter-model variability that lowermost stratospheric water vapor decreases local temperatures, shifts the subtropical jets, strengthens the stratospheric circulation, and shifts the tropospheric eddy-driven jet poleward. The mechanistic model experiment in combination with atmospheric observations further shows that the prevailing moist bias in current models is likely caused by the transport scheme. The related effects on atmospheric circulation are of similar magnitude to climate change effects.

Primary authors: CHARLESWORTH, Edward (Research Center Jülich, IEK-7, Stratosphere); Prof. PLÖGER, Felix (Research Center Jülich, IEK-7, Stratosphere)

Presenter: CHARLESWORTH, Edward (Research Center Jülich, IEK-7, Stratosphere)

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