

Earth's protective stratosphere affected by clouds from below

Background: Small changes in the humidity of Earth's stratosphere can have a big impact on Earth's climate. Moisture in this extremely dry environment 35 miles above the planet regulates the delicate composition of gases such as ozone that protects life on Earth from UV rays. The stratosphere receives moisture primarily from the tropospheric layer below and, to an unknown degree, from deep convective clouds that rapidly transport humid air upwards. This study uses two complementary modeling approaches to estimate the overall impact of deep convection on global stratospheric humidity.

Findings: The main source of stratospheric humidity is the transport of humid air and ice into the tropical uppermost troposphere, followed by ascent (see figure caption). Direct hydration of the lower stratosphere by deep convective cloud tops that penetrate the tropopause is relatively small on a global scale.

Implications: The impact of convection on the global lower stratospheric water vapor budget is relatively small in the current climate, although it can be much larger on a regional basis such as over summer monsoon regions. Nonetheless, as the summer monsoon anticyclone and convection have been shown to substantially influence the distribution of trace gases in the lower stratosphere, a significant change in monsoon convection and/or cirrus cloud distribution in future climate could potentially have a measurable effect on the composition of the stratosphere.

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