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Satellite Observations Validate Stratosphere Temperature Models

A view of the blue haze of Earth's atmosphere. Credit: iStock.com/sharply_done

Depending on whether you look above the poles or above the equator, Earth's stratosphere can start anywhere between 6 and 20 kilometers above the surface. Regardless of its relative height, however, the atmosphere plays an important role in our planet's climate. It contains ozone (O_3), a molecule that readily absorbs harmful ultraviolet radiation from the Sun and protects life on the surface below. The more radiation that is absorbed, the higher the temperature rises.

Since the 1970s, however, some human-made compounds—especially chlorofluorocarbons—have been depleting ozone levels and thus cooling the stratosphere. Over this period, increases in long-lived greenhouse gases like carbon dioxide have also cooled the stratosphere. Accounting for these effects, scientists have modeled just how much cooler the stratosphere should be, but these models have not always closely agreed with actual observations from satellites.

A new study by *Maycock et al.* uses improved satellite temperature readings and shows that these observations are more in line with simulations from the Chemistry-Climate Model Initiative.

The primary evidence that modeled stratosphere temperature trends did not match observations came from a 2012 study. Observations of stratospheric temperatures from the late 1970s to the present rely primarily on measurements from a series of infrared sounders called the Stratospheric Sounding Unit (SSU), which are on board satellites orbiting Earth's poles.

On the basis of the data available at the time, the earlier study showed that modeled trends of stratospheric temperatures taken from Phase 5 of the Coupled Model Intercomparison Project and the Chemistry-Climate-Model Validation project differed significantly from the SSU record. It also showed that two versions of the SSU itself differed from each other in terms of temperature trends.

Since that time, however, other researchers have reprocessed and refined the SSU temperature records, and scientists have continued to improve the chemistry climate models, warranting the new comparison from the authors reported here.

The researchers report that the updated data sets are now in closer agreement, with the models now predicting temperature trends within the margin of error inherent in the satellite observations. They conclude that the improvement is mostly the result of the refined SSU observations rather than improvements in the models.

The temperature of the stratosphere is important as it relates to the ozone shield but also because processes in each layer of the atmosphere affect those around it. With the troposphere below warming at dangerous rates, understanding the behavior of the stratosphere will continue to be a vital field of research. (*Geophysical Research Letters*, https://doi.org/10.1029/2018GL078035, 2018) **—David Shultz, Freelance Writer**