Revisiting the mystery of recent stratospheric temperature trends

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Abstract

Simulated stratospheric temperatures over the period 1979-2016 in models from the Chemistry-Climate Model Initiative (CCMI) are compared with recently updated and extended satellite observations. The multi-model mean global temperature trends over 1979-2005 are -0.88 ± 0.23, -0.70 ± 0.16, and -0.50 ± 0.12 K decade^{-1} for the Stratospheric Sounding Unit (SSU) channels 3 (~40-50 km), 2 (~35-45 km), and 1 (~25-35 km), respectively. These are within the uncertainty bounds of the observed temperature trends from two reprocessed satellite datasets. In the lower stratosphere, the multi-model mean trend in global temperature for the Microwave Sounding Unit channel 4 (~15-25 km) is -0.25 ± 0.12 K decade^{-1} over 1979-2005, consistent with estimates from three versions of this satellite record. The simulated stratospheric temperature trends in CCMI models over 1979-2005 agree with the previous generation of chemistry-climate models. The models and an extended satellite dataset of SSU with the Advanced Microwave Sounding Unit-A show weaker global stratospheric cooling over 1998-2016 compared to the period of intensive ozone depletion (1979-1997). This is due to the reduction in ozone-induced cooling from the slow-down of ozone trends and the onset of ozone recovery since the late 1990s. In summary, the results show much better consistency between simulated and satellite observed stratospheric temperature trends than was reported by Thompson et al. (2012) for the previous versions of the SSU record and chemistry-climate models. The improved agreement mainly comes from updates to the satellite records; the range of simulated trends is comparable to the previous generation of models.

References

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