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Drivers of the recent tropical expansion in the Southern Hemisphere: Changing SSTs or ozone depletion?

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Several studies have reported that global climate models underestimate the observed trend in tropical expansion, with the implication that such models are missing key processes of the climate system. We show here that integrations of a chemistry-climate model forced with observed sea surface temperatures (SSTs), greenhouse gases, and ozone depleting substances can produce 1980 to 2009 expansion trends comparable to those found in most reanalyses data products. It is shown that the weight of the evidence clearly points to stratospheric ozone depletion as the dominant driver of the tropical SH summertime expansion over the period in which an ozone hole was formed (1979 to late 1990s), although SST trends have contributed to trends since then. Studies that have claimed SSTs as the major driver of tropical expansion since 1979 have used prescribed ozone fields that underrepresent the observed Antarctic ozone depletion. Correct representation of the SSTs changes is important for the Northern Hemisphere. The ensemble mean trend (which captures only the forced response) is nearly always much weaker than trends in reanalyses. This suggests that a large fraction of the recently observed changes may, in fact, be a consequence of natural variability and not a response of the climate system to anthropogenic forcings.