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Stratosphere-troposphere coupling: Tropopause structure and its long-term evolution

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Stratosphere-troposphere coupling by definition involves the tropopause. Characteristics such as the height of the tropopause may serve as a useful indicator of climate change. The height of the tropopause is often considered to be primarily set by the combined effects of a dynamically active troposphere and a stratosphere in near radiative equilibrium. Several studies over the past decade or so have suggested modifications to this picture: stratospheric dynamics has been shown to play an important role in modulating the height of the tropopause on intra-seasonal, seasonal, and interannual time-scales. The role of stratospheric dynamics can be most simply viewed in terms of the stratospheric residual mean meridional (~Brewer-Dobson) circulation which tends to lift the tropopause within its upward branch in the tropics and tends to lower the tropopause within its downward branch in the extratropics, especially during winter and spring. Here, we build on our recent work that has shown that more than half of the equator-to-pole contrast in tropopause height can be attributed to stratospheric dynamics. The impact of stratospheric dynamics on tropopause structure is quantified using chemistry-climate model (CCM) output provided by the CCM Validation Activity for SPARC (CCMVal), as well as output from the CMIP5 models, coupled to off-line radiative transfer calculations. Differences in tropopause structure between different models reveal insights into the model's representation of stratosphere-tropopause coupling. The impact of long-term changes in stratospheric dynamics (viz. the Brewer-Dobson circulation) on trends in tropopause structure is also evaluated from the different models.