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Attribution of modelled column ozone trends to chemistry and dynamics: Signs of recovery?

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The decrease of the concentration of ozone depleting substances (ODSs) in the stratosphere over the past decade raises the question to what extent observed changes in stratospheric ozone over this period are consistent with known changes in the chemical composition and possible changes in atmospheric dynamics. We present a trend study involving a series of ozone sensitivity calculations with a stratospheric chemistry transport model (CTM), covering the period 1978–2009, as well as results from an assimilated long-term ozone dataset covering roughly the same period (1979–2007). In order to account for the reversal in ODS trends, ozone trends are analysed as piecewise linear trends over two periods, 1979–1999 and 2000–2009. Modelled column ozone (TO3) inter-annual variability and trends are in excellent agreement with satellite observations. In the period 1979–1999, strong negative TO3 trends are observed in mid- and polar latitudes. Changes in in-situ chemistry, export of ozone depleted air from polar latitudes, and changes in meteorology contribute in a similar magnitude to annual mid-latitude trends. In most seasons, in-situ chemistry is the strongest contributor, while dilution of ozone-depleted polar air masses dominates during southern hemisphere spring. Over the period 2000–2009, positive linear trends in modelled TO3 are present, but not yet statistically significant. Changes in linear trends between 1978–1999 and 2000–2009 are significant at mid- and high latitudes of both hemisphere during most seasons. However, changes in meteorology have contributed up to $\sim 50\%$ to these TO3 trend changes.