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Stratospheric ozone loss and Antarctic climate change: an update from a stratosphere resolving Chemistry Climate Model simulation

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The evolution of Antarctic climate during the past four decades was characterized by enhanced tropospheric westerlies and a negative trend in near-surface temperature over the Antarctic plateau during the austral summer, while the Antarctic Peninsula showed a warming (Thompson and Solomon, 2002). Model simulations suggested that these trends are most certainly attributable to the Antarctic ozone depletion since the early 1980s (Gillett and Thompson, 2003). However, the more recent publication of Steig et al. (2009) finds a warming of the whole Antarctic continent since 1957 in data from satellites and automatic weather stations.
Motivated by this discussion we have analysed changes in stratospheric ozone, temperature and dynamics, and the corresponding signal in Antarctic climate in a transient simulation of the period 1960 to 2000, performed with the stratosphere-troposphere Chemistry-Climate Model (CCM) EMAC. The model has been integrated following the SCN2d scenario recommendations of the SPARC CCMVal initiative for the temporal evolution of greenhouse gases, ozone depleting substances and sea surface temperatures/sea ice.
The model reproduces the main observed features of the Antarctic stratosphere since the 1960s, e.g. the establishment of the ozone hole in the 1980s, a negative stratospheric temperature trend, and a longer lived and deeper polar vortex and its more intense breakdown. The enhancement of the tropospheric jet is well reproduced as well. With respect to the near surface trends the model seems to support the recently published results of a weak positive temperature trend all over Antarctica. Analyses of heat and humidity fluxes will be used to support the interpretation of the model results.