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Past and future conditions for polar stratospheric cloud formation simulated by the Canadian Middle Atmosphere Model

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Abstract. We analyze here the polar stratospheric temperatures in an ensemble of three 150-year integrations of the Canadian Middle Atmosphere Model (CMAM), an interactive chemistry-climate model which simulates ozone depletion and recovery, as well as climate change. A key motivation is to understand possible mechanisms for the observed trend in the extent of conditions favourable for polar stratospheric cloud (PSC) formation in the Arctic winter lower stratosphere.

We find that in the Antarctic winter lower stratosphere, the low temperature extremes required for PSC formation increase in the model as ozone is depleted, but remain steady through the twenty-first century as the warming from ozone recovery roughly balances the cooling from climate change. Thus, ozone depletion itself plays a major role in the Antarctic trends in low temperature extremes.

The model trend in low temperature extremes in the Arctic through the latter half of the twentieth century is weaker and less statistically robust than the observed trend. It is not projected to continue into the future. Ozone depletion in the Arctic is weaker in the CMAM than in observations, which may account for the weak past trend in low temperature extremes. In the future, radiative cooling in the Arctic winter due to climate change is more than compensated by an increase in dynamically driven downwelling over the pole.

Final Revised Paper (PDF, 2288 KB) Discussion Paper (ACPD)

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