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Polar mesospheric ozone loss initiates downward coupling of solar signal

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In recent years, increasing evidence has pointed that winter-time middle atmospheric ozone changes initiated by energetic particle precipitation (EPP) are linked to regional climate variability at ground-level. The mechanism for this link is, however, still unclear. Proposed explanations focusing on EPP-indirect effect does not explain the timing of the observed ground-level changes, which take place during winter, rather than in spring.

In this study we present results from Whole Atmosphere Community Climate Model (WACCM) simulations where polar winter upper mesospheric ozone is reduced to levels corresponding to observed in situ ozone changes driven by EPP. The results show a rapid coupling of atmospheric heating to dynamics, with signal propagating downwards resulting in poleward shift of the tropospheric jet. Large scale background atmospheric conditions determined by the Quasi Biennial Oscillation (QBO) influence the stratospheric response to EPP, but significant responses in the tropospheric eddy-driven jet take place broadly consistently for both QBO phases.

Based on our results, the signals from the initial EPP driven in situ ozone changes at high mesospheric altitudes propagate downwards in timescales that correspond to observed tropospheric level climatic changes linked to EPP.

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