Polar Ozone Response to Energetic Particle Precipitation Over Decadal Time Scales

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One of the key challenges in polar middle atmosphere research has been to quantify the impact by energetic particle precipitation (EPP) as part of total solar forcing on the atmosphere and assess the related response on atmospheric chemistry over solar cycle time scales. This is especially true for electrons having energies between about 30keV and 1 MeV, so-called medium-energy electrons (MEE), which directly impact the mesosphere increasing ionisation which impacts ion-chemistry, NO_x, HO_x and ozone. There has been a persistent lack of adequate description of MEE ionization in chemistry-climate simulations. Here we use the Whole Atmosphere Community Climate Model (CESM/WACCM) and include EPP forcing by solar proton events, auroral electron precipitation, and a recently developed model of MEE precipitation. We contrast our results from three ensemble simulations with those from the fifth phase of the *Coupled Model Intercomparison Project* (CMIP5) in order to investigate the importance of a more complete description of EPP to the middle atmospheric ozone, odd hydrogen, and odd nitrogen over decadal time scales. Our results indicate an average EPP-induced polar ozone variability of 12–24% in the mesosphere, and 5–7% in the middle and upper stratosphere (Andersson *et al.* 2018). This level of variability is in agreement with previously published observations and is likely to influence atmospheric radiative balance. Analysis of the simulation results indicate the importance of inclusion of MEE in the total EPP forcing: In addition to the major impact on the mesosphere, MEE enhances the stratospheric ozone response by a factor of 2.

Key words: ozone, electron precipitation, solar forcing, CMIP5, solar cycle

References

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