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Winds of winter: Assessing high latitudinal winter response to energetic electron precipitation

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There is increasing evidence that solar-related forcing mechanisms can influence middle atmospheric conditions, especially during winter. One element is energetic electron precipitation (EEP) from the near-Earth space into the polar atmosphere. These particles originate from the interaction between the solar wind and the magnetosphere, and peak typically a few years after sunspot maximum due to the increase of high speed solar wind streams from low latitudinal coronal holes in the Sun. EEP influences high latitudinal atmospheric chemistry by creating nitrogen (NO_x) and hydrogen oxides (HO_x) in the mesosphere and lower thermosphere. These chemicals are effective of destroying ozone in the catalytic cycles. As a consequence, ozone depletion is usually observed in the mesosphere with in a few days after elevated EEP events. In addition, NO_x has a prolonged lifetime during polar night, and can descend to lower altitudes with dominating large-scale circulation in the winter hemisphere. Ozone destruction in the high latitudes during winter can lead to thermal and dynamical alterations in the mesosphere and the stratosphere, which are manifested by westerly zonal winds in the mid-/high latitudes, i.e. the polar vortex. Further on, polar vortex dynamics influence the tropospheric circulation by altering the prevailing westerly winds in the polar front and the North Atlantic Oscillation (NAO), the leading circulation variability in the Northern Hemisphere. In this presentation, we assess the observational and chemistry-climate model results on this topic. We show that the EEP can have significant inter-annual influence for winter dynamics, from the middle atmosphere down to the surface.