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Three dimensional model simulations of the impact of solar particle precipitation on the upper polar atmosphere

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Solar eruptions and geomagnetic storms can produce fluxes of high-energy protons and electrons, so-called Solar Energetic Particle Events, which can enter the Earth's atmosphere especially in polar regions. These particle fluxes primarily cause ionisation and excitation in the upper atmosphere, and thereby the production of HO_x and NO_x compounds, which are catalysts for the reduction of ozone.

Besides the formation of HO_x and NO_x, and the resultant decrease of ozone, the abundance of other species like HCl, $ClONO_2$, and NO_y is affected by solar particle induced ion-chemistry, as observations indicate.

To simulate the impact of such particle events on the middle and upper atmosphere, ionisation rates calculated by the Atmospheric Ionization Module Osnabrück AIMOS (University of Osnabrück) have been implemented into the Bremen 3D Chemistry and Transport Model. The model is driven by meteorological data provided by the Leibniz-Institute Middle Atmosphere Model LIMA (IAP Kühlungsborn), to cover altitudes up to the mesopause. To include the ion-chemistry of ClO_y and NO_y in the neutral chemistry scheme of the Bremen 3D CTM, parameterised production rates calculated by the University of Bremen Ion-Chemistry model UBIC are implemented in the model.

Model calculations for different large solar proton events have been carried out and results will be presented and compared to measurements by the Michelson Interferometer for Passive Atmospheric Sounding MIPAS (ENVISAT) instrument.