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Model simulations of NOx-induced ozone loss processes in the upper and middle stratosphere caused by the solar proton events of October-November 2003

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During the enormous solar proton events (SPEs) in October-November 2003 a large amount of high energetic protons were emitted and reached the Earth's middle atmosphere in the polar cap areas. Observations by the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) on board the Environmental Satellite (ENVISAT) have shown that SPEs in Oct/Nov 2003 have significant effects on the composition of the stratosphere and mesosphere in the polar regions. After the Oct/Nov 2003 SPEs, MIPAS observed ozone depletion signatures associated with significant enhancements of NO_x (= NO + NO_2) in the upper stratosphere and lower mesosphere. Also, the NO_y components HNO_3, N_2O_5, and $ClONO_2$ were observed to be strongly enhanced after the Oct/Nov 2003 SPEs. Global full chemistry calculations performed with the 3D version of the Chemical Lagrangian Model of the Stratosphere (CLaMS) will be presented. The impact of the SPEs in Oct/Nov 2003 on polar ozone loss processes in the upper and middle stratosphere was studied. Before the first SPE had occurred, the model was initialized on beginning of October 2003 with IMK-IAA-MIPAS observations. The upper boundary conditions at 1 hPa are updated every 24 hours by using the results of a simulation performed with the Karlsruhe Simulation Model of the Middle Atmosphere (KASIMA) where enhanced NO_x concentration in the mesosphere during disturbed periods have been derived from MIPAS observations. Our findings show that intrusion of mesospheric air into the stratosphere, transporting high burdens of NO_x, affects the composition of the polar vortex down to about 700 K. We quantify the NO_x-induced ozone loss, in particular that caused by the mesospheric

NO_x intrusions.