Effects of January 2005 SPEs on the chemistry of the polar atmosphere
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Alessandro Damiani1,∗, Bernd Funke2, Dan Marsh3, Manuel Lopez-Puertas2, Michelle L. Santee4, Lucien Froidevaux4, Shuhui Wang4, Charles H. Jackman5, Thomas von Clarmann6, Angela Gardini2, Raul R. Cordero1, Marisa Storini7

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1 Physics Department, University of Santiago de Chile, Santiago, Chile, 2 Instituto de Astrofisica de Andalucia, CSIC, Granada, Spain, 3 National Center for Atmospheric Research, Boulder, Colorado, USA, 4 Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, USA, 5 NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA, 6 Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research, Karlsruhe, Germany, 7 Institute of Interplanetary Space Physics, INAF, Rome, Italy

Intense ionization in the upper stratosphere/mesosphere of the polar regions, caused by two intense Solar Proton Events (SPEs) that occurred in January 2005, led to important changes in the atmospheric chemistry. Aura Microwave Limb Sounder (MLS) and ENVISAT Michelson Interferometer for Passive Atmospheric Sounder (MIPAS) recorded these variations mainly in the northern polar regions. SPE-induced HOx (OH, HO2) production led to mesospheric ozone depletion and changes in chlorine species (e.g., HCl, HOCl, ClO). Furthermore, evidence of SPE-induced ClONO2 changes demonstrates that a significant interplay between NOx and ClOx is present also under SPE conditions.

MLS and MIPAS data are compared with the National Center for Atmospheric Research Whole Atmosphere Community Climate Model (WACCM4) results. WACCM4 generally reproduces the SPE-induced variability in the examined species, nevertheless some small discrepancies between observed data and model predictions (e.g., for stratospheric HCl) still remain.

Finally, comparing SPE-induced changes and year-to-year variability for upper stratospheric chlorine species, we show that chlorine variations attributed to intense SPEs are comparable in magnitude to the chlorine variability that is observed after sudden stratospheric warmings.

Keywords: Solar Proton Events (SPEs), atmospheric chemistry, polar regions, middle atmosphere

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