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Atmospheric composition changes caused by particle precipitations during the 2002-2004 polar winters as observed by MIPAS/Envisat

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We show in this paper the atmospheric composition changes in the polar stratosphere and mesosphere by the solar storm of October-November 2003 measured by MIPAS. It includes changes in NOx, O3, HNO3, N2O5, ClONO2 and HOCl in the North and South polar regions. This simultaneous measurements of such a large number of atmospheric species, with global coverage, obtained by MIPAS constitute an unprecedented dataset to study the atmospheric effects caused by large solar storms. Model studies were carried out with 1 D / 2 D models to investigate processes directly during the events. Model results for NOx increase and ozone loss reproduce the measurements fairly well, while HNO3, N2O5 and ClONO2 are not reproduced well at all. We conclude that while the formation of NOx and HOx due to ionisation is fairly well understood, processes leading directly to NOy formation are not yet well understood. In addition, we also show the abundances of NOy species in the upper stratosphere and lower mesosphere in the Arctic and Antarctic winters from Sep 2002 through March 2004. These data shows an enormous varibility with unusual high values in some winters. An analysis is presented on the origin of those variations and extreme values on the basis of the changing atmospheric dynamics (using the CH4 and CO tracers) as well as on the solar varibility, including the mid-term effects of the extraordinary solar storms of Oct-Nov 2003.