# Supplementary Materials

## Vogel et al. ‘Model simulations of stratospheric ozone loss caused by enhanced mesospheric NOx during Arctic Winter 2003/2004’

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## Additional scatter plots

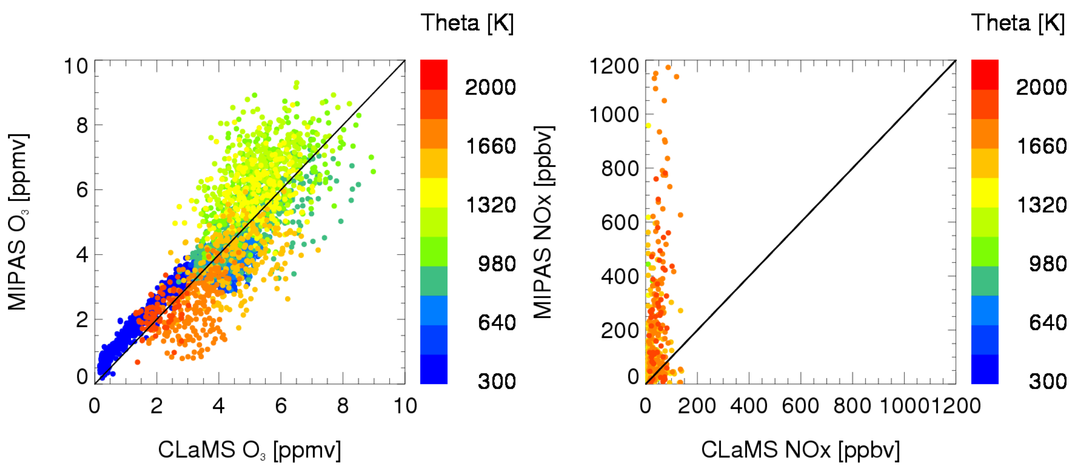


Figure 1: CLaMS reference run vs MIPAS measurements for ozone (left) and $NO_x$ (right) on March 18th, 2004. In addition to Fig 5 [Vogel et al., 2008], it is shown here that some $NO_x$ mixing ratios measured by IMK/IAA-MIPAS are much higher than simulated $NO_x$ for the reference model run. For ozone the CLaMS results are in good overall agreement with the measurements by IMK/IAA-MIPAS.

## Discrepancies between MIPAS and simulated $NO_x$ below 750 K

Discrepancies between MIPAS measurements and simulated $NO_x$ mixing ratios below 750 K in November and December 2003 were found as shown in Figure 5 [Vogel et al., 2008]. The question is whether these discrepancies are consistent in time and altitude with satellite observations of the $NO_x$ enhancements following the SPEs of late October 2003. The $NO_x$ enhancements following the SPEs of October and November 2003 caused by in situ stratospheric $NO_x$ production were found mainly at altitudes between 35 km and 60 km at the end of October and in November 2003 [e. g. Lopéz-Puertas et al, 2005a, Seppälä et al., 2004]. Significant ion pair production rates caused by SPEs in October and November 2003 were found down to approximately 25 km altitude ($\approx$ 650 K potential temperature) (Jackman et al., 2005b). Significant enhancements of $HNO_3$ cause by $NO_x$ chemistry were found around 25 km (between approximately 20 km and 30 km) at the end of October and in November 2004 [e. g. Lopéz-Puertas et al., 2005b]. Caused by the low statistics of simultaneous measurements of NO and $NO_2$ for altitudes between 400 K and 800 K and equivalent latitudes greater than 70$^\circ$ N is it difficult to answer this question. Nevertheless, for this region $NO_x$ measurements exist for November 1st, 11th, and 21th and December 24th. An intercomparison between MIPAS measurement and CLaMS shows that the regions with the largest difference between measurements and CLaMS are mainly located in the vortex region (see Fig. 2 in supplement), where due to the local production of $NO_x$ caused by SPEs an enhancement of $NO_x$ would be expected. Further, observations on November 1st and 11th show that the regions with the largest difference between measurements and CLaMS results are located in the same longitude and latitude range where enhanced $HNO_3$ was found in MIPAS measurements at 650 K potential temperature (see Lopéz-Puertas et al., 2005b, Fig. 3). This is an indication that differences below 800 K potential temperature in November and December may be caused by the fact that in CLaMS the local production of $NO_x$ by ion chemistry is not considered. However, definite conclusions are difficult because of low statistics.

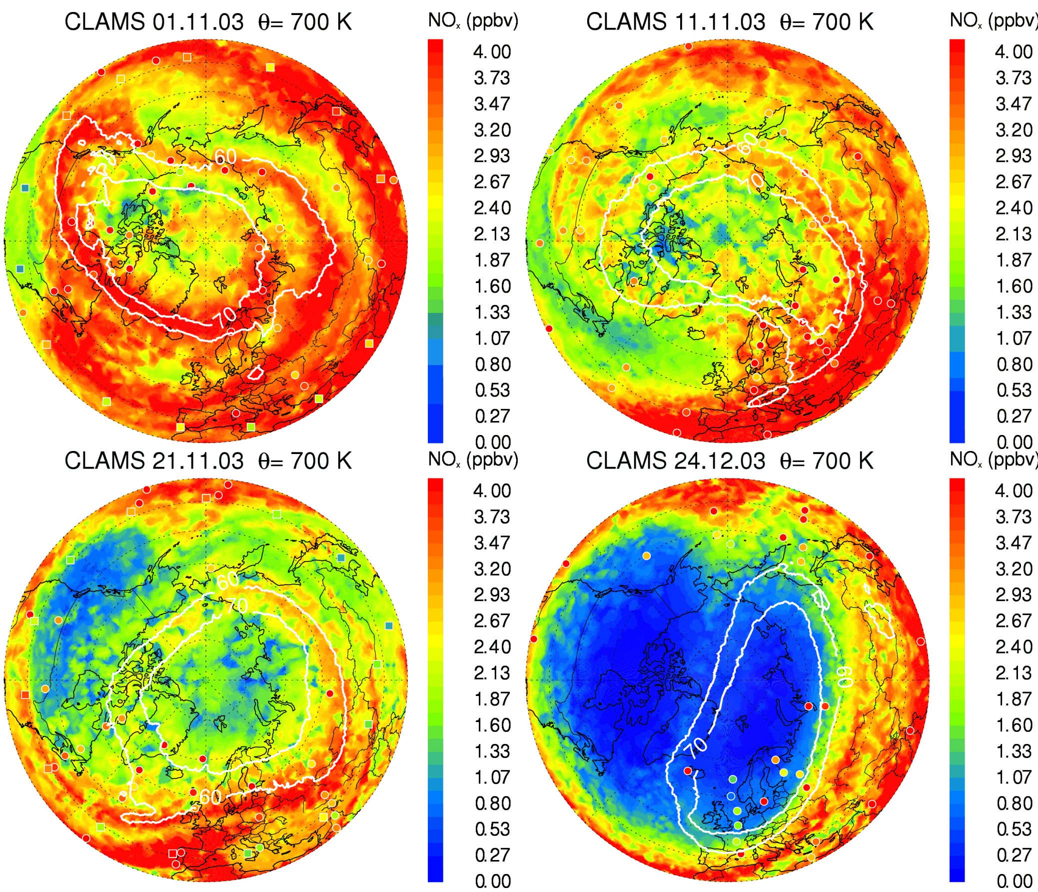


Figure 2: Horizontal view of $NO_x$ at 700 K potential temperature for the reference model run. The isolines for the equivalent latitude at 60° N and 70° N are marked by white lines. The model results and satellite observations (IMK/IAA-MIPAS: circles and HALOE: squares) are shown for noon time.