Arctic Winter 2009/2010 and 2010/2011 in Comparison : Denitrification and Polar Stratospheric Cloud Formation

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1. INTRODUCTION:

Polar stratospheric clouds (PSCs) play a key role in stratospheric ozone depletion. They form in the polar winter stratosphere at temperatures below T < 195 K. The sedimentation of large nitric acid (HNO_3) containing particles leads to an irreversible removal of HNO_3 and thus limits the deactivation process in springtime allowing the ozone-destroying catalytic cycle to last longer.

2. OBSERVATIONS:

The polar stratosphere was extremely cold during the Arctic winter 2009/2010 between mid-December 2009 until the end of January 2010. The Arctic winter 2010/2011 was one of coldest winter on record with four months of PSC occurrence.

Odin/SMR Observation of Denitrification:

Strong denitrification was observed in the Arctic in mid of January 2010 by the Odin Sub Millimetre Radiometer (Odin/SMR) that up to then had been the strongest denitrification that had been observed n in the entire Odin/SMR measuring period (2001-2010). However, the 2009/2010 winter was excelled by the 2010/2011 winter with denitrification nearly as severe as in the Antarctic.

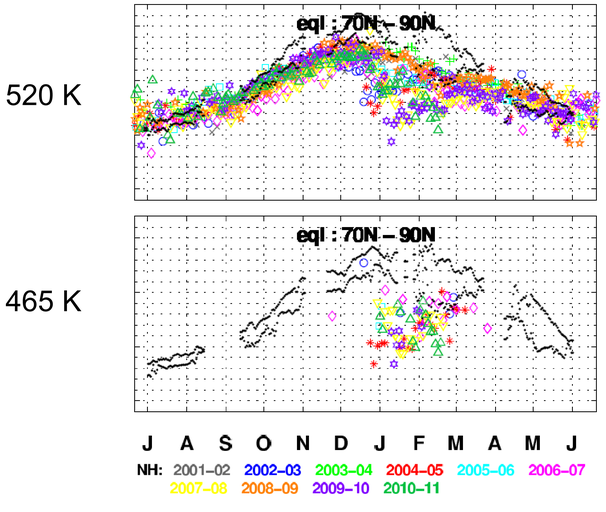

Figure 1: *Annual HNO_3 variability derived from Odin/SMR observations at equivalent latitudes between 70° and 90° N for the Arctic winter 2001/2002 to 2010/2011 (color) and the climatological mean derived from UARS/MLS (1991-1998) observations (black) at 465 and 520 K.*

3. ARCTIC WINTER 2009/2010 AND 2010/2011 IN COMPARISON:

2009/2010

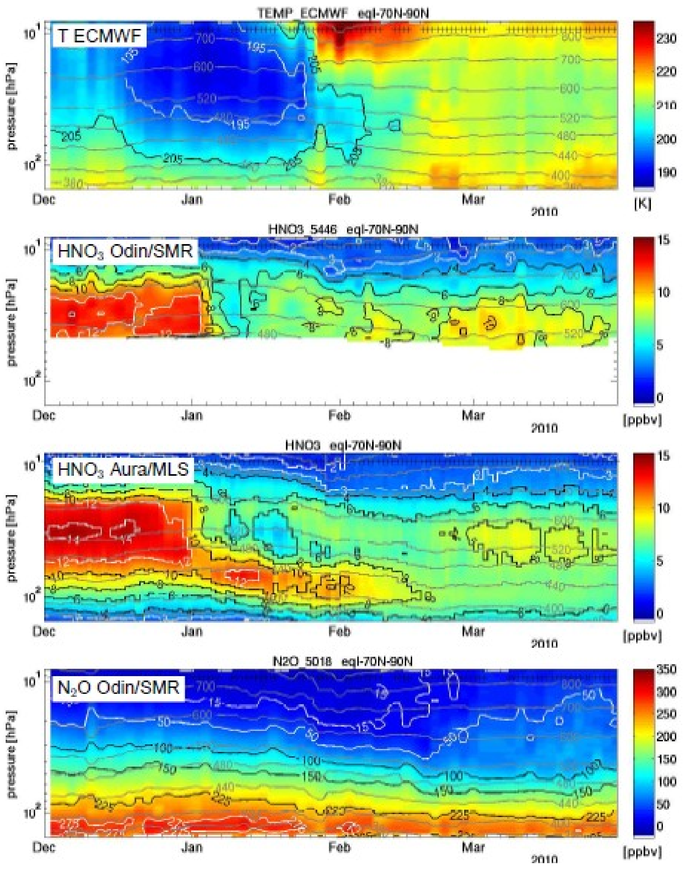

Figure 2: *Temporal evolution of temperature, HNO_3 and N_2O at 70° to 90° N for the Arctic winter* ***2009/2010****.*

2010/2011

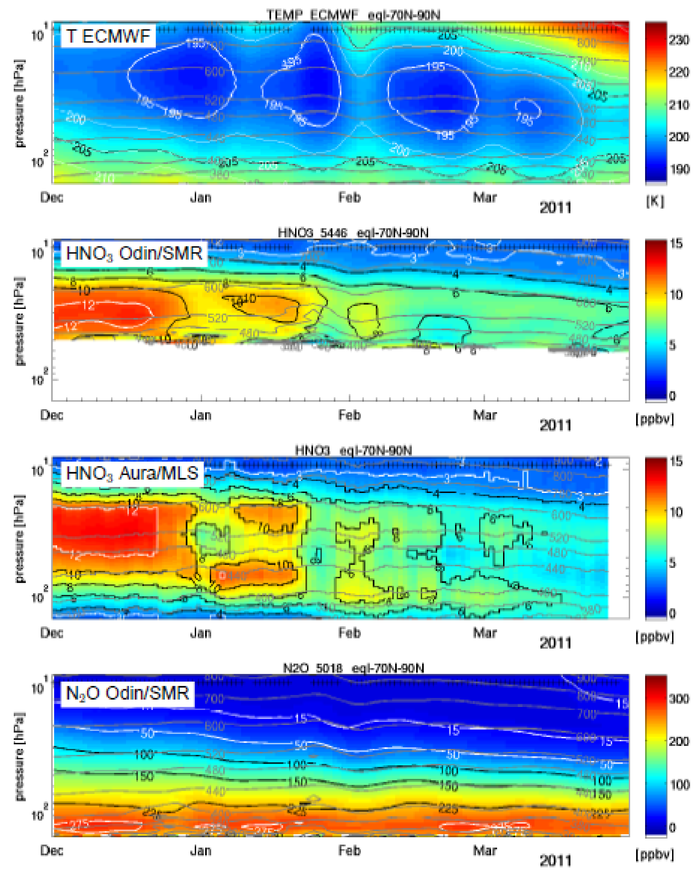

Figure 3: *Temporal evolution of temperature, HNO_3 and N_2O at 70° to 90° N for the Arctic winter* ***2010/2011****.*

2009/2010: A cold phase with temperatures below 195 K occurred between 480 and 700 K from mid December to end of January allowing formation of PSCs. Denitrification is seen by distinct minima (and maxima below indication re-distribution of HNO_3) in beginning of January, mid of January and end of January.

2010/2011: Cold temperatures were prevailing from December to April with four phases of temperatures below the PSC formation threshold temperatures. Denitrification occurred during the second and third cold phase (begin to mid of January and February).

4. CONCLUSIONS:

- PSC occurrence over four months in 2010/2011, but PSCS were not as persistent as the ones that formed during the one month cold period in 2009/2010.
- Strong denitrification observed by Odin/SMR and Aura/MLS in 2009/2010 and 2010/2011. In 2010/2011 the strongest denitrification in the entire Odin/SMR and Aura/MLS measurement period was observed.

References: *Khosrawi et al. (2011), ACP (results on the 2009/2010 winter).*