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[Volumes and Issues](#) [Contents of Issue 18](#)

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Nitric acid in the stratosphere based on Odin observations from 2001 to 2009 – Part 1: A global climatology

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Abstract. The Sub-Millimetre Radiometer (SMR) on board the Odin satellite, launched in February 2001, observes thermal emissions of stratospheric nitric acid (HNO₃) originating from the Earth limb in a band centred at 544.6 GHz. Height-resolved measurements of the global distribution of nitric acid in the stratosphere were performed approximately on two observation days per week. An HNO₃ climatology based on more than 7 years of observations from August 2001 to April 2009 covering the vertical range between typically ~19 and 45 km (~1.5–60 hPa or ~500–1800 K in terms of potential temperature) was created. The study highlights the spatial and seasonal variation of nitric acid in the stratosphere, characterised by a pronounced seasonal cycle at middle and high latitudes with maxima during late fall and minima during spring, strong denitrification in the lower stratosphere of the Antarctic polar vortex during winter (the irreversible removal of NO_y by the sedimentation of cloud particles containing HNO₃), as well as large quantities of HNO₃ formed every winter at high-latitudes in the middle and upper stratosphere. A strong inter-annual variability is observed in particular at high latitudes. A comparison with a stratospheric HNO₃ climatology, based on over 7 years of UARS/MLS (Upper Atmosphere Research Satellite/Microwave Limb Sounder) measurements from the 1990s, shows good consistency and agreement of the main morphological features in the potential temperature range ~465 to ~960 K, if the different characteristics of the data sets such as the better altitude resolution of Odin/SMR as well as the slightly different altitude ranges are considered. Odin/SMR reaches higher up and UARS/MLS lower down in the stratosphere. An overview from 1991 to 2009 of stratospheric nitric acid is provided (with a short gap between 1998 and 2001), if the global measurements of both experiments are taken together.

[Final Revised Paper](#) (PDF, 6014 KB) [Discussion Paper](#) (ACPD)

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