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- Special Issues
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- Title and Author Search

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Evolution of stratospheric ozone during winter 2002/2003 as observed by a ground-based millimetre wave radiometer at Kiruna, Sweden

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Abstract. We present ozone measurements from the millimetre wave radiometer installed at the Swedish Institute of Space Physics (Institutet för rymdfysik, IRF) in Kiruna (67.8° N, 20.4° E, 420 m asl). Nearly continuous operation in the winter of 2002/2003 allows us to give an overview of ozone evolution in the stratosphere between 15 and 55 km. In this study we present a detailed analysis of the Arctic winter 2002/2003. By means of a methodology using equivalent latitudes we investigate the meteorological processes in the stratosphere during the entire winter/spring period. During the course of the winter strong mixing into the vortex took place in the middle and upper stratosphere as a result of three minor and one major warming event, but no evidence was found for significant mixing in the lower stratosphere.

Ozone depletion in the lower stratosphere during this winter was estimated by measurements on those days when Kiruna was well inside the Arctic polar vortex. The days were carefully chosen using a definition of the vortex edge based on equivalent latitudes. At the 475 K isentropic level a cumulative ozone loss of about 0.5 ppmv was found starting in January and lasting until mid-March. The early ozone loss is probably a result of the very cold temperatures in the lower stratosphere in December and the geographical extension of the vortex to lower latitudes where solar irradiation started photochemical ozone loss in the pre-processed air.

In order to correct for dynamic effects of the ozone variation due to diabatic subsidence of air masses inside the vortex, we used N₂O measurements from the Odin satellite for the same time period. The derived ozone loss in the lower stratosphere between mid-December and mid-March varies between 1.1±0.1 ppmv on the 150 ppbv N₂O isopleth and 1.7±0.1 ppmv on the 50 ppbv N₂O isopleth.

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