Effect of the October 2003 solar proton event on stratospheric NO$_2$ over Europe derived from results of NO$_2$ ground-based measurements

V. Aheyeva, A. Gruzdev, and A. Elokhov
A.M. Obukhov Institute of Atmospheric Physics, Moscow, Russia (ageyevav@tut.by)

We analyze data of ground-based spectrometric measurements of the stratospheric column NO$_2$ contents (SC NO$_2$) at mid-latitude stations of Zvenigorod (55.7°N, 36.7°E) and Harestua (60.2°N, 10.8°E), and high-latitude stations of Sodankyla (67.4°N, 26.6°E) and Kiruna (67.8°N, 20.4°E). The stations are the part of the Network for the Detection of Atmospheric Composition Change (NDACC), and the data of the measurements are publicly available at the NDACC web site (http://ndacc.org). Episodes of a significant increase in the SC NO$_2$ in late October-early November 2003 were detected over the four stations. The observed NO$_2$ increase was associated with the transport of stratospheric air from the polar stratosphere region where a significant increase in the NO$_x$ concentration had occurred in the end of October due to the strong solar proton event. The amplitude of the observed SC NO$_2$ increase at the high-latitude stations was about 80 percent relative to the mean SC NO$_2$ contents peculiar to the end of October and diminished with decreasing latitude to about 40 percent. The method of NO$_2$ observations at the Zvenigorod station make it possible retrieving NO$_2$ vertical profiles. Analysis of the NO$_2$ vertical profiles corresponding to the day of the largest increase in the column NO$_2$ content over Zvenigorod station and to days before and after it showed the growth of NO$_2$ concentration above 30 km related to the air transport from the polar stratosphere. The NO$_2$ concentration in the upper stratosphere over Zvenigorod in the end of October increased by about 50 percent, and one third of this increase may be related to the effect of the October proton event.