Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10446, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10446
EGU General Assembly 2008

Impact of climate variability on tropospheric NO2 retrieved from GOME and SCIAMACHY measurements

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In the last decade the Global Ozone Monitoring Experiment (GOME) onboard ESA's 2nd European Remote Sensing Satellite (ERS-2) has been providing global measurements of atmospheric species from space. Measurements from the GOME instrument have been used to retrieve the amounts and distributions of tropospheric trace constituents from space, such as NO2, SO2, and H2O. Since the beginning of August 2002 the SCanning Imaging Absorption spectroMeter for Atmospheric CartograpHY (SCIAMACHY), launched on board of ENVISAT, is making global observations. SCIAMACHY is an extended version of GOME, providing better spatial resolution, a wavelength range that extends into the NIR and most importantly the ability to measure alternating vertical profiles in the stratosphere and nadir columns. Tropospheric NO2 columns derived at the Institute of Environmental Physics of the University of Bremen were used in this research.

Here we present a study of both monthly and seasonal tropospheric composition variability over Europe, using the nitrogen dioxide (NO2) retrieved from the GOME and SCIAMACHY instruments, within the 1995-2006 period. Prior to any analysis some work has been performed in order to compare simultaneous data from both instruments. Data from SCIAMACHY was resampled in order to obtain an extended dataset for NO2 tropospheric composition. Afterwards, monthly and seasonal cycles were

quantified and compared and the year-to-year variability of atmospheric composition has been analyzed. Seasonal cycles were removed from the time series in order to identify specific events as well as trends. Data for selected European areas have also been analyzed and trends in these areas were quantified. Finally, we investigated how climate variability is related to low atmospheric composition and eventual atmospheric composition change, using North Atlantic Oscillation (NAO) index.

Our results show how maximum concentrations of NO2 vary during the year, with a maximum of NO2 during winter in the European region. Although the maximum concentrations of NO2 are found over the United Kingdom, Germany and Northern Italy, there are negative anomalies over these areas for the last years of the considered decade in contrast to positive anomalies occurring in Southern Europe.

Individual trends were analyzed, for both winter and summer seasons, on three selected regions (Northern Italy, Northern Europe and North-western Iberian Peninsula). Northern Europe and Northern Italy regions present a significant decreasing trend in winter season, while the Iberian Peninsula shows an increasing trend in summer which could be explained by summer wildfires. In summer, the Northern Europe region also presents a significant decreasing trend.

To conclude, the impact of the winter (JFM) NAO index has been assessed on the three different defined regions. The Northern Europe and Northern Italy regions present strong negative correlation values for both seasons, with relative maximum values for NO2 anomalies over Northern Europe. These negative correlations seem to indicate that warmer and cloudier winters (positive NAO) are related to the reduction of NO2 over Europe.

This research is conducted in the framework of ACCENT (Atmospheric Composition Change - The European Network of Excellence) AT2 Task.