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One year of 3-D MAX-DOAS tropospheric NO_2 measurements over Brussels

Ermioni Dimitropoulou, Michel Van Roozendael, Francois Hendrick, Alexis Merlaud, Frederik Tack, Caroline Fayt, Christian Hermans, and Gaia Pinardi

Belgian Institute for Space Aeronomy, UV VIS DOAS Group, Belgium (ermioni.dimitropoulou@aeronomie.be)

The Multi-AXis Differential Optical Absorption Spectroscopy (MAX-DOAS) technique has been widely used over the last decades in order to extract simultaneous measurements of atmospheric trace gases and their vertical distribution in the troposphere. Using this technique, many species can be measured and one among them is the nitrogen dioxide (NO_2). Tropospheric NO_2 is an important anthropogenic pollutant which plays an important role in atmospheric chemistry. Its main emission sources are associated to combustion processes (traffic, industrial activity and domestic heating). Furthermore, NO_2 is generally seen as a proxy of air pollution, as it is a significant precursor of photochemical ozone production (O_3) and nitric acid (HNO_3).
For the present work, the BIRA-IASB MAX-DOAS instrument operated in Uccle (Brussels, Belgium) is used to measure nitrogen dioxide (NO_2) and subsequently to develop new approaches concerning the investigation of the vertical and horizontal spatial distribution of this trace gas under moderate to high pollution conditions, such as those observed in Brussels and its suburban area. The BIRA-IASB MAX-DOAS was set to perform two different modes: (1) a vertical scan composed by 10 elevation angles in a fixed viewing (azimuth) direction pointing to the center of Brussels and (2) an azimuth scan at a constant low elevation angle. This measurement strategy permits the retrieval of 3-D NO_2 distributions around the measurement site.
A new parameterization method has been applied in two different wavelengths in order to describe the spatial and temporal vertical column densities (VCD) and the near-surface concentration gradients of NO_2 but also the most important source areas in and around Brussels. Ancillary in-situ observations from the regional air-quality telemetric network, meteorological data and car-DOAS measurements, covering one year, has been jointly exploited in order to study the seasonal cycle of NO_2 in Brussels as well as its diurnal variation. Finally, the present 3-D distribution measurements contribute to the TROPOMI tropospheric NO_2 validation.