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Spatio-temporal variability of the urban NO_2 distribution in Bucharest during AROMAT-2

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Nitrogen oxides, NO_x (NO_x = NO + NO_2) play a key role in tropospheric chemistry. In addition to their directly harmful effects on the respiratory system of living organisms, they influence the levels of tropospheric ozone and contribute to acid rain and eutrophication of ecosystems. As they are produced in combustion processes, they can serve as an indicator for anthropogenic air pollution. Characteristic absorption features of NO_2 in the UV-Visible spectral range enable the application of the Differential Optical Absorption Spectroscopy (DOAS) method, to derive its abundance by remote sensing.

AirMAP, an airborne imaging DOAS instrument developed at the IUP Bremen, is capable of retrieving gapless trace gas maps of NO_2 (and SO_2) column densities at a spatial resolution better than 100 m.

AirMAP participated in the ESA funded AROMAT-2 campaign that was held in 2015 in Romania. Within this context, four research flights were carried out above the city of Bucharest to create maps of the urban NO_2 distribution. The flights aimed at capturing the temporal variability of NO_2 in the central part of the city on different time scales. For that purpose, two flights per day were performed on Sunday and Monday each, in the morning and afternoon, respectively. During the flights, the city center was overpassed 11 times in total. During each of the flights, the same area was covered up to three times with constant temporal offsets of about 40 min to enable a systematic investigation of the NO_2 field in the common area of the overpasses, having an extent of about 7 x 24 km^2.

In addition to large spatial gradients, also temporal variability is observed on short time scales.

The upcoming geostationary Sentinel-4 satellite (S-4) will have an hourly sampling at a spatial resolution of 8 x 8 km^2. As the spatio-temporal scales of the investigated dataset are comparable to S-4, this study may provide a first assessment on the magnitude of variability to be observed by this future Copernicus mission.