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Strong spatial variability of NO_2 over polluted areas and within emission plumes observed by aircraft imaging DOAS

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In the troposphere, nitrogen dioxide, NO_2, is mainly produced from nitric oxide, NO, emitted by combustion processes. Enhanced NO_2 amounts are an indicator of air pollution and may lead to boundary layer ozone production as well as acidification and eutrophication of ecosystems.
The IUP Bremen AirMAP (Airborne imaging DOAS instrument for Measurements of Atmospheric Pollution) has been used for NO_2 observations over point sources and polluted areas during aircraft campaigns in 2011 and 2013. The instrument yields NO_2 column densities at fine horizontal resolution, down to 30m ground pixel side length, and at good spatial coverage. Areas of several km^2 are covered with NO_2 measurements within a few minutes.
Aircraft observations of spatial NO_2 distributions are presented for different locations in Europe and different source regions, such as power plants, cities and motorways. The obtained NO_2 maps reveal large spatial variability. For example, large gradients in the transition between rural and urban areas, spatial variability over cities and extended areas and, in particular, remarkably strong non-uniform distributions within individual emission plumes downwind of point sources are observed. The observations have implications for experimental emission estimates, the deduced relevance of emission sources and downwind chemistry, as well as the interpretation of satellite- and ground-based remote sensing measurements. The focus of this study is the analysis of the amounts and detailed spatial signatures in the NO_2 maps, which is made possible by the favourable AirMAP imaging capabilities.