



Vertical information content of nadir measurements of tropospheric NO₂ from satellite

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When applying satellite measurements in atmospheric pollution research, one commonly used species are tropospheric NO₂ columns. They can be useful for the identification and evaluation of natural and anthropogenic NO_x emissions and their changes over time as well as for process studies and for the investigation of atmospheric transport events.

However, the lack of vertical resolution is one major limitation of the commonly used DOAS retrievals of NO₂ columns from satellite observed radiances. Combined with the altitude-dependence of retrieval sensitivity, this entails the use of a priori information on the NO₂ vertical profile. This significantly contributes to the retrieval uncertainties, which could be reduced if information on the vertical location of the NO₂ could be retrieved from the measurements themselves.

In this study, we investigate the vertical information content of nadir NO₂ observations in the UV/visible wavelength range. For this purpose, we revisit the vertical sensitivity of DOAS retrievals of NO₂, which is encoded in the averaging kernels, and contrast these findings with the results from a formal solution to the inverse radiative transfer problem, using synthetic spectra representing measurements over polluted regions. As a result, we can show that in certain cases, it is indeed possible to derive information on the vertical distribution of NO₂ from the DOAS analysis alone, reducing the dependence of the retrievals on a priori information in these situations.