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Investigation of NO_2 vertical distribution from satellite data by using two NO_2 DOAS retrievals

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NO_2 is an important indicator for air pollution from anthropogenic as well as natural sources. NO_x emission sources and their horizontal distribution are well known from satellite measurements. In contrast, knowledge of the vertical NO_2 distribution is only limited. To address this issue we developed a new NO_2 differential optical absorption spectroscopy (DOAS) retrieval in the UV spectral range for satellite observations from the GOME-2 instrument on board EUMETSAT's MetOp-A satellite. This new UV NO_2 retrieval is compared to a common NO_2 retrieval in the visible spectral range.

Here we show that by using retrievals in the UV and visible, sensitivity to the vertical distribution of NO_2 can be achieved in satellite measurements. Box air mass factor calculations show that sensitivity below 9km is clearly higher in the visible spectral range whereas above 9km, the sensitivity is somewhat higher in the UV range. Due to the higher sensitivity of the visible spectral range closer to the ground, the NO_2 slant columns derived from the visible spectral range are mostly higher than in the UV spectral range. Nevertheless, our new NO_2 retrieval and the common NO_2 retrieval from the visible spectral range show a similar horizontal distribution. In both spectral ranges, well known NO_2 signals over highly polluted areas, e.g., China or biomass burning areas like Africa south of the equator can be observed. However in some areas, NO_2 signals clearly visible in the visible spectral range cannot be detected in the UV spectral range, such as in Africa north of the equator over the biomass burning regions. From the differences in NO_2 slant columns, we can gain insight into the vertical distribution of NO_2.

By using air mass factors, slant columns can be converted into vertical columns. For air mass factor calculations, an a priori NO_2 profile is needed from model simulations, here the MACC2 interim reanalysis fields. If the model simulates the NO_2 profile with correct height dependency, there should be no differences in NO_2 vertical columns for the two wavelength ranges. Therefore, we can gain additional information about the NO_2 height dependency from a comparison of vertical columns. In some regions the vertical columns agree well. However, there are also regions with large differences in NO_2 vertical columns, especially in winter season.