On the improvement of satellite retrievals of NO2 using aerosol measurements

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The background...

The several instruments flying on satellite (e.g., GOME, GOME-2, SCIAMACHY and OMI) allow for the observation of atmospheric pollution from space. Concentrations of trace gases (such as ozone (O3), nitrogen dioxide (NO2), sulphur dioxide (SO2)) can be inferred from the measured backscattered solar radiation.

The retrieval of tropospheric columns of NO2 from satellite measurements is based on several a priori assumptions used in the computation of an airmass factor (AMF). The improvement of those is essential to obtain more accurate tropospheric NO2 values.

This sensitivity study was performed by changing the radiative transfer model (RTM) Scatran (Rozanov et al., 2005) the aerosol optical depth (AOD) and vertical distribution of aerosol layer, independently from the trace gas distribution. Like this we uncertainty key factors are identified and the current retrieval can be improved.

In this poster, we show the latest results obtained for the analysis performed

Why is this study important?

The aerosols present in the atmosphere will interfere with the satellite measurements of tropospheric NO2. The signal can be:

- enhanced because of multiple scattering in aerosol layer;
- or shielded by an aerosol layer standing for example above the trace gas.

The effect of aerosol scattering is quite complex and depends both on their profile (like vertical distribution and optical depth) as well as their optical properties (e.g., size distribution and refractive index).

Currently in IUP-Bremen, the NO2 retrieval method uses data taken from climatological assumptions (Richter et al., 2005). A synergistic approach is ideal to account with the full spatial and temporal variability of aerosols and its characteristics: using data of aerosol optical properties and vertical profiles measured either at ground (e.g. AERONET, EARLINET) or of space (e.g. MODIS, MERIS, CALIPSO).

The results

The settings for the sensitivity study

The AMF are dependent on many factors and the correct definition of both aerosol and trace gas (NO2 here) vertical profiles is important for the accuracy of the retrieved tropospheric columns.

Depending on the relative vertical distribution of NO2 and aerosol, sensitivity changes of up to +/- 50% can be obtained.

For more realistic urban profiles of both NO2 and aerosols, the effect of aerosol is much smaller.

Distinction between fine and coarse aerosol is significant to determine the magnitude of the aerosol influence. In addition, it is also recommended to consider the particles’ optical properties and the load of aerosol.

Acknowledgements

The CHIMERE data used to define the NO2 profiles was kindly provided by Matthias Beekmann and Qijie Zhang.

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Selected references

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What have we learned...

- The AMF are dependent on many factors and the correct definition of both aerosol and trace gas (NO2 here) vertical profiles is important for the accuracy of the retrieved tropospheric columns.
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