Evaluating the dependence of OMI NO\textsubscript{2} slant columns on retrieval settings

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Introduction
- NO\textsubscript{2} is one of the most important satellite data products
- OMI has been providing a high resolution NO\textsubscript{2} data set since fall 2004
- combining OMI data with other data sets (GOME, SCIAMACHY, GOME-2)
- requires excellent consistency of the retrievals
- here, the consistency of NO\textsubscript{2} slant columns from the University of Bremen (IUP-UB) retrieval is evaluated and compared to the NASA operational product as well as to GOME-2 data
- three different “heritage” fitting windows are evaluated on OMI data:
  - 425 - 450 nm (SCIAMACHY), 405 - 465 nm (OMI), and 425 - 497 nm (GOME-2)

Effect of different fitting windows
- comparison of the NO\textsubscript{2} slant columns retrieved in the three fitting windows shows excellent agreement
- correlation coefficients are all larger than 0.99
- slopes between retrievals including the NASA operational product are very close, correlation coefficients are all larger than 0.99
- excellent agreement
- there are small offsets between the IUP-UB retrievals but a systematic high offset to 1, the 425 - 450 nm window yielding slightly lower values (-1.5%)
- these values are usually removed by fitting quality criteria
- in the 425 - 497 nm fitting window there are spurious high values of 1.5 \times 10^18 \text{ molec cm}^{-2} in the NASA slant columns
- for a small number of fits at low latitudes (see lower left corner of figures) which are
  - not seen in the 425 - 497 nm window and in the NASA retrievals

Sensitivity to tropospheric NO\textsubscript{2}
- the sensitivity of nadir observations of tropospheric absorptions depends on wavelength
- in the absence of clouds, sensitivity increases systematically with longer wavelengths as result of reduced Rayleigh scattering
- wavelength dependence of surface reflectivity can enhance the effect
- the presence of aerosols can reduce the effect
- this needs to be taken into account in the atmospheric NO\textsubscript{2} distribution

Data and analysis settings
- University of Bremen (IUP-UB) data analysis:
  - NASA operational lv1 V3 data
  - 425 - 450 nm, 405 - 465 nm, 425 - 497 nm
  - in the absence of clouds, sensitivity increases
  - convolution of all cross-sections with parameterised OMI slit function
  - liquid water and sand signal included in 425 - 497 nm fit
  - averaged solar irradiance
  - destriping (if any) using same orbit data over equatorial region
  - two phase spike removal

NASA data:
- NASA operational lv2 V3
- 405 - 465 nm fitting window
- only NO\textsubscript{2} slant columns used
- original or de-striped data, see figure captions

Conclusions
- OMI NO\textsubscript{2} slant column retrievals using different fitting windows show a very high degree of correlation
- comparison of IUP-UB retrievals with the operational NASA data set reveals an offset, NASA data being higher
- comparison with IUP-UB GOME-2 data shows qualitatively the expected behaviour (photochemical model needed for quantitative analysis)
- there seems to be slightly less striping in the IUP-UB retrievals but all data are
  - good after de-striping
- there are some spurious high values in IUP-UB data at low latitudes for the
  - smaller fitting windows which are not present in the NASA data
- in cloud free situations, the larger NO\textsubscript{2} signal in the 425 - 497 nm window over polluted scenes is evident and can be used for improving NO\textsubscript{2} retrievals
- the sand signal reported for GOME-2 is also present in OMI data
- these tests are relevant for the decision on TROPOMI / Sentinel-5-PrecurSOR NO\textsubscript{2} retrieval settings

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Selected references