Abstract:

In preparation for the Sentinel-5 satellite mission, the operational (baseline) UVN ozone profile retrieval will be verified using our (IUP) retrieval algorithm. The vertical ozone distribution in the stratosphere and troposphere is determined from the backscatter spectrum in the ultraviolet spectral range (270 nm - 335nm). The IUP retrieval consists of a combination of optimal estimation and Tikhonov regularisation.

For a first application, our adapted ozone profile retrieval has been applied to synthetic data sets using 55 instrument characteristics (spectral resolution, instrument noise). The quality of the IUP algorithm has been tested (uncertainty budget, vertical resolution) and are compared with previously developed algorithms and the operational algorithm. The retrieval error in the stratosphere is about 2% and can increase up to 10% in the troposphere depending on the selected scenario. To validate the IUP algorithm for real data application, two selected orbits from OM (on AURA) were processed.

Result:

• Both ozone profile retrieval can well reproduce the ozone profiles in the test scenarios and improve the estimation in comparison to the a priori ozone profile.
• The estimated retrieval error is around 2 to 3% in the stratosphere and stays below 10% in the troposphere.
• For the evaluation of the quality of the retrieval also the vertical resolution should be considered. It is in the middle at 10 km (determined by the number of independent quantities). In some cases, however, the vertical resolution is much higher.

Method:

• Ozone profile retrieval with Optimal Estimation and Tikhonov regularisation (Rodgers, 2000)
• 2 different retrieval approaches:
  • IUP standard retrieval: 1 step retrieval (270 nm - 335nm)
  • IUP 2 step retrieval (separate Huggins and Hartley bands retrieval to improve tropospheric retrieval (similar to baseline algorithm, Miles (2015))
• create a synthetic dataset with 55 instrument characteristics for various viewing geometries, different RTM settings and 2 different albedos:
  • 5 Camelot profiles
  • RTM settings: no polarisation and no Ring effect, with polarisation but no Ring effect, with Ring effect but no polarisation
  • Viewing geometry: 5 solar zenith angles, 5 viewing angles, 2 azimuth angles
  • 2 albedos

Application for OMI data:

OMI orbit 04-10.2006 17:42 contains ozone hole conditions:
Across track mean of retrieved ozone profile. The retrieval algorithm (1-step) reaches convergence in about 75% of the pixels. The ozone hole can be reproduced by the ozone profile retrieval.

OMI orbit 21.10.2006 05:12 contains polluted tropospheric layer (China) and ozone hole. Across track mean of retrieved ozone profile. Here the retrieval algorithm reaches convergence in about 78% of the pixels. The pollution in the troposphere is not apparent in this figure. It may only be an effect from averaging, but this is still under investigation.

References: