Atmos. Meas. Tech. Discuss., 3, C556–C559, 2010
www.atmos-meas-tech-discuss.net/3/C556/2010/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Improved ozone profile retrieval from spaceborn UV backscatter spectrometers" *by* B. Mijling et al.

Anonymous Referee #2

Received and published: 28 May 2010

This discussion paper provides useful information on the performance of the OPERA, developed at KNMI, for retrieval of ozone profiles from GOME measurements. The study focuses on retrieval convergence and processing time as measures of the algorithm efficiency to identify conditions that pose difficulties. Areas and conditions with poor performance are identified, and algorithm and measurement modification are proposed and tested to improve the performance. The title is somewhat misleading as the GOME instrument's polarisation sensitivity, SAA sensitivity, Band 1a measurement noise, and large FOVs play important roles in producing many of the results. The results for algorithm performance for different ozone cross section data sets are timely and welcome.

I have tried, somewhat unsuccessfully, to keep the discussion in this review on what

was done in this study as opposed to what could be done in three or four other studies.

Given concerns about iteration, convergence, and processing time, it is not clear why the A Priori is used as the first guess. (The only benefits would be in the interpretation of the initial measurement residuals and a standardized set of starting points for convergence and counting the number of iterations. Since both of these change with the choice of a climatology, even that is lost.) One could use previously retrieved profile for adjacent FOVs to reduce the expected number of iterations and to improve convergence. It would also be interesting to see how the non-convergent cases for one climatology perform when given the retrieved profiles for a better performing climatology as their first guesses.

The convergence criteria on Page 1168 line 10 use the A Priori covariance as part of the measure. This means that the later tests with different covariance matrices will have different convergence criteria. Ann alternative is to use a measure of the size of the measurement residuals as the stopping criteria.

The calculated DFS for the retrievals are a useful measure, but as noted they are sensitive to the choices of the two covariance matrices. (If one somehow had an A Priori set that was close to the truth, then the measurements would not add much, but the results would be good. It is also not clear how one includes the information in a total ozone estimate as used with TOMS climatology in the DFS calculation and whether measurements are used twice; once in obtaining the total ozone estimate and again the profile retrieval.) The retrieved profiles should be examined to see how their covariance about the A Priori profiles compares to the assumed profile covariance, and the final measurement residuals should be examined to see how they compare to the assumed measurement error covariance. Biases in the initial and final residuals can provide indications of calibration or model biases. These should be examined for the cross-section studies. (It is not clear how possible measurement calibration biases are addressed in this study. More information on the process used to derive them would be useful, e.g., is it recalculated when the ozone cross sections are switched? The

determination of a radiometric offset could remove information. The results for these offsets should be communicated to the Level 1 processing team.) One could claim that the SAA difficulties were caused by an underestimation of the Band 1a measurement noise for that region. (The local wavelength to wavelength variability could provide one measure of the measurement noise.) The processing of the data to remove the outliers is a good idea and is shown to work well. The plot on the right side of Figure 3 shows some SAA effects producing large negative impacts on the radiances which are not filtered. Do the authors have any comments on the physical source of these or plans to improve the filters to identify them?

A good set of measurements combined with a good forward model should always have a reasonable retrieved profile. One can check non-convergence results to see how the measurement residuals are varying; Are the measurements internally inconsistent, that is, is there small scale structure in the residuals as functions of wavelength that is symptomatic of measurement errors? (Relaxation techniques can be used to obtain convergence for nonlinear problems. For ozone profile retrievals, one can have each iteration move a fraction of the full profile change given by the linearized step result to avoid cycling between results. The fractional value can be selected to insure that the maximum likelihood cost function is decreasing at each iterative step.) It would be good to provide convergence statistics for the algorithm applied to other instruments to determine which problems are caused by GOME measurement or calibration idiosyncrasies snf which are more general results.

The GOME measurements should be able to provide good cloud pressure, cloud fraction, and absorbing aerosol estimates by using rotational Raman scattering, discrete reflectivity channels, and aerosol index methods in the 340 to 380 nm wavelength interval. These should be more consistent with the quantities needed for the 265 to 330 nm range used in the algorithm than those from a much longer wavelength region. (See Sneep, et al. (2008), Three-way comparison between OMI and PARASOL cloud pressure products, JGR, 113, D15S23, doi:10.1029/2007JD008694 and Vasilkov et al.

(2008), “Evaluation of the OMI cloud pressures derived from rotational Raman scattering by comparisons with other satellite data and radiative transfer simulations,” JGR, VOL. 113, D15S19, doi:10.1029/2007JD008689 for more information.)

How much do the retrievals change for the different choices of climatologies and covariances, and are they well predicted by the Averaging kernels and the portion of the A Priori profile differences that lies outside of the retrieval null spaces? (See Rodgers, C. D. (1990), Characterization and Error Analysis of Profiles Retrieved From Remote Sounding Measurements, J. Geophys. Res., 95(D5), 5587–5595, doi:10.1029/JD095iD05p05587.)

There are additional considerations for choices of climatologies and A Priori information related to the expected use of the retrievals in operational versus climate applications.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 1163, 2010.