

This is the review of the paper by C. Scannell et al. titled "A review of the ozone hole from 2008 to 2010 as observed by IASI". The paper addresses relevant scientific questions about relevancy of the satellite ozone observations for the detection of ozone recovery. Authors compare the ability of measurements taken in the Infra-Red or UV-Vis part of the Solar spectrum to capture the spatial and seasonal development of the Polar ozone hole. The IR measurements have the advantage of taking observations during the Polar night conditions, which are unattainable for the UV-Vis instrumentation, and during both sunlight and night time during ozone hole development. While the sounding provides the most accurate and vertically resolved sensing of ozone vertical distribution, they are launched only once a week, while satellites take daily scans of the spatial and vertical ozone distributions. The agreement with the GOME and ozonesonds is found to be within 30 %. The Antarctic ozone is exhibiting signs of the recovery and it is of great importance to monitor these changes. The Antarctic ozone hole is meticulously observed by ground-based, the in-situ, and satellite remote sensing systems. All instruments are frequently compared to assure the long term changes are not affected by instrumental changes, calibration artifacts, and the differences are well understood. Therefore, this paper is very important as it described validation of IASI ozone column and profile data. It is aimed to answer the questions of the IASI ozone measurement limitations and retrieval uncertainties. This paper is recommended for publication after minor revisions.

#### General comments:

This paper presents the new FORLI-O3 retrieval, and discusses its accuracy relative to other correlative measurements. It would be good to know the range of the measurement and smoothing errors of the retrieval. These can be estimated using Rodgers (2000) equations (2.19 and 2.17 respectively). It would be also good to know the changes in the vertical resolution of the retrieved ozone profile (possibly looking for the shift in the maximum sensitivity of the retrieved layers) as function of surface brightness (Figure 4).

The fact that IASI could not capture the reduction of ozone over the land at the altitudes between ~20 and 25 km is clear from the AK plots shown in Figure 4 (b), where the AK plotted at 25 km does not exhibit sensitivity to ozone variability in that altitude range. And from the sounding flown at the South Pole (<http://www.esrl.noaa.gov/gmd/ozwv/ozsondes/spo.html>) it is clear that the main depletion occurs between 14 and 24 km altitude. Therefore, the IASI retrieval would rely on the a priori information to fill in the gaps... It would be useful to include the plot showing the AK over the snow, which is more appropriate for the discussion. It is also of interest to plot the contribution function  $D_y$  (Rodgers, 2000), which clarifies how the difference between measured radiance (brightness) and the calculated from the a priori ozone profile converts to the difference between measured and a priori ozone profile. Since the IASI total ozone column is compared to the GOME, it would be most useful to present the AK for the TO rather than ozone profile. It would clarify how vertical profile contributes to the total ozone column (plotting Jacobian for change in the total column due to change in layer ozone).

One concern is about the trend ability of the data set: would the change of the surface brightness (climate related changes in the snow coverage) create any artificial trend in the retrieved ozone column or profile record?

Here are detailed comments:

- 1) P.4721, line 18 – there seems to be missing part of the sentence: “pla x 2 pixels” probably means “platform that records the surface image as the set of 2x2 circular pixels”. I would change the “on board” to “onboard”. Also should mention that the nadir measurements are taken every 50 km (before the swath width information).
- 2) P. 4722, line19: could be changed to “in the 960–1075  $\text{cm}^{-1}$  spectral window”
- 3) P. 4722, line 20: replace to “between observed and fitted spectrum. The level of the IASI instrumental noise (dashed line) is also provided for comparisons”.
- 4) P, 4722, line28 “global, near real time”
- 5) P. 4723, line 1: “per day, which are”
- 6) P. 4723, line1 : please provide a reference for the Eumetcast antenna system.
- 7) P. 4723, line 5, replace “below” to “less than” – otherwise it is confusing, and “was” to “were”.
- 8) P. 4723, line 7. “~~This~~ While IASI was providing a good global overview of the ozone distributions and concentrations of ~~ozone~~, the above discussed issues made it difficult “
- 9) P.4723, line 9 . Make a break in the long sentence. “as the Antarctica. This is the area where as not only there are ~~were there~~ large gaps ... , but there are also data gaps...”
- 10) P.4723m line 21, “ where the left panel shows results retrieved from the NN scheme and the right panel show data derived by the FORLI-O3 scheme.”
- 11) P. 4723, line 23-26. “The FORLI scheme, unlike the initially developed NN scheme, has no limit on scan angle width, ~~and~~ can adjust the surface temperature, and thus processes all the data resulting in a much greater spatial coverage”
- 12) P.4724, line 7: “depending on the which version of FORLI ~~which~~ is used (Wan, 2008).
- 13) P. 4724. Line 11: “~~for~~ based on a given a-measurement  $y_i$  (the IASI radiance spectra), which accuracy is defined by with an error covariance matrix”
- 14) P. 4724, line 15, change “which” to “that”
- 15) P. 4724, line 16 – use comma after “Therefore”
- 16) P. 4724, line 17 “results with some a priori information, by choosing the ...”
- 17) P.4724, line 27 “infra-red. Here-In the FORLI-O3 retrieval”
- 18) P. 4725, line 25-26 “ Over the ocean the retrieved spectrum shows significant strength in the ozone absorption band in of the thermal infrared spectrum with significant strength. However, ~~on the contrary~~ , although over the ice caps even the ozone band is still observed in the spectrum taken over the ice caps, ...” absorption and emission by ozone? Not clear.
- 19) P. 4725, line 25 “Because of the ~~weaker~~ weakening of the ozone spectral signal over the ice, part of the vertical information is lost.
- 20) P. 4726, line 20, “appeared to level ~~out-off~~, but have also slowed down the ozone loss rates”

- 21) P.4726, line 22 – what does the “typical ozone maps” mean in the context. Are these retrieved using FORLI-O3 retrieval? According to Figure 5 caption it should be, but what version (several versions are available, but not indicated in the plot).
- 22) P. 4726, line 27 change “of” to “or”.
- 23) P. 4727, line 2, Figure 6 indicates periods of different versions of FORLI-O3 used for IASI retrieval. How do these versions compare? Is there a period of time in IASI measurement when several versions are compared?
- 24) P. 4727, lines 7-16, provide references to the historic publications and the latest WMO Ozone Assessment report.
- 25) P. 4727, lines 18-19 – provide reference to other papers that discussed 2009 ozone hole shape.
- 26) P. 4730, line 2 “7 – 8 %”?
- 27) P.4730, line 4 instead of “such a bias” use “similar bias”
- 28) P.4730, line 5, “and (space) maybe”
- 29) P. 4730, line 8 Overestimated by how much?
- 30) P. 4730, line 29 “Though, as already discussed above, there is ...”
- 31) P. 4731, line 6-7 The statement needs to be changed to clarify that IASI has limited sensitivity to ozone profile variability in the upper troposphere and lower stratosphere over the land, and particularly over the snow, and thus relies on the a priori climatology.
- 32) P. 4731, line 22 change: “to IASI” to “from IASI”
- 33) P. 4731, line 26 – would the difference of 0.5 degrees from the coastal station location result in the use of the IASI retrievals over the ocean? How many of the analyzed IASA profiles are derived from the spectrum over the ocean and over the land? If you separate these two groups, how would the comparisons change? Have you compared IASI against South Pole station ozone sonde record?
- 34) P. 4732, line 24 – please collaborate more information on the meaning of “well defined: AK. Does it mean that you chose only profiles where AKs were equally distributed vertically for better vertical coverage?”
- 35) P. 4732, line 27 separate words “profilesmeasured”
- 36) P.4733, line 4 – in Figure 12 and 13, it would be of interests to add the high resolution profiles measured by ozone sonde (prior to the AK smoothing). It is of concern that the highly stratified vertical ozone profile would not compare well with the IASI. I would also object to plot high resolution IASI profiles – IASI retrieval has no information about high vertical resolution. So, it is better to compare ozone sonde profile integrated in the thick layer for comparisons with IASI, where the thickness of the layer is defined by the IASI AK resolution.

#### Figure captions

1. The grey line ~~is~~ in the bottom panel represents the residual of the fit, which is comparable to the IASI instrument noise level (dashed line).