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Atmospheric Measurement Techniques Discussions

Interactive comment on "The ground-based MW radiometer OZORAM on Spitsbergen – description and validation of stratospheric and mesospheric O_3-measurements" *by* M. Palm et al.

Anonymous Referee #1

Received and published: 20 May 2010

General comment: From the title of the paper one would conclude that the intent of the paper is to give an overview of the ground-based ozone radiometer OZORAM operated at Spitsbergen, its data analysis and some validation with two satellite instruments. Expectations are not quite fulfilled. The main weight of the paper is put on the discussion of the profile retrieval with a special emphasis on the error analysis. One key conclusion is that the retrieval is affected by not sufficiently well known spectroscopic parameters leading to oscillations in the retrieved O3 profile. In addition the authors compare the retrieved profiles with those from EOS/MLS and TIMED/SABER. Profiles from OZORAM deviate from those from the satellites in the best case by 20%. Almost missing are details about the instrument that are important in the retrieval. Though

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the authors state “the publication mainly describes mostly instrumental aspects” this is not the case. Three times the authors say that the instrument has been modified to enable the measurement of mesospheric O3. However these instrumental details are not given. Completely missing is any tribute to other similar O3 instruments reported in the literature or operated within NDACC. The reviewer got the impression that the authors use data from ECMWF in a wrong way and that conclusions they make are doubtful. Unfortunately the quality of the paper is in a very immature state and the aim of the paper is not reached. The paper in its present form is not suited for publication and must be revised.

Specific comments: Section 2 The OZORAM instrument. For details about the instrument reference to Klein (1993) is given. This is a Ph.D. thesis and not easily available. Table 1 lists some significant changes of the receiver. The system temperature changed from 3500K to 1100K. This is a very substantial change and it would be interesting to know what has changed. What kind of mixer is used, is it cooled, are these numbers DSB or SSB?

Page 1936 line 15: What were the modifications and optimizations?

Page 1937 line 1: Give details (figure) about the side band rejection as a function of frequency. The measured side band rejection is an important parameter in the retrieval. It is not clear whether the authors took this into account with sufficient detail. The image side band is situated on the wing of the strong O2 line at 118 GHz and might affect the retrieval in case the filter is not properly tuned. Therefore please provide a plot of the measured side band suppression as a function of frequency.

Line 9 and 11: The word “spectrum” resp. “spectra” is used in a confusing way. What is called a spectrum yH or yC actually is not a spectrum in the sense as used later on. The values of yH and yC are spectrometer outputs which then are changed to brightness temperature according (1) to lead to an O3 spectrum, called y.

Line 15 and 18 and many more times: The word via actually stems from de-via-tion,

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but here it would be appropriate to say “by” equation.

Line 20: TSIG here corresponds to one of the measured spectra y. This is not evident. I recommend abandoning these confusing “ys” and using the common term of brightness temperature.

Line 21: Figure 2 gives a measured and calibrated spectrum. The line wing temperature of approx. 140K seems to be rather high for a December situation in the arctic. This high value might be due to very humid tropospheric conditions or due to problematic sideband suppression. What was the opacity at 142 GHz during these days? What was the column density of water (if available from balloon soundings)?

Page 1938 line 12: What is meant by on-disk?

Line 14: What is the actual integration time, i.e. looking in the direction of the atmosphere and not to a calibration load?

Page 1939 and 1940 The section about absorption needs rewording as it mixes up important physical quantities. The authors mix up absorptivity with absorption coefficient and give a wrong equation of Kirchhoff’s law! I recommend that authors consult a basic book about radiation! The absorption coefficient as used in equation (3) has dimensions of inverse meters what of course is correct. However in eq. (6) not the absorption coefficient is meant but the dimensionless absorptivity. Equation (6) must be removed. Equation (4) can be omitted as it is clear and given in the description of the JPL catalogue.

Page 1940 line 5. The spectrum is not “created”... Equation (7) is not quite correct. On the left hand side the spectrum y actually is a brightness temperature (see above) but the right hand side is expressed with the Planck expression.

Nowhere in the paper the authors give any details about how they correct tropospheric effects. This is a very important aspect and if not properly done can lead to significant problems in the retrieval. Please add a paragraph about this issue.

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Section 2.3.3. This section is written like a powerpoint presentation. The same is true also for section 2.4.1. and 2.5.5 This should be avoided.

Page 1941 line 3 and 4: It is not clear what exactly is meant in the context when the authors say that the area under the line . . . This is true for optically thin lines but not for O3.

Line 18: Explain how the noise (system temperature) is linked with the covariance.

Line 19: The a priori profile is a mean value. Give details, annual mean or what?

Page 1942 line 14. What is done with spectral artifacts, give more details about offsets due to non-linearities. Where are they generated, how are they taken into consideration?

Page 1943 section 2.5.2. Later on a special weight is put on the spectral parameters. It would be good to mention these effects already here.

Page 1945 table 2. This table is not very helpful as is. It should incorporate the actual values used in the forward model. Give the numbers.

Line 8: How wrong is wrong, what is right? Please specify. How accurate is the brightness temperature of the cold load known (not the physical temperature)?

Line 17: Probably the polar angle should be the elevation angle I guess.

Page 1946 section 3.2 results This section is very short and deserves some more text to explain details. It would be interesting to know what is the delta O3 to a mean value at the altitude of the so-called filament. What is the vertical extension of the filament? Figure 8 gives O3 values over Spitsbergen of roughly 11ppm at 30km altitude. This however cannot be seen in the profiles of OZORAM. Figure 7 (middle) gives 7ppm at most! Actually I assume that what is displayed in Figure 8 is wrong! Values of the order of 11 ppm at Spitsbergen ar far too high. I generated a plot with ECMWF data myself and include it here.

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I guess that the authors made some mistakes when interpolating the data.

Figure 7 bottom: It seems as if the O3 distribution has a double peak most of the time (oscillation in the retrieval?). Also the values are rather low. MLS O3 data for the period of the sudden stratospheric warming look very different. See figure below.

It would be interesting to plot potential temperature contours as an overlay to the ozone profiles to highlight downward and upward movement during the stratospheric warming.

Page 1947 line 7: I suggest to omit the wording “simulated retrieval” as it is no retrieval

Page 1948 line 7: Please specify the used values (see comment above for table 2). The spectroscopic data set consists of line intensity, pressure broadening parameter and temperature dependence. But actually only the line intensity differs from JPL to HITRAN as the other two parameters are not tabulated in the JPL catalogue. The uncertainty for the line intensity is given as 5% however in Pickett et al (1998) it is 1%.

Page 1950 On the oscillations I am not convinced that the oscillations come from uncertainties in the spectral parameters before I have seen how the authors take care of the side band suppression and the tropospheric correction.

Page 1963 Figure 4 What kind of hardware changes happened in between? This is not given in section 2.2

Page 1964 Figure 5 It does not make sense to plot values higher than say 80km

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Interactive comment on Atmos. Meas. Tech. Discuss., 3, 1933, 2010.

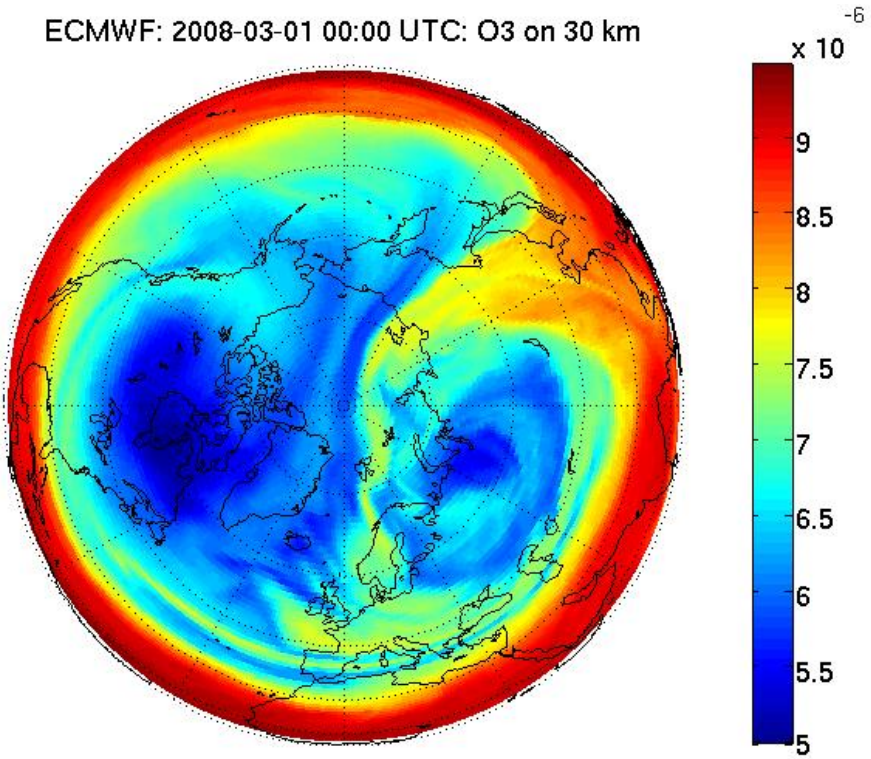

Fig. 1. O3 VMR at 30 km based on ECMWF data for 1st March 2008

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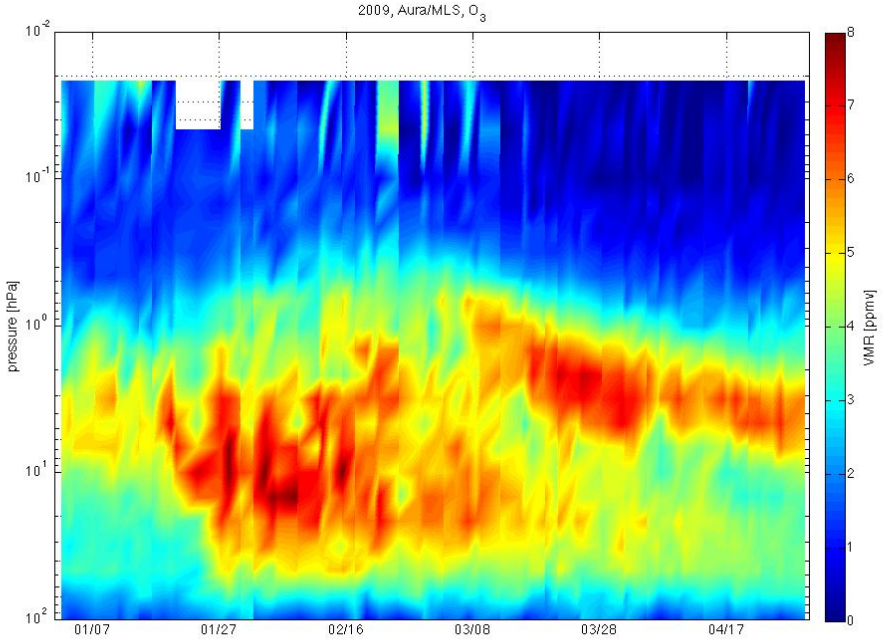

Fig. 2. O3 VMR profiles based on downloaded MLS data

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