Atmos. Meas. Tech. Discuss., 4, C761–C764, 2011
www.atmos-meas-tech-discuss.net/4/C761/2011/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Sensitivity of Dobson and Brewer Umkehr ozone profile retrievals to ozone cross-sections and stray light effects" *by* I. Petropavlovskikh et al.

Anonymous Referee #1

Received and published: 31 May 2011

The paper deals with the vertical ozone distribution derived from Umkehr measurements (performed by Dobson and Brewer spectrophotometers) using the state of the art UMK04 retrieval algorithm for Dobson data and a modified UMK04 algorithm for Brewer data. The paper presents sensitivity analyses exploring the following effects: (i) out-of-band stray light effects making use of measurements of slit functions of individual spectrophotometers of the "Fourth North American Interagency Intercomparison of Ultraviolett Monitoring near Boulder, CO" 1997 (published by Lantz et al., 2002)"; (ii) changes of ozone absorption cross sections and their temperature dependences (the replacement of the presently recommended ozone absorption cross sections in the Huggins band (Bass and Paur, 1985) by more recent laboratory measurements of

Brion, Daumont and Malicet (1995) is presently evaluated for possible introduction in all instruments making atmospheric ozone measurements from space and ground (when using the respective wavelength region). The sensitivity analyses indicate that the retrieved ozone profiles are only slightly modified by replacement of the ozone absorption cross sections whereas the falsification of the profile caused by out-of-band stray light effects leads to an error in the order of maximally 7% in the upper stratosphere. The paper is basically suitable for publication in AMT. However prior to publication in AMT the following points need to be taken into account: General comments: 1. The paper basically shows that out-of-band stray light effects are not taken into account properly in the presently used Umkehr algorithms which is an important problem. However, I miss the discussion of these findings in a broader perspective and in a comprehensive way (see point 16). 2. I recommend to briefly describe the strengths and the weaknesses of the Umkehr method (including the kernels) and a brief discussion how the accuracy of Umkehr profiles are determined. Specific comments: Abstract 3. The Abstract should not only contain what has been done but it also needs to cover the key findings i.e. that the out-of-band stray light effect is not properly treated in the presently used Umkehr retrieval algorithms leading to falsifications of the ozone profiles of up to 7% in the upper stratosphere which has a substantially larger impact on the retrieved ozone profiles than the considered change in ozone absorption cross sections and the presently ignored effect of temperature dependence of ozone absorption cross sections. Introduction 4. Line 2 ff, p. 2009: "The Dobson network has been collecting ... since the 1930s (Dobson 1926). ... It has proven to be very stable ....". I think this sentence is misleading as it suggests that "the" Dobson network continuously existed since the 1930. The concept of the Dobson network design in its present form with a primary Dobson instrument goes back to the early 1970s and it was gradually extended to a global network since the second part of the 1970s. Indeed, Dobson put several instruments first in a European and thereafter in a "quasi-global" "network" for some years, and a few stations continued operation over many decades and instruments on more sites started continuous measurements since around IGY but I don't

believe that it is correct to use the term “the Dobson network” for these earlier measurements in connection with the Dobson network in its present form which started to exist only in the 1970s. 5. Line 19 ff, p. 2009: What means: “Therefore regular calibration of the instruments . . . as is done in the Dobson network” ? I thought that Brewer instruments are supposed to be intercompared with travelling Brewer standard instruments every two years which is more often than in the Dobson network. 6. Line 13, p. 2010: You might add that prior to the satellite era regular Umkehr observations from a few sites were the only source of information for ozone in the upper stratosphere. 7. Line 16, p. 2010: Did BUV instrument provide reliable ozone profile information ? 8. Line 27, p. 2010: The sentence “The Integrated Global ....” is not precise: The committee “ACSO” (Absorption Cross Sections of Ozone) is a joint ad hoc commission of the World Meteorological Organization (WMO) (Scientific Advisory Group (SAG) of the Global Atmosphere Watch (GAW) and IGACO-O3/UV and the International Ozone Commission IO3C) of the International Association of Meteorology and Atmospheric Sciences (IAMAS). Background 9. Line 13, p. 2012: Fig 3: The sequence of the numbers of the Figures in the text dictates the numbering of the Figures in the manuscript, i.e. Fig. number 3 should become number 1. 10. Line 4, p. 2013: Some remarks concerning vertical kernel sensitivity might be appropriate here. Stray-light contribution in Dobson and Brewer Umkehr measurements 11. Figure 4: Legend: Could you add for clarity for which slit these measurements were performed. 12. Line 27. P. 2018: You might use the full name instead of TMTF in order to avoid confusing the reader with too many acronyms. Effects on Dobson and Brewer Umkehr ozone profile retrieval 13. Line 11-14, p. 2020: I suggest to quickly summarize here how the accuracy of Dobson and Brewer Umkehr ozone profiles is defined and determined and please give available numbers. The given information is very vague. 14. Line 14, p. 2020: To which of the two 2 references of Petropavloskikh et al., 2005 is referred to ? Discussion and conclusions 15. First paragraph: I don’t see a clear connection of the first paragraph of p. 2022 to the other part of the conclusions. It is not clear whether the list of given publications aims to be complete. If this is not intended the papers should be declared as

examples. 16. Line 25, ff on page 2022: Since the paper basically only demonstrates a problem of the Umkehr method I expect more concrete information how important this problem is and how the method will be developed (compare comment 1). How large is the stray light effect in the context of the uncertainty of the method ? (Please extend the information of the accuracy of the Umkehr method given in line Line 11-14, p. 2020 and discuss it in the section Discussion and Conclusions.) Is it feasible to document the effect of the stray light problem by comparison with measurements of collocated instruments such as microwave or LIDAR ? Or is the uncertainty in retrieved ozone profile from Dobson/Brewer instruments expected to be that large, that a refined Umkehr algorithm taking into account the stray light effects has lower priority ? I furthermore miss a more clear elaboration of the further development of the retrieval; “The method is under development ....” (line 26, p. 2022) is not sufficient to me. Which method do you mean ? I thought the data used in this paper are sufficient to characterize stray light effects. If this is not the case this would imply that you need to declare that the used measurements are insufficient to provide enough information to describe the stray light effect in an appropriate way. Or do you mean that the introduction of such measurements in a systematic way in the Dobson/Brewer network needs more work ? Should the measurement of the slit function become part of the regular Dobson intercomparisons ? How do you plan the further development of the Umkehr retrieval algorithm for Dobson instruments ? What are the steps to be planned for the retrieval developments of Brewer instruments ? Are further comparisons with of other measurement methods are intended (groundbased or satellite instruments) ? Should one also consider to use specific temperature profiles instead of averaged temperature profiles (as used in the sensitivity analysis).

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 2007, 2011.