Atmos. Meas. Tech. Discuss., 5, C1459–C1462, 2012
www.atmos-meas-tech-discuss.net/5/C1459/2012/

Atmospheric Measurement Techniques Discussions

Interactive comment on "A compact, fast ozone UV photometer and sampling inlet for research aircraft" *by* R. S. Gao et al.

Anonymous Referee #2

Received and published: 3 July 2012

Review of "A compact, fast ozone UV photometer and sampling inlet for research aircraft," by Gao et al.

General Comments:

The manuscript describes incremental improvements in an instrument for the measurement of ambient O3 from aircraft via UV absorption. It builds on the decades-long heritage of a well-respected instrument deployed by NOAA. Novel improvements include the use of polarized light to fold the optical path thereby improving instrument precision for a given physical cell length. The authors were able to achieve slight reductions in instrument size and weight, while maintaining, or slightly improving, instrument performance. It appears to be a very nice instrument, though it is clearly an incremental

improvement using good ideas, as opposed to totally novel approach. The overall quality of the manuscript is very high. The instrument and its performance are thoroughly described. I recommend publication essentially as is, though I suggest that several minor modifications be considered.

Specific Comments:

(1) Pressure measurement: Are there 2 sensors, 1 for each cell, or is there only one? Section 2.8 is all written in the singular, as if there is only 1 sensor. If there is only 1, where is it, and how accurately does it reflect the pressures in the 2 cells? I'm concerned the pressure in a cell could differ depending on which of the 2 flows is directed through it, the scrubbed flow or the sample flow. Or, are the 2 flows so similar that there is no pressure difference? If there is one sensor on each cell, then please state this.

(2) Noise from turbulence in sample cell: How significant is this? And how does it really affect the precision? It is certainly plausible that this is a significant effect, but I am a bit surprised. The authors attribute the worsening of precision, when in flight, to this effect, but I am not convinced that this is correct. Could there not be other effects in flight? Vibration? Electrical noise? Pressure fluctuations? How well understood is the effect of turbulence on precision, and how certain are the authors that this is the dominant effect, vs. other possibilities?

(3) Given the focus on the instrument itself, and a relative lack of focus on inlets, I don't think "and sampling inlet" belongs in the title. In any event, 2 inlets are mentioned, so if it is kept, it should be made plural. I appreciate that inlets are hugely important and may compromise instrument performance, but there really is very little focus on inlets in the manuscript.

(4) p. 3485, lines 5-7: It is stated that the artifact is small, and then it is stated that there is a negative bias of <10 ppb. 10 ppb strikes me as large, if this is 10 ppbv of O3. Please clarify.

AMTD

5, C1459–C1462, 2012

(5) Sample flow control and "dwell time" of the measurements: How continuous is the sample coverage? Is an interval of data tossed out after the valves switch? Please include this detail. Another way to say this is this: what are the start and stop times for a given 0.5-s value, and is there actually a time gap between consecutive reported values? I think there will be a gap.

(6) P.3479, lines1-3: I would not go so far as saying that the reported values will not be valid if O3 changes significantly during the flushing period. No instrument perfectly samples all ambient variability. The measurement would still be an average, would it not? And so still valid, just not with the best time resolution.

(7) Related to (5) above: The 2 cells could potentially have a systematic offset from one another for a given time period in flight (in derived O3 mixing ratio). Is this the case? It seems this would be a useful diagnostic of instrument performance. The authors must have looked at this. Are differences found? Is anything done, at the data reduction stage, to eliminate such differences?

(8) Also related to (5) above: I am concerned about a potential negative bias from this technique that results from a lack of plug flow, and the potential for some scrubbed air to remain in the sample cell while the absorption measurement is being made. Can the authors relieve me of my concern? It seems to me that it might take a few times the plug-flow time to really purge the cell of all the scrubbed air, yet a shorter time is used (p3479, lines 9-12). How is the required flow for a true flush time determined? Are the PDs sampled at a high rate and leveling-off looked for? Is this done in flight to insure the quality of flight data?

(9) Optical Configuration: Are there any problems due to lack of perfect polarization, or lack of perfect alignment of the optical components. Is alignment robustly maintained? Is the technique sensitive to misalignment?

(10) Abstract, line 9: The sampling rate is quoted as 2 Hz, without a qualifier. However, later it appears that this only applies at high altitudes. I gather from p.3482, lines 12-

AMTD

5, C1459–C1462, 2012

18, that at lower altitudes the frequency degrades to 1 Hz and 0.5 Hz. If so, then the abstract should reflect this.

(11) Little to nothing is mentioned of data acquisition. Little is required, but perhaps a few sentences are in order.

Technical:

p.3484: should be fig. 3, not 2

p. 3491, fig. 2: the red letters are hard to discern, esp. on a printed copy, a little better on a computer screen. Have you tried a lighter color, even white?

p. 3485, line 6: suggest using ppmv, rather than ppm. Likewise for ppb if that is O3 mixing ratio.

p. 3476, line 26: could say "precision generally improves" rather than "increases," as the precision's numerical value will decrease.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 3473, 2012.