

Atmos. Meas. Tech. Discuss., referee comment RC2
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Comment on amt-2021-385

Anonymous Referee #1

Referee comment on "Traceable total ozone column retrievals from direct solar spectral irradiance measurements in the ultraviolet" by Luca Egli et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-385-RC2>, 2022

Review of Egli et al., "Traceable total ozone column retrievals from direct solar spectral irradiance measurements in the ultraviolet"

General Comments

The authors present a retrieval for the measurement of total column ozone based on the "QASUME" reference spectroradiometer, based on absolute measurements of the spectral irradiance which are traceable to SI. This general concept is a break from the traditional notion of "traceability" in the ozone community which has historically always meant traceability to an artefact, namely Dobson 83 or the Toronto Brewer triad.

The manuscript is very relevant and suitable for publication in AMT with minor revisions. Most of my specific comments below are essentially just requests for a bit more guidance for the reader.

My one overall comment is that I would appreciate some more introductory motivation and discussion for the concept of a "traceable" retrieval, as I suspect this idea will not be very familiar to many of the readers of AMT (in contrast to the idea of a traceable measurement in a laboratory setting, or the concept of an uncertainty budget for an atmospheric retrieval, both of which are widely understood).

Some specific points I would like to see discussed are as follows:

- What is the motivation for the approach taken here in the manuscript, compared to the traditional Dobson and Brewer concept of traceability? (You do already give two advantages in lines 16-17 I note).
- Is the definition of "traceability" of a retrieval you give (line 73), in common use?
- Additional data are required in the retrieval, for example profiles of ozone and temperature measured by ozonesondes. However these measurements are not traceable, unlike those from QASUME – what is the impact of that?
- The uncertainty is based specifically on conditions in Davos. However, the text states the instrument has been used at 33 different locations around the world. Does this mean the traceability of the ozone retrieval does not apply at these locations?
- Even though you have an established climatology it is always possible for the atmosphere at any one moment to be in a very unusual state, or even in an unprecedented state – how does your approach cope with that? Can you still say "accounting for all possible uncertainties"? (Line 19)

Specific Comments

Line 28 The website is useful but you need to also give a formal citation, for example to the most recent assessment.

Line 32 "Variations of the solar constant" isn't the main point here.

Line 45 perhaps "with the then state-of-the-art"

Line 55 What do you mean by "fundamental" here? You then go on to say most of the difference can be accounted for if well-understood issues are taken into account.

Lines 58-60 I think it would be better to list a wider range of instruments here that have also used a similar spectral range even if not in the same geometry. For example, NDACC UV spectroradiometers have been making similar measurements for decades (although global, not direct) from which it is possible to retrieve total ozone. Similarly there are the DOAS and MAX-DOAS instruments which are nowadays very widely used (using zenith rather than direct-sun measurements of course).

Line 64 Actually, I would have "expected" the opposite. Measuring the full spectrum gives you many more data points but, each point does not necessarily contain any additional independent information and, speaking very generally, a ratio is usually able to be measured much more precisely than an absolute quantity.

Line 72 This definition of "traceability" (for a retrieval) is not the same as the definition of

traceability for an instrument. You need to explain to the reader whether this definition is your own or is generally used.

Line 111 Is the airmass for ozone?

Line 119 Why is "traceable" in quotation marks here – is the implication that you are using the word in a particular way?

Lines 147-151 It seems a bit odd to me that you would show the plot of residuals before giving any details of what you are fitting. Normally in a paper this would be the other way around. Perhaps you could let the reader know the details are coming.

Line 152 Saying the residuals are "flat" seems a bit optimistic to me, there is some possible structure there, apart from the high frequency variation

Lines 152-154 Is it possible to explain this more clearly?

Line 162 Using aflugus can only be a starting approximation for a specific location and season etc

Line 174 Using values for that particular day, or an average, or something else? Would this introduce an additional uncertainty?

Lines 171-174 As mentioned in my general comments, the use of outside information like the Payerne ozonesondes provokes a number of questions. Ozonesondes and radiosondes have their own issues of course and are not traceable to SI. Do you know how representative Payerne is for the vertical structure of ozone over Davos?

Lines 175-181 I think you should mention the limitations of this assumption for the AOD.

Lines 185 You should give at least some details of your assumptions for SO₂, and how good you expect them to be, particularly as SO₂ is likely to be highly variable in time and space.

Lines 190-199 How do you know there will not be other non-negligible absorbers within this wavelength range?

Line 206 Is the "overall uncertainty of 0.91%" for every wavelength?

Line 213 Shouldn't you assume the more conservative limit of 0.72% ? Is there a physical consideration here?

Lines 215-216 Wouldn't the better approach here be to consider the uncertainties of the laboratory-measured ozone cross-section, (which I understand was one of the original motivations for the ATMOZ project) and propagate them through to the resulting total ozone value?

Line 240 This is quite confusing. Is there a difference between IUP and IUP_A and IUPA?

Lines 245-248 I don't follow the reasoning here. The ozone cross section at a specific temperature and wavelength has a true value which can in principle be measured, and we hope is getting more accurately measured as laboratory techniques improve. Why even consider the older Bass & Paur values at all?

Lines 250-266 Again I am struggling with the reasoning. Doesn't the TSIS come with an uncertainty, which you could propagate through to the total ozone value?

Lines 269-285 Is the standard deviation really enough, do you know whether extreme values are properly represented in the uncertainty? Also do you need to take into account the uncertainty in the mean value of 225.2 K caused by radiosonde errors or bias?

Lines 309-310 It is not clear to me what happened to the aerosol and SO₂ and their effect on the uncertainty?

Line 323 Do you use a normal distribution for the random values?

Technical comments

Line 29 Remove the apostrophe

Line 32 "surface of the Earth" or "Earth's surface"

Line 40 "have" should be "has"

Line 41 "to [form] a global network"

Line 88 "has been" operated

Line 91 Replace "chapter" with "section"

Line 99 "enables" rather than "ensures", or perhaps "ensures outdoor measurements are able to be made"

Line 103 Replace "timeout" with "missing "

Line 109 Insert "to" after the word "equal"

Line 109 "a maximum of 4.5 minutes"

Line 112 "described" not "describes"

Line 137 "et al."

Line 149 "surface of the earth"

Line 151 You don't mean "exemplarily" here

Line 182 You need to re-word this, at present it reads as if Lord Rayleigh is personally scattering the photons around!!

Line 203 Delete "well", otherwise it sounds like the authors are complimenting themselves!

Line 207-209 I can't quite follow the meaning of this sentence, please re-word to make it clearer

Line 324 Apostrophe should be a comma.

Line 330 Apostrophe should be a comma.

Line 334 "negligibly" instead of "neglectable"

Line 336 "proves" not "proofs"