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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The US Dobson Station Network Data Record Prior to 2015, Re-evaluation of NDACC and WOUDC archived records with WinDobson processing software" *by* Robert D. Evans et al.

Anonymous Referee #3

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GENERAL COMMENTS

The authors are to be congratulated for undertaking this major body of work to produce a consistently processed dataset of such long duration stretching back more than fifty years. It is often very difficult to work with such old data and (if it still exists) metadata. The NOAA Dobson record is certainly a crucial dataset for science representing many regions of the globe over these decades, not just the USA. The authors are therefore also to be commended for documenting their reprocessing activity for the ongoing benefit of all users of the data.

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Discussion paper

However, in its current form I don't believe the paper is acceptable for ACP, due to its lack of the appropriate level of rigour, and of transparency, for a scientific publication. In too many places the reader unfortunately gets the impression that an old black box has been replaced by a new black box, the operation of both of which is left completely mysterious. At many of the stations shown, the daily values of ozone have very frequently changed by as much as 10-20%, this is a big difference ($\sim$ 50 Dobson Units) and needs a proper explanation if the user is to have any confidence in the new dataset, and to meet modern expectations of transparency of data processing.

The revised version of the manuscript should include specific explanation of the old processing as far as possible, but much more importantly, proper explanation of what the current software (WinDobson) is doing. Without this, the current paper cannot serve as any sort of documentation of the resubmitted data in the WOUDC and NDACC databases. Certainly, the single document referred to with regard to WinDobson is not at all adequate as it contains no information at all about what the software actually does to the data. The major issues of concern to me in this respect are: (1) How WinDobson analyses an intercomparison to deduce the calibration – this seems to be different to the old system? (2) The difference between the "statistical methods" used to calculate zenith corrections in the old and new systems. (The results in some places differ substantially for an unknown reason, for example, refer lines 217-218). (3) The different methods for selection of a representative daily value. (There is discussion of the complications of time zones but I can't find a clear statement of how WinDobson does this selection).

Another general comment is that it seems in many cases (for a reason that is obscure to me) the WOUDC archive is missing long periods of data (indeed whole years at many stations eg Mauna Loa, South Pole, Boulder) and at some other stations WOUDC holds an out-of-date version of the data (eg Wallops Island, OHP, Perth, Lauder). Perhaps it would be more pertinent to compare the new dataset with the internal NOAA archive in these cases, which I assume doesn't contain these long gaps and has the most recent

re-processing results? (This is only a suggestion.)

SPECIFIC COMMENTS Line 20: "data quality controls built into the new software" – I am not saying this should be in the abstract but in the body of the paper, the authors should explain it what these tools are, and in particular, is the software identifying or removing bad data (and if so, how?) or are the tools merely GUIs to assist manual QC?

Line 29 "either . . . and " should be "either . . . or"

Line 29 Does the figure really add anything? It seems to be based heavily on WMO Report GAW 183? The optical arrangement seems to be included just for interest rather than being referred to again in the text.

Line 33: "The importance of the Dobson Spectrophotometer and its measurements are demonstrated by use of Dobson Units . . . " This statement does not follow logically and is not suitable for a scientific publication.

Line 33 "KM" should be "km"

Line 38 – GAW Report 183 should be listed in the references.

Line 40 "The instrument's readings . . . caused by its passage" – the way this sentence is written the instrument is passing through the ozone layer!!

Line 41 "N-value" should be better explained

Line 41 I object to the use of the terminology "RtoN tables". The community term is "N tables", I think this paper needs to be consistent with GAW Report 183 and all earlier reports and papers and not introduce different terms for the same thing.

Line 43 "The usefulness" – "usefulness" is not the right word here. The table will always be useful but it might become inaccurate over time.

Lines 45-47 The various metrological terms are not being used in the ISO sense as

recommended by GCOS (eg GCOS 200 page 293), but I concede many in the scientific community do not follow these either.

Line 46 – where does the figure of 1% come from? Is there a source for this?

Line 47 – "the accuracy is dependent on knowledge of the ozone and temperature profile" – I find this wording misleading because in fact you don't have any knowledge of the ozone or temperature profile at the time of measurement and have to make assumptions

Line 48 "a static value" – I also find this wording misleading because a reader might assume each station has its own (static) value – I suggest re-wording to make it clearer that the same value is used at all locations whatever their geographic position as well as all times of the year. The fact that the height of the ozone layer also is just approximated should also be stated.

Line 52 – give a source for the "2-5%"

Line 61 – "there are measurements of TOC" – perhaps change to "there are records of measurements .."

Line 65 – "Two stations have been either closed or been transferred .." – wouldn't it be easier to say one station has been closed and one has been transferred?

Line 77 – "RLA" – I don't believe this term is commonly used in the Dobson community but I might be wrong – I can't find it in GAW #183.

Line 79 "referencing" -> referencings

Line 82 "calibration tables" – this term needs defining – the reader will not know if it is the same as the N-tables or not.

Line 84 "is to be reprocessed" – this is a crucial point that needs to be explicit. Is the correction applied backwards in time either by the new system or the old system, and if so, how?

Line 84 "is to be reprocessed" – I find this expression strange, it sounds like something from a manual, but the paper needs to say what has actually been done in practice.

Line 85 – ". . . by the 2010s were difficult to use and maintain" – perhaps this comment is more relevant to the work itself and not so relevant to the paper, but I don't find it very credible. It couldn't have been too difficult to recompile the old fortran code on a modern PC (unless maybe the source code had been lost?) I am sure the old programs couldn't have been very complicated.

Line 89 – the document at the weblink is really just an advertising brochure containing various screen shots. It has no information about what the software actually does in terms of how it treats the data. I see this as the single major weakness of the present manuscript. I don't believe it is acceptable in the year 2017 to submit data to databases but without disclosing how the data have been processed.

Line 90 – "this software has a different statistical method . . . and set of rules . . . " - which need to be explained in the next section

Line 98 "personnel inspection" – perhaps replace with "human inspection" or "inspection by personnel"?

Line 103 ". . .comparisons . . . could be performed using tools internal to WinDobson . . ." – the important thing here which is left unsaid is what was done with the comparison values? Was it just for interest or was it part of the QC process? Does WinDobson automatically exclude outliers? Clearly if you're deleting different points in a day that will change the daily value unless I am missing something?

Line 106 "fundamental wavelength pairs" – there has been no explanation of why ADDS are being considered "fundamental"?

Line 108 "Time periods with differences greater than this were investigated to determine the source of the problem, and correct any differences" I can't understand what you were doing here, sorry, were the differences caused by mistakes of some sort?

Please clarify.

Line 113 "The new method has resulted in ∼91% of zenith sky derived total ozone (ADZB) within 2% . . ." Is this comparison based on the same time period that has been used to derive the coefficients for the statistical relationship, or have you used one period to calculate the coefficients and then a second period to test the fit? Otherwise it is possible to over-fit an overly complicated function (eg 6-degree polynomials in multiple variables) which gives excellent results in the training period but not afterwards.

Line 114 "the 2006 Operations Handbook" – this report should be referenced and referred to by a consistent name.

Line 114 "the 78% value" – but this value comes from a short study conducted in the 1950s!! Surely there is something more recent and thorough you could compare to?

Line 128 – ". . . some adjustments were made in the WinDobson process for some stations" – please explain what you did – this seems very arbitrary?

Line 133 "The older processing included time periods of special processing . . ." – maybe I am misunderstanding this, but it sounds like previously attempts were made to correct for the two mentioned problems, but now you're not going to try to correct for them anymore? Why wouldn't this be a problem?

Line 140 "The older processing modified the reference lamp correction . . . " I just can't make sense of this sentence sorry, is it possible to make it clearer?

Line 149 "For some stations . . ." The paragraph explains why this is tricky, but I can't see any clear statement of how it should be done, or how the old software used to do it, or how the new software does it? This needs to be explicit.

Line 154 "Data archives sometimes failed to be updated . . ." I also found this statement hard to make sense of. Are you saying NOAA updated your internal records but neglected to pass on the reprocessed data to WOUDC?

Line 168 "the new R-N tables" – this is inconsistent with the terminology used earlier in the manuscript "RtoN tables" but again I would prefer the community-accepted term "N tables".

Line 174 "... probability distributions ... " I agree distributions are the clearest way to show the difference. The fact the curves are symmetric shows there is no systematic bias but I would have thought the most important point was the width of the curves reflecting the uncertainty.

Line 183 "...compared to WinDobson record" -> "... compared to the WinDobson record"

Line 189 "The NDACC archive appears to have updates not reflected in the WOUDC Archive." – How is this situation possible? Did NOAA forget to send in the reprocessed data or was it a deliberate decision? Does NOAA retain its own archive which contains all updates?

Line 200 "There are several periods missing from the archive, including all of 2015". Again, I don't really understand this situation? Why would a whole year be missing? Given the large apparent gaps, would this study be more meaningful if it compared NOAA's internal archive rather than WOUDC?

Line 217 "This station record shows a larger offset .... Due to the change in zenith observation results" But why? What exactly has changed? Why would it be bigger at this station than the other? Wouldn't Nashville be sunny anyway and have a smaller proportion of zenith observations?

Line 227 "The selection of observations should be changed ..." What does "should be" mean here? Have they actually been changed in the new processing or not?

Line 237 "The data from July 2013 to July 2014 is missing from the Archive". I assume "the Archive" means WOUDC? Again we have the situation I find very strange that a whole year is simply not present.

Line 246 "Alaska" -> "Alaska, USA"

Figure 2 – I think this is a good plot but:

- South Pole seems to be missing.

- The blue lines for "others" seem pretty bad to me at some stations, eg BNA, FBK, WAI, BRW, SMO. This does not seem consistent with the earlier claim of 2-5% for zenith readings.

Figure 3 – I think this is a good plot too.

Figures 4-17 general comments

- In the caption, I would prefer the full station name be given rather than the 3-letter code, a reader outside of NOAA would find this cumbersome

- Does panel 1 really show daily values? There don't seem to be enough dots.

- It is confusing enough, that panel 1 shows ozone in DU but then panel 2 changes to percentage difference, but made doubly so by the fact that the y-axes aren't labelled!

- In panels 2 and 4, rather than the red line showing the linear trend, which I don't think is very pertinent, it would be better to show the zero line

- Panels 3 and 5 should also show a zero line

- Do the labels on the black vertical lines mean the end of each year? Usually "2015" on a tick mark would label the start of 2015, not the end.

Figure 5 – There is an abrupt shift in the mid 1980s which looks unphysical – could you comment on this?

- Panels 4 and 5 show some very high values for the differences, many months being between 10 and 20%. Can you really account for this?

Figure 11

- In the first ten years or so there are some very low values of total ozone (down to 200 DU) which then disappear after 1979. This looks like bad data to me.

- There is a step change in the difference around 2005 but I didn't see any explanation for the cause.

Table 2 I'm not sure the offset and, in particular the linear trend, are worth giving in the table. It would seem very unlikely that a reprocessing such as this would end up resulting in a long-term trend. I would rather see a summary of the distributions shown in figure 2, such as 2 sigma values for, perhaps AD-DS, CD-DS, AD-ZB, AD-ZC .

Table 3 I think the idea of this table is good but it is slightly misleading because there seems to be a lot of variations between the stations and the table shows combined results. Some of the stations have much greater spread than the overall average figures. However, I wouldn't object to this if table 2 could be changed to give station-by-station distribution figures as suggested above.

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