Atmos. Chem. Phys. Discuss., 15, C1385–C1394, 2015
www.atmos-chem-phys-discuss.net/15/C1385/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global OZone Chemistry And Related Datasets for the Stratosphere (GOZCARDS): methodology and sample results with a focus on HCl, H_2O, and O_3" *by* L. Froidevaux et al.

Anonymous Referee #2

Received and published: 7 April 2015

This manuscript describes the GOZCARDS data set comprised of several key stratospheric constituents. The goal of GOZCARDS is to combine data from multiple satellites into a consistent record suitable for long-term analysis. This paper describes the methodology used in constructing the data set, as well as provides analysis examples for each of the primary constituents. Continued long-term stratospheric time series analysis depends on our ability to combine data from multiple instruments, and as such documentation and validation of the methods used to construct this data set are very important to the research community. The manuscript is appropriate for publication in

ACP with some notable revisions.

General Comments:

Overall the analysis and approach is good. However, I fear the length of the manuscript (27 figures, plus appendix and supplemental material) makes the paper in its current form very difficult to digest. I feel some of the analysis confuses the main point of the paper, which is the methods used to construct the data set, and the consistency between the source data sets used by GOZCARDS which directly effects the uncertainty of the final product. While I understand shortening the manuscript at this point is easier said than done, I suggest the authors consider whether some of the detailed analysis in particular can be removed, and possibly put into a separate manuscript. Though I'm not sure it would help significantly with length, in several sections the manuscript could be written more concisely. I will make a few suggestions in my specific comments, but general suggestions include writing in present active tense as much as possible, limiting qualitative descriptors, especially when the actual results follow in parentheses, and using tables as much as possible.

For example, Tables 1 and 2 are very imformative, and easy to refer back to as needed. Can the general data screening information be put into a table? It is convenient to have all the filtering information in one place, but there are many details that are covered in the relevant publications that are not needed in the narrative. The authors might put the filtering information in a table, sticking just to the actual filtering and not including all the details as to what each filter is doing, for example: UARS MLS precision > 0 MMAF_STAT = "G", "t", "T" Quality=4 Livesey et al (2003)

Converesly, if the authors do want to describe what each filter means (precision > 0 ensures only a negligible constribution to the retrieval from a priori, as an example), they might consider putting it in the Appendix as the SAGE filtering is done. Either way the information is presented in one place, but not in the main portion of the paper. There are other bits of information that seem to be repeated multiple times, such as

the ACE_FTS data processing problems in 2010, that can be noted in the tables or in the data providance information, rather than repeatedly in the text.

The description of the merging process seems overly complicated. For HCl and H2O, if I understand correctly, the reference level is the average between mean HALOE values from August 2004-Nov 2005 (all that exist), mean ACE-FTS values over the same time period (all that exist), and mean AURA MLS values, but only averaged over the months that ACE-FTS has data. However, since the figures and discussion are keyed to a multi-step process, I do not recommend any large changes, just look for opportunities to simplify the text when possible. Also in the wording, keep in mind that the multi-instrument mean used as reference is not necessarily the correct answer, it is just a common reference. If AURA MLS were perfect, for example, it would still be adjusted in this procedure. In later discussion when referring to data sources that are biased low or high, I believe it is important to clearly state that they are biased high or low relative to the reference level.

Specific Comments/Wording Suggestions (many are minor and not mandatory)

p5850

General in abstract, don't need abbreviations unless you are using the abbreviation mutiple times in the abstract (i.e. don't need MERRA and ESDR). L9-L10: I'm not sure about the word debiased, it implies the full bias is removed, but in fact only the relative bias is removed. What about "To merge ozone records we first adjust each time series by its mean offset with respect to SAGE II during periods of measurement overlap to remove relative bias, and then average. For other species we use a multi-instrument mean computed during overlap periods as the reference." L17-18: and lower stratospheric Aura MLS data L20: On 6-8 year time scales [in general work to consolidate space by limiting the use of parentheses.

L25-p5851 L2: this could be shortened: "Short-term tendencies of lower stratospheric and column HCl vary, with increases from 2005-2010 at northern mid-latitudes and

deep tropics, but decreases after 2011 in northern mid-latitudes and increases at southern mid-latitudes. "

p5851 L17 I think you can end the sentence at reference and the meaning is clear [saving little bits of space] L17: remove next sentence, this is confusing and not needed in the abstract

p5852 L10: of independent ground-based data (as in analysis of independent...) L19-20: A slow recovery of the ozone layer towards pre-1985 levels is expected... L22: High quality ozone and other constituent datasets are needed to document past variability and to constrain... [suggestion to reduce word count]

p5853 L8: here is an example of how one might consolidate the words a bit: ... on a common latitude/pressure grid, using the following high quality satellite limb sounding instruments:[move list starting on line 15, and rest of paragraph, up.] Then change last sentence to "All source data sets still have shortcomings or imperfections, but in creating the GOZCARDS Earth Systems Data Record (ESDR) we maintain the integrity of the original data and do not arbitraily disgard data, nor do we attempt to fill in spatial or temporal gaps in the record." The sentence on ways to fill in data is beyond scope of paper is not needed.

P5854 L7: see Sect. 5.1.1 L8: profiles in two narrow latitude bands every day L11-14:consolidate here [you've just introduced the source files and grid, so no need to refer back to these ideas]: Next we merge the GOZCARDS source data files by computing average biases between different source files during periods of overlap, and then adjusting each source file to a common reference to remove the relative biases. Non-zero biases ... L16: such as differences in radiance measurement system or wavelength range, the retrieval algorthm, or in the vertical, temporal or spatial resolution. [no need to refer to Level 1 or Level 2, especially if you have to then define what you mean] L17: remove sentence starting "A useful reference" and start next sentence as Toohey et al. (2013) studied ... L21: '... vs. averages of output sampled

at sub-orbital track locations'

P5855 L4-5: remove clause "these analyses ... discussed later" L8: Si2N initiative (....) [remove 'which stands for'] L18: replace 'main' with 'source' [since source data sets already defined] L19-20: Section 6 briefly mentions GOZCARDS N2O, HNO3 and temperatures...

P5856-5857 L5: As mentioned before, the filtering done according to various data teams can be summarized either in a table or in the appendix. The special filtering for ACE-FTS is appropriate for the text body. Also there is no disucssion of SAGE here, or reference to the appendix that I saw. I suggest moving this information out of the main text body, but if it is not moved, SAGE should be mentioned.

P5857 ACE-FTS: this discussion was a little confusing, and could be simplified. "When analyzing ACE-FTS data we found it necessary to to remove occasional large outlier values that could significantly impact the monthly zonal means. Our outlier screening procedure ... for each year of data."

L12: What do the authors mean by independent zonal means from the ACE-FTS team? Is this a data set that the ACE-FTS filtered using their own method and it compares well? I'm not clear on how the zonal means supplied by the team are independent. L17: remove 'in the tropics' because the limits are extended in all latitude bands L17: remove parentheses around good L21-22: such data sparseness can increase trend uncertainties, for example. [I don't follow the rest of this sentence, comparisons with AURA gave confidence in trend results from ACE-FTS?] L24: add this last filter to the table or appendix, as it is standard. L28: have been set to -999 in the GOZCARDS files

Section 3.1: This section is a bit confusing. First extra screening is covered, then the band deterioration on MLS, then validation studies, then more screening, more on the band deterioration and then more validation studies.

Suggest adding "Froidevaux et al. (2008) found anomalously high MLS HCl vs. aircraft data at 147 hPa at low latitudes; these values are not included in the GOZCARDS HCl data set." to the screening info after the HALOE aerosol screening. Then summary of validation work Then 'Finally, AURA MLS HCl data are not recommended for trend analysis at pressures < 10 hPa (reference?) even if monthly ... measurements. Aura MLS switched to backup band 14 after primary HCl band 13 showed signs of rapid degradation in early 2006. For pressures 10 hPa and above, the long-term band 14 data are considered robust, but drift in band 14 HCl in the upper stratosphere led us to not include AURA MLS HCl upper stratospheric source data in the GOZCARDS record.

Section 3.2: [the first two sentences don't add new information, but it would be helpful in Table 2 to note that the AURA MLS is included only from 10 hPa and below] 'Although not included in the final merged product, we do use the 2004-2005 absolute Aura HCl measurements at pressures less than 10 hPa to compute the offsets for the ACE-FTS and HALOE source files in a consistent manner at all pressure levels. Figure 1 ...

P5860 L14: remove phrase in () L18: remove "too" L29: the average of the months when data from both instruments exist (i.e. at ACE-FTS temporal sampling).

P5861 L4: we weight L11: thus removing any relative bias L15-16: checked against indepedent data sets from two institutions? This needs more detail, or to be removed. Did the authors compare to two other merged data sets? L29: is biased low relative to the reference mean and needs to be increased by the offset value.

P5862 L 7: detailed examples of upper and lower stratospheric offsets L 18-20: This seems a general data information statement, and should be moved up to the ACE-FTS screening section, if it needs to be mentioned explicitly.

P5863 L17: ... merged values is given by the range of available ... L18: remove sentence 'We have made such a calculation....' L23: in relation to the reference values

P5864 L4 ... comparisons; although not an official product, users can readily... L6-

16: this seems a more general description of the GOZCARDS files. Should some or all of this information be covered elsewhere, before getting into individual constituent discussion. Maybe at the end of the data screening/binning section.

Section 3.3 This section is very long, and seems like a good place to make some larger cuts. As a reader interested in the GOZCARDS data, I am most interested in GOZCARDS comparisons with other results. I would suggest at the very least removing Figure 10. The authors can simply state, as they have, that analysis showed the short-term drifts in the period from 2006-2011 to be most hemispherically asymmetric. I would suggest ending this section at P5866 L27 (end sentence with GOZCARDS lower stratospheric HCl trends agree quite well.) This shows what GOZCARDS can do, which is what users need from this paper.

P5865: L1: Remove sentence 'The GOZCARDS HCl ..." this was covered already, and is in the Tables. L4: ... documented by satellite-based ... L12: ... for the one and a half year band 13 AURA MLS data record ...

P5866: L2 less negative trends L13: Is putting Fig 9a, 9b and 9c in parentheses required? It seems a bit odd, but it might be a journal requirement. If not, I would suggest removing the (). L12-13: remove 'For the results' L17: and both positive and negative values

P5868 Section 4.1: consider writing in active voice. '... we screened HALOE H2O data for high aerosol extinction values, closely following the screening used in the Stratospheric ... '

P5869 L7: (Version 20 or VPMC) could be used ... L16-17: do the authors mean the resulting UARS MLS source data span 1991-1993? L20: The validation results here are confusing. Is it necessary to talk about V2.2 and V3.3 AURA MLS validation? Sticking to V3.3 might limit some of the confusion.

p5871 L3: Sentence #2, this sentence could be removed, as the reason given for

not including SAGE H2O seems good enough, that speculation to retrieval problems after the volcano are not needed. L9-L16: Do the authors mean care should be taken because there are missing bands in the GOZCARDS? Since space is at a premium in this paper, I would consider taking this paragraph out. Most users should be aware of sampling issues when averaging without full coverage and it's already been made clear that missing values are not filled in GOZCARDS. L18: remove "(mentioned earlier)"

P5872 L10: with a large drift in the difference time series L15: if the two time series L16: consider removing this sentence 'The main point here... ' [this is understood] L19: end sentence at ACE-FTS data [don't need to mention again data ending in 2010]

P5873 Section 4.3 This section is well written, but it reads like a completely new paper, and possibly could be part of a new manuscript. For the purposes of this paper however it seems far too detailed, especially considering the overall length of the paper. One suggestion would be to use the first sentence of the section, then skip to Fig 15 through the end of the section.

P5876 L14: remove commas around "is needed"

P5877 L12 were disgarded L24: It is known

P5880 L 11: remove 'as described in Sect 5.1' L13: remove sentence 'The monthly means ... ' I think the construction of monthly means after screening is applied follows from section 5.1 and doesn't need to be restated.

P5882 L9-11: Isn't the sentence starting 'Biases' at the end of line 9 repeating what was said in the line above? It might be possible to shorten the diurnal section, just noting that the data are simply not co-located in time (sunset to 1:30am is a large time range). Solving this issue really requires model output which isn't feasible for this work (at least this version). L21: Only at 3.2 hPa and above, correct? L18-27: This paragraph is a little confusing. Why is stability of measurements coming up now (assuming the authors are not still considering diurnal ozone variations). Is this not a

consideration for all constituents?

P5886 L3 - end of section: The Ziemke Chandra results have always been anomalous, and it is probably not worthwhile persuing this comparison. Updated column ozone comparisons could be made with SBUV MOD (which do not agree with ZC12); SBUV is considered the better "trend-quality" data set. However, given space constraints, it is not clear that a column ozone analysis is needed. The authors could easily end the section after the review of the GOZCARDS profile comparisons that have already been done.

P5888 L23: We now breifly mention the N2O, HNO3 and temperature GOZCARDS records that were part of the delivery ...

P5889 L6 end sentence after data record [again don't need to repeat this information about ACE-FTS if it is mentioned in the general data screening section and/or Tables] L11-14: wording is confusing. Suggest 'Until then the GOZCARDS N2O record will include AURA MLS N2O though the end of 2012 only, to avoid the discontinuites resulting from the shift to 190 Ghz band N2O in the current V3.3 data. L19-20: Is this sentence referring to the first validation studies mentioned? If so, combine these sentences. 'Validation results for the first few years of AURA MLS and ACE-FTS N2O shows agreement mostly within 5% in the stratosphere (Lambert et al., 2007; Strong et al., 2008)'. L25: is illustrated in Fig. S15, showing generally highly correlated fiends and insignficant drifts ...'

P 5890 L5 remove parentheses L19: can remove 'the quality of'

P5891 L 2: and 2012 agree mostly within 10-15% L15-18: remove parentheses

Summary and Conclusions: This section is also quite long, and will have to be changed to reflect changes made, particulary in the summary sections for each constituent. In the interest of space, a higher level summary, focusing primarily on the data set methodology, would suffice.

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