

Interactive comment on “New dynamic NNORSY ozone profile climatology” by A. K. Kaifel et al.

Anonymous Referee #1

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1 Major comments

The paper presents the new NNORSY ozone profile climatology. This climatology exists in 4 versions, which use an increasing number of input parameters. All versions, including the first version (TLL), use time (of the year?), latitude, and longitude as input parameters. The second version (TLLO), in addition, uses the total ozone column as input. The third and fourth versions use the temperature profile (TLLT), or the temperature profile and the total ozone column (TLLTO) as input. Such a profile climatology is very useful, and the neural network approach is new and promising for a climatology. Topic and paper are well suited for AMT.

Overall the paper is well written and illustrated. It is put into the context of existing literature and previous work. The authors do a very good job motivating and introducing

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their new climatology (sections 1 and 2). They also give a good account of the underlying database (section 3), and of some basic validation of their climatology (section 5.1). However, I also find that the paper is lacking in several aspects:

- Maybe I missed it, but it is not clear to me whether the “time” input parameter is time of the year, i.e. an annual cycle in the climatology, or is a longer-term time, e.g. including multi-year phenomena like trends, QBO, etc. The later might be suggested by Figs. 8 to 12. This needs to be clarified.
- There is virtually no description of how the neural network approach works and how it is implemented. Section 4 on the network training is also rather short. I think more description should be added.
- I found no indication in the paper where the climatology is available (URL?), how the software is structured, how the user interface works. To make this climatology usable for a wider public, this information should definitely be added.
- I found no information in the paper about the temperature profile input for the climatology. How many pieces of temperature information are required? Is one lower stratospheric temperature level. e.g. 50 or 100 hPa, enough? Is tropospheric temperature required? Is upper stratospheric temperature necessary? How many levels? I think these are important questions for a potential user of the climatology. They should be addressed.
- Section 5 on validation presents some basic validation in 5.1 and Figures 6 and 7. However section 5.2 and Figures 8 to 12 (and even 13) don't present very much in terms of validation at all. These time altitude cross-sections of the difference between observations and climatology essentially show the evolution of observed ozone anomalies. Very similar results would be obtained with any other climatology. These false color plots are about the observed ozone evolution. They give

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very little information about the NNORSY climatology. Especially the ACE data are so sparse that very little can be seen.

- I would strongly suggest to replace Figs. 8 to 12 by figures like Fig. 7, which show the mean bias and the standard deviation between observations and climatology. These could easily be obtained by deriving these statistical quantities along the time axis of the current false color plots. These new figures then need to be discussed. The current discussion of the current Figures 8 to 12 is way too short, or these figures don't present enough useful information. I also find some contradictions between these figures, which are not explained enough in the text. See my 2nd-last minor comment below.
- Section 5.3 touches on some very important aspects. However, I think that currently it is much too short, and not satisfactory. For me as a user, a very fundamental question would be: Which of the 4 climatology versions should I use? Is TLL enough? Should I use TLLO, because I might have total ozone column data (e.g. many Dobson Brewer stations). Is it worthwhile to also use temperature profiles (TLLT or TLLTO)? I think these are very fundamental questions, that can and should be answered by the paper. Figs. 14 and 15 are definitely a step in the right direction, and are therefore important. It would be very good to see similar pictures showing the role of different temperature profiles.
- Fig. 13, to me, indicates very little significant difference between the different climatology versions. Based on this Figure, I would not know which version to use. At Northern latitudes including total ozone seems beneficial. Why not at Southern latitudes and above the Antarctic? I think it might be helpful to show the bias averaged over all latitudes, or latitude bands (presentation similar to Fig. 7). Also: The impact of using temperature profiles seems very small, but again this does not come out very clearly in Fig. 13.
- Also regarding Fig. 13: Bias is one aspect. However when looking at the 4 dif-

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ferent versions, it would also be very important to know how adding more input parameters (total ozone, temperature) reduces the standard error / deviation between observations and climatology. If/where these error reductions are small, there may be no benefit for the extra work of providing additional parameters. This would be very important for a user to know and should be discussed.

- Can consistent biases, e.g. in the Antarctic ozone hole, or near the tropopause, not be corrected in the climatology? Future project?
- The English should be improved, e.g. through thorough checking by a native speaker?

2 Summary

I think the NNORSY climatology is a very useful reference climatology for ozone science. Its' description should be published and AMT is a good journal for it. The current manuscript generally does a good job. However, the entire validation section 5 and its' figures need a major revision. After this revision, which must address the major points raised above, the paper should be OK for publication in AMT.

3 Minor comments

- Page 778, line 10: Should be McPeters in both cases.
- Page 778, lines 22 to 24: It is not clear to me, how the temperature profiles contributed to this climatology. Please explain.
- Page 779, line 8: Typo: "ann"

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- Page 779, lines 12 to 13: Spell out or explain “GDP5”, “Godfit”. I don’t know what these things are.
- Page 779, line 25 “highly non-linear”: I think that is an over-statement. Many of these correlations are close to linear. If they were highly-non linear they would be very difficult to capture with any precision. Make a less dramatic statement.
- Page 780, line 6: What is difference between a “dynamic” input parameter and a normal input parameter? I think “dynamic” should be omitted, here and in other places.
- Page 780, lines 8 to 10: There is something wrong with this sentence. Split into two / fix English.
- Page 780, line 27: “has” → “had”.
- Page 781, lines 4 to 8: I don’t think that spatial and temporal resolution are really an issue or a valid criterion for a smooth/average field like an ozone climatology. These fields usually don’t have sharp features, where resolution is an important issue. Only the tropopause might be such a sharp feature, but that is an issue that needs to be resolved with appropriate input parameters or coordinate systems. I would omit these sentences dealing with resolution here. Better to discuss it later in the text, as is already done.
- A different question might be the diurnal cycle (time resolution) emerging above 40 km altitude. Is that diurnal cycle addressed by the time input parameter? It would be good to have a clarifying statement somewhere.
- Page 781, line 23: Already state here which (re-) analysis is used.
- Page 782, line 11: What is the ZSW database? Spell out / explain.
- Page 782, line 17: Does GEOS-4 have ozone profiles as well?

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- Page 782, line 22: “too large”. How often does that happen? 0.1, 1, 10% of the profiles?
- Page 783, line 19: What are training patterns? Are they ozone profiles? If so, then it would maybe be better to use ozone profiles or measured ozone profiles throughout the text.
- Page 785, lines 7 – . . . : Which total ozone data are used? Groundbased Dobson / Brewer? TOMS?
- Page 786, lines 10 to 19: What about the apparent stratospheric warming and QBO signals in Figs. 8, 10. Why are they not discussed at all? Are these time series the right thing for a climatology validation? I doubt it. See my major comments.
- Pages 786, 787: Much too short for the discussion of 6 complex multi-panel Figures. See also major comments above.
- Page 787, lines 6 to 7: Smoothing error should not be an issue here, since the sonde profiles are smoothed as well (Page 784 lines 26, 27). All these biases make me wonder about NNORSY. Why does it not get them right? A simple averaging of correct profiles would give no bias. Are the SAGE and HALOE input data not screened well enough at altitudes below the lower stratosphere?
- Page 788, lines 18 to 19: I really don’t understand why the Antarctic ozone hole is not resolved well. Over the 1995 to 2007 time period of the training data, the ozone hole should be a very well established and recurring feature. There is not much change in ozone hole size and depth over this period. So I am wondering why the neural network does not reproduce it. Is there too much smearing in from other altitudes? Is that not fixed by the networks ability to account for non-linear relations? Please explain better. Is the bias problem fixed when total ozone is used as input parameter?

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- Page 788, line 25; page 789 line 6: What is “inter-tropical”? Don’t the authors just mean tropical? I would delete the “inter”.
- Page 789, line 10: I would add the approximate height resolution in km after Umkehr layers. Is it 5 or 8 or 10 km? Then you have comparability to the 3 km later in the line.
- Page 789, line 18: After reading pages and pages how good the climatology is, I definitely wanted to know where I can get it. So where can we get it? Give a web-address or something here (and also in the abstract). See also my major comment. If this climatology does not become publicly available: What is the point of describing it in AMT?
- Table 2: Is it planned to also have other vertical and ozone coordinates? Pressure, mixing ratio? That would be a very good thing!
- Fig. 6 caption: Typo “NNORY”.
- Fig. 7 caption: What time period is used? How many profiles? Please add this information.
- Fig. 7 and Figs. 8 to 13: Why is NNORSY always low in the region around / below the tropopause? What do the Figures show: NNORSY - Instrument or Instrument - NNORSY? “vs” is not clear. What about the apparent positive difference vs MLS below 20 km that is also seen in Fig. 12 against the sonde stations? Why does that not appear in Fig. 7
- Figs. 14 and 15: It would be good to also add the corresponding TLL profile in each panel, e.g. in another color, or as a thick line.