

Interactive comment on “Hemispheric ozone variability indices derived from satellite observations and as diagnostics for coupled chemistry-climate models” by T. Erbertseder et al.

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Reply to Referee 1

First of all we would like to thank the anonymous referee for the valuable comments. Thanks also for the useful suggestions for minor changes. We will consider all annotations when creating the revised manuscript. We believe that the paper will strongly benefit from the comments.

In the following we will briefly address the remarks, suggestions and specific comments given by the referees.

The outline of the paper was intended to be as follows:

In a first step we aimed at introducing the hemispheric ozone variability indices derived from satellite observations in order to investigate stratospheric dynamics. The suitability of total ozone as a tracer for stratospheric dynamics was quantified by Wirth (1993). We understand our approach as a logical continuation of these findings by introducing a simple hemispheric measure for dynamic activity in the stratosphere. We present time series of the indices for wave number one and two together with inter-annual means and standard deviations for each month. We conclude this with some discussion.

In a second step we exemplify the use of these indices for evaluating model results of coupled-chemistry climate models in general. The application of the indices as diagnostics is exemplified by results of E39/C. This paper is meant to be a point of start. Once the indices are introduced we plan to apply them to results of different CCMs.

In our opinion, the paper is not a mere comparison only. Following the suggestion we have changed the abstract, the introduction and the motivation accordingly in order to clarify this intention.

Contrary to this review, referee 2 emphasises that the paper is written in good English. Since referee 2 and two other native speakers underline that the paper is well written (except for the conclusion) we cannot see that the presentation is hard to follow and the wording is insufficient.

Summarizing the reply to referee 1, we aimed at partly restructuring the paper as recommended, improving the outline and clarifying the arguments. Here we have tried to find a balance between referee 1 and referee 2. Additionally, we have modified the title as suggested. We have considered all minor changes and technical comments in order to improve the paper.

1) *Title: There is only one model presented here and the focus is on the applicability of a measure for ozone variability to compare a CCM and satellite observation:*

-> Following the suggestion we have adapted the title, since the diagnostics is only ap-

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plied to the results of one coupled-chemistry climate model (E39/C). We have changed it into “Hemispheric Ozone Variability Indices derived from satellite observations and comparison to a coupled-chemistry climate model”.

2) *I would suggest an alternative structure (using the figure numbers as they are as a guideline):*

a. *Reworked introduction (shorter and automatically stronger motivation, details below).*

-> We followed the suggestion and have shortened the introduction and rewritten the conclusion in order to strengthen the motivation and overall outcome of the paper. This is also in agreement with the recommendations of referee 2. The motivation for the comparison does not appear early in the paper since in our opinion the manuscript is not a mere comparison study (see below at 2d).

b. *Explanation of the methodology used.*

-> As a matter of fact, in our original manuscript the methodology was presented first, then the data. The problem was that it was unclear to the reader to what kind of data the Harmonic Analysis is applied to. It was not clear that global ozone fields from TOMS or a CCM are applied and how (on a monthly mean base, on a daily base). Some thought about ground-based measurements. That was the reason why we have changed the order of the chapters prior to submission. The structure as it is has the advantage that the section describing the hemispheric ozone variability indices blends over to the results, i.e. the time series of the indices (Figure1).

c. *Introduction of the key data sets: Immediate focus on E2000 and T2000, mentioning the relation between T2000 and the full TOMS time series.*

-> As stated above we aim at introducing the hemispheric ozone variability index for several possible future applications. As it is presented for the first time and has been derived for the full TOMS total ozone data record, we briefly describe the TOMS data

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set and then introduce the relevant subset of data (T2000) used for the comparison to E2000. However, we confine the description of the CCM results to E2000.

d. *Delete figures 1 and 2 and indicate the results for the full TOMS time series in the following text/figures.*

-> Since the index has been derived from total ozone monthly means from TOMS for the first time, we think that figures 1 and 2 should not be deleted. They introduce the index as time series and then as monthly means including the standard deviations. The figures highlight the temporal behaviour of the index, concerning the annual cycle, outliers, inter-annual variability, stability, trends, etc. They stress our intention to present the quantity “hemispheric ozone variability index” first and then apply it to evaluate a CCM. By omitting these figures we would reduce the paper to a simple comparison of two data sets. In our opinion, adding the values for the whole period in figures 6 and 8, as suggested, would result in too busy plots and confuse the reader.

e. *Figure 3 (and relate T2000 to the longer time series by words/numbers)* f. *Figure 4 (illustrating the hemispheric means and their biases)* g. *Figure 5 (discussion of the latitudinal distribution of wave amplitudes)*

-> 2e to 2g follow the previous structure and have been kept. Following your suggestions we present the latitudinal distributions first and then the hemispheric averages. We originally intended to treat wave number one first then number two. In the new version the structure follows the figures 5, 7, 6 and 8 as recommended.

h. *Figure 7 (further discussion of the latitudinal distribution for wave 2)*

-> The order has been changed accordingly.

i. *Figure 6 (the hemispheric average for wave 1) - here the authors could include the results for the full TOMS time series as well (maybe as a dashed line)*

-> The order has been changed accordingly. However, the results for the full TOMS time series have not been added, since figures 1 and 2 have been kept.

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j. *Figure 8 (the hemispheric average for wave 2) - here the authors could include the results for the full TOMS time series as well (maybe as a dashed line)*

-> The order has been changed accordingly. However, the results for the full TOMS time series have not been added, since figures 1 and 2 have been kept.

k. *Summary and Conclusions*

3) *The repeated use of "manifold":*

-> "manifold" has been replaced by "many" accordingly

4) *The use of "coincidence" is unusual:*

-> we have replaced "coincidence" by "agreement"

5) *5674, line 1: "This explains that ..." should read "Is in agreement with the too stable polar vortex in ..."*

-> Syntax has been changed accordingly

6) *5674, line 16: "Ozone is well known to play a major role in understanding the atmosphere." This sentence does not make sense.*

->The sentence has been deleted.

7) *5674, line 15 "Northern" should read "North". The authors should take the sentence apart and divide it between "dynamics" and "chemistry".*

->"Northern" has been replaced by "North"; The sentence was divided into dynamical and chemical processes/contributions

8) *Page 5675, lines 23-26: This statement should come earlier in conjunction with page 5676, lines 7-14.*

-> Introduction has been modified accordingly.

9) *As mentioned earlier, section 2 should start with the methodology, taking up the*

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points made in the introduction about why something like this is useful, followed by the description of the data used in this particular study.

-> Has been changed. Please see reply to 1, 2a, 2b.

10) *Page 5681, lines 1-3: This statement is central to the introduction, even though you may want to repeat it in this context.*

-> The statement has been kept in this context in order to recall this crucial point.

11) *I will not go through the following text, because it should change quite a lot to reflect the restructuring of the paper. I cannot see any scientific problems with the content of the paper - but the presentation is hard to follow and the wording is often insufficient.*

-> We agree that the paper benefits from a strengthened introduction, a rewritten conclusion and some restructuring. On the contrary, we cannot relate to the insufficient wording that is mentioned. The manuscript was read and checked by two native speakers prior to submission. Furthermore, referee 2, a further native speaker, emphasised the good English of the manuscript. Since referee 2 underlines that the paper is well written (except for the conclusion) we cannot see that the presentation is hard to follow due to reasons related to language or wording.

12) *"Discussion and Conclusion" section should follow the new structure as well. The first two paragraphs should basically become two short sentences.*

->the Discussion and Conclusion has been completely rewritten which is line with the recommendations of referee 2

13) *Page 5692, line 16: The authors are not discussing "ozone budgets" here; they averaged total ozone values (sometimes split into contributions by different wave numbers).*

-> "ozone budgets" has been replaced by "total ozone means"

14) *Page 5694, line 21: I do not know what the authors are saying here ("conditions...").*

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-> The climate conditions (boundary conditions) for the time slice experiment representing the dynamics and chemistry of the year 2000 are defined in Table 1.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 5671, 2006.

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