**Response to reviews**

on our paper acp-2009-50 "Spatio-temporal observations of tertiary ozone maximum". We thank both anonymous reviewers for their attention to our paper. We greatly acknowledge comments and suggestions. Below we present the detailed replies to each comment.

**Review#1**

Reviewer #1

1) I have a minor question as to the use of MSIS data. Have the authors attempted to merge ECMWF and MSIS to provide continuity at altitudes where they overlap.

Authors

Yes, a procedure that ensures validity of the hydrostatic equation for the resulting profiles was applied. We noted this in the revised version.

Reviewer #1

2) Another minor question. What exactly is meant by three point smoothing? Is this done in latitude, time or both.

Authors

Smoothing is in both latitude and time. We clarified this in the revised version.

Reviewer #1

3) Figure 2 would be enhanced if these plots were supplemented with additional plots containing cross-sectional slices of these two-dimensional data sets. For instance two or three cross sections of the GOMOS data and the WACCM results over-plotted, with time as the independent variable, would better illustrate the model-measurement comparisons. These cross-sections could be for 60, 70 and 80 degrees latitude.

Authors

First of all, we would like to clarify that the validation of WACCM is not an objective of our paper. The comparisons with WACCM can provide only information whether the phenomenon is generally understood or there are missing important processes.
Furthermore, WACCM is a free-running climate model and therefore the winds generated within the model are unlikely to match the observed winds on any one day. The particular dynamical situation obviously cannot be reproduced by the model (and it does not).
Time-series comparisons (like figure 5), if presented, will not provide additional information, from our point of view.

Reviewer #1

4) Is it possible to run the WACCM model to better replicate the viewing times of GOMOS data set? Looking at Figures 3 and 4 and reading the text associated with these figures gives the impression that apples are being compared to oranges. It is difficult, to impossible, to determine how well the model compares to the measurements by looking at these figures.

Authors

We refined our comparisons with WACCM model based on Figures 3 and 4. We replaced Figure 3 with a new (analogous) one, which shows GOMOS data only from the longitudinal band from 30W to 30E. Thus, the GOMOS data and WACCM data represent now the same state of the atmosphere.
In the text, we removed the discussion related to the influence of data mismatch.
We added a discussion on possible reasons for slight overestimate of tertiary ozone maximum by WACCM into section 4. We added also a short note on possible reasons for GOMOS-WACCM discrepancy into the summary section.

**Review#2**

Reviewer#2
we are told that O3 is measured "accurately" by GOMOS because bright, hot stars are used at high latitudes in winter - but some statement of the accuracy would be useful.

Authors
In our paper, the accuracy of GOMOS data are indicated explicitly in section 2: "The accuracy of individual selected profiles at ~70 km is ~1.5-7%, depending on stellar brightness."
In the revised version, we also specified explicitly the accuracy of retrievals for bright hot stars: after the note "These latitudinal bands have a very good daily coverage by occultations of the brightest stars (Sirius, Rigel, Procyon), which allow very accurate ozone measurements" we added "(uncertainty of individual profiles is ~1.5-2 % at altitudes ~70 km)".
Due to large data averaging, the uncertainty of the averaged data is clearly (much) smaller.

Reviewer#2
One point the authors should
consider is adding a short discussion about why WACCM overestimates the maximum O3 concentration in the TOM by about 50%, compared with the observations. Is this a significant difference and, if so, what could be the possible reasons?

Authors
From our point of view, WACCM is in satisfactory agreement with GOMOS data. The overestimate of the magnitude of the TOM by WACCM is significantly smaller than it has been seen in the ROSE model (Marsh et al, 2001). One reason for the difference can be that WACCM is a free-running climate model and therefore the winds generated within the model are unlikely to match the observed winds on any one day. This difference in meteorology could contribute to the apparent discrepancy between model and observations. A relatively large variability as shown in Fig.3 also supports our hypothesis. Additionally, since this phenomenon (TOM) involves hydrogen chemistry and occurs only at high solar zenith angles, it suggests that the model overestimates could stem from inaccuracies in the simulated water distribution in the winter mesosphere or problems with the photolysis rate of water at near-polar night conditions.
In the revised version, we added:

- a discussion on possible reasons for a slight overestimate of tertiary ozone maximum by WACCM into section 4.
- a short note on possible reasons for GOMOS-WACCM discrepancy into the summary section.

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Please find the file with indicated changes in the manuscript.

As a corresponding author, I confirm that all co-authors concur with the submission in its revised form.

Yours sincerely,

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