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Comment

Interactive comment on “Summertime stratospheric processes at northern mid-latitudes: comparisons between MANTRA balloon measurements and the Canadian Middle Atmosphere Model” by S. M. L. Melo et al.

Anonymous Referee #2

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Overall: This is a relatively routine paper that compares model calculations (from the Canadian Middle Atmosphere Model) to a limited set of observations (balloon-borne measurements of ozone and temperature, plus a single profile each of long-lived gases CH₄, HCl, HNO₃ and N₂O). As such, it has some utility as a "validation" of the model. It does not really convey any new scientific results of note.

Specifics:

The paper starts out with a fairly extensive introduction focused on the state of under-

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standing of lower stratospheric ozone, especially the observed trends in ozone at the mid-latitudes. While this is an appropriate context from which to motivate the observations and model calculations, it somewhat misleads the reader into thinking that he will learn something new about mid-latitude ozone trends. The authors do point out and discuss an oddity in the ozone profiles measured during summer 1998 - the persistence of a low-ozone feature that may be a remnant of polar vortex air. However, given the relatively sparse data set and the inability of the model to reproduce this feature, they cannot really attribute the cause of the observation, nor explain how much it (and others like it) may contribute to mid-latitude ozone trends.

The introductory section is written well. In the second paragraph, it would be more appropriate to cite primary sources (e.g., journal articles) rather than WMO 2006 for the rates of mid-latitude ozone loss. At the end of paragraph three in this section, references should be cited.

In section 3, description of the model is incomplete. The reader should be supplied with information about how the model is initialized and how it is run (e.g., time step, how chemical species are calculated, etc.)

Section 4:

In section 4.1, paragraph 2, the description of a "model day" is not clear. Perhaps this is because I don't know how many profiles are calculated by the model on a daily basis - I just couldn't understand here what was being averaged when.

Later in the same paragraph, the authors comment that temperature points above 20 km fall below the 1:1 line in Figure 2, implying that the model is undercalculating the temperature. Why is this "interesting"? What does it mean? Should the model be doing better than this? How do you know?

In paragraph 4, the authors describe the histograms plotted in Figure 3. I am not sure what significance they draw from these comparisons. How important might sub-grid-

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scale variability be in explaining these differences? Why start the altitude bin at 10 km? Where is that in relation to the tropopause? Couldn't the values in this bin be affected by strat-trop exchange processes that are not represented in the model?

The same general questions apply to the description of Figure 4 in paragraph 6. What is the significance of the model's differing performance over different altitude ranges? Wouldn't altitudes between 10 and 15 km be more of tropospheric character? How well are the chemical and dynamical processes of the UTLS known and/or represented in the model?

In section 4.2: With regard to Figure 5, what do the error bars on the DU-FTS data represent? Accuracy? Precision? at what statistical significance?

In paragraph 2 of this section, some results from an earlier version of CMAM are shown to illustrate the importance of vertical diffusivity. Are there any other significant differences between the two version of the model?

Toward the end of section 4.2, there is a discussion of the HCl observations and model results, including climatological data from the UARS HALOE instrument. The authors seem to be searching for a reason why the model is wrong here, rather than looking at potential errors in the two measurements. They should look at some comparisons of DU-FTS HCl with other HCl measurements and also at the HCl validation work done for HALOE data.

Section 5:

Much of this section discusses the extent of agreement between observations and model calculations of ozone profiles. Of considerable interest is the persistent layer of depleted ozone observed in 1998. The authors cite a number of studies to build a case that this observation could be the remnant of a polar vortex filament, but do not go the extra step to determine whether the time-scales required are consistent. For example, they note (at the end of the third paragraph from the end) that the photochemical life-

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time of ozone at altitudes of 20-28 km is of order 100 days or more. Yet certainly this timescale varies with season (one would expect it to be much shorter in high latitude summer). Moreover, how much of an "ozone loss" could persist from the break-up of the polar vortex (at the end of March) and the observation time period 5 months later? Could the "depleted" HCl in this altitude range as observed by the DU-FTS instrument be a vortex remnant as well?

In the penultimate paragraph, there is a description of polar vortex strength and temperatures in 1997 and 1998 that seems inconsistent. Typically colder temperatures are associated with a more stable polar vortex and more significant ozone loss. This paragraph seems to say the opposite.

Figures:

Figure 2 - It would be more useful to expand the scale on the temperature plot - all of the data are clustered over ranges of 10-15 degrees while both axes span 40-50 degrees.

Figure 4 - The text says that in each plot the "Sonde yyyy" data are averages of all sondes launched that year, yet the plot shows "fuzzy" profiles which would seem to represent ranges. Which is it?

Figure 6 - There should be errorbars plotted for both measurements (i.e., in both directions on the MANTRA observations).

Technical errors:

Section 4.2, paragraph 1: "...averaged profiles and ARE used here TO REPRESENT the model variability..."

Section 4.2, paragraph 3: "However, the ALTITUDE of introduction of Cly..."; The last sentence in this paragraph is only a fragment.

Section 4.3, paragraph 2: "...can be compared with other DATASETS (plural) through

correlations."

Section 4.3, paragraph 3: "TAKEN together with Figure 5, the change in SLOPE above about 25 km SUGGESTS that..." The rest of the sentence is nonsense - I don't know what it means.

Section 5, paragraph 2:"...looking at individual profiles we see THAT the occurrence..."

Section 5, last paragraph: "... during 1997/98 is described in DETAIL (not plural) by Langer..."

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