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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The annual cycle in lower stratospheric temperatures revisited" *by* S. Fueglistaler et al.

Anonymous Referee #2

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General Comments

This paper investigates the out-of-phase seasonal march between the tropical and extratropical lower-stratospheric temperature (and thus a near cancellation in the global mean temperature) revealed and interpreted by Yulaeva et al. (1994). By using global analysis field such as ERA-Interim rather than relying on coarse resolution MSU-4 data, the authors have found that the cancellation does not hold exactly on a pressure surface in the lower stratosphere. They show that the pumping effect of the midlatitude wave-drag on the tropical lower-stratospheric temperature (Yulaeva et al., 1994) explains only a half of the amplitude, and that the remainder comes from the latitudinal structure in the static stability and radiative effect arising from ozone variations. The positive feedback from ozone to temperature is quite interesting.

The discussion is extended further to interannual variations and long-term trend. Although the statistical significance remains an issue (as expected), it is interesting to see that the correlation between the tropical and extratropical temperatures changes from positive in the raw data to negative when high-pass filtered.

Some of the statements, however, appear too strong. What Yulaeva et al. (1994) discovered is the essential role of the wave-driven residual circulation on the seasonal march of the lower-stratospheric temperature. Their main focus was to challenge a general belief at the time of publication that the annual cycles in tropopause height and temperature are driven by tropical tropospheric diabatic heating. Their finding is still valid in this context. They tried to identify the most important process in driving the annual cycle and did not make such a statement as it was understood "without any need for a contribution from radiative equilibrium temperature" (lines 329–330). The elimination of the above statement from the present paper does not undermine the value of the findings by current authors.

There appear numerous typographical issues such as the citation of equations ("eqn. 2" should be "Eq. (2)", for example) to be cleared before being sent for printing. However, the overall quality of the manuscript is good. The reviewer recommends this paper for publication after the following specific issues are properly corrected and addressed.

Specific Comments

Line 3: "Yulaeva, Wallace and Holton" will be "Yulaeva, Holton and Wallace".

Line 10: The term "artefact" sounds too strong. The concept they presented remains essentially intact, although the feedback from ozone is an important finding of the present study.

Line 19: The term "static stability" may be less confusing than "stratification" here.

Lines 74–75, "simulated MSU-4 data from ERA-Interim" and **right-hand panels of Fig. 3:** The weighting function provided by RSS is derived by assuming the US Standard Atmosphere. As the atmospheric thermal emission in the tropics is much different from that in the midlatitude, the weighting function in the tropics will be more or less different from that in midlatitude shown in Fig. 3. Is the common use of a single weighting function justified for the present purpose? Successful reproduction of those results by Yulaeva et al. (1994) does not necessarily guarantee the correctness of such treatment.

Line 191: "70 hPa" may be "67 hPa" as indicated in the figure.

Line 214: "in in latitude" may be "in latitude".

Lines 279 through 286: The description on the use and interpretation of high-pass filter need to be made concise by rearranging the text.

Lines 329 to 330: The statement "without any need for a contribution from radiative equilibrium temperature" may be eliminated.

Fig. 4(b): The contours labeled by 0 look strange. The values over the equator are mostly positive, although those illustrated are difference relative to the equator. Is the "equatorial value" annually averaged?

Fig. 5: The amplitude of climatological annual cycle in ozone (a) shows maximum around 30°S and decreases toward nodal latitudes around 25°N. On the other hand, the corresponding temperature adjustment (b) exhibits maximum amplitude around 10°N. How can such difference arise?

Fig. 6(d): The explanation for dotted and dashed lines given in the caption is not consistent with the labels embedded in the figure.