Atmos. Chem. Phys. Discuss., 10, C10580–C10581, 2010
www.atmos-chem-phys-discuss.net/10/C10580/2010/

Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #1

Received and published: 1 December 2010

This paper presents a diagnostic study of variability in lower stratospheric temperatures, revisiting the famous Yulaeva et al results from 1994. There are two main conclusions: 1) the seasonal compensation in temperature between tropics and extratropics noted by Yulaeva et al for MSU4 satellite measurements is partly an artifact of the vertical weighting of MSU4, and there is less compensation for specific pressure levels (i.e. there is a global mean annual cycle in temperature for specific pressure levels). 2) A significant part of the observed global mean annual temperature cycle on pressure surfaces can be explained by two factors: radiative response to ozone variations in the tropical lower stratosphere, and latitudinal variation of background static stability. This is an interesting and novel paper, and makes a contribution to improved understanding of large-scale stratospheric temperature variability. Overall the paper is well written, and I have only minor comments to be considered in revision.

1) It is noted that water vapor variations could provide an additional radiative forcing mechanism for tropical temperatures, but this is probably a small effect (although the relative seasonal changes in water vapor are large in the tropical lower stratosphere). Can the authors provide an approximate magnitude for the expected temperature response to realistic water vapor changes (probably a straightforward calculation)?

2) I do not understand the sentence beginning line 247. What specific result shows that dynamically forced variations can account for only half of the observed tropical temperature variations? (Perhaps this is referring to global mean variations as shown in Fig. 6d; I do not see a factor of two for the tropical results in Fig. 6d).

3) Minor discussion regarding line 254 and following: There is an acknowledged difference in the ozone seasonal cycle in the tropical lower stratosphere as analyzed in pressure (altitude) vs. potential temperature surfaces. The potential temperature surfaces exhibit a seasonal variation in response to diabatic processes (radiative heating), associated with the seasonal cycle in upwelling (linked with corresponding temperature changes). So to say that half of the seasonal cycle in ozone occurs from the seasonal movement of isentropes does not really explain anything (to me). Ultimately the ozone seasonality is a response to tropical upwelling (in phase with temperature, and hence acts as a positive feedback to temperature, and noted in this paper), with some additional contribution from in-mixing.

4) There is quite a lot of scatter in the anomaly scatter plots in Figs. 7-8, and I think it would be reasonable to quote statistical uncertainties in the associated regression slopes in Section 5 (i.e. in discussions of how well the interannual anomalies match the seasonal slope). Also line 340: the seasonal slope is not a good proxy for trends, as discussed previously in the text and suggested in Figs. 8e-f.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 26813, 2010.

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