Review of "Quantifying and Predicting the Mesosphere and Lower Thermosphere Density during Austral Summer" by Zhang et al.

The manuscripts uses SABER observations to show that summertime variability of the polar temperature at 80 km is well correlated with variability over a range of altitudes and latitudes.

Major Comments

Section 3.2 describes a trend but provides no evidence that this is statistically significant. By eye, it is evident that the year-to-year variability is so large that it is difficult to identify a trend. Later, in Section 4.3 and Figure 12, the authors indicate that no statistically significant trend is seen. For these reasons, descriptions of the trend and speculation of its cause in Section 3.2 should be deleted. It is appropriate to show the analysis in Section 4.3 since the text is clear about the lack of significant response.

The text is written as if T80 "causes" the interactions. At various points, the text implies that T80 is driving a polar thermospheric response and a low latitude response rather than the reverse (or that both time series are responding to events at some other location). The paper attributes the variations to polar upwelling but does not address the question of what causes the upwelling to be variable. A full investigation of driving mechanisms is outside the focus of the paper. Nevertheless, the authors should be careful to point out that the physical process driving the T80 variability could also directly affect the variability at other locations.

Minor Comments

1. Please give a precise definition of T80; "near 80 km over the summer polar region" is not sufficient.
2. (l. 47-48) This sentence doesn't belong in the list of evidence for external forcing of MLT variability since the events it describes result from internal dynamical coupling.
3. The description of the physical processes contributing to the higher temperature above the summer mesopause (l. 64-67) omits the contribution of the downwelling circulation (see e.g. N Wang 2022; JC Wang 2023). Acknowledgement of the downwelling is also appropriate at l. 121, 162, 252. In Section 4.1, the statement that "Stronger upwelling elevates local temperature …" is misleading. Although the correlation has been shown, it is not appropriate to imply that upwelling raises the temperature.
4. There is no figure that shows how the magnitudes of the day-to-day changes compare with that of the interannual variability of monthly means. This value can affect the reader's confidence in the predictive power of the previous monthly mean. A rough idea of this can be gained from the changes in the range of values in Figures 7 and 8. Can this be illustrated or summarized?

Editorial Comments

l. 259: "subjacent" is this a word?

References

Wang, N., Qian, L., Yue, J., Wang, W., Mlynczak, M. G., & Russell, J. M. III. (2022). Climatology of mesosphere and lower thermosphere residual circulations and mesopause height derived from SABER observations. Journal of Geophysical Research: Atmospheres, 127, e2021JD035666. https://doi.org/10.1029/2021JD035666

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