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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Quantifying contributions to the recent temperature variability in the tropical tropopause layer" *by* W. Wang et al.

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This paper focuses on a problem of interest to the scientific community: understanding the trends in the temperatures around the tropopause. Nevertheless, this paper falls far short of what is necessary for publications.

The basic approach of this paper is to take observations over a 10-year period and compare those to a climate model simulation in order to determine the factors that control the trend. There are major problems, however, with this approach that lead me to conclude that the results of this paper are simply not reliable.

1. Model does not reproduce the trend: it is not stated as explicitly as it should be, but in Sections 4 and 5 it is revealed that the model produces a TTL trend that is much smaller than the 10 years of observations. In fact, in the final summary, more than half

of the observed trend is attributed to errors in the model's vertical resolution. Given such a large difference between the model and the observations, how can you trust that the model tells us anything about the observed trend?

It is an interesting conclusion that vertical resolution has such an important effect, but it calls into question all of the other conclusions about attribution of the observed trend. One could write an entire paper about the effect of vertical resolution, but the paper would be quite different from this paper (it would, for example, not contain Section 3).

2. 10-year trends are unreliable: Anyone who has done any kind of atmospheric data analysis knows that looking at a 10-year trend is fraught with danger. In particular, a few outlier months can really torque the trend, so the model must simulate the year-to-year variability really well. The big worry here is that there is short-term variability in the atmosphere that is not accurately captured by the model. The model does use observed SST, but I don't see any reason to expect that this therefore includes all the short-term variability.

As an example, it is well-known that Brewer-Dobson variability has a big impact on TTL temperatures. Is the model getting the right BD circulation variability, with the right phase? Lack of correctly simulating this variability could be one of the reasons that the model does not reproduce the observed TTL trends. Note that using a much longer time series would avoid these problems.

3. no autocorrelation in error estimates: Based on the discussion of error bars, it does not appear that the authors have taken autocorrelation of the time series into account in calculating error bars on the trend. All of the time series considered here are autocorrelated – meaning that a month is more likely to be high if the previous month was high – and this means that there are fewer independent samples in the time series than there are months. As a result, I suspect that the error bars will be larger than those presented here, which will reduce the statistical significance of the paper's conclusions. If the authors choose to revise this paper, they must recalculate

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the error bars to incorporate autocorrelation.

4. paper's conclusions make no sense: Finally, the conclusions of the paper make no sense. It is well known, for example, that tropopause-level temperatures increase over the 21st century in climate models. It seems virtually certain that this is due to some combination of increasing surface temperature and increasing greenhouse gas concentrations (after all, what else could it be?). However, this paper concludes the opposite: that warming SST and increasing greenhouse gases COOLS the TTL. Given that this goes against every other analysis of models that I've seen, I strongly suspect that problems in the methodology (discussed above) are the cause of this highly curious conclusion. If the author's revise this paper, they have to more directly explain these results.

I wish I could be more encouraging, but in the end I am not convinced that the results of this paper are correct. There are too many methodological errors and logical flaws in it for the results to be considered reliable.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 22117, 2014.