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Interactive comment on "The radiative role of ozone and water vapour in the temperature annual cycle in the tropical tropopause layer" *by* Alison Ming et al.

Anonymous Referee #1

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General

Ming et al. analyze the role of radiatively active trace gas variations on the amplitude, phase and structure of the annual cycle in lower stratospheric temperatures through their impact on the radiative energy budget. The tracer variations are understood to be a consequence of the same (dynamical) process that drives the temperature variations. In line with previous authors, they find that ozone strongly amplifies the temperature amplitude, while water vapor dampens the temperature amplitude. The work presented is a major step forward - related previous work has mainly focussed on making the case that these "thermal forcings" are important, and cannot be neglected. The present work presents a much more quantitative analysis and, importantly, integrates

the thermal forcing in a (simplified) general circulation model, which shows (not unexpectedly) that the assumption underlying SEFDH (vertical velocity remains constant) is not well justified. The paper is well written, but could be shortened in some place. I have mostly technical comments, listed below.

Minor comments

Abstract: I think the abstract could be somewhat condensed, and (i) more quantitative information could be given; (ii) the text switches back and forth between amplitude, phase, ozone, water and temperature (e.g. around Lines 6-12), which is confusing.

P1/L7,8: "... and out of phase with the observed annual cycle of the tracer mixing ratio."

P1/L8: Suggest: "The ozone contribution calculated here is ..."

P1/L9: Suggest to replace "This difference" with "The difference"; but see general comment on Abstract above.

P2/L20: Suggest (the tropopause temperature is important for stratospheric water, not dehydration per se.) "Therefore the temperatures at 90hPa and 100hPa shown in Figs 1(c/d) are more directly relevant to water entering the stratosphere than the temperature at 70hPa."

P4/L26: Quantitative details for H2O missing in previous work. Fueglistaler et al. state that their calculations " show that the temperature adjustment for the annual cycle in water vapour around 70 hPa is about an order of magnitude smaller than that for ozone." At the time of writing Fueglistaler et al., this seemed to be sufficient information. However, in the context of your ozone effect being substantially larger than theirs, it is interesting to note that their water vapor impact (around 0.2K) is also smaller than your water vapor impact (your Figure 5b gives 0.6K).

I think it would be great if your paper could resolve these quantitative differences better, such that your paper can be cited as the best quantification of the radiative effects. The Fueglistaler et al. numbers are taken from the calculations with the Edwards-

Slingo code, but results with the Fu-Liou code were rather similar (see Fueglistaler et al., page 3702; last paragraph). The calculations using the Fu-Liou code gave slightly larger amplitudes, but the differences were much smaller than the differences to your calculations; at the time, we decided to go with the Edwards-Slingo results as they were obtained from a software configuration that has been used in previous studies by Piers Foster. It would be great if you could resolve the questions you discuss on page 10/11 regarding the role of the radiative transfer code versus trace input data - the ozone and water vapor files used by Fueglistaler et al. for the calculations with the Edwards-Slingo and Fu-Liou code can be made available.

Finally, can you quantify the impact on the global average temperature? An important point of Fueglistaler et al. is that one should not assume that the global average temperature remains constant (as e.g. implied in Yulaeve et al.1994); it would be interesting to see the numbers from your calculation. You do discuss the role of extratropical heating rate variations on the tropical amplitude, and it appears to me it that would be fairly straightforward to also show the annual mean cycle of global average temperatures.

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