

Atmos. Chem. Phys. Discuss., referee comment RC2
<https://doi.org/10.5194/acp-2021-514-RC2>, 2021
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Comment on acp-2021-514

Anonymous Referee #2

Referee comment on "A simple model of ozone-temperature coupling in the tropical lower stratosphere" by William J. Randel et al., Atmos. Chem. Phys. Discuss.,
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Review of Randel et al. "A Simple model of ozone-temperature coupling in the tropical lower stratosphere"

This study examines the strong correlations between ozone and temperature variations in the tropical lower stratosphere over a range of time scales using both ground-based ozone/temp. from SHADOZ balloon measurements and satellite based measures combining MLS ozone with GPSRO temperature measurements. Noting the strong in-phase relationship largely driven by circulation variations. The authors work through the process of developing a simple model for this relationship and discuss the timescales, locations, and feedbacks that are operating. The paper is well organized and clearly written and would be a very welcome addition and certainly of interest to the readership. I think the paper could be published as is but I have a couple very minor comments that the authors might consider.

There is discussion (page 8) of the photochemical control becoming dominant above 27 km, I would imagine that there is still some significant contribution at 24 km since it is in the transition region, how much of the O₃/T relationship is begin impacted by photochemistry (might be opposite direction, i.e. increased T decreased O₃) at that level.

Lines 275-277 and figure 8 related to the unexplained difference in the semi-annual - annual (X sigma/T sigma) magnitude, this is referenced to 24 km, although lines 284-285 mention similar behavior over a range of altitudes. Does the vertical behavior provide any additional information? Is there anyway to look at SHADOZ beyond just the QBO periodicity, do the SHADOZ profiles have to be deseasonalized.

For Figure 9 why does the SHADOZ amplitudes only go to 24 km and in this figure there is SHADOZ data for annual cycle so is it not deseasonalized for this figure. From the levels that are shown the amplitude of the annual response from SHADOZ is a bit smaller than the model with MLS/GPSRO showing much larger amplitudes and a growing difference above 22 km, any thoughts if the difference in vertical resolution between the relatively lower resolution ozone and higher vertical resolution GPSRO temperatures could be playing a role or something else.

Have you considered looking at what the MLS Ozone/MLS Temperature amplitudes would produce?