

Interactive comment on “Ozone and temperature decadal solar-cycle responses, and their relation to diurnal variations in the stratosphere, mesosphere, and lower thermosphere, based on measurements from SABER on TIMED” by Frank T. Huang and Hans Mayr

Anonymous Referee #2

Received and published: 1 May 2019

The manuscript presents an attempt to estimate interference between the decadal solar cycle and diurnal cycle in temperature and ozone profiles using SABER measurements. This type of study would be useful for the satellite community to reconcile observed differences in the response to the decadal solar cycle associated with the differences in measurement times. However, the manuscript needs a major revision, and in its current state does not provide clear conclusions and evidences. My general comments are provided below. General comments: -There is essentially no descrip-

C1

tion of the SABER dataset used in this study and preliminary steps taking to create zonal means that are analyzed in this study. There is a brief mentioning of interpolation, but it is not clear whether this interpolation is required and how it can alter the final dataset. Authors show that the response on solar cycle can be different at different local times, but it's not clear if these differences are statistically significant and not aliasing from differences in sampling across local times or regression model etc. -The analysis is based on multi-regression model, where some terms could be cross-correlated. There is no discussion whether this model is appropriate for the study, what are the uncertainties of this model, and how these uncertainties can affect the derived results. -In this paper authors mostly focuses on the equatorial region, but they never provided a motivation for doing this. Are responses on the solar cycle larger in the equatorial band? It would be helpful if author can summarize their results and provide a global map identifying altitudes and latitudes where the differences in responses are stronger due to differences in measurement time. -The main motivation of this paper is to demonstrate that the response on the solar decadal cycle could be different depending on solar local time. Authors claim that this effect can explain a large fraction of differences in the solar responses reported in previous studies. I hoped that Section 5 can shed light on this issue and offer some explanation based on results of this study. Instead authors show responses on the solar cycle in O3 and temperature from many different instruments leaving readers to wonder why the results are different and could it be due to differences in measurement time. Specific comments: Line 21: Suggest to replace “Our results of responses” by “Responses derived in this study”; Line 43-44: this statement requires a reference. Also, it might be better to say “the magnitude of responses”; Line 47-49: Currently this statement reads like there were no detailed studies on the diurnal cycle, while there are numerous studies on this topic. I assume you meant that previously nobody considered connections between the diurnal cycle and solar decadal cycle. Line 51: does “global empirical results” refer to responses on the 11-year solar cycle? Then replace it with “...previously global responses on the 11-year Solar cycle from empirical measurements ...” Lines 78-83: this exact paragraph

C2

is repeated again (lines 400-405). Is there any specific reason for doing this? Line 84: On the first two pages authors many times mentioned “previous results” and that they don’t agree with each other. It would be helpful to be more specific and say something like: “In study A the ozone response on the solar cycle at altitude X km was Y DU, while study B claimed only Z DU”. Otherwise, these statements look very vague. Line 107-108: Section 4 shows results for a few local times, not for all 24-hours. Section 2.0. Some basic information regarding to SABER measurements should be provided here: altitude range, vertical resolution, space and temporal sampling. Figure 1 and the corresponding legend: On all plots it says that results are shown in Line 188: What does it mean “consistent with 3D models”? Line 189-190: This statement is confusing. Do you mean “. . .our earlier results”? Figure 2: what is the purpose of Figure 2? Since this paper is about responses on the solar cycle at different local times, I have difficulty to understand why the ozone time series are shown here considering its 0.06 correlation with the solar cycle. Line 235-238: Please, state how did you define solar maximum and minimum. Is that a month where the F107 flux has it’s minimum/maximum, or an average over a few months around that time? Line 253: replace “8” with “18”; Line 255-256 and Sec. 3.1: Is there better way to show HALOE results rather than “manually transferred values”. Can you reach out to authors of the study and ask for the dataset? Also, this section list so many reasons why HALOE and SABER results might differ that by the end of this section I fill that there is no value in comparing them. Figure 3, caption: replace “solar activity” with “solar decadal cycle”. Figure 4, caption, line 316: It should be first explained that these are results based on HALOE analysis and then the reference should be given. Section 4: it would be useful to show the response on the solar 11-year cycle as a function of solar local time for several altitude levels (similar to fig. 1). Line 391-394: it is not clear from the context what “global results” are refer to. Is it global response on the solar decadal cycle? Section 5: I am not sure what is the purpose of this section. Authors heavily criticized previously published studies because the diurnal effect wasn’t taking into account. In this section, results from previous studies are collected, but authors do not offer any explanation for the

C3

observed spread in the results. Does diurnal effect explain the differences? Line 476: should be “at the Equator” Section 6 and Figure 11: The figure has two a) panels and two b) panels, and I was not able to understand what is shown on those plots. Reading section 6 didn’t help me to understand that either. This section and figure should be revised.

Interactive comment on Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2019-38>, 2019.

C4