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Comment on acp-2021-640

Anonymous Referee #2

Referee comment on "Impact of biomass burning and stratospheric intrusions in the remote South Pacific Ocean troposphere" by Nikos Daskalakis et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-640-RC2, 2021

Impact of biomass burning and stratospheric intrusions in the remote

South Pacific Ocean troposphere

Daskalakis et al., 2021

*This paper uses in situ and satellite observations of O3 and CO with a global 3-dimensional model of tropospheric chemistry to examine the tropospheric ozone changes over the remote south Pacific Ocean during past 20 years. They also used tagged CO tracers and stratospheric ozone tracers in the model as well as the sensitivity runs to assess the impact of biomass burning and stratospheric intrusion on the tropospheric ozone variations over this pristine region. The logic of this paper is clear, although somewhat verbose at some locations and some descriptions are confusing. It therefore deserves publication in ACP, if some remaining issues can be described better or clarified. These are summed up here below.*Line 31: ppbv and other ppbv in the paper: v should not be subscripted. There are also some similar typewriting problems, e.g. different font size at line 379, not subscripted of 3 in O_3. Please correct them all.

Line 34: Do you mean 15-23 ppb CO account for about 25% of the total CO in the troposphere of the tropical and subtropical South Pacific? How did calculated the number 25%? It is confusing. To account for the total troposphere, it is precise if you calculate the contribution based on tropospheric column CO.

Line 68: Rewrite this sentence. Convert it into several short sentences.

The projected increasing trend in STE O3 flux has been attributed to decreasing levels in O3 depleting substances (ODS), and to increasing greenhouse gas concentrations (Meul et al., 2018). Then describe them separately.

Line 84 & 88: Zeng & Pyle, 2005. I also notice some similar problems existing in other references. Please correct all of them.

Line 90: driving instead of drives? which driving the Walker circulation weakens.

Line 104, not clear, what does ENSO-3.4 warming mean? Why is not a predictor anymore?

Line 108: Double check the year range of early part and most recent decade of Samoa record. Do you mean: The increase observed in the early part of the O3 record (1981-2000) has leveled off in the most recent decade (2000-2010)?

Line 121: evaluate -> derive

Line 126: I don't think this sentence is correct. CO also has a relative long lifetime and is a good transport tracer. Also, this sentence is opposite of what you discussed later in this paragraph.

Line 134: has been based -> was based

Line 142: The authors should rewrite the objectives of this work. For example, objective b is overlap with objective e. The objective of this paper 1: understand tropospheric ozone variability over tropical south Pacific, 2: understand the drivers of O3 changes from dynamical part (STE and transport) and from source part (emissions).

Line 150: add a reference of HTAP task force.

Line 154: What is the full name of TM4-ECPL, similar problem for HALOE, AEROCOM et al. Make sure you specify all the abbreviations at the first time they appear in the paper.

Line 159: What do you mean of 'between 20 and 25"?

Line 160: Does the oversimplified chemical scheme in the stratosphere affect its simulation of stratospheric o3? If so, how trustable of model's O3 STE?

Line 198: Figure 1: need modify the figure to make stations clearer. 1: Guam, Christmas and Lauder are CO locations and need use + symbol. 2: What are the names for other CO stations? 3: for Samoa and Papa Nui where both O3 and CO are measured, the red dot plus + symbol would be proper.

Line 200: Table 1: is m.a.s.l meter above sea level? Please specify it.

Line 216: MOPITT CO product is total column and profiles, but not tropospheric column. Although CO concentration is small in the stratosphere, it still generates significant difference between total and tropospheric column.

Line 243: Please rewrite and be precise when describing the relationship between ITCZ and SPCZ and give references. SPCZ should be a portion of the ITCZ.

Line 255: "In addition, winds blow towards the SPCZ from the northeast in the east tropical Pacific and weakly from the west in the west tropical Pacific (Figure 2b)"

Do you mean the easterly winds from tropical east Pacific is stronger than the westerly winds from the west tropical Pacific?

Line 290: Figure 3: the colorbar is confusing, which red stands lower values than green. Which two stations are the two black dots in the figure? Also it would be helpful if you can also label all the station in these figures.

Line 295: Need rewrite this part: It is hard to tell that model overestimates happen over most polluted regions from the figure. The overestimate over northern India is less than 10ppb, while we see much higher overestimate in the higher latitude in both hemispheres. Do you know what caused those high model bias? Are the overestimates in the model over polluted regions are caused by the possible excessive emissions in the model? What is the emission inventory used in the model for both anthropogenic and biomass burning?

Line 304: This should be the total column CO, not the tropospheric CO. Please correct other places in the paper as well. MOPPT CO profile only have 10 level, which is impossible to get a correct estimate of tropospheric column.

Line 307: modelled -> simulated

Line 331-332: It looks to me that model shows a large underestimate at Rapa Nui at 13.1km. Should the normalized mean bias be -67% instead of 67%? And comparing Figure 6 with table 2, the NMB seems has an opposite sign with the difference between model and observations (MD-OB). Could you please check whether you have the right sign? The Equation should be NMB=sum(model-obs)/sum(obs)*100%

Line 351: do you mean that the interannual variations induced by ENSO affects the calculated trends? Any way to separate them?

Line 355: Need rewrite this paragraph. My understanding is ENSO years, the strength of the South Pacific high weaken, which weaken the subsidence and the stratosphere ozone input? On the other side, ENSO may lead to intense fires over Indonesia. These two effects counteract with each other.

Line379: different fonts

Lin 414: it is not clear how the stratospheric ozone tagged tracer is defined. Please be more specific on this important variable of your analysis.

Lin425-430: Between 150E and 280E, I could not see that "can see that there is a higher contribution of biomass burning to O3 levels (about 3 ppbv more) in the subtropics (Figure 9f) than in the tropics (Figure 9c)". Which level do you refer to? In addition to the transport patterns discussed here, it would be clearer if the authors also discuss the relative location of ITCZ and emission source regions during this season.

Figure 9: are we supposed to see the sum of two contribution is 100%?

Line 438: Please specify the lon-lat ranges of individual biomass burning source regions.