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# *Interactive comment on* "Interannual variability of the atmospheric $CO_2$ growth rate: relative contribution from precipitation and temperature" *by* J. Wang et al.

**Anonymous Referee #3**

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This paper analyses CO2 growth rate variability at Mauna Loa using the simulations of net primary productivity (NPP) and heteorotrophic respiration (RH) from 7 terrestrial dynamic global vegetation models (DGVMs). They find that NPP anomalies can mostly explain the observed CO2 interannual variations (IAVs) at MLO, suggesting a stronger role of precipitation, on contrary to some of the recent studies suggested temperature as the main controlling factor for CO2 IAVs. Precipitation (soil moisture) has long been thought to be one of the main driver of terrestrial sink/source of CO2, especially over the tropical regions. This paper further strengthen that claim. The manuscript is generally well written. However, I found the analysis a bit shallow and conclusions are sometimes not well substantiated by data. I have marked some comments below. The



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Discussion Paper

manuscript can be accepted for publication after a suitable revision.

title: as per the claim, I do not feel the paper really attempted to quantify the "relative contribution" of temperature and precipitation on CO2 sources sinks. To be precise I was looking for number how much fraction of the CO2 IAVs is due to precipitation, and how of much of the CO2 IAVs is due to temperature. I only found the total sensitivities of CO2 IAVs to T & P.

p.19074, l.15 : The models look to be more sensitive to T an P compared to measurements. Why is that. One of the reasons I can imagine is that the models do not include fires, but they are producing the IAV by increasing sensitivity to climate variables.

Such tuning is probably also leading to the large sink increased simulated by the models in the recent years.

p.19076, l.1 : I think this is true mainly in the temperate and boreal regions. p.19078, l.1 : as you may know some part of this record has to come to Keeling's data, until about 1970. including a reference to SCRIPS/Keeling is appropriate here.

p.19079, l.19 : Is this the real reason? how about low cloudiness and greater amount of incoming solar radiation?

p.19080, l.16 : is there a mismatch in '-v1' and '/V2/'?

p.19081, l.7 : if you are interested only in the region of 23S-23N, the previous step of making data at 1x1 deg wasn't needed.

p.19081, l.10 : 'temperature over land lags ENSO by 4 months'. I cannot understand the significance of this general statement. The timing of heat wave due to ENSO cycle vary from continent to continets (America, Africa and Asia) and the location, say the nothern and the southern Southeast Asia.

this study would have been more useful for process-level understanding if the authors broke down the tropical regions by continents and by hemispheres.



BGD

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p.19083, l.17 : PCP or TMP and ENSO shows similar correlation coefficient. then why conclude the 'soil moisture plays a key role ...'?

p.19083, l.25 : why blame inverse models, if you are not analysing those results. The inversion models still have some advantages to be used..

p.19086, l.2 : this is an overstatement - the bottom line is that the NPP models are oversensitive to climate, and the tuning of all 7 DGVMs are perhaps biased. for example, we may need greater disturbance flux compared to what is simulated by the models, if one compare the DGVM results with say fire emissions from say GFED.

p.19086, l.13 : I think the negative correlation are a bit strange for VEGAS model. Any explanation?

p.19086, l.28 : does this mean CFta and NPP are not casually related?

p.19089, l.15: need some reference on grided analysis, which seems to exist as per the sentence

p.19089, l.19: this is not the real world! some areas are more influenced by fires, which you do not capture by these DGVMs

p.19089, l.26: interesting observations, but too speculative...

p.19090, l.4 : you should mention whether your results agree with some others - from this sentence there seems to be some

p.19092, l.2 : maybe because there is a time lag between emissions to occur and concentration growth rate. Also note that not the whole tropical land experience the severity of an El Nino at the same time. Do have an alternative explanation ?

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