

## ***Interactive comment on “Importance of El Niño reproducibility for reconstructing historical CO<sub>2</sub> flux variations in the equatorial Pacific” by Michio Watanabe et al.***

### **Anonymous Referee #2**

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This paper describes the benefits of advanced data assimilation method in advanced CMIP6-class climate model compared to CMIP5 model. The model results and their mechanisms have been well described in this manuscript. I would recommend this paper is acceptable in this Ocean Science Journal with some support analysis based on comparison using observations to verify the assimilation skills, which could be much elevating the values of this paper.

L52. Can we discard the biological pump on the results, especially in the La Nina states? Author represented NINO3-CO2F correlation coefficients, which means both El Nino and La Nina events. As we know, decreasing the phytoplankton in El Nino

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event could affect the CO2F variability modulated by DIC solely but I wonder whether the strong positive bloom in La Nina event could absorb the CO2 into the ocean. If then, the better performance of the phytoplankton assimilation skill can be a key to elevate the better CO2F skill. Composite analysis between CO2F at El Nino and La Nina and taking difference of them to see the asymmetry would elevate the biological influence on CO2F in this model. If then, you may provide supporting figures of chlorophyll skills in this model using satellite-derived chlorophyll concentration using such as ESA-CCI (<https://esa-oceancolour-cci.org>) or GlobalColour in Hermes (<http://hermes.acri.fr>).

L142. What about observational skills in the region for CO2F associated with ENSO compared to NEW-assim skill -0.41? This can be depending on the definitions of regional and temporal scales but as you cited Dong et al (2016) represents above 0.6 skills in many CMIP5-class model (it seems like opposite sign for CO2F). Of course they do not have assimilation but do you think the ENSO-CO2F skill is generated by some limitations coming from assimilation? Otherwise you may add comparison between OLD and NEW model correlation (or regression) skill of ENSO-CO2F without assimilation (freerun) to argue this issue as a table likewise arranging skills of OLD, OLD-assim, NEW, NEW-assim and with skill of available SST reanalysis and pseudo observation data of CO2 flux at least single observation dataset such as using Landschutzer et al 2016 (link: [https://www.nodc.noaa.gov/ocads/oceans/SPCO2\\_1982\\_2015\\_ETH\\_SOM\\_FFN.html](https://www.nodc.noaa.gov/ocads/oceans/SPCO2_1982_2015_ETH_SOM_FFN.html)), opened to public or data-based estimates of carbon cycle variability (<http://www.bgc-jena.mpg.de/CarboScope/?ID=oc>), which is needed by personal contact to access. If then, you may add some figures and discussions in chapter 3.1 for comparison of ENSO-related CO2F skills between in observation, OLD, and NEW model in spatial and temporal scales. If the results are significant, this could be providing the most benefit in this paper and persuading rest of results being reasonable. According to this, you may see some figures and references in Hongmei Li et al. 2019 as you cited.