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Interactive comment on "What drives the latitudinal gradient in open ocean surface dissolved inorganic carbon concentration?" *by* Yingxu Wu et al.

Anonymous Referee #2

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Wu et al. present a detailed analysis of factors driving the surface ocean concentration of dissolved inorganic carbon (DIC). Their study is based on the recently released GLODAP v2 dataset. In order to compare DIC in a global perspective they use salinity normalized DIC (NDIC). The major conclusion of their study is that sea surface temperature (SST) is the major driver of DIC variability, followed by changes in alkalinity and Southern Ocean upwelling. Major comments: Since the study is based on the normalization of DIC I'm wondering about the used normalization. It was shown that an easy division by salinity is problematic especially in a global perspective. The authors should validate their approach or at least discuss its problems. The authors use the GLODAP v2 dataset for the surface ocean. During their calculations they convert data

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several times into pCO2. I'm wondering if the use of SOCAT as a pure surface ocean data set might be useful in order to check the calculations. What is with seasonality? Are the authors using seasonal average? I want to suggest merging the discussion and results sections. There are a lot of parameters discussed and described. Streamlining the sections and shorten it might help the readability. The whole manuscript is not easy to read. This is partly just to the fact that a lot of conversions are done and the reader had to keep track of it. There is not much that can be done to this. But the authors should carefully proof read their manuscript as some phenomena are discussed in several different positions of the manuscript. Again I want to advocate shortening it where possible in order to improve the readability. Some formulations sound odd and sometimes it's going back and forth especially in the introduction section. Specific comments (pp/ll): 01/24: cite the most actual GCB from 2017 or even 2018 01/29: I'm not sure, but is it worth to explain what CO2* is? 02/31 – 03/03: the authors discuss Takahashi (2014) work on page 2. On page 3 they say "since these studies the database was extended. . .". This doesn't make sense. 03/12: "other processes" sounds very broad. Can you specify? 03/14-16: repetition from before 03/18-20: Repetition from before 04/13: I prefer "water depth" over "seafloor depth" 04/25ff: Do the authors take spatial variability of atmospheric CO2 into account? 04/29: what is xCO2air? Please explain. 05/1-11: Somehow I got confused. It's a lot of steps for a quite easy process. But right now I also don't have a better solution. Just wanted to mention my first thought. 05/22ff: The formulation is odd. The authors state that they discuss the results in order of their hypotheses with exemptions. There are only three hypotheses so that sentence doesn't make sense to me. 06/10ff: The authors mention that the increased pCO2 has the potential to elevate values above atmospheric level. But it also can just lower the gradient if seawater is undersaturated. 07/03: ". . .Antarctic Circumpolar Current (ACC). . ." 07/05: The term "L3" is not introduced. 07/25: One example of not thoroughly structured the document. The authors talk about phosphorus and Redfield. They don't give a number nor a reference. This comes with part of the discussion here later. Please merge. 07/33: Do you mean equation 10? 08/07: Together with Eq. 9

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it reduces to nDICsurf = nDICsupply – NCP – 0.5xALK*CaCO3 08/09: RC should be RC:P 08/11: reference to Figure 5b is 5c 08/12ff: Presenting all the values in a table might be easier to read. 08/28: the effect has the potential to lower seawater pCO2 below atmospheric values. 09/32: Why are you not using the nitrate values from GLODAP? 11/01: Is evaporation only happening in the Atlantic? 11/15: Why is nDICtemp the gas exchange effect? Can you explain? 17/17ff: CDIAC is no longer maintained.

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