Review of "What drives the latitudinal gradient in open ocean surface dissolved inorganic carbon concentration?" by Yingxu Wu et al.

The authors present an analysis of driving mechanisms behind the north-south gradient of surface ocean DIC. The study is based on DIC and alkalinity data from the database GLODAP v2.

Major issues:
The authors calculate pCO2 from DIC and TA data, which results in a non-equilibrium pCO2. This is then converted to a standard temperature and calculated back to TA and DIC assuming that pCO2 is back to its initial value. As a major part of the pCO2 disequilibrium in the ocean is associated to temperature changes wouldn't it be more useful to assume equilibrium with the atmosphere (at in-situ temperature as well as at standard temperature) when calculating the temperature effect on DIC?
The two major weaknesses raised during the first review iteration are still persisting, the normalization of DIC without a freshwater component and the disregard of seasonality.
I am not convinced that excluding areas strongly influenced by riverine input is enough to solve the problem with the DIC normalization. Fitting the alkalinity against the salinity gives also in the open ocean a non-zero intercept that can be vary from region to region. With the GLODAP v2 dataset there is an excellent database to calculate this intercept and it's regional variations. It has at least to be discussed what influence this would have on the latitudinal gradients.
Regarding the seasonality I do understand that there is not enough data in the Southern Ocean to resolve and discuss seasonalities. But nevertheless these influences need to be discussed. The salinity normalization of phosphate, for example, can produce relatively high residual phosphate and thus 'unused DIC' during summer in regions with low salinities although these might experience phosphate limitation during summer. Also I am missing a notice that using phosphate concentrations as tracer for the influence of primary production is a simplification. C:P ratios are highly variable, not only, as mentioned, regionally, but also seasonally. Under phosphate limitation phytoplankton is still able to fix carbon, and release it as DOC.
As a last major point, the manuscript is partly very difficult to read. The discussion of effects on DIC and nDIC is sometimes confusing and the reader might get lost which of both is discussed and why.

Minor issues:
p. 10 l. 21: Here DIC_{obs} and $nDIC_{obs}$ are discussed, right?

p. 11 l. 12: Rephrase this sentence. It reads as if you have data at 70°S in the northern Atlantic.

p. 12 l. 13: This part needs some changes. Most of the DIC variability is in fact not caused by changes in alkalinity but by dilution and evaporation and therefore is

not existent anymore when discussing the nDIC. Alkalinity and DIC are just influenced in a similar manner.

p. 12 l. 25: TA and salinity are only in the open ocean highly correlated

p. 13 l. 9: nutrients, **nDIC** and nTA?

p. 13 l. 10: delete 'then'

p. 13 l. 30: change of nTA, or change of TA relative to the DIC changes

p. 14 l. 22: this should also be a function of the chemical composition: how low is the iron concentration in the upwelled water in comparison to the other nutrients.

p. 14 l. 23: delete '.'

Figure 1: increase the resolution of this picture. The description at the colour axis only says DIC

Figure 2: Here a direct influence from evaporation & precipitation to DIC is missing. Also, in the description of the figure it is written about both DIC and nDIC. For which of these two is the diagram?

Figure 5: The resolution of the picture should be improved. The map should be deleted from this picture. Show the location of the transects in Figure 3 instead. I think all figures should follow a common design when it comes to setup and fonts. Please change the design of this figure match the other figures. I don't understand the use of the black contour lines. Either, choose them in a way that the cover the entire data range or delete them.

Figure 8: Are these the same transects as in figure 5?

Figure 9: Change the rotation of the longitudinal label to 0°.