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Interactive comment on "Diagnosing CO$_2$ fluxes in the upwelling system off the Oregon coast" *by* Z. Cao et al.

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Cao and co-authors use a conceptual model to estimate CO2 dynamics/fluxes in up-welling systems. The model is referred to as OceMar (Ocean dominated Margin) and is derived from the work by Dai et al. (2013) in the Caribbean region. In short, it is based on the idea that the carbon to nutrient ratio in upwelling water determines the surface water CO2 levels. Biological consumption determined from decreasing nutri-ents concentrations will decrease the pCO2. The final pCO2 value when nutrients are drawn down to zero can either be greater (CO2 source the atmosphere) or less than atmospheric (CO2 sink) depending on the C:N ratio of the source water.

The concept is elegant and simple, and "works" in some environments and less so in others. For the Pacific upwelling system the authors essentially show that it does not

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work very well. As described in the paper for the method to work, the system has to fulfill the following:

1. It should be in steady state

2. Alkalinity needs to be modeled as a function of salinity

3. Biological uptake needs to follow Redfield stoichiometry, in particular the C:N ratio is assumed to be 6.6:1

4. Endmembers need to be well described.

5. The residence time of the water needs to be on the same order as biological response

The authors use two case studies in the USA West Coast upwelling system, one off the coast of Newport OR, and one at the Oregon-California border. The method " works" at the former and fails at the latter which is attributed to non-steady state conditions.

The fundamental issue is, that it is difficult to independently determine if the criteria for successful application will be met. Thus, if the calculated pCO2 values end up being reasonable compared to observation it can be assumed that they are, or that compensating errors yield a reasonable value. When the values do not meet expectation it can be assumed that some of the criteria are violated. We know that upwelling systems are highly dynamic; that Alkalinity to salinity ratios are regionally constant for surface waters but not for subsurface (or many upwelling systems); that Redfield stoichiometry is an average that often does not hold in surface water analyses; and that endmembers are difficult to determine. Therefor the applicability and use of the approach seems limited.

The paper is nicely written and well-researched. A minor issue is that the Revelle Factor appears to be misinterpreted and incorrectly used by assuming that a fractional change in pCO2 in the same as the air-water concentration difference (plus that temperature, alkalinity, and salinity do not change).

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