

## ***Interactive comment on “Wind driven changes in the ocean carbon sink” by N. C. Swart et al.***

### **Anonymous Referee #2**

Received and published: 6 August 2014

Swart and co-authors investigate wind and eddy changes on the air-sea CO<sub>2</sub> flux. The authors conduct three interesting and relevant experiments, where they (I) investigate the effect of historical wind changes on air-sea CO<sub>2</sub> flux using the 20CR wind product and the UVic ESCM, (II) compare results derived from a variable eddy transfer coefficient to a constant one and (III) compare results using 6 different wind products.

While the experiments conducted are relevant for publication, I have some doubts about the presentation of the studies and the conclusions drawn in the manuscript. E.g. the authors find that over the 1950-2010 period the SH westerlies intensification led to a net reduction of the ocean carbon sink of about 10% of the total uptake by 2010, however the reader is left in the dark if this number is significant or within the uncertainty of the cumulative flux from 1950-2010 (particularly given that the fluxes are so sensitive to the wind product used, as the authors show in their study (III)). Although I think the issue here is mainly the current presentation of the manuscript and the num-

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ber of changes proposed below is low, I do think some major revisions are needed. Please find a list of all comments in the major and specific comments section below.

Specific comments:

Abstract, line 2: “observed wind forcing” - Please consider changing to “observation-based” etc. as you are not using actual observations.

Abstract, line 5: “observed wind changes act” - the use of “observed” again causes confusion. Do you mean the changes in observations, or the changes that are observed by the authors from the 20CR product?

Abstract, lines 7-13 and conclusions (page 8034) lines 17-21 and Figure 2 (page 8044): You argue that the carbon cycle is sensitive is sensitive to the variable eddy transfer coefficient, however when looking at Figure 2, the difference between the 2 products appears to be neglectable small for the air-sea flux. Please clarify.

Abstract line 15, Page 8032 lines 19, page 8032 line 21 and page 8033 line 18: There are several occurrences where the term “significantly” is used but it is not clear if an actual statistical significance test has been conducted. In the abstract line 15 you argue that the wind trends over the 1980-2010 period are significantly different between the 6 runs. Table 2 illustrates the significance level of each run individually (indicated by bold numbers), but not in comparison, i.e., if they are significantly different. Same for page 8032 lines 19 and 21 where the reader is referred to figure 6, but it is not clear if the significance has been tested. Finally, on page 8033 line 18, it is again not clear if the difference between the flux trends is significant.

Page 8025 line 6: “remain” remove the “s” at the end

Page 8026 lines 10-14: I assume the term “realistic” refers to the comparison with observations. Please consider changing “realistic” to “in good agreement with observed (or observation-based) data”.

Page 8026 line 13, page 8029 lines 5-7 and page 8033 lines 10-12: “observational

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uncertainty” - Presumably this refers to the results from the ocean inversion studies, also plotted in figure 2a. As you show these results explicitly consider using the original reference and not the IPCC report. Particularly if the reader is interested in the actual “observational uncertainty” number it can be hard to find in the IPCC report. Furthermore, it is worth mentioning that these “observational uncertainty” numbers are derived from ocean inversions, as different estimates, e.g. the Takahashi et al (2009) estimate for the year 2000 or others outlined in Wanninkhof et al. (2013), do exist, but are not mentioned here (NB: I do not suggest to include other estimates, but to be clear about what observation-based estimate the results are compared to).

Page 8028 lines 1-6: Thank you for the clear outline on how trends and their significance are calculated, but what about uncertainties in the net CO<sub>2</sub> flux estimates (see e.g. comment in general section. This uncertainty estimate might be relevant for the results of the wind experiment)? Furthermore, In figure 7 you show that the difference between the runs is within observed uncertainty, but are they within each others uncertainty (as differences appear to be mainly within 0.2 PgC/yr – at least for all runs except CFSR)?

Page 8028 lines 17-19: This has been identified in the introduction

Page 8028 lines 19-20: “currently the best available” Please provide a reference for this statement, or if it was your own finding, please clarify how you get to this conclusion.

Page 8029 line 2-3: “according to the observations” which ones? Please provide a reference.

Page 8030 line 2: “large interannual variability” - I am not convinced by the term “large” on a global scale. The references provided for this statement do not clearly indicate large interannual variability globally, although Lenton et al. 2013 report substantial interannual variability relative to the annual mean flux in the Southern Ocean and Wanninkhof et al. 2013 reports large interannual variability in the tropical Pacific.

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Page 8030 line 9: can you comment on what “internal variability” means here?

Page 8048 caption figure 7: Please add description of observation estimate markers and reference to caption.

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Interactive comment on Biogeosciences Discuss., 11, 8023, 2014.

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