Interactive comment on "Uncertainty of the global oceanic CO2 uptake induced by wind forcing: quantification and spatial analysis"
by Alizée Roobaert et al.

Roobaert Alizée et al.

Anonymous Referee #2 (R2)

R2 : In their manuscript the authors present an in depth study of the impact of different gridded wind speed data products - such as CCMP, ERA, NCEP1 and NCEP2 – utilized to determine air sea fluxes of carbon dioxide on global and regional scales. Therefore they combined those data with a globally re-gridded sea surface climatology of pCO2 values covering the years from 1991 to 2011. By employing different parameterizations for the calculation of CO2 fluxes they found a strong dependence of this number on the choice of the specific wind speed product.
To constrain the variability of air to sea fluxes of CO2 is of great importance for assessing the global ocean carbon sink and the concomitant acidification. In order to minimize the error in the flux calculations the authors propose to recalibrate the piston velocities (k-formulations) for the respective wind speed data product.
The manuscript is well written and contains important informations and innovations.
The methods and results are clearly presented. However, the manuscript would benefit from a short discussion of the consequences for Earth system modeling. What is the expected impact of the findings in this study on model projections regarding the evolution of the future carbon sink? A short clarifying paragraph would be helpful.

I recommend publication in "Biogeosciences"

As elaborated in answer two of reviewer 1, it is not straightforward to compare the observation-based uncertainties derived here to model-derived uncertainty assessments. Nevertheless, as explained in the revised text (pg 15 lines 2-10), one can speculate that because of the dynamic pCO_2 adjustment mechanism in models, combined with the use of a single k formulation and a given wind product to carry model projections, the uncertainties induced by the wind forcing could be underestimated in the assessment of the future ocean carbon sink by a given model.

Uncertainties in the present and future ocean CO_2 sink are constrained by model ensembles relying on different k parameterizations, wind products and spatio-temporal resolutions. But as already mentioned in the original manuscript "*In numerous modeling studies, FCO_2 is still calculated using k-parametrizations from the literature combined with a different wind product from the one used to calibrate the coefficient c (e.g. Aumont and Bopp, 2006; Bourgeois et al., 2016; Matear and Lenton, 2008; Le Quéré et al., 2007; Schwinger et al., 2016; Thomas et al., 2008)* ». Following reviewer's 2 suggestion, we have now added in the revised text (pg 10 lines 26-28): ***« These inconsistencies call into question the assessment of the wind-induced uncertainties associated with the future ocean CO_2 sink and a systematic approach, similar to the one used for the observation-based estimation of the present-day FCO_2, should help better constrain model-derived uncertainties. »***

As well as some considerations regarding the need for an update of these formulations of k in global models at the end of our conclusions section (pg 15 lines 11-17):
"***Currently, the uncertainty in the global CO_2 uptake by the ocean is estimated by comparing multiple global models (Ciais et al., 2013). Unfortunately, these models use various formulations of k, some of which are outdated like that of Wanninkhof (1992)***

and wind products which are not always consistent with their formulation of the piston velocity. Based on our analysis of the impact of the choice of the wind product and its resolution on FCO_2, we believe it would be beneficial to update these representations of the CO_2 exchange in these models. Ideally, the value of c should be adapted to match a global k consistent with the global average derived from the latest ^{14}C budget (Wanninkohf et al., 2014)."

Finally, models are constantly evaluated and improved upon by observations based estimates, for the calculation of which our uncertainty estimates are relevant. We believe that it is in this context that our study is also particularly relevant and potentially the most impactful for the global carbon modelling community and future model projections.

Again, we are grateful for the reviewer's evaluation of our manuscript.
On behalf of all co-authors,
Alizée Roobaert