



Comment on **essd-2021-16**

Andrea Fassbender (Referee)

Referee comment on "SeaFlux: harmonization of air–sea CO₂ fluxes from surface pCO₂ data products using a standardized approach" by Amanda R. Fay et al., Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2021-16-RC3>, 2021

General Comments:

Fay and coauthors aim to improve the global net air-sea CO₂ flux estimate and ease model-data comparisons by making a diversity of pCO₂ data products (n=6) with methodological differences more consistent and releasing the results as a new data product: SeaFlux. Their approach involves relying on a climatological pCO₂ data product to spatially extrapolate estimates from other pCO₂ data products with more limited ocean coverage. After extrapolating all pCO₂ data products to the same ocean mask, the authors calculate the net air-sea flux using three wind speed products, while accounting for gas exchange coefficient sensitivities to the individual wind speed products. The authors find that the flux estimate discrepancies between these products can be reduced most by simply using a consistent ocean domain for the pCO₂ data products.

The paper is clearly written, the findings are important, and the data product will simplify model-data comparisons. However, a justification for the extrapolation approach is not provided, and a few simple analyses are required to verify that the approach is "a step forward from" existing methods. Reviewers 1 and 2 have already outlined several concerns; therefore, I will keep this brief and focus on specific suggestions and technical corrections for the authors to address.

Specific Comments:

My primary concern is with the pCO₂ scaling approach. It is not clear why the MPI-ULB-SOMFFN climatology was used for gap filling rather than the time evolving JENA-MLS data product. As noted by Reviewer 2, the authors could test their scaling method by using JENA-MLS as the reference data product to see if they achieve similar results.

It is also unclear why the authors use an ensemble mean scaling factor when individual scaling factors for each data product may be more appropriate as it would allow more data to be used (i.e., a consistent mask wouldn't be required) to determine the scaling factor for most products. I can understand the desire to maintain consistency in the data extrapolation between products, but it's not clear that this approach makes more sense than creating individual scaling factors for the data extrapolations. More information is needed to explain why this decision was made.

As a sensitivity test, the authors could apply their methodology using JENA-MLS to scale MPI-ULB-SOMFFN (and vice versa) directly AND using an ensemble mean, to see which yields a better result. They could also do this using (1) the common missing data mask as well as (2) each missing data mask from the four other data products to evaluate whether the resulting extrapolation bias is sensitive to the extrapolation area. The authors could also apply the linear-scaling approach used in the Global Carbon Budget (GCP) to MPI-ULB-SOMFFN and JENA-MLS (using the missing data masks from the four other products) to quantify the resulting extrapolation biases and determine whether their approach is indeed more accurate than the GCP method.

The suggested analyses may help clarify which approach is best for achieving data product comparability.

Technical Corrections:

Title: The 2 in pCO₂ should be subscripted.

Line 36: pCO₂ is not yet defined.

Line 37: Add "modern" before "global mean uptake"

Line 43: "variations" should be "variation." It seems that the atmospheric pCO₂ growth rate is the largest driving force governing the net exchange of CO₂ across the air-sea interface unless you're talking about sub-annual or pre-industrial timescales. Please clarify.

Line 57: How about: "These differences in flux calculations introduce uncertainty in comparisons between the products and with Global Ocean Biogeochemistry Models (GOBM)."

Line 95: pCO₂ was already defined.

Line 97: A "we" seems to be missing.

Line 100: Satellite SST and EN4 subsurface salinity data are used to calculate parameters required for the air-sea flux calculations. What depth are the EN4 salinity data from?

Line 108: Slightly awkward wording. What about: "Flux is defined as being positive when CO₂ is released from the ocean to the atmosphere and negative when CO₂ is absorbed by the ocean from the atmosphere."

Line 117: "...relationships between pCO₂ and proxy variables are expected". The next sentence starting on this line doesn't seem to make sense. Maybe get rid of "in contrast."

Line 130: "net global(?) fluxes"?

Line 159: There seems to be a formatting issue. Additionally, it's not clear if you are talking about the original global flux for each model, or not.

160: Is this because some products are missing the Arctic? That seems important to clarify.

Line 162: "...the final CO₂ flux also depends on the..."

Line 82: Remove equal sign.

Line 330: Typo.

Figure 2: I would recommend converting this a four-panel figure with the inset graph having its own panel since there is space. Add a-d lettering to match the caption.

Table 1: It is not clear what "unfilled area listed" means. Should this be "Area coverage"?

Table 2: Should the 3rd row be titled "Mean Annual Global Flux"