

RC2: 'Comment on essd-2021-233', Anonymous Referee #2, 02 Oct 2021

General Comments:

This manuscript describes a new database (ABC Fluxes) of CO₂ flux measurements in arctic and boreal ecosystems. Overall the manuscript is well written and clear. However, the process of downloading data needs to be clarified – as I explain below, the big green “Download Data” button on the ORNL DAAC website did not give me a complete data file. One apparently needs to scroll down to the bottom to request the entire dataset, but this is not at all apparent at first pass and could lead to users missing data.

I also question the decision to exclude studies with limited measurements during the summer (while including limited measurements in off-seasons due to data scarcity during those time periods). While I agree that data sets with limited repetition are more uncertain than data with many repetitions, ideally ABC Fluxes users could make their own judgements about whether to include this data in their work. I recognize that going back to include this data is likely unfeasible at this point, so please instead provide an idea of how many studies were excluded. Then, perhaps future versions of ABC Fluxes could include these additional studies.

1) Data downloading

Thank you for this important feedback. We contacted ORNL DAAC in September and they have fixed the data downloading process now.

2) Excluding studies with limited measurements

We agree with the referee that our decision to exclude summertime monthly measurements with <3 temporal replicates might have led to a loss of data that could have been useful for some data users, and hope to add those to the next version of the database. However, we think that

there are some good justifications on why such measurements were excluded from the first version of the database which we aimed to clarify in lines 425-442:

“At chamber and diffusion sites, we disregarded observations including a low number of temporal replicates within a month (<3 individual measurements in summer months) and only one measurement month to ensure the temporal representativeness of the measurements. For the spring (March-May), autumn (September-November), and winter (December-February) months, one temporal replicate was accepted due to scarcity of measurements outside the summer season (June-August); measurement frequency is included in the database. We excluded monthly summertime measurements with <3 temporal replicates because within summer months, meteorological conditions and the phenological status of the ecosystem can vary significantly (Lafleur et al., 2012; Euskirchen et al., 2012; Schneider et al., 2012; Heiskanen et al., 2021), and a single measurement is unlikely to capture this variability. Our decision to exclude measurements that have only one measurement month was based on our goal to assess the temporal variability of fluxes. We justified the acceptance of a lower number of temporal replicates for the other seasons based on the assumption that flux variability is lower during the winter months, and at least during most of the spring and autumn months, due to the insulating effects of snow (Aurela et al., 2002; Bäckstrand et al., 2010). We estimate that excluding measurements with <3 temporal replicates during the summer months resulted in a 10 % loss of data. In total, 98 % of the chamber observations were from published studies; we assume that the peer review process assessed the quality of published data.”

We added the following description of studies that were seasonal in lines 330-340:

“We did not include fluxes reported at longer timesteps (e.g., seasonal aggregations), which, based on our rough estimate, resulted in a 10-20 % loss of data from sites and periods that would have been new to ABCflux. These excluded data primarily included some older, non-active eddy covariance sites and seasonal chamber measurements (e.g., (Nobrega and Grogan, 2008; Heliasz et al., 2011; Fox et al., 2008)). However, many of these data were located in the vicinity of existing sites covered by ABCflux (e.g., Daring Lake, Abisko), thus excluding these measurements does not dramatically influence the geographical coverage of the sites.”

We want to stress that studies that measure fluxes to estimate monthly budgets often measure them more than once during the summer months; thus our decision to exclude measurements

with <3 temporal replicates during the summer months did not lead to significant losses of data. Studies that have fewer replicates often standardize fluxes to a common light level and temperature to compare across sites (e.g., NEE at 600 PAR or Reco at 20 Celsius) instead of trying to provide monthly mean fluxes or extrapolate the measurements across the entire month (see e.g., Shaver et al. 2007, Sorensen et al. 2019, Cahoon et al. 2016).

Specific Comments:

Line 208: “fluxes from plants and soils to the atmosphere.”

We corrected this.

Line 216: Since you have included the measurement scale for eddy covariance and chamber measurements, please comment on the measurement scale for snow diffusion.

We added this information.

Line 250: At some point in paper, please quantify (at least approximately) how much data you lose by using monthly values and excluding papers that do not report data on a monthly basis.

See our response above.

Lines 304 – 309: the sub-plot labels b, c, d, and e are mixed up

We corrected this.

Line 313-314: Here you only cite 5 prior synthesis efforts, but your Table has 7 other efforts. Is this an oversight, or is there a reason you did not look at two of the synthesis papers to identify potential data?

We added Baldocchi et al. 2018 and Luyssaert et al. 2007 to the citation.

Line 323-328: I am curious to hear more about why you decided to exclude summer measurements if there weren't many replicates. While fewer replicates will make the uncertainty higher, eliminating these data sets entirely could throw away potentially valuable information that ABCfluxes users may want. It seems to me that, in an ideal world, ALL data of sufficient quality (if not quantity) would be included, and then database users can decide whether or not to include these small studies in their results. I am not suggesting you re-do the database now to include all these disregarded summer points, I recognize that would likely be a huge time investment, but I am curious to know approximately how many datasets were discarded.

See our response above.

Line 364-368: Please clarify here that in FLUXNET2015, “_QC = 0” means measured values and “_QC = 1 means good quality gap-filled values. Otherwise, your phrase “0 = extensive gap-filling, 1=low gap-filling” could be interpreted to conflict with the FLUXNET2015 QC designations and may confuse people. You could write something like “indicating percentage of 366 measured (quality flag QC = 0 in FLUXNET2015) and good-quality gap-filled data (quality flag QC = 1 in FLUXNET2015); average from daily data; 0=extensive gap-filling, 1=low gap-filling).

We added this correction, together with a reference to the Fluxnet2015 web page where this is described.

Line 397: Ah! I now see that the dataset is supposed to have 6309 rows. The first time I downloaded this dataset I went to <https://doi.org/10.3334/ORNLDAAAC/1934>, logged in, and clicked on the big green “Download data” button near the top of the page. However, the file I get from this only has 1408 rows. I now see that if I scroll down the webpage I

can request a much large file. Why does the “download data” button not provide the full dataset? Can this be changed? If not, you may want to warn the user about this in your text.

Thank you for pointing this out - we had not noticed it. ORNL DAAC should now have fixed it.

Table 3: please clarify that by “Number of observations” you mean # of months of data.

We clarified this.

Line 515: Please clarify that the likely reason you have less data from 2015-present is because of a reporting lag, not because eddy covariance towers are measuring less data now.

Thank you for this important point - we added a sentence about this.