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Biogeosciences Discussions

Interactive comment on "Quality control of CarboEurope flux data – Part I: Footprint analyses to evaluate sites in forest ecosystems" *by* M. Göckede et al.

M. Göckede et al.

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Answers to main concerns

1. Include CO2 fluxes before/after filtering the data

The authors assume that 'changes of the fluxes' refers to the effect on the annual NEE budget when applying the described footprint filter on the eddy-covariance data, since single flux measurements are not modified but simply flagged. We agree with the referee that this would be a highly interesting research topic, particularly when findings could be related to commonly adapted data quality screening methods. However, processing of the QA/QC flags using the quality assessment scheme as presented by Foken and Wichura (1996) in the revised version by Foken et al. (2004) requires high-frequency eddy-covariance raw data, which are not available in the CarboEurope database. For the presented study, we received such raw data directly from the site investigators, but for each site only a few months of data are available (see also Table 2 in the manuscript). Starting over with the data collection and processing to end up with 25 full site years of flux data would imply an enormous additional workload that is beyond the scope of this study. As long as the above mentioned QA/QC scheme (Foken and Wichura, 1996; Foken et al., 2004) is not part of all the standard eddy-covariance data processing within CarboEurope (Mauder et al., 2007), which would make the QA/QC flags available in the database, application of this scheme has to be restricted to studies with either short timeframes (such as this one) or fewer participating sites.

For a single site and a single year of data, Ruppert et al. (2006) demonstrated the usefulness of the flux data quality assessment scheme as presented by Foken and Wichura (1996) in the revised version by Foken et al. (2004), and compared the results to those of a friction velocity (u*) threshold criterion. In that study, however, no footprint filtering was used. Since the application of this scheme basically alters the length and distribution of data gaps over the year, the net effect on the annual NEE would also be highly dependent on the gap-filling procedure applied afterwards (e.g. Moffat et al., 2007).

Application of the footprint filtering (i.e. using the land cover composition within the footprint to flag data) would in principle be possible for extended timeframes, since the required input data is stored in the CarboEurope database. However, in the context of this study it does not make sense to apply this filter alone, since the differentiation between 'good' and 'bad' data is dependent on the objectives of each specific study (see also Section 4.1 of the manuscript).

2. Extend description of methodology

The second paragraph of Section 3.1 was extended to give more details on the coupling between footprints and flux data quality assessment. The description of the flux data quality assessment was moved from Section 2 into a new Section 3.3 'Flux data quality assessment'. This new section gives more information on the flagging procedures for eddy-covariance data.

3. Shorten repetitive part of manuscript

The repetitive parts in the results sections were deleted (see also below).

Specific comments

1. We changed the title to 'Quality control of CarboEurope flux data. Part I: Coupling footprint analyses with flux data quality assessment to evaluate sites in forest ecosystems'.

2. The settings of the classified footprint calculations were optimized to fit the CarboEurope dataset. The maximum deviation found for this study was 1.13m, for a total measurement height of 40m.

3. Atmospheric stability was calculated as the ratio of measurement height zm and Obukhov length L. Values for the Obukhov length L varied in 9 steps between -1 and -80 for unstable cases, and in the same way between 1 and 80 for stable cases. For neutral stratification, an Obukhov length of 1000000 was used. The settings correspond to atmospheric stability ranges which are dependent on measurement height and therefore vary from site to site, but which span the entire stability range where footprint simulations are valid for each of the sites analyzed here.

4. The computation of the source weight function itself is not affected by the absolute horizontal wind speed, only by the relationship between horizontal and vertical transport which is represented by the friction velocity u*. The wind direction only influences the source weight function through the roughness length, which is computed through a flux aggregation model (Hasager and Jensen, 1999) and therefore dependent on the fetch (Göckede et al., 2006). However, the wind direction is extremely important for

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using footprint analyses in the context of the site evaluation approach as presented in this manuscript: While the footprint algorithm computes size and shape of the source weight function, and its distance to the tower position, the wind direction determines the exact position where that source weight function is projected on the matrix which represents the surrounding terrain.

5. An additional table (Table 3) was added that summarizes the flux percentages obtained for all sites, differentiated into 3 categories ($>$95%, $>$80%, $>$50%).

6. The first paragraph of Section 4.2 was deleted except for the first and last sentence. The rest of Section 4.2 was shortened.

7. The description of the integral turbulence characteristics is given in the new Section 3.3 on 'Flux data quality assessment'.

8. A sentence on the treatment of the u* criterion was added to the description of data processing in Section 2.

9. The stability range for stable stratification was added to the figure caption.

10. Wind speed does not alter the footprint results (see also comment #4).

11. We agree with the reviewer that the concept of e.g. a 90%-footprint as described in his comment is the most familiar one for most users. However, this concept cannot be directly related to the isolines of normalized accumulated source weight as shown in the Figure. The isoline for e.g. a 50%-footprint would encircle the area that contributes 50% of the total flux, as stated in the reviewer’s comment. In the accumulated source weight function, however, the 50% isoline marks a ring of cells that have exactly half the influence on the flux measurements (integrated over time) than the peak of the function, but the encircled area does not account for 50% of the flux. Therefore, there is no way to derive a 90% footprint from the peak percentages.

12. The authors have been trying out a large number of different layouts for the figures presented in this manuscript, with the conclusion that there is no better way of

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summarizing these different layers of information. We are aware of the problem that some information content may be lost if the manuscript is printed out on black and white. However, the only true alternative we see is simplifying the classifications used so that they could be represented in well discernable grayscales; this, on the other hand, would imply to lose some information in the first place, so we decided against.

Technical corrections

1. The colon was inserted as suggested.

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