Biogeosciences Discuss., 6, S1144–S1147, 2009
www.biogeosciences-discuss.net/6/S1144/2009/

Biogeosciences Discussions

Interactive comment on "On observational and modelling strategies targeted at regional carbon exchange over continents" *by* C. Gerbig et al.

C. Gerbig et al.

Received and published: 10 June 2009

First of all we thank the reviewer for the helpful comments to our paper. In the following reply we try to address the comments the reviewer made.

Reviewer: "... it is a bit unclear on what type of audience the article is targeted. Considering wider audience, however, the style is somewhat rarefied. Therefore it might be worthwhile to honestly target the article to a smaller group and clarify and deepen the presentation of authors own results connected to this specific manuscript. Detailed comments on the modeling errors and representability have already been given; thus just a few short notes are given here which deal with the presentation and interpretation of the results."

Response: In the abstract as well as in the introduction we have mentioned that the

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

paper is concerned with regional carbon budgets from top-down (inverse) analysis of atmospheric measurements as well as with bottom-up analysis of local scale process information. The publication in the context of the special issue "Regional exchange of carbon between land and the atmosphere", should help targeting the appropriate type of audience. To further make clear the targeted audience, we modify the second sentence in the abstract to: "This paper discusses evidence for a number of important shortcomings of current generation modelling frameworks designed to provide regional scale budgets from atmospheric observations."

Although results of the simulations we used for this paper have been published before, the simulations have not been looked at (or presented) in such a systematic way that allows for assessing the relative influence of near-field vs. far-field contributions. The purpose of this paper is to assess the implications of the findings related to the strong near-field influence for estimating regional carbon exchange. We regard this as important information also for the wider community, as it has impact on inverse modeling strategy, on up-scaling of local fluxes to regional and continental scales, and on the design of the measurement network.

Reviewer: "p. 1322 What means a typical tall tower? How would the results change for a surface site vs. tall tower?"

Response: In the introduction (page 1319) we introduced the term tall towers as towers with a height of around 200 m or taller. We will add this information also on page 1322 in the revised manuscript. Regarding the changes of the results for near-surface site vs. tall tower, we will modify the statement in the revised manuscript at page 1324, line 10: "Note that only contributions related to afternoon measurements (15:00 local time) are shown, when mixing is deep and transport models are assumed to be able to accurately represent the measurements (Geels et al., 2007). This is also a time when differences between a measurement at around 300 m (e.g. from a tall tower) and at 30 m (as used here for the Harvard forest tower) are very small due to the fast vertical mixing by turbulence (Bakwin et al., 1995); consequently these simulations for a short

BGD

6, S1144–S1147, 2009

(30m) tower can be regarded as representative also for a tall tower during well mixed afternoon periods."

Reviewer: "p. 1322 The simulations were made for August 2002. Why was this period chosen, and how would you expect the results to change over the course of the year?"

Response: We chose a month during the growing season as fluxes are large and have the strongest impact on the annual carbon budget. On page 1325, line 20 we stated in the manuscript: "Periods during the dormant season are substantially less affected by this effect due to the absence of photosynthesis which causes the diurnal cycle. However, biases during the growing season will have an impact on annual or decadal budgets. "

Reviewer: "p. 1323 Equation (2): The footprint and surface flux functions should be explained in more detail, since they are central elements in the simulations. Please clarify, what will be the role of lateral boundary conditions in the light of current results."

Response: We fully agree that the description is not sufficient and we will modify the explanation of footprint and surface fluxes in equation (2) in the revised manuscript to: "The footprint f(...|...) (in units of ppm s/moles) with units of relates the surface flux A(...) x F(...) (in units of moles/s, as the product of grid cell averaged flux density and grid cell area) at location phi_i, r_j, and at time t_m to mixing ratios at time t_r at the tower located in the origin of the coordinate system. Thus the footprint elements represent sensitivities of mixing ratios at the measurement location to upstream surface fluxes at prior times (note f(...|...) is zero for time t_m$>$t_r). Summation over the prior times t_m then results in contributions from each surface grid cell to the observable mixing ratios at the measurement location."

Regarding the lateral boundary condition: The results of our study do not affect the role of the lateral boundary condition. As the regional model domain is chosen such that the lateral boundary is far away from the observation site, influences from the boundary are mixed over larger scales when they are advected to the site. The choice of the regional

BGD

6, S1144–S1147, 2009

domain in a sense determines the scale of the far-field influence, as also discussed in our response to referee Peter Rayner.

Reviewer: "p. 1329 A lot of attention is put on presentation of model-data-fusion system. Still it would be good to specify more clearly and in more detail the new points presented in this work."

Response: The new point put forward in this paper in terms of model-data-fusion is the suggestion to deal with the requirement of higher spatial resolution by using high-resolution nests. This is introduced on page 1330. A further new point that we suggest is to strategically combine tall towers with eddy flux systems or short towers in their near field for better characterization near the tower, so that atmospheric concentration measurements can be used as a constraint on the larger scales (page 1331, discussion of the impact on network design). We will modify the manuscript to make this more clear also in section 2.3.

Reviewer: "p. 1332 A list of recommendations would indeed be a good addition here, whether in rank order or not."

Response: As we stated in our reply to the first reviewer, in the conclusion we had listed some recommendations, but we agree to make these more visible in the revised version of the paper.

Interactive comment on Biogeosciences Discuss., 6, 1317, 2009.