Atmos. Chem. Phys. Discuss., 12, C2203–C2206, 2012
www.atmos-chem-phys-discuss.net/12/C2203/2012/


Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Observing the continental-scale carbon balance: assessment of sampling complementarity and redundancy in a terrestrial assimilation system by means of quantitative network design" *by* T. Kaminski et al.

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Received and published: 7 May 2012

This manuscript describes the application of CCDAS to network design questions. The system is nicely set up in that it combines different data streams from ecosystem measurements of fluxes and from atmospheric mixing ratio observations obtained with flask sampling and continuous measurement systems. Furthermore, its ability to quantitatively propagate uncertainties in these data streams and their representation in the modelling framework is commendable. The manuscript is clearly written. However, a number of questions remain that I would like to see addressed before accepting the



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paper for publication.

General comments:

1) Given that the study uses a structural error of zero (offset term in Eq. 2 set to zero) the assumption of uncorrelated data uncertainties has a dramatic impact. The data uncertainties need to account for representation errors. Such errors, e.g. due to an incorrect representation of a flux site in the biosphere model, would typically correlate over time. So the assumption of uncorrelated uncertainties seems incorrect, and would cause an underestimation of the resulting uncertainties. Indeed, the results from the text case with single flux sites indicate, that the posterior uncertainty changes by only a very small amount (<5% for NEP, <10% for NPP) when using 100 times smaller data uncertainties. Given that this data uncertainty needs to include measurement error and model error, this seems to point to a problematic choice of the data uncertainty where the model appears nearly perfect.

2) Similarly, uncertainties due to the model's representation of atmospheric mixing ratio measurements at a specific location might e.g. be due to orography, such that a mountain station can not be correctly represented as the model does not resolve the mountain as such. This would also introduce a bias (temporally correlated error) rather than simple uncorrelated noise. Also note that due to the daily frequency assumed for continuous data, the 1.5ppm uncertainty average out to about 0.27ppm uncertainty for a given month, which is rather small compared to the 1 ppm uncertainty assigned to monthly flask observations.

3) The balance between flux and mixing ratio data uncertainties decides on the outcome of the network design assessment. This needs to be clearly discussed. Given the issues mentioned above regarding the temporal correlation in data uncertainties and given the fact, that no structural error was accounted for, I think a clear justification needs to be given for this choice of balance in uncertainties.

4) It is unclear why flask and continuous observations of atmospheric mixing ratios



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are treated so differently. An individual flask sample analysis represents the mixing ratio in a similar way as a continuous measurement, with the only difference that flasks integrate over a flask filling period and are less frequent (e.g. once or twice a week). I can not see how this justifies using different atmospheric transport models to represent these similar data sets (P7216 L16-23).

Detailed comments:

P 7216 L 15 ff: Using monthly mean flask data means that the information contained in synoptic variability is not represented properly and can not be used. Also, using daily averaged continuous data ignores the diurnal cycle, which contains information on the partitioning between respiration and photosynthesis. This should at least be discussed.

P7217, L 17: here “model” should be specified, the sentence probably refers to the structural uncertainty of the terrestrial biosphere model.

P 7220 L16: The choice of the prior uncertainty values should be motivated

P7221 L 11: As there is no site “143-9” listed in Table 3, I assume that “143-5” is meant? However, this would mean that they cover different PFTs (which would imply that the discussion in section 4.1 should be revised)?

P7224 L 15: “our sampling period of 20 yr would probably average out much of this time-dependent fine-scale structure“ The dominant causes for such sub-grid variability in mixing ratios are flux variability (associated e.g. with PFT distributions at fine scales) and orography, as shown in Pillai et al., 2010. I can’t see how these change over 20 years in a way that the uncertainties could average out. Pillai, D., Gerbig, C., Marshall, J., Ahmadov, R., Kretschmer, R., Koch, T., and Karstens, U.: High resolution modeling of $CO_2$ over Europe: implications for representation errors of satellite retrievals, Atmos. Chem. Phys., 10, 83-94, doi:10.5194/acp-10-83-2010, 2010.

P7225 L19: it is unclear why there are no global parameters, as each “multiplicity” has 18 global parameters.

P7227 L 13: “it is important to cover the full range of different PFTs and not the range of climates to which a given PFT is exposed” this depends very much on the ability of the biosphere model to correctly model the response of fluxes to different climates. Assuming that this is perfect (as this study does, see P7220 L20) will not allow for drawing such a conclusion.

Jena, May 7, 2012, Christoph Gerbig

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 7211, 2012.