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Biogeosciences Discussions

Interactive comment on "Regional scale modelling of meteorology and CO_2 for the Cabauw tall tower, The Netherlands" *by* L. F. Tolk et al.

Anonymous Referee #1

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The present paper "Regional scale modelling of meteorology and CO2 for the Cabauw tall tower, the Netherlands" explores the plausible ranges of parameter values for both surface energy fluxes and surface CO2 fluxes at the mesoscale. Simulation results from RAMS-Leaf3 coupled to the biospheric model 5PM are compared to the CO2 concentration measurements at the Cabauw tall tower for 22 days in June 2006. Two main questions are addressed here, first the impact of the surface energy flux errors on the simulated CO2 concentrations, and second the plausible range of the simulated CO2 concentrations due to surface CO2 flux uncertainty in the biospheric model parameters. Several concerns remain, especially the estimation of the plausible ranges of parameter values. The authors should consider carefully the experiment design that can lead to biased estimates of the uncertainties.

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General comments: Defining the range of plausible values for a given parameter remains the most important step to generate a realistic ensemble of simulations. The final uncertainty is directly related to the initial uncertainty through the model propagation. The present study uses results from Groenendijk et al., 2009 in which model parameters are estimated by comparing model results to flux observations from a large number of Fluxnet sites. The range of the parameter values correspond to the variability of the parameter for a given Plant Functional Type at different locations. The authors should describe more precisely the induced variability in the CO2 fluxes. Then, the variability of the simulated CO2 fluxes can be compared to the observed fluxes. For example, the Vcmax for grassland is somehow surprisingly low. Why the "best estimate" is 40umol.m-2.s-1 whereas the range of values is centered on 70umol.m-2.s-1 from Groenendijk et al., 2009 ? The impact of parameter variability was shown for the CO2 concentrations. An additional figure, similar to the Figure 6, would illustrate the impact of the parameter variability for the CO2 fluxes. The biospheric model can be simple, or highly sophisticated, the parameter variability has to be consistent with the observations. As you focus on a very limited domain, the range of parameters could locally be very different than a large scale study with a larger variety of soils, plants (variability in a pft), and climates. You assessed the range of variability of your CO2 flux parameters by comparing modelled and observed CO2 mixing ratios. This methodology leads to include unrealistic parameter values if your transport model is biased. By comparing to CO2 flux measurements, you would avoid at least atmospheric model bias and show if the parameter values correspond to plausible fluxes.

Concerning the variability of the surface parameters, previous studies applied statistical analysis of the Cabauw measurements to optimize flux parameters in Land surface model (e.g. Jackson et al., 2002). Even if some parameters were different (available water instead of soil moisture for example), it appears that minimal conductance values are much lower (about 40 s/m). There is no need here to justify what is the true range of values, but the differences should be explained or assumptions should be made to explain such discrepancies between models. Especially when looking at the table 5,

BGD

6, C1493–C1496, 2009

the range of Latent and Sensible Heat fluxes do not cover the observed values. Considering the probability density function related to a plausible range of parameter values, LE and H modelled values should include the observed values. The first assumption would be the range of values is too limited. Could you justify why the modelled LE and H heat fluxes are too large (or too low) compared to the observations? Does your model require unexpected large/low parameter values to simulate realistic LE and H?

Jackson, C., Y. Xia, M. K. Sen, and P. L. Stoffa, Optimal parameter and uncertainty estimation of a land surface model: A case study using data from Cabauw, Netherlands, J. Geophys. Res., 108(D18), 4583, doi:10.1029/2002JD002991, 2003.

Specific comments: In the study of Groenendijk et al., 2009, parameters are changing on a weekly time step. This technical point is not addressed in the present paper. Have you used constant values for your simulations, or are the parameters changing during your simulation?

Suggestion: Considering the title of the paper, I would suggest a more precise description of your work. The paper focuses on the impact of surface flux uncertainty on the atmospheric simulation. Considering a “Regional scale modelling” study implies many other sources of uncertainty that you don’t explore (even if you refer to other studies in the discussion).

P5893 -22-23: The resolution of the references are much larger than the present study. (Lin and Gerbig 2005 and Gerbig et al., 2008), confusing for the reader, especially after citing Villa et al, 2004 using LES simulations 2.1 simulation period and domain: what is the topography of the domain? It is not of a major importance in your domain, but it could affect others and increase dramatically the transport error. p5898 – 3: number (of number) ... p5901 – 20: ...indicate an uncertainty... : vague. What do you mean? Could you rephrase. P5902 – 3-12: There is a relationship between horizontal and vertical resolutions. Increasing the number of vertical layers is not sufficient to improve the vertical mixing. Concluding that improvements of the PBL scheme are necessary

BGD

6, C1493–C1496, 2009

requires additional investigations. P5904 – 21: "... terrestrial fluxes are in the footprint of the observation": Could you re-phrase. P5907 – 29: The 10ppm variation in the background is not very clear on the total CO2 concentrations in Figure 6. The flux contributions look also very similar to previous days (160-162) especially at 200m high where the background concentrations affect the most the measurements. Could you explain why the 10ppm drop in the background is not observed in the data?

Interactive comment on Biogeosciences Discuss., 6, 5891, 2009.