Biogeosciences Discuss., 6, C1679–C1681, 2009
www.biogeosciences-discuss.net/6/C1679/2009/

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.

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Received and published: 24 August 2009

The paper presents high-resolution mesoscale model simulations of atmospheric CO2 transport and meteorology for three weeks in summer, 2006 for a region covering Netherlands and adjacent areas. The modeling results for the surface fluxes and the atmospheric fields are compared against the observations. It is interesting to see how different type of uncertainties, such as the parameters constraining the land surface scheme and the CO2 flux model result in predicting a wide range of the atmospheric CO2 mixing ratios. This is very important, since the transport model uncertainties have to be taken into account in CO2 inversions where we usually assume the atmospheric transport from meteorological models is flawless. The uncertainties in the biospheric CO2 flux model lead to much larger differences in atmospheric CO2 simulations com-

pared to the uncertainties of the CO2 mixing ratios caused by errors in the surface flux model of the RAMS model. This result concludes that in future regional inversions the atmospheric signal could be a potential source for minimizing the uncertainties in terrestrial biospheric CO2 flux estimations. The work involves a state of the art mesoscale meteorological model coupled to a CO2 biospheric model. It should be noted that the analyzing nighttime CO2 simulations in the paper deserves attention, since a large fraction of the nighttime measurements is avoided in the current inversions due to the inappropriate modeling of nocturnal boundary layers in the meteorological models.

The paper is well organized, the language is clear. I have few comments to be considered in the paper.

Section 2.2: It would be very useful if the authors describe how CO2 tracer is transported in the model. How the vertical mixing of CO2 is handled? You mention non-local turbulence parameterization, do you have a non-local term for the CO2 mixing also? Do you use a cumulus parameterization for the 4km grid? If so, does the model mix CO2 in convective clouds?

Section 3.2: Does the RAMS model use LAI or only vegetation fraction? You mention LAI here, what kind of measurements are they (surface, remote sensing)?

Section 4.2, lines 10-15: Here you talk about the differences in the CO2 respiration fluxes due to different surface flux parameterizations in the model. What about the CO2 uptake? One should expect that different surface fluxes may alter simulated cloudiness, which affects radiation and consequently the CO2 uptake in the 5PM model.

I suggest presenting vertical profiles of CO2 mixing ratios in the paper similar to the meteorological fields shown in Figure 4.

Section 5: The difference in simulated CO2 mixing ratio of 1.7 ppm is attributed to the PBL height errors. Since the wind field is also sensitive to the PBL parametrization, it would be worthwhile to check how the horizontal advection change due to the different

surface fluxes in the modeling system impacts the CO2 mixing ratios in the boundary layer. According to Lin and Gerbig, 2005 the horizontal transport errors also play a significant role in the uncertainties of atmospheric CO2 simulations. Other processes such as shallow and deep convection may result in different CO2 distributions as well depending how these processes and related CO2 mixing are done in the model.

Figures: I suggest enlarging Figure 4 and stretching Figure 5.

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