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Biogeosciences Discussions

Interactive comment on "Mesoscale modeling of the CO_2 interactions between the surface and the atmosphere applied to the April 2007 CERES field experiment" *by* C. Sarrat et al.

C. Sarrat et al.

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Dear Almut Arneth,

The authors would like to thank you for all your constructive comments and corrections. All of them are now included in the manuscript. In the following we will try to answer to each of your questions or suggestions.

- First of all, the abstract has been completed by summarizing the main results and conclusions of this study.

- Concerning the model description, a summary of the Isba-A-gs surface scheme has been added.

- Your third point is about the CO_2 "hot spot" North of FAGR. This is a typical problem of calibration currently encountered in mesoscale modelling. Indeed, the modification of the soil respiration included in the model, increased (of almost 10 ppm) the CO_2 concentration everywhere the winter crops are cultivated. This maximum of CO_2 located in the north west of the domain was due to this increase of soil respiration but the magnitude of the spatial variation before and after the calibration is similar than in other places. This maximum is probably due to the residual nocturnal respiration. It is nearly impossible to state whether or not this result is realistic since no observation is available in this area and we can only rely on the good comparison with aircraft data in other places. A short discussion is now included in the manuscript.

- About the soil respiration calibration, we have now slightly modified the manuscript following your point. The calibration has been done only for winter and summer crops vegetation types, but each vegetation type has a different value of RE_25. At CNRM, the objective is to improve the parameterization of soil respiration and to implement a new simple and robust respiration parameterization, eventually already published. We are now testing, calibrating and validating in the surface scheme, a parameterization of the soil respiration (R_{soil}) including the Soil Water Index (SWI), first in the surface scheme, in the off-line mode, that will be introduced latter in the on-line coupling with the meteorological model Meso-NH. This simple parameterization is the following:

$$R_{soil} = RE_{25} * SWI * Q_{10}^{(T_{soil}-25)/10},$$

where SWI = $\frac{W_G - W_{WILT}}{W_{FC} - W_{WILT}}$,

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W_G = Soil Water Content, W_{FC} = the field capacity and W_{WILT} = the wilting point.

However, for the need of this modelling work a simple linear dependency on soil moisture can be proposed from the 2005 and 2007 field campaigns. In this paper, the idea was not to modify in depth the initial formulation of the model. For instance, the reference 25C temperature was initially defined for the surface temperature. This conducted to a too high soil respiration during the day. This is why we modified the scheme by considering the soil temperature at 20 cm (which was available in the force restore method used for soil temperature!). We think also that the 20 cm temperature is more adapted to represent the soil respiration than the surface temperature.

- The comparisons at the surface flux stations are very difficult because of the large spatial variability of the fluxes and the soil moisture at the regional scale. The calibration of the respiration is done using the nocturnal fluxes at the local stations, and the validation with early morning aircraft observations of CO_2 concentrations. In fact, we think that the aircraft data are taken at a scale more suitable for comparisons with the 8 km resolution model. This is confirm by the Fig. 3 showing a good comparison with CO_2 but also by the Fig. 7 and 8, with the Sky Arrows aircraft's fluxes, showing a better agreement and a trend to overestimate the NEE! A source of error is also the well-known underestimation of the observed turbulent fluxes which increase the difficulties of comparison with modelled latent heat and CO_2 fluxes.
- More information are added on the ISBA-A-gs surface scheme, including the parameters affected to each vegetation type.
- The discussions and conclusions sections have been reorganized;

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- The captions have been completed, the Figures 1, 2, 5, 7 and 8 redrawn. The manuscript has been corrected as suggested.

Please do not hesitate to contact us, if you have any remark or suggestion.

Sincerely yours.

Claire Sarrat and Joël Noilhan.

Interactive comment on Biogeosciences Discuss., 6, 515, 2009.