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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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The authors would like to thank the referee for all the comments, suggestions and corrections. As you will see we tried to consider all of them. The corrections included in the revised paper are listed below:

- First, the authors think that the originality of the paper is not probably sufficiently emphasized in the introduction and may give the impression of a modest contribution. In the field of atmospheric mesoscale modelling, it is still a real challenge to correctly simulate the full interaction of the fast carbon cycle between the troposphere and the surface. For instance, nowadays there is no operational numerical weather prediction model that includes the fully interactive $CO_2$ with



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simulated water and energy cycles. Among the difficulties for short range simulations, a good physical parametrization of the coupled water, energy and carbon exchanges between the surface and the atmosphere is needed, as well as a correct mapping of the surface properties, initialization of the soil moisture and $CO_2$ vertical profile in the atmosphere. In addition, specific validation at the regional scale has to be conducted and CERES 2007 offers the possibility to evaluate the mesoscale model performance not only at the local scale (evaluation against surface flux data) but also at the regional scale (evaluation toward aircraft concentration and fluxes data in the boundary layer). Additionally, we think that another original point of this study is to show how using boundary layer measurements of $CO_2$ concentration, we were able to correct the surface scheme parameters such as soil respiration and LAI. To our knowledge, this approach is not so usual.

- This paper is not a reference paper for the CERES 2007 experiment, which is described more in details by Dolman et al, this issue. However, additional details on the CERES 2007 field campaign are added in the manuscript.

- p518, line 8, the definition of the Bowen ratio, the ratio between the sensible and the latent heat fluxes, is given (B=$\frac{H}{LE}$).

- p520, line 9, the original global ECOCLIMAP database (Masson et al., 2000) has been improved specifically for South-West of France using the SPOT-VEGETATION NDVI profiles (from 1999 to 2003) to build a new map with 62 land covers. Particular improvements have been made on the crops distinction based on the interannual variations of the LAI and a good knowledge of the land use map of this area. More information are added in the manuscript.

- p520, line 21, 1800 UTC corresponds to 2000 LT. When we reinitialize the model every day at 1800 UTC, the limited area of interest is less influenced by the large scale conditions, than if the model runs continuously for the whole period. That is the main reason why we preferred to reinitialize since no large $CO_2$ analysis was



**BGD**

6, S778–S781, 2009

available. A specific sensitivity study on the influence of the $CO_2$ initialization has been conducted with the CERES 2005 data set (see Sarrat et al., 2007).

- p522, line 11, in our study, the respiration is first calibrated against the early morning observations when the assimilation is negligible and therefore the simulated $CO_2$ surface flux independent on LAI. Then, the LAI is calibrated against the diurnal concentrations.

- p522, line 20, this study shows the limitations of the ISBA-A-gs surface scheme respiration parametrization. We are now testing, calibrating and validating in the surface scheme, a new parametrization of the soil respiration ($R_{soil}$) including the Soil Water Content (SWI):
$R_{soil} = RE_{25} * SWI * Q_{10}^{(T_{soil}-25)/10}$,
where $SWI = \frac{W_G - W_{WILT}}{W_{FC} - W_{WILT}}$, with $W_G$ = Soil Water Content, $W_{FC}$ = the field capacity and $W_{WILT}$ = the wilting point.

- p525, line 7, in the Fig.6, the nocturnal respiration is the dominant processes measured during the night. For the model, at 8 km resolution, it is very difficult to reproduce this high concentration, because very small scale and local phenomenon are dominating and because the measurements in Marmande specifically are done close to the surface (few meters) while the first level of the model is 20 m height. It is easier for the model to reproduce the nocturnal concentrations in Bellegarde where the measurements are operated at 60 m height, corresponding the third model level.

- the other corrections and suggestions have been taken into account in the revised manuscript.

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



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6, S778–S781, 2009



Sincerely yours.

Claire Sarrat and Joël Noilhan.

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