**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "High resolution modeling of CO_2 over Europe: implications for representation errors of satellite retrievals" *by* D. Pillai et al.

Anonymous Referee #4

This text is based on my initial report as a referee since my questions have hardly been addressed by the authors.

This paper uses mesoscale modelling to set up a parametrization of the standard deviation of the representation error of global models with respect to retrievals of the CO_2 total column. Such a scheme could benefit the inverse schemes for CO_2 surface fluxes.

The topic is interesting and the paper could be an excellent one. However, in the present shape, it is rather confusing. I recommend that the following points are addressed before it is published in ACP any further.

1- the A-SCOPE instrument is repeatedly cited, but there is a 10^4 factor between the

horizontal resolution of that lidar project and its modelling in the paper. The authors should remove the mention to A-SCOPE. In their response, they have indicated that they do not expect the difference in resolution to matter. However, since only a theoretical instrument is considered here, they should use a more appropriate model than ASCOPE, like GOSAT.

2- the authors did only part of the parametrization job. What about the horizontal correlations of the representation error? What about their temporal correlations (e.g. from one day to the next)? In their response, the authors claim that there is no spatial correlation: I do not disagree, but this should be discussed directly in the paper. They also say that "Temporal correlation does exist and leads to the fact that the errors are not solely random, but have a bias component on monthly scales". I agree. And this confirms the fact that temporal correlations are missing from the paper.

3- the concept of random/bias component of monthly standard deviation ($\bar{\sigma}_{c,col}$) is awkward and of very limited use in the present context. The authors should only average the variances. The authors' reply about this point is mainly a copy of their last paragraph in page 20607. Now this paragraph does not make any sense to me from a strict statistical point of view and should be revised.

4- the variability of the monthly averaged concentration is not interesting either in this context. What inverse modellers would like to use is an estimate of the representation error at the space-time resolution of their measurement. If the XCO_2 masurement is instantaneous, as seems to be the case here, one would use errors for instantaneous XCO_2. Aiming at monthly fluxes in some inversion schemes (as is said in Section 3.1) is a separate question. In a very brief reply, the authors claim that modellers would be interested by errors at the resolution of their model. Still, the observation error covariance matrix in an inverse system has the dimension of the observations. Regarding the model resolution, I guess it would be something like hourly and certainly not monthly.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 20599, 2009.

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