**Atmospheric
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Interactive
Comment

Interactive comment on "High resolution modeling of CO$_2$ over Europe: implications for representation errors of satellite retrievals" *by* D. Pillai et al.

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We would like to thank anonymous referee for his comments. Authors' responses to these comments are as follows:

1- the A-SCOPE instrument is repeatedly cited, but there is a 10ˆ4 factor between the horizontal resolution of that lidar project and its modelling in the paper. The authors should remove the mention to A-SCOPE. The model resolution actually better fits GOSAT.

Yes, we agree that there is 104 factor difference between the horizontal resolutions of the A-SCOPE lidar project and model simulations used. However, the spatial differ-

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ences in CO2 columns between 0.1 km and 10 km is expected to be small and mostly due to turbulence (eddies that carry signatures in CO2), which is rather random. On the other hand the spatial differences between 10 km and 100 km are expected to be larger (see variogram studies in Lin et al., 2004). Therefore we think the scale of the simulation is appropriate to assess representation errors of coarse models.

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)?

As the spatial representation error is due to subgrid variability (subgrid with respect to the coarse model), it is not expected that there is any correlation between adjacent grid cells of the coarse model resolution). Temporal correlation does exist and leads to the fact that the errors are not solely random, but have a bias component on monthly scales.

3- the concept of random/bias component of monthly standard deviation (sigmaˆbar_{c,col}) is awkward and of very limited use in the present context. The authors should only average the variances.

We disagree with this. We modified page 6 (or 20607)-(1st and 2nd Paragraph) which makes the concept clearer. Also please see our responses to F.M Breon and 2nd reviewer.

Random errors are expected to decrease when averaging over longer time periods, e.g. for deriving monthly fluxes where the bias term could not get cancelled out. Hence we attempt to address the bias term of representation errors.

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 XCO2 masurement is instantaneous, as seems to be the case here, one would use errors for instantaneous

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XCO2. Aiming at monthly fluxes in some inversion schemes (as is said in Section 3.1) is a separate question.

We disagree with this. Modelers would be usually interested in errors at the resolution of their model, and they are also interested in the full covariance matrix. In case of the spatial representation errors, involves the temporal correlation.

Please also note the Supplement to this comment.

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

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