**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.

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This paper uses a high spatial-resolution simulation of atmospheric CO2 to study the spatial variability of the surface and column concentrations. The simulation results are used to evaluate the representativity error of a potential satellite that would make a single or multi measurements within the grid scales and that would be interpreted as the average over the grid scale.

The paper is mostly clear, well written, and of potential interest to those in the "CO2 satellite" business. It can also be of interest for a slightly broader audience interested in atmospheric dynamic and chemistry. As such, there is no doubt that this paper should

be published. I have only minor comments that could be used by the author to make their manuscript a bit clearer.

One significant comment concerns the use of "bias" in the manuscript. The authors looked at the spatial variability of the column concentrations at a given time, but also after temporal averaging over a month. The later is given the term "bias". In the context of satellite remote sensing and the use of its observations to retrieve surface fluxes, one may fear a bias if multiple successive observations are used within a grid box at the exact same location. In practice, this would not be the case, first because very few satellite observations will be available within a 100x100 km grid bow at the monthly scales (on different days), and also because the few observations will probably be acquired at different locations (depending on the instrument pointing). As a consequence, the "bias" does not apply to the study context. It should be made clear in which context there is realy a bias to be feared.

My other significant comment concerns the numbers that are quoted in the text and the abstract, in particular the 1.2 ppm. This is the highest value found for the representativity error, over a region of high relief. The number is quoted and compared to the accuracy objective of the satellite sensors. In most case, the accuracy objectives are expressed in RMS terms, and it is then not fair to compare such accuracy target to a maximum error. I suggest the authors provide typical numbers rather than the max error.

Other comments: Abstract : I suggest to provide the mean, median or 90% percentile rather than the max error. See also general comment Abstract : I do not think that it is clear what the "bias component" is. See also general comment Page 2, second paragraph. "Community". Which community Page 2, third line from bottom, "sampling error". What is the sampling error ? Is it the same as measurement error ? Page 5, second paragraph, "reasonably well". R2 is between 0.16 to 0.44, which some may find rather poor correlations Page 5, last sentence of second paragraph. I could not see that from the table. Please rephrase or comment Page 6, end of second

paragraph, concerning stratospheric concentrations. I tend to agree, but is there any real measurement to support this statement ? Page 6, first line of third paragraph, There is a strong need for a proper definition of this monthly average. Is it the monthly average of sigma_c,col, or the standard deviation of the monthly averaged column concentrations ? I tend to believe it is the second from further reading of the manuscript but it is realy not clear Page 6, end of third paragraph, see general comment concerning biases Page 8, end of second paragraph, see general comment concerning biases Section 4.2. I suggest to start by saying that the number provided in the previous section assume there is a single measurement per grid box. In practive, satellites provide several measurements which may be averaged and reduce the representativity error. The impact depends on the sampling, and will be discussed here. I do not think that the "corner" sampling is really of interest as it is directly related to the results of the previous section, assuming a random sampling within the box. Section 4.2.1, last sentence of first paragraph, "a factor of 2 larger". Not clear than what (although it is clear when looking at the table) Summary and Outlook, last sentence of third paragraph, This sentence may be misleading. One does not realy capture the error. It provides an estimate of the error so that less weight are given to the observations is regions of high variability. Figure 7 caption. The blue line is not the 1:1 line but the best fit.