Interactive comment on “Three-dimensional methane distribution simulated with FLEXPART 8-CTM-1.1 constrained with observation data” by Christine D. Groot Zwaaftink et al.

Anonymous Referee #1

Received and published: 20 July 2018

This paper is nicely written and addresses sharply the question whether local nudging of CH$_4$ mixing ratios at the surface towards stationary observations does improve the overall 3-dimensional performance.

It is an attractive method to directly include several local surface observations instead of averaged two dimensional fields. The authors provided a coherent evaluation with surface stations and aircraft profiles. However, I also would be interested in the comparison with spatially inclusive and comprehensive data sets as satellite data, which would further evaluate the whole column.

In the following I list a couple of questions concerning the manuscript.

C1

1. On page 2 line 44 you state that inverse modeling approaches need GHG concentrations as input. That is likely the case, however, I wonder if you mean the inverse modeling of CH$_4$. In this case, nudging towards observations as in your case would influence the a priori. Maybe you could be a little more specific in what kind of situation the 3D concentrations are needed. Moreover, what do you think about the use of these 3D data sets for radiation simulations?

2. Introduction: To my knowledge there are a couple of models which perform nudging of GHGs. Could you list some and describe the difference or similarity to your method?

3. Page 3 line 108-110: Where does those fields come from? Simulations of Chemistry-Climate Models? I understand that some reference work is not published, but the loss of methane is an important part in the simulations and needs to be replicable.

4. Page 3 line 118-121: This is a very long sentence. However, the information it holds is very crucial (simulation period). Please reformulate. Furthermore, why is the scaling factor applied?

5. Could you also invest a sentence in this paragraph on the introduction of your reference and sensitivity simulations? It gets lost in the results. I like the table 1 as an overview, however, it is difficult to understand without a short explanation (what is important?).

6. page 8 line 307: Have you considered the methane lifetime? Compared the one of FLEXPART and TM5? What about OH and temperature?

7. page 9 line 333: Are the simulated profiles sampled to the campaign profiles? Or is a certain spot chosen?
• General: If the performance of this nudging method decreases at higher altitude, I am curious to what extent does this improve the 3 dimensional field of the whole atmosphere/troposphere. Since the 3D fields are part of the motivation, could you comment on that?

Technical corrections:

• page 6 line 207: What about NW1 and NW2? I would assume that it should be (NV1-3 and NW1-3).

• Table 1: Could you highlight (additional horizontal line) the simulations with variable spatial width? What do the variable temporal width (NW1-3) mean? How are they constructed?

• Fig 11, legend: Should it be TM5 RA instead of RM5 RA?