

Review of "Variability of tropospheric methane above the Mediterranean Basin inferred from satellite and model data" by P. Ricaud et al.

Overall, the revised manuscript has been significantly improved from the previous version. In particular, the inclusion of trajectory model simulations adds credibility to the correlation between the methane variations and the circulation. However, I think the overall structure of this manuscript can be improved even further by putting a little more work. Below are my suggestions for the authors may take into consideration.

1. I think using measurements from more than one satellite and multiple model simulations are definitely beneficial to this type of work. However, one still wants to know how those satellites products are selected for this work among others and how using three different model simulations are beneficial to the comparisons. Did the authors include AIRS upper tropospheric profiles because IASI does not provide vertical profiles of methane? Are GOSAT data considered to be useful to this work even with fewer measurements with higher noise? Is one of the research goals to validate the satellite products? This can be added in the section starting from L97.

2. What are the similarities and differences between the three models used in this study? And again why those three models are selected and used in this study? I think comparing results from two different CTMs, for example, would be simple to understand. But when I look at the results from three different models, e.g., CTM, GCM, and CCM, I am not sure how to interpret their differences. Aren't the results from the model simulations expected to be different? Section 2.2 includes detailed description of the three models. But I think it would be more useful to know what to expect from those model simulations. Is one model supposed to be better in simulating methane in the troposphere because of better chemistry modules, dynamics or resolution, etc.?

3. Section 3 (L313~): I think it would be easier for the readers to understand the results if the figures are individually presented here instead of describing them all together. As a reader, I would like to be able to exactly follow what the authors are referring to, in each figure, which will also help understand results in a big picture. For example, which figures do I have to look at when I read L325-329?

4. L39: ~12 years and is supposed to be well mixed

5. L52-54: This sentence can be rewritten for clarity. Also, at the end of the sentence, ..critical issue was to evaluate 'something..'

6. L54: Full acronym for IPCC has to be given here.
7. L61-62: these long-lived greenhouse gases, e.g., CH<sub>4</sub>, N<sub>2</sub>O and CO<sub>2</sub>, account for
8. L69: To illustrate, global (or regional) model simulations
9. L72: asymmetry in precipitation over the MB?
10. L76: References to the O<sub>3</sub> and CO budgets needed here. I also wonder how relevant of those two species to this study.
11. L76-79: Needs references here.
12. L81: Names of specific locations instead of 'over there'
13. L97-98: What are the challenges to measure and simulate long-lived species in the troposphere specifically?
14. L99-100: This statement is not entirely true. Recent measurements of CH<sub>4</sub>, N<sub>2</sub>O and CO<sub>2</sub> from HIPPO show large hemispheric asymmetries in their global distributions (Wofsy et al., 2011).
15. L118: Table 1 summarizes...Also references to each instrument can be added to Table 1.
16. L136-139: References are needed here.
17. L169-170: The datasets -> Datasets, The satellite data -> Satellite Data
18. L171-173: This sentence can be rewritten, something like, 'Our study uses CH<sub>4</sub> measurements from there different sensors and only the pixels measured over the Mediterranean Sea are considered due to larger systematic biases over land.'
19. L176-177: This sentence can be rewritten, something like, 'The amplitude of diurnal cycle is larger over land than over the sea.'
20. L184-185: Thus by applying temporal and geographical averages...
21. L322-324 (also L979): by (from) the NCEP/NCAR reanalyses...
22. L480: What does 'broader vertical domain' mean?
23. L483-485: What is the supporting evidence for those statements?

24. L499-501: I'm not sure how to interpret the meanings of three 'evolution' in one sentence.

25. L538: What is the resolution of the trajectory model?

26. L544: Does the position of gravity center mean a maximum in probability distribution function (PDF)?

27. L612: consistent with each other

28. Figure 12: This is a very nice diagram. However, I am not sure if the relative size and magnitude of the low -pressure center at the surface and the high-pressure system in the upper troposphere are the same. I think the upper tropospheric anticyclonic center has to be larger than the cyclonic center at the surface.