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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Systematic detection of local CH_4 emissions anomalies combining satellite measurements and high-resolution forecasts" *by* Jérôme Barré et al.

Anonymous Referee #2

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The authors have developed a method of combining modeled forecasts and satellite observations of CH4 to isolate local CH4 anomalies that might be associated with discrepancies in anthropogenic emissions. Identifying emissions from point sources such as power plants against background CH4 can be challenging. The manuscript presents a clever approach for doing so that takes advantage of the newly available high-resolution CH4 retrievals from TROPOMI and the equally high-resolution CAMS forecasts. The confirmation of the previously identified CH4 source in western Turkmenistan is a nice demonstration of the potential utility of the approach. I recommend the manuscript for publication in ACP after the authors have addressed my comments below.

Main comments

1) My main concern is that the specification of the filter parameters seems to be subjective. On lines 209-211 the authors explain that specifying a length scale (sigma) of 5 degrees retains large-scale structures in the signal, whereas a length scale of 0.5 degrees results in the loss of too much signal. As a result, they selected a length scale of 2 degrees. How did they decide when too much signal is lost? It would be helpful if the authors could be more quantitative. In addition, what is meant by "large-scale" in this context? For example, the panels in Fig. 8 for sigma of 0.5, 1.0, and 2.0 for both the 10-day and 30-day windows all look similar to me. I can see the three regions of CH4 enhancements in the southwestern US and Mexico in all six panels, so it is unclear why the case for sigma = 2.0 with a 30-day window is best. If there is a tacit assumption being made about what specific scales are of interest and the type of emissions that are associated with those scales, that assumption should be explicitly stated as it places a constraint in the utility of the approach.

2) In a similar vein, on lines 217-221 the authors stated that they selected a three-sigma threshold for the outlier classification because it "provides suitable results." It is unclear how "suitable" is defined here? They stated that a narrower range "starts to fail isolating important anomalies and conversely a wider range might fail to capture useful information." What are the important anomalies that are not detected with the narrower range? The discussion here should be expanded to give the reader a better sense of what are the implications of this threshold for the type of anomalies that can be detected.

3) I am also concerned about the lack of discussion about the potential impact of biases. The filtering does remove "large-scale" biases, but it would be helpful if the authors could comment on the impact of spatially and temporally varying biases on smaller scales (i.e., scales between sigma and the "large-scale"). These could arise from the influence of transport errors, for example.

4) Line 269-270: Is the over-prediction in the Los Angeles area seen only in the Aug-Sept period (i.e., in the right panel)? It doesn't seem to be present in the Jun-Jul plot (left panel). If that is the case, it should be noted in the manuscript. What could be the cause of this temporal variation?

Technical comments

1) Lines 14, 81, 108, 109, 114, 162, 170, 275: A space is needed between the numbers and units, e.g., "9 km" instead of "9km".

2) Line 52: I believe the "Pandley et al." reference should be "Pandey et al."

3) Line 75: Please change "earth" to "Earth".

4) 4) Lines 336, 341, 343, 354, 360: The line spacing between the references is irregular.

5) Figure 5: It is difficult to see the features in the plot for Europe. Since the objective here is to show that ability of the model to capture fine scale features, why not plot the European sector with a different scale to better emphasize these features?

6) Figure 7: It is unclear what is the time period for the data shown here.

7) Figure 9: It is difficult to see the yellow/gold colors for the low forecast category.

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