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## ***Interactive comment on “How consistent are top-down hydrocarbon emissions based on formaldehyde observations from GOME-2 and OMI?” by T. Stavrou et al.***

**Anonymous Referee #1**

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Stavrou et al. utilize GOME-2 and OMI HCHO columns in an inversion with the adjoint of the IMAGESv2 CTM to evaluate the consistency of a posteriori emissions derived from the two different satellite sensors for anthropogenic, biogenic, and biomass burning VOCs. There was a good degree of consistency between the results obtained for biogenic and biomass burning emissions, with some interesting regional differences. Impacts of specific events such as Russian fires and Amazonian drought are discussed. This work is useful in the context of several recent studies that have used one or more satellite HCHO products to estimate biogenic and/or biomass burning emissions of VOCs. It is generally well-written (though a bit cumbersome to read at

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times, see comments below) and the scope is certainly appropriate for ACP. I recommend publication after the following comments are addressed.

General comments:

- Since monthly averages are used in the inversion, it would be good to know how the variation in frequency of retrievals between the two sensors (due to cloud cover, etc.) is handled in the cost function. Differences in coverage are touched on a bit in the results sections (specifically with regards to solar zenith angle and cloud cover), which is helpful information that could be expanded upon. Are there any systematic differences between the two sensors that could be introduced in Section 4?

- What are the implications of including isoprene as the only biogenic VOC in the a priori emissions? It seems like the seasonality of satellite-retrieved HCHO in some regions (particularly in the U.S.) is such that it peaks sooner in the summer than the model HCHO. Could this be due to the impact of VOCs that have earlier springtime emissions, such as methanol?

- It's difficult to navigate the discussion in Sections 6 and 7 with so many figures to flip back and forth through, particularly in regards to the discussions on biomass burning. You mention biomass burning results for the North China Plain for June, a month which is not included in Fig. 9, so you have also included the timelines of fluxes for different regions in Fig. 12. Is there any way to combine or condense this a bit? Also, some of the navigation would be helped if the text more explicitly referred to what aspect of a particular figure illustrates the point being made (i.e. rather than making a statement that ends with a reference to Fig. X in parentheses, I would start more statements like "The data for region Z in Fig. X show. . .")

Specific comments:

- Page 12024, Line 12: Is there any justification to be provided for the a priori uncertainty values used?

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- Page 12026, Line 2: What numbers are being referred to here? The global ones? Looking at Table 3, OMI-HE corresponds to a  $\sim 8\%$  decrease from the a priori isoprene emissions, whereas OMI-DE corresponds to a  $\sim 16\%$  decrease. Correct? It would be odd if both produced larger isoprene reductions than the standard OMI inversion ( $\sim 13\%$ ).
- Page 12027, Line 19: Here it mentions that Fig. 14 contains a posteriori results for both the OMI and GOME-2 inversion, but only the OMI results are shown.
- Page 12028, Line 12: How do we know this is not just a conflation of the isoprene and biomass burning emissions? It seems the isoprene increase in the OMI inversion is highly correlated spatially with the biomass burning emission increase (though different months are shown), whereas a posteriori isoprene over the rest of Europe is reduced relative to the a priori (in the GOME-2 inversion at least).
- Page 12030, Line 1: I find it hard to see that the ratio of 13h30 to 9h30 columns is lower in the model than the satellite for Northern China in Fig. 7, given that the lines are all on top of each other. Can you include values of this ratio somewhere?
- Page 12031, Line 27: The fluxes attributed to GOME-2 and OMI here are reversed compared to Table 3.
- Section 7.1 and Fig. 15: As the discussion here centers on August 2010, I'm assuming that is the month shown in Fig. 15, but the figure caption says March 2010.
- Elimination of passive voice (phrases such as "is found to be" and "is estimated at") throughout the manuscript would improve flow and more concisely communicate the main points.

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