

Reply to anonymous Referee#2

We would like to thank the reviewer for his/her positive evaluation of the manuscript and for the useful comments and suggestions. Below we address the raised concerns. The reviewer's comments are *italicized* and our replies are given in [blue](#).

Bauwens et al. present an analysis of nine years of global hydrocarbon emissions inferred from OMI formaldehyde observations. 2005-2013 global distributions of pyro genic and biogenic VOC fluxes are derived from OMI HCHO columns and the adjoint inversion scheme based on the IMAGESv2 global CTM. The distributions, their interannual and seasonal variations are discussed for the different regions where the changes are the most important compared to the a priori emissions. The inversed emission fluxes are compared and discussed according to the various independent inventories. Trends over the studied period are derived and discussed. The paper is well written and structured with detailed discussions of the major changes compared to the a priori in terms of distribution, seasonality and interannual variability. Trends are also well documented and discussed. This work is suitable for ACP publication and I recommend it after the following specific comments are addressed.

Specific comments:

- Page 5, lines 25-26: it should be interesting to give a range of retrieval errors to see how it compares to the representativity error.

The retrieval error amounts to about 40-60% of the OMI column over emission regions and ranges between $4\text{-}7 \times 10^{15}$ molec.cm⁻². The assumed representativity error of 2×10^{15} molec.cm⁻² is generally low in comparison, and has little effect on the total error because of the geometric summation.

- Page 5, lines 26-27: On which studies, references the a priori error estimate of biogenic and pyrogenic fluxes is based? Please, discuss this point.

We acknowledge that the precise values of the flux error estimates are very uncertain. The factor of 3 error on the a priori biogenic and pyrogenic fluxes reflects the high variability of the pyrogenic emission source and the strong uncertainties associated with the biogenic emissions, as demonstrated by the large range of literature emission estimates (Sinderalova et al., 2014, Arneth et al. 2011). This is now added in the revised manuscript. The sensitivity of our inversions to the chosen error estimates was evaluated by means of sensitivity inversions in Stavrou et al. (2015).

- Page 6, lines 1-3: Some of the regions are not covered by the observations depending the season. How does this impact on the retrieved fluxes? Can the induced uncertainty be estimated?

When top-down constraints are missing over a region or month, the a posteriori emissions remain generally close to the a priori, although they are affected by neighboring emission regions,

because of transport of formaldehyde precursors, and because of the spatiotemporal correlations implemented in the inversion scheme.

- Pages 7-8 – discussion of Figure 4: Europe presents a large interannual variability, which is not discussed in this section. Please, add some explanations here or mention it and refer to the corresponding section (section 8) if suitable.

We now mention that the interannual variability of the optimized emissions is thoroughly discussed in Sec. 4, 5, 6, and 8.

- Page 9, lines 27-28: it is not clear how agricultural fires can be maximum in December while they are dominant for other periods of the year. Could you make it clearer, please?

In this region, both natural and agricultural fires peak in December, but the agricultural fire season, from September to May, lasts longer than the season of natural fires, which occurs between November and March. Therefore, in the beginning and end of the fire season the agricultural fires are dominant (Magi et al., 2012). This is now clarified in the manuscript.

- Figure 1: it would help to provide difference plots

The figure has been adapted.

Technical comments:

- Page 5, lines 13-15: the sentence is too long and should be rephrased for clarity.

Clarified.

- Page 10, line 28: remove “in Northern Africa” after “the isoprene fluxes”.

Removed.

- Page 16, line 27: there are two “and” close to the end of the line. Remove one.

Corrected.