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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Quantification of CO emissions from the city of Madrid using MOPITT satellite retrievals and WRF simulations" *by* Iris Dekker et al.

Anonymous Referee #2

Received and published: 10 August 2017

The paper presents a new method for estimating mega-city emissions from satellite data in combination with a chemical transport model. It goes beyond the method presented by Pommier et al. (2013) where satellite data only were used to estimate emission trends. In general the paper is well written, and I recommend publication after the following concerns have been addressed.

General Comments:

The relatively large differences between the results presented in the manuscript using MOPITT V5 data and those in Pommier et al. (2013) should be discussed more systematically. Are those differences only due to differences in the wind direction (surface

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– 700 mbar averaged winds at 0.75 deg resolution vs. surface – 750 mbar averaged winds at 1 deg. resolution) as mentioned in P10 line 10? It would help to show the differences in winds to those in Pommier et al. (2013); are those larger for LA where the largest discrepancy in downwind minus upwind total column CO is found? In this context also complex topography or coastal effects should play a role, causing winds extracted from analysis files at different resolution to differ more, or even making the choice of an upwind and downwind region within the complex flow invalid. As stated later also a slight change in the rotation point, e.g. related to the imperfect geolocation bias correction applied to the V5 data, causes differences; however the rotation points used in the estimate using V5 data should be identical to Pommier et al. (2013) as the same geolocation bias correction was applied to the data.

The role of the background scaling factor should be made more clear, e.g. by explicitely writing the dependence of the modelled column averages (X_mod[i]) on f_backg and f_emiss, as the model is fully linear this should be straight forward. In this context (i.e. in section 2.3.6) also the sensitivity experiments should be introduced, where changes in "WRF's background emissions" are applied as described in section 3.5.

Appendix: The text for each appendix should include all references to figures and tables included within each appendix. The way the figures are referred to only from within the main text of the manuscript seems to suggest that the figures would be better included in the manuscript itself rather than the appendix.

Specific comments

Pg 8 Ln 16: add a period at the end of the sentence

Pg 8 Ln 22: Please add the notion that the r-square value measures the explained spatial variance of the annually averaged column mole fractions (if I got this right).

Pg 8 Ln 32: "both backgrounds" please explicitly state what those two different background fields are.

Pg 9, Ln 13: “to still maximize the available information” this is unclear; why does using column average mixing ratios maximise the information?

Pg 10 Ln 6: table A2 is referred to before table A1

Pg 10 Ln 35: replace “weighing” by “weighting”

Fig. 5: I suggest to separate the two time periods by colour, and the three different rotation points by symbol shape. This would make it easier to read the figure.

Pg 14 after line 20: the line numbering is incorrect, also on the following pages; I will use the indicated line numbers in the following

Pg 15 Table 1: the table needs reformatting, e.g. use shorter descriptions or labelling for the filters applied (column 4) to shorten the table

Pg 17 Ln 39: 20x20 “optimization method” should be mentioned in the methods section under 2.3.6; why does the change from 2x2 km to 20x20 km have such impact, given the MOPITT resolution of 22 km?

P18 Ln 16: “changing WRF’s background emissions“ what is meant by that? Section 2.3.6 does not give any clue on what “background emissions” could mean.

P18 Ln 25: “replacing the normal background simulation, without emissions, with a background simulation that has emissions in the area outside the optimisation area” this seems to be in conflict with the statement in section 2.3.6 (P8 Ln 28-30) where it is mentioned that emissions outside of the 200x200 km box around Madrid are already used in the standard case.

Pg 22 Ln 7: the Jacob et al. (2016) has been published as a final paper

Pg 33 29: What is specifically meant by the “oversampling method”? Does that include the rotation of the grid according to wind direction? If so, which wind was taken for the rotation of the WRF grid at each time step, WRF winds or ECMWF winds at 1 deg. as for the MOPITT observations? This needs to be clearly stated so that the reader can

follow what has been done.

Pg 33 line 36: “the stability of the model” may be reformulate to “a lack of spatial variability in the model”

Pg 33, last two sentences: those sentences are repeated from page 8 and should be removed

Pg 35, Fig. A1: The observations seem to have a vary coarse resolution, as indicated by jumps with a step width of 0.1 mg/m3 (corresponding to about 90 ppb). As the background during summer months is about 80 ppb, this resolution seems a bit coarse. -> include in discussion, mention at least

Pg 35, caption Fig. A2: Concentrations from only one location are shown, the text should be revised.

Pg 40: values seem to have a second decimal point instead of a +/-

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