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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 #1

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This manuscript presents a quantification of CO emissions over Madrid, based on MOPITT measurements and WRF simulations. In my opinion, this paper represents an interesting work and it is a good complementary work of the study done by Pommier et al. (2013). I was very interested to read this paper especially by thinking that it is a good idea to use a model to optimize the estimation of the emissions. This part was lacking in the work previously done by Pommier et al. (2013). This paper fits perfectly for this journal. Nevertheless, the manuscript is not well structured, making sometimes difficult to read. Thus I recommend publication in ACP after the comments below are addressed.

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Discussion paper

Structure: Section 2.3.5: I do not understand why you present Fig A6 before A3, A4... The problem of organization is also shown with the caption in Fig A1. At this stage I do not know what the correction factor is. This factor is only mentioned from page 9. Moreover, in Fig. A1 the caption and the colors of the curves do not match. There is no dotted line.

It is odd to finish the paper by the sensitivity tests. These tests should be done before to analyze the results of the WRF optimization method.

Page 10: Table A2 is described before Tab. A1.

Difference with P13: The authors concluded – quoting the text: "the emission proxies in P13 are too optimistic". In the same time, they wrote that the RD can change up to 25% due to the mis-location of the city center. With a quick check with the work done by Pommier et al. (2013), we can see that the locations of the city used in this work do not match perfectly with the coordinates used in P13. For example, Sao Paulo is 23.54S, 46.64W in your work and 23.53S, 46.62W in P13. This represents only a difference of 2 km but it seems even a difference of 0.7 km has an impact on the RD. It is interesting to see that P13 did not take into account this problem of location. It is probably a missing source of error in their study. Thus I agree with the authors the uncertainties in P13 are probably underestimated.

Another remark about the differences between both studies: the differences may be explained by 3 parameters: - The resolution of the wind are not similar (0.75 in P13 vs 1deg in this work) - The PBLH (750 hPa in P13 vs 700 hPa in this study) - The filter used for the MOPITT data (cloud fraction = 0 and cloud index = 2 in P13 vs cloud diagnostic = 1, 2 in this study). How do use the pixels where there is a conflict between sea surface and land? P13 filtered out these data. The discrepancy between both studies may decrease if similar criteria are used.

Other major comments:

Introduction: Is there any publications about the CO trend/pollution over Madrid? It will be informative to have a comparison of your results with previous studies.

Page 3, line 1: Pommier et al. 2013 did not quantify emissions. Estimate the change in the emissions is more appropriate. Clerbaux et al. 2008 did not calculate the emissions but they detected urban CO plumes. Thus delete this reference for this sentence. Then you can write, "Clerbaux et al. (2008) and Pommier et al. (2013) already demonstrated that . . ."

Page 7, line 11: does it means you exclude the first days of your run? What is the period of your simulations? You should introduce this information before Section 2.3.5.

Page 7, line 5: the climatological data, is it for the column or the profile? I guess it is the profile. Please provide the information.

Page 8, lines 26-27. There is a repetition of this information: "background simulation without emissions". Please rephrase.

Page 9, lines 24-27: It is not clear. Please rephrase.

Page 10: I am not sure to fully understand your discrepancy (0.5×1017 molecules/cm2). If I average the absolute difference between Vd-Vu from your study and Vd-Vu from P13 in 2000-2003, I find 0.45×1017 molecules/cm2. Is it the calculation done? Please clarify this point. Same question with 0.009 and 1.04 as I do not find these values in Tab. A1.

Page 10, line 20: -20%: where does the number come from?

Tab. A1 There is an error with the numbers. I think it is for example Moscow: 3.19 ± 0.04 The "$\pm$" is missing everywhere.

Page 11, Sect 3.2.1. Did you test your results by excluding 2000 and 2001 since there is a lack of data (i.e. Jan-Feb 2000 and June-July 2001)?

Line 14: What does it mean? "For example, a year with below average cloud cover. . ."

Page 13, line 4: “AK is scaled”. It is confusing. You should specify that you are scaling an artificial AK for your test. During my first reading, I understood you wanted to artificially change the MOPITT AKs.

Tab1 why there is only a few values underlined? Do you want to highlight something?

Page 17, line 24: 32% and in Tab A1 it is 33%

Line 26 “with the increase estimated using the WRF optimization method” and in line 21, it is written -8%. Please clarify.

Fig 7. C and F are similar. Please check if the maps are correct.

Page 30. What is this paragraph below figure 7?

Fig9. Write in the caption the difference between both panels.

Figs. A1 and Fig.A2: Add statistical values for the comparison: correlation coefficient, NMB, etc.

Fig A1. Please improve the resolution of this figure.

Page 33 and Fig. A6. Why there are less data in Figs. A6a and A6b. I think it is due to the lack of observations related to the period of the measurements. So please write the number of observations available for the comparison for each plot. What these 10000 points refer to? It is confusing. The differences between MOPITT and WRF could also be related to the difference of the initial horizontal resolution (22km $\times$ 22km at nadir for MOPITT and $0.125^{\circ} \times 0.0625^{\circ}$ in the model).

Last line Appendix B. It is the same sentence in Sect 2.3.5. Do not need to repeat twice.

Minor comments: Page 2, line3: quality, spatial resolution

Line 6: (e.g., Beirle et al.,2011; Liu et al.,2016). Line 15: (e.g., Holloway et al., 2007; Khalil and Rasmussen,1990) Line 34: (e.g., Hooghiemstra et al.,2012a; Leeuwen van

et al., 2013; Hooghiemstra et al. 2012b; Girach and Nair, 2014; Yin et al., 2015; Jiang et al., 2017) Same thing for page 4, line 8 – page 8, line 19.

Page 2, line 10: at ground level at high concentration

Line 16: CO is also highly dependent on seasonal variation.

Page 4, line 2: (Deeter et al., 2013; 2014) Line 3: vegetation - Deeter et al., 2009) Line 8: Deeter et al. (2014; 2016).

Page 7, line 16: we used emissions from the EdgarV4.2

Page 8, line 21: “coarser spatial resolutions”: Please provide these resolutions.

Page 10, line 34: weighting

Page 11, line 20: need to correct the numbers: 10ˆ16 10ˆ17

Page 12, line 24: (from surface to 800 hPa).

Page 12, line 25 & Fig. A4: AK area. Do you mean AK vector?

Page 15: problem in inversion studies (Jacob et al., 2016).

Page 20 line 8: Do not begin the sentence with “Or,”

Fig1. Please add the location of Madrid on the map.

Figs. 2 & 5. It is very nice and interesting.

figA6. Add labels (a), (b), (c) and (d) on the scatterplots.

Tab. A1 & A2. Write: “. . . from this study and Pommier et al. (2013). The values from Pommier et al. (2013) are provided in parenthesis”.

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