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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Regional pollution potentials of megacities and other major population centers" *by* M. G. Lawrence et al.

Anonymous Referee #4

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Review of Regional pollution potentials of megacities and other major population centers M. G. Lawrence, T. M. Butler, J. Steinkamp, B. R. Gurjar, J. Lelieveld

————————-General Comments————————-

The paper addresses the effect of megacities on the regional buildup of pollutants near their sources versus long-range export. Artificial tracers of different lifetimes are initialized at major pollution centres, and their behaviour is examined and quantified in terms of pollution potentials. These pollution potentials are determined to a large extent by the transport patterns prevailing at the specific geographic location of the source. Therefore many of the findings are quite obvious for an educated reader who is familiar with the atmospheric circulation. In addition, some of the findings are re-

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peated using different metrics. Thus, although the subject is important and politically highly relevant, reading becomes a bit tedious sometimes. Straightening and shortening would considerably improve the paper, and emphasize the interesting findings, e.g., about the importance of vertical transport for both regional pollution around the source and low-level long-range export. When reading the text, it is difficult to pin down the essential statements, because too many details are mixed in. It would probably improve readability to limit the discussion to the 10day tracer, and then add one separate paragraph on the 1day and 100day tracers, in which the relevant time scales of transport and tracer life times are compared. In addition, the discussion of individual cities could be better structured along the transport patterns and not be scattered over the manuscript. Please find my detailed comments below.

————————-Specific comments————————

13324, abstract/ Should be rewritten. Some of the statements are obvious, the important ones are not highlighted enough, see comments below.

13324, 22 efficient long-range transport/ efficient long-range transport close to the surface

13324, 25 threshold/ This is misleading, as you are not examining thresholds exceedences in a given region as usually done, but the areas in which a threshold density is reached. See comments below.

13328, 18 What is the vertical resolution? Give at least that in the BL

13329, 6 One gridcell per MPC? If the source gridcells are not of the same size, the emissions are not the same for each city?

13329, 6 1kg per s/ per gridcell? per m2 ? per m3 ? homogeneous mixture in lowest layer assumed?

13329, 20 metric based on annual means?

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13331, 8 Please add a sentence that these metrics are discussed in terms of ranks.

13332, 3 semi-offline/ Which part is online? 13333, 10 Column dispersion is similar for all mega cities, independent of the local or regional transport pattern. This is an interesting finding, which is missing in the abstract and conclusions.

13335, 2nd paragraph/ This paragraph is too detailed. Straighten and discuss in terms of transport pattern. The intraregional differences are obvious as different transport regimes prevail.

13335 to 6, 24 to 25 the whole paragraph/ These remarks are obvious. It is clear that a city on an island and one in-land result in different fractions of pollution over landĚI would suggest deleting the whole paragraph to avoid to bore the reader.

13336, 6 to 26 the whole paragraph/ too detailed

13338, 4 to 22 /The reason for this is.../ Why is this a reason? And why is it then only true for these cities and not for others where vertical mixing is weak? Please clarify and improve your argumentation.

13339, 12 /It is directly evident... It can also be seen (even better, if the figure was larger) that the tracers are more efficiently transported in the horizontal direction once they have reached altitudes $>$5km. Do cities in convective regions have stronger effects in the upper troposphere than NH cities in non-convective regions? This is not discussed in the paper as your metrics Ax are limited to the BL.

13339, 16 to 17 /500 km/ Why do you consider this additional area? And then why not for the 100d-tracer? It could be entirely omitted as it does not provide new information.

13339, 20 to 28 /latitude of MPCs/ This discussion is not very sensible, as the specific geographic location of a city plays a major role. The authors are aware of this when they mention the influence of the Hadley cell. The paragraph needs to be considerably shortened!

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13340, 4 /tracers have the same global mass/ ? 3 tracers of different global mass, see 13337, 14-15

13340, 13 to 23 whole paragraph/ Delete this paragraph. It is obvious that cities that are situated at the latitude, but in different regions do not show the same dispersion pattern. Delete also figure 6.

13340, 24 to end /convection leads to dilution in the BL/ This statement is missing in the conclusions.

13341, 20 /Delhi Fog/ I assume that this expression refers to very high pollution levels in the city of Delhi, whereas you investigate the area which polluted by the emissions from Delhi (Ax). I find your way of discussion misleading.

13342, 5 to 28 /paragraph too long/ Local pollution effects cannot be simulated by global model, as the authors state themselves. Therefore they should not discuss them at length even using an additional metric. 13343, 1 to 12 /too long, repetition (I do not need to recall, I still remember...)

13343-13344, 13 to 6 Information about the volume of the grid cells is needed here, which height do you assume? again, is your emission rate per m2 or per m3 or per grid cell?

13343, 22 to 25 /density near the source does not depend on life time but only on mixing conditions/ interesting! missing in the abstract and the conclusions

13344, first para repetition: this is a global modelĚ

13344, 9 to 12 /Note that.../ repetition, please delete sentence

13344, 12 to 15 /Note, however,/ move upwards, p 13343, line 28 before sentence ‘At this end...’ ?

13344, 16to 17 /only two orders of magnitude/ why ‘only’? factor 100 seems significant to me

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13344, 26 /maximum possible areas/ assuming instantaneous mixing?

13345, first para/ It would be nice to rewrite this paragraph to improve readability. I am not sure if the reader learns a lot from all these calculations.

13345, 10 /strong conc. of short-lived tracers near the source/ But above (page 13343, line 22 to 25) you found that the conc. near the source is independent of the tracer's life time?

13345, 2nd para/ This discussion redundant; the same statement has already been made above for ELR1km.

13345, to 46 /high low-level concentration near the source is correlated with large low-level export/ This is an interesting discussion. Basically you are saying that if a tracer remains close to the surface, it stays there over large distances. Efficient dilution is always coupled to convective mixing out of the BL. Please link to your statement that ELR1km ˜ 1/EUT. The horizontal transport above 1km height is more efficient than in the BL (as can be seen in Fig. 1). In section 3.1 you find that ELRCOL does not vary much between the MCPs. Given your findings here, I do not understand why?

13347, numbered conclusions 1. to 5./ These conclusions are a direct consequence of the transport patterns, and they should be given in this context. The way they are formulated now, they risk appearing trivial. Instead, important conclusions are missing, see comments above.

13347, numbered conclusion 3/ Please reformulate and improve readability. E.g., the need for more work is not a veritable scientific conclusion from your work, this statement should be moved out of the numbered items to come down to more pointed statements. See also comments above.

13347, numbered conclusion 7 /local pollution/ Local pollution was not subject of the study, as mentioned by the authors several times. Therefore no conclusions can be made on local effects, please limit your statements to the regional and continental

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scales. In addition, why should a MPC be free of the potential for local pollution?

————————-Technical corrections————————-

13328, 11 /good global coverage/ strange expression, better ‘homogeneously distributed’

13328, 12 /improved global coverage/ ditto, better ‘more representative’

13331, 6 /orthogonal/ complementary?

13331, 25 /data/ meteorological data

13332, 21 /column density/ imprecise expression, better use column-integrated density or column mass

13333, 6 to 7 /outside the source column/ i.e. transported further than 100km?

13333, 18 /figures/ The maps on figures are too small, it is not possible to see much. In addition, the choice of the scale determines the picture. 13335, 22 /another of the additional tracers/ an additional city?

13336, 2 /rms/ why not standard deviation?

13337, 4 /1.5% smaller/ by 1.5% than the 1km values? this would correspond to a factor of 100 not 10.

13347, numbered conclusion 3/ chosen MPCs major MPCs (this is why they have been chosen)

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 13323, 2006.