

Response to Referee #2

We thank referee #2 for the comments. In the following, we repeat the most significant of these comments in italics, and provide our responses in normal font.

- *My impression of this paper is more positive than that of reviewer #1, and I recommend publication, although I agree that the complete absence of measurements or evaluation is a weakness. However, the main purpose of this paper is as far as I understand, a comprehensive and consistent comparison between many different megacities at different locations and with different meteorological conditions using the same scientific tool and same type of analyses. It should be made clear in the paper that for this type of study only a model can be used and an evaluation against measurements for each of the studied megacities would be beyond the scope of this paper.*

Following the reviewer suggestion we have included the following sentence in the introduction of the revised paper: "We mention that for this study which is comparing several metrics for many megacities only a modeling approach seems feasible. Consistent measurements collected for all megacities are unavailable to date. Moreover in this study the plumes are followed across many scales, and such plumes cannot be isolated in a straightforward way, in measurement data, from emissions from larger regions. Therefore, a detailed comparison with measurements for every megacity is unfeasible and is not part of this study"

- *In addition more references have to be given on previous dispersion studies where FLEXPART has been successfully evaluated (more recent than Stohl et al 1998).*

Following the referee suggestion several references have been added regarding the model evaluation and the following paragraph included in section 2.1 of the paper:

"FLEXPART is a widely used transport model and has been extensively validated with measurements. Some examples of validation relevant to the present study are against: 1) large scale tracer experiments in Stohl et al. (1998), 2) aircraft measurements of large scale intercontinental megacity pollution plume in Stohl et al. (2003), 3) aircraft measurements of a pollution plume transported from Eastern Asia to Europe in Stohl et al. (2006), 4) in-situ observation of Asian pollution transported into the Arctic lowermost stratosphere in Roiger et al. (2011) and 5) measurement of the transport of American megacity pollution into the North Atlantic in Neuman et al. (2006)."

Answer to the minor comments

We thank the referee for the many corrections. We report below the most significant minor comments and our answers. All other minor corrections have been done as suggested by the referee.

- *page 69, line 27: NYC is not 20 times larger than St. Petersburg. I know you have this from your table 1, but these population figures must have been derived differently (and thus inconsistently) for the two cities. For NYC 46 million includes the entire 'agglomeration', for St.P. 2.6 million is probably only within the administrative boundary. For an emission impact study one should use the agglomeration number in both cases.*

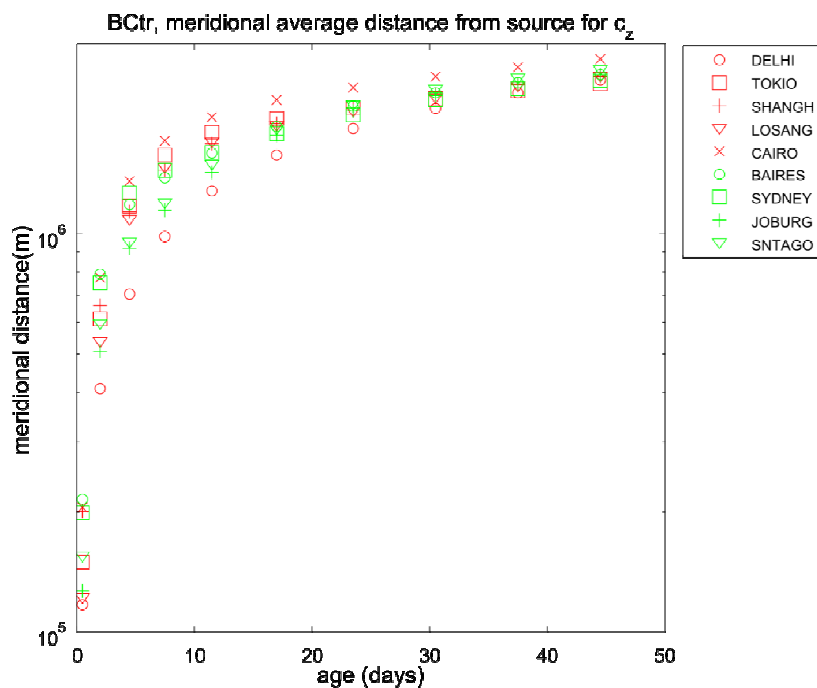
The definitions of the megacities extensions are indeed not perfectly consistent. The mask defining this extension was decided in collaboration with the MEGAPOLI partners and provided to the consortium members by T.M. Butler (personal communication 2010). With this definition the New York megacity is actually the extended New York, Washington and Boston area (15 grid cells, see table 1 and Figure 1). However, since the emission and population are defined using the same mask, the results are consistent, i.e. increasing the area to double the population would also increase the emissions.

To clarify this point we have included the following comments in the paper in section 2.2: “It should be noted in Fig. 1 and in Table 1 that the definition of the megacities is not perfectly consistent since extended areas, like the agglomerate of New York, Boston and Washington (here just called the New York megacity for simplicity), the Dhaka megacity and the Po-valley are compared to more localized areas, like Chicago or Paris. However, the emission and population are consistently extracted using the same mask”.

We have also modify the sentence at page 69 to: “The cumulative numbers reported in Table 3 (column 2 and 4) show that with our definitions of the megacities extension, for BCdp all the megacities in Asia contribute less than the sole city of Saint Petersburg and that the extended New York area has a similar contribution to Saint Petersburg despite having almost 20 times the population”.

- *Page 72, line 19: 'due to the generally longer distances' I think another important reason is the generally weaker meridional transport in the Southern Hemisphere, isn't it?*

Although this may be plausible, from our data we did not observe a significant difference between the meridional transport distance from cities at similar latitude in the southern and northern hemispheres. This is reported in the picture below for a sample of the investigated megacities with latitude between about $\pm 28(26)$ and $\pm 35(35)$.



References not included in the previous version of the manuscript

Stohl, A., C. Forster, H. Huntrieser, H. Mannstein, W. W. McMillan, A. Petzold, H. Schlager, and B. Weinzierl (2006): Aircraft measurements over Europe of an air pollution plume from Southeast Asia - aerosol and chemical characterization. *Atmos. Chem. Phys.* 7, 913-937.

Roiger, A., H. Schlager, A. Schäfler, H. Huntrieser, M. Scheibe, H. Aufmhoff, O. R. Cooper, H. Sodemann, A. Stohl, J. Burkhart, M. Lazarra, C. Schiller, K. S. Law, and F. Arnold (2011): In-situ observation of Asian pollution transported into the Arctic lowermost stratosphere. *Atmos. Chem. Phys.* 11, 10975-10994, doi:10.5194/acp-11-10975-2011.

Neuman, J. A., D. D. Parrish, M. Trainer, T. B. Ryerson, J. S. Holloway, J. B. Nowak, A. Swanson, F. Flocke, J. M. Roberts, S. S. Brown, H. Stark, R. Sommariva, A. Stohl, R. Peltiers, R. Weber, A. Wollny, D. T. Sueper, G. Hubler, and F. C. Fehsenfeld (2006): Reactive nitrogen transport and photochemistry in urban plumes over the North Atlantic Ocean. *J. Geophys. Res.* 111, D23S54, doi:10.1029/2005JD007010.