Related articles

Volume 7, issue 4 | Copyright

Development and technical paper | 18 Jul 2014

A novel model evaluation approach focusing on local and advected contributions to urban $PM_{2.5}$ levels – application to Paris, France

H. Petetin et al.

Received: 16 Oct 2013 – Discussion started: 05 Dec 2013 – Revised: 07 Mar 2014 – Accepted: 21 May 2014 – Published: 18 Jul 2014

Abstract. Aerosol simulations in chemistry transport models (CTMs) still suffer from numerous uncertainties, and diagnostic evaluations are required to point out major error sources. This paper presents an original approach to evaluate CTMs based on local and imported contributions in a large megacity rather than urban background concentrations. The study is applied to the CHIMERE model in the Paris region (France) and considers the fine particulate matter ($PM_{2.5}$) and its main chemical constituents (elemental and organic carbon, nitrate, sulfate and ammonium), for which daily measurements are available during a whole year at various stations (PARTICULES project). Back-trajectory data are used to locate the upwind station, from which the concentration is identified as the import, the local production being deduced from the urban concentration by subtraction. Uncertainties on these contributions are quantified. Small biases in urban background $PM_{2.5}$ simulations (bias of +16%) hide significant error compensations between local and advected contributions, as well as in $PM_{2.5}$ chemical compounds. In particular, winter time organic matter (OM) imports appear strongly underestimated while local OM and elemental carbon (EC) production is overestimated all along the year. Erroneous continental wood burning emissions and missing secondary organic aerosol (SOA) pathways may explain errors on advected OM, while the carbonaceous compounds is likely to be related to errors in emissions and dynamics. A statistically significant local formation of nitrate is also highlighted from observations, but missed by the model. Together with the overestimation of nitrate imports, it leads to a bias of +51% on the local $PM_{2.5}$ contribution. Such an evaluation finally gives more detailed insights on major gaps in current CTMs on which future efforts are needed.

Please read the corrigendum first before accessing the article.

Download & links

- Article (PDF, 1002 KB)
- Corrigendum
- Supplement (1214 KB)

How to cite: Petetin, H., Beekmann, M., Sciare, J., Bressi, M., Rosso, A., Sanchez, O., and Ghersi, V.: A novel model evaluation approach focusing on local and advected contributions to urban $PM_{2.5}$ levels – application to Paris, France, Geosci. Model Dev., 7, 1483-1505, https://doi.org/10.5194/gmd-7-1483-2014, 2014.