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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Parameterization of subgrid aircraft emission plumes for use in large-scale atmospheric simulations" *by* A. D. Naiman et al.

Anonymous Referee #2

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Overview

This manuscript describes a new method (SPM) to parameterize (non-reactive) plumes generated by aircraft exhausts into global models. The basic idea of the method is to represent the plume as a succession of ellipses connected by segments forming a single aircraft trajectory. In this sense, it is a Lagrangian subgrid parameterization for large-scale models. The method is validated against previously published Gaussian plume parameterizations and large-eddy simulations of passive tracer dispersion.

General comment

I appreciate the idea of representing the plume structure as an ellipse transported by

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mean wind, shear and diffusion deduced from the local large-scale variables, which eases the integration of the plume into a large-scale model.

Although the method provides a good representation of the geometry of a (non-reactive) plume, it doesn't address the key question of parameterizing the chemical or the microphysical processes of the material contained in the plume –which act as chemical/microphysical subgrid perturbations for the large-scale model. As I can understand from the discussion in Sec. 4.1, it is the microphysical/chemical module of the GCM that takes care of solving for these processes. The SPM runs at the same time with the GCM and is initialized using data from separated LES or other databases of small-scale simulations covering the vortex phase of the wake. This is okay for passive tracers because the controlling processes are linear and so the plume concentrations can be easily rescaled to feed the GCM. For non-linear processes like chemical reactions or contrail microphysics the problem is that the initial distribution of, say, ice retrieved from the database can be completely disconnected from the running GCM and the SPM. This is quite critical for contrails: for example how would you match the background supesaturation of the running GCM with the ice distribution obtained from a separate LES? How would this impact the resulting global distribution of contrails? Please discuss these issues.

Although the authors mention the paper by Jacobson et al., 2009, no results of the application of SPM to a GCM are actually reported in the present paper. In this sense, the title of the paper and much of the discussion are misleading and the reader gets confused because is expecting a parameterization of contrails or aircraft emissions (i.e. reacting with the atmosphere) rather than a non-reactive plume parameterization.

To summarize, in order to be published the paper should be reorganized and the objectives more clearly identified. What I propose is one of the following pathways. The first one is to reshape the paper by clearly presenting it as a purely passive plume parameterization. For example a technical note cloud fulfill this objective. On the other hand, if you stick up for the suitability of SPM to general aircraft emissions, then the issues

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9, C9626–C9628, 2010

raised above should be thoroughly discussed and the results of its application to GCM included in the paper. In this case you may also consider the possibility of merging the paper with Jacobson et al, 2009.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 24755, 2009.