

Interactive comment on “Lagrangian analysis of low level anthropogenic plume processing across the North Atlantic” by E. Real et al.

Anonymous Referee #1

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Review of the paper Lagrangian analysis of low level anthropogenic plume processing across the North Atlantic by Real et al.,

General comment

The paper documents in great details the evolution of an anthropogenic plume transported across the Atlantic. The plume was sampled several times by different research aircrafts from the eastern coast of the United States until Europe, allowing for a Lagrangian-type investigation of the behavior of the plume with respect to different processes including chemistry, wet and dry deposition, and mixing.

The paper presents interesting results in terms of the relative contribution of individual processes that influence the plume processing. It is well written and clear in general.

However, as further discussed below, I have a couple of issues with the modeling framework which should be addressed by the Authors before the paper is accepted for publications.

Specific comments

Page 7515, line 25-26. I find the different statements concerning the Lagrangian match or "no match" on 22 July to be a bit confusing. Where does the statement from line 14-15 "Therefore it appears that the Lagrangian match on 22 July is less good" come from? It is not clear whether this is from this study and from another paper. It seems to me that the Authors have difficulties to reproduce the observed concentrations on that day and that therefore they think that the Lagrangian match for 22 July is not as good as for the other days. If this is the case, then they should say so. This discussion should be clarified throughout the paper.

Page 7519, line 11. The Authors should try to describe (even briefly) the level of details used in the chemical mechanism. For example which hydrocarbons are treated?

Page 7521, lines 5 to 13. The heterogeneous hydrolysis of N_2O_5 is a major sink for NO_x and it is not clear for me why this reaction is simply neglected while other processes are taken care and discussed with great care. The simulation runs through 6 consecutive days and nights and therefore this sink could be important. The fact that NO_x levels are too low in their simulation and that accounting for this heterogeneous reaction would further decrease the NO_x levels is just not a good rationale. Instead this reveals that some processes may be not well represented or still lacking in the modeling framework. Could the Authors include this reaction as well as the main known heterogeneous reactions that could affect the NO_x and HO_x evolution during the transport? Also, in a previous paper, the Authors have shown that aerosols significantly perturb the photochemical activity of the plume. Could that be the case here at least during the first two days - are aerosol concentrations high enough in this case?

Page 7525, section 4.2.2. Please list the chemical species that experience wet depo-

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sition in addition to HNO_3 .

Page 7527, lines 15 to 20. Statements such as "better agreement", "slightly overestimated", "slightly underestimated" should be avoided as much as possible and more quantitative information on the model performances should be provided.

Page 7528, lines 25 to 30. The values used for mixing rates appear to be a bit arbitrary to me (and especially the shift from 10 to 2). How were these values chosen? Similarly, the method to define the background values is not entirely clear to me. Also, I do not really understand the statement on line 9-11 page 7529: How can plume concentrations be similar to background values? Maybe this will be made clearer when the Authors explain how they have specified their background concentrations.

Page 7541. Why is the evolution of hydrocarbon concentrations not shown? Could they provide an additional constrain on the mixing and the OH levels in the plume?

As a conclusion, do the Authors have indications for the frequency of occurrence of such cases? It would be nice if they could comment on that. In addition, is there indication of the impact of this plume on the European atmosphere? They mention that removal of CO by OH (and thus low CO levels) could be the reason for a difficult identification of long-range transported plumes over Europe. Do they have indication that indeed this is the case for that plume?

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 7509, 2008.

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