Atmos. Chem. Phys. Discuss., 7, S254–S256, 2007
www.atmos-chem-phys-discuss.net/7/S254/2007/


Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Inverse modelling-based reconstruction of the Chernobyl source term available for long-range transport" *by* X. Davoine and M. Bocquet

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Received and published: 22 February 2007

Thank you very much for your comments. Besides we have greatly appreciated the (useful) way you chose to go deep into the points you have picked up.

1) We have tried to avoid giving mathematical details because we feared it could act as a repellent and minimise the results. But if you feel the present form makes wanting more (which is good), we will do so.

2) We agree our statement was a bit loosely. The idea under the the statement was that we have made sensitivity analysis (with or without the proper continuity equation implemented) on ETEX and Chernobyl. The results are that the simulation are barely sensitive to it, at the ground level. This is not the case for air quality ($NO_x$ and $O_3$),

where discrepancy of up to $20\%$ can be observed because emissions are spread all over the domain. This is the reason why we have abusively made this statement. This will be made clearer.

Now, one of the reasons why the sensitivity to the air density variability is very weak in our accidental release studies, is also because we don't have any convection scheme implemented. As you suggested, if we had such a scheme, we would probability observe bigger differences (especially in the case of Chernobyl).

3) Thank you very much for this comment/suggestion. We will reshape the text in the light of you comment. We will keep in mind your idea, as it offers a nice compromise between the subtlety of physical parametrisations and the the intricacy of the inverse modelling chain. A comment about it will be added in the conclusion. The section on parametrisations, which was very brief, will be enhanced to reflect the difference between parametrisations.

4) 4-1. The impact of dry deposition is much weaker than wet scavenging (except maybe in the area a few hundred kilometres around the source).

4-2. This a nice idea. We could implement an heat plume rise formula. The parameter $\gamma_k$ would have then a stronger dependence on altitude (its vertical profile could be a Gaussian centred around the effective height). However, in the case of Chernobyl, the rise would be difficult to assess a priori (thermal effect ?, mechanical effect ?, etc). This is not the case for nuclear incidents that happen, when a pipe is broken in the heat exchange system. Then the (radioactive) leaking vapour is released into the atmosphere to diminish the pressure through an exhaust pipe. This is a calibrated event, the standard heat plume rise being essentially driven by the gas velocity (because of the very high pressure) which could be estimated a priori.

4-3. We consider the concentrations as representative of a lumped species, which is certainly a very crude approximation. Doing otherwise is possible but then nuclear aerosols should be modelled which complexifies the problem considerably. This would



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make the physics non-linear and the inverse modelling approach as explained in the manuscript should be changed. Intermediary steps such as the one you suggested for wet scavenging are preferable.

In addition to taking into account your remarks, we will also enhanced the discussion and the comparison Gaussian inversion / entropy-based inversion (see the answer to Ivan Kovalets's short comment) in the revised version.

Best regards,

Marc Bocquet

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Interactive comment on Atmos. Chem. Phys. Discuss., 7, 1, 2007.