Atmos. Chem. Phys. Discuss., 9, C3845–C3850, 2009
www.atmos-chem-phys-discuss.net/9/C3845/2009/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Estimating trajectory uncertainties due to flow dependent errors in the atmospheric analysis" *by* A. Engström and L. Magnusson

Anonymous Referee #1

Received and published: 13 August 2009

Review of "Estimating trajectory uncertainties due to flow dependent errors in the atmospheric analysis" by Engström and Magnusson

General remarks

The authors present a compact, interesting analysis of two methods to estimate the "flow dependent error" during backward trajectory calculation. A new aspect of the study is the use of the Ensemble Transform method to generate perturbed analysis fields for the trajectory calculation.

While the paper is well written and addresses an interesting topic with a new method, I feel that drawing wider conclusions from the analysis is hampered somewhat by the

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

limited data set. I would therefore strongly encourage the authors to extend their trajectory data set in order to provide more widely applying conclusions from their work.

Specifically, I recommend that the authors should address the following points before the paper is accepted for publication in ACP:

1. Some justification is needed why trajectories are only started at 850hPa. This choice strongly limits the conclusions from this study to cases where trajectories near the ground are considered. The two methods could behave very differently at different vertical levels, for instance at the mid-latitude tropopause or in the polar stratosphere.

2. The method description needs some clarification. It remains unclear how the individual perturbed analyses are obtained and how they differ from one another.

3. The hemispheric differences in Fig. 1 are not fully discussed. How much of the differences in the northern hemisphere (NH) are due to the limitation of the study to NH winter? Also, the implications of the tropical vs. mid-latitude characteristics are not fully taken into account in the discussion of the two case studies.

4. It would be a very insightful extension of this study to compare the results with findings from calculations with ensemble members, or trajectories that include parameterizations for turbulence or convection. Furthermore, the two methods could be easily combined to increase the spread in yet another set of calculations. Some of these points are natural questions that arise on reading the manuscript and should be addressed in the discussion.

Detailed comments

Pg. 15748

L. 20-23: add references

Pg. 15749

L. 1-5: The term 'error' needs a definition here. There are many different kinds of

ACPD

9, C3845–C3850, 2009

trajectory errors, stemming from the calculation method, the interpolation scheme, the input data etc. Also, you could clarify already here that the focus is on the spatial uncertainty of a trajectory calculation, rather than for instance the uncertainty of tracers along the trajectory.

L. 11: historical -> backward?

L. 15: 'One widely used method...' needs reference

L. 20: reference?

Pg. 15750

L. 2: needs reference (or repeat Bannister reference)

L. 16: The reference Magnusson 2009b was not available to the reviewer. Which properties where compared, and how was the expected analysis error derived?

L. 21: use -> uses

L. 27: 'the spatial uncertainty'

Pg. 15751

L. 17: 'the the' -> the

L. 18: historical -> backward?

Pg. 15752

L. 19: 'relative the' -> 'relative to the'

L. 21: The sentence is not clear, which statement does 'this' refer to?

Pg. 15753

L. 2: is -> are

L. 6: How were the 20 perturbed analyses obtained? Did you sample the maximum

ACPD

9, C3845–C3850, 2009

perturbation randomly? Is each of the 20 sets dependent on or independent of he previous perturbed time step?

L. 9: 'For each analysis one trajectory...': how is this trajectory related to the 15 trajectories calculated each day?

L. 25: How much of the differences in the northern hemisphere (NH) are due to the limitation of the study to NH winter? How would the result look like for a NH summer month, for example?

Pg. 15754

L. 6: Magnusson reference not available

L. 13: Was the displacement chosen randomly? Note that this initialization introduces a latitudinal bias (1° longitude near the pole <> 1° lon at equator!).

Pg. 15755

L. 1: is -> are

Pg. 15756

L. 4: sample -> samples

L. 6: As seen in Fig. 1 the error in the extra-tropics is exaggerated - hence the EA error growth might be extreme. This would make the actual differences between the EA and IS method appear relatively small. Have you examined other case studies in the extra-tropics?

Fig. 3: the labeling of the panels for 20051218 and 20051219 is mixed up. Each panel in the figure should have a letter assigned that should be used in the discussion of the figure (applies also to Fig. 2).

L. 20: Where in which panel of Fig. 3 is that region? To me, the differences between the different kinds of trajectories appear relatively small. The sentence in L. 22 is not

ACPD

9, C3845–C3850, 2009

clear, what do you mean by appearance?

L. 26: 'are generally'

L. 27: Which other methods do you mean? How strongly is this case study impacted by the underestimation of analysis error seen in Fig. 1? Trajectory calculations in this region are probably not very trustworthy in general due to the relevance of (deep) convective transport - assuming that the ECMWF trajectory model does not parameterize turbulence and convective transport in some way.

Pg. 15757

L. 1: 'aimed to sample special flow situations': not clear, special in which way?

L. 18-20: 'appears to be exponential...', 'This behavior could be...', 'could be set up...': this section is formulated quite vaguely, rephrase

For clarity, 'deviation speed' should be defined in the text explaining Eq. 1.

Pg. 15758

L. 13: 'The length scale is dependent...': either expand this statement to make the point clearer and more substantial, or remove it.

Pg. 15759

L. 2: 'One backward trajectory is using...': the sentence is not clear. Are not 15 daily trajectories calculated as stated in Sec. 2?

L. 4: 'The effect...' unclear, rephrase

L. 22: 'The growth rate is much higher...': does this finding imply that parameterized small-scale turbulence during the trajectory calculation could be equally useful in providing rapid initial dispersion growth?

Pg. 15760

ACPD

9, C3845–C3850, 2009

L. 3: play -> plays

L. 15: 'The conclusion from...': to what extend is this conclusion limited by only considering trajectories starting in the lower troposphere?

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 15747, 2009.

ACPD

9, C3845–C3850, 2009