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Interactive Comment

Interactive comment on "Intercomparison between Lagrangian and Eulerian simulations of the development of mid-latitude streamers as observed by CRISTA" *by* F. Khosrawi et al.

Anonymous Referee #1

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General comments

This paper uses both Lagrangian and Eulerian models to examine streamer development in the midlatitude stratosphere. The goal is to assess the impact of mixing on the streamer development by intercomparison of the models with various initializations and mixing parameterizations and by evaluation with respect to CRISTA data during early November 1994. This paper will provide a useful comparison for the scientific community, yet I think it would benefit from the specific comments listed below. I would particularly like to see point 1 addressed before publication. The rest of the points are minor suggestions for strengthening the clarity and presentation.

Specific comments

1. The goal of the paper is to compare Lagrangian and Eulerian simulations of streamers. This is done using the KASIMA model, with dynamics based on nudging the temperature to ECMWF values, and the CLaMS model, which is driven by UKMO data. I think the problem could be addressed more clearly by driving both models with the same dynamics. As currently presented, some of the differences are likely due to different dynamics, and some due to different transport models. There is no discussion of how dynamical differences may be affecting the results. I would strongly suggest that the authors present at least one test case in which the same dynamical fields (and initial conditions) are used with both a Lagrangian and Eulerian model.

2. Is the transport in KASIMA done in the spectral framework of the GCM or using a grid-point model? The paper describes the KASIMA transport as a two step flux corrected algorithm, which suggests the transport is done on a grid (also you say that there are 8000 “grid boxes” in the KASIMA T42 simulation). Could you describe this in more detail? Also, can the flux correction be modified at all to examine its effects on the mixing processes in the Eulerian framework? You do examine the effects of running KASIMA at two horizontal resolutions, but you don’t address the impact of the chosen Eulerian mixing parameterization.

3. Another issue is that the vertical coordinates of the two models are different. KASIMA uses pressure levels while CLaMS is based on isentropic levels. The latter should in principle do a better job simulating quasi-isentropic transport in the stratosphere, while the former may have excessive vertical mixing. It would be helpful if you could comment on this issue. It would be more helpful to compare the CLaMS results with an Eulerian calculation with isentropic vertical coordinates.

4. Is the CLaMS model run in diabatic or adiabatic mode? If the former, how are the heating rates calculated?

5. For CLaMS, could you explain the difference between the 24-hour advective time step and the 30-minute time step used in the Runge-Kutta scheme?

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6. I had some difficulty making out various features in Figure 1. I could identify the two NH streamers, but the SH streamer was very difficult to see against the background of higher N2O. I wonder whether you could make a contour map of this data to put next to the point map in order to guide the reader.

7. Also, you should explain in the text how the synoptic map was made from the asynoptic CRISTA observations. You allude to “trajectory calculation” in the figure caption, but it is unclear what dynamical fields were used to run the trajectories, whether or not they were adiabatic, and at what level the trajectories were initialized. Also, assuming they were initialized at 700 K, why were all the model plots made at 675 K? Why not use exactly the same level?

8. Are there available estimates for the accuracy and precision of the CRISTA N2O data? It would be helpful to mention them.

9. The differences in model reproduction of the streamers (Figs. 2 and 3) could be addressed more quantitatively by running the models with the same dynamics, as suggested in point 1.

10. It might be worth noting that both models show high ozone in the region centered near 140 W, 50 N. This appears to be in an anticyclonic circulation, which is likely part of the planetary wave event that caused the east Asian streamer. Also, the models show a swirling pattern centered near 120 E, 70 S, which appears to be associated with the anticyclone that was involved in the Southern Hemisphere streamer.

11. The inability of the 9-year KASIMA run to get the correct N2O gradients may be related to errors in residual circulation, in addition to the chemistry errors you mentioned.

12. In Section 4.5 you should be more specific as to how N2O was initialized in these runs. Also, do these runs use the nudging technique that was used in the 9-year KASIMA run? If so, how can you account for the better ability to capture the Southern Hemisphere streamer in the shorter runs?

13. What is the approximate horizontal resolution of the T106 run? Is the same flux correction routine used for both T42 and T106?

14. This may be beyond the scope of this paper, but it would be interesting to examine the time evolution of the tracer PDFs in both models from initialization to 6 November. In particular, how does the PDF before the streamers arise compare to the PDF during the streamers. How much impact to the streamers have on the tail of the PDFs?

15. You may want to reference the papers by Hu and Pierrehumbert (Journal of the Atmospheric Sciences, 2001, 2002), which also examine the structure of the PDFs for stratospheric tracers.

16. In your conclusions, you say that the KASIMA (T42) simulations provide a reliable basis for establishing a streamer climatology. Yet the comparison of the KASIMA (T109) run with CRISTA shows a weaker exponential tail. Therefore wouldn't you expect this run to considerably underestimate the amount of streamers?

Technical corrections

P6190, L2: "of of" should be "of"

P6191, L15: "levels" should be "level"

P6191, L19: "between" - do you mean "centered near"?

P6192, L3: "in" should be "at"

P6193, L2: "these altitudes" - "this level"

P6194, L15: "over" - "of"

P6194, L20: "streamer" - "streamers"

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 6185, 2004.