

Interactive comment on “Climatologies of streamer events derived from a transport model and a coupled chemistry-climate model” by V. Eyring et al.

Anonymous Referee #2

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This paper describes climatologies of "streamers" (tongues of tropical air intruding into the extratropical stratosphere) derived from (i) a 9-yr run of a chemical transport model which is nudged toward ECMWF analyses and (ii) several "time-slice" runs with a coupled climate-chemistry model. The seasonal variations of streamers is presented and compared between the two models and between simulations of past and future climates. The influence of streamers on mid-latitude ozone is also examined.

This manuscript contains several interesting results and will be of interest to many readers of ACP. However, before publication I think revisions, as outlined below, are required .

Specific Comments

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1. The English needs to be greatly improved. I have included many corrections in the technical comments section, but this is by no means an exclusive list. The paper could also be more concise.
2. The two models have different horizontal resolution. Does this impact comparisons between the two streamer climatologies? Does KASIMA have higher frequency of streamers simply because it has higher spatial resolution and can resolve more streamers? A good way to test this would be to sample the KASIMA output at same spatial resolution of E39/C, and then calculate the streamers.
3. I am a bit confused about the statements about models missing ozone trend and role of streamers (pg 2301). While a change in streamers could contribute to the ozone trend, if the model shows this change in streamers then its change in ozone includes this effect and this could not be reason why model doesn't get correct ozone trend.
4. Why do you restrict the analysis to only 21 to 25 km? You mention problems with upper tropospheric systems, but do these mean algorithm can't be applied in 18-21 km region? Also what about above 25 km? You consider a larger altitude range in the ozone section; why not for rest of the paper?
5. I think you should include an examples which highlights the problems with vertical displacements methods (pg 2303). Can you show a case where there is vertical displacement but clearly no streamer, as well as a case with streamer which is not picked up by vertical displacement method.
6. Why do you apply the vertical criteria to E39/C and not KASIMA (pg 2313). If you applied it to KASIMA then you could compare directly with the Orsolini and Grant as they also used a CTM driven by analysed winds. Also, I think you need to show some of these results, and better support you claims dismissing these results.
7. The discussion about link between streamers and vortex is confusing (pg 2310-2311). First (line 10) its stated that shape of annual cycle indicates a link, but then on

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next page its stated that the vortex is not primary mechanism. I would remove the first sentence as the annual cycle of streamers doesn't match that of the vortices, e.g., NH vortex generally breaks up in March-April but number of streamers doesn't drop until June-July.

8. How do the winds change between the 1960 and 2015 simulations (pg 2315)? Both Chen et al (1994) and Waugh (1996) discuss the seasonal variation in streamers in terms of changes in zonal winds (and Charney and Drazin etc). Is there a change in zonal winds consistent with the change in streamer frequency?

9. I found the discussion at the beginning of section 5 a little confusing. Can question (1) be restated as saying by how much does the midlatitude ozone decrease because of low ozone entrained in the streamers? Then to examine this you modify the air inside streamers so that ozone is no tropical but rather mid-latitude values.

Also, is tropical ozone always lower than mid-latitudes? At high altitudes isn't ozone higher in the tropics? Does this affect you streamer criterion?

10. I am not sure the differences in the streamer climatology really shed light on the cause of the cold pole problem (pg 2320). I am not saying the discussion about possible causes of this problem is incorrect, but I don't see how this work has really added anything other than further evidence that the model isn't getting the wave dynamics correct. I think most of the discussion at the end of pg 2320 and following paragraph should be removed.

Technical Comments

(M,N) = page M line N

(2298, 2): streamers of what? I think you need to refer to n₂o and o₃ in the first sentence and define what you mean by streamers.

(2298, 9) (and several other places): I don't see the need to say "For the first time". Why not just say "We determine ...".

(2298,11) I don't think you can call KASIMA output "observations". Observations went into the ECMWF assimilation system, and then the ECMWF analyses went into the model. So output is a combination of observations and models.

(2298, 15) "... the validation of a streamer ..." I don't think you have validated anything, rather you have compared climatologies from two models.

(2298, 18): Remove "It turned out that". Also don't need both "qualitative" and "fair" before agreement.

(2299, 18) I think Waugh 1996 is correct reference. Also, is "Callaghan" correct?

(2299, 22-23) The sentence "Therefore, (quasi-) horizontal ..." should be combined with previous sentence or removed.

(2300, 24) "has newly been" -> "is"

(2300, 27) Remove "For the first time", and "has been" to "is"

(2301, 2) "... a respective streamer ..." Why is it respective? I'd suggest removing respective.

(2302, 21) "states" -> "shows"?

(2303, 7) I don't think "availability of the algorithm" is what you mean. Do you mean "usefulness" or "regions of applicability"?

(2303, 15) remove "and"

(2306) I don't think all the details, and references, about parameterisation schemes are needed. The features which are relevant for this study are the ones listed in table 1.

(2307) Section 3.1 repeats a lot of the discussion from previous subsections. Any material that is not should be moved to previous section.

(2308, 1-3) Wouldn't it be easier just to say that there is little interannual variability in the number and location of the streamers?

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(2310, 24-) This paragraph is "discussion" and should be in the next section.

(2315, 27) "play a minor role" -> "play only a minor"

(2321, 9) "In the literature"

(2322, 2) "partly significant"?

Interactive comment on Atmos. Chem. Phys. Discuss., 2, 2297, 2002.

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