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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evidence of impact of aviation on cirrus cloud formation" *by* C. S. Zerefos et al.

Anonymous Referee #2

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GENERAL COMMENTS

The paper provides additional evidence of impact of aviation on cirrus cloud formation by analyzing cirrus observations from space (as taken from the International Satellite Cloud Climatology Project, ISCCP) with air traffic data (DLR fuel consumption data for 1992). The approach follows earlier ideas and the results are in rough agreement with results previously provide by Pat Minnis and his coworkers (see Fahey and Schumann, 1999; Minnis et al., 2001) and includes results from a recent paper of Minnis et al. submitted for J. Climate (cited as private communication). The results show that cirrus increased significantly in certain air traffic regions and seasons and this helps to assess the potential amount of cirrus changes due to aviation. This is important and should be published.

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Discussion Paper

The data used and the statistical analysis performed so far appear to be valid in general. The results are compared to results from the literature. The results and conclusions are presented generally in a clear, concise, and well structured way. Hence, the paper is basically acceptable.

SPECIFIC COMMENTS

The usefulness of the paper for assessing the change in cirrus and the aviation impact would be enhanced if the authors could also provide values of the differences in global cirrus amounts globally in addition to the various regions during the 15 year period of analysis (1984 to 1998) and should quantify the so-called spreading factor according to Minnis et al. (2001), i.e. the ratio between the amount of observed cirrus change in air traffic regions and the amount of line-shaped contrail cover as given by Sausen et al. (1998).

I do not understand how the authors produced the results given in Table 3. This table cites regions with low and high contrail cover. However the data base used seems to include the fuel consumption only. Perhaps the authors are using the output from the study of Sausen et al. (1998)? This need to be clarified in chapter 2.

The paper accounts for the effect of changes in due to natural phenomena, such as ENSO, QBO and NAO (3341, 2 ff), but does not explain in sufficient detail how this is done. The reference to Zerefos et al. (2003) is insufficient in this respect, because that reference is to a conference abstract without technical details. I suggest to provide further information so that the reference Zerefos et al. (2003) is not needed (and deleted).

Moreover, the description of how the regression analysis was made to account for the effect of tropopause variability (temperature variability only or also humidity and height of tropopause?) was removed (3341, line 16), needs clarification. I suggest to provide further information. With respect to tropopause variability see also Santer, B. D.; et al., Behavior of tropopause height and atmospheric temperature in models,

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reanalyses, and observations: Decadal changes, J. Geophys. Res. Vol. 108 No. D1, 10.1029/2002JD002258 (2003).

3345, 5 and Figure 3: I assume that the percentage cirrus changes refer to the actual cirrus cover amount in those latitude belts (in which year?). I suggest to say this explicitly and to provide more detail on the amount of cirrus that is found. I suggest that you include the amount by further curves in the figures.

3345, 25-28 and elsewhere: I do not understand how one can come from monthly trends to annual trends by multiplication by a factor of 12. If the values are given in units of change in % per month instead of % change per year, than I would understand. Please clarify.

3346, 11: you say the differences should be mainly attributed to the different data sets. Why can't you check this by using identical data sets? Otherwise there remains the potential for other technical reasons (errors).

3347 10-12: can you provide a reason for the difference in significance of monthly and annual trends?

TECHNICAL CORRECTIONS

Page 3336, abstract, line 12: why "however". This is also only for one region. Correct text or include the global value and the ratio between cirrus change and line-shaped contrails

3337, 7: replace surface by nucleus (that may also depend on volume, not only on surface)

3338, 1: replace "follows" by "followed", because that range is no longer supported by the more recent studies (such as Marquart et al., JGR, 2003, in press).

3338, lines 4 to 21 should be reduced considerably because this paper does not refer to details of contrail observations.

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3339, 1-3: Boucher made this attribution only cautiously and not without mentioning alternative reasons. This paper should cite Boucher's statements more accurately.

3339, 10: it should be made clear that Fahey and Schumann (1999) included that table based on contributions from unpublished work by Pat Minnis (the paper cited with that table was submitted but not published until Minnis et al., 2001).

3342, 7: what is the appropriate number of degrees of freedom? I assume you used the number of data points. But please discuss briefly your assumption whether these data are statistically independent of each other.

3341, 10: here and possibly elsewhere: plural of aircraft is aircraft (without s). Correct this spelling error.

3342, 24, and 3348, 10: the reference Minnis et al. is not needed to support that statement. Otherwise you could use many other earlier papers that show the dependence of contrails on meteorology.

3349, 16: add comma after forcing

3350, 31-32: lower cases in title except for Mt. Pinatubo.

3351, 7-15: Reference Minnis et al. (2003) contains essentially the content of Minnis et al. (1997). Delete the reference to the earlier report.

3351, 28-29, replace Krcher by Kärcher, fr by für.

3354, Table 2: explain the abbreviations (WA, W.EUR, USA, NATR, NA, NP, NATR) in the table.

Figs. 2 and 3: use different symbols on the various curves so that one can read which curve belongs to what also in black-white copies of these figures. Or better: avoid use of colors in the figures.

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Interactive Comment