

Interactive comment on “Impact of aircraft NO_x emissions on the atmosphere – tradeoffs to reduce the impact” by M. Gauss et al.

Anonymous Referee #1

Received and published: 17 January 2006

This paper provides valuable information for aircraft impact on the atmosphere beyond what has been presented in other papers. I do not know of any other paper that has used comprehensive tropospheric and stratospheric chemistry in combination with such an optimized advection scheme. The paper definitely deserves publication in ACP.

The newly introduced aircraft inventories, which include feedbacks of flight altitude shift to fuel consumption, allow a fresh look at the net impact of such shifting. I even think that the authors have underplayed this considerable progress in their paper, as it is not mentioned in the abstract and casually noted in the concluding section. It might have been expressed that considering this feedback is a necessary pre-requisite if the

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consequences of short-term flight altitude shifting is to be assessed. (For long-term shifting with adjusting aircraft design to the new flight routes, the normalized approach may be acceptable for a sensible assessment.)

Nevertheless, I think that major revision of the paper is required to improve the quality of the presentation. I comprise my criticism in three major points and add a number of suggestions that may help to improved some details of the presentation.

A0) Major points: I have three main critical points where I think that a major revision is worthwhile, all of them are related to the way the results are presented:

A1) The separation of presenting the ozone radiative forcing (RF) calculations from the description of the corresponding ozone change perturbations is difficult to comprehend. In both abstract and conclusions this leads to an unsatisfactory comparison of column ozone (in DU) with methane forcing (in RF units). Such a comparison of different parameters does not allow reasonable conclusions with respect to the net effect. Furthermore, it is possible that for ozone change patterns showing a dipole structure (such as Fig. 15, right) even the sign of the column ozone change may not be a reliable predictor for the sign of the related RF change.

If the authors cannot provide a convincing reason why the ozone RF results are not to be included in the present paper, I recommend that the methane RF results should be left out as well and be postponed to the anticipated later publication (p.12277, l.21), leaving the present paper to describe NO_x, ozone, and OH concentration changes. The authors may consider to declare the two corresponding papers as "Part I" and "Part II".

A2) The designation of the simulations ("1", "2", "3", ...) has quite a technical character, apparently due to historical reasons (as No. "4" is missing). This non-suggestiveness makes the understanding of text and figures unnecessarily difficult. I therefore recommend to provide the simulations with more suggestive names, e.g.: yy = reference, 1 = base, 2a = polar-NORM, 3b = down-ADJ, etc., or something similar.

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A3) There is a (too) large number of figures in the paper, and some of them are not discussed very deeply (e.g., Fig. 3, Fig. 10, Fig. 14). Likewise, the 2b scenario is only briefly mentioned one time in the text without drawing any conclusions. The authors may consider to focus their paper on those aspects that are relevant for their main conclusions.

B0) Minor suggestions:

B1) p. 12256, l. 9: A hint may be included to the "b" scenarios, e.g., "... are investigated, including feedbacks of flight route shifting to fuel consumption and emissions."

B2) p. 12256, l. 19: Replace "...lower altitudes." by "...altitudes below."

B3) p. 12256, l. 21: Replace "...the stratospheric decrease dominates..." by "...the contribution from higher altitudes dominate..."

B4) p. 12258, l. 2,3: Removing "which is lost primarily through the reaction with OH" may make the sentence more readable without loss of important information.

B5) p. 12258, l. 7: "...act on spatially and temporally different scales...", Stevenson et al. (JGR 2004, doi:10.1029/2004JD004759) may be mentioned here.

B6) p. 12259, l. 3: "...results contributed to TRADEOFF by the Oslo CTM-2..." to relate this paragraph to the preceding one.

B7) p. 12260, l. 28: Specify if the daily, monthly mean, or annual mean tropopause is used because this information is needed to understand later arguments concerning differences of the scenarios in certain seasons.

B8) p. 12262, l. 7: "... of fuel burnt, NO_x emissions, and flown distances..."

B9) p. 12263, l. 7: Explaining the parameters controlling E.I.(NO_x) in the various inventories may help the reader to understand these numbers.

B10) p. 12263, l. 14: "tropopause" should read "troposphere"

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B11) p. 12263, l. 20: Is the absence of military aircraft in "1" the only difference with respect to "yy" ?

B12) p. 12264, l. 15: See introducing remark! "This approach reflects the impact change resulting from alternative flight routing in a more realistic way than the normalized scenarios. Moreover, it allows ..."

B13) p. 12265, l. 3: Why have forecast data rather than real data for 2000 been used ? Provide a reasoning or a reference.

B14) p. 12265, l. 5,6: Is there a spinup period for the chemistry, and how long is it ? Can year to year variability be neglected (reference) ?

B15) p. 12265, l. 13: I think that Table 3 should be introduced before Table 1. Alternatively, both tables may be merged into one.

B16) p. 12266, l. 17: "... during these months."

B17) p. 12266, l. 24, 27: "certain altitude/ height" may be replaced by a more quantitative phrase.

B18) p. 12268, l. 10 etc.: Does this imply that a global mean CH₄ decrease has been calculated from a global mean OH increase, and that this global mean CH₄ change has been converted to a radiative forcing. Please, state so or otherwise. Which radiation code has been used to calculate the CH₄ RF ? (see A1, however.)

B19) p. 12269, l. 7: Replace "sensitivity" by "relative change".

B20) p. 12272, l. 12: Replace "chemical net production" by "ozone net production".

B21) p. 12273, l. 12: To relate this sentence to the preceding one, I suggest the reformulation: "In contrast, an increase in the tropospheric ozone column is modeled at mid- to high Northern latitudes for the lower-altitude scenario (3b).

B22) p. 12274, l. 20: "...which is again most pronounced during summer, as it was in

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the lower-altitude case (Fig. 14)."

B23) p. 12274, l. 23: "...NOx emissions from fuel burn enhancement is positive"

B24) p. 12275, l. 8: "... are opposite in sign to what ..."

B25) p. 12276, l. 5: "In spite of ..." , this sentence needs to be reformulated

B26) p. 12277, l. 5: "... use of high latitude routes..."

B27) p. 12277, l. 6: Please, reformulate the begin of this sentence.

B28) p. 12278, l. 5-7: In view of flight altitude sensitivity considerations, the recent paper of Fichter et al. (Meteorol. Z., 2005, p 563ff.) may be cited here.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 12255, 2005.

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