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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Simulated radiative forcing from contrails and contrail cirrus" *by* C.-C. Chen and A. Gettelman

**Anonymous Referee #1**

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I appreciate the most recent additions and explanations by the authors. However, their considerations concerning optical depth and radiative forcing from linear contrails are (in my opinion) unlikely to resolve the inconsistencies I perceive.

Above all, I am puzzled by the statement that "Dietmüller et al, 2008 ... artificially enhanced aviation emissions by a factor of 20 and it inevitably increased the optical depth for contrails ...". Such straightforward relation between emissions and optical depth is unlikely to exist, as more emissions lead to enhanced contrail coverage, while ice water path and optical depth of the contrail mainly depend on ambient supersaturation. Hence, the simulation analysed by Dietmüller et al. (2008) will have the same optical depth characteristics as the unscaled simulation from Marquart et al. (2003) from which it has been derived, with typical optical depth values between 0.02 and 0.1. Con-



sequently, the diurnal cycle of contrail radiative forcing for the unscaled simulations is equivalent to that of the scaled simulations (see page 63 of Marquart, 2003), and only the magnitude increases in response to higher coverage. Further, I think that Newinger and Burkhardt's (2012) Figure 3b not at all supports the results of the present paper. There is at least semblance of a relative noon minimum in Newinger and Burkhardt's picture (despite coverage being not constant over the day), while in Figure 2 of the present paper the noon values are by a factor of about 5 larger than immediately after sunrise or before sunset. I conclude that the finding of stronger shortwave forcing at dusk and dawn in comparison to noon conditions (all other parameters left unchanged) under summer conditions is valid for the whole optical depth regime from 0.05 to 0.5, and that the present paper's results thus need careful auditing and/or interpretation. The compensation of shortwave and longwave forcing components is comparatively large in the present paper, and it is an issue whether that could be caused by artificially strong shortwave forcing at low solar zenith angles.

The authors recall their Figure 6 to underpin that their model is in a regime of contrail optical depth between 0.05 and 0.1 . However, Fig. 6 refers to contrail cirrus values and in fact (as a consequence of the simulation strategy) indicates an optical depth (or ice water path) change for all cirrus clouds with aviation included or excluded. It is not necessarily true, and even counter-intuitive, whether Figure 6 describes the properties of linear contrails as well. Considering Figure 3 of Fortuin et al. (1995) I would rather suspect the linear contrails in the present paper to be in a regime of very large ice water contents and optical depths. Considering that the present paper assumes very small particles for the initiated contrails, the behaviour for the resulting contrail forcing resembles qualitatively well Fortuin et al.'s findings: A tendency towards small or even negative net forcings for HIGH ice water path and SMALL particles under summer conditions, which would explain the seasonsal cycle in Figure 3 of the present paper. Finally, as your previous paper (Chen et al., 2012) reports very small coverage values of the initiated contrails, being in a regime of small optical depths as well makes your radiative forcings for these contrails even look unexpectedly large.

I'd like to thank the authors for extending Table 1 by consistent triples of radiative flux changes. There seems to be at least one typo, though: For the global contrail cirrus values, the present values of Delta_FSNT, Delta_FLNT, and Delta_RESTOM still do not fit.

Closing, I'd like to remind that my final recommendation to this paper will be dependent on how carefully differences of the present paper's results with previous work are addressed and explained in the final version. If there are additional caveats to be made, these ought to find their way to the interpretation and conclusions.

References (only if not mentioned before): Fortuin, P. et al., 1995, Annales Geophysicae, 13, 413-415.

Marquart, S., 2003 (in German language), to be obtained, e.g., from http://edoc.ub.uni-muenchen.de/1341/

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