Dear Referee 3,
We thank a lot for your valuable comments and suggestions. We followed them as explained below.
The reviewers comments are repeated in **bold letters,** our replies are given in *italic,* and text modified or added to the manuscript is given in blue.

This paper describes a parametrization of contrails that is embedded in the two moment cloud microphysics of the COSMO regional atmospheric model. It is followed by a case study including the impact of contrails and contrails-cirrus on short wave radiation and on possible PV production. The paper presents interesting new results, but before being published the authors should address the following points.
Thanks a lot for your remarks. Most of your points address errors and mistakes that one does only recognize when having a very close look at the manuscript. Your review helped a lot improving our manuscript.

General remarks:
1. I was a bit surprised that the authors have chosen a model with a complete representation of atmospheric chemistry and aerosols (COSMO-ART) for this study. From the description of the parametrization in Section 2 it seems to me that changes by aircraft to atmospheric chemistry as well as soot emissions are not directly considered. Thus it seems that the usage of the COSMO model (without the computationally expensive ART modules) in conjunction with the 2-moment scheme of Seifert and Beheng (2006) are sufficient for the present study. If this is not the case it should be shown more clearly why the ART modules are needed.
Indeed, no interactions of aircraft emissions are considered in this study. Also, no soot emissions are taken into account explicitly.
But COSMO-ART comprises more than only parameterizations for aerosol dynamics and gas phase chemistry. For example, the infrastructure, e. g. the ART-tracer structure and modules to read emission data are used for the contrails parameterizations. Also the coupling of aerosol-dynamics and the microphysics is adapted to calculate contrail microphysics.
In the future, we want to extend the model to also consider aircraft emissions. Therefore, the entire COSMO-ART model is referred to.
We add in Sec. 2 (Model Description) after
"In this section, the parameterizations to calculate the microphysical properties of ice crystals and the modifications to represent contrails are presented."
The model system COSMO-ART comprises a detailed treatment of aerosol dynamics and gas-phase chemistry (Vogel et al., 2009). However, most of these features are not used for the simulations shown in this study. Nevertheless, large parts of the infrastructure contained in COSMO-ART, e. g. the tracer structure and modules for reading emission data are adopted for the contrails parameterizations.

2. Whereas the case study in section 4 is well described, sections 2 and 3 are rather hard to read and understand and would profit from a rewrite. In section 2.1 it is very difficult to understand where the description of the standard cirrus class is ended and the description of the newly introduced contrail class starts. I would thus recommend separating by introducing a new section. Also this section would highly profit from a table explaining the differences between both classes as well as a schematics such as Fig 1 in Salzmann et al. (2010) to highlight the interactions of the newly introduced contrail ice class with the other ice classes. A Table is provided at the end of the paper explaining the differences, but is not referenced in the text. I would moreover suggest in Table 1 to distinguish more clearly between the cirrus and contrail ice class. Similarly in section 2.2 a Table would help to understand the differences between the interactions with radiation of both classes.

Refrain from presenting schematics, as very complex for SB06, also actually contrail – cirrus interaction not too complicated to understand.
We change Tab. 1 to more clearly distinguish between contrail ice class and natural ice class.
We change in section 2.1 The Contrail Ice Class, page 4, line 4:
"A longer description including various formulae is deferred to the appendix."
to:
A longer description including various formulae as well as a table showing the different coefficients characterizing both the contrail and the cirrus ice class (Tab. 1) is deferred to the appendix.
Section 2.2: There are no differences in the interaction of contrail / natural ice with radiation.

3. It seems quite strange that a completely new scenario "bio fuels" is introduced in the last section of the paper, but referenced already in Fig 12. I would suggest to keep section 4.5 as sensitivity case study, and not introduce a new scenario here. As shown by Ferrone (2011) biofuels also have an impact on the Appleman-Schmidt criterion and this would need to be changed accordingly.
We do not aim at introducing a new "bio fuel" scenario where also effects on contrail formation had to be included (as you correctly mention). It is common practice in contrail studies to study the sensitivity to the initial ice crystal number. Various reasons (uncertainty and variability of EI_iceno-value, biofuels effect) to do so exist.

Specific remarks:
4. In the last line of page 2, the resolution of Global Circulation Models (GCMs, the abbreviation is not introduced) are given as 250km, however most recent models have a resolution of 50 km or higher (IPCC, 2015).
This is a fair point, but the argument is still valid comparing to 50 km resolution. We change in page 2, line 32:
"Compared to GCM parameterizations, this omission seems acceptable in a regional model, as the spatial resolution is much higher (horizontal grid size of 2.8 km 250 km in a GCM) ."
to
Compared to GCM (Global Circulation Model) parameterizations, this omission seems acceptable in a regional model, as the spatial resolution is much higher (horizontal grid size of 2.8 km versus 50 km in a GCM).

5. Caption of Figure 2: The abbreviation COSMO-DE is not introduced
Actually, the name of the domain is not important. COSMO-DE is the domain, used by the German Weather Service to run their high resolved forecast for Germany
We change the caption of Fig. 2 from
"Flight trajectories for the COSMO-DE domain …"
Flight trajectories for the simulated domain …

6. Figures 3, 4, 6 and 7 would become more interesting and easy to interpret if a difference plot between the middle and right column would be added.
We avoid difference plots here, as their interpretation becomes problematic. Due to the design of our model, we cannot distinguish between contrail cirrus and natural cirrus in the cirrus ice class.
By formation of contrails in the aviation simulation, humidity changes and thus partly, no cirrus clouds form, where they do in the reference simulation. Also the properties of natural cirrus may change in the aviation simulation.

7. Figure 8 and 9: If I understood correctly, the black boxes should highlight the same areas but they are slightly shifted.
Indeed, the boxes were not covering the same areas, thanks for the remark. Due to restructuring the section, Fig. 9 (black boxes) are not shown anymore.

8. In the list of abbreviations given on page 31 and 32 some Units are erroneous. Units such as kgˆ(-/mu), mˆ(-/mu); kgˆ(-b_vel); kg ˆk do not exists.
In case, one insists on SI units, this is a fair point, although the quantities are defined as such in Seifert and Beheng (2006).
We convert the equations, where the strange units occur (A6, A7) into numerical value equations and remove the units.
We add in Appendix A:
page 24, line 6:
Here, m is in units of kg.
page 25, line 5:
In Eqs. A6 and A7, m and \overline{m} are in kg; and v and \overline{v}_{k} are in in m s-1.
page 25, line 20:
… with, L in units of m:
Also Tab 1 and the list of abbreviations is changed accordingly.

References:

Ferrone, A, (2011): Aviation and climate change in Europe: from regional climate modelling to policy-options.
http://hdl.handle.net/2078.1/74779

IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp, doi:10.1017/CBO9781107415324.

Salzmann, M., Y. Ming, J. C. Golaz, P. A. Ginoux, H. Morrison, A. Gettelman, M. Krämer, and L. J. Donner, 2010: Two-moment bulk stratiform cloud microphysics in the GFDL AM3 GCM: Description, evaluation and sensitivity tests. Atmospheric Chemistry and Physics, 10, 8037-8064, doi:10.5194/acpd-10-6375-2010.

Seifert, A. and Beheng, K. D.: A two-moment cloud microphysics parameterization for mixed-phase clouds. Part 1: Model description, Meteorol. Atmos. Phys., 92, 45 – 66, doi:10.1007/s00703-005-0112-4, 2006.