The reviewer's comments are repeated in bold, my replies use normal font.
I thank the reviewer for his/her thorough reading of the manuscript.

**Review of "Properties of young contrails – a parametrisation based on large eddy simulations" by S. Unterstrasser**
**This study develops a parametrisation of young contrail depth and ice crystal number for incorporation in larger scale models. The proposed parametrisation is based on the evaluation of a Large Eddy Simulations dataset, previously described in other two recent studies (Unterstrasser 2014; Unterstrasser and Goersch, 2014). Contrails in general, and contrail-cirrus in particular, are probably the largest aviation climate forcing and remain its largest source of uncertainty. Improving contrail parametrisations for global circulations models is therefore still needed and this study can potentially bring an important contribution to that effort.**
**The paper is generally well-written and I think it is an important piece of work. However, my main concern is that, at least in the present form, the paper does not bring the substantial scientific contribution of an ACP research article and would therefore be more suitable as an ACP technical note or as a Geoscientific Model Development paper.**

I admit that the description of the parametrisation and its design is here and there of technical nature.
Nevertheless, I think that the present manuscript is suited to be considered for publication in ACP for the following reasons:
GMD is intended to be a platform to describe, evaluate or compare models. In the present work, none of these criteria are fulfilled. Clearly, the work is based on model results, but it is not a work about a model. Moreover, the application of the proposed parametrisation is not limited to the case, where it is incorporated in some global or regional model, where it could improve the contrail initialisation.

In my opinion, a novel and self-contained scientific contribution is derived from the results of a LES model. The main achievement of the present work is that simple formulations for contrail depth and number could be found, that are versatile enough to take into account many sensitivities. The manuscript demonstrates in detail the performance of the parametrisation which is proven to be an excellent tool for incorporating contrail vortex phase processes in any related application. This is not restricted to model-based approaches, e.g. the contrail depth parametrisation can be compared to lidar observations of young contrails.

The benefits of such a parametrisation are manifold:
1.) Contrail properties are provided over a very large parameter space and gives a more complete picure of the early contrail microphysics and geometry, not yet explored in such detail in previous studies. Section 4.2 presents a comprehensive sensitivity analysis and ranks the importance of the input parameters.
2.) The parametrisation can increase the fidelty of future GCM or regional contrail climate estimates. In particular, biofuel experiments should consider the effect during the vortex phase as outlined in section 4.1.
3.) The parametrisation offers an ideal framework for comparing results from various LES models as done in section 5.2. Such a quantitative comparison was always hampered by the fact that each group used different base states. Moreover, this framework allowed to pinpoint one outlier model.
4.) Section 4.3 discusses implications on the ice crystal number concentration. This property can be measured more easily than the total ice crystal number, as in-situ measurements usually sample only parts of the contrail. Hence, section 4.3 relates the numerical results with observations, even though a 1-to-1 comparison is difficult as reasoned in section 5.3.

All in all, those points represent a substantial scientific contribution itself in my opinion.

**If the paper is to be kept as a research article, then a major revision would be needed to add a stronger emphasis on the Applications and Discussion sections. There is a number of ways in which this could be achieved, a couple of possible suggestions being the following:**
**1. A great advantage of this proposed parametrisation is its relatively simple analytic form, which makes it particularly suitable for large scale models. It would be very interesting to quantify how large an effect it would have on current best estimates for contrail cirrus coverage and radiative forcing, maybe by incorporating it in the (Burkhardt and Kaercher, 2009) parametrisation. Also, to what extent is this new parametrisation likely to reduce the uncertainty currently associated with contrail cirrus forcing?**

The inclusion of the parametrisation in the GCM contrail model of Burkhardt and Kärcher, 2009 is desirable. As this model is developped at the same institute, it is a natural candidate for integrating the proposed paramerisation in a global model. However, this model use a one-moment scheme predicting only ice water content and is insensitive to the choice of the initial ice crystal number. Recent improvements include a switch to a two-moment scheme, additionally solving a prognostic equation for the ice crystal number. The updated scheme (which is a more appropriate candidate for linking both works) is not yet described in peer-reviewed literature and a manuscript on this is currently under review. It is certainly planned to incorporate the parametrisation in this updated contrail model in the future.

Hoewever, the application of the parametrization it is not limited to this GCM. A fortran programm given in the supplemental material is intended to encourage also other groups to incorporate the parametrisation in their contrail models.
For the sake of clarity I would prefer to focus on the derivation of the parametrisation and straightforward implications and applications as done in section 4 and 5. Describing its implementation in a GCM and presenting GCM results would certainly go beyond the scope of the present manuscript.

**2. The point that current studies focusing on mitigation options through the use of biofuels might overestimate the effect of biofuel if they neglect vortex phase processes is probably the main scientific conclusion of the paper in its current form. It might be interesting if this analysis could be expanded.**

It is true that this is one conclusion, that is also an important one, as the effect of biofuels on the contrail climate impact has received much attention in the recent past. This is one reason, why the soot reduction experiment was chosen as an example of how to apply the parametrisation. To accommodate to the increased interest in this topic, section 4.1 is expanded and an additional figure is included in the revised manuscript.
Nevertheless, I want to remark that the main achievement of the parametrisation is, that for the first time a simple formulation was found, which allows to easily incorporate vortex phase processes in any related study. The soot experiment is just one possible application.

**Minor specific comments:**
**- it is stated at page 28941, lines 22-23 that the new parametrisation covers a much larger parameter space than the one in (Unterstrasser, 2008) and is therefore more universal. Is it possible to include somewhere in the results section a quick comparison between the two for a case covered by both parametrisations?**

Even though the Unterstrasser et al 2008 paper is well cited in the literature, the analytical parametrisation in particular is not widely used. Hence, I do not think it is necessary to inform potential users about the differences between that version and the new version. Moreover, the parameter space covered by the earlier version was very narrow and a comparison would not give much insight.

Previous studies already compared results of various EULAG model versions and interested readers are refered to these studies.
Whereas Unterstrasser et al 2008 relies on a two moment bulk scheme, all follow-up studies use the Lagrangian ice microphysics code LCM by Sölch & Kärcher, 2010.
Unterstrasser & Sölch, 2010 presents EULAG-LCM results, compares them with the EULAG-BULK results and demonstrates advantages of the LCM-approach. As a next step, we switched from 2D to 3D.
Unterstrasser, 2014 presents 3D-EULAG-LCM simulations and compares them with the 2D-EULAG-LCM.

**- page 28944, lines 20-23: please add a sentence on how representative is this large LES dataset**

A paragraph is added.

**- the use of the "U2014" and "UG2014" abbreviations should be revised for consistency**

Done. Note that Unterstrasser et al, 2014 refers to yet another publication and should not be mistaken with Unterstrasser, 2014 and Unterstrasser & Görsch, 2014.

**- page 28957, line 23: "subtleties", not "subleties"**

Done.

**- page 28960, line 18: please clarify what does 1.65+-0.23 represent (is it a factor?)**

Yes. Done.

**- page 28960, lines 20, 25: "analogous", not "analogeous"**

Done.

**- page 28961, line 9: "importance, which has been", not "importance, which have been"**

Done.

**- page 28966, line 4: "usually not all of them", not "usually not all them"**

Done.

**- Fig. 3 legend states that panels (a) and (b) are as in Fig. 2. It should be clarified what is meant by this, considering that they have different X and Y axes.**

Done.

**- Fig. 4: please clarify the exact meaning of "9 down", "5 down", "5 up" and "11 up"**

Done.

**- Fig 5: E_obs should be explicitly defined in the caption**

Done. Also included in the caption of Fig. 6.

All cited papers can be found in the reference list of the original ACPD publication.