

Thank you to the reviewer for providing the updated line references with respect to the discussion manuscript. We have responded to these comments in addition to the original reviewer 2 submission.

*P17818, line 15: Is the result of less high and low lightning extremes a fault of the lightning parameterization, or a fault of the convective cloud parameterization in the models?*

RESPONSE. This is an important point and one which cannot be specifically addressed in this study. The narrow range of flash rates is an overlooked consequence of using the cloud-top height parametrisation. It is important to highlight that our study, along with other studies which used different reanalysis, regions, scales and models, have shown such biases to exist. Identification of the modelled difference in flash rate frequencies supports the need for smaller-scale studies to determine the realistic nature of flash rates in storms. Furthermore, it raises the possible need for a study to determine the effect of such a frequency distribution of flash rates on emissions and atmospheric chemistry. We have included additional text in section 4.3 to expand on this point.

*Line 18-19: Is this improvement in all models, or only in the ERA model? This may be strongly model dependent.*

RESPONSE. The results are directly relevant to CTMs using ERA-Interim and acts as a proof of concept for a large-scale ice flux based parametrisation that can be tested in other models. This point has been explicitly included in the conclusions. Furthermore, early work applying the parametrisation in the UKCA chemistry-climate model shows promise that it could be used successfully there.

*P1720: lines 16-20: While reanalysis data give the best representation of the world, they do not include cloud data critical for the lightning parameterisations. All cloud parameters in the reanalysis are modeled. So the quality of the results depends on the modeling of clouds, ice flux, precip, etc in ERA.*

RESPONSE. Observation and modelling of cloud parameters is still a topic of research and therefore there are still many unknown sources of error in these features. The essential modelling of lightning emissions must use these variables. Our work provides a new perspective on the formation of a more physically based parametrisation and provides information to those that must implement such parametrisations, despite all associated uncertainties. As well as this it draws attention some potential points of study for those looking at the uncertainties using smaller scale

data, such as the flash rate frequency distribution, the Central African strong dependence on ice flux and the use of cloud area in an ice flux parametrisation.

*Fig 2: see comments above*

*Discussion and Conclusion: I think you need to address the above points in the discussion and conclusion of the paper. The presented new parameterization may be good in the ERA reanalysis, but what about other GCMs like ECHAM? All parameterisations are sensitive to the model parameters used, and the convective parameterisations. This point is extremely important, and just because the new parameterization is best in ERA does not mean it will be best in any other model.*

RESPONSE. We thank the reviewer for this comment and do feel this point to be important for those reading the paper to understand the context and usefulness of this study. We have modified the conclusions to note this point. We cannot comment specifically on ECHAM, but the parametrisation is to be fully tested in UKCA and by publishing this study the opportunity is provided for other modelling groups to carry out their evaluations.