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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Using cloud ice flux to parametrise large-scale lightning" *by* D. L. Finney et al.

Anonymous Referee #1

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This is a very well written paper which contains the development of a new parameterization for lightning flash rates for use in chemical transport models and contains a comprehensive evaluation of this new scheme as well as four existing schemes. The new parameterization uses the cloud ice content from the ECMWF ERA-Interim reanalysis, along with the upward cloud mass flux and cloud fraction to estimate cloud ice flux, which is an important component of the non-inductive theory of cloud electrification. The authors found that including the cloud fraction data in this calculation was an important feature. The results show that by a variety of statistical measures, the cloud ice flux scheme outperforms the existing schemes in comparison with lightning flash observations from the Lightning Imaging Sensor (LIS).

One significant piece of information that is missing from the paper is a description of

how the cloud ice is computed in the ECMWF model. Is it computed through some interaction of the convective and microphysical parameterization schemes?

Otherwise, my comments are more minor, and are listed below:

p. 17825, lines 7-8: Need to be explicit and put the names of the schemes here, rather than make the reader look ahead to all of the subsections to find them. I suggest a wording such as, " ....for the cloud top height, updraught mass flux, convective precipitation (polynomial), and convective precipitation (linear) parametrisations of Sections 3.1 - 3.4, and 1.09 for the new cloud ice flux scheme of Section 4.

p. 17828, lines 15-16: .....been introduced into large-scale lightning parametrisations due to lack of sufficient microphysical detail in global models. Improved representation of cloud ice in global models now allows....

p. 17831, lines 8-9: Need to note that the cloud ice flux method only improved the correlation with LIS lightning flashes by 0.06 over cloud-top height, which is a non-microphysically based method.

p. 17833, line 6: Minnesota should be changed to New Mexico

p. 17840: The authors conclude that the updraught mass flux and convective precipitation (polynomial) schemes performed the poorest. Both of these schemes were developed using data from another reanalysis. I wonder if that might play a large role in their poor performance here when used with the ECMWF ERA-Interim reanalysis? Some comments concerning this issue would be appropriate on this page. At a minimum, perhaps lines 14-15 could be modified to "....found to perform poorly for the metrics used here, at least when applied using the ECMWF ERA-Interim data."

p. 17847: Figure 1 caption: .....annual LIS totals for each of the 10-year, 5-year, and 2-year climatologies, respectively.

p. 17852: Figure 6: An issue that has appeared in the application of most lightning schemes and with most input meteorological data has been the overestimate of flashes

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in the Amazon Basin and the underestimate in Central Africa. The cloud ice flux method does not appear to have solved this problem! This result should be mentioned in the text. The authors note in the text the Central African underestimate, but should also point out that the Amazonian problem still exists, but it is not as severe as with the cloud-top height approach.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 17817, 2014.