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Geoscientific
Model Development
Discussions

Interactive comment on "Evaluating a lightning parameterization based on cloud-top height for mesoscale numerical model simulations" *by* J. Wong et al.

Anonymous Referee #1

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This manuscript evaluates a commonly used parameterization for lightning flash rate to determine its applicability in mesoscale models. The Price and Rind (1992) parameterization uses the cloud top height as the predictor of total flash rate and a formulation using cold cloud depth (Price and Rind, 1993) to determine the IC/CG flash ratio. These schemes are tested in the WRF model at 36- and 12-km horizontal resolution. A 4-km (cloud-resolving) resolution run was also conducted which used a related parameterization scheme involving the maximum vertical velocity as the flash rate predictor. The model flash rates are compared with observations from the National Lightning Detection Network (NLDN) and the Earth Networks Total Lightning Network (ENTLN). These parameterizations had not previously been thoroughly evaluated in a mesoscale model,

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Interactive Discussion

Discussion Paper

and thus this work provides valuable advice in their application, especially in terms of the IC/CG ratio and grid resolution "calibration factor". In general, the manuscript is well written and logically presented, but a number of clarifications are needed in the text. I recommend that it be published after addressing the specific comments listed below:

Specific Comments:

p. 3494, Line 24: also mention the first paper addressing the role of ozone as a greenhouse gas in the upper troposphere which is Lacis et al. (1990, JGR).

pages 3495-3496: The manuscript provides a summary of the various flash rate parameterization schemes used in models of all scales. Please separate the discussion into separate paragraphs for those used in global or regional models with parameterized convection and those used in cloud-resolved models. Add mention of the scheme by McCaul et al. (2009, Weather and Forecasting) which is used in the operational NOAA HRRR model at 3-km resolution.

Page 3502: Some further clarification needed concerning the NLDN data. Weak positive polarity flashes detected by NLDN are thought to be IC flashes. NLDN data from 2011 are segregated into IC and CG flashes and the user probably does not need to be concerned with this issue. However, the original 2006 data did not have these designations, and the weak positive flashes had to be filtered out of the NLDN data set by the user. Were the 2006 data you used in this original form, or were they a reprocessed data set given in the same format as the 2011 data? If they were the original data, the filtering needs to be done before they are used in this analysis.

page 3503, line 5: The authors have used a constant value of 65% detection efficiency for IC flashes from ENTLN, while the values may range from 50 to 85%. Please provide an estimate of how much error the estimate of 65% could induce in the IC/CG ratio.

page 3503, line 25: add the following phrase at the end of the sentence: "...except at

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the high end of the distribution."

page 3505, line 4: Is this spatial variation of bias within the analysis region? Or, is this the range when the spatial variation of DE is taken into consideration? I don't understand why a range of the median bias is given here. It would seem to me that the variations in the DE fro CG flashes would have been taken into account BEFORE the median bias was calculated (ie., in determining the NLDN CG flash count).

page 3506, lines 3-6: ....for ENTLN CG and IC flashes... If you know the spatial distribution of DE, why not apply them rather than using constant values?

page 3507, line 14: factor of $\sim$10 bias. Is it a high or low bias?

page 3508, line 1: double the 3-hourly OBSERVED lightning? But, JJA 2011 showed only 13% median daily bias for 36 km (p. 3505, lin3 3). Why is the 3-hour bias so much greater?

page 3508, line 7: identical frequency distribution. For both 12-km and 36-km?

Figure 2: Can a different color scale be used. It is difficult to differentiate between the values in the 100 to 1000 range (a factor of 10) to assess model performance because the colors are so close to the same.

Figure 3: Figure needs improvement. I can't see solid versus dotted red lines on the time series plots.

Figure 9: I don't see the black line for "WRF online adjust". Is it coincident with the blue line?

Interactive comment on Geosci. Model Dev. Discuss., 5, 3493, 2012.

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