Geoscientific Model Development Discussions

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Comment on gmd-2021-351

Anonymous Referee #1

Referee comment on "A parameterization of long-continuing-current (LCC) lightning in the lightning submodel LNOX (version 3.0) of the Modular Earth Submodel System (MESSy, version 2.54)" by Francisco J. Pérez-Invernón et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-351-RC1, 2021

Overview:

Pérez-Invernón present a novel method of parameterizing the distribution of Long-Continuing Current (LCC) flashes within the framework of a chemistry and climate model. These flashes may have a disproportionate role in the ignition of wildfires and the triggering of sprites.

General Comments:

In general, the paper is well written although the number of figures could be reduced and the discussion section is a bit tedious.

Specific Comments:

L68-69: What is the rationale for using two thresholds for LCC flashes? Are LCC18 flashes much more likely to result in fires or sprites? Have others made this division? If no, perhaps only show one or two plots of them.

L111: Expand on why updrafts are especially important in determining the number of LCC flashes as opposed to the total number of flashes.

L115-117: Justify the use of a gridded 0.25 degree resolution vertical velocity product to parameterize flashes which occur at a higher spatial resolution. Is the product a one-hour average vertical velocity or an instantaneous value.

L137: Add a sentence explaining how the Luhar et al. parameterization is improved over Price and Rind.

L143: How do you re-grid the data onto the 2.5 x 2.5 degree grid?

L159-160: What was the correlation between updraught mass flux and the ratios?

L168: Figure 3: The vertical lines used to show the binned data are confusing. Wouldn't it make more sense to show the values as x's or +'s? The binned data still shows several ratios of 0 and 1. This suggests that the bins may be too small. How much would the results change by if you increased the bin size by a factor of 2-5?

L172-179: What do you do for values LCC9 (LCC18) values above 0.5 (0.3) kg m-2 s-1?

L185: I see "good" agreement for mass fluxes < 0.3 as opposed to 0.5. Are both quadratics used between 0 and 0.5 or is only the LCC9 one used for 0-0.5?

L190: Is this the updraught velocity from EMAC? How does the updraught velocity from EMAC compare to that from ERA5?

L224: Why do you give values for two resolutions? How does the horizontal resolution vary between T42L90MA and T52L41DRL? Does T stand for triangular?

L235: When evaluating the schemes you may want to evaluate them separately over land and water. Parameterizations with separate land and ocean schemes should do much better at capturing the land/ocean contrast. You may want to indicate in Table 2, which these are.

L242-245: Be sure to emphasize the observed value of 2:1. It seems to get lost in all of the discussion of ratio shifting.

L268: You state that the lightning parameterization underestimates the ratio over the oceans; however, in Figure 7, I see larger values for Pcth+Aprec than for ISS-LIS, especially between 25 and 45S. What am I missing here?

L265: Figure 9-12: Do not shown more than 2 significant digits for the correlation.

L265: Figure 9-12: In caption state whether positive values mean the parameterization has overestimated or underestimated the ratio. Ideally, positive values should indicate that the model has a high-bias.

L265: Figure 9-12: It is a bit overwhelming looking at 4 6 plot panels. You may want to show 4 panels instead (Perhaps remove the LCTH and Aupdr plots; the former because it is similar to the more widely used Pcth scheme and the latter because it performs poorly).

L265: Figure 9-12: From a reader's perspective, it might make more sense to show biases in LCC9 flashes as opposed to biases in the ratio

L285-286: The description of what is shown in Figure 13b is unclear. Please re-write.

L308: … but why is the impact of aerosols larger for LCC flashes than for "normal" flashes?

L310-316: In DJF the ISS-LIS has few pixels with data over the North Atlantic while the model has high values there (see Figure 7a-b). Is some of the "missing" seasonality in the observations due to sampling constraints?

L317-339: These listings of underestimations/overestimations are tedious unless accompanied by some analysis as to why the ratios are too low or too high. Either delete or add some analysis or even speculation. Also, I'm not sure the repeated Blakeslee et al. (2000) citations are needed for something so basic.

L340-364: Again, this section is tedious and perhaps unnecessary.

L365: Be sure to remind the reader as to why a LCC parameterization would be useful.

L373: Is the novel scheme competitive with the cloud-top-height schemes when parameterizing total flashes or is its use best limited to the parameterization of LCCs?

Technical Corrections:

L1-2: This type of flashes are ... Flashes of this type are

L6: Previous reports ... Reports

L28: Despite the evidences ... Despite evidence

L32: LSS are mostly assembled by ... LLS include

L35: may lack of a high ... may lack a high

L37: are not useful to provide ... provide little

L84: clearer shown ... clearly shown

L213: Double check 5 hours; 1, 3, or 6 are more typical.

L281: higher correlation ... highest correlation

L282: lower correlation ... lowest correlation

L283: higher ... highest

L294: Table 3 caption: approximately values ... values

L296: showed ... shown

L319: When referring to Figure 9 be clear as to whether you are referring to DJF or the entire year.

L393. mesosphere . ... mesosphere.