

Interactive comment on “The effects of lightning-produced NO_x and its vertical distribution on atmospheric chemistry: sensitivity simulations with MATCH-MPIC” by L. J. Labrador et al.

Anonymous Referee #1

Received and published: 17 November 2004

This work attempts to assess the impact of lightning NO_x production on tropospheric chemistry and to reduce uncertainties associated with estimations of NO_x production by lightning. Various model sensitivity simulations were designed and conducted and comparisons were made between the various sensitivity runs and between model results and atmospheric measurements of several key species. Although this sort of model simulations helps to better understand the role of lightning-NO_x production, it is rather disappointing to find out that several of the key aspects of lightning NO_x produc-

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tion remain uncertain. As such it is essential for this paper to clearly describe to what extent this study contributes to the understanding of the following issues:

(1) One of the uncertainties in lightning NO_x production concerns the global lightning distributions. As discussed on p6243, the lightning parameterization according to Price and Rind (1992) produces a noticeable difference from lightning observations of OTD/LIS. Were any simulations performed using the lightning distribution on the basis of OTD/LIS observation? Also, it needs to be clarified how the satellite lightning observation from OTD/LIS is constructed in figure 1 since the two satellite sensors cover distinct latitudinal ranges and time periods.

(2) Another area of uncertainty in lightning NO_x production lies in the global annual NO_x production rate. The statement of “0 Tg yr⁻¹ as being too low and 20 Tg yr⁻¹ being to high” on p. 6259 adds little to our current understanding.

(3) Can any conclusions be drawn from their work on NO_x production rate per flash, also with the consideration of the two types of flashes (i.e., IC vs. CG)?

(4) Another major issue is related to the vertical distribution of lightning produced NO_x. It is rather confusing from this work on which assumptions of vertical distributions would be more appropriate, PICK98, uniform distribution, or else. The work by Tie et al. (2002) assumed a production rate of 3.5Tg yr⁻¹ in the upper region of clouds. That simulation would not be sensitive to the convective scheme used.

Clarification of those issues will improve the importance of this work.

Two recent papers related to this work should be referenced and considered: B. Ridley et al., Florida thunderstorms: A faucet of reactive nitrogen to the upper troposphere JGR 109 (D17): Art. No. D17305 SEP 8 2004. R. Zhang et al., Impacts of anthropogenic and natural NO_x sources over the US on tropospheric chemistry, Proc. Natl. Acad. Sci. USA 100, 1505-1509 2003.

I pointed out numerous grammatical/style errors in their original manuscript. The re-

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vised manuscript is improved but still needs to be proofread. Below are a few examples:

P. 6240, abstract. Line 6, change “was” to “is”. Line 10, change “indicate” to “indicates”.
P. 6241. Lines 1-2, the phrase “started to be conducted” is rather awkward. Line 18, remove the comma after “lightning”. P. 6242. Line 6, change “modeling” to “model”. P. 6244. Line 20, “a an” needs to be fixed. P. 6245. Line 13, replace “was” by “were”. Line 21, replace “was” by “were”. P. 6246. Line 15, the phrase “a 2, 5, and 10 Tg yr-1 production rate” is awkward and perhaps be replaced by “a production rate of 2, 5, or 10 Tg yr-1”. P. 6247. Line 15, the phrase “might be biased high” doesn’t read well. P. 6254. Line 21, change “location” to “locations”. P. 6255,. Line 15, “Other than with for PICK20 run” needs to be rephrased. P. 6257. Line 10, “show” to be replaced by “shows”. Line 13, “were” to “are”.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 6239, 2004.

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