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Atmospheric Chemistry and Physics Discussions

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.

L. J. Labrador et al.

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We appreciate very much the constructive comments of the referee.

1) No simulations were performed using the LIS/OTD distributions. The reason for this is that O3 varies non-linearly with the concentration of its precursors and some of these precursors are often enhanced in areas of deep convection. So, in order to get the most accurate budgets in the simulations, it is the necessary to parameterize the flash rate in term of model-calculated fields in such a way that lightning is co-located with the areas of vertical transport of O3 precursors. On the other hand, there could be

clouds in the model producing little or no lightning. These clouds can, however, carry O3 precursors to the free and upper troposphere enhancing their levels there.

The observed lightning distribution of panel a) in figure 1 was made using a combined LIS/OTD dataset available from NASA's Global Hydrology and Climate Center (GHCC). A line explaining this has been added to the text.

2) While there is a growing consensus in the scientific community that a 20 Tg(N)/yr source of NOx from lightning might be too high, there is not yet enough evidence and at present the uncertainty is still too large to definitively rule out the figure. At the AGU's 2004 fall meeting's Thunderstorm, Lightning, and Atmospheric Chemistry session, for example, five out of 10 speakers cited the 20 Tg(N)/yr of NOx from lightning production rate in their work and another one implied the range in his NO molecules/flash production estimate. It is rather unfortunate that, based on the available information, we cannot arrive at a more solid conclusion concerning a "best" production rate and we certainly wish we could, yet we feel that is as far as we can prudently go; at least, however, we do provide very strong evidence against the 20Tg(N)/yr value.

3) For our model runs, the NOx production rate per flash is a tunable parameter used to prescribe a global lightning NOx production rate, therefore no conclusion can be drawn from it.

4) The reviewer is correct. While we state that we cannot arrive at a solid conclusion concerning a production rate of NOx from lightning, we do not make it clear enough that this is also the case for any particular vertical distribution. While we tend to favor the Pickering vertical profiles for a prescribed vertical distribution of lightning-NOx in global models, much as with the production rate, the lack of observations as well as the large scatter in those available preclude us from singling it out. Our main conclusion in this respect is similar to that concerning the production range: more observation campaigns, particularly in key areas such as the tropical continents, are needed to validate model results. A statement has been added to the text reflect this fact.

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Reference has been made to the work by Ridley et al in Table 1 as well as in the discussion. It is worth noting that from the collected data the authors infer, depending on the assumptions made, lightning NOx production rates ranging from 1.1 to more than 19 Tg(N)/yr. Reference to the work of Zhang et al has also been made.

We have addressed the style/grammar errors in the manuscript, as suggested. We appreciate the referee's keen eye in this area.

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