

Interactive comment on “Estimates of Lightning NO_x Production based on High Resolution OMI NO₂ Retrievals over the Continental US” by Xin Zhang et al.

Anonymous Referee #2

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This manuscript presents new methods for estimating the lightning NO₂ and NO_x production using OMI NO₂ retrievals. The Berkeley high resolution OMI retrievals are used, which should provide better a priori NO₂ profiles than use of the much coarser GMI model previous LNO_x analyses. The new methods that are discussed should provide better accounting for background NO_x; however, it is not made clear in the manuscript how this is achieved. This point needs to be addresses in a revision. There are numerous minor points which need attention, which are listed below.

Line 10: previous work does not neglect below-cloud LNO₂. Full LNO₂ and LNO_x profiles extending to the surface are used from the GMI model is such work as Pickering

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et al. (2016), Bucsele et al. (2019) and Allen et al. (2019).

line 15:surface are...

line 16: originates

lines 26-27: ...radiative forcing between when simulating future lightning using a new upward cloud ice flux (IFLUX) method and when the commonly used cloud-top height (CTH) approach is used.

line 28-29: 5 - 16% increases in what? 15% decrease in what?

line 30:radiative forcing due to ozone was found....

line 31: also need to compare with results of Romps et al. (2014)

line 39: Satellite...

line 48: convection.

line 71:based on a modification of the method.... Need to describe what is different.

line 75: Are you sure that it is the background subtraction causing the negatives? Many of the negatives resulted from the removal of the stratospheric slant column NO₂ from the total NO₂ slant column.

line 80: two parts of NO₂ that can be....

line 81:above clouds (pixels with CRF >0.9) and....

line 88:contamination by anthropogenic....

lines 129-130: not sure why this phrase about NLDN is here when you are using ENTLN and not NLDN. Remove?

line 142: How is flash rate parameterized?

line 175: how is this comparison of pixels computed?

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line 181: Does the Xu and Randall method consider subgrid convective clouds or only grid-scale cloud based on the microphysics parameterization that generates the grid-scale clouds? If it is the latter, this method is not appropriate as a criterion to evaluate model convection.

line 184: a time period.....LNO_x to be detected by

lines 184-188: Using these criteria will result in a low bias in the PE results. Bucselá et al. (2019) found that PE is larger at small flash rates. These small flash rates are being discarded here.

line 203: daily summations Is this what is done in Pickering et al. (2016)?

line 218:....(Table 2), as the CRF criterion increases from 70% to 90% and to 100%.

line 223:...to derive production per flash (production efficiency, PE).

line 228: cloud properties

line 229: PEs

line 259: ratio of CG to IC I don't think there was any particular assumption of this ratio in Pickering et al. (2016).

lines 263-264: this is not obvious from the Figure 5 plots

line 271: peaks of the LNO₂ profile are...

line 275: from 0.8 to 0.2 as the cloud height increases....

line 278: LNO₂ production (<30 mol/stroke) occurs

line 284: Is this necessarily true? LNO_x production per flash may be smaller in high flash rate storms.

lines 287-288: ... (postconvection) in which LNO_x has already been redistributed.....uses LNO_x production profiles.....(Allen et al., 2012; Luo et al., 2017)

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line 296: 2X500 mol NO flash-1 This designation can be confusing. Some readers may think you mean 1000 mol/flash

line 308: different than that....

line 401-402: we find that the effect is regionally dependent. Both.....NO₂ cause different comprehensive effects due to nonlinear.....

Table 2: How many grid boxes per day typically qualify under your criteria?

Table 3: Need to indicate how the percentage difference was calculated in the caption. Which one was in the denominator?

Figures 7 and 8: What do the various colors of shading indicate? What are the scales for the horizontal plot at the top and the vertical plot on the side?

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