

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

Received and published: 2 January 2020

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

C1

et al. (2016), Bucsela 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?

C2

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. Bucsela 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)

C3

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?

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-372, 2019.

C4