

The manuscript introduces an updated scheme for calculating the lightning NO_x emissions by using the gridded hourly NLDN flash data. The updated scheme has improvements in simulating the NO_x emissions compared with the previous scheme using the monthly NLDN flash data, which also requires two different scale factors in determining the lightning flash. The study also developed another scheme using linear and log-linear parameters, which is suitable to use when the hourly lightning flash data are not available, or the air quality simulations are set up to run real-time forecast, or future climate simulations. I personally appreciate the content and scope this study introduced. Natural source, such as lightning, will play an important role in determining the O₃ attainment, especially in the western U.S. I think the manuscript is acceptable to be published by the journal. I have some comments that need the authors to address.

Major comments:

Allen et al. (2010, 2012) developed the lightning scheme also using the flash rates from the NLDN, the same as the author proposed. I did not see what updates or advances the authors made considering that. Is that mainly because Allen et al. used monthly flash rates, while the authors used hours? Please elaborate.

The quality of the figures embedded in the manuscript are really low. I suggest the authors prepare clear plots when they submitted the manuscripts for review.

Minor comments:

Line 28: suggest to remove “scheme and associated LNO_x”

Line 64-65: the authors should add some references listing how the previous studies about lightning NO_x affect surface ozone, before the authors could make the conclusion of the importance of LNO_x.

Line 82: remove “For instance”

Line 94: use abbreviations for “could-to-ground” since it was defined before

Line 97-106: I suggest moving this parts into methodology.

Line 108: what is old and new scheme? It is confusing since the manuscript mentioned at least 4 schemes: previous parameterizations; Allen et al. 2010; hourly NLDN, and the newly developed parametrization scheme.

Line 120: I suggest to remove this paragraph since this lightning NO_x option was not discussed later in the manuscript any more.

Line 131: to convert “what”?

Line 167-168: remove “Wang et al (1998)”

Line 170: change to “and NO produced by CG flashes at a lower layer of the atmosphere (600hPa)”

Line 211: CP was already defined in previous content

Line 211: In section 4, the authors used the different version and configurations of WRF to explain the performances of different years LNO_x simulations. So here it would be helpful to show the verions/configuration of the WRF from 2002 to 2014.

Line 245: convective precipitation was defined earlier

Line 276-277: rewrite this sentence.

Line 280: see comments earlier. Please list the differences for the WRF versions.

Line 335-337: how the authors make the conclusions that the poor relations of NLDN flashes and model predicted CP was associated with the poor simulations of precipitation by WRF?