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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Dynamics of nitrogen oxides and ozone above and within a mixed hardwood forest in Northern Michigan" *by* B. Seok et al.

Anonymous Referee #2

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Review of "Dynamics of nitrogen oxides and ozone above and within a mixed hardwood forest in Northern Michigan, by Seok et al.

General comments:

The authors use profile measurements and a single-column model to simulate the diurnal behavior of the vertical distribution (over a 40 m height) of NOx and O3 at a forest site in northern Michigan. The months of August and November are simulated and contrasted, as the biology and weather differ significantly between these 2 months. An interesting feature in the observations is a morning peak in NO and also a morning peak in NOx. It is concluded that the morning peak in NO is due to the photolysis of

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NO2 advected to the site from urban areas to the south. However, the results are very unclear as to what causes the peak in NOx. In my view, the paper comes up very short on this important objective. Indeed when the authors address the cause of the NOx peak toward the end of the paper, this is the claim: "the observed morning NOx maximum appears to be caused by (1) the photolysis of NO2 . . ., or (2) . . ." I may be missing something, but I think the authors may not mean this. Photolysis of NO2 to NO does not cause any change in NOx. Is this a mis-statement or what the authors really intend? If it is intended, it merits further explanation, as many will interpret as I have done. I find it frustrating to have a lack of clarity on what is such a fundamental point of the paper. Also, the authors fail to address, head on, the fact that the high levels of NOx, which they attribute to advection from urban areas to the south, have a diurnal peak that consistently falls shortly after sunrise. This is bewildering. It seems that back trajectories are called for, along with a determination of transit times from the urban areas. I find it very puzzling, indeed interesting, that there is such a tight correlation of the timing of the NOx peak and sunrise. Why is it not much more variable? On some days, does the peak occur at a different that can be explained by differences in transport? Have the authors considered boundary layer development/growth (hence dilution)? In summary, I find the paper lacking in two important respects, important since they relate to a fundamental objective of the paper, and that is to explain the diurnal pattern in NOx. The two issues: (1) a claim that the NOx peak is due to photolysis of NO2 (2) if the NOx has an urban source, then why is its peak so tightly correlated with sunrise? (any relation to boundary-layer evolution?)

Specific comments:

p 32516, line 18: "on" –> "to"

p 32517, line 2: Soil emissions are not too significant, so why list that one first?

p 32519, line 20: "including" –> "and" (since NO2 does not include the other species)

p 32519, line 28, and following: This depends on age. It is a reasonable estimate at

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young age, but is not reasonable, even for anthropogenic source, at old age (since NOx has been converted to other species).

p 32520, line 9: How is detection limit defined?

p 32554, fig 3 caption: "dotted" –> "dashed"

p 32528, line 12: It is said that understory NO [at <=20 m?] is larger than above canopy NO. I do not see this in fig. 4.

p 32532, line 10: What is the "stability effect"?

section 4.3: I can see why there is a tendency for the NO peak to be tied to sunrise, but why the NOx peak? If the NOx peak is due to transport from polluted regions, is this just a coincidence then? And related to the transit time from the urban areas. I would not expect such close correlation with sunrise. This is puzzling.

p 32536, line 9: add 's' to 'mean'

p 32541, last 3 lines: "the observed morning NOx maximum appears to be caused by (1) the photolysis of NO2 . . ." This must not be what the authors really mean. Photolysis of NO2 does not alter NOx. It converts one form of NOx to another form of NOx.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 32515, 2012.