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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Emissions of nitrogen oxides from US urban areas: estimation from Ozone Monitoring Instrument retrievals for 2005–2014" *by* Z. Lu et al.

Anonymous Referee #2

Received and published: 22 July 2015

In their paper "Emissions of nitrogen oxides from US urban areas: estimation from Ozone Monitoring Instrument retrievals for 2005–2014", Lu et al. report on an analysis of OMI satellite observations of tropospheric NO_2 column amounts over the US yielding detailed emission estimates for 35 major urban areas. This study builds on earlier work by Beirle et al. and Valin et al. but extends on it by using low wind speed situations to better estimate the absolute NO_2 burden and applying the effective life time derived from high wind speed scenarios after rotation by wind direction. The results show very good correlation with the absolute emissions from bottom-up estimates and also with their temporal evolution. The paper is well written, reports on an interesting and

thorough study of satellite derived emission estimates and fits well into the scope of ACP. I therefore recommend it for publication after minor revisions.

Comments

- One of the interesting aspects of this paper is the comparison of NO_2 columns taken at different wind speeds. As expected, NO_2 columns are larger in urban areas at low wind speed which is relevant for emission estimates and interpretation of satellite maps. However, I'm surprised to see that in Figure 1c, there is not the expected ring of low (blue) values around the hot-spots. On the contrary, NO_2 levels appear to be higher nearly everywhere at low wind speed with the exception of the Great Lakes area. Do you have any explanation for this?

- As pointed out in the manuscript, not only the NO_2 columns over urban areas are larger at low wind speed, but also their relative changes over time. This is interesting but not explained in the paper. In my opinion, one explanation could be that at high NO_2 levels, the non-linearity in NO_2 lifetime increases the observed trends as under polluted conditions, the same reduction in NOx emissions leads to larger reductions in NO_2 columns as it would under cleaner conditions. If this is the case, I would argue that the larger trends reported in this study are not necessarily an improvement over values derived from all wind conditions.

- Also with respect to the difference in emission estimates at different wind speeds I would assume that in the absence of non-linearities in NOx chemistry, there should not be a difference in NOx emissions or trends derived from all wind situations if the averaging areas are large enough (as usually was the case in previous studies).

- The discussion of uncertainties is in my opinion somewhat misleading as the effect of cancellation of some systematic errors in trend analysis is not taken into account. As a result, all changes in OMI derived quantities over time shown in

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Figure 5 are smaller than the error bars which would make them non-significant. I think this should be improved.

- I do not see the point of Figure 8 and recommend to remove it.

Technical Comments

- p14963, l19: inventories of NOx -> inventories of NOx emissions
- p14963, l20: bottom up inventories are uncertain but I would guess that both fuel type and technology are rather well constrained
- p14963, l25: not sure if current satellites really have “high temporal and spatial resolution” for NO_2
- p14965, l24: (also elsewhere) as there are several OMI NO_2 retrievals, I would replace “the OMI NO_2 retrievals” by “OMI NO_2 retrievals” or “TEMIS OMI NO_2 retrievals”
- p14966, l10: the multi-annual -> a multi-annual
- p14967, l19: make -> makes
- p14967, l23: “to smooth” – I don’t think that a high sampling rate smooths the data – better sampling will lead to smoother looking averages but in fact, the level of details is higher, not lower as after smoothing.
- p14968, l16: Please add spatial resolution of ERA-interim data in km for comparison with your 2 km sampling grid
- p14968, l25: I think this point deserves a little bit more discussion – if the NO_2 plume of a point source depends on the evolution of wind speed over the last hours, why is it OK to just take the wind field at one (interpolated) time, arbitrarily selected to be 12:00 LT?

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- p14969, l10: and the longitudes -> and longitudes
- p14969, l14: one-dimension -> one-dimensional
- p14970, l16: parameter -> parameters
- p14970, l20: “we made additional treatments in processing” sounds odd to me
- p14971, l1: the north-westerly -> north-westerly
- p14972, l12: countries -> counties
- p14973, l2: inclusive -> included
- p14974, l20: in sum -> in summary
- p14985, l10: While I agree that “a comprehensive and integrated analysis of satellite observations, ground-based measurements, and bottom-up emissions can overcome shortcomings of the individual datasets”, I don’t think this has been done in the manuscript at hand.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 14961, 2015.