Review of Global high-resolution simulations of tropospheric nitrogen dioxide using CHASER V4.0

By Sekiya et al.

This manuscript describes results from a decent study of the impact of horizontal resolution on model simulations, with focus on NO2 evaluated against mainly satellite observations. It illustrates the gain in performance when moving from 2.8° towards 1.1° and 0.56°, showing on global scale a relatively limited improvement in performance. Nevertheless, on a local scale generally significantly improved performance was shown mostly for the 1.1° vs the 2.8° resolution model experiments. A difficulty encountered in this system is that not only chemistry changes, but also the meteorology changes in this online system, as documented briefly by the authors. A more detailed analysis of differences (e.g.: to what extend are photolysis rates different on a high-resolution model run compared to a reference run, e.g. due to differences in clouds) would be interesting, although I can see that this may be beyond the scope of the current manuscript.

Also it was shown that in particular for the O3-HOx-NOx chemistry the resolution makes a difference, considering that with NOx confined in smaller grid boxes, leads to an overall reduced efficiency in ozone chemical production, but increased stratosphere-troposphere exchange. Whereas the authors focus mainly on changes in NOx chemistry over megacity and biomass burning regions, I miss a more detailed analysis of effect of lightning NOx emissions as applied on different spatial resolution: Is it correct that with higher horizontal resolution the lightning NOx emissions will result in less efficient ozone production, and would simulations suggest that a re-tuning of total NOx emissions (apart from uncertainties in profile shape) may be necessary?

P 9. L17: the authors relate the larger negative biases in comparison to GOME-2 observations than to OMI to difficulties in the model to capture the nocturnal thin boundary layers, associated to vertical resolution. Indeed, the number of vertical model layers is relatively small (32), but still I wonder if authors can substantiate this conclusion. Couldn't there be other reasons (missing chemistry, uncertainties in diurnal cycle in emissions, biases between OMI and GOME-2?) that could explain the discrepancies seen?

In my opinion the Discussion section is a bit on the long side, and contains elements that may fit better in the introduction, mainly sec. 5.3 and 5.4. Also authors state in P17, L17 that high-resolution CTM's will be able to assimilate observations at nearly measurement resolution. I believe this is too optimistic, at least for global CTM's, considering the horizontal resolution of TROPOMI observations.

P4, L10: A nudging to 12-hourly ERA-Interim re-analysis data is applied. Here I wonder why the authors don't use 6-hourly EI data. Are authors confinced that 12-hourly nudging is sufficiently accurate?

Technical comments:

P2, L18: Suggest to change to: "High-resolution simulations can lead to improvements in two ways:"

P3, L31: suggest to change to "…deposition is calculated…"

P4. L6: remove 'The' in 'this 43 vertical layers…'

P4. L15: "for the 2008 simulations"

P4.L18 "for the two study years"

P8, L29: "we found an increased error…"

P8, L30: "convection"

P8,L34 to P9, L17: check missing use of word "the" at several instances

P9, L18: suggest to reformulate to "Negative biases with respect to GOME-2 were larger than to OMI …"

P9, L16-31: repetition of text, can be removed here.

P11, L10: "In comparison with OMI retrievals, with increasing model resolution **the** slope **for East Asia** became…"

P11, L33: "The negative…"

P12, L4: change "chemical concentrations" to "trace gasees"

P12, L6: change "The 1.1 and 0.56" to "All", and change "while" to "but"

P12, L13: "within 0.5%": are you sure about this accuracy against the observations?

P15, L21: "a significant"

P15, L27: "simulations"

P15, L29: "Improve the tropospheric…"

P15, L32: "calculations"

P17, L1: Note that the TropOMI retrieval product will use TM5 on a global 1x1 horizontal resolution (Williams et al., 2017).

P18, L27: "captures the regional"

P18, L31 "points"

P18, L35: what is the Post-K computer?