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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Study of the diurnal variability of atmospheric chemistry with respect to boundary layer dynamics during DOMINO" *by* B. J. H. van Stratum et al.

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General comments

As the reviewer correctly pointed out, relatively little information was given at the introduction on previous studies related to the subject, and related to that, the originality of our results. Within the limits of the introduction, both points have been addressed in the revised manuscript by providing more background information on previous literature to (i) revise the already published work on the influence of boundary layer dynamics on atmospheric chemistry and (ii) by placing it in context, to stress the originality of our work.

The reviewer poses two additional questions related to the numerical experiments with the box model: (i) the initialization and (ii) the comparable results in both the box model and MXLCH for HO_2 and H_2O_2, and the relatively large difference in OH.

First, regarding the initialization of the box model case: The initial CBL-properties were deliberately chosen different from those in MXLCH. By initializing the box model with time-averaged meteorological properties (more specifically the boundary layer height, potential temperature and specific humidity), the atmospheric boundary conditions for the chemical species (e.g. the mixing depth of the surface input of NO) are on average similar to those in MXLCH. To our opinion, this provides the fairest comparison between MXLCH and the box model and with that, the influence of boundary layer dynamics. We have clarified this approach in section 3, and added a reference to Table 4 to indicate that identical initial and boundary conditions are used for the chemical species in both the experiments with MXLCH and the box model.

The second comment, related to the different behavior of OH compared to HO_2 and H_2O_2, is an interesting point on how atmospheric chemistry responds differently to ABL dynamics. Although it is expected that OH, with its high reactivity, should be relatively insensitive to ABL processes, the difference in mixing ratio between the box model and MXLCH is actually caused by ABL dynamics. Because of the overestimation of NO in the box model (Fig. 4.), the production of OH is enhanced through R14: $NO + HO_2 \rightarrow OH + NO_2$. This is partly compensated with an enhanced loss of OH through (mainly) R7-8-9-10-17-21, but on average leads to a slightly higher mixing ratio in the box model. R14 is also the main contributor to the decrease of HO_2 in the box model, which again is partly compensated through R6-7-10-15-17. In other words, the OH-reactivity depends on reactants than can be influenced by the ABL dynamics. In addition, we should mention that Fig. 5. shows a large difference in scales, ranging from the order of 0.1 ppt for OH to 100 ppt for isoprene and H_2O_2. We have extended

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and elaborated more on the discussion on Fig. 5., clarifying the above mentioned processes.

Specific and technical comments

All other specific and technical corrections have been applied as proposed by the reviewer.

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