

Interactive comment on “Impacts of urban land-surface forcing on air quality in the Seoul metropolitan area” by Y.-H. Ryu et al.

Anonymous Referee #1

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General comments

This is a very nice modeling and analysis study that highlights the role of urban breeze circulation on ozone. The manuscript provides clear, important interpretations for complicated nature of ozone transport and chemistry over the region of complex terrain, heterogeneous land-use and emissions of ozone precursors. Separate calculation of advection and chemical process is very helpful in understanding the ozone budget. This manuscript would be a good guide for air quality modelers to interpret the model results over urban areas surrounded by complex terrain and sea. I suggest this manuscript to be accepted for ACP with minor corrections.

Specific comments

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1. The authors used the term of “Low NO_x” or “High NO_x” or “NO_x rich”. The meaning of this definition can be understood in the context. However, “Low NO_x” is commonly referred to state of NO_x < ~0.1 ppbv. It might be better if overall NO_x level in Seoul can be defined in the regime of “NO_x-limited” or “VOC-limited” at first using the model values, then use “Low NO_x” or “High NO_x” within that regime. Depending on the regime where it is, reduction of NO_x can produce more ozone or less ozone. The authors can refer to the reference below and references therein.

Duncan, B. N., et al. (2010), Application of OMI observations to a space-based indicator of NO_x and VOC controls on surface ozone formation, *Atmos. Environ.*, 44, 2213-2223.

2. Abstract line 11 Through the less O₃ destruction by NO in the NO_x-rich environment → Any comments on O₃ chemical production due to diluted nature in URBAN case? The same argument for line 14-15 in page 25812 in section 5.

3. Page 25795 line 8-9 Did the model results reproduce the observations of wind and temperature?

4. Page 25796 line 3-4 Was data assimilation or nudging of large scale meteorological field (NCEP final analysis data) applied? 72 hour is long for plume simulations without any of these adjustments of large-scale forcing.

5. Page 25797 line 5-9 This part needs more clarification. Is base year of emission inventory 2007 and does it need to be adjusted (projected) to 2008 level? I thought the episode in 2010 was simulated in this study.

6. Page 25797 line 18 Could you provide specifics on observed temperature or insolation?

7. Page 25800 line 1-8 & Figure 3a and b The modeled ozone is lower where NO_x is higher in Figures 3a and b, which are not supported by the observations. And recirculating ozone over the ocean intruding into inland in the model seems to be too

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high. Any speculations for this in terms of NO_x and VOC emission inventory such as too high NO_x emission or too low VOC emission? It is notable that ozone over the ocean in NO-URBAN case is higher than that in URBAN case (Figures 3b, 3b, 9e, 9f). Any discussion on this? NO₂ measurements often include nitric acid, PAN, and other organic nitrates. In addition, the level of measurements is lower than the model first level, which made the comparison difficult for the species with large vertical gradient near the surface. It might be good to mention difficulties in comparing the model results with the measurements.

8. Page 25802, line 26-28 The authors regard the entrainment as main cause for the increase of ozone during 9-12 LT. It might be good to compare the contribution of entrainment (diffusion and/or advection) and chemistry to ozone budget in this time. A figure similar to Figure 6 for 9-12 LT helps to understand which process is more important.

9. Figure 7 How does NO₂ profile look like? Since NO₂ is deposited at the surface, O_x is expected to decrease near the surface. Does the model emit NO₂ as well as NO? Can any comments on NO₂ profiles be added to understand O_x profiles?

10. Isoprene versus anthropogenic VOC (mobile and industrial sources) Throughout the manuscript, the importance of isoprene on ozone production over the mountain and urban area was addressed. It might be good to add the plot of model isoprene value to demonstrate the role of isoprene. If isoprene is added in Figure 8 (like NO₂) or Figure 13, that would be very useful. In Figure 12, k[OH][VOC] is presented. Thus, isoprene can be plotted instead of k[OH][VOC] in Figure 13. Or NO₂, isoprene, and other VOCs at 1500 LT can be plotted following the cross section of Figure 10. It might be good to mention that dilution and transport of anthropogenic VOCs may follow NO_x.

11. Wind vector and temperature If the authors have a nice plot comparing observed wind vector and/or temperature at 1500 LT with the model values as in Figure 3, I suggest to include it in the manuscript maybe just before Figure 3. That makes the

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arguments in the manuscript stronger.

I hope to see overall larger size of figures for the plots like Figure 3.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 25791, 2012.

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