

## ***Interactive comment on “The relative importance of various source regions on East Asian surface ozone” by T. Nagashima et al.***

**Anonymous Referee #1**

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### General comments

The manuscript presents a detailed source attribution for surface ozone over several regions within East Asia. While the methods are not new, their application yields new information regarding seasonal cycles of surface ozone over this region, and the emphasis on intra-continental transport is complementary to a recent international coordinated effort focused on intercontinental transport, mentioned in the introduction. It would be useful to discuss how the findings presented here compare with, extend, or contradict the conclusions coming out of that effort.

Throughout the text, the English could use some improvement.

### Specific comments

C3553

Abstract: “Tagged tracer method” should be explained. Rather than “recent years”, give the specific years examined. L14: What is increasing greatly in summer?

The discussion in Section 2 overlaps with that in 2.2 and could be combined.

Section 2.1. awkward phrasing final sentence of first paragraph – is the stratospheric model output assimilated into CHASER? Does this vary interannually?

Section 2.2 The treatment of the stratospheric tracer needs to be better explained. As shown by Hess and Lamarque (Hess, P. G. and J.-F. Lamarque (2007), Ozone source attribution and its modulation by the Arctic oscillation during the spring months, J. Geophys. Res., 112, D11303, doi:10.1029/2006JD007557), the conclusions will depend on how this tracer is defined, with a large sensitivity in the northern hemisphere. They argue that an approach similar to the one employed here will overestimate the stratospheric contribution. Some discussion is appropriate. Why does the concentration of the tagged tracer need to be scaled at all? Shouldn't the sum of the tracers equal the total ozone?

Section 2.3 Do the emissions vary by year? Do the biogenic and lightning sources respond to the model meteorology?

Section 3.1 The discussion jumps around here and could be more clearly organized. Same for Section 3.2.

P9089 L10 Plus also a lack of summertime photochemistry at these sites? L14. Why are the model estimates for stratospheric contribution here lower?

P9089 L20. Why should the minimum in the stratospheric contribution change over interior continental sites?

Section 3.2 This section might be better titled “Seasonal cycles of East Asian surface O<sub>3</sub>”.

P9091 L11–15. This seems like it belongs in Section 2.

C3554

Section 3.3 Are these results expected to depend on the model resolution (e.g., see Lin et al., Atmos. Chem. Phys., 10, 4221-4239, 2010)? How do the seasonal cycles of stratospheric contribution compare to those shown in earlier publications for North America or Europe?

P9093 L18-20. Is this true even in October? This sentence should clarify that it is referring to the “cold” season.

P9095 L14-19 seems to repeat points above – combine, and include the numbers directly from figure 5. Somewhere “domestic” should be defined.

P9097 L9-20. Are these variations those associated only with meteorology or do model emissions also change each year?

Section 3.4 Is the model sampled at the site locations for this comparison?

P9098 L16-19. The model does not show this feature so L25-26 should be rephrased.

P9099 L2-3. Why does the nighttime matter since daytime values are used here? Can the urban observations be excluded for model evaluation? L6-9. Might this be shown more directly by summing the hours above 60 ppb and comparing the percentage above this value in the observations and in the model?

Section 3.5 Is it meaningful to look at the model values above 90 ppb when it doesn’t simulate the frequency of these events well? Why is the stratospheric contribution so much higher at CHN-NCP (P9100 L15) than in JPN/KOR? Is the elevation higher?

P9103 L14-17. This statement is problematic since Figure 6 shows that the model fails to simulate the increase in high O<sub>3</sub> in summer.

P9104 L1. It would be useful to provide a quantitative estimate for this baseline o<sub>3</sub>.

Table 1 can move into supporting information since the key points are evident from Figure 2. Alternatively, the statistics could be added to each individual panel in Figure 2 if the Figure is substantially enlarged.

C3555

Table 2. Are the source and receptor region labels swapped? This seems repetitive with Figure 4. I suggest moving the contribution values to supplemental information, and keeping only the coefficient of variation which is the key point discussed in the text from this table. IDC+ needs to be explained.

Figure 4 can be condensed to focus on the most important information. I suggest just showing the top panels and decreasing the total number of panels by combining regions as done in Figure 5. In the top panels, do I interpret correctly that the contributions are only the shaded regions? That means we have to read the difference of the top and bottom of the white area for the free troposphere contribution? This plotting method makes it a little complicated to easily see seasonal cycles; might it be clearer to just plot the amount from the different regions rather than shading this way? It’s hard to extract information from the barplots (bottom panels figure 4). While this might be improved by showing only the top 3-4 source regions, it’s probably best to move these to supplemental information and enlarge them so that the interested reader can extract quantitative information. The information is much better presented in Figure 5; the total O<sub>3</sub> could be given at the top of each bar in Figure 5 to allow the reader to estimate the absolute contributions.

Technical comments Abstract L24: “expect” should be “except”

P9079 L17 reinforcement -> enforcement ?

P9084 L21. Clarity -> brevity? L24: refer to the map of the regions.

P9089 L2 what is the “observed lower portion of daily mean...”?

P9089 L24. “condensed O<sub>3</sub>” is awkward.

P9094 L6 is awkward; the foreign source regions are not in East Asia.

P9095 L1-5 seems to repeat earlier points – cut or condense.

P9096 L15-18 where and when?

C3556

Section 3.4 The region labels should be consistent in the text and figures.

Section 4. Define "S-R relationship"

Figure 1. red letters are hard to see.

Figure 2 is too small. It'd be better to organize the panels in the order in which they're discussed in the text (or at least explain the current logic). The red vs. green is not discussed separately in the text so I don't see the need for the distinction in record length. How are the model calculations interpolated to the longitude, latitude, and altitude of each site?

Figure 3. The season labels are hard to see on the plots.

Figure 4. What is the black line? The dashed red line needs more spaces as its hard to distinguish from the solid line. The caption should explain the map of the regions.

Figure 6 caption. Define what is meant by "ridge line". Are the frequency distributions constructed by using 10 ppb bins and then the average is taken across the 6 years within each bin?

Figure 7 is too small.

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Interactive comment on Atmos. Chem. Phys. Discuss., 10, 9077, 2010.