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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influence of meteorological variability on interannual variations of the springtime boundary layer ozone over Japan during 1981–2005" *by* J. Kurokawa et al.

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This review is by Owen Cooper, editor of this manuscript. I am providing my review now in order to stimulate discussion of the paper. I have not yet had the benefit of reading the reviews by the two anonymous referees and their assessments will have a major influence on the decision to publish the paper in ACP. My current opinion (which may change depending on the reviews of the anonymous referees) is that the authors have presented a very nice analysis of the influence of interannual meteorological variability on boundary layer ozone above Japan. I find the modeling techniques to be sound,

and the identification of the varying MSLP anomalies and wind patterns support the conclusions. These results will be useful to the scientific community and are entirely appropriate for ACP. One area that can be improved is to add some discussion as to why the model overestimates ozone in the boundary layer of Japan, which also involves examining the ozone trends for different categories of monitoring sites such as rural, suburban and urban. I elaborate on this point in the text below.

The authors have used a regional chemical transport model to examine the influence of increasing emissions and IAV of meteorology on boundary layer ozone above Japan. As they point out on page 7564, the actual values of the modeled ozone are not as important for this study as the interannual variability and the increasing trend. I agree with the authors on this point. But on the other hand it is a little disconcerting that the model consistently over predicts ozone by 50%. Furthermore, if surface measurements of O3 rather than Ox were available, the discrepancy would be even greater.

The authors offer only one brief explanation, suggesting that the model's coarse resolution does not allow the correct simulation of ozone titration by NO. I would like the authors to explore this point in more detail for 2 reasons. 1) Identification of the problem will allow the reader to better judge the situations under which the model can be considered to be reliable. 2) Identification of the problem will be helpful to the modeling community in general because other modelers have consistently over predicted Japanese ozone.

I am currently editing a paper that should soon appear in ACP. The ACPD version is:

Lin, M. et al, Mechanisms controlling surface ozone over east Asia: a multiscale study coupling regional and global chemical transport models, ACPD, 8, 20239-20281.

In this study the authors found that their regional model over predicted Japanese ozone due to problems with too much ozone entering the model at the boundaries (Dr. Lin can provide the revised version of the paper: mlin26@wisc.edu). I wonder if your model might also have a similar problem because ozone in your study is too high for years

with strong westerly flow (transport from Asia) and also for years with strong southerly flow (transport from the Pacific).

Regarding your hypotheses that the problem is due to the model not resolving ozone titration, a simple test would be to compare the model output to measured Ox in three groups: rural, suburban and urban. The ozone titration problem should be more evident for the urban sites, while the rural sites should have better agreement with the model.

Finally, examining time series of Ox broken down by rural, suburban and urban locations will be one final check that upwind ozone has a major impact on Japan. If upwind ozone and interannual variability affect all regions of west central Japan, then similar ozone trends and IAV should be seen for the three types of measurement sites. Adding a figure showing the trends for these three categories would be helpful for understanding your analysis and will also be of interest to researchers who keep track of ozone trends.

Additional comments:

Some additional explanation of the Ox measurement methodology is required. If I understand you correctly, the Japanese government does not directly measure O3 but instead measures Ox. Please list the major species that contribute to Ox. Mixing ratios of Ox must be greater than mixing ratios of O3 and there must be some sites in Japan where both are measured simultaneously. Please give an indication of the difference between O3 and Ox, with the understanding that this will vary between sites, especially between rural and urban sites.

page 7563 line 7-8 Do you mean to say: The majority of Ox instruments were calibrated with the KI method.

page 7563 line 16 I don't understand what is meant by: Also KI scale for Ox showed about 9% larger sensitivity than O3 scale. Please elaborate and/or re-phrase. And please define what you mean by "scale".

page 7563 line 19 What percentage of the 136 stations is rural, suburban and urban?

Minor comments:

In the comments below, if no explanation is given, please insert (or substitute) the text provided into the appropriate place in the manuscript.

Title of paper, Please modify the title to read: Influence of meteorological variability on interannual variations of springtime boundary layer ozone over Japan during 1981-2005

Abstract, line 3 of springtime boundary layer ozone

Abstract, line 14 influence of the

page 7557 line 5 tropospheric ozone influences the Earth's climate as a greenhouse gas (Intergovernmental Panel on Climate Change, 2007), and negatively

page 7557 line 14-15 the recent increase of O3

page 7557 line 16 also reference the recently published Tanimoto et al, Atmos. Environ. 2009, regarding ozone trends at Mt. Happo

page 7557 line 25 and throughout the paper Replace "meteorological fields" with "meteorology" unless you are talking about output from a forecast or reanalysis model.

Page 7558 line 12 influenced by large export events from East Asia.

page 7558 line 13 the influence of IAV of continental-Asian outflow on tropospheric O3

page 7558 line 15-16 influence of meteorology on the IAV

page 7558 line 17 continental-Asian outflow

page 7558 line 19 The purpose of this study is to

page 7561 line 1 You state that the inflow concentrations of O3 from the stratosphere are set to zero, but what about ozone in the stratosphere within the model domain?

Does it contain ozone so that any fresh stratospheric intrusions in the model domain will impact tropospheric ozone?

page 7562 line 4 When calculating BL ozone do you include data from all times of day in the average?

Page 7562 line 23-24 where the influence of O3 from continental Asia is expected

Page 7563 line 14 Please define NIES.

page 7566 line 7 compared to the climatology.

page 7566 line 18 appear in almost the same area

page 7566 line 20 we identify the processes

page 7567 line 24 The regression lines for all data

page 7568 line 20 from continental Asia is large, transport from the Pacific

page 7569 line 16 relationship

page 7570 line 5, line 6 and line 10 relationship

page 7570 line 13 and elsewhere When describing the NINO3 index please specify that it corresponds to the Niño 3 region which is commonly used in studies of El Niño.

page 7570 line 21-23 The correlation coefficients for all data (large ASPA data) between Niño 3 and ASPA and between Niño 3 and O3 anomalies were 0.52 (0.58) and -0.40 (-0.57) respectively.

page 7572 line 7-8 For example, a large O3 anomaly region in 1987 (an El Niño year) was slightly shifted

page 7572 line 11 exceptionally low

page 7572 line 24 relationship

Table 1 change “Word Abbreviation” to “Abbreviation Definition”

Figure 4 The panels are too small. Please increase by at least 50 %. Also, please change the units of e) and f) to hPa.

Figure 5 and 6 Modify the legend to read: blue dot: ASPA > 1 or ASPA <-1 green dot: -1 < ASPA < 1

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 7555, 2009.