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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influence of the variation in inflow to East Asia on surface ozone over Japan during 1996–2005" *by* S. Chatani and K. Sudo

Anonymous Referee #1

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Influence of the variation in inflow to East Asia on surface ozone over Japan during 1996-2005 by Chatani and Sudo

The authors use a regional chemistry transport model coupled to a global ditto to investigate variations in surface ozone over Japan during the ten-year period, 1996-2005. The work seeks to explain why near-surface ozone is increasing over Japan in spite of decreased NOx- and NMHC emissions in the country. It also discusses the importance of inflow of ozone to Japan from other parts of East Asia and further a field.

The paper includes a thorough review on previous work. The paper is generally well written although there are a number of formulations that could be improved (some suggestions given below).

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The experimental design and set-up is impressive and the study could have been a very useful contribution to understanding the fate near-surface ozone in the Northern Hemisphere.

A number of circumstances unfortunately limit the value of the study. Most bothersome is the poor correspondence between model results and observations. As long as the model can not accurately reproduce near-surface ozone over Japan (e.g. Figs. 4-6) it is difficult to trust the conclusions drawn from the model study.

The poor performance of the model could partly be sought in the type data used for evaluation, i.e. measurements collected at >1000 "populated areas" in Japan. Given the resolution of the model (including the emission inventory) it would have been more appropriate to evaluate the model against data collected at regional monitoring stations, such as the EANET data, or similar. A brief attempt was made to compare the model results to individual time series at 10 Japanese EANET stations. It is remarkably that no evaluation (i.e. comparison with observations) of the model's performance outside Japan is made, especially after speculating that the main reason for the model's poor behaviour is excessive ozone production in NE China.

From Figs. 4-5 it appears that the regional model merely shifts the level of ozone by a constant value, i.e. the seasonal cycle of WRF/Chem is more similar to CHASER than to the measurements. The statistical analysis does not convincingly show that the regional model is better than the global model (except for the overall bias). I suggest a more rigorous evaluation of WRF/Chem, focussing on background stations in the whole domain rather than urban stations in Japan only.

The discussion about possible reasons for the overestimation of ozone in Northeast China on pp. 30833-30834 is a bit speculative and far-fetched, in my opinion. The authors discuss possible deviations of emissions during certain months in certain areas (e.g. "Beijing region") or refer to studies in the Pearl River delta which is quite a distance from Beijing and Japan.

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It is suggested that erroneous emissions may be the cause for the overestimated ozone concentrations in Japanese populated areas from summer through early winter. Would it not be worthwhile to test the impact of neglecting temporal (seasonal and diurnal) variations of emissions as well as neglecting biomass burning in the present set-up. Emissions from biomass burning often contribute to a very large fraction of ozone precursors.

On page 30833 it is also stated that "...transport of ozone from a high concentration zone to Japan may be overestimated in summer." Could it not be that the transport from the clean Pacific during summer is underestimated? The model performance at the remote island stations Ogasawara and Hedomisaki seem to be good throughout the year. The problem with the model performance could therefore be sought in the description of the wind speed and direction (both in CHASER and in WRF/Chem). Maybe you could evaluate this important meteorological parameter?

On page 30827 almost a full paragraph is spent discussing CMAQ. While I appreciate all references to previous work on the subject, I don't think it's necessary to go into details of e.g. deficiencies in the vertical transport of CMAQ.

Page 30829, line 22: Is it really the "Japanese government" that has noticed that ozone represent the major fraction of all photochemical oxidants. It would be good, if you could support this statement with a reference.

On page 30831 you mention that the present study only deals with "surface ozone", contrary to other studies, e.g. Kurokawa et al (2009a). What do you mean with "surface ozone". Is it from the lowest layer of your model, or is it scaled to a particular height over the surface? Please clarify.

Page 30835: When discussing interannual variability of ozone over Japan you may also want to refer to: Calori, G., Carmichael, G.R., Streets, D., Thongboonchoo, N., Guttikunda, S.K., 2001. Inter-annual variability in sulphur deposition in Asia. Journal of Global and Environmental Engineering 7, 1–16.

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The “wind-arrows” in Figs. 3, 8, 11 are too small. They need to be larger.

Use identical colour-legend for the seasonal and annual values in Fig. 3.

Exchange “Whole months” to Annual Mean (or similar) in Fig. 3 onwards.

Minor, editorial, issues

Page 30824, line 1: “Air quality simulation . . .” -> “Air quality simulations . . .”

30824, 20: “carbons” -> “CO2” or “carbon”

30825&30826: Consider rephrasing some of the instances of “influence” since it is used in great numbers on these pages.

30825, 27-28: “for the past years” Unnecessary, delete?

30826, 2: “its” -> change to “the regional CTM’s” ?

30826, 19: “both” Unnecessary, delete?

30826, 25: “in other seasons as well as spring” Unnecessary, delete?

30827, 21: “major” -> change to “a large” ?

30827 & 30828: use “x” instead of a dot to describe the grid-size and number of grid-cells ?

30827, 25: “sigma-P” -> change to “sigma-p” ?

30828, 15: “simulation results” Unnecessary, delete?

30829, 3: Start a new paragraph after “. . . lower stratosphere.” ?

30829, 3&26: Don’t use point when writing the number of monitoring stations. Write 1045 (or 1 045).

30830 onwards: “whole months” is confusing. Use “all months” or “annual mean” or “yearly average” etc. to label this category.

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30830, 21: “southern ocean” ? For me southern ocean is the part of the Atlantic, the Pacific and Indian Ocean that is immediately north of Antarctica. Is this what you mean or is southern ocean a Japanese name for the part of the Pacific north of the equator?

30831, 13: “. . . that band of a high ozone” -> “. . . that a band of high ozone” ?

30833, 3 onwards: “The simulation-reproduced . . .” The whole sentence needs rephrasing.

30833, 18. “southern ocean”

30835, 8: “picking up” -> “selecting” ?

30835, 16: “southwest ocean” Not a familiar name of an oceanic regions for me.

30835, 17-18: “but they are not obvious in ‘Low’ years.” Language needs improvement.

30836, 19: “. . . variation in inflow.” -> variation in modelled inflow.” ?

30837, 29: “. . . were calculated . . .” -> “. . . were also calculated . . .”

30838, 18: “. . . increasing rate of ozone” Reformulate?

30838&30839: Consider replacing a few of the instances of “increasing rate”.

30839 11-12: “. . . a regional CTM with a global CTM were coupled” -> “. . . a regional CTM were coupled with a global CTM”

30840, l11: “Multiple simulations studies . . .” -> “Several modelling studies . . .”

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 30823, 2010.