

# ***Interactive comment on “Discrepancies between MICS-Asia III Simulation and Observation for Surface Ozone in the Marine Atmosphere over the Northwestern Pacific Asian Rim Region” by Hajime Akimoto et al.***

## **Anonymous Referee #2**

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In the present paper, Akimoto et al. analyzed observations of surface ozone and simulations with NAQM and CMAQ models to investigate the possible causes of model estimates at selected sites in East Asia. The authors concluded that observation-model disagreements at the sites were possibly due to model uncertainties in long-range transport, in-situ photochemical formation, and O<sub>3</sub> dry deposition and that the discrepancies between the models might be from different O<sub>3</sub> dry deposition schemes. The authors finally recommend a higher O<sub>3</sub> dry deposition in CMAQ and empirical measurements of dry deposition flux over East Asian marine areas. The paper presents

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a few insights into the possible causes of model overestimates in O<sub>3</sub> over East Asian marine areas. However, I suggest that some more thorough and deeper analyses, as listed below, would be needed before its publication.

Major comments:

1. What're the major differences between CMAQ 5.02 and 4.7.1? If they're very similar in lots of aspects, what's the point to compare these "two" models? It would be much more interesting to compare it with another "independent" model.
2. I would suggest a detailed analysis of O<sub>3</sub> budgets, including chemical production/loss terms and physical removal terms of O<sub>3</sub>, at the sites, which might be also helpful for understanding the model overestimates. For example, underestimates of chemical loss of O<sub>3</sub> due to the halogen chemistry in the models would also contribute to the overestimates of O<sub>3</sub> at these oceanic sites.
3. One major conclusion in this paper is that the overestimate in O<sub>3</sub> over the study region in CMAQ is due to too small O<sub>3</sub> dry depositions whereas the better agreement between NAQM and observation might have resulted from a relatively larger O<sub>3</sub> dry dep. It would be interesting to conduct a few sensitivity model simulations, e.g., applying higher O<sub>3</sub> dry deposition rates in CMAQ or implementing the dry deposition that used in NAQM into CMAQ, to support the authors' major conclusions.

Minor comments:

1. Line 69: I don't think the present paper aims to "solve" the discrepancies between models and observations. It may provide some useful information on advancing the current understandings of discrepancies between the two models and between modeled and observed O<sub>3</sub> at the sites.
2. Line 102-105: It would be good to elaborate a little bit here to illustrate how important the role of air-sea exchange plays instead of just citing the papers.
3. Line 106: It's not clear to me that a "more detailed comparison" is compared to

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which study?

4. Does JST mean Japanese local time? Need to clarify.
5. unit of O<sub>3</sub> needs to be consistent: in some places, it's ppb but others as ppbv.
6. Fig 1: Overlapping monthly winds in the figure may help readers better understand the transport patterns of O<sub>3</sub> in the region.
7. Line 197: I would suggest the authors to avoid stating the model/models “excellently” capture observations. It seems that NAQM still overestimates observed O<sub>3</sub> by ~30-40% during nighttime.
8. Line 229: “. . . along with the edge of the Pacific High”: it would be good to add isopiestic lines or wind patterns in Fig 4. It would be better to add the spatial pattern of O<sub>3</sub> on this day from NAQM as well.
9. Line 281: I'm wondering if this soil NO<sub>x</sub> from sugar cane fields had been considered in any of these models?
10. Line 282: It's not clear to me what the term “diurnal O<sub>3</sub> formation” means.
11. Fig 5: I would suggest the authors plot the comparisons of observed and simulated NO<sub>2</sub> in one plot and the comparisons of NO in the other. That would be more consistent with the analyses in other similar figures and clearer for NO values.
12. Fig 6: I would suggest plotting the comparisons of modeled chemical production between three models in the same figure.
13. Fig 7: What're the simulated values from the other two models like at these two sites?
14. Line 419: “. . . identified as the cause of overestimate”: I would say the three factors are possible causes of models overestimates in O<sub>3</sub> since there could be other possible reasons.

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15. Line 422: May need to clarify the regions or sites that were suffered from overestimates in transported O<sub>3</sub> from continents. I'm also curious about whether the transport patterns of O<sub>3</sub> over the study region are significantly different in June or August from that in July.

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