

# ***Interactive comment on “Modeling Trans-Pacific Transport and Stratospheric Intrusion of Tropospheric Ozone using Hemispheric CMAQ during April 2010: Part 2. Examination of Emission Impacts based on the Higher-order Decoupled Direct Method” by Syuichi Itahashi et al.***

**Anonymous Referee #2**

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Itahashi et al. (2019) investigated the impacts of emissions from East Asia and US on surface O<sub>3</sub> over Northern Hemisphere using HDDM in H-CMAQ. They found comparable impacts by the emissions from East Asia and US on surface ozone over western US with US domestic emissions having larger impacts on surface ozone over eastern US while emissions from East Asia have much larger impacts on free troposphere through trans-pacific transport. But they also found the impacts of recent emission changes in East Asia on US O<sub>3</sub> levels were small. The manuscript is in general well written but

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there are several concerns about the methodology used in the manuscript.

## ZOC of emissions

The estimation on the emission impacts is based on only one H-CMAQ simulation, is that correct? If so, the ZOC estimates are not really accurate as if we reduce all the targeted emissions, meteo/dynamics will also change, which could have feedbacks on the estimations of the emission impacts. The atmospheric conditions will be different under normal and ZOC scenarios. Any explanations on this?

Also, ZOC is not a really realistic scenario and the impacts of ZOC are probably over-estimated in this work. So your conclusion about the impacts of the emissions from East Asia may not be that robust. As in your last part of the work, the impacts of recent changes in the emissions from East Asia were found to be small to insignificant. Unless all the emissions from East Asia were removed, significant impacts would exist over western US at surface and entire US in free troposphere? In other words, To what degree of the changes in the emissions of East Asia should be achieved to show noticeable impacts on US?

For ZOC scenario, does it simply remove all the NO<sub>x</sub> and NMVOCs emissions? How to distinguish between anthropogenic and natural emissions for NMVOCs? Are the impacts of ZOC the total impacts from the removal of both NO<sub>x</sub> and NMVOCs? Can we have individual impacts from the removal of NO<sub>x</sub> only and removal of NMVOCs only? Or maybe we can infer from the sensitivity to these emission? This information could provide more guidance on future emission mitigations.

Specific comments:

Page 1, Abstract, line 24, “with a magnitude of about 3 ppbv impacts on a monthly mean . . .” 3 ppbv O<sub>3</sub>?

Page 4, line 4, “O<sub>3</sub> mixing ratios and an those of inert tracer. . .”, grammatical error

Page 5, line 5-6, equation (3), should  $S_{i,j}(2)$  have the unit of square of the concentra-

tion?

Page 6, and Figure 1, any physical meaning on second-order sensitivity? line 9-10, can you explain more on “concave response”?

Page 6, line 27-28, what do you mean by “Svocs and Snox”? it is not equal to Svocs + Snox, right? Maybe you mean Svocs-nox ? Please clarify.

Page 7, line 17-18, regions in VOC-sensitive regime are not clearly shown in Fig 2. You may want to change the color scale to improve the quality.

Page 21, Figure 3, are these impacts based on zero-out of both NO<sub>x</sub> and NMVOCs at the same time? See my general comments above.

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