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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Response of Global Surface Ozone Distribution to Northern Hemispheric Sea Surface Temperature Changes: Implication for Long-Range Transport" *by* Kan Yi et al.

Anonymous Referee #2

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This paper presents a very detailed description of changes in ozone due to basin wide changes in SST. Changes can be up to 5 ppbv. The authors have provided great detail for the mechanisms behind the changes. The previous reviewers have commented on many aspects of this paper. Here I will restrict my comments to the overall methodology.

In short, for reasons explained in more detail below I am having difficulty interpreting the paper's results. The authors need to justify their methodology in detail, expand on some of the sensitivities of the solution to the methodology chosen and possibly run some addition simulations to put the results in context.

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Discussion paper

The authors set rectangular patches of ocean temperature warmer (or colder) by 1 degree within very large ocean-basin domains. The reasons for this setup are not well explained. How did they choose the size of the patch? How did they choose the southern and northern boundaries? The various patches are not similar in latitude or longitude nor do they apparently align with the edge of the ocean basins. We know the resulting circulation changes are sensitive to where the SST is perturbed. In particular there are large differences between the impact of SST perturbations in mid-latitudes and those in the tropics. Teleconnections stemming from tropical ocean SST perturbations can have long-range impacts depending very much on the location of the perturbation. Changes in ocean temperature gradients are also likely to be important for the transport. We note that the simulations in this paper rather dramatically modify the ocean temperature gradients along all boundaries of the perturbation. While the authors smooth out the gradients I am not sure of the resulting impact. I would like to understand the impact of the details of their methodology on the solutions. As it stands I don't really see a strong justification to how they perturbed the ocean temperatures.

I am also having a difficult time interpreting the results. If the authors are interested in understanding the importance of SST perturbations on present day transport it would make sense to perturb the SST using realistic SST variability – perhaps an EOF analysis would be helpful here. This is because the result is sensitive to how the SST is perturbed. If the authors are interested in the importance of climate change it is also difficult to interpret the results. Perturbing the SST in one ocean basin is likely to alter the land-sea pressure gradients and transport in a different ways than changes under CO2 influenced climate change. It may be possible to parse the impact of transport changes from climate change in terms of the perturbation simulations carried out by the authors but they have not done this.

So, I'm not sure what I ultimately have learned from the paper. The authors do a great job in providing details of transport changes due to SST modification: changes in stability, in clouds, in overall transport and other processes are important. It is not

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surprising that whole-scale changes in SST modify the transport and ozone chemistry. However, it is unclear to what extent these details are an artifact of their simulation setup and how they apply to the real world (either to interannual variations in SST or to climate induced variations). Specific details of the solution are likely to depend on how the SST has been changed. Thus I'm left with a very detailed analysis but I'm not sure what I have really learned.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1001, 2016.

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