

## ***Interactive comment on “Foreign influences on tropospheric ozone over East Asia through global atmospheric transport” by Han Han et al.***

**Anonymous Referee #2**

Received and published: 13 May 2019

This publication represents a robust analysis of contributions to surface and tropospheric ozone. While several prior studies have found similar results, and in this sense the study is maybe not completely new, the comprehensive analysis of contributors to ozone over Asia has clearly added value.

On the downside, I think it is regrettable that the authors have not attempted to align their study better with the HTAP2 source-receptor studies, that included harmonized simulations of emission sensitivities and responses over East Asia and a number of other world regions, updated and harmonized emissions, etc. As a result, it is becoming more difficult to evaluate uncertainties related to the use of one specific model compared to other models.

Nevertheless, I find the overall analysis convincing, the material well presented, and

therefore recommend to publish the manuscript in ACP, with some suggestions for minor revision presented below.

Minor suggestions:

I. 17 East Asia defined as ....

I. 48 the ecosystem=>ecosystems.

I. 54 why?

I. 57 I don't find this in Fiore's paper. Anyway as the ozone response depends on the emission reduction strength, the sensitivity will depend on the magnitude of perturbation. In this sense perturbations that are close to the present situation (i.e. a 5, 10 or 20 %) are used for Source-receptor relationships, sometimes with a correction for larger perturbation sizes. These have been used e.g. in HTAP1, and HTAP2, and other studies by individual researchers also for Asia. A nice paper that combines source attribution and tagging paper: <https://www.geosci-model-dev.net/11/2825/2018/>. It can be used to address some of the uncertainties. I also note that it is not very clear around I. 154 how exactly the tagging was done- and there are several ways to do so.

I. 98. It is confusing to talk about trends when you really talk about interannual variability.

I. 127 I notice that this resolution is meanwhile not really state-of-the-art. Mention already here that you also do higher resolution sensitivity simulations

I. 130 Unfortunately the different choice of regions compared to HTAP1 or HTAP2 does not help in comparing to other model simulations.

142-145 I guess what the authors are doing here is introducing a correction factor so that the sum of the individual region 100 % perturbations nicely sums up to a global perturbation? How large are these corrections?

I. 164. Linoz. Does this effectively mean a constant yearly influx of stratospheric ozone

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by 484 Tg in these variation. Note that it is likely that there is a correlation between large scale circulation (and I guess monsoon as well) and strat-trop exchange.

I. 137 Why were 2006/2007 chosen? And not more recent years (e.g. HTAP's 2010)

I. 157 No variation in chemistry. In the next line the authors explain this is achieved by extracting production/loss data for 2005. This is going to lead to inconsistencies (and hopefully identical results for 2005). This needs discussion.

I. 170. The results of using different resolutions and meteorological drivers, needs to be somehow included in the discussion of uncertainties.

I. 194 here the operational definition of troposphere needs to be given.

I. 202-204 In this case North American ozone is both from natural and anthropogenic emissions as well as stratospheric ozone that entered the North American region?

I. 330 I recommend also to consider the results of Turnock et al, ACP, 2018, which discusses HTAP2 results.

I. 346. This finding warrant a bit more discussion, given the similarity of emissions but longer distance compared to Europe.

I. 368 I guess that can well be, also given the fact that many other models have larger stratospheric influxes. Would the conclusions change substantially if the number would be double. It is unclear to me how stratospheric ozone influx is accounted in the various attribution methods (e.g. influx of ozone In Europe, is that European ozone as well?)

I. 410 It is not so clear why you would need 3x2 monsoon indices. If they are so different, please summarize what aspects they would represent stronger. Please also clarify how monsoon (summer phenomenon) indices also can have significant correlation with winter ozone.

I. 540 It would have been great to use the HTAP2 compilation for 2008/2010- as did many other models. It would be good to mention at least the differences.

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