December 18, 2024

Comments by Owen R. Cooper (TOAR Scientific Coordinator of the Community Special Issue) on:

**Drivers of change in Peak Season Surface Ozone Concentrations and Impacts on Human Health over the Historical Period (1850-2014)**

Steven T. Turnock, Dimitris Akritidis, Larry Horowitz, Mariano Mertens, Andrea Pozzer, Carly L. Reddington, Hantao Wang, Putian Zhou, and Fiona O'Connor

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This review is by Owen Cooper, TOAR Scientific Coordinator of the TOAR-II Community Special Issue. I, or a member of the TOAR-II Steering Committee, will post comments on all papers submitted to the TOAR-II Community Special Issue, which is an inter-journal special issue accommodating submissions to six Copernicus journals: ACP (lead journal), AMT, GMD, ESSD, ASCMO and BG. The primary purpose of these reviews is to identify any discrepancies across the TOAR-II submissions, and to allow the author teams time to address the discrepancies. Additional comments may be included with the reviews. While O. Cooper and members of the TOAR Steering Committee may post open comments on papers submitted to the TOAR-II Community Special Issue, they are not involved with the decision to accept or reject a paper for publication, which is entirely handled by the journal's editorial team.

**Comments regarding TOAR-II guidelines:**

TOAR-II has produced two guidance documents to help authors develop their manuscripts so that results can be consistently compared across the wide range of studies that will be written for the TOAR-II Community Special Issue. Both guidance documents can be found on the TOAR-II webpage: https://igacproject.org/activities/TOAR/TOAR-II

*The TOAR-II Community Special Issue Guidelines*: In the spirit of collaboration and to allow TOAR-II findings to be directly comparable across publications, the TOAR-II Steering Committee has issued this set of guidelines regarding style, units, plotting scales, regional and tropospheric column comparisons, and tropopause definitions.

*The TOAR-II Recommendations for Statistical Analyses*: The aim of this guidance note is to provide recommendations on best statistical practices and to ensure consistent communication of statistical analysis and associated uncertainty across TOAR publications. The scope includes approaches for reporting trends, a discussion of strengths and weaknesses of commonly used techniques, and calibrated language for the communication of uncertainty. Table 3 of the TOAR-II statistical guidelines provides calibrated language for describing trends and uncertainty, similar to the approach of IPCC, which allows trends to be discussed without having to use the problematic expression, "statistically significant".

**General comments:**

Lines 52-54
This discussion seems to be referring to the suggestion that surface ozone at northern mid-latitudes might have doubled from the 1950s to the year 2000, and that this rapid increase is not reproduced by the models. However, the idea that ozone doubled is now out of date. In the first phase of the Tropospheric Ozone Assessment Report, Tarasick et al. (2019) conducted the most comprehensive assessment of historical ozone observations, digging up old and forgotten datasets missed by other studies. Tarasick et al. (2019) did not find evidence for a doubling of surface ozone, and concluded that ozone increased by roughly 30-70% from the mid-20$^{th}$ Century until the early 21$^{st}$ Century. These findings were accepted by IPCC AR6 (Gulev et al., 2021), and the CMIP6 models generally agreed with this rate of increase (Griffiths et al., 2021).

Line 71
A more recent analysis of the ozone climate penalty is provided by Zanis et al., 2022.

Line 194
The cold bias in UKESM is mentioned here, but no explanation is given. Could this be related to higher aerosol loading in this model?

Line 236
I realize that the output is focusing on 10-year periods, but the year 1855 doesn't really coincide with 1850, as listed on line 227.

Line 242
Here it is stated that ozone more than doubled in most regions from 1950 to 2010, but from my reading of Figure 3, the increases were not this great. As the plots are small, it is not easy to read the numbers exactly, but ozone in South Asia seems to increase from about 30 ppb to nearly 60 ppb, so for this region one could argue for a doubling, but not for the other regions. For example, it seems that ozone in Western Europe increased from 30 ppb to about 44 ppb (an increase of about 50%) from 1950 to 2010, with a similar increase in High-income North America. These 50% increases fall within the 30-70% increase reported by Tarasick et al. (2019), based on historical observation at northern mid-latitudes.

Figure 3 shows that the highest ozone mixing ratios in 1850 occurred in Central Sub-Saharan Africa, and Figure 5 shows that the highest attributable fraction occurred in the same region. What drove ozone production in this region in 1850? Biomass burning?

Figure 4
The concept of the ozone climate penalty indicates that ozone concentrations in high emission regions should increase (if emissions are held constant) due to the increase in heatwave conditions (across highly populated areas) that are more conducive to ozone formation. However, the histpiSST simulation shows that ozone exposure increased slightly when the climate was fixed at 1850. One would think that ozone exposure would decrease if the climate was fixed at the colder 1850 conditions (i.e. less heatwaves in highly populated areas). What is the explanation for the increase?

Line 285
Unites should be United

Line 290
You can't really say that there was no risk globally in 1850, as ozone values in Central Sub-Saharan Africa were above 32.4 ppb.

Line 355
Here it would be helpful to indicate the magnitude of the future temperature changes that produced the notable ozone climate penalty reported by Zanis et al. 2022.

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