Comments by Gabriele Pfister (TOAR II Steering Committee Member) on *"MIXv2: a long-term mosaic emission inventory for Asia (2010–2017)"* by Li, M. (corresponding author), Kurokawa, J., Zhang, Q., Woo, J.-H., Morikawa, T., Chatani, S., Lu, Z., Song, Y., Geng, G., Hu, H., Kim, J., Cooper, O. R., and McDonald, B. C.

This manuscript was submitted to ACP as part of the TOAR-II Community Special Issue, https://doi.org/10.5194/egusphere-2023-2283, 2023 Preprint. Discussion started December 8, 2023; discussion closes January 19, 2024. I, Gabriele Pfister (National Center for Atmospheric Research, Boulder CO) am providing this comment as a member of the TOAR II Scientific steering committee.

Owen Cooper, TOAR Scientific Coordinator of the TOAR-II Community Special Issue 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.

General Comments

This paper presents an update to the publicly available MIXv1 Asian emissions inventory as described in Li et al., (2017) and which has been widely used for scientific research. The MIXv2 effort has combined seven available regional Asian inventories and two global inventories into one consistent data set, which is a significant effort. Amongst other updates, MIXv2 combines up-to-date regional emission inventories, provides higher spatial resolution (from 0.25 degrees to 0.1 degrees), extends the time period from 2008-2010 in v1 to 2010-2017 and also includes open biomass burning and shipping emissions. MIXv2 is also being provided in different chemical specifications which will help modelers to map them more easily to chemical speciations of their choice.

There is no question about the need for improved, state-of-the art emission inventories to characterize changes over time and space and reduce uncertainties in simulating air quality and climate. TOAR studies heavily rely on both observations but also modeling studies and specifically for the latter accurate emission inventories and their trends in time and space are essential input. Having a consistent multi-year emission inventory will also provide a context for the analysis of ozone observations and trends. As such this paper and the provided emission data set make a significant contribution to TOAR, to atmospheric chemistry research in general but also to policy making. The inclusion of CO_2 emissions in addition to air pollutants will be a great benefit to studying the combined effects of air quality and climate change.

The paper presents a comprehensive description of the underlying emission inventories and the methods used to generate the final MIXv2. In addition, it provides a detailed analysis of the derived MIXv2 emission drivers and trends including analysis of individual sectors, as well as a

comparison to other inventories. The paper shows that Asian emissions are a large part of global anthropogenic emissions. Changes in emissions over 2010-2017 vary by region and sector and the analysis shows a general latitudinal shift in emissions but with different trends for different species. This will lead to significant changes in ozone production over Asia and further impacts the global tropospheric ozone budget. It will be important to have follow-up modeling studies exploring these impacts and placing them into relation to observed changes.

The paper includes a ton of information, potentially too much for the casual reader but no question important information for anyone using MIXv2. However, the authors might want to consider moving some of the Tables and Figures to the Supplement to make it easier to navigate through the paper.

Other comments that I hope the authors find helpful

Line 75: It might be helpful to be more specific what type of process-based model has been used

Section 2.2: Maybe state right upfront that seven regional and two global inventories have been combined

Line 163: I suggest to mention in the introduction already that anthropogenic sectors are reported on a monthly basis while open biomass emissions are available with daily resolution

Section 2.5: I understand what the authors try to say about inconsistencies at borders, but I would acknowledge that there is a general inconsistency between the different countries given that the regional inventories rely on different reporting and approaches.

Section 2.5: The authors provide brief discussions on the limitations and potential uncertainties of MIXv2 but I would add that one other limitation, specifically for air quality studies, is also the lack of a diurnal cycle as well as stack height information for point sources. I suggest adding this to the discussions as potential future development needs.

Line 404 ff: While listed in the caption for S1 I would also include in the text what inventories are used for global reference

Section 3.2: I would be cautious defining the emission changes in open biomass burning as "trend" given the large year-to-year variability in this sector.

Line 554: Maybe rephrase to: *Monthly variations of emissions, which are highly sector dependent, are estimated by MIXv2.*

Line 623-625: This sentence reads confusing.

Section 4: Please be specific if the comparisons include open biomass burning or not. E.g. I assume Figure 12 only looks at anthropogenic sectors?

Line 673: To provide **a** potential …

Line 682ff: I assume with MIX the authors mean MIXv2?