

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2022-657

Anonymous Referee #1

Referee comment on "Global sensitivities of reactive N and S gas and particle concentrations and deposition to precursor emissions reductions" by Yao Ge et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-657-RC1>, 2022

Fine particles (PM_{2.5}) and reactive N (N_r) and S (S_r) are important air quality mitigation targets due to their negative effects on human health, ecosystem diversity, and climate. This study uses the EMEP MSC-W model coupled with WRF meteorology for 2015 to explore the sensitivity of global and regional N_r, S_r, and PM_{2.5} to 20% and 40% reductions in anthropogenic emissions of NH₃, NO_x, and SO_x. They found the multiple co-benefits and small disbenefits of individual emissions on different species are highly geographically variable, which reveals the importance of prioritizing emissions strategies and order of precursor reduction. The subject matter is appropriate for Atmospheric Chemistry and Physics. The manuscript is also generally well-written, but I recommend a major revision before the paper is accepted for publication.

General comments:

The paper systematically describes an evaluation of PM and N/S concentrations and deposition sensitivity to precursor emissions, but overall, I feel a too weak connection with any empirical evidence:

- Although the paper is already very long, I suggest adding a brief section and 1-2 new figures that describe a "base" scenario that shows the simulated concentrations of related chemical species compared against available observations.
- Such a 20-40% emission reduction occurred in many parts of the world, for example, the United States/Canada, EMEP, and East Asia regions. There are also long-term air quality observations available in these regions. How are your sensitivity results compared with this observational evidence?

- Line 717. Is it possible that the significant seasonality in these few areas is related to the vegetation on the land surface?

- Line 737-738. Consider elaborating and expanding it by citing some related references.

- Line 778-779. This sentence seems a bit vague. Please check it.

12 . Line 789-790. There are several grammatical errors here. Please check and rewrite it.