Throughout the paper: The "x" in "NOx" is not a subscript. It should be. Please fix it.

Response: Modified in the revised manuscript.

L59-62: The myriad interactions between NO_x and ozone should be discussed upfront in the introduction, e.g., how under high-NO_x environments a reduction in NO_x may enhance ozone via reduced ozone titration by NO and reduced OH titration by NO_2 (indeed Reviewer #1 also asked about it). Such nonlinearity of NO_x-ozone relationships are discussed elsewhere in the paper, but should be brought upfront in the introduction to set the stage for the rest of the paper.

Response: Thanks for pointing this out. We added relevant discussions in the introduction part (L55-L63):

"The non-linear response of ozone formation to its precursors is well established (Kleinman et al., 1994; Sillman et al., 1990). In regions classified as NO_x-limited, reducing NO_x emissions is an effective strategy for ozone mitigation. However, in regions classified as VOC-limited, typically characterized by high NO_x emissions such as metropolitan areas, decreasing NO_x emissions may actually result in increased ozone concentrations due to reduced ozone titration by NO and suppression of OH by NO_2 (Seinfeld and Pandis, 2016). Under such circumstances, reducing VOC emissions will counteract ozone increases caused by reducing NO_x emissions."

Sect. 3.1.2: It is unnecessary to capitalize "Uncertainties" in the heading.

Response: Corrected in the revised manuscript.

L260: If the ratio is 15:15:15, isn't it just 1:1:1? Does the number 15 carry any significant physical meaning? They do not add up to 100 either, so this is not clear why such a peculiar numerical ratio is used.

Response: In NPK compound fertilizer, the numbers such "15:15:15" represent the ratio of the three primary nutrients present in the fertilizer: nitrogen (N), phosphorus (P), and potassium (K). Each number represents the percentage of the nutrient by weight in the fertilizer. In the case of 15:15:15 NPK fertilizer, it means that the fertilizer contains 15% nitrogen, 15% phosphorus, and 15% potassium. The remaining percentage typically consists of other secondary nutrients, micronutrients, and filler materials. We have retained this terminology in the revised manuscript, as it is a customary convention for nomenclature. To avoid confusion, we have added explanations in the revised manuscript (L268-L270).

Sect. 3.3 and 3.4: As Reviewer #1 pointed out, in some regions soil NOx reductions can cause ozone to increase due to reduced oxidant titration. The authors responded correctly in the response file, but did not extend the discussion and explanation in the revised manuscript.

Indeed, the authors are recommended to discuss in greater detail why NOx reductions do not cause ozone to increase in high-NOx regions, which is what most previous studies have found. The comparison with previous studies, e.g., Shen et al. (2023), should also involve more explanation why the authors' results differ significantly from what's suggested by previous studies, highlighting the similarities and differences.

Response: Thank you for the suggestion. We have added relevant discussions in the revised manuscript (L398-L406):

"With a 25% reduction in soil NO emissions, there was a widespread small decrease in monthly average MDA8 ozone concentration (ΔMDA8: -1.5±0.9 μg/m^3), except over NCP where ozone showed a slight increase (up to 1.3 μg/m^3) in Shandong and Henan province. These ozone increases reflect the nonlinearity of ozone chemistry and this nonlinearity becomes stronger in regions with large NO_x concentrations, especially where O_3 production is characterized as VOC-limited (such as NCP). When soil NO emissions were cut by 50%, the effect of reduced O_3 titration is overwhelmed by reduced O_3 formation due to less NO_x available, thus the ΔMDA8 showed a ubiquitous decrease across entire China with an average ΔMDA8 of -5.5 μg/m^3."

We also added the similarities and differences between our results and those of others in the revised manuscript (L482-L496):

"The findings of this study align with previous studies, emphasizing the important role of soil NO emissions in influencing surface ozone concentrations in China. Furthermore, spatial heterogeneities exist in terms of both the soil NO emissions and the responses of ozone to reductions in soil NO emissions. However, it should be noted that the spatial pattern of ozone response to reduced soil NO emissions in this study is different from Shen et al. (2023). For instance, with a 30% reduction in soil NO emissions, O_3 concentration increased by 3-5 ppb over Inner Mongolia, Heilongjiang, Xinjiang, and Tibet and decreased by 0-2 ppb over the Yangtze River basin in Shen et al. (2023). In this study, a 20% reduction in soil NO emissions was found to lead to widespread but small decrease (less than 4 μg/m^3) in ozone concentrations except the NCP (Fig. 6a). These inconsistences may stem from the differences in the estimated soil NO emissions, both associated with the magnitude and the spatial distribution, as also noted in other study (Zhu et al., 2023). Therefore, more observations, such as direct measurement of soil NO flux, especially over agricultural areas, are urgently needed to better constrain the estimated soil NO emissions."

Concluding section

Every article must have a final section where the overall advances are concisely summarised and put in context. Although the results section may include some discussion, a synthesis and interpretation must appear in the final section. ACP expects that the concluding section will normally include the following components, although not necessarily in separate paragraphs:

Summary: Summarise the main results and relate them to the objectives, questions or hypotheses of the study. The summary should include the main quantitative results.

Synthesis/interpretation: Explain and interpret the results concisely to enable readers to make sense of them as a whole.

Comparison and context: Compare the results with previous studies to put them in context. Explain consistencies, inconsistencies and advances in knowledge.

Caveats and limitations: State how these affect confidence in the overall results, and where future work is needed.

Implications: Discuss what the results mean for our understanding of the state and/or behaviour of the atmosphere and climate, which is the main requirement for publication in ACP. The editor's acceptance/rejection decision will be strongly guided by this component of the concluding section.

Response: Thanks for the guidance. Our revised conclusion part is as following (L497-L526):

"Soil NO emissions are non-negligible NO_x sources, particularly during summer. The importance of soil NO emissions to ground-level ozone in China is much less evaluated than combustion NO_x emissions. In this study, the total national soil NO emissions were estimated to be 1157.9 Gg N in 2018 based the BDSNP algorithm, with a spatial distribution closely following that of fertilizer application. High soil NO emissions were greatest over Henan, Shandong, and Hebei provinces, which differs significantly from where anthropogenic NO_x emissions are. Distinct diurnal and seasonal variations in soil NO emissions were found, mainly driven by the changes in soil temperature as well as the timing of fertilizer application. Uncertainty analysis of the estimated soil NO emissions reveals a range of 715.7~1902.6 Gg N that warrants further study and, preferably, constraint from observations.

Using two ozone source attribution methods (BFM and OSAT), we evaluated the contribution of soil NO emissions to ground-level ozone concentration for June 2018. Both methods suggest a substantial contribution of soil NO emissions to MDA8 ozone concentrations of 8~12.5 $\mu g/m^3$ on average for June 2018, with the OSAT results consistently higher than BFM. Soil NO emissions were shown to increase of ozone exceedances days (i.e., MDA8 above 160 $\mu g/m^3$) by 10.0%~43.5% depending on region. Reducing soil NO emissions could generally reduce the ground-level ozone concentrations and population exposure to unhealthy ozone levels, especially over NCP and YRD. For example, a 50% reduction in soil NO emissions decreased land area experiencing ozone above 160 $\mu g/m^3$ by 15.2% and the population exposed to this ozone concentration by 8.0%. However, even with complete removal of soil NO emissions, approximately 450.3 million people are still exposed to ozone above 160 $\mu g/m^3$.

The major findings of this study reinforce previous studies by highlighting the important contribution of soil NO emissions to surface ozone concentrations in China, although substantial uncertainties remain with soil NO emission estimates. Observational constraints on the magnitude of soil NO_x emissions in China are needed. Ozone response to reducing soil NO emissions varies by region due to the non-linear chemistry of ozone formation. Future ozone mitigation strategies should consider the potential benefit of reducing non-combustion NO_x emissions, such as soil NO, with due consideration to the sensitivity of ozone to reducing NO_x in the region."

Reference:

Kleinman, L., Lee, Y. N., Springston, S. R., Nunnermacker, L., Zhou, X., Brown, R., Hallock, K., Klotz, P., Leahy, D., and Lee, J. H.: Ozone formation at a rural site in the southeastern United States, Journal of Geophysical Research: Atmospheres, 99, 3469-3482, 1994.

Seinfeld, J. H. and Pandis, S. N.: Atmospheric chemistry and physics: from air pollution to climate change, John Wiley & Sons2016.

Shen, Y., Xiao, Z., Wang, Y., Xiao, W., Yao, L., and Zhou, C.: Impacts of agricultural soil NOx emissions on O3 over Mainland China, Journal of Geophysical Research: Atmospheres, e2022JD037986, 2023.

Sillman, S., Logan, J. A., and Wofsy, S. C.: The sensitivity of ozone to nitrogen oxides and hydrocarbons in regional ozone episodes, Journal of Geophysical Research: Atmospheres, 95, 1837-1851, 1990.

Zhu, Q., Place, B., Pfannerstill, E. Y., Tong, S., Zhang, H., Wang, J., Nussbaumer, C. M., Wooldridge, P., Schulze, B. C., and Arata, C.: Direct observations of NO x emissions over the San Joaquin Valley using airborne flux measurements during RECAP-CA 2021 field campaign, Atmospheric chemistry and physics, 23, 9669-9683, 2023.