RC2: 'Comment on egusphere-2023-2910', Anonymous Referee #1, 29 Mar 2024

The article titled "The effect of different Climate and Air Quality policies in China on in situ Ozone production in Beijing" by Beth S. Nelson et al. explores how different air quality (AQ) and carbon neutrality (CN) policies in China affect the production of ozone (O3) in Beijing. It delves into the complex relationship between emissions of volatile organic compounds (VOCs), nitrogen oxides (NOx), particulate matter, and the photochemical production of ozone.

In general, this article is well-motivated and written. The intention to evaluate the various emission change scenarios in air quality perspective is prudent. The change in emission is discussed fairly thoroughly in the discussion. However, the change in oxidation capacity and climatology are not factored in the analysis. For example, it is expected a smaller HONO production in the future particularly from heterogeneous reaction sources. In addition, higher temperature and extreme weather are expected due to climate change. I would recommend adding more quantitative discussion from these factors.

The authors would like to thank the reviewer for their feedback. We agree that although this study provides a valuable insight into how ozone production might be expected to change under changing VOC and NOx mixing ratios, there are many compounds not included due to the currently available projects in the DPEC inventory. This means that it is not possible to include HONO projections due to the uncertainty in how HONO levels are expected to change in the future. We also have not considered “extreme” cases, as this is also beyond the scope of this study. To ensure this is fully acknowledged, we have added additional text to section 3.5 (“Sensitivity of changes in concentration of specific AVOCs and ASA on in situ O_3 production”), and in the conclusion section of this study, which comments on the quantitative sensitivity of the model to changes in HONO.

Additional text added to Line 204:

“This study focuses on the impacts of emission changes on chemical processing, and it is likely that meteorology will also evolve due to a changing climate. However, here we assume that meteorological parameters remain at observed (APHH 2017) levels in all scenarios.”

Additional text added to Line 391:

“It is worth noting that projections in HONO mixing ratios are not included in the DPEC inventory at the time of this study. As a result, mixing ratios of HONO are kept constant under all model scenarios. How HONO might change under different future scenarios is highly uncertain. Although it is generally expected that HONO mixing ratios will correlate with changing NO_x, its formation is dependent on multiple factors including photolysis rates, heterogeneous chemistry on particulate matter and surfaces, and meteorological conditions (Sander and Peterson, 1984; Lee et al., 2016). However, a recent study found that reductions in NO_x during the COVID-19 lockdowns in the Chinese megacity of Zhengzhou did not lead to comparable reductions in HONO during the day (Wang et al., 2024). When HONO is increased by 5% in the model, we observe a 1.9% increase in O_3 production. This shows that O_3 production is highly sensitive to changes in HONO and emphasises the importance of improving our

understanding of how HONO might be expected to change under different socioeconomic, climate, and carbon neutrality goals."

Additional text added to Line 489:

"The focus of this study is the impacts of the changing VOC emissions scenarios on photochemical O_3 formation. However, there are several other important factors that will evolve in a changing climate that will likely affect the formation and concentrations of O_3, such as meteorology and extreme temperature and biomass burning events impacting urban areas such as Beijing. Heterogeneous sources of HONO, an important source of OH radical in urban environments (Lee et al., 2016) are also likely to change, impacting on urban oxidising capacity and hence O_3 formation. However, how these factors are likely to change are highly uncertain, and should be looked at further in future studies."