Dear authors,

Although the revisions greatly improved the manuscript, the referees have some final comments that I would like to ask you to address:

Response: Thank for editor's suggestions. We have responded the comments of referees. The detailed responses are as follows:

Comment 1: I find the authors' work on future total ozone is solid and professional. The methodology for bias correction using observational constraints and machine learning, validation with K^+ and other fire tracers, and future projections of total O_3 under different scenarios is rigorous and valuable. My fundamental concern lies with the estimation of future fire-sourced ozone, which is also the core focus of the manuscript. The authors' framework is as follows: (1) derive a more credible observationally constrained total O_3 field, and then (2) use the fire/total O_3 ratio (r) from GEOS-Chem simulations to apportion fire-sourced O_3. I fully agree with the general logic of "first constrain the total, then use model-derived fractional contributions to allocate sources," as this idea has precedents in air pollution source attribution studies.

Response: Thank for reviewer's approvement. We have confirmed the robustness of this methodology.

Comment 2: However, what I question is the assumption that the fire/total O_3 ratio (r) from GEOS-Chem can be treated as a stable parameter, not only for the historical period but also extrapolated decades into the future. This assumption is insufficiently supported. In their response, the authors cite McDuffie et al. (2021) as evidence. Yet McDuffie et al. only analyzed a single year (2017), deriving $PM_{2.5}$ fractional contributions and applying them within that same year. Their study did not attempt to apply the 2017 fractions to other years or future scenarios. Thus, McDuffie et al. only shows that the "observationally constrained total + model fractions" framework can work within a static year, but it does not justify carrying a historical ratio unchanged into future decades. If this method were to be extended into the future, the ratios should ideally come from simulations under the corresponding future year and scenario, not simply borrowed from a historical baseline. In reality, fire-sourced O_3 contributions are strongly dependent on wildfire occurrence and characteristics, which vary substantially year to year and will likely change even more under future climate conditions. It is therefore highly unlikely that the historical ratio would remain stable into mid- or late-century scenarios. The manuscript's key results—regional contrasts in fire-sourced O_3 concentrations, crop production losses, and the associated policy implications—are all derived from this ratio assumption. If the ratio is not robust, the entire chain of conclusions regarding heterogeneous future fire-sourced O_3 impacts could be systematically biased. To conclude, the reliability of the fire-sourced O_3 estimates remains uncertain, and the paper's central claims about future crop yield impacts therefore require stronger justification."

Response: Thank for reviewer's suggestions. The reviewer's suggestions are highly valuable, and the issue raised has always been a key consideration in our modeling process. It is possible that my initial response did not adequately elaborate on each step of our modeling approach, leading to some misunderstandings. In fact, we fully agree with the reviewer's suggestions, and our methodology aligns precisely with their recommendations.

It would be unscientific and problematic to assume a fixed ratio of fire-generated O_3 to total O_3 from historical periods and extrapolate it unchanged into future scenarios. Instead, we employed a machine learning approach to calibrate total O_3 concentrations under future scenarios. The proportion of fire-related O_3 within the total O_3 in these future scenarios was simulated using the

GEOS-Chem model. For instance, the ratio of fire-related O_3 and the total O_3 in SSP1-2.6 scenario was calculated based on the simulated fire-sourced O_3 concentrations divided by simulated O_3 concentrations (from all of the sources) in this scenario. For the four different climate scenarios considered, the contribution of wildfires varies significantly—a factor we thoroughly accounted for in our modeling.

However, directly validating future fire-sourced O_3 concentrations remains challenging. Instead, we performed indirect validation using historical data, such as with K^+ and levoglucosan tracers, which demonstrated strong performance. Given the strong spatiotemporal transferability of numerical models, we have confidence in the reliability of our future scenario simulations.

To avoid the confusion, "The ratios of fire-sourced O_3 concentrations and the total O_3 concentrations during historical and different climate scenarios were not invariable, which were estimated by GEOS-Chem based on different meteorological conditions and emission scenarios." has been added in the revised version (Line 162-164).