We are grateful to the reviewer for their suggestions on our manuscript. We feel the manuscript is significantly improved as a result of their suggestions. We also thank them for their support and kind comments on the nature of the manuscript.

The paper details the addition of nitrogen process into the DO3SE-Crop model. Nitrogen O3 interaction within a plant physiology is a very import element toward the definition of the yield of a crop and its quality. The paper is complete and there are no major comments or suggestions to be made a part for the 3 listed below. It is supported by a thorough and complete literature, which well places the current study in terms of scientific relevance and novelty. The content is presented in a clear and structure way and it is supported by necessary appendixes. This kind of modelling is complicated by definition, as it has to rely heavily on observation and parametrizations while aiming at a level of generality and applicability to a number of different cases. The authors have taken all necessary steps to make sure that they are in control of the parameter space and are able to identify rather precisely the relevant parameters that control the process. In light of the above, the paper may be published though I would like 3 points to be clarified.

1 - in the nice flow-chart representation of figure 1 the authors present the complete chain of causes and effects that relate O3 and N detailing what is in the model already, what is not and what has been added. If I concentrate on box 1, I see for example that the process of neutralization of ozone uptake into the leaves is not modelled so my question is how do you calculate the excess of ROS not neutralised which then affects all other boxes (2 and 3)? How do you go from "Ozone enters the leaf" to "Accelerated senesce" in box 2 and "Reduced carboxyl oxidation" in box 3 in the actual model? It looks as if the chain that defines the storage of N is well represented in the new module but for ozone we go from entrance in the leaf to carboxyl efficiency reduction. Is the rest parameterised?

This is a really valuable point raised by the reviewer. While the antioxidant processes are not explicitly modelled, we do simulate short term effects of O_3 on reducing carboxylation efficiency and subsequently photosynthesis. For the short-term damage the plant has the capacity to recover overnight from this damage, depending on leaf age. The older the leaf is, the less its recovery capacity. We also simulate a long-term effect of O_3 on accelerating senescence. These processes are given in detail in another paper of TOAR2 but are generally modelled by considering a modifying factor that varies between 0 and 1 depending on accumulated O_3, leaf age and cultivar specific parameters for the short-term, long-term and recovery factors. For example, O_3 tolerant and sensitive varieties will have different parameterisations. We appreciate that it is not presently clear from the diagram. We have added a few sentences to the section describing the diagram which provide an overview of the DO_3SE-Crop O_3 damage processes and refer the reader to the other study in TOAR2 which describes the DO_3SE-Crop model. (Lines 117-121 of the revised manuscript)

2- In the analysis of the Sensitivity results the authors mention:" . *In our sensitivity analysis we observed a difference in the magnitude of S1 (the uncertainty in the output variable that is attributed to varying only that parameter) and ST (the uncertainty in the output variable that is attributed to varying a chosen parameter in combination with the other selected parameters) (Saltelli et al., 2008) between the different O3 treatments. It is unclear why this effect occurred. It isn't possible to determine whether the magnitude of S1 and ST is anomalous for the low or medium O3 treatments, or whether a pattern exists at all in S1 or ST between O3 treatments since the present study considers data on one cultivar for one location only."* Can this discrepancy be attributed to a non-linear interaction between additional parameter added in

the analysis and the other one? This would explain an increased sensitivity and could be determined by analysing the level of co-relation existing between the parameters used for the sensitivity. May be worth exploring.

We agree with the reviewer that there is certainly a non-linear interaction of some form, which given the complex and inter-connecting nature of crop modelling is unsurprising. The difficulty comes with ascertaining whether the shape of the non-linear response of the sensitivity indices to O_3 is typical. In the present study we parameterised the model for one growing location and one cultivar so we cannot conclude whether the response is typical. If future work reveals that this is a common response for several locations and wheat growing varieties then it would be interesting to investigate the crop modelling processes underlying this to explain the response. However, we feel this is beyond the scope of this particular study. We have modified the sentences describing the effect to more clearly explain this point. We also believe that the original text implies an expectation of a linear response and that the newly modified text will more clearly explain the nuance of the response between O_3 treatments (lines 587-591 of the revised manuscript).

3- This manuscript will be published as contribution to the TOAR Special Issue. However, I do not see a single reference to the project in the paper, which seems a bit odd in my humble opinion. Clearly, it could be published as a standalone publication, though if the authors have chosen the TOAR SI they must have a reason and the readers should informed about it. Otherwise it looks like a "hopping on a freight train" (apologies for the analogy no offense intended) when you would have plenty of credit to afford a ticket for the first class wagon. I am sure there is a plausible explanation and a paragraph that links this beautiful work to TOAR should be added.

We appreciate the reviewer's comments regarding the inclusion of the paper in TOAR2. We now begin the introduction (Lines 29-37) with reference to the previous phase of TOAR and the goals of the second phase. We reference TOAR2's goal of investigating the impacts of tropospheric ozone on human health and vegetation, which this paper addresses by its development of new methodologies to consider the interaction between O_3 and N processes in wheat, which will subsequently impact crop quality and human health. We hope this addition makes the link between the TOAR2 project and the present work clearer.