Response to the reviewer 1

We are grateful to the referees for their time and energy in providing helpful comments and guidance that have improved the manuscript. In this document, we describe how we have addressed the reviewer's comments. Referee comments are shown in black and author responses are shown in blue text.

Review summary:

Lei et al., present a new model that combines a dynamic vegetation model that includes biogeochemistry (YIBs) with a widely used chemical transport model (GEOS-Chem). They run the model offline and with 5 different online conditions. They use model results to validate the model against measurements (particularly gross primary productivity and leaf area index). They explore the effects of building the online model on ozone mixing ratios, ozone deposition, and ozone damaging effects on terrestrial activity (such as gross primary productivity). In general, the global average change in ozone mixing ratios is quite small. However, they do find some notable differences in ozone deposition rates between GC and GC-YIBs, and they find the online model does improve ozone deposition rates when compared to the limited observations that are available. Finally, the utility of the model is demonstrated by their results on the effects of ozone on terrestrial productivity. Using the online model, they find gross primary productivity can decrease up to 15% in certain areas due to the damaging effects of ozone pollution. This study provides a valuable tool for investigating links between the terrestrial biosphere and atmospheric chemistry, which is a critical (and under-studied) research area for predicting the effects of climate change. The authors could improve the manuscript in a couple areas to better communicate their reasoning and clarify concepts to the reader. I recommend the paper for publication after addressing the minor comments summarized below, which should help them accomplish this.

➔ Thank you for your positive evaluations. All the questions and concerns have been

carefully answered and the paper has been revised accordingly.

Specific comments:

Section 3.2, particularly lines 305-308. The authors state that the difference in ozone mixing ratios between the Online_All and Online_LAI suggests that "changes in stomatal conductance play the dominant role in regulating surface [O_3]." I am not following this logic and I think they need to better clarify how they are making this connection. The description of the model runs just says Online_All has daily dynamically predicted LAI and hourly predicted stomatal conductance while the Online_LAI has daily dynamically predicted LAI and the original dry deposition scheme. It is not obvious to me how comparing the output of these two model simulations leads to the conclusion they have provided, and this could be better explained.

Response: The configurations of Online_ALL and Online_LAI simulations are the same except for stomatal conductance. Online_ALL simulation uses hourly stomatal conductance simulated by YIBs, which dynamically responds to environmental factors (e.g., temperature, water stress, radiation, CO_2 and so on). However, Online_LAI simulation uses prescribed stomatal conductance, though it uses online-predicted LAI the same as Online_ALL. As a result, the difference between Online_ALL and Online_LAI represents the effects of updated stomatal conductance on surface [O_3]. In revised paper, we changed "the original dry deposition scheme" to "prescribed stomatal conductance" to clarify. (Line 298)

Discussion of Figure 6 and 7: it is unclear what value is added by including figure 6. The figure shows the different land types in the original GC dry deposition scheme where different land types are prescribed fixed parameters for stomatal conductance. The online model is different because it calculates stomatal conductance based on photo-synthesis and environmental forcings (L. 332-333). Then they show that dry deposition comparisons between the original and online model vary by biome type in Figure 7. This would be expected simply knowing the original model uses prescribed

parameters based on land type while the online model calculates stomatal conductance! The map shown in Figure 6 does not provide any additional useful information. It might be more helpful to describe in more detail how the fixed parameters in the original GC model were developed. That would be more useful than the map of different land types.

Response: The main purpose of Fig. 6 is to show the location and deposition land type of sites (black points) used for evaluations of dry deposition. We have moved Fig.6 into SI as suggested (now Fig. S2).

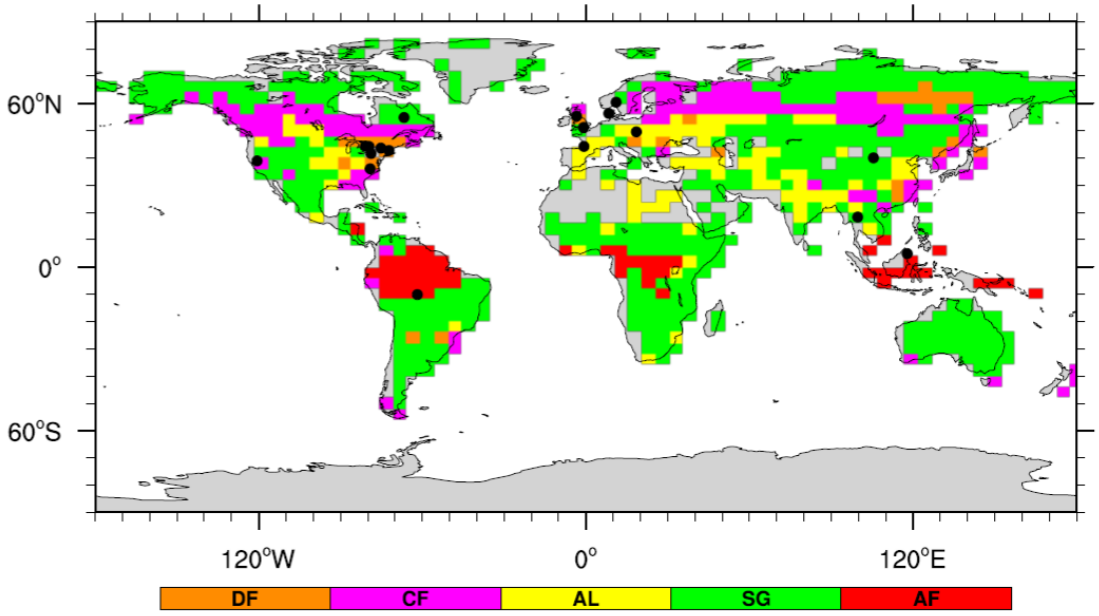

Figure S2 The major dry deposition land type at each grid cell converted from YIBs land types. DF, CF, AL, SG and AF represent deciduous forest, coniferous forest, agricultural land, shrub/grassland and amazon forest, respectively. Black dots indicate the locations of measurement sites used in evaluation (Table 2).

Figure 7: it is unclear which online GC-YIBs conditions were used to generate this figure. Five different online conditions were described in the methods and it should be clarified for each figure which model results are being included. In general, the authors do a good job making this clear, but Fig 7 stands out as an example where they did not specify this.

Response: Results of online GC-YIBs shown in Figure 7 (now Figure 6) are from simulation Online_ALL. In the revised paper, we clarified in the figure caption as follows: "Figure 6 Comparisons of annual O_3 dry deposition velocity between online GC-YIBs (Online_ALL simulation) and GC (Offline simulation) models for different land types …"

Technical corrections:

Page 13, L. 284: missing a period at the end of the last sentence

Response: Corrected as suggested.

Page 14, L. 290: "[: : :] model overestimates annual [O_3] in southern China while predicts lower values in western Europe [: : :]". "while predicts" is not the correct grammar.

Response: We revised the sentence as follows: "Although offline GC-YIBs model overestimates annual [O3] in southern China and predicts lower values in western Europe and western U.S." (Lines 346-347)

Page 14, L. 300: "GC-YIBs predicts larger [O_3] of 0.5-2 ppbv". I think the authors mean the GC-YIBs predicts HIGHER [O_3] BY 0.5-2 ppbv.

Response: Corrected as suggested.