Author response to comments from referee #3

September 30, 2022

Comments and replies

I've been asked to review the revised version of the manuscript for the first time. The aim of this paper is to describe a simple model linking CO2 emissions to ocean acidification and sea level rise; numerous updates have been suggested already in the first round of review.

I'm not an expert on ice sheet modeling, but I think the first 2 reviewers addressed that part already and the authors followed all of the suggestions and improved the manuscript compared to the fist iteration.

In general, I think that such a fast, simple model would be a pretty interesting addition to the literature. However, the results that the authors obtain for SRM have been already discussed in the literature before: for instance (Zarnetske et al. 2021) talk about the fact that ocean acidification wouldn't be reduced, and while the land carbon sink might be increased (see for instance Cao and Jiang, 2017), that's really not by much. It would be good for the authors to acknowledge the work done in this area and say that their results confirm (or not if they don't) previous findings.

Thank you for the positive comments and suggestions. We have taken them into account in the following way. Regarding the SRM results, we have explained how SRM in SURFER only affects the temperature by construction, i.e., there are no feedbacks into the carbon cycle (ll. 540 - 544). We have also expanded the discussion on SRM (ll. 607 - 625), citing both of the suggested references and including a discussion on how feedbacks into the carbon cycle could be added to a future release of the model.

A few general comments

- The paper also deals with SRM but the title does not suggest that: "emissions" is a pretty vague term to include both anthropogenic CO2 emissions and SRM. I suggest to change it to something that actually explains it's about both.

We see your point and we have changed the title to: "SURFER v2.0: A flexible and simple model linking anthropogenic CO2 emissions and solar radiation modification to ocean acidification and sea level rise".

- By the way, the term that is now more widely used for SRM is Solar Radiation Modification and not Management (see NASEM report in 2021) or Sunlight Reflection Methods.

  Thank you for pointing this out. We have changed the term to Solar Radiation Modification throughout the manuscript.

Introduction

- I would suggest at least explaining what SRM is in the introduction - it might not be so widely known as the authors think and a reader can't be expected to go look at the references provided.

  We added an explanation of solar radiation modification in the introduction (ll. 13 - 17).

- L 12: because of the long

  We have fixed this typo. Thanks.

- L 14: not sure "value" is the right word here: assessing the efficacy is perhaps a better term

  By assessing the value we actually mean to assign a value judgement in which efficacy might not be the sole criterion. To clarify we have changed the expression to "assign a value judgement".

Section 2

- L 79: SO2 is a gas, so "SO2 aerosol injections" is not really a meaningful definition.

  Indeed. We have modified this to "SO_2 injections" here and throughout the manuscript.

- L 412: I would remove the square brackets [] for the estimates of ECS and TCR.

  We have removed the square brackets.

Section 3

- L 480: " We have considered that the Solar Radiation Management sulphur injections remain zero during the whole simulation period." unclear of why it is relevant here. The RCPs and SSPs do not have SRM, and the G6 experiment is another thing and discussed in another section. This phrase is repeated multiple times in the following paragraphs and it really doesn't need to: maybe say at the

beginning of Section 3 when you'll be considering SRM instead of all the scenarios where you're not.

Thank you for the suggestion. In the beginning of Sec. 3 we have added an overview of the different examples presented and clarified there that only the example of Sec. 3.5 considers SRM (ll. 466 - 470).

- Figure 9 (and following figures): it is customary to name the panels in alphabetical order to make it easy on the reader; the legend hides one of the panel's results.

  We have reduced the legend fontsize so that it does not hide the results in one of the plots in Figs. 9 and 10. For the panels we have included the different plots as subfigures each with its own subcaption.

- Fig. 18: The comparison between SURFER results and G6 is interesting, but it could be done in just one plot. If the authors want to contact me (being the author of the 2021 paper cited, dv224@cornell.edu) I'll gladly give them the SO2 values to combine the two figures in one.

  Thank you for sharing the data with us. We have combined the two plots into a single one, see Fig. 18, and we have thanked you in the acknowledgements.