Comment on egusphere-2022-1
Anonymous Referee #2

Tye et al. analyse climate model projections under a high-emissions scenario (RCP8.5) and a scenario in which the warming and some aspects of it (gradients) are counterbalanced by stratospheric aerosol injection (GLENS). A novelty of their approach is that they have a single-model large ensemble (20 members). The analysis focuses on extreme climate indices in an early and a late 21-year period.

The study is written in excellent English language and Figures are in very good shape.

The paper does not include much novelty or surprising results. Temperature and precipitation indices approximately behave as expected and as documented in earlier studies. The authors do not exploit much the fact that they dispose of a large ensemble. Basically only the average effects are investigated, not the possible variation between individual weather trajectories. An aspect that is not treated in many other studies is the investigation of vegetation. However, for unclear reason, the authors do not disentangle the role of CO2 (RCP8.5) and of SAI (GLENS minus RCP8.5). This is in contrast to the analysis of temperature and precipitation and would seem to me very useful for vegetation, too.

However, since the study is thoroughly conducted, has a synopsis of the various effect,
and also shows quantitative effects (particularly usefully readable in Fig. 5 and 9), it might still be useful to publish the paper. Certainly, it would be beneficial if the authors could demonstrate from observations for the BASE period that the model compares well to observations; so far it is a pure simulation study.

In conclusion, I propose that the authors consider

- showing some evaluation of the BASE period with observational data in terms of extreme indices

- adding the RCP8.5 to the vegetation response analysis,

- as well as a number of specific comments below.

l69 could specifically note the difference in energetic influences of greenhouse gases and aerosols (e.g. Salzmann, Sci. Advances 2016)

l175/176 The values that are not discussed can be omitted from the Table.

l181 is that IPCC AR6? Should be clarified

l230 the label “Feedback” is inconsistent.

l230 It is necessary that some logic is brought to the order of the regions, e.g. clarifying by colour the continents and perhaps a north-south gradient. There is very little discussion of these results in the text.

l236 There is circular reasoning in the sentence. What is the true cause for the impacts?
"consistent" in magnitude or pattern? or just in sign?

Here as well: what is the real unit? days per year? or days per 21-year-period (see below)

Magnitude and in some extended regions, sign

check units?

Where does this discussion of aerosol come from? Do the authors mean, aerosol sedimenting from the stratosphere after injection? Much more discussion on such an effect would be needed.

Fig. 4. The label says “Frequency”, Table 1 says “days” as unit. What is true? Is it days per 21-year-period? Or days per year?

Is this a result at all? I thought to understand that should be true by construction of GLENS?

But is this not the entire meaning of a large ensemble, to be independent of the specific initial conditions for each run?

Explain shading around curves

Eleven years are not exactly half of 21 years.

It would be useful to show this induced east-west SST gradient and discuss its reasons here, since this is fundamental for the subsequent discussion.

Is this also quantitatively the case, i.e. 7 % per K?
Check units

Is this just a qualitative statement (then referring to Clausius-Clapeyron seems useless) or does it hold quantitatively?

Why is the reference (RCP8.5) not shown here? (and not in Fig. 11 either?)

The authors could check in a straightforward manner whether the contraction is also found in their model.