Reviewer #1

The authors utilize the HadGEM3-GC3.1 climate model to examine the impacts of reduced SO_2 emissions from shipping. They estimate the resulting aerosol effective radiative forcing to be 0.13 W/m^2. Additionally, their global coupled simulations for the period 2020-2049 predict a global mean warming of 0.04 K, averaged across this timeframe. The revised manuscript shows significant improvement and addresses the comments I raised in my previous review. I recommend acceptance of the paper after minor revisions.

1. Why does sulfate reduction lead to warming in the tropical eastern Indian Ocean, yet cooling in the central to eastern Pacific? How might this scenario change if sulfate reduction were not implemented? What specific role does SO_2 from shipping play in this process? Moreover, do emissions from dimethyl sulfide (DMS) and sea salt also contribute to these effects?

Sulfate reduction causes reduction in negative aerosol ERF due to aerosol-radiation interaction and aerosol-cloud interactions, causing warming. Warming near the surface of eastern Indian Ocean and western Pacific enhances the upward motion in these regions and easterly anomaly in the trade wind in the central Pacific as shown in Figure S5. This resembles the La Nina and leads to westward anomaly of surface current and enhanced upwelling of sea water to cool SST in this region where the impact of reduced aerosol is small (as inferred by Figure 1 and 3). Figure S6 is added to show the westward anomaly of surface current in the tropical Pacific. This is our interpretation and it is briefly outlined in section 3, although this is not the central point of this study.

We are evaluating the change due to the reduction of shipping sulfur emissions by comparing two ensembles under SHIP20 and SHIP100 scenarios. If sulfate reduction is not implemented, there will be no difference in any variable because we are comparing identical scenarios.

SO2 from shipping is quickly oxidised to form sulfate particles, which exert negative radiative forcing mainly through the aerosol-cloud interactions. It is this radiative forcing that caused the changes described above.

The emissions of DMS and sea salt are calculated interactively in the model based on surface windspeed. However, we do not expect significant differences in their emissions caused by shipping sulfate reduction. Therefore, their effects are largely cancelled out in the differences between ensembles, resulting in minimal net effect and a small contribution to the uncertainty due to the random variability.

2. The study primarily discusses the changes in shortwave and longwave radiative forcing to explain the observed temperature changes. However, sensible heat and latent heat fluxes are also important components that could influence temperature variations. Including these metrics would provide a more complete explanation of the underlying mechanisms driving temperature change.

The focus of this paper is radiative effects of reduced aerosols due to shipping fuel change and their impacts on temperature. There is a well-established physical relationship between radiative energy imbalances and global mean temperature without the need to explore sensible and latent heat fluxes. An analysis of sensible and latent heat would require a full exploration of all the relevant regional energy terms as in Richardson et al. (2018) in the PDRMIP study (https://journals.ametsoc.org/view/journals/clim/31/23/jcli-d-17-0240.1.xml), including the additional terms that they included. This is vastly beyond the scope of our study, which aims only to explore the temperature responses.

3. Line 162: There appears to be an issue with Figure S5, as it only contains one plot. Please check and correct this figure.

We appreciate that the reviewer pointed out that this part of texts refers to wrong figures. Instead of correcting the text we changed the order of figures in supplementary materials because it is the order in which they are referred to in the main text. The old Figure S3 is now Figure S5 that is referred to here. The text three lines above referring to Figures S3 and S4 were also previously wrong but now they refer to the correct figures.

4. Lines 165-167: In Figure 2, why does increased precipitation correspond with higher sulfate loading? This relationship requires further clarification.

We thank the reviewer to find an error in the text here as well. This text should state that reduced rainfall (shown in figure 5) caused the increase in aerosol loading (as shown in figure 2) due to reduced wet deposition. The text has been corrected.

Reviewer #2

accepted as is