Response to Referee #1:

We first thank the valuable comments of the reviewer. We have taken reviewer's comments into consideration and revised the manuscript accordingly. All the changes have been highlighted in the revised manuscript. Our detailed responses are as follows.

This paper elaborates the role of fast-response and slow-response in shaping the total equilibrium response of the East Asian summer monsoon (EASM) to SO_4 and BC using the Community Earth System Model. This paper states the importance of ocean response to aerosol forcing in driving the changes of the EASM. I recommend for its publication after revision.

Comments: (1) Lack of clarity at a few places in the manuscript. For example: In section 2.2 add details of how an ensemble of five perturbed simulations is obtained. Explain why the averaging time of SO_4 (60 yrs) is less than BC (300 yrs).

Response: The ensemble of five perturbed simulations for BC was performed by altering the atmospheric initial conditions by an air temperature difference at round-off level (order of 10^{-14} ºC). To enhance the signal-to-noise ratio of the response, the 300 years in the BC perturbed simulations (60 years × 5 members) was conducted because of weaker BC forcing than SO_4. We have added these statements. Please see line 8 – 9 in page 4 in the revised manuscript.

Section 3

Line 1: Do you mean changes in optical depth induced by SO_4 or BC?

Response: Yes, it is. We have corrected it. Please see line 3 in page 5 in the revised manuscript.

Lines 4-5: "The aerosol optical depth increases significantly over most of the globe except for some oceans due to the increase in anthropogenic aerosol loading". Mention the region of the oceans.

Response: Done. Please see line 5 – 9 in page 5 in the revised manuscript.

Lines 22-23: Comparison with previous studies if any.

Response: Done. Please see line 28 – 31 in page 5 in the revised manuscript.

Figure 3: It is interesting to show opposite response due to SO_4 and BC aerosols on SSTs. This discussion should be elaborated.

Response: Accepted. We have elaborated the opposite SST responses due to SO_4 and BC. Please see line 25 – 28 in page 5 in the revised manuscript.

It will also be interesting to know the simulated annual mean SST changes caused by SO_4 and BC for the northern and southern hemisphere separately.

Response: Accepted. We have added the SST changes caused by SO_4 and BC for both hemispheres separately. Please see the line 31 in page 5 – line 1 in page 6

and Table 2 in the revised manuscript.

Anomalies in wind should be plotted in Figure 5a-c. It will provide information on circulation changes.

Response: Accepted. We have added the figures of anomalous winds induced by SO_4 and BC in the supplement material. Please see the Figures S2 and S4.

I suggest plotting tropopause anomalies in Figures 5d-f. Drop in geopotential height and tropopause has linkages with suppression on monsoon convection and weakening of the EASM.

Response: Accepted. We have added the figures of tropopause height anomalies induced by SO_4 and BC and the corresponding discussions. Please see the Figure 7, line 17 – 21 in page 7, line 31 in page 8 – line 2 in page 9, and line 15 – 16 in page 9 in the revised manuscript.

I also suggest plotting monsoon Hadley circulations in Figure 7 and 11 along with precipitation. Discussions on subsidence/ascending motion will be helpful.

Response: Accepted. We have added the figures of changes in meridional circulations and stream functions induced by SO_4 and BC in the supplement material and the corresponding discussions. Please see the Figure S2 – S5, line 32 – 33 in page 7, and line 25 – 29 in page 9 in the revised manuscript.

Add confidence level (95% or 99%) in figures 7 and 11 as hitch lines to show the results are significant.

Response: This has been added. Please see the revised figures.

I think that Figures 7 and 11, both indicate that for BC and SO_4 (both) precipitation pattern for the total-response is a sum of the fast-response and the slow-response. If the magnitude of the fast-response is higher than the slow-response, then it dominates. Please verify by quantitative analysis and results should be modified accordingly.

Response: Accepted. We have modified the statements about which response dominates over the total response of precipitation to BC and SO_4 in different regions. Please see the line 2 – 8 in page 8 and line 25 – 31 in page 9 in the revised manuscript.

Table-2 suggests that BC induces a weak increase in precipitation due to slow response and decrease due to fast response. While SO_4 induces a decrease in precipitation due to both slow and fast response. Figure 7 and 11 suggest that total response induced by SO_4 weakens the EASM but total response by BC aerosols is "wetter-south-dryer-north". Do this wetter-south-dryer-north points to weak increase or decrease in overall precipitation? Does this study conclude that SO_4 and BC both cause a decrease in overall precipitation?

Response: Table 2 was aimed at the regional mean changes over East Asia. It could be misleading by using large areal average. Thus, we improved the

statements in this Table. Please see the Table 3 in the revised manuscript.