Responses to Reviewer#1

1. The manuscript reads well and is convincing until section 4.2. In this section looks into the spectral characteristics of the correlation between the EASM and precipitation in the model simulations. It claims that there exist a 60-year quasi periodicity is almost all PMIP3 simulations and the CESM ensemble. I have two main concerns. One is that the spectra of the running correlations in the CESM ensemble do not really look similar in the different ensemble members. This ensemble has been conducted with the same forcing and with the same model, so that the spectra - if they represent a real signal- should look, in my opinion, much more similar. For instance, the simulation in left column middle row shows a spectrum that is very different from the simulation in the right column middle row. This means that either the statistical significance of the spectral peaks is not really well estimated: the peak at about 130 years that appears in this latter simulation as significant does not appear in any other ensemble member. This may be due to the construction of the time series. The running correlation are calculated with a 31-year filtered applied to the EASM and precipitation time series. I suspect that this filtering may introduce spurious peaks in the spectrum, although it is difficult ascertain before hand. I suggest to calculate the spectrum of a time series resulting from calculating the running correlation of random time series and see in how many cases spurious spectral peaks arise. I found a bit suspicious that the spectral peaks that the authors claim are twice and four times the period of the running window width.

Thank you very much for the insightful comments.
1. We acknowledge that there are some differences among the spectra derived from CESM ensemble members. On one hand, we focus on the spectra of RPC/PC, which depends not only on variations of the winds and precipitation but also on their relationship. This makes the spectra more complicated than a simple index, such as a precipitation index. On the other hand, the key factor affecting the fluctuation of the PRC/RC may be different among the CESM simulations. As you mentioned, the correlation shown in Fig. 11 is relatively low, though it is statistically significant. This result suggests that other factors except for the AMO may also contribute to the RC fluctuation, but they are not robust signs among the ensemble members. In other words, although the model employs the same external forcings, the temporal evolution of internal variability of climate system (e.g., PDO) is not the same due to different initial conditions. As listed in Table S1 and S2, the SST over North Pacific is more sensitive to the initial conditions than that over the North Atlantic in the CESM-LME simulations, resulting in the complex phase combinations of the AMO and PDO (Fig. S7). Therefore, the combination of different phase of internal variabilities may enhance or damp the relationship between the winds and precipitation, hence leading to the complexity of the spectra. In the revised manuscript, we add some discussions on this point (Page 8, Line 1-8).
2. Following your suggestions, we verified the significance of the spectrum with a Monte Carlo simulation (Page 4, Line 9-14). Specifically, we generated two random arrays with the same length of the original data, and then calculate the spectrum of their 31-year running correlation. We repeat previous steps 10,000 times and get 10,000 spectra, the fifth (tenth) percentile at each timescale is set as threshold for $\alpha = 0.05$ ($\alpha = 0.1$). As shown in Fig. 10, the running correlation between the original data could induce some spurious spectral peaks on short timescales (i.e., 22-year) but not on a longer timescale. Thus, in some ensemble members, the spectral that peaks around twice and four times of the running window width is unrelated to the application of running correlation.

2. The explanation of the involvement of the North Atlantic SSTs on the link between EASM and precipitation is actually very weak. It is based on a statistical result without any physical explanation. This s a reflection of another weakness in the study. The authors clearly show that there are multi-decadal periods where the link EASM-precipitation breaks down. This must have a local and immediate reason, for instance that in those periods other local patterns of variability vary more strongly, or that the sources of moisture in the Western Pacific become colder or other similar reason. But if there is a long-distance effect of the North Atlantic SSTs, this has to be mediated by a regional mechanism, add this is not explored at all in the study. In addition, the correlations displayed in Figure 11 are really low. This figure also shows the area where at least 7 of the nine ensemble members show the same sign of the correlation. However, this result may not be that significant as it seems at first sight. On average 4 or 5 simulations will show the same sign, so that 7 can be not that unusual when considering that this test is applied to all grid cells of the simulation at the same time (this is the simultaneous multiple test problem or field significance). In other words, the chances that one single region in the world passes the 7-over-nine-same-sign test are probably not that low.

1. We add some discussions on the possible mechanisms about how the AMO affected the EASM-precipitation relationship (Page 7, Line 23-31).

The formation of precipitation is not only affected by the moisture but also related to the local thermal condition. When the temperature gets lower, the moist air gets easier to saturate if the moisture is constant. Previous studies have shown that the AMO could influence the temperature over East Asia positively (Lu et al., 2006; Wang et al., 2013). During the cold (warm) phase of the SST anomalies over North Atlantic, the temperature over East Asia tends to be colder (warmer) (Fig. S6). As the EASM strengthens, the moisture transported to monsoon region increases, which is propitious to improve precipitation. Meanwhile, the lower (higher)-than-normal temperature condition over East Asia is helpful (unhelpful) to the saturation of the air and thus promote (hamper) the formation of precipitation, which results in a more (less) robust positive EASM-precipitation relationship.

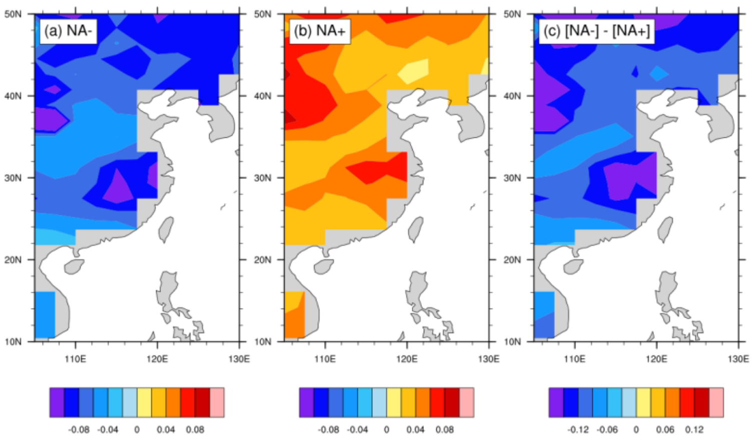

Figure S6. The summer surface temperature anomalies during the (a) negative phase (NA-) and (b) positive phase (NA+) of SSTA over the North Atlantic (30°−70°N, 80°W−0°). (c) The difference in summer surface temperature between the NA- and NA+. The NA+ (NA-) is selected for the time periods that the summer SSTA over North Atlantic exceed its 1.2 (-1.2) standard deviation. Units: °C.

2. We applied the Monte Carlo simulations to demonstrate that the SST variation over the North Atlantic is a significant factor connecting with the EASM-precipitation relationship (Fig. xx?). Although PDO is another potential factor regulating the EASM-precipitation relationship, its temporal evolution is very sensitive to the initial conditions among the CESM-LME (Table S2), that is, the phase of PDO varies with individual ensembles in the same time interval. This may be responsible for the low variance explained by the AMO shown in Fig. 11.

3. Figure R1 shows that most anomalous SSTs around the world only passed the 4- or 5-over-9-same-sign-test, except over the North Atlantic region, where can passed the 7-over-9-same-sign-test. The result of 7-over-9-same-sign-test is similar to that of the Monte Carlo simulation test (Fig. 11), proving the rationality of the 7-over-9-same-sign-test.

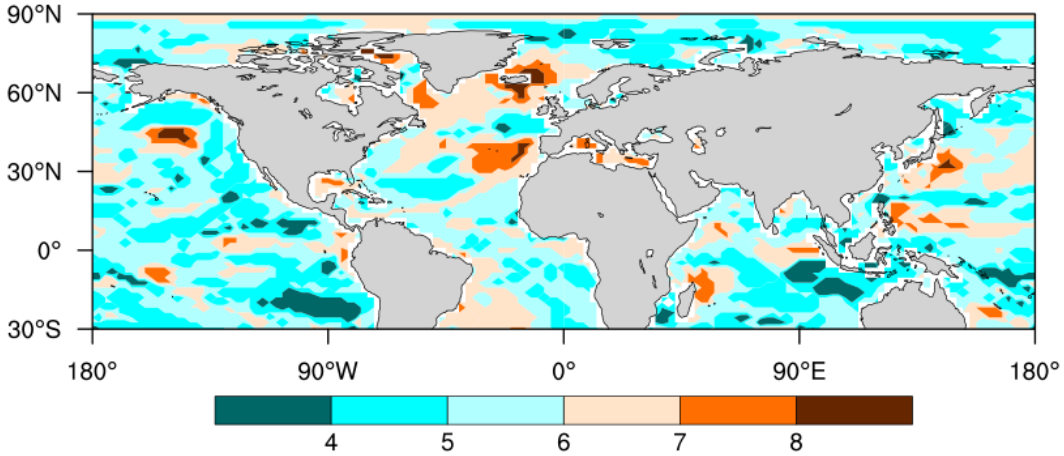

Figure R1. Numbers of ensemble members in CESM-LME full-forcing experiments that agree with the MEM result in the connection between the AMO and EASM-precipitation relationship (shown in Fig. 11).

References

Wang, J., Yang, B., Ljungqvist, F. C., Zhao, Y.: The relationship between the Atlantic Multidecadal Oscillation and temperature variability in China during the last millennium, J. Quaternary Sci., 28, 653-658, 2013.

Lu, R., Dong, B., and Ding, H.: Impact of the Atlantic Multidecadal Oscillation on the Asian summer monsoon, Geophys. Res. Lett., 33, 2006.

3. Page 2, line 5: 'aforementioned EASM-precipitation relationship is possibly changeable over recent decades (e.g., Shi and Zhu, 1998; Li et'

Perhaps, changeable -> not stable

Corrected.

4. Peng et al. (2014) also implied that several severe droughts that occurred over eastern China were.

Peng et al is not in the reference list

We add the reference of Peng et al. (2014). (Page 11, Line 23-24)

5. page 3, line 21:'ESM because of its climate drift in long-term simulations (Gupta et al., 2013).

These simulations have a rough time span’
rough time scape -> approximately cover a span
Corrected.

6. Page4, line2: Specifically, we calculate the geological distributions of the correlation between the EASM strength and summer precipitation
geological -> spatial
Corrected.

7. Page 4, line 11:’ CGCM3) to 0.79 (GISS-E2-R), all passing the 95% significance test. The centered root-mean-square errors range from 0.99 (MRI-CGCM3) to 1.55 (HadCM3),
are over the 95% significance level.
units for RMSE are missing - I guess they are m/sec
The RMSE has been normalized by the standard deviation of the observation, thus it is a dimensionless quantity.