Response to Reviewer 1

This manuscript investigates the interannual variations of the observed precipitation extremes over the western Japan during June and July with the three datasets, i.e., the Radar-AMeDAS during 2006–2022, the 54 rain gauge data during 1952–2022, and the 5km mesh 10-member RCM simulations covering the 59-year period 1952–2010. Differences in the data periods result in an interpretation of the results being difficult and ambiguous. Since the correlation coefficients are discussed and not climate values, data from the same time period should be used.

We thank the reviewer for their useful suggestions. Following the reviewer's recommendation, the same 1952–2010 period is now used for rain-gauges, d4PDF, and principle component analysis of SST. The methodology has been simplified; rain-gauges are clustered, and d4PDF grid-points located at rain-gauges are compared to the rain-gauge clusters. With respect to monsoon indices calculated from JRA55 and d4PDF, the same period of 1958–2010 is used, because JRA55 starts from 1958.

Furthermore, the short 17-year time period of the Radar-AMeDAS DATA is questionable in discussing clustering calculations and inter-annual variations. There is no rationale for comparing Radar-AMeDAS and RCM simulations because the model is forced with the observed SSTs, and therefore should be compared to data between the same periods. However, in this case, the common period is only 5 years, 2006-2010. Therefore, clustering and subsequent analysis should be performed on the rain-gauge data for the period 1952-2010, the same period as the d4PDF. I recommend to re-submit the manuscript. One choice would limit the analysis to an evaluation of model performance by comparing long-term rain-gauge and d4PDF simulations.

Following the reviewer recommendation, Radar-AMeDAS is no longer used, and the analysis is now performed only on long-term rain-gauges and d4PDF. Almost all of the results in the revised manuscript has been re-computed with revised methodology, then re-written.

Response to Reviewer 2

This paper investigates relationships between precipitation extremes over western Japan and major SST modes over the Pacific based on observational data, and it tries to explain the relationships through the modulation of monsoon activity. Then, the paper verifies the representation of the obtained relationships in d4PDF data. I found it difficult to evaluate this paper due to several issues listed below during the review. Therefore, I would like to reassess the significance of this paper after the authors have addressed these issues.

We thank the reviewer for his careful reading of the manuscript and his useful suggestions. Almost all the results in the manuscript has been re-computed with revised methodology, then re-written.

First, this paper seems to have incorrect notations in the figure numbers and similar references listed below. Authors should carefully proofread the manuscript before submitting it.

We apologise for the many incorrect notations and references. These errors came about due to past revisions of the manuscript. Following the reviewers major comment #4, most of the supplementary material listed below have been removed. The necessary information is now summarised in the main text.

- Lines 350: Supp. Figs S3-3a -> Supp. Figs S1-3a ?

This material has been removed, since the comparison between COBE-SST and COBE-SST2 is not necessary. The summary of the comparison is now stated in Lines 161–162 of the main text, to describe the robustness of the SST modes. However, a comparison of scores from Principle Component Analysis (PCA) of COBE-SST2 using different time periods has been added to Fig. 1, and described in Lines 312–323.

- Lines 351-355: Similar mistakes as above.

This material has been removed. Please refer to response above.

- Supplementary Material Section 1: Supplementary Figure S2-0 -> Supplementary Figure S1-0 ?

This material has been removed, since the plots are not necessary. The values of explained variances from COBE-SST2 are now stated in Lines 285–290 of the main text.

- Supplementary Material Section 1: Similar mistakes in other figure captions in this section.

The remaining material in this section has been removed, because the comparison between COBE-SST and COBE-SST2 is not necessary.

- The caption of Supplementary Table S2-1: “Meteorological stations used, in three columns, with names in English and Japanese. Years listed with the shaded station are those with insufficient data and not considered.” It seems that this explanation does not fully correspond with Table S2-1.

This material has been removed. Since the revised manuscript uses more than double this number of rain-gauges, this table would become very large, but probably not necessary.

- Supplementary Material Section 2: Figure S2-2 -> Supplementary Figure S2-1 ?

This material has been removed, since the revised methodology uses d4PDF grid-points at rain-gauge locations.

- Supplementary Material Section 4: Table S3-1 -> Supplementary Figure S4-1 ?

This material has been removed, since radar-AMeDAS is no longer used.

- Supplementary Material Section 4: Placing Figure S4-5 just below Figure S4-4 would be better.

We agree with the reviewer, but this material has been removed. Since the revised manuscript expands the study domain to the large islands of Japan, figures comparing 20 km and 5 km d4PDF in multiple regions would need to be added. This is a lot of material that is probably not necessary.

In addition, the plotting method used in such figures has been changed (Fig. 4 in the revised manuscript). I think it is hard for readers to see the cluster sizes based on color. The size of the clusters are now directly shown as marker sizes. (This comes at the price that topographical details are not as clear. But since the study domain covers a larger geographical extent, i would be difficult to see anyway.)

- Supplementary Table S6-1a, S6-1b, S6-2a, and S6-2b: What does “ENSO-NC” mean in the rightmost column? There is no explanation of this term in the table caption and the manuscript.

We apologise for the lack of explanation. The revised manuscript now evaluates the first five modes of Pacific SST anomalies. “ENSO-NC” refers to non-canoncial ENSO. Lines 285–294 now discusses this mode in relation to the other modes. It is the 5th mode if calculating PCA for the 1921–2023 period, but the 4th mode for the 1952–2010 period (also the d4PDF period). The supplementary tables have been removed since the revised manuscript now uses a simpler method for comparing between d4PDF and rain-gauges.

- Line 9 in the caption of Supplementary Table S6-2a: 99.9th percentile hourly rainfall -> 99th percentile daily rainfall

This material has been removed, since the revised manuscript now uses a simpler method for comparing d4PDF and rain-gauges.

- Line 174: dJF -> DJF

Since the temporal window of the PCA vector was 15 months, the small letter “d” was originally used to differentiate it from the December of the same year after JJA (June-July-August), “D”. This has been changed to D[-1] to indicate that this was the December of the previous year before JJA.

- Line 175: Djf -> DJF

The small letters “j” and “f” were originally used to differentiate it from the January and February of the same year before JJA, “J” and “F”. This has been changed to J[+1] and F[+1] to indicate that these were the January and February of the next year after JJA.

Second, I think Table 2 is the most crucial result in this paper; however, I could not understand what type of observational data the presented results are based on and which period they covered. Please note this information in the table caption. In addition, I could not understand the results easily because the results of observation and d4PDF are displayed in layers with complex notations. I would like to ask the authors to present the observations and d4PDF separately.

We agree with the reviewer that the notation was excessively complex. Table 2 now lists the correlation coefficients for rain-gauges and d4PDF separately, in columns side-by-side.

Third, I am concerned about the difference in the periods of the Radar-AMeDAS data and the d4PDF data in interpreting the results. Since the overlapping period between the Radar-AMeDAS data and the d4PDF data is short, it would be better to focus on comparing the ground observation data with the d4PDF data. There is no problem with using the Radar-AMeDAS data as supplementary data. Another choice is that using AMeDAS data would provide more spatially dense observational information since the late 1970s.

Radar-AMeDAS is no longer used. Although there was radar data in early periods, there were format and resolution changes over the years. There seemed to be some numerical artifacts in the early time periods, likely due to sparse radar coverage. I have tried to remove these numerical artifacts using simple methods but the results remain unsatisfactory. In addition, the early data resolution is coarser so some spatial interpolation into corresponding rainfall extremes must be applied. This was why I decided not to use the early radar-AMeDAS.

Fourth, in this paper, many figures and tables are presented in the supplementary section and are cited in the main text. However, I do not believe all these figures and tables are necessary to reach the paper's conclusions. Presenting numerous results with little significance only wastes the reader's time. Please carefully select the figures and tables to be included in the paper. Associated with this point, it seems that the analysis of Ph99.9 and Pd99 has a minor role in this paper, so I think this analysis could be omitted.

We agree with the reviewer. All supplementary material has been removed, and whatever is necessary is inside the main manuscript. The number of monsoon indices has been halved from 14 to 7, since the excess indices do not actually provide more information or improve the conclusions.

Regarding upper percentile rainfall, in the original analysis, the 99th percentile hourly rainfall and 90th percentile rainfall in the latitude-longitude boxes were found to be lower than range of values that were calculated from rain-gauges and cluster. To ensure that the conclusions were consistent for the same numerical range of rainfall values, the 99.9th percentile hourly rainfall was also calculated and used to check the 99th percentile hourly rainfall. The 99th percentile daily rainfall was also calculated and used to check the 90th percentile daily rainfall.

[Other comments]

1. In this paper, the SST mode four is interpreted as the Pacific Decadal Variability mode. Please show a temporal correlation between this mode and a well-known climate index, such as the IPO or PDO index, which would be available on a website.

The correlation between the “PDV” mode with the IPO is now described in Lines 309–311. In addition, the correlation between the “ENSO” modes and the SOI is now described in Lines 301–305.

We have done the correlation for both IPO and PDO indices, and both produced very similar correlation coefficients with the “PDV” mode. We prefer the IPO index to the PDO index for two reasons. Firstly, it describes a domain that is more similar to the one used in this manuscript. Secondly, higher frequencies were filtered, and it is the low frequency signal that we would like to verify. The correlation coefficient of 0.49 with the “PDV” mode is not strong, but is the best match amongst the first 5 modes.

2. Line 533: observations -> JRA55

We have removed this table. “JRA55” is used where the correlation coefficients are given in the text, such as Lines 504, 512, 517, 522. Yhe results described as “observations” only when rain-gauges and JRA55 are correlated (Lines 474–475) .