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Interactive comment on "Spatiotemporal patterns of synchronous heavy rainfall events in East Asia during the Baiu season" *by* Frederik Wolf et al.

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Response to Anonymous Referee # 2

We gratefully appreciate the very positive impression of the reviewer regarding the presentation of our study. Furthermore, we thank them for the very interesting and useful suggestions improving the coherence of the manuscript.

In the following, we present a point-by-point response to the comments and remarks, with the comments of the reviewers shown in blue, italic font.

- *In my experience, TRMM data are biased, resulting in general an underestimation of the effective heavy rainfall amount. The choice to assume 90th percentile as threshold for identifying heavy rainfall, instead of higher ones, and the fact the authors work on rainfall occurrence of rain amount exceeding that threshold should not have significant effects on the proposed analysis, but a brief discussion about the reliability of TRMM data in the context of the study probably could be appropriate.*

  We thank the reviewer for this useful comment. We acknowledge the presence of biases in the TRMM data, while still believing that it presents the most suitable data set for our study in terms of spatiotemporal resolution and coverage. As long as the biases at a given point in space are not time dependent, utilizing our approach should not be affected by those circumstances at all, since – as the reviewer emphasizes correctly – we are not interested in absolute rainfall sums. We will clarify this point in a revised version of our manuscript.

- *The paragraph 2.2 Event Coincidence Analysis (ECA) and 2.3 Functional Network analysis should be revisited because they are not sufficiently clear specially for people not familiar with the methodology proposed. For example, the variable sj in Eq.(1) is not defined. Furthermore it is not clear to me why for* $\tau = 0$*, Qij of Eq.(5) and Eq. (6)should be different.*

  We fully agree with this statement, which is also well in line with corresponding observations of reviewer #1. We will further work on the two mentioned sections to clarify the necessary methodological details thereby make this part better accessible to readers that are not yet familiar with functional network analysis and event synchrony measures.

- *I am not so sure that ECA is in each case better than ESS. There are proposals that solve the drawbacks in Quiroga et al. 2002, see for example Conticello et al,2018, InternationalJournal of Climatology, 38(3), 1421-1437., or Conticello et al. 2020, WaterResources Research 56.4 (2020): e2019WR025598.*

The reviewer is completely right in their comment. Indeed, we were not meant at all to emphasize here that ECA is superior to, or better than ESS. Rather, ECA does not experience the intrinsic problems of an uncorrected ESS in the presence of temporally clustered events that can indeed be corrected for by proper declustering. In this context, the two mentioned references are most useful and will be thoroughly addressed in our revised manuscript. Some further more detailed discussion on the differences of climate network properties obtained with ESS and ECA as similarity measures can be found in a recent paper co-authored by some of us (Wolf et al., Chaos, 2020), with a follow-up study just being about to be submitted. As a result of those corresponding more systematic intercomparisons, we would like to emphasize that networks constructed based on both ESS and ECA indeed capture similar information, yet may substantially differ in their higher-order characteristics. We will attempt to clarify those points in a revised version of our manuscript.

- *3) If and eventually how the morphology of Japan, characterized by steep mountains 1500 to 3000 m. high, affects heavy rainfall spatiotemporal structure of the region examined, probably deserves some mention.*

We agree that the elevation of the Japanese Alpes and other mountain ranges in the area of interest markedly affects the spatial patterns of heavy rainfall, which can also be partly observed in Fig. 1b. However, it is interesting to observe that the “most synchronized” heavy rainfall sequences occur over the open ocean and the Sea of Japan rather than over land. This could point to orographically

induced heavy precipitation more often occurring along with smaller frontal systems or more localized convective rainfall in our study region and the considered season, rather than in a coherent large-scale spatially organized manner. On the other hand, elevation (along with the land–sea contrast) shapes atmospheric circulation in the study region and thereby intimately contributes to the existence of those circulation patterns that are finally responsible for the emergence of the reported double-band structure of synchronous heavy rainfall activity. We will add a note on this observation to our revised manuscript.