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Interactive comment on "Spatially asynchronous changes in strength and stability of terrestrial net ecosystem productivity" *by* Erqian Cui et al.

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General comments: In the manuscript "Spatially asynchronous changes in strength and stability of terrestrial net ecosystem productivity", Chen et al. studied the spatial variations of annual mean NEP and IAV_NEP using in-situ eddy covariance observations and gridded NEP datasets from FLUXCOM and CLM4.5. They proposed a new approach that decomposes NEP into beta, log(U/R) and log (CUP/CRP) and used some of them as "local indicators" to indicate the spatial variation of NEP and IAV_NEP. I am intrigued by this study and find it has the potential to provide some emergent constraints on NEP that we much need at local scales, though I feel some minor revisions are needed to clarify the motivation and the interpretations of the Results.

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Specific comments: 1. “Spatially asynchronous” is a bit misleading phrase as it makes me wondering what is meant to be spatially asynchronous/synchronous for NEP, or is it simply used as a substitute for “spatial variation”. I think the running title of the manuscript is more accurate which suggests that the authors studied “spatial variability” of NEP and NEP_IAV and found local indicators for them.

2. The first part of the results (section 3.1) serves to prove that there are large spatial variations in NEP and IAV_NEP, and to further motivate a need to study “local indicators” for NEP and IAV_NEP. However, many literatures have reported large spatial variations of NEP and IAV_NEP already, and I feel this kind of reasoning is more suitable to be included in Introduction rather than Results. In addition, FLUXCOM NEP is used here but we know is might not be the best source to study IAV_NEP (Jung et al., 2020).

3. The IAV_NEP and beta for shrublands and savannas are among the smallest compared to other PFTs (Figure 3). Is it at odds with previous global studies that suggest semi-arid ecosystems contributed the most to global IAV_NEP?(Ahlström et al., 2015).

Technical comments: 1. In the legend of Figure 1 please indicate the source of NEP data.

2. L74. Do you mean the “relative differences” between photosynthesis and respiration or between their covariances?

3. L100. Rephrase. “to address the local indicators”?

4. L102. Reference for FLUXNET2015 is Pastorello et al., 2017.

5. L84 -86. Generally, I feel there is a need to clarify why there is a need to find a local indicator (which is also a new phrase)? Does it help in the attribution of spatial variation of NEP and IAV_NEP to different processes, or does it provide an independent constrain on NEP and IAV_NEP?

6. L135. I understand the scale-mismatch between model and eddy-covariance sites is

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difficult to address, but is it possible that muted spatial variation of NEP and IAV_NEP from gridded products is partly related to the scale mismatch?

7. L229. “difference” -> “variation”.

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