Interactive comment on "Asymmetric Responses of Primary Productivity to Altered Precipitation Simulated by Ecosystem Models across Three Longterm Grassland Sites" *by* Donghai Wu et al.

Anonymous Referee #1

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This manuscript presents a study of modeled and observed grassland NPP variability across years and three sites (Konza Prairie, Stubai Valley and the Central Plains Experimental Range). Fourteen terrestrial ecosystem models are used to simulate these three sites and the analysis focuses on modeled and observed responses of NPP to precipitation variability, and the asymmetry of these responses, i.e. different magnitude NPP responses for equivalent increases and decreases in precipitation. To assess model responses to precipitation variability in more detail, simulations that alter precipitation across a range of values at all three sites are also conducted.

In general the manuscript is well written and the simulations are extensive and well ex-

ecuted. The introduction is strong and well written with many references and fairly clear definition of goals. Given the organization of the abstract and the introduction, I find the presentation of results is not well structured. Also, the application of statistics could be improved. The interpretation of the results in the discussion is not well executed and the conclusions regarding mechanism are not well tied to a strong understanding of the mechanisms encoded in the models.

The abstract and introduction are structured around the asymmetry of responses and spatial versus temporal differences in responses. Yet the results are organized first with the simulations that alter precipitation (Figs 1 and 2); then the analysis of modeled and observed responses to spatial and temporal variation in precipitation (Figs 3 and 4); and then back to the model results of altered precipitation (Fig 5). I suggest leading with Figs 3 and 4, the comparison of model results and observations. Then follow with the altered precipitation results. The results from altered precipitation simulations should be used to interpret the model and observation comparison.

Uncertainty and statistics must be presented for the observations. Figs 3 and 4 need uncertainty bars on the observations. Why were stats done on the asymmetry of the model ensemble and not the observations. Statistical analysis of asymmetry in the observations must be done. In my view the stats on the model ensemble are unnecessary.

The discussion is poorly organized and in many cases only tangentially linked to the results presented in the study. The authors should rewrite the discussion, trying to avoid generality and link into their specific results.

There is an initial paragraph missing which summarizes the key result(s). The first paragraph of the discussion is mostly irrelevant, only the penultimate sentence relates to this particular study. The second paragraph of the discussion belongs in the results. The third paragraph is reasonable but should come later when trying to interpret the discrepancies between modeled and observed results. Section 4.2 is reasonable and

should lead the discussion, after the first paragraph suggested above.

p12 l28 – were these simulations done without using soil texture form the sites? That is a major oversight. It is clear that soil texture is a key driver of water availability in these models and could be a major reason for the discrepancy. If this were a single model study I would insist, but the logistics of a model intercomparison are such that I won't insist. Nevertheless, the authors should consider redoing the simulations with the actual soil textures. If they opt not to do this then it needs to be made very clear in the methods that site soil textures were not used in the study and the discussion should interpret the results in this context in more detail.

Section 4.3 is not really related to the study. None of the key conclusion in this section have been teased out from the analysis. Most of the recommendations are based on the literature cited in the section. What, in this study specifically, have you found the models are lacking and how can that be addressed? The authors need to do a much better job of identifying the short-falls in the models compared with the observations and providing a logical understanding of the causes of these shortfalls. Do some models perform better than others? If so, why?

The conclusions are poor. The first sentence stating novelty is unnecessary. The first half of the second sentence is not what I take from the results. Fig 4 shows the models do a bad job of capturing asymmetry at SGS but not at KNZ or STU. The second half of the second sentence is primarily speculation. The third sentence is a throwaway and is unnecessary. The fourth sentence seems to suggest that the collaboration between site investigators and modelers in this study was not very strong. The fifth sentence is about extremes, which this study only tangentially addresses, responses to "normal" variability are the focus of the study.

Minor comments:

p2 l3 – Unclear. Do you mean changes in variability or just variability? P2 l3-5 – Suggest moving this sentence to after the following one. P2 l5, l15, l20 etc – What

do you mean normally variable? P2 l8 – you switch between using asymmetrical and non-symmetrical, pick one and stick with it p2 l13-15 – awkward sentence, rephrase p2 l17 – what do you mean consistently here, across what? Sites? P2 l19-21 – Be more precise in what you mean here, what do you mean "extent of negative drought effects" and "impacts of increased precipitation" ? By "extent" and "impacts" do you mean different things? P3 l10 and many other places – "P-ANPP" sensitivities, you are analyzing ANPP in response to precipitation, it is conventional therefore to put ANPP first. Change to "ANPP-P". p3 l17-20 – this is a reasonable argument but depends on time-scale p4 l7 – quantify these rainfall regimes by adding MAP p4 l13-15 – this sentence is unnecessary, delete it or move to the discussion p4 l15-16 – this sentence is unnecessary, delete it p8 l15 – must add uncertainty to the observations p12 l8-10 – this sentence comes from nowhere, delete it p12 l28 – this is unclear, do you mean use measured SWC as an input? P12 l28 – rephrase "This will help in figuring out"

Figure 1. Differences in x-axis scales should be noted in the caption.

Figure 2. As above. Observations should be added to the ANPP plots.

Figure 3. Ho do you calculate a "mean slope"? Need uncertainty for observations. Technically standard deviation is not a measure of uncertainty, it is a measure of variability. I think your shading represents model variability.

Figure 4. The grey boxes are unnecessary, just use a black line if you want to show the mean/median. Change "pulses" to "gains." Need obs uncertainty.

Figure 5. "1 sigma ∼17 %" was this the same across sites? Again, do you mean uncertainty or variability?

Table 1. Add variability (standard deviation) to MAT, MAP, and ANPP. If soil texture was not used in the simulations make this clear in the caption.

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