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Interactive comment on "Assessment of Irrigation Physics in a Land Surface Modeling Framework using Non-Traditional and Human-Practice Datasets" *by* Patricia M. Lawston et al.

Anonymous Referee #4

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General comments:

This is an interesting paper on the evaluation of an irrigation scheme within a land surface modeling framework. This is an area that needs research and I see this a potentially valuable contribution on the matter.

While generally well written, the structure and organization of the Background (particularly Section 2.3) and the Methods sections needs to be improved to ensure a better flow and enhanced readability. The study region, models, input datasets and evaluations should be described in a more logical and orderly manner with less intermixing. These issues are described in more detail in the specific comments below. The discussion section is very short and would benefit from more elaboration and high quality

insights on the limitations and challenges as well as opportunities for irrigation modeling.

Some of the used input datasets need more justification. GVF is an important dataset for the irrigation modeling but is reported at coarse resolution (3 and 16 km) inconsistent with the resolution of the LSM (1 km). Not clear to me why a 1 km based version isn't used here. The MODIS phenology product (produced at 500 m resolution) would probably be more useful in this context for establishing the start and duration of the growing season.

I'm also a bit concerned that 1 km isn't the most appropriate scale to do irrigation modeling and accuracy assessments as you will inevitable run into mixing of rainfed and irrigated fields given the characteristic size of the fields. LSM runs at 500 m resolution would probably have been more appropriate, also considering the scale of the CRNP validation dataset, and feasible using widely available surface inputs generated at consistent resolutions.

Specific comments:

1) Page 1 L14: Please define the scale associated with "high resolution"

2) Page 1 L19: What precisely does the "human practice data" consist of?

3) Page 1 L21: "two irrigated fields" – what irrigated fields are you referring to here (soybean and maize)?

4) Page 2 L21 and L25: Please define what you mean by coarse and high resolution here.

5) Page 6 L1-7: This paragraph reads a bit confusing with mentioning of all the different temporal and spatial resolutions. A bit unclear what product version is used for the evaluation. Does the 12x12 km survey area correspond to the 15x15 km domain of this study? Why the domain difference?

6) Page 6 L8-16: This Section adds to the confusion by repeating some of the statements above and also adding additional evaluation datasets (human practice data etc.) not related to the CRNP (although that is the title of the Section). Differences between the CRNP and COSMOS datasets should be clarified, if any. The finishing paragraph relates the overall objectives and novelty of the work, which don't belong here. This Section requires some revision – the evaluation components might be more appropriately positioned in the method section. You may need a completely separate section for describing the additional datasets mentioned here.

7) Section 2.3: The CRNP data description is currently part of the introduction/background part of the manuscript. While it makes sense to mention and introduce the data as a useful validation source in this context, I feel that the detailed description of the actual dataset used here for evaluation purposes should be moved to a separate section in the Methods section (or Methods and data section). Here you could appropriately describe all the datasets used in the study.

8) Section 3: I would start this with a description of the study area and domain to set the stage.

9) Section 3.1: I find this section quite confusing to read as it includes both modeling and evaluation details and references to elements described in Section 3.2. I think you need to rethink the organization of the Method section adopting a more logical organization for improved flow and readability. Personally, I would prefer to have all model descriptions first before the description of experiments and evaluations to be performed.

10) Page 8 L1-5: So why isn't the GVF datasets provided at 1 km to be consistent with the LSM resolution? You also need to specify precisely what the GVF product is used for, when first introduced. From what I can read later in the manuscript it is predominantly used to determine the start and end of the growing season; couldn't you use the MODIS phenology product (see comment 12) more appropriately for this

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purpose? In addition, this product is available for the full duration of the study.

11) Page 8 L12-15: You need to mention the resolution of these input datasets. Is the UMD crop type product static or is a separate classification provided for each year? The annual Cropland Data Layer (https://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php) product (provided at 30 m) is updated for each year to account for crop rotations and changing crop type patterns and might be a more correct source to use for something like this.

12) Page 9 L4-5: The GVF product is used for establishing the length and timing of the growing season. A more appropriate source for this would be the MODIS global vegetation phenology product (MCD12Q2) currently produced at 500 m resolution that is also more consistent with the LSM resolution and the CRNP validation dataset (and the scale of irrigation effects). Reasons for not using something like this should be addressed.

13) Page 9 Section 4: A brief intro statement would be useful here.

14) Page 10 L7: The relationship used to compute the root zone length from GVF should be provided in the methodology.

15) Page 12 L6: This is the first mentioning of a rainfed validation site within the study domain. Details like this should be provided in the method section (preferably in a dedicated study region section).

16) Page 13 L8-13: This should be moved to the methodology section. A shorter summary of the CRNP would suffice here.

17) Page 13 L15: Not clear what modifications were made to the COSMOS product; provide a section reference or more details here. Also a bit confused about the references to both CRNP and COSMOS as they are presumably the same thing?

18) Page 13 L14-15: I wonder if a non-cumulative PDF wouldn't be better in this context?

19) Page 14 L6: I believe that the GVF is provided at 3 km (and 16 km) rather than 1 km resolution, correct?

20) Section 5: The discussion is very brief and lacks more substantial and high quality discussion elements on limitations, challenges and opportunities.

21) Page 15 L3-8: These are useful details that should have been provided in the methodology or result sections

22) Page 15 L9-12: Not sure I understand this correctly, particularly the part about the scaling by GVF being more important than changes in rooting depth.

23) Page 15 L13: The method for determining the start and end of the growing season hasn't been described anywhere, but it must be. Justifications for adopting that methodology (rather than relying on existing phenology products for instance) should also be provided.

Technical corrections:

1) Page 4 L1: "with a two different.." - should be "with two different.."

2) Page 4 L23: "..water resources region..."?

3) Page 5 L14: use "high resolution" rather than "high-resolution"

4) Figure 5: I would also show the irrigation amounts here as done in Figure 7. Why is the impact of irrigation high when no irrigation is applied (e.g., during rain events)?

5) Figure 5: Issue with the legends – they are not consistent with what is shown; currently I can only distinguish two different line styles.

6) Figure 5: a and b rather than top and bottom should be used for more precise figure referencing in the manuscript. This also applies to the other figures.