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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.

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1 Summary

The manuscript presents a study of the impacts that a sprinkler irrigation scheme in a land surface model have on the latent and sensible heat fluxes, and more substantially in the soil moisture state on a small, high resolution domain containing center-pivot sprinkler irrigation systems. The study explores the sensitivity of the results to two parameters: the irrigation intensity as prescribed by an input data set (GRIPC), and the greenness vegetation factor (GVF) used to scale the irrigation amount depending on the growth stage of the crops. The soil moisture state is compared to fixed soil

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moisture probes and a gridded soil moisture product, both using Cosmic Ray Neutron Probes. Including irrigation in land surface models is becoming more important to properly characterize the state and fluxes in agricultural regions, and thus efforts to evaluate the impact that either the choice of irrigation scheme or their input datasets have on the model results is certainly relevant to HESS. The study introduced modifications to the irrigation scheme such as using a real-time greenness vegetation factor data (as opposed to a climatological one) and also introduced a modification in the method to develop a soil moisture gridded product.

Overall, the manuscript is well written and the conclusions reached are sufficiently supported by the results. However, there are some few comments that I think would improve the readability of the manuscript, particularly with the description of some of the input datasets (GRIPC and in situ irrigation) as well as part of the methodology. Therefore, my recommendation is acceptance with minor revision.

2   General comments

1. The title refers to *"non-traditional"* and *"human-practice"* datasets. However, it is not clear what the authors mean by these two concepts. It might be the case that *"non-traditional"* is referring to the use of Cosmic Ray Neutron probes, but this is not obvious. In contrast, "human-practice" data is defined in Page 6, line 13 to be the irrigation amount. However, it is not clear if this term is referring to the GRIPC dataset used throughout the study (which is based not only on human data, but also on remote sensing data), or to the amount of irrigation applied at two sites, as mentioned in Page 6, line 10.

2. Related to the previous comment: although a reference is given for the GRIPC dataset, a brief description of this dataset would benefit the manuscript. An estimate of the uncertainties related to this dataset would also be helpful.

3. Also related to the first comment: a description of the irrigation data from the study in Franz et al. (2015) is also worth including. This is especially important in Figure 7, where irrigation at the maize site is shown, as well as in the text (Page 12, lines 14-16).

4. The methodology for defining the growing season was not included in the Methods section. It is however mentioned later in the Discussion section on Page 15, lines 13-14 *"The method for determining the start and end of the growing season, based on the 40% annual range in climatological GVF, proved to be reliable for this study area and climate"*.

3 Minor comments

1. Page 2, line 9: (referring to observational data) *"are generally not obtainable at the scale of LSMS"* and Page 5, lines 19-21: *"available at the same spatial scale as LSMs"*

What do the authors mean by scale of LSMs? land surface models can be run at a great range of scales. Perhaps the authors are talking specifically about high-resolution LSMs such as in this study? If so, please specify this.

2. Page 4, line 1: *"For example, a flood irrigation parameterization..."*

It is not clear if this is referring to scheme number 1 or 2 defined above in Page 3, lines 19-22. The text would benefit if this term ("flood irrigation parameterization") would be included in Page 3, lines 19-22 where applicable.

3. Figure 1: The titles in each sub-figure are confusing. Perhaps the titles could read (top left, top right, bottom left, bottom right): "GRIPC irrigation intensity", "Tuned irrigation intensity", "Climatological GVF", and "Real-time GVF" to better identify what is being shown. Furthermore, the figure would improve by the inclusion of labels "a", "b", "c" and "d". Finally, the colorbar for the top figures (which is the same for both) could be shown in the center as it was done for the bottom figures.

4. Page 11, line 2: *"the SPoRT GVF is greater than climatology in June"*

Please clarify: do the authors mean "greater than climatological GVF"?

5. Page 11, lines 3-4. *"However, in September, the SPoRT GVF detects the (negative) vegetation response to the July drought and irrigation amount and flux impacts are reduced".*

What do you mean by "the sport GVF detects the negative vegetation response to the July drought?" is it because it is a real-time product as opposed to the climatological product and the fact that 2012 was particularly dry?

6. Page 11, lines 4-7. *"These seasonal scale impacts illustrate that the NLDAS-2 forcing (e.g. precipitation) data, via changes to soil moisture, drives the irrigation timing during the growing season and that the behavior of the irrigation scheme is consistent with expectations of human triggering of irrigation during dry and wet periods".*

I am not sure I follow completely what is meant here. Is this saying that we expect irrigation triggering when there is no (or small amounts of) precipitation and no triggering when there is? If so, then this is already phrased better in the next lines (page 11,

lines 9-10): *"At the interannual and seasonal scale, irrigation amounts and impacts are driven primarily by background rainfall regime, given by the forcing precipitation, with only small changes evident between the methods"*.

7. In Figure 7, why not include the soil moisture from the CRNP gridded soil moisture product as well for comparison with the fixed probes?

8. Page 13, lines 11-12 *"In this study, we modify the spatial regression technique to treat irrigated and non-irrigated areas differently by using the CRNP (irrigated) rainfed data in the regression for (irrigated) non-irrigated gridcells"*.

I am not sure I follow the last part with the parentheses "by using the CRNP (irrigated) rainfed data in the regresion for (irrigated) non-irrigated gridcells". Could you please clarify this?

9. Referring to the same text in the last comment, in my opinion, since this is also a novel contribution (the modification of the spatial regression technique for the gridded product), a comparison between the previous and the new product could be included as supplementary material.

10. Page 13, lines 17: *"during which irrigation was applied at the irrigated maize site"*

Only at the maize site? or the whole domain shown in Figure 1? The caption reads *"when irrigation was applied at the irrigated maize and soybean sites"*. To my understanding, the maize site and soybean sites are only parts of the whole domain, and this figure (Figure 8) is showing a spatial comparison of the whole domain.

11. Figure 8: In the legend, consider changing "CoSMOS" to "CNRP" to be consistent with the rest of the paper.

12. Page 14, lines 9-10 *"Furthermore, when irrigated and non-irrigated areas are averaged separately, the irrigated (Control) simulations match the distribution of irrigated (non-irrigated) areas well"*.

Again, I do not understand the use of the parenthesis here "irrigated (non-irrigated)".

4 Technical corrections

1. Page 7, line 19 *"as evidenced by only 5% of the gridcells having intensity less than 100% (Fig 1)"*

I think this should be "Fig 1a" instead of "Fig 1".

2. Page 7, line 22 *"(i.e. observationally tuned: Fig 1)"*

I think this should be "Fig 1b" instead of "Fig 1".

3. Page 7, lines 19 and 22 and Page 8, line 4.

Check consistent use of either "(Fig X)" or "(Figure X)".

4. Figure 6: Label in Y-axis "Change in Domain Avg Qle" instead of "Doman"

5. There is a dot missing in Page 13, line 24 before "The model distributions do not match the CRNP CDF, which instead shows..."