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Interactive comment on "A case study of field-scale maize irrigation patterns in Western Nebraska: Implications to water managers and recommendations for hyper-resolution land surface modelling" *by* Justin Gibson et al.

Anonymous Referee #1

Received and published: 20 September 2016

Overall Comments:

Overall, this is a well-written manuscript describing 4 new ways to account for irrigation that could be used by managers and modelers alike. This type of work is much needed, as the human element/drivers of new LSM physics remain a challenge in how to account for them and prescribe them accurately. This is also a novel dataset put to good use. The schemes use sound assumptions and represent an array of complexities.

The paper is a worthwhile contribution, but becomes a bit thin in the results section and a few of the major limitations are glossed over and require further discussion. As

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a result, I recommend major revisions in order to help the manuscript become more impactful and useful for irrigation-related studies.

In addition, I strongly recommend that, if possible, the results/analysis be extended to time series and sub-annual breakdowns of irrigation water vs. precipitation (and variability) for each of these schemes. Much of the utility for managers and more so for modelers will be on the diurnal and sub-seasonal scales, in which they need to obtain the water balance, soil moisture, and fluxes correct in order to couple to the atmosphere and represent the precipitation connection more accurately (i.e coupling).

Also missing is the broader applicability of these schemes outside of this unique, well-instrumented and reported-on field/domain. Other locations with less decision-making data points or coarser precipitation will no doubt find greater challenges.

Specific Comments:

L24: What is difference between a conservative and water savings routine? Sounds similar if you do not know the terminology. This is explained better in the paper itself, but maybe a word or two in the abstract could help better clarify what is meant by each.

L29: Is the actual transition of information and decision making part of this paper? Or is it suggested that it would be valuable in the future for managers? If the latter (which according to the paper itself there is no transition or decision making taking place (yet!), then please clarify this here to suggest it may be useful in the future (not that it already has been useful).

L52: might want to mention that the impact of SM on these is really modulated by the flux contribution to the atmosphere (SHF, LHF, or evap fraction, or just ET). So getting the SM-Flux relationship correct is critical, and i.e irrigation is essential as a component of that.

L58: Which are the 'both' here? L59: Is there a predictive nature to irrigation decision-making? Do Calendars vs. Consultants vs. Probe percentages change over time due

to other factors (technology, financial, drought, etc.)? Are consultant-based decisions consistent (is the advice consistent) over time?

L99: Not clear what is meant by 'irrigation triggering regimes'? Earlier (abstract) they were referred to as 'routines' that could be incorporated into LSMs. Regimes suggest something different?

L122: What is the native resolution of SSURGO relative to the study area and field scale?

L125: Same for SPNRD.

Section 2.2: Based on the descriptions of these, are this ranging from the most simple to most complex (in order)?

For H, would it be possible that the minimal yield loss could be set so high as to represent larger irrigation than in CM?

L168: 'amount of water'

L179: Has this approach been used in the past? There are no references, and based on interviews and expert knowledge. How did you come up with 6.5 exactly? If the ultimate goal is to have this in an LSM, I can envision that it might be very sensitive to this 6.5 number and thus overly simplistic. Are there any other knobs to turn?

L185: This sounds reasonable as first order approximations for extreme rainfall. What about the low-intermediate rainfall conditions and the speed of drainage? Should the delay estimates be constant regardless of the soil type (conductivity), land cover, and precipitation rate?

L243: What is meant by seasonal dynamic?

L280: All assumptions embedded in these approaches have been explained and seem reasonable. The proof is in the pudding, of course, and the results will bear that out. However, it might be useful to summarize what the input requirements and the as-

sumed/tunable parameters are for each approach as well, if they are to be used in LSMs. An example here is the date ranges that are used. 6.5 is another as is -500cm, and the depths of the soil pressure.

L284: Where are they located with respect to the study site and the fields? Should some kind of interpolation (or average) be used as well?

L293: Mean ETc?

L294: Totals of what?

L297: This is critical. The 4 schemes rely on P as the most important input (right?). Forcing for LSMs comes from satellite and gauge-based datasets, likely much coarser (e.g. .125-deg) than the <1km field scale. How will this be addressed? How can we capture the irrigation variability without knowing that of Precip?

L325: I think a lot more could be said - this is the critical result/figure from this paper. There is a lot of error bar info on there and other aspects that could be discussed. The low bias stands out and is significant.

L328: 'Regimes' again.

L338: See earlier comment. This is a major limitation to all of these approaches and modeling irrigation at this scale.

L356: What does this imply about the assumed yield-irrigated amount relationship? That they underestimate and still didn't impact yield is even more surprising. There must be a lot of leeway (i.e. overwatering?).

L373: You are saying that, based on these models, you can get away with much less water and still produce the same yield, correct? Isn't that something that should have been quantified in the past (or known by the farmers)? Or is this still largely unknown? How certain are we that the models are correct and that the yield will still be met?

L384: Supports the need for a bit further analysis/figures looking into the time series

of the results.

L392: This was alluded to in an earlier comment: How can we know that prior decision making holds in the future or during other conditions not in the recent historical record?

L404: Why? Is it because soil types here are so are similar, with slowly varying properties?

L433: How about a controlled experiment/field to test sensitivity and realism of these schemes and resultant quantities? Is that reasonable in the future?

L443: Any predictive capabilities?

Section 4: This discussion section was welcome - lot of areas that need study but this is a good start.

L453: 'may be useful'?

Section 5: The conclusions are a bit thin, and perhaps should focus on some of the limiting factors and broader/future applicability (precip forcing, decision making, soil properties).

Fig. 1: Hard to tell exactly where these fields are as this box points to a point on the corner of CO and NE.

Fig. 1: Might be interesting to overlay a 1km model grid on these to see what we are dealing with when trying to resolve individual fields.

Fig. 2 (Caption): Is this from STATSGO or from individual field samples?

Fig. 3 (Caption): Inferring that heavier precip is more localized?

Fig. 4 (Caption): depths across all sites?

Fig. 5: Hard to see the error bars (busy plot already) - are they important or can they be conveyed in a sentence or two (general trends of increasing w/irrigation amount?).

Fig. 5: They are all underestimating the reported totals, though the slopes are consistent mostly weighted by the very high anchor points (600mm). Very mixed bag at lower values (300mm).

Fig. 6 (Caption): Is this P+I from observations, or output from the schemes?

Fig. 7: What is going on in 2008?

I'm a big disappointed in the analysis/figures. Would have been nice to see some time series of how these schemes are all working over time and in response to precip and precip variability.

To this end, it will be important for LSMs to get the seasonal and sub-seasonal cycle right (including the exact timing of irrigation) if they are to be used for coupled modeling and initialization. So the long-term or annual totals do not tell the whole story.

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