We thank the reviewer for their careful attention to our manuscript. The paper has improved substantially as a result of their thoughtful comments. Please see our responses to the comments below in blue.

Reviewer #1:

This study uses a high-resolution, regional coupled modeling system to investigate the impacts of irrigation dataset selection on land-atmosphere (L-A) coupling. Results show that L-A coupling is sensitive to the choice of irrigation dataset and resolution and that the irrigation impact on surface fluxes and near surface meteorology can be dominant, conditioned on the details of the irrigation map (i.e., boundaries, heterogeneity, etc), or minimal. I'm really interested in this study. There are a few comments below.

Firstly, in my view, estimation of irrigation amount and choice of irrigation water source and irrigation method are also key aspects in parameterizing irrigation water use and modeling its impacts. So, I'm going to ask a few questions around these.

We fully agree that irrigation amount, source, and method can be critical factors in the simulation of irrigation impacts on the water and energy cycles. In fact, our motivation for this line of research is to improve the 'where, when, and how much' questions of irrigation in our modeling systems. There are quite a few studies where we and others address these (how much and 'how') factors directly (Lawston et al. 2015, 2017; Nie 2018,2019), but to our knowledge no study has directly addressed the impacts of the often overlooked irrigation fraction maps (which impacts where, and when). In order to complete a direct assessment of the impacts of the irrigation map independently, it was necessary to control for the other irrigation scheme factors, as varying more than one factor at once would confound the results. Each of the irrigation scheme options was carefully selected based on previous research, and represent what would be our current best approach to amount, source, and method (while recognizing these could all use work in the future as well). We expand on our reasoning for the options selected in response to the questions below and have clarified in the text where appropriate.

Estimation of irrigation amount.

1. This study chose 50% of field capacity as the irrigation trigger threshold and 80% of field capacity as the target, I am interested in why this study chose this parameter (default parameter or based on observations of irrigation amount?).

The irrigation scheme is designed so that the irrigation water will turn on if the root zone moisture availability in the morning (6am) is drier than a user-defined percentage of field capacity (i.e., the 'threshold'). The 80% field capacity is a default value that acts to 'turn off' the irrigation when the soil moisture reaches this value. We chose 50% for

the 'on' threshold based on previous research of Ozdogan et al (2010) who used the same irrigation scheme and modeling system, where this 50% was "based on discussions with local experts in Nebraska and California, followed by trial and error." The sprinkler irrigation scheme and thresholds were also evaluated extensively in Lawston et al. 2015 for a subset of the current study area using ground-based soil moisture and local irrigation data. The method of application (sprinkler, drip, or flood) for the irrigation schemes within this modeling system was also assessed in Lawston et al. 2015 for a subset of the study area.

The text has been updated to clarify this point and include more specific justification for using this threshold (Lines 180-184 – italicized text added or changed):

"4) The root zone must be dry enough to require irrigation, as determined by root zone moisture availability that falls below a user-defined threshold of field capacity. Ozdogan et al. (2010) determined 50% of field capacity to be sufficient based on correspondence with local experts in Nebraska and California and trial and error. Due to this previous work, as well as previous assessments of the irrigation scheme and modeling system (Lawston et al. 2017), this study also uses a threshold of 50% of field capacity."

2. The immediate effect of different irrigation maps is irrigation amount of the region, but this study also lacked the validation of irrigation amount. Therefore, the simulation of irrigation amount lacks credibility. Is it feasible to make research based on this?

Although there was a comprehensive suite of meteorological observations taken during GRAINEX, the campaign was not able to collect information about irrigation amounts due to privacy concerns (Rappin et al. 2021). Thus, detailed information about irrigation amount during this time is not available, nor was it the goal of this study. We recognize that validating 'amount' is another aspect of irrigation modeling that is a challenge and needs further study before assessing the value of a particular irrigation scheme and application. This is unfortunately a common issue for high-resolution studies that involve human practices (McDermid et al. in press).

That being said, the work presented here is a sensitivity study where the goals are to specifically assess the impact of different irrigation maps on land-atmosphere coupling in the model and how that corresponds to the coupling we are able to observe through the comprehensive land-atmosphere GRAINEX datasets, that are quite rare for irrigated regions. We attempt to make clear that the purpose is not to discern the most accurate irrigation map (Line 162) nor to make broad conclusions about real-world effects of irrigation from the modeling results alone, as those would require a more

rigorous validation of the irrigation amounts simulated. Rather, we focus on the range of possible outcomes (in terms of land-atmosphere coupling) that one could produce from simply changing one input to the model (i.e., the irrigation fraction map), with the understanding that no single run is necessarily the 'correct' simulation. This study and its results serve as a cautionary tale to future irrigation modeling efforts that may overlook the importance of the irrigation map in the interpretation of the results.

Lines 162-165 have been revised as follows to make clear that this is a model sensitivity study:

"It should be noted that the purpose of this study is not to discern the most accurate irrigation map for the study area. Rather, this work is a model sensitivity study that seeks to understand if and to what extent irrigation heterogeneity (via irrigation map selection and resolution) can impact simulation and prediction of land-atmosphere coupling and ambient weather, and discusses the implications of such impacts in the context of sub-grid scale process representation in coarser scale models."

Choice of irrigation water source.

In your study, water is withdrawn from different sources or only simple source for irrigation?

In this version of the model and irrigation scheme, the irrigation water is not drawn from any particular source (e.g., groundwater, surface water, etc). We acknowledge that constraining and tracking irrigation water through the earth system is important at longer time scales and for water resources applications. There is ongoing work that connects these schemes to groundwater (Nie et al. 2019) and future work by our modeling groups will connect irrigation schemes to surface water and other management types (such as dams, etc). Our research questions, however, specifically target land-atmosphere interactions at the diurnal and local scale for which the importance of irrigation source attribution is negligible.

irrigation method

"Water was applied as precipitation (mimicking a 'sprinkler' application)". Is this set according to the actual local conditions?

Yes – according to the USDA, sprinkler system (e.g., center pivot systems) are the most common type of irrigation method in Nebraska, irrigating about 80% of farm acres on 68% of farms (NASS, 2009; Lawston et al. 2015).

The follow text has been added (Lines 186-187):

"Center pivot sprinklers are the most common method of irrigation in Nebraska (NASS 2009)."

Secondly, graphical abstract: It contains too many elements, and it is difficult to understand the meaning of each sub-picture without detailed captions.

We can't seem to find the graphical abstract in the manuscript documents. Perhaps Figure 1 was used for a graphical abstract by default? We would be happy to remove or revise this if directed (logistically) to where it is and how to change this.

Minor comments:
Line 27, "PBL" -> "planetary boundary layer (PBL)"

Corrected

Line 91, "planetary boundary layer (PBL) " -> "PBL"

Corrected

Line 427, "Chen F. and Avissar R.,", Whether there is a disunity in this piece? Line 464, "——, ——, T. E. Franz..."

The entire references section has been revised to comply with the journal format.

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