Reviewer #2

Comment R2.1:

The authors developed a new irrigation scheme in the ISBA land surface model, in which several parameters could be assigned by input. This is of great importance, as in simulations, the spatial heterogeneity of the irrigation application could be taken into account with this new scheme. However, not all properties of this new scheme have been presented, like the irrigation methods, irrigation rate and irrigation time. It seems that the authors made a lot of efforts to prove that the new irrigation scheme is better than the old one, while this is always challenging, as there are always some other factors that may affect the results. I am not surprised that the results are not convincing enough. As we can see, in this study the seasonal patterns of LAI and GPP do not match the observations, and a possible reason may be that the crop growth module of the model is not suitable for the crops in this region, and there are few that the new irrigation scheme could do with this problem. Thus, it is very important to know what scientific question the authors are addressing here: a new irrigation scheme which considers spatial heterogeneity of irrigation, or a new irrigation scheme which is more suitable for the region of Nebraska? For me, the authors should show more this new irrigation scheme could do, and how it will affect the outputs of the model, rather than insisting on the superiority of the new scheme. Finally, the authors need to restructure some parts and rewrite some sentences.

Response R2.1:

Many thanks for your comments. I the revised version of the manuscript, we strived to clarify the objectives of the paper and to improve its structure (see also Responses to the Editor and to Reviewer 1).

Comment R2.2:

L92: add the reasons why you chose to only consider offline simulations.

Response R2.2:

"While the SURFEX framework allows the coupling of terrestrial processes with atmospheric and hydrological models, only offline ISBA simulations are considered in this study. The evaluation of the new irrigation scheme is made over the state of Nebraska (United States of America, USA). This area presents a high density of irrigated fields (Fig. 1) and large freely available observational datasets for evaluation."

was replaced by

"In the SURFEX platform, the ISBA model can be coupled to the CTRIP model (Decharme et al., 2019, Munier and Decharme, 2021) which is specifically designed to represent water dynamics within rivers and aquifers. The SURFEX framework allows the coupling of terrestrial processes with atmospheric models and hydrological models. For agricultural drought and water resource monitoring, SURFEX can also be operated of-

fline, forced by a pre-existing dataset of atmospheric variables. Only offline ISBA simulations are considered in this study. The new irrigation module represents water demand for irrigation, only, and irrigation is not limited by the lack of water resources. This has consequences on water conservation. However, water used for irrigation is usually withdrawn from aquifers, rivers or reservoirs. These compartments are not re-presented in ISBA but a new module dedicated to dam/reservoirs is currently under development. The evaluation of the new irrigation scheme is made over the state of Nebraska (United States of America, USA). This area presents a high density of irrigated fields (Fig. 1) and large freely available observational datasets for evaluation."

References:

Decharme, B., Delire, C., Minvielle, M., Colin, J., Vergnes, J. P., Alias, A., ... & Voldoire, A. (2019). Recent changes in the ISBA-CTRIP land surface system for use in the CNRM-CM6 climate model and in global off-line hydrological applications. Journal of Advances in Modeling Earth Systems, 11(5), 1207-1252.

Munier, S., & Decharme, B. (2021). River network and hydro-geomorphology parametrization for global river routing modelling at 1/12° resolution. Earth System Science Data Discussions, 1-28.

Comment R2.3:

L95: this part is the description of study area, so I believe it can be moved to Section 2.

Response R2.3:

"The evaluation of the new irrigation scheme is made over the state of Nebraska (United States of America, USA). This area presents a high density of irrigated fields (Fig. 1) and large freely available observational datasets for evaluation."

Was moved to Section 2.

Comment R2.4:

L105: It's a bit weird wo have this part here, I would move it after the description of model and the new irrigation scheme.

Response R2.4:

We agree. Section 2.1 will be placed at the end of Section 2. Section 2.4 will be moved to the beginning of Section 2 together with Sections 2.2 and 2.3.

Comment R2.5:

L115: specify a bit more how this rule is applied here.

Response R2.5:

Yes. "spatial rescaling" was replaced by "spatial resampling".

The 300 m × 300 m resampled irrigation map was published on zenodo (https://doi.org/10.5281/zenodo.6011618).

Comment R2.6:

L131: give the reasons why you chose this period.

Response R2.6:

"A subset of the ERA-5 forcing over Nebraska was used for the time period from 1979 to 2018."
was replaced by

"A subset of the ERA-5 forcing over Nebraska was used for the time period from 1979 to 2018. This period was chosen in order to encompass various validation datasets."

Comment R2.7:

L195: be simulated or be assigned?

Response R2.7:

"A number of irrigation variables need to be simulated such as the irrigation amount, the irrigation rate"
was replaced by

"A number of irrigation parameters need to be assigned such as the irrigation amount, the irrigation interval".

Comment R2.8:

L238: what is the difference between drip and flood irrigation?

Response R2.8:

"In this study, only sprinkling irrigation is considered."

was replaced by

"In this study, only sprinkling irrigation is considered as this is the dominant irrigation type in Nebraska. Drip and flood irrigation will be evaluated in future works. The activation of a given irrigation method is described in Supplement 5. For sprinkling irrigation, water is added to the precipitation forcing. For drip and flood irrigation, the water flux is applied directly to the soil surface with no leaf interception as explained in section 2.3.1. Considering the static equipment used for drip irrigation, there is no irrigation interval (Δt_{Wn} **= 0 day)."**

Comment R2.9:

L321: since the USGS provide data every five year, then it is possible to compare the yearly irrigation water amount rather than the multi-year averaged value.

Response R2.9:

A direct comparison would not have been statistical significant because complete USGS observations were available only for 6 years during the considered time period.

Comment R2.10:

L327: It is always challenging to evaluate a model by comparing the model output to satellite-based fluxes data, as it is not easy to validate the quality of the data. My suggestion would be doing a single point run, and comparing the results with the station-observed data.

Response R2.10:

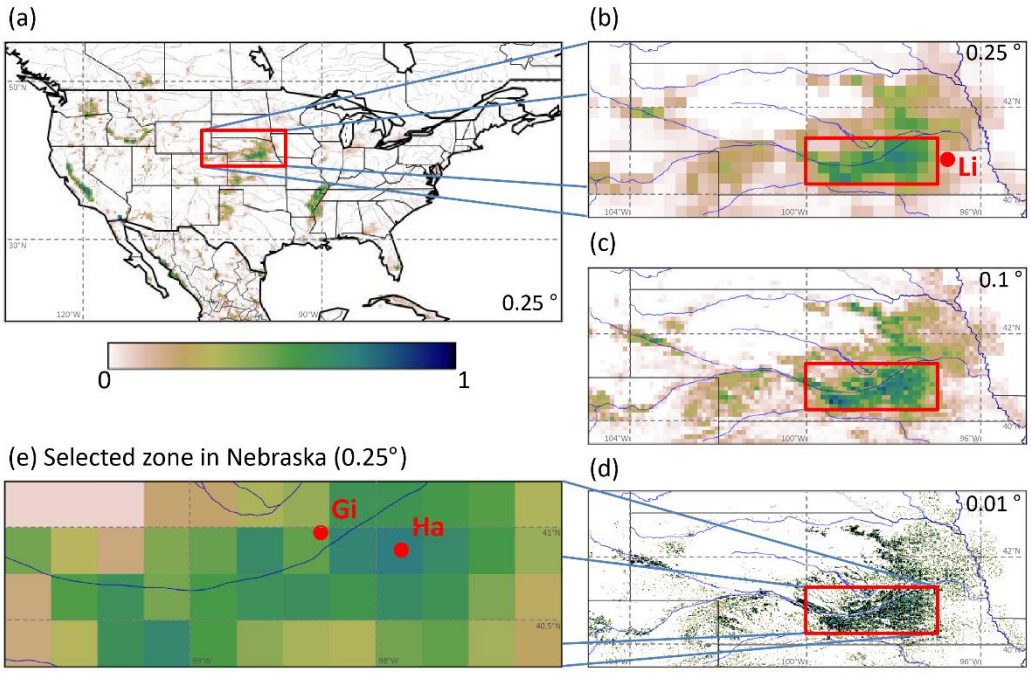
We included new elements in Table 4 showing the added-value of crop and irrigation options on LAI simulation. See response R1.2 to Reviewer 1.

Comment R2.11:

Figure1: Add the lat-lon grid on the frames.

Response R2.11:

This is a new version of Figure 1, incorporating lat-lon grids:



Comment R2.12:

Figure5: Specify that positive value for Correlation (b) means that the result of ISBA_pheno_irr is better, and for RMSD (c) negative value means that result of ISBA_pheno_irr is better. Otherwise it could be a bit confused.

Response R2.12:

A sentence was added to Section 2 specifying this.