Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2020-129-AC2, 2020

Biogeosciences Discussions
Open Access

Interactive comment on "Climate data induced uncertainties in simulated carbon fluxes under corn and soybean systems" *by* Varaprasad Bandaru

Varaprasad Bandaru

vbandaru@umd.edu

Received and published: 30 August 2020

-To test the relative importance of the different forcing climate variables, the author chose to successively replace one variable from the observed forcing dataset by the corresponding gridded variable. Although this method is often used it doesn't respect the physical consistency of the climate forcing (eg: the forcing could impose high shortwave with high precipitation, or low relative umidity with precipitation etc) and depending on the model, this can lead to unrealistic results, specially if the model resolves a surface energy and water balance. This caveat should be at least discussed in the discussion.

Printer-friendly version

Discussion paper

Response: Thank you for your suggestion. To address this, I conducted global sensitivity analysis using extended fourier amplitude sensitivity test (EFAST) method to determine total and first order sensitivity indices for various climate variables. Based on the sensitivity analysis, I revised all the sections of the manuscript. Results did not vary significantly from other previous analysis. However, one major difference is that global sensitivity analysis suggested, shortwave radiation is not a major influential factor under both irrigated and non-irrigated corn and soybean systems which is in contrast to earlier analysis. In the earlier analysis, shortwave radiation is one of the dominant factors influencing NEE under irrigated conditions.

-The author uses relative humidity instead of specific humidity. The problem is that relative humidity mixes information on air water content and temperature.

Response: As per the reviewer's suggestion, vapor pressure deficit was included in the place of relative humidity.

-The author bases its analysis on a comparison between forcing variables from the gridded datasets and the observed ones with mean bias and mean absolute percentage error (MAPE) as metric. He then looks at the impact of these errors on simulated NEE and uses MAPE as metric. The stated goal is to look at the effect of climate data uncertainties on the net carbon balance of crops. To do that the author has to look at bias of NEE, not MAPE. What matters first is the annual amount of carbon absorbed or released. Second, once the author shows the error, he should explain it. This is a modelling study and the author has all the tools to explain what is happening: when NEE is increasing, is it because of an increase in NPP or a decrease in heterotrophic respiration? The author just mentions the possibility although he just has to look at the model results to see what is happening.

Response: We have included bias along with MAPE in the figure 5 (please find attached). As per reviewer's suggestion, we elaborated the discussion section to better explain the changes in the NEE.

Figures a: all the figures should be in color, and the axes titles should be bigger ËŸ

Response: Couple of figures were changed to color. Some figures may not require color as they are bar charts.

Detailed comments: L 182-187: this description is not satisfying. I could not understand what NLDAS is by just reading it. The description from the NLDAS website is not longer and far more informative. “through downscaling” of what ?

Response: Revised the text. “NLDAS is a weather forcing model that downscales NARR weather parameters and adjusts weather variables to account for the vertical difference between the NARR and NLDAS fields. NLDAS produces weather variables at fine spatial (1/8-degree, approximately12 km) and temporal resolution (1-h) (Cosgrove et al., 2003). In addition, it corrects biases in shortwave radiation using Geostationary Operational Environmental Satellite (GOES) data (Pinkeret al., 2003). NLDAS precipitation data are constructed by takingdaily gauge-based precipitation data and disaggregating to hourly resolution using radar data (Xia et al., 2012)”.

L 205: “constitute an independent”

Response: Revised the sentence. “Observational data at meteorological weather stations”

L 229: should be 2.4 instead of 2.3. Similar for all the subsections

Response: Revised all the sections.

L256-263: These steps were not done for calibration also ? if yes, the author should put this before the calibration part. If not he should explain better how they performed calibration without spin-up or soil data.

Response: Corrected this. Spin-up runs were performed during the calibration process.

L 267: - the author should add a Table with the simulations âAËŸ c Unless I missed it, ′ the author doesn’t explain what shortwave data he uses with PRISM âAËŸ c The author ′ should explain how he imposes irrigation

Response: In the place of these simulations, we conducted sensitivity analysis using the EFAST method. For that we implemented 1500 simulations using a range of weather variables produced using variation ranges in climate variables.

L 281-287 : looking at a relative error of temperature in degree Celsius doesn't make any sense because the error is large for small values of T. And small values of T in C don't represent a small store of anything, it is just an arbitrary scale. The results of MAPE would be completely different in âŮęK. Ex: in âŮęC : Wg = 2, Wo = 1 : MAPE = (2-1)/1 % = 100% In âŮęK : Wg = 275, Wo = 274 : MAPE = 1/274 % = 0.36 % It does make sense for variables where the zero is not an arbitrary point like shortwave radiation or precipitation: 0 W means no radiation, and 0 mm means no water. On the contrary 0âŮęC does not mean no energy (0 K does).

Response: Point is well accepted. To clarify that, we included a figure showing the comparison of average values of weather variables from gridded data sources over the growing season.

L 299-306: we would want to know the mean bias over the whole growing season
Response: Mean precipitation bias over the growing season was found to be less than 0.1 mm for all data sources which is mainly due to counterbalance positive and negative bias values over the growing season resulting in very less growing season bias.

L 312: in this section the author has to explain which simulations he is looking at. If I am not mistaken, in Figure 4 and 5 the author looks at the 4 simulations with the 4 untouched gridded datasets and in Figure 6 he uses the additional simulations where 1 variable is changed at the time. This should be clearly stated in the text and in the figure captions. The author could refer to the Table summarizing the simulations I suggested.

Response: Point is well accepted. As mentioned, the section on influence of individual climate variables on NEE estimates was completed revised using global sensitivity

Printer-friendly version

Discussion paper

analysis. We made necessary changes to clearly show the difference between different simulations.

L319: I would talk about seasonal cycle instead of “better alignment”

Response: Point is well accepted. We included seasonal cycle trends as well as overall uncertainty.

L327: this is where the author should look at his model results. He can look at NPP and heterotrophic respiration (or GPP and total respiration) to understand what is happening. A simple description is not enough, this is not data.

Response: Point is well accepted. We elaborated the discussion section to better explain the trends in NEE using NPP and soil respiration values.

L 348 : there seems to be a problem with this sentence

Response: We completely revised this section.

L 354: I believe it should be section 3.1

Response: We completely revised this section.

L 376-378: NLDAS and NARR assimilate weather data, so this argument is not sufficient

Response: The data used by NARR and NLDAS is produced using the Eta model, now referred to as North Amercian Meso (NAM) which is one of the forecast models used for short-term weather prediction in the United States. The text is revised to clarify this.

L 392-394: this argument is not correct for temperature. It depends on the unit chosen (âŮęC instead of âŮęK).

Response: I am not sure about this comment. The uncertainty is estimated using observational data at flux towers which are in the same units.

L395-405: the study covers DoY 90-300, spring to fall. Winter months are not studied, so this all paragraph doesn't make any sense.

Response: Here I meant to say spring and fall. Spring and fall have similar challenges as winter with less prominence. Revised this section to clarify.

L406 Trend is used here (like in the rest of the manuscript) in the common language sense, which is a bit disturbing. The author didn't compute a trend. Reword.

Response: Revised it. "Seasonal patterns and uncertainties in NEE estimates"

L412-415: circular argument – the author should use "assimilation" instead of "sequestration" to avoid this

Response: Corrected it.

L 423-425: problem with the sentence

Response: Corrected it.

L 433: "climate variables won't translate linearly to the. . ." why would the author believe that ? I would add "As expected . . .."

Added "as expected"

L437: "However, the biases . . .." I don't believe the author showed this result.

Response: Biases were shown in figure 5.

L457-459: what is the link between "daily biomass" (what is this? a stock or a flux?) and NEE ? If you use this argument you have to show these results from the model.

Response: Daily plant biomass determines NPP. Revised the text to clarify it.

L470-472: "shortwave radiation determines total potential biomass": this is extremely strange. SW radiation is the primary driver of photosynthesis. EPIC doesn't calculate Photosynthesis?

Response: Crop growth model in the EPIC is based on Monteith's light use efficiency concept, and it uses shortwave radiation to estimate APAR, which determines the potential biomass based on light use efficiency values of individual crops.

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2020-129, 2020.

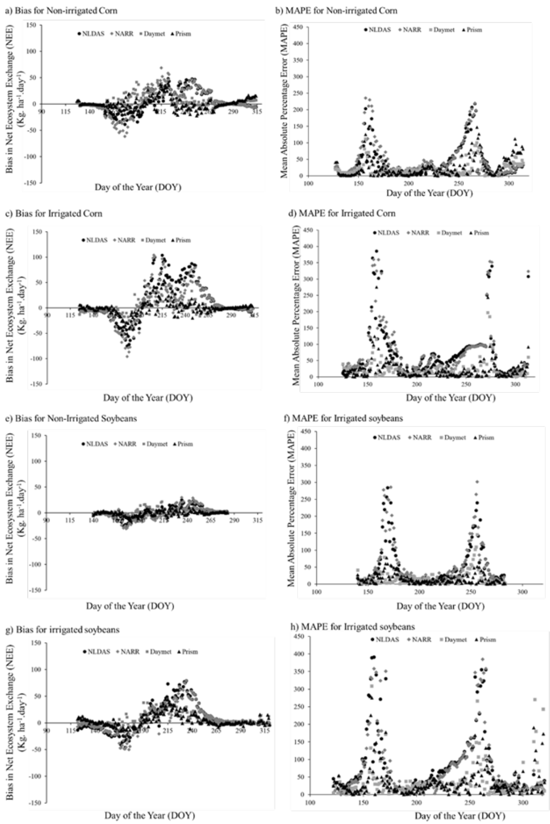

Fig. 5. Comparison of bias and Mean Absolute Percentage Error (MAPE) in daily Net Ecosystem Exchange (NEE) estimates for irrigated and non-irrigated corn and soybeans, simulated using gridded climate datasets.

Fig. 1.

Printer-friendly version

Discussion paper