

Response to Reviewers

Many thanks for your comments, we have addressed them below. Reviewer comments are in blue and our responses are in black.

- This is silly, but: I really like the color of your tracked changes!

Thanks!

- Thanks for defining ISIMIP in the abstract, but Project should also be capitalized.

Thank you this has been corrected in the manuscript.

- Consider adding the "10k-20k more efficient" number you mentioned in your reply to Reviewer 2 —that's huge!

Yeah 😊. Added.

- L41: Comma should be a semicolon

Thank you this has been corrected in the manuscript.

- L74: Comma needed after "crops"

Thank you this has been corrected in the manuscript.

- Please add text explaining that pasture PFTs are not grazed or otherwise managed.

Added text to say this on line 77:

Both crop and pasture surface types undergo land-use change according to externally forced time-varying land use, but the pasture is not grazed and is otherwise unmanaged.

- L81: Consider reverting "C3G" and "C4G" to "C3 grasses" and "C4 grasses" for legibility. These abbreviations aren't used elsewhere in the manuscript. (I agree with your revision to include the abbreviations next to the initial PFT definitions, as this will likely help future users of your outputs.)

Reverted to using C3 Grasses and C4 Grasses in main text and only using C3G and C4G in the plots.

- L87: Comma should be a semicolon.

Thank you this has been corrected in the manuscript.

- L99: "carbon assimilation" should be "net primary productivity", no? "Carbon assimilation" refers to GPP. What is "nutrient support"?

We have change this sentence to read *"This results in a reduced carbon assimilation Net Primary Production (NPP) when we include nitrogen limitation."*

- L113-119: For readability, please replace "C3Cr and C4Cr PFTs" with "cropland" and "C3Pa and C4Pa" with "pasture".

Reverted to using C3 Crop / C4 Crop and C3 Pasture / C4 Pasture where needed in manuscript.

- L119: Please briefly summarize how crop and pasture burning differ from natural grasslands.
- L137: "Convective occurs" needs a noun in between—probably "rainfall".

Thanks this has been corrected in the manuscript

- L171–2: "transiting" should be "transition" "historical" should be "the historical period"

Thanks this has been corrected in the manuscript

- Table 1 is missing sea-level air pressure. Is this because it's the only one JULES doesn't use? If so, indicate that only used variables are included.

Thanks this was an oversight in reproducing the table and has been added to Table 1 now.

- L195: Comma should be a semicolon.

Thanks this has been corrected in the manuscript

- L197: Delete Rose, as it's a technical term not previously defined.

Reference to Rose has now been removed in the manuscript

- L198: Capitalize Github.

Thanks this has been corrected in the manuscript

- L208: Sentence should start with "The"; line should end with a comma.

Thanks this has been corrected in the manuscript

- L209: Missing word? An "ancillary" what?

Thanks this has been corrected in the manuscript

- L224: Missing word after "smaller".

Thanks this has been corrected in the manuscript, so the sentence now reads:

Strong variations between the simulations are also seen in the Brahmaputra basin with some smaller variations in the Chang Jiang basin.

- L228–9: Are "river channel evaporation and transmission losses" anthropogenic? If so, please add a brief explanation; otherwise, please rework this text.

Not necessarily, though we realise the sentence makes it sound that way. We have reordered the sentence to read *"In arid and semi-arid basins river flow and runoff tends to be over-estimated, which could be due to missing processes such as river channel evaporation and transmission losses (Haddeland et al., 2011; Döll and Siebert, 2002) and anthropogenic water extraction, primarily irrigation (Richey et al., 2015)"*.

- L291: "to low" should be "too-low" Replace "Australia in" with "Australia, which is" "model" should be "models"

Thanks this has been corrected in the manuscript

- L296: Hyphen needed in "too low".

Thanks this has been corrected in the manuscript

- L297: Replace "like" with "as in".
Thanks this has been corrected in the manuscript
- L298: "to high" should be "too-high".
Thanks this has been corrected in the manuscript
- L317: Start sentence with "Without fire," to contextualize "already".
Thanks this has been corrected in the manuscript
- L357: Comma needed before "or". Also: Consider replacing "or" and following with "and vice versa".
Thanks this has been corrected in the manuscript
- L358: "North" shouldn't be capitalized.
Thanks this has been corrected in the manuscript
- "The observed Sahel"? Delete "observed"?
Thanks this has been corrected in the manuscript
- L360: ", for example" should be "; for example,"
Thanks this has been corrected in the manuscript
- L361: Comma needed after "trees".
Thanks this has been corrected in the manuscript
- L363: ", however" should be "; however,"
Thanks this has been corrected in the manuscript
- L386: "including lack of larch forest" isn't really complete; please rework. E.g., "for example by simulating too little larch forest". This would also make the sentence easier to read if it were in parentheses rather than being offset with commas.
Thanks this has been corrected in the manuscript
- L560–1: I'm confused by this sentence, I think because of ", however,".
I think this is in reference to Figure 1, as the caption is on line 650 which is similar to 560?
On this basis, we have amended the text in the Figure 1 caption to be as follows:

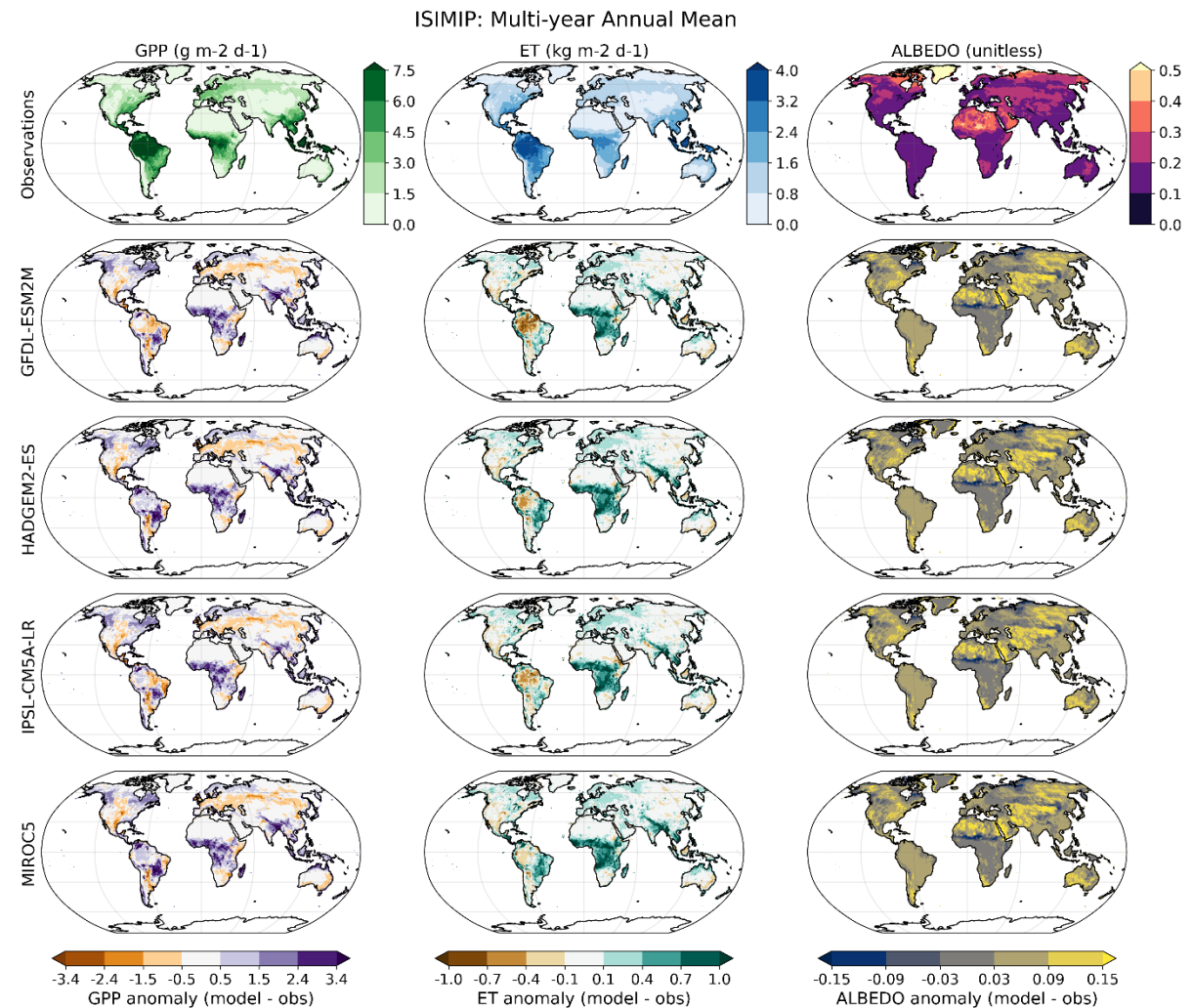
Figure 1: Multi-year mean bias of catchment scale runoff simulated by JULES driven by 4 sets of climate driving data compared to runoff derived from (Dai, 2021). Number of years of observations contributing to the multi-year mean varies depending on catchment and the observations that are available. Observations used are within the period 1980-2006. ISIMIP2b forcing data derived from 4 CMIP5 GCMs: GFDL-ESM2M; HadGEM2-ES; IPSL-CM5A-LR; MIROC5.

- Fig. 3: Legend text is much too small. Text in figures should not be much smaller than caption text. Albedo units should be "unitless", not "unknown". Left-most color scheme is improved, but there's still both red and green. Please improve colorblind-friendliness, perhaps by using the same color scheme as the right-most column. ColorBrewer is a good resource, as is the Color Blindness Simulator. Observed albedo color bar: It looks like everything from 0.5 to >0.8 is the

same color. You can thus set the "over" triangle to start at 0.5. (Similar issue with observed ET color bar.)

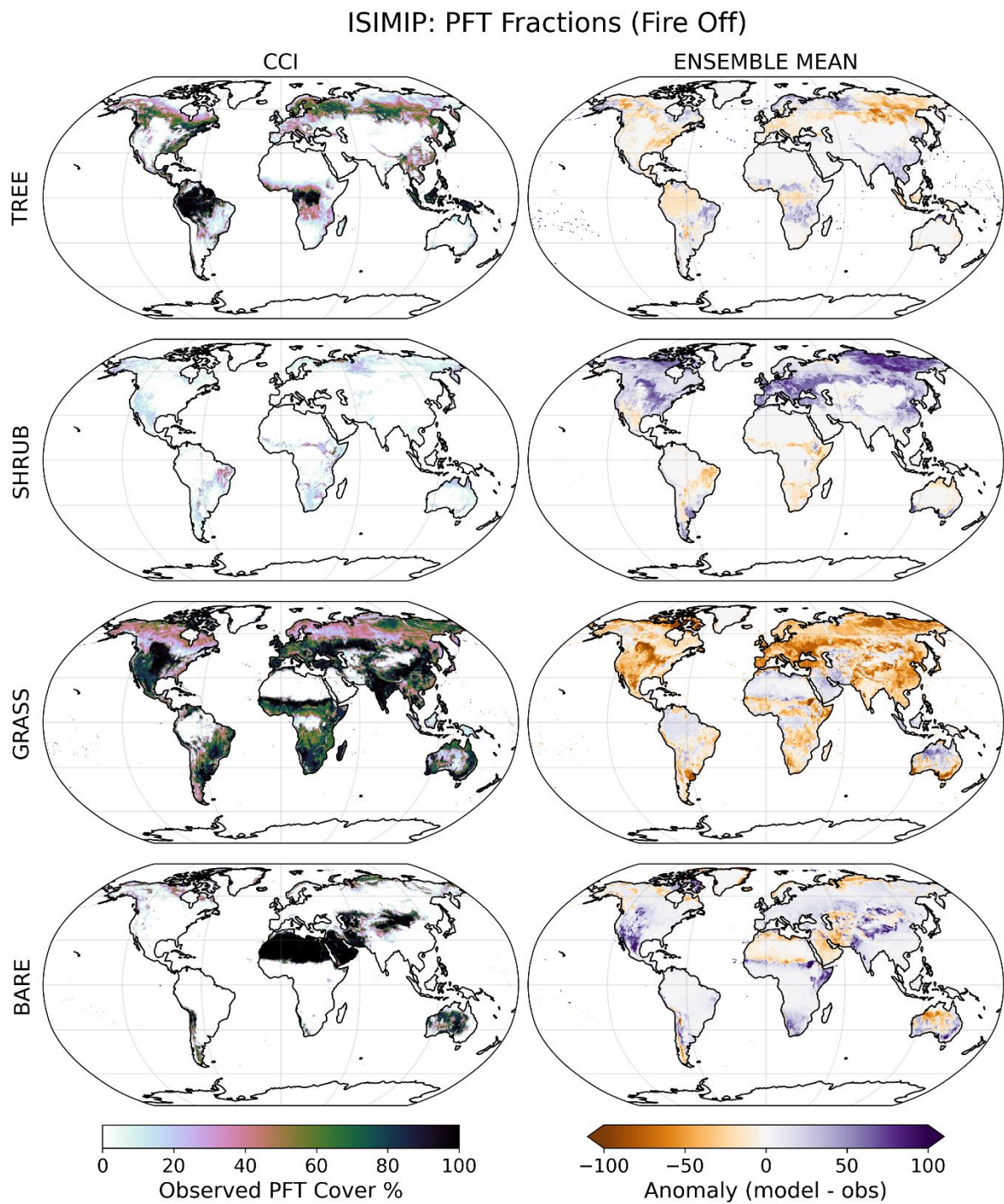
We have made changes to the figure in the manuscript, as shown below. I think we have addressed all issues:

- Font sizes increased everywhere
- Legends clearer, and no redundancy
- Colour schemes are now colour-blind safe
- Albedo units corrected



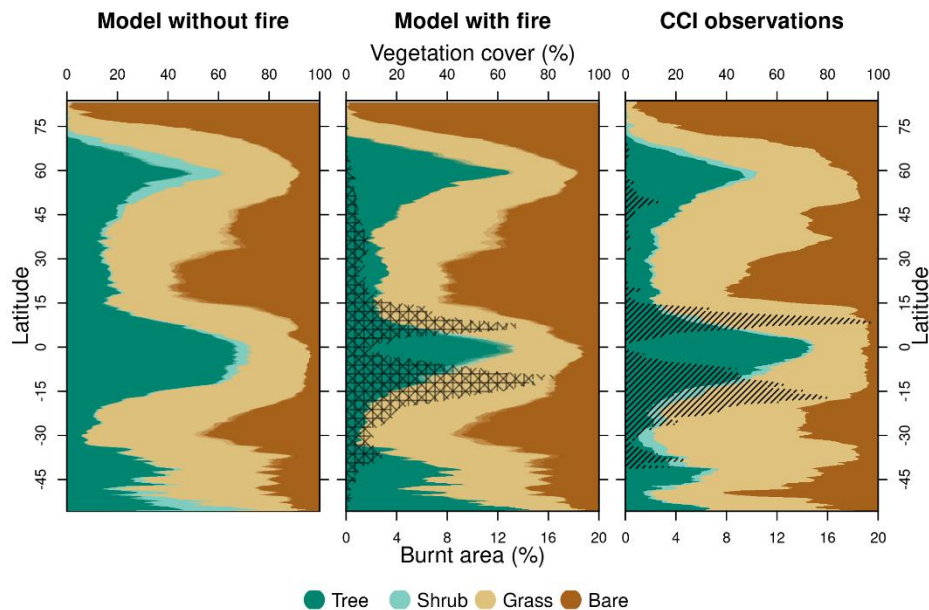
- Fig. 4: Legend text is much too small. Maps are also really small; consider splitting into two figures (perhaps with one in Supplement.)

We have made changes to the figure. As suggested, we reduced the complexity of the figure by calculating an ensemble mean vegetation distribution, and just showing the anomaly of that in comparison to observations. There were very minimal differences between each ensemble member. The figure now looks like this in the manuscript:



- Fig. 6: Legend text and axis tick labels are slightly too small. Figure labels are hard to read; please move them off the plots and into the surrounding whitespace.

We have made changes to the figure, which now looks like this in the manuscript:



- Code availability: Please explain that accessing the JULES-ES source code requires registration and that this can be requested at https://jules-lsm.github.io/access_req/JULES_access.html. (This is linked in the Wiltshire et al. paper you referenced, but it's important enough that it should also be here.)

Added text as in Wiltshire et al to explain access to JULES code:

Note that to view and use the JULES-ES source code, access will be required to the Met Office Science Repository Service (<https://code.metoffice.gov.uk/trac/home>) and is available to those who have signed the JULES user agreement. The easiest way to access the repository is by completing the online form to register here: http://jules-lsm.github.io/access_req/JULES_access.html

- Fig. S2: Consider converting m/m² to mm (multiply by 1000), as this is a unit more readers will be familiar with.

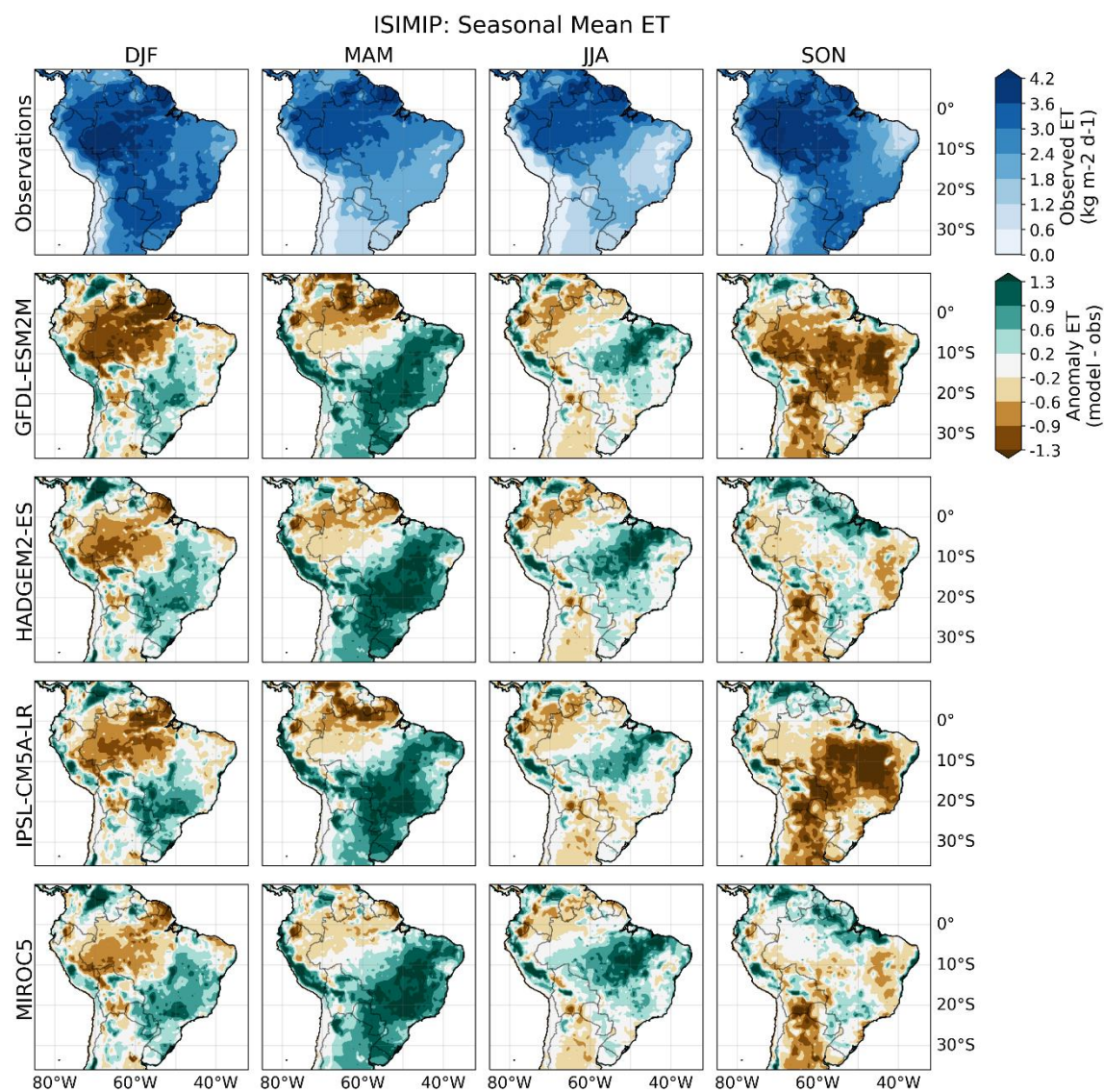
We have made this change

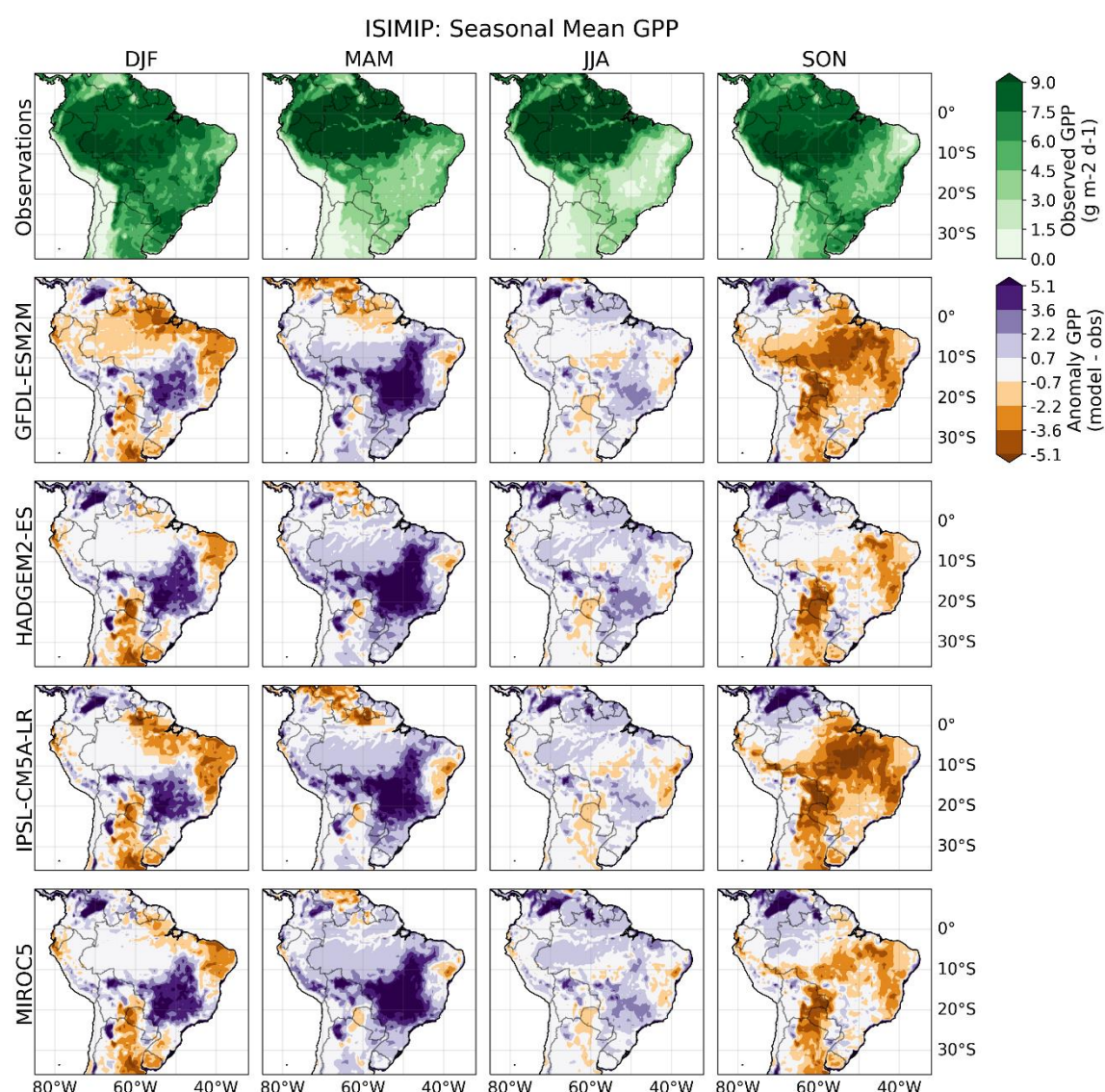
- Fig. S3: Caption needs a period at the end.

Added

- Figs. S4 and S5: Legends are still too small to read, as are lat/lon labels. Row/column labels are better but still a bit small.

Done. Figures changed to increase font sizes in legends, lat/lon labels and row/column labels. As follows:





- In your response to Reviewer 2's comment about Fig. S1, you say "See comment above." What comment, exactly?

It is in response to the reviewers comment about line 129 of the original m/s, were we wrote:

ISIMIP has huge data requirements, and once we finalised development, we only retained the data required for ISMIP submission and evaluating and using the final configuration. We, therefore, did not retain outputs for the variables listed by the reviewer. The extensive evaluation throughout the rest of the study demonstrates that the ISMIP set-up, including the disaggregator, does not degrade model performance. We now realise that picking out the disaggregator for additional supplementary consideration is a distraction from the paper's main aim. We will remove this plot from the revised manuscript.