Effects on Early Monsoon Rainfall in West Africa due to Recent Deforestation in a Convection-permitting Ensemble

By Julia Crook et al

The paper addresses the effects of historical deforestation in West Africa on rainfall and other meteorological variables in the same region. They use a seemingly novel approach based on 5-day convection-permitting ensemble forecasts coupled to a modular land surface model which allows them to attribute regional meteorological changes directly to vegetation-induced changes in surface fluxes, roughness, and albedo without large-scale circulation feedbacks. After a regional scale discussion of the results they focus on two regions with contrasting initial soil moisture conditions and analyze processes related to rainfall in detail.

I was asked to evaluate if the authors responses to Reviewer 1 were sufficient and I was not reviewer in the previous round. In addition, I provided some comments that hopefully help the authors to further improve their manuscript. My main concern is the statistical significance testing (see comment below). The paper is clearly written and structured. My impression is that this is a creative and novel approach and I'd be happy to see it published in WCD once the remaining issues are addressed.

In the following I briefly evaluate the responses separately for each of the reviewers comments. In my impression only for comment 3 it is not clear if the authors addressed the reviewers concerns appropriately.

1. I find the section 2.1.3 now clearly written even though I can't judge how reasonable the switching off of soil evaporation is. In general, I find the paper mostly clearly written.
2. The model is now well described, the motivation for its use is stated and the limitations are mentioned.
3. If I understand the comment of Reviewer 1 correctly, the authors are asked to compare their modeled precipitation to observations. As the starting date of the runs is 1st June 2014, rainfall should be compared to measurements during 1st – 5th June. The authors elaborate on why they can't use observations directly but I'm not 100% convinced. If I understand correctly, the "current" forecast is more or less a "real" forecast for 1st – 5th June 2014. Comparing this output to observations of that period should be possible and I think important to do in this study. Of course the focus of this study is not on forecast validation but on the effect of deforestation. Nevertheless, a comparison to observations would provide important context.

4. The authors well explain their rationale to selected the two study regions
5. Ok
6. Ok
7. Ok

Comment

I appreciate that the authors used a statistical significance test. However, there needs to be a clearer description of the method used. Importantly, did the authors account for multiple testing, i.e. was the false discovery rate controlled (Wilks, 2016)? If not, this is an issue because significance could just emerge by chance when so many tests (over the whole study domain) are done. This correction could be done, e.g. with a Benjamini-Hochberg correction (for python, see https://www.statsmodels.org/dev/generated/statsmodels.stats.multitest.multipletests.html). Also this correction could help remove some of the patchiness of some of the plots such that there is more focus on the dominant differences.

Minor comments

L19 “we for the first time estimate” → I’m not a native speaker but to my ears it sounds better to say “we estimate for the first time”, or maybe remove “for the first time” completely

L25 “thermally induced enhanced” → “thermally enhanced”

L43 Unclear if you only talk about the biogeophysical changes or also the biogeochemical changes. With regard to the former it seems more precise to say “local (surface) warming”

L79: They found **that** the enhanced (?)

L156: real life → reality

L204: Figure 2, which indicates the simulated region, shows maps of …→ Figure 2 shows maps of (...) in the target region

L206ff: I suggest revising this section and potentially split it in two. The first paragraph is about the statistical significance test so it could have its own section named “Statistical significance test”. The second paragraph is in principle only about the criterion for the definition of deforestation. This topic already appears in Fig 2g which is referred to in the previous section (section 2.2). Hence, the description of the criterion for deforestation could be simply added in section 2.2. In my opinion, there is no need to describe that you look at two focus regions or that you first compare albedo etc. This could be part of an introductory paragraph to the results section and not the methods section. I’m aware this is also a bit a matter of taste but I just feel it improves readability.

Further, the first paragraph of section 2.3 suggests that for albedo, surface roughness, and initial soil moisture you also use a T-test to assess statistical significance. However,

it is unclear to me how this can be done given that (if I understand the methodology correctly) for these variables you only have one field for 1950 and one for current condition (i.e. no ensemble members). If you don't use a T-test, then there is no need to mention these variables in this section.

L235: highFSMC → high FSMC

L244: Detail but I find LH as abbreviation of latent heat flux more intuitive. This would also be consistent with the abbreviation of sensible heat flux (SH)

L250: strong,radiative → strong, radiative

L262ff: Sentence structure is unclear. Why does net downward long-wave radiative fluxes decrease? And what does this have to do with reduced roughness length? Is it that reduced roughness length warms the near surface (as a result of reduced heat land-atmosphere heat fluxes) which, as near surface temperature rises, leads to larger upward long-wave radiative fluxes? This will then, when downward long-wave remains constant, lead to a decrease in *net* downward long-wave radiative fluxes. If this is how we need to think about it I would appreciate a bit a clearer explanation here.

L268: may dominate. , → remove period

L271: increases long-wave emission: not sure if it is clear that this refers to long-wave emission by the surface, and not by the atmosphere. Maybe a clarification would help.

L360: these regions. → period missing

L375: whenoceanic → when oceanic

L377ff: I find the last part of this sentence not very clear. Maybe try: "to show that to understand rainfall changes it is crucial to analyze how deforestation affects dynamics and thermodynamics"

L382 and elsewhere: To improve readability, I suggest to use approximately or approx. instead of ~

L384: "The regions of positive convergence coincide with the high rainfall patterns." Not sure if I agree. If I compare Fig. 8a and 8c I see that convergence and rainfall coincide sometimes but not always/everywhere. Do you refer only to a certain part of the plot? If yes, it would be helpful if it was specified which part.

References

Wilks, D. S. (2016). "The Stippling Shows Statistically Significant Grid Points": How Research Results are Routinely Overstated and Overinterpreted, and What to Do about It, *Bulletin of the American Meteorological Society*, *97*(12), 2263-2273. Retrieved Jan 12, 2023, from https://journals.ametsoc.org/view/journals/bams/97/12/bams-d-15-00267.1.xml