

Earth Syst. Dynam. Discuss., community comment CC1  
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## Comment on esd-2022-5

David Wårlind

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Community comment on "The biogeophysical effects of idealized land cover and land management changes in Earth system models" by Steven J. De Hertog et al., Earth Syst. Dynam. Discuss., <https://doi.org/10.5194/esd-2022-5-CC1>, 2022

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Some questions that will focus on the EC-Earth model:

EC-Earth description (row 128)

- LPJ-GUESS does vegetation dynamics, but not energy balance. So how is the surface energy then calculated would be the first question of a reader? I'm puzzled that nowhere in the manuscript is HTESSSEL, that does the surface energy and water balances, mentioned. HTESSSEL is the main component you need to understand to figure out why EC-Earth is behaving as it does in this study. HTESSSEL receives vegetation fractions, LAI, and type for high and low vegetation from LPJ-GUESS. The types have specific parameters for albedo, roughness length etc associated with them in hard-coded look-up tables in HTESSSEL. In this section, you will need to add a description of HTESSSEL and its biogeophysics.

Spinup (row 149-150)

- Have any legacy effects, on climate, vegetation, C and N pool/fluxes, disappeared after these 10 years? Or you are not after an equilibrium state after these 10 years for the CTRL simulation? And for the FRST you would need more than 10 years to get a fully mature forest in areas of transitions to natural land cover (where trees grow), in LPJ-GUESS.

100% forested world (Figure 1, row 174)

- If you set the Natural land cover fraction to 1 for all gridcells in the input file for LPJ-GUESS, then you have a 100% potential forest world. But then the question comes. Will trees grow everywhere with 2015s climate? In reality, it doesn't, and nor for EC-Earth/LPJ-GUESS, as you see in figure 1. The other models have set the physical parameters to represent a forest, but they don't either have a forest with biomass in all the areas (the forest isn't growing at high latitudes, tundra regions). Why hasn't EC-Earth done the same with prescribing a 100% forest world in HTESSSEL and then letting LPJ-GUESS do the biogeochemical cycles as in the other models?

EC-Earth doesn't have any bushes (shrubs) (row 175).

Latent and Sensible heat (figure 4)

- Here you need to study and understand what HTESSSEL is actually doing (not LPJ-GUESS). Opposite sign for both latent and sensible heat compared to the other models (sign convention in HTESSSEL)? How have the different vegetation types in HTESSSEL affected this? Especially for fig 4c as the albedo effect between a crop type world in HTESSSEL can't have the same value as a forest type world.

No FRST-CTL effect (row 386-388)

- The only fraction of gridcells that get afforested in EC-Earth is areas that used to be cropland or pasture. When do you start to look at the effects of afforestation? LPJ-GUESS won't be able to have a fully-grown forest after the 10 years of "spinup" that you have after the change. It will take a while for bare soil after the transition to grow a mature forest. For some areas, it may be 100s of years. So, if you look at the effect after a shorter time period than that, then you will not have the effect of a forest, but rather a grassland mixed with trees. How is it in the other models? Do they have a mature forest directly after a transition into a 100% forest world? The trees are just there from one day to the next and growing?

Irrigation expansion (row 410-412 and 489-490)

- As there is no effect in HTESSSEL from the irrigation in LPJ-GUESS (water cycles are disconnected) I wonder if there is an idea to look at this setup with EC-Earth? Also, crop vs irrigated crop type physical parameters in HTESSSEL doesn't differ.

Cropland expansion (row 441-443 and 455-456)

- HTESSSEL will be using cropland vegetation type values instead of forest values. How do these differ? Boysen et al. 2020 found that HTESSSEL didn't run out of water despite high AET from the overproductive grass. But here we have crops, which will only be present at a fraction of the year, and then there will be bare soil (high LAI during crop growing season and zero when crops have been harvested), which should result in high sensible heat. But HTESSSEL will see it as a crop type the whole year, so might be that the HTESSSEL values aren't affected that much by the zero in LAI?
- How can't there be any albedo effect? Should be albedo differences between forest vegetation type and cropland type in HTESSSEL.