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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Global distribution of hydrologic controls on forest growth" *by* Caspar T. J. Roebroek et al.

Anonymous Referee #2

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General comments: In their work the authors present a method where they link forest growth patterns to precipitation and water table depth on the global scale. They use long term high resolution satellite products for fAPAR, modelled groundwater table depth and globally distributed precipitation. They have developed a classification scheme of ecohydrological classes based on the correlation between water table depth and fAPAR as well as precipitation and fAPAR. To assess the impact of climate and landscape position on the distribution of these ecohydrological classes, the authors make use of the Köppen-Geiger classification (climate) and 7 landscape classes derived from the global water table depth map. They discuss and illustrate their findings for several regions of the globe. In the end, based on their findings they develop a conceptual framework of forest growth and its link to hydrologic gradients in the landscape.

Finally, the authors discuss how their findings can support a better representation of forest growth in global environmental modelling which is still a relevant question. The manuscript is well written and conceivable. It is provided with an extensive supplement which contributes to the understanding of the manuscript. There are some small points which should be clarified because they might lead to misinterpretations which, I will address in specific comments section and section for technical correction. However, I have two major points which should be discussed by the authors with more emphasis. How have the landscape positions been validated, the map presented in Figure S6 makes sense at the global scale, but how valid are the results if you look at the landscape scale, where the authors develop their conceptual framework? I assume this can be easily done with global topography data such as SRTM. I would encourage the authors to discuss this a little bit more in detail since the landscape position is a critical part in your analysis. In the description of the Ecohydrological classes in section 2.3 I would stronger present the effects of temperature on forest growth in the higher landscape positions to avoid misinterpretations. Since this class is mostly present in the higher landscape classes of the temperate regions.

Specific comments

statement line 12 to 14 In my mind this statement is only true for water limited areas. For more humid, energy limited environments like the temperate and boreal zones I am not sure whether water availability determines whether vegetation grows or not especially when it comes to trees. I would argue that in the colder climates and higher mountainous areas plant growth an especially Tree growth is also limited by temperature which can be clearly also seen by the tree line distribution in the high mountain areas in the temperate regions as well as in the northern climates.

Statement line 16 to 20 This statement might be true on large continental scale, however as experiences of the drought years 2018 and 2019 in Europe have shown that forests mainly consisting of species trees species with shallow roots such as spruces suffered serious damages during the droughts.

Statement line 45 to 47 Rooting depth also depends soil properties like the existence of a layer of higher density in the soil profile. This is for instance very often the case in landscapes which have developed after the glaciation period or have been influenced by glaciation (e.g. in North America, Central Europa, Northern Part of Asia).

Figure 6: I would have expected a stronger temperature effect on forest growth also in the lower landscape classes like low mountain areas and hilly landscapes. How can this be explained?

Figure 7: For the boreal and temperate regions the figure indicates a deep and unchanging rooting depth from low mountainous, mountainous and high mountainous regions. This is misleading. In fact in these areas the rooting depth decreases with elevation. In the higher elevations only shallow soils over bedrock can be found. So the development of the rooting depth should be similar as presented in the arid region.

Technical note:

Legend Figure 1 change contrained to constrained

Figure 7 the color codes of the arrows and lines need to be explained, either in the legend or the figure caption

Figure S20 the figure caption mentions relationship between fAPAR and climate and landscape positions but the legend says WTD, please clarify.

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