

Title: Can large-scale tree cover change negate climate change impacts on future water availability?

Authors: Engel et al.

Review

This manuscript describes an initial evaluation of how possible future tree planting (up to the potential carrying capacity) would interact with climate change to change water availability. The study is a useful first estimate of an important practical problem since tree planting is often promoted as being a suitable mitigation strategy.

The topic is suitable for the journal and the paper is very well written and easy to follow. I had very few substantive comments.

As an initial study of a complex phenomenon it has many drawbacks but to the credit of the authors many of those are described in detail in section 4.

One aspect of the project design/methodology that was not commented upon is the inclusion of the Budyko process to separate P into Q and ET. I did not understand why this step was included since the climate model projections include ET and Q and you could use those directly. (See Roderick et al 2015; Milly & Dunne 2017). (Also see point 3 below.)

I think it might be useful to extend the discussion a little further to give full context. The idea of planting trees to their “potential” and then assessing the hydrologic changes is challenging but useful. Overall the global impacts of tree planting (or climate change) on runoff were small (Fig. 3) but could be important locally. Imagine we actually did plant all of those trees. The other impacts are on biodiversity (likely increase) but the big impact would be on agricultural production which would decrease (by a lot). Something should be said about this in the discussion.

Details

1. Line 16. “.... Water availability with more than 5 mm yr⁻¹.” I did not understand what the 5 mm yr⁻¹ was referring to?
2. Line 34. Typo. ... increased **by** more
3. Line 403-404. Yes, the Budyko models do not explicitly account for that but the climate models do (see Yang et al 2019, Hydrologic implications of vegetation response to elevated CO₂ in climate projections, Nature Climate Change). This begs the question of why use the Budyko models to split the P between ET and Q. You could use climate model output directly and avoid the Budyko step in the methodology.

References Cited

Milly, P. C. D. and Dunne, K. A.: A Hydrologic Drying Bias in Water-Resource Impact Analyses of Anthropogenic Climate Change, *Journal of the American Water Resources Association*, 10.1111/1752-1688.12538, 2017.

Roderick, M. L., Greve, P., and Farquhar, G. D.: On the assessment of aridity with changes in atmospheric CO₂, *Water Resources Research*, 51, 5450-5463, 10.1002/2015wr017031, 2015.

Michael L. Roderick, 1/10/2024