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Hydrological implications of future tree cover change and climate change

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The availability of fresh water over land may become increasingly scarce under climate change. Future large scale tree cover changes can either enhance or mitigate this water scarcity. Previous work focused mostly on the impact of tree cover change in our current climate. Instead, we investigate the impact of climate change and future global tree cover change on precipitation, evapotranspiration, and runoff (water availability) in a future climate. To do so, multiple datasets and methodologies are combined; data from five CMIP6 models, a future tree cover change dataset, six Budyko models and a moisture recycling dataset. With this interdisciplinary data-driven approach the separate and combined effects of future climate change and future large-scale tree cover change can be quantified. The changes in water availability are studied on grid cell level (1 by 1 degrees), averaged over the globe, and aggregated for selected river basins (Yukon, Mississippi, Amazon, Danube and Murray-Darling).

Globally averaged, future climate change results in an increase in runoff where future tree cover change decreases the runoff. Both effects are of similar magnitude and lead to a limited net effect in water availability compared to the present climate. However, locally, the effects of tree cover change and climate change can be substantial, resulting in changes in water availability of more than 100 mm/year, either positive or negative. For the five selected river basins different responses in direction and magnitude of water availability are found due to future tree cover change under climate change. In all catchments, except the Mississippi basin, the climate change signal dominates over the tree cover change signal. For the Mississippi basin we find a dominant impact of tree cover change, opposite to the climate change signal, resulting in reduced water availability.