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On the impact of land use changes in terrestrial water cycle and the role of plant trait variability

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The impact of land use changes, together with variability in climate forcing, is of utmost importance for making projections of future terrestrial carbon and water dynamics. Terrestrial ecosystem models are widely used for quantifying such impacts at the catchment, regional, and global scales. They usually approximate vegetation heterogeneity with broad categories, named Plant Functional Types (PFTs), following a generic land use classification. Despite most of the studies analyzing the impact of land use changes in terrestrial water and carbon cycle are made using the PFTs conceptualization, the approach has been recently criticized. This is mainly due to mounting evidence of high inter- and intra-specific plant trait variability. In the present study, we use a trait-based approach to quantify the impact of land use changes in terrestrial water cycle (i.e. transpiration, evaporation, recharge). More specifically, proxy plant species are generated using an empirical distribution of plant traits as well as their observed cross-correlation. Their behavior is tested using a mechanistic ecohydrological model (T&C) that computes the influence of plant traits on the water cycle (e.g., transpiration, soil water dynamics). Plot scale simulations are carried out for a range of climates representative of different elevations and wetness conditions in the European Alps. In order to quantify the importance of topography and lateral water fluxes, catchment scale simulations are also performed. To this purpose a small experimental catchment, located in northeastern Switzerland, is selected for testing spatially explicit, land-use change scenarios. Using this framework, we investigate the sensitivity of terrestrial water dynamics to changes in land cover. While plant trait variability leads to highly different vegetation carbon dynamics, water fluxes are only marginally affected. These results highlight that the impact of changes in land cover (e.g., grassland, evergreen, deciduous, or mixed forest) in terrestrial water dynamics, may not be as pronounced, at least in wet regions, as often articulated with numerical simulations based on the PFT conceptualizations or from small scale manipulation experiments.