Changes in root zone storage capacity and their effects on river discharge and gross primary production

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Root zone storage capacity \((R_z)\) is a parameter widely used in terrestrial ecosystem models that estimate the amount of soil moisture available for transpiration. However, \(R_z\) is subject to large uncertainty, due to the lack of data on the distribution of soil properties and the depth of plant roots that actively take up water. Our study makes use of a mass-balance approach to investigate \(R_z\) in different ecosystems, and changes in water fluxes caused by land-cover change. The method needs no land-cover or soil information, and uses precipitation (P) and evapotranspiration (ET) time series to estimate the seasonal water deficit. To account for some of the uncertainty in ET, we use different methods for ET estimation, including methods based on satellite estimates, and modelling approaches that back-calculate ET from other ecosystem fluxes. We show that reduced ET due to land-cover change reduces \(R_z\), which in turn increases baseflow in regions with a strong rainfall seasonality. This finding allows us to analyse the trade-off between gross primary production and hydrological fluxes at river basin scales. We also consider some ideas on how to use mass-balance \(R_z\) in water-stress functions as incorporated in existing terrestrial ecosystem models.