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# Using optimality principles to couple terrestrial carbon and water cycles in hydrological models

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Hydrology has been guided by establishing empirical relationships between the movement of water through landscapes and the application of the conservation of mass law in catchments. This has resulted in models with complex calibration frameworks that often overlook the physical and biochemical water-related processes linking plants to hydrological cycles. Studies have revealed that some of the empirical relationships in catchments might also reflect a potential ecosystem's coevolution with climate, driving catchments to optimise their supply and demand limits. This agrees with the eco-evolutionary optimality principles used in vegetation modelling that are based on the hypothesis that canopy conductance acclimates to environmental variations by balancing the costs of carbon assimilation and maintenance of transpiration rates. Here, we developed meaningful interfaces between simple models and approaches based on the use of optimality principles in vegetation modelling and hydrology. Our work is based on the application of the P-model to estimate to quantify gross primary productivity and transpiration and the use of a mass-balance approach to quantify the root zone storage. These integrations not only provide a more nuanced understanding of hydrological processes but also pave the way for more accurate and physically-informed models in hydrology. Our findings underscore the potential of using eco-evolutionary principles as a unifying framework in hydrological research, offering new insights for understanding and predicting water movement in catchments under varying climatic and ecological conditions.