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Rooting depths regulate the global water cycle

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Ecosystem productivity and evapotranspiration fluxes are fundamental regulators of the global carbon and water cycles. Where and how much plants grow is largely determined by atmospheric conditions and soil water availability. It is the reliance of ecosystems on soil water that links their fate tightly to precipitation and groundwater reach. Here, we explore the controls on plant root uptake imposed by climate at the large scale and by groundwater accessibility at the local drainage scale, aiming to untangle the spatial and temporal global patterns of rain-fed and groundwater-fed ecosystems. To this end, we use observed atmospheric and productivity conditions to model the seasonal evolution of root uptake and soil moisture profiles and their coupling to the water table, with a global groundwater-soil-vegetation framework at the 1km resolution. Results indicate highly variable uptake-depth across seasonal and local hydrologic gradients, and a far more common occurrence of deep (>5m) uptake than previous thought. Implications to future environmental change are briefly discussed.