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Global distribution of groundwater-vegetation spatial covariation

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Groundwater is an integral component of the water cycle, and it also influences the carbon cycle by supplying moisture to ecosystems. However, the extent and determinants of groundwater-vegetation interactions are poorly understood at the global scale. Using several high-resolution data products, we show that the spatial patterns of ecosystem gross primary productivity and groundwater table depth are correlated during at least one season in more than two-thirds of the global vegetated area. Positive relationships, i.e. larger productivity under shallower groundwater table condition, predominate in moisture-limited dry to mesic conditions with herbaceous and shrub vegetation. Negative relationships, i.e. larger productivity under deeper groundwater table condition, predominate in humid climates with forests, likely, indicating a drawdown of groundwater table due to substantial ecosystem water use. Interestingly, these opposite groundwater-vegetation interactions are primarily associated with differences in vegetation than with climate and surface characteristics. These findings put forth the first evidence of an extensive and non-negligible groundwater-vegetation interactions at the global scale. Simultaneously, it also highlights the need for better considerations of groundwater-vegetation interactions and their determinants in studies linking global carbon and water cycles.