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The role of water in the fate of carbon dioxide: Implications for the climate system

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Terrestrial water and carbon fluxes represent one of the largest movements of mass and energy in the Earth's outer spheres. The water vapour fluxes associated with plant physiology can be estimated from oxygen-18 and deuterium contents of precipitation and river water. The studies of large watersheds in North America, South America, Africa, Australia, and New Guinea show that approximately two thirds of the annual water flux from ecosystems typical of higher-latitude regions can be attributed to plant transpiration. Transpiration in high-rainfall, densely vegetated regions of the tropics represents a smaller proportion of precipitation and is relatively constant, defining a plateau in response to incident solar radiation. The patterns of water transpiration and net primary productivity mirror each other, confirming that the terrestrial water and carbon cycles are inherently coupled via the biosphere. This offers a conceptual perspective on the dynamics of energy exchange between terrestrial systems and the atmosphere, where the carbon cycle is essentially driven by solar energy via the water cycle intermediary.