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# Biotic pump of atmospheric moisture as driver of the hydrological cycle on land

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Under gravity land inevitably loses water to the ocean. To keep land moistened, the gravitational water runoff must be continuously compensated by the atmospheric ocean-to-land moisture transport. We show that the dependence of annual precipitation on distance from the ocean differs markedly between the world's forested and non-forested continent-scale regions. In the non-forested regions precipitation declines exponentially with distance from the ocean with an established global mean $e$-folding length of several hundred kilometers. In contrast, in forest-covered regions (Amazonia, Equatorial Africa, Siberia) precipitation does not decrease or even grow along several thousand kilometers inland despite significant runoff. This points to the existence of an active biotic pump transporting atmospheric moisture inland from the ocean. Physical principles of the biotic moisture pump are investigated based on the previously unstudied properties of atmospheric water vapor, which can be either in or out of hydrostatic equilibrium depending on the vertical lapse rate of air temperature. A novel physical principle is formulated according to which the low-level air moves from areas with weak evaporation to areas with more intensive evaporation. Thanks to their high leaf area index, natural forests maintain high transpiration fluxes, which support the ascending air motion over the forest and "suck in" moist air from the ocean, which is the essence of the biotic pump of atmospheric moisture. Replacement of the natural forest cover by a low leaf area index vegetation radically changes regional atmospheric circulation and can lead to an up to tenfold reduction in mean continental precipitation and runoff, in contrast to the previously available estimates made without accounting for the biotic moisture pump. The analyzed body of evidence testifies that the long-term stability of a human-friendly terrestrial water cycle is unachievable without the recovery of natural, self-sustaining forests on continent-wide areas.