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Editorial

Editorial Note on Evapotranspiration

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EDITORIAL

Evapotranspiration as a process is referred to simultaneous losses of water from plants and soil surfaces to the atmosphere. It consists of two particular processes: transpiration and evaporation. Transpiration is referred to water losses from the plant; evaporation is water loss directly from the soil surface, or from evaporating surfaces other than the plants. The precondition of transpiration is transport of the water from soil through plant to the atmosphere. Therefore, evaporation of water previously intercepted by the plant canopy surface from rain (intercepted water), is treated as evaporation too. Physically, evapotranspiration is phase change of the liquid water to water vapor and its transfer to the atmosphere. The evaporation surfaces during transpiration are mostly internal stomata surfaces.

The importance of evapotranspiration (ET) in sustaining the global- and continental-scale hydrologic cycle and replenishing the world's freshwater resources has been recognized for thousands of years. State-of-the-art climate models and even the old nineteenth century theories based on the Clausius–Clapeyron equation indicate that global ET should increase in a warmer climate resulting in an acceleration of the hydrologic cycle. However, attempts to reconstruct continental-scale ET over the past century are clouded with uncertainties in both magnitude and direction of long-term trends. Long-term proxies of ET, such as pan evaporation and the imbalance between rainfall and runoff in major river basins, do not agree about whether continental-scale ET is increasing or decreasing.

ET is affected by a combination of factors, including warmer temperatures, decreased bulk canopy conductance associated with rising CO_2 concentrations, and large-scale land-use change. Attempts to resolve the uncertainty in ET trends are challenged by the difficulty in integrating micro scale processes, such as water transport through soil pores and plant xylem, into a framework that can describe regional- and continental-scale patterns of ET. Novel theoretical 'tactics' are clearly needed to further the development of constitutive laws describing ET, perhaps moving beyond the nineteenth century laws such as the Clausius–Clapeyron, and to describe how to scale ET to regional and continental fluxes

Plant transpiration is pretty much an invisible process. Since the water is evaporating from the leaf surfaces, you don't just go out and see the leaves "breathing". Just because you can't see the water doesn't mean it is not being put into the air, though. One way to visualize transpiration is to put a plastic bag around some plant leaves. As this picture shows, transpired water will condense on the inside of the bag. During a growing season, a leaf will transpire many times more water than its own weight. An acre of corn gives off about 3,000-4,000 gallons (11,400-15,100 liters) of water each day, and a large oak tree can transpire 40,000 gallons (151,000 liters) per year.

Energy is required to change the state of the molecules of water from liquid to vapour. Direct solar radiation and, to a lesser extent, the ambient temperature of the air provide this energy. The driving force to remove water vapour from the evaporating surface is the difference between the water vapour pressure at the evaporating surface and that of the surrounding atmosphere. As evaporation proceeds, the surrounding air becomes gradually saturated and the process will slow down and might stop if the wet air is not transferred to the atmosphere. The replacement of the saturated air with drier air depends greatly on wind speed. Hence, solar radiation, air temperature, air humidity and wind speed are climatological parameters to consider when assessing the evaporation process.

Where the evaporating surface is the soil surface, the degree of shading of the crop canopy and the amount of water available at the evaporating surface are other factors that affect the evaporation process. Frequent rains, irrigation and water transported upwards in a soil from a shallow water table wet the soil surface. Where the soil is able to supply water fast enough to satisfy the evaporation demand, the evaporation from the soil is determined only by the meteorological conditions.

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