Ecological Optimality of Canopy Scale Vegetation Properties – Theoretical Perspectives and Empirical Evidence

Jon Quebbeman and Jorge A Ramirez
Department of Civil and Environmental Engineering, Colorado State University

Abstract. Plant carbon assimilation via photosynthesis results in transpiration from stomata and depletion of soil moisture, and requires water transport from soil to atmosphere through the soil-plant-atmosphere-continuum. We examine the hypothesis that, at evolutionary time scales, natural selection leads to vegetation properties (*e.g.*, stomatal conductance) that tend to maximize water use efficiency (*i.e.*, maximize carbon assimilation while minimizing water use). Optimality can be achieved through adaptation of a variety of specialized plant properties and strategies, such as how stomata respond to soil moisture deficits and the carbon demand, growth rates, etc. The above hypothesis allows the determination of canopy scale properties as a function of climate. Without attempting to explicitly define all properties of a stand and canopy, this study determines optimal dynamic vegetation properties in a changing climate, and compares performance to empirical soil moisture responses.