Implications of Dynamic Vegetal Processes Affecting Future Water Yield: Consideration of Optimality Theories in Long-Term Hydrologic Modeling

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Abstract. Accurate estimates of future water supplies are essential for efficient planning and management of water resources. This is typically accomplished by using down-scaled projections of future climate in terrestrial biosphere models resulting in estimates of future runoff and baseflow. Land surface systems also respond over shorter time periods where estimates of vegetal states are more consistent, but longer simulations require consideration of dynamic vegetation. Improper specification of vegetal states over long periods can lead to gross errors in model projections. There exist several approaches to incorporate dynamic vegetation in terrestrial biosphere models, including the *so-called* Dynamic Global Vegetation Models (DGVMs); however, they rely heavily on regression models or mechanistic models parameterized using regressions. An alternative approach is to use optimality theories where certain vegetal states become emergent outcomes of optimality. This study considers the application of new optimality theories in long-term hydrologic simulations that allow dynamic vegetation responses to climate variability, and compares hydrologic responses from static vegetal models over a range of scales.