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Interactive Simulation of 3-D Ecoclimates

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Over the last years, the role of forests in climate change has received increased attention. This is due to the observation that not only the atmosphere has a principal impact on vegetation growth but also that vegetation is contributing to local variations of weather resulting in diverse microclimates. The interconnection of plant ecosystems and weather is described and studied as ecoclimates. In this work we simulate ecoclimates by modeling (1) the local climate-response of individual plants in large-scale ecosystems, (2) the vegetation impact on the atmosphere, and (3) the soil hydrology. We employ interactive state-of-the-art methods for simulating ecosystem growth and weather dynamics to enable a realistic animation of vegetation growth, plant competition and cooperation mediated by light and soil water, as well as cloud transitions. Our plant ecosystem model simulates the growth of individual trees with branch-level geometry. We couple an ecosystem with a weather model to locally sample weather variations over time, which enables us to simulate the long-term climate-response of individual tree models. Simultaneously, the composition of an ecosystem affects the development of weather: individual trees vary in how they release vapor or transfer heat to the air. Our framework allows us to interactively explore the growth- and climate-response of individual trees and of an ecosystem as a whole.