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A soil moisture dependent model of stomatal conductance

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A crucial step towards assessing the interconnected roles of soil moisture and nitrogen control on plant physiology and productivity in temperate ecosystems is the refinement of a unified, mechanistic model of canopy conductance, taking into account forcing by soil moisture as well as other climatic and biophysical variables. We generalize current approaches to the modeling of canopy conductance, creating a new process-based framework in which both stomatal and canopy conductances are modeled as the minimum of two separately derived conductance values, one limited by soil moisture and the other limited by plant physiology (i.e. light, temperature and rubisco activity). A model is tested using micrometeorological data collected from a temperate, successional grassland in the eastern United States. The simulated time series of stomatal conductance reveals distinct periods of limitation by 1) soil water availability (during periods otherwise favorable to plant CO2 assimilation) and 2) other biophysical processes (such as light or temperature-limited periods). This co-limitation of stomatal conductance by soil moisture and plant physiological processes illustrates the importance of both control mechanisms on transpiration and carbon assimilation rates in temperate ecosystems.