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Soil Moisture Controls on Water and Carbon Fluxes in Semi-Arid Regions

J.D. Albertson(1), C.A. Williams(2), T.M. Scanlon(3), and N. Montaldo(4)

(1) Department of Civil and Environmental Engineering, Duke University, Box 90287, Durham, NC, 27708, USA - e-mail: john.albertson@duke.edu

(2) Natural Resource Ecology Laboratory, Colorado State University, Campus Delivery 1499, Fort Collins CO, 80523, USA - e-mail: caw@nrel.colostate.edu

(3) Department of Environmental Sciences, University of Virginia, Box 400123, Charlottesville VA 22904, USA – e-mail: tms2v@virginia.edu

(4) Dipartimento di Ingegneria Idraulica, Ambientale, Infrastrutture viarie, e del Rilevamento, Politecnico di Milano, Piazza Leonardo da Vinci, 32, I-20133 Milano MI, ITALY, - e-mail: Nicola.Montaldo@polimi.it

Savanna research is broadly guided by questions regarding either: (1) the structural co-existence of the grasses and the trees, or (2) the functional behavior of these systems with respect to water and carbon cycling. In this paper we address the functional aspects of savannas, and demonstrate that the function, when integrated in time, forms the basis to describe structural aspects, such as the relative densities of grasses and trees on the landscape. We present a parsimonious representation of controls on energy, water, and carbon cycling in savannas. We then proceed to demonstrate its skill through comparison to actual field data. We show how this approach captures the central information cascade from rainfall inputs through the water, energy, and carbon budgets. The field results, when analyzed in the context of the proposed framework, are encouraging, suggesting that: (i) field-scale ET in a savanna may be readily estimated by reducing a simple measure of PET by a linear function of soil moisture in the root zone, and (ii) field-scale net carbon fluxes may be linear related to these ET fluxes through a temporally stable, but land cover-specific, water use efficiency. Beyond the field data, the use of remotely sensed land cover data along with rainfall data demonstrates the ability to estimate the spatial and temporal distribution of the

different plant cover types as needed to prescribe appropriately the water limitation function and the water use efficiency. And, finally, it is shown how an integration of the carbon fluxes into biomass changes can extend calculations of savanna function through time to present an evolving picture of the savanna structure.