Long-term dynamics of water and carbon in semi-arid ecosystems: a gradient analysis in the Patagonian steppe

Jose M. Paruelo, Osvaldo E. Sala & Adriana B. Beltrán

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Abstract
We used a soil water simulation model and remotely sensed data to study the long-term dynamics of transpiration, evaporation, drainage and net primary production across a precipitation gradient in Northwestern Patagonia (Argentina). The proportion of precipitation transpired, the precipitation use efficiency and the transpiration use efficiency were constant across the gradient that covered a range of 150 to 600 mm. The proportion of water evaporated was higher than the proportion drained at the driest extreme of the gradient. The opposite relationship was observed at the wet extreme. Two important characteristics of arid-semiarid systems dominated by winter precipitation emerged from our analyses: the importance of drainage losses and the asynchrony between evaporation and transpiration fluxes. These characteristics of the water dynamics influence the relative abundance of plant functional types and are crucial to generate heterogeneity at the landscape level. The coefficient of variation (CV) of transpiration, evaporation and ANPP was, in general, lower than the CV of annual precipitation. This pattern suggests a buffering capacity of the ecosystem. The ecosystem would be able to damp at the functional level inter-annual changes in the availability of resources.