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Carbon and water exchanges in a semi-arid watershed: the role of interannual climate variability and woody plant encroachment

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Globally, large portions of drylands may see significant vegetation composition shifts in the coming decades. However, we know very little about how such changes influence ecosystem processes including CO_2 and H_2O exchange. Observed increases in the density of woody plants in North America's grassland and savanna ecosystems may be an important terrestrial carbon sink and could alter patterns of regional hydrologic cycling. During the 2003 and 2004 growing seasons we compared data from a network of three eddy-covariance towers within a semiarid watershed to address the role of riparian vegetation structure in the linkage between ecosystem carbon and water exchange. Towers were located in a riparian grassland, a riparian savanna and a riparian woodland along the San Pedro River in southeastern Arizona, U.S.A. Our analysis indicates that the duration and magnitude of ecosystem carbon and water exchanges is tightly linked to precipitation at the grassland and shrubland sites. Furthermore, ecosystem carbon and water exchange is decoupled at the woodland site where the deeply-rooted, dominant over-story species, *Prosopis velutina*, has access to abundant alluvial groundwater. A dynamic linkage of carbon and water exchanges in the riparian woodland during the growing-season reflects the onset of mid-summer convective storms associated with the North American monsoon. Furthermore, our analysis reveals a complex time-course of ecosystem carbon assimilation across vegetation types and the important role that ecosystem respiration plays in these systems' carbon dynamics. This research highlights the interaction between growing-season precipitation, plant-available alluvial groundwater and riparian vegetation structure in

governing ecosystem carbon and water balance in semiarid ecosystems.