

Multiyear Riparian Evapotranspiration and Groundwater Use for the Upper San Pedro Basin

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ABSTRACT

Riparian evapotranspiration (ET) is a major component of the surface and subsurface water balance for many semiarid watersheds. Measurement or model-based estimates of ET are often made on a local scale, but spatially distributed estimates are needed to determine ET over catchments. In this paper, we discuss a model that we developed that uses 16-day, 250-1000 m remote-sensing products to determine riparian ET and groundwater use for the years of 2001 - 2005 within the San Pedro watershed in southeastern Arizona. The inputs for the model were derived entirely from the NASA MODIS sensor and consisted of the Enhanced Vegetation Index, land surface temperature, and a land surface water index. The model was calibrated with multiyear ET measurements over representative riparian vegetation types within the watershed. Three years of eddy covariance data for the three riparian sites reveal that ET and groundwater use increased as woody plant density increased. Groundwater use was less variable at the woodland site, which had the greatest density of phreatophytes. Reach-scale annual riparian ET was more correlated with precipitation along the reach of the river that had more perennial flow sections. Drought conditions throughout the study period might have resulted in decreasing phreatophyte health (and its corresponding groundwater use) along the portions of the river with less perennial flow. Riparian groundwater use for the watershed was highest in 2001 then declined and was essentially stable for the period of 2003 through 2005. The high 2001 rates were likely due to large floods in the previous year and caused elevated water levels in the alluvial aquifer.