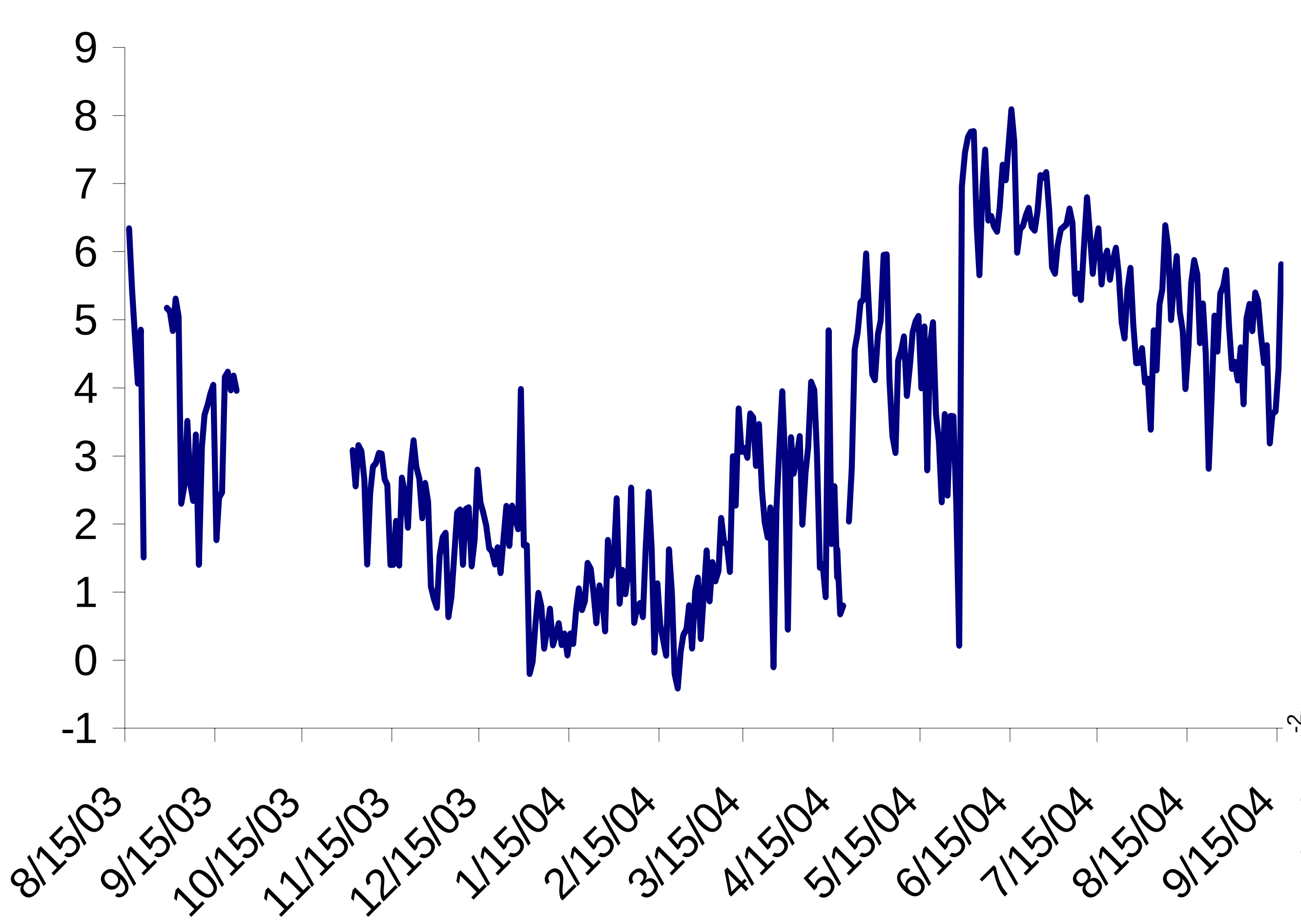
Micrometeorological Measurement Of Riparian Evapotranspiration

John Kochendorfer, Rich Niswonger, Kyaw Tha Paw U, Patrick Wenzinger

Dept of Land Air and Water Resources, University of California, Davis, CA, 95616

jkoch@ucdavis.edu

Upstream Site Daily Evapotranspiration



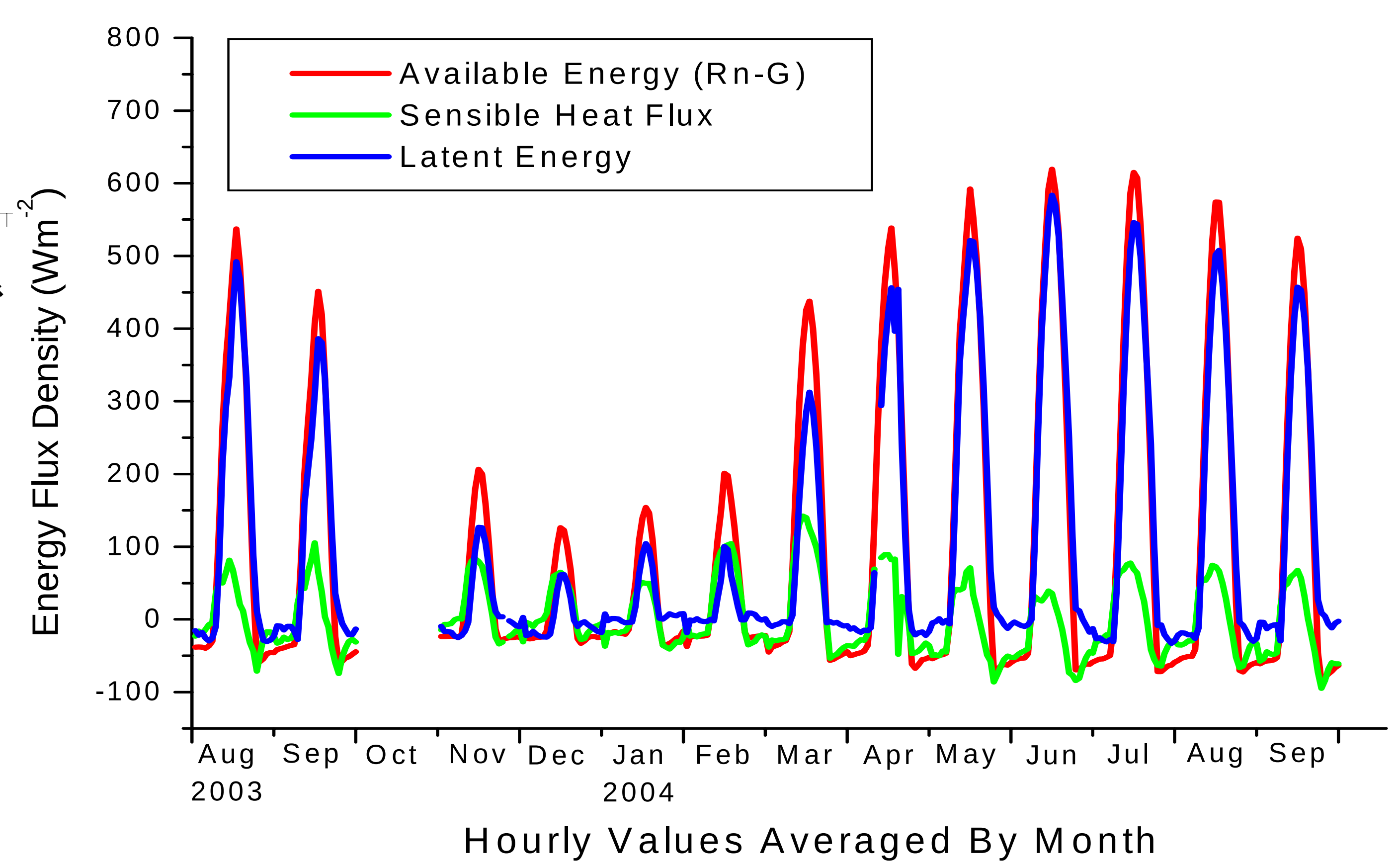
he upstream tower spraying water onto the narrow riparian corridor

Eddy covariance tower at the downstream site

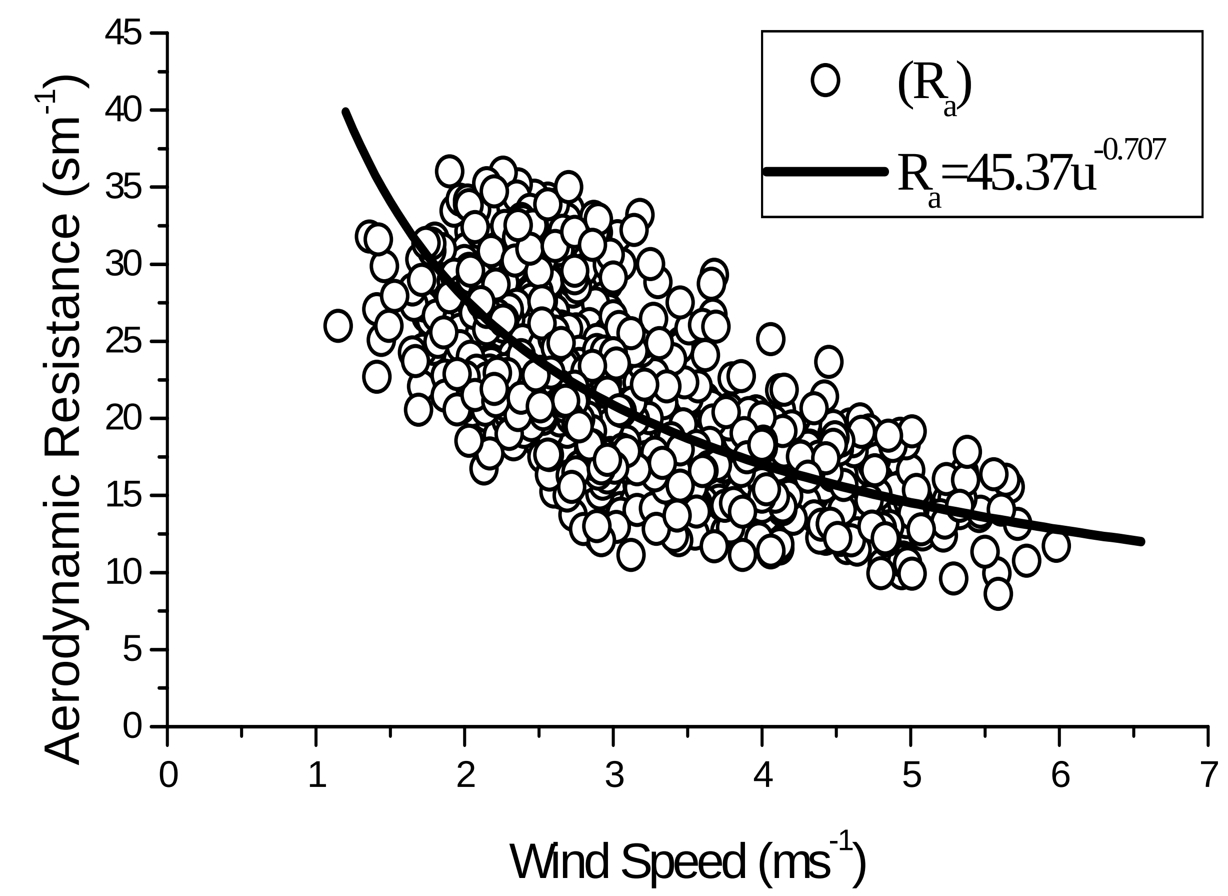
Along the Cosumnes River in California's Central Valley, a field study at two different riparian sites provides evapotranspiration estimates for use in hydrological and ecological studies. Biomicrometeorological measurements of riparian ecosystems presents a challenge because of the vegetation lies along a narrow band, limiting fetch required of many traditional biomicrometeorological methods.

We use eddy-covariance at the downstream site. At the upstream site, where fetch is very limited, we implemented an energy balance-infrared thermometry technique which is less sensitive to advective energy losses. We have been collecting data at the upstream site since July, 2003 and at the downstream site since February 2004.

Diurnal Upstream Site Energy Balance



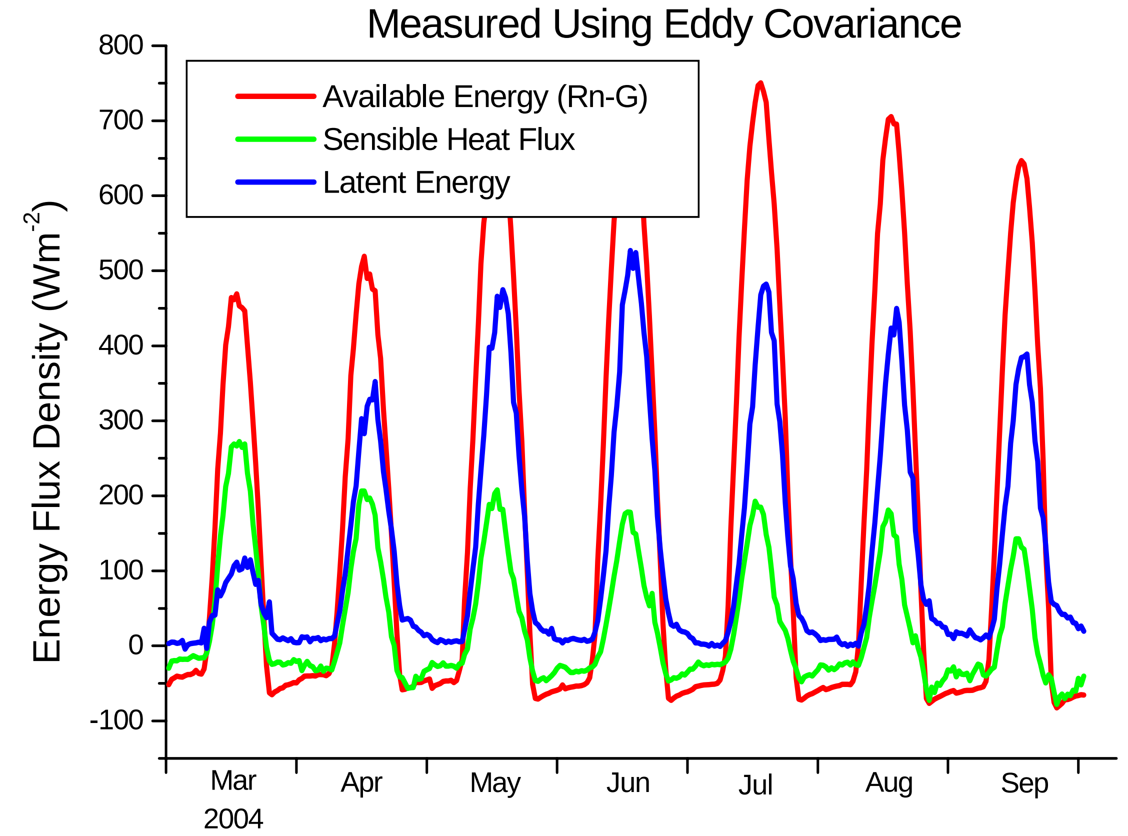
Night 206-207 Aerodynamic Resistance (R_a) vs. Wind Speed



30 sec. averages of aerodynamic resistances estimated at the upstream site by assuming that LE = 0 at night. The equation from this one night, $R_a = 45.37u^{-0.707}$ is almost identical to the equation we use to describe the aerodynamic resistance as a function of wind speed. It is interesting to note that the power to which the wind speed is raised (-0.7) is between what we would expect for a homogeneous canopy (-1) and an isolated object (-0.5)

Picture taken of the downstream site eddy-covariance sensors while the tower is leaned over temporarily. A Campbell CSAT3 sonic anemometer measures vertical and horizontal wind speed and a LiCor 7500 gas analyzer measures H_2O and CO_2 concentrations. This data is logged 10 times a second by a Campbell datalogger along with other micrometeorological variables and is downloaded from the datalogger by a single board computer every 60sec. A covariance between the vertical wind speed and temperature, H_2O, and CO_2 is calculated for half-hour periods. This calculation provides a direct measurement of the turbulent exchange of sensible heat, H_2O vapor and CO_2 between the Cottonwood forest and the atmosphere.

Diurnal Downstream Site Energy Balance
Measured Using Eddy Covariance



Hourly Values Averaged By Month

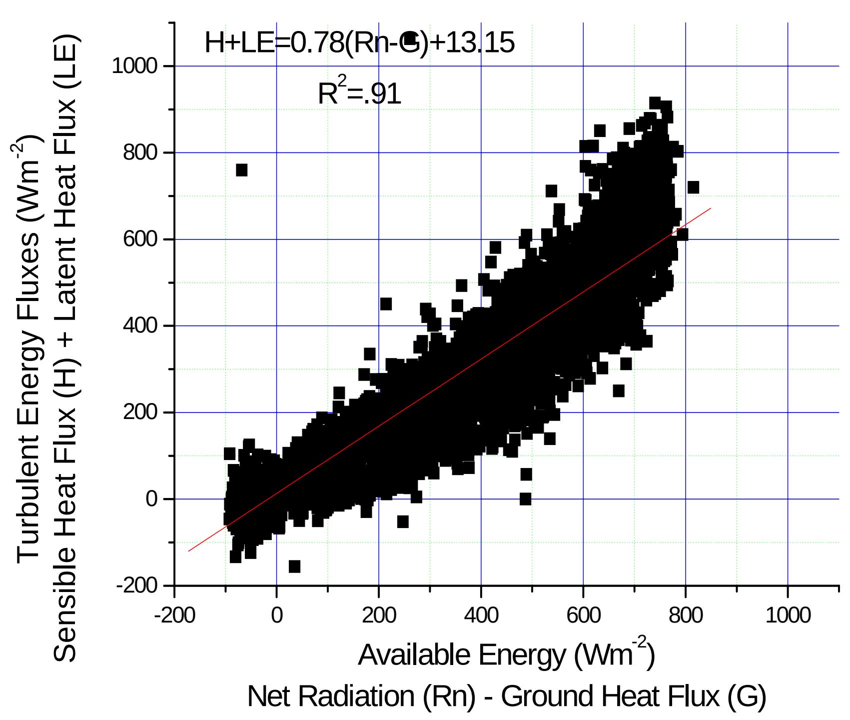
At the upstream site we estimate the aerodynamic resistance using two different methods and use this estimation to then solve for latent energy (LE) as a residual in the energy balance. The first method is to solve for aerodynamic resistance when the canopy is wet and stomatal resistance is assumed negligible:

$$r_h = \frac{\rho \cdot C_p}{(R_n - G)}\left\{(T_s - T_a) + \frac{[e_s(T_s) - e_a]}{\gamma}\right\}$$

In the second method we solve for aerodynamic resistance at night and we assume LE is negligible.

$$r_h = \frac{\rho \cdot C_p}{(R_n - G)}(T_s - T_a)$$

Downstream Site Energy Budget Closure



This plot gives us an indication of how well the measured half-hour turbulent fluxes are accounting for the available energy. We are not accounting for storage in the canopy however. 0.78 (22% lack of closure) is typical for half-hour eddy-covariance measurements.

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