Evapotranspiration response of a high elevation Rocky Mountain (Wyoming, USA) forest to a bark beetle epidemic

John Frank[1,2] , Bill Massman[3], and Brent Ewers[4]
U.S. Forest Service, Rocky Mountain Research Station, Fort Collins, CO

Abstract. In recent years, considerable amounts of forested area in western North America have been impacted by bark beetle epidemics. These disturbances result in significant tree mortality that inevitably alters the balance of ecosystem water exchange. In this study we investigate the impact of a bark beetle epidemic on the evapotranspiration (ET) in a high elevation Rocky Mountain forest. The GLEES AmeriFlux site (southeastern Wyoming, USA), located in a high elevation subalpine forest dominated by Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*), is currently experiencing an outbreak of spruce beetle (*Dendroctonus rufipennis*). This beetle epidemic, which caused significant tree mortality in 2008, has impacted 90% of the basal area of the spruce, which accounts for 71% of the basal area of the forest. Annual eddy-covariance measurements of ET have steadily decreased since a maximum of 75.0 cm in 2006 to a minimum of 57.6 cm in 2010, despite increased annual precipitation in every year since 2007. A major component of this trend is summertime ET (July to September), which averaged 26.2 cm from 2005 to 2007, but decreased to 22.5 cm in 2008 and then to 20.6 cm from 2009 to 2010. In 2010, eddy-covariance measurements of the gross photosynthetic capacity of the forest were reduced to 54% of the 2005-2007 levels, suggesting that the reduction in ET was due to a loss of spruce transpiration. Winter sublimation (November to April) has been more variable, averaging 26.9 cm from 2005 to 2008 before decreasing to 24.9 cm in 2009 and a minimum of 21.2 cm in 2010. This recent trend could be a reduction of winter sublimation due to the loss of spruce needles and reduced canopy interception of snow.

[1] U.S. Forest Service; Rocky Mountain Research Station; 240 W. Prospect Rd., Fort Collins, CO 80526; Tel: 970-498-1319. Email: jfrank@fs.fed.us
[2] Department of Botany and Program in Ecology; University of Wyoming; 1000 E. University Ave; Laramie, WY 82071;Tel: 970-498-1319
[3] U.S. Forest Service; Rocky Mountain Research Station; 240 W. Prospect Rd., Fort Collins, CO 80526; Tel: 970-498-1296. Email: wmassman@fs.fed.us
[4] Department of Botany and Program in Ecology; University of Wyoming; 1000 E. University Ave; Laramie, WY 82071; Tel: 307-766-2625. Email: beewers@uwyo.edu