Calibration of the Simultaneous Heat and Water (SHAW) Model using Sap Flow Measurements of a Salix-based Evapotranspiration Landfill Cover System

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A short-rotation woody crop system is being demonstrated as an alternative landfill cove for the Solvay Wastebeds (Syracuse, NY, USA). The region has a humid climate with four distinct seasons and average precipitation of 1016 mm yr^{-1}. In 2004, the project team planted ten willow varieties, using two cutting lengths, at a density of 15,000 plants/ha in four replications in a completely randomized block design. Individual plots consisted of three double rows of plants with 25 plants in each row. The wastebed had been amended with biosolids (c. 1990).

Stem sap floe was measured for 93 days in 2006 on four willow varieties (SX64 *Salix miyabeana,* SX61 *S. sachalinensis*, 9870-23 *S. sachalinensis** *S. miyabeana,* and 9882-34 *S. purpurea*) using Dynagage sensors. The Simultaneous Heat and Water (SHAW) model was calibrated considering sap flow as a surrogate measure of transpiration and using the Parameter Estimation Software Tool (PEST) on a subset of the sap flow measurements. Soil albedo, air entry potential, pore size distribution index, plant albedo, leaf water potential, and stomatal resistance were optimized to values of 0.26, -2.5 m, 2.0, 0.35, -162.5 m, and 125 s m^{-1}, respectively. The mean difference (MD) and root mean square error (RMSE) were 0.07 mm hr^{-1} and 0.085, respectively, between measured and predicted hourly transpiration values, indicating that the SHAW model slightly under-predicted transpiration. The remaining subset of sap flow data was used to validate these findings. The MD (-0.02 mm hr^{-1}) and RMSE (0.074) indicate that the SHAW model overestimated the hourly transpiration rates.

The model-predicted transpiration trends well with the sap flow measurements. The differences might be attributed to accuracy of measuring sap flow and to the model assumptions regarding temperature and radiation transpiration within the stand canopy.