Appendix 1

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Transpiration is modeled with a mass balance model in a Bayesian hierarchical, state-space framework to infer individual moisture reservoirs. The actual transpiration at day t since rain for tree i in drought d depends on the transpiration calculated from sap flux ($y_{id,t}$) and the accumulation of actual, unobserved transpiration ($T_{id,t}$) through time. Actual transpiration is a latent predicted state with a conditionally normal distribution, including observation error (variance σ^2) and process error (variance τ^2). Inverse gamma distributions were priors for the variances. We specified normally distributed observation error on the potential transpiration estimates (π) to account for uncertainty in local microclimate among trees and through time. The natural log of potential moisture reservoir (ω_i) was modeled as a linear function of the natural log of tree diameter at breast height (D_i), the local topographic wetness index (W_i), and factor codes for species ($\mathbf{Z_i}$) so that we could make predictions for trees that did not have transpiration observations. We included an interaction between diameter and the local wetness index to address differences in belowground allocation with changes in the local moisture environment. The reservoir is assumed to be approximately recharged following rain events, although the inclusion of a latent initial state ($T_{id,0}$) allows for partial depletion at the beginning of each drought. For one transpiration observation,

$$
\begin{aligned}
&y_{id,t} \sim N(T_{id,t}, \tau^2)\\
&T_{id,t} \sim N(\mu_{id,t}, \sigma^2)\\
&T_{id,0} \sim N(m_1, m_2)\\
&\mu_{id,t} = A_i \pi_{id,t}(1 - \omega_i^{-1} \sum_{c=0}^{t-1} T_{id,c})\\
&\ln(\omega_i) \sim N(\mathbf{X_i}\beta, \rho^2)\\
&\mathbf{X_i} = [1 \quad \ln(D_i) \quad W_i \quad \ln(D_i)W_i \quad \mathbf{Z_i}]\\
&\beta \sim MVN(0, \mathbf{I}b)\\
&\pi_{id,t} \sim N(PET_{id,t}, \phi^2)\\
&\phi^2 \sim IG(q_1, q_2)\\
&\rho^2 \sim IG(r_1, r_2)\\
&\sigma^2 \sim IG(s_1, s_2)\\
&\tau^2 \sim IG(u_1, u_2)
\end{aligned}
$$