Seasonal variation in the temperature response of leaf respiration in *Quercus rubra* at the Black Rock Forest

K. L. GRIFFIN and C.Y. Xu, Columbia University, Lamont-Doherty Earth Observatory , 61 Route 9W, 6
Biology , Palisades, NY 10964

Leaf respiratory temperature responses of *Quercus rubra* were measured throughout the 2003-
growing season in a deciduous forest in northeastern USA, in the upper and lower portions of the
canopy at two sites with different soil water availability. Consequently, stand-level canopy foliar
carbon loss (R_{canopy}) was modeled for a virtual *Quercus rubra* monoculture in these two sites. The
base leaf respiration rate (R_0, respiration at 10 ºC) of *Q. rubra* was significantly affected by season,
site water availability, canopy height and their interactions. Upper canopy leaves generally had
higher R_0 than lower canopy leaves. At the drier site, a more significant seasonal pattern in R_0 was
observed, while at the more mesic site, a stronger canopy position effect was detected. By contrast,
the temperature coefficient (E_0, the activation energy of respiration as a single reaction) was constant
(52.5 ± 5 kJ mol^{-1}). Leaf reducing monose could partially explain the seasonality in respiration (32%
- 79%), and leaf nitrogen (N_{area}) was well correlated to the canopy position effect. R_{canopy} of *Q. rubra*
was first estimated by a "full distributed physiology model", which. integrates the effects of season,
site, and canopy position on R_0. Sensitivity examination indicates that neglecting the season, site and
canopy height effects on leaf respiration resulted in up to a 130% error on the estimation of R_{canopy},
but canopy level model parameterizations could be simplified by assuming a constant E_0 (error <
5%). From June 8th to October 28th of 2003, the modeled R_{canopy} of the virtual *Q. rubra* monoculture
was 6.3 mol CO_2 m^{-2}
ground, and 13.5 mol CO_2 m^{-2} ground, at the drier and the more mesic site
respectively. These results suggest that the temporal and spatial heterogeneities of R_0 need to be
considered in ecosystem models, but it is potentially predictable from well understood leaf
properties. Meanwhile, simplifications can be made in *Q. rubra* by assuming a constant temperature
coefficient (E_0, e.g. 52.5 kJ mol^{-1} in this study)