



Effects of wind speed on leaf energy and gas exchange

Stanislaus J. Schymanski and Dani Or

Institute of Terrestrial Ecosystems, Swiss Federal Institute of Technology (ETH) Zurich, Switzerland
(stan.schymanski@env.ethz.ch)

The common practice of modelling transpiration from plant leaves as an isothermal process (assuming equal leaf and air temperatures) may introduce significant bias into estimates of transpiration rates and energy partitioning. In a recent study (Schymanski et al., 2013, PLOS ONE, in print) we investigated effects of fluctuating irradiance (sunflecks) on leaf thermal regime and transpiration rates using a physically-based leaf model. Results suggest that leaf temperatures may deviate substantially from air temperature, leading to greatly modified transpiration rates compared to isothermal conditions, even under steady-state conditions. The results also highlighted the importance of intrinsic thermal protection imparted by transpiration flux. In this study we consider leaf energy balance to systematically investigate effects of wind speed on plant heat and gas exchange. Surprisingly, under certain conditions increasing wind speeds can result in a decrease in transpiration rates. This is due to the feedbacks between sensible heat flux, leaf temperature and latent heat flux. The model predicts that for high wind velocities the same leaf conductance (for water vapour and carbon dioxide) can be maintained with less evaporative losses. This may have profound implications for estimates of water use efficiency (WUE, the amount of carbon gained by photosynthesis per unit of water lost by transpiration), and the interpretation of changes in "Potential Evaporation" in relation to plant water use.