Hotplate-derived Wind Speed and Snowfall Rate

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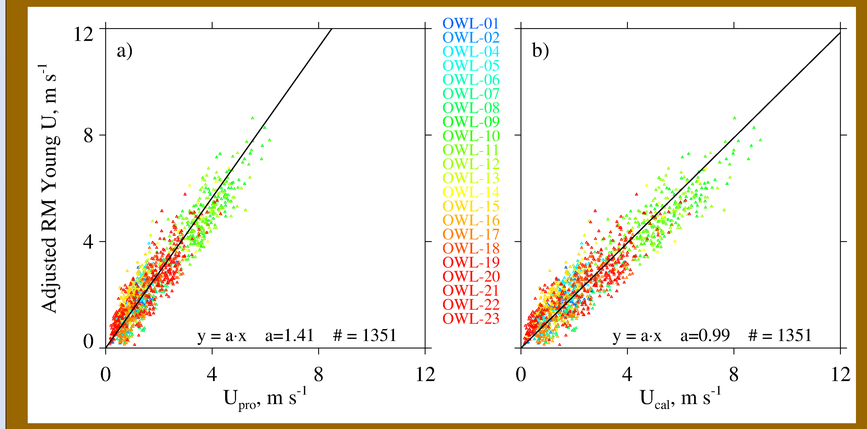
Objectives: Addressing two issues relevant to the ~ 70 hotplate precipitation sensors sold by Yankee Environmental Systems (YES): 1) Two publications (Boudala et al. 2014; Zelasko et al. 2018) report bias in the YES-derived wind speed (U_{pro}), and thus error in determination of snow particle catch efficiency and in precipitation amount. Here, a calibrated hotplate wind speed (U_{cal}) is formulated via an energy budget analysis. 2) A new snow particle catch efficiency function is developed and tested. The new function is expressed in terms of the calibrated wind speed (U_{cal}).



a) **Vane anemometer vs YES wind speed (U_{pro}) during OWLeS (North Redfield Site; Zelasko et al. 2018).**

b) **Vane anemometer vs calibrated wind speed (U_{cal}) during OWLeS (North Redfield Site; Zelasko et al. 2018).**

Up and Down Surfaces (precip and wind speed)

LW and SW Sensors

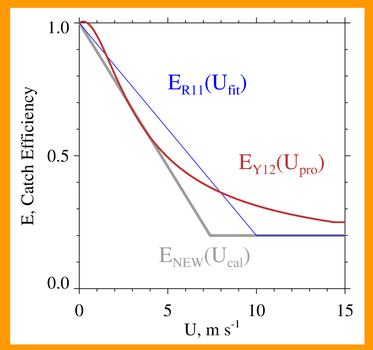
Temperature

Electronics

Calibrated Hotplate Wind Speed –

$$U_{cal} = \frac{\mu}{D_h \rho} \cdot \left(\frac{Q_{dn} - A_h \varepsilon_h \sigma T_h^4}{\alpha D_h K \cdot (T_h - T)} - \frac{\gamma}{\alpha} \right)^{1/\beta}$$

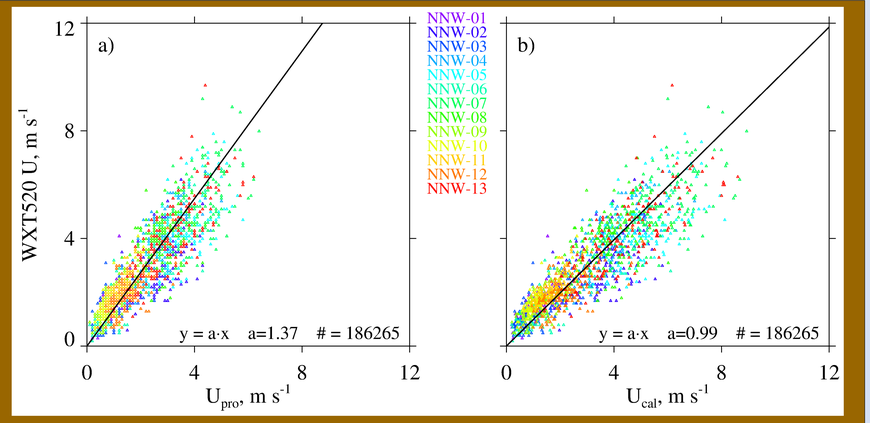
Measurements: Q_{dn} and T
Constants: μ, D_h, A_h, ε_h, σ, K
Derived Calibration Coefficients: α, β, γ, and T_h



Rasmussen et al. 2011 (R11)

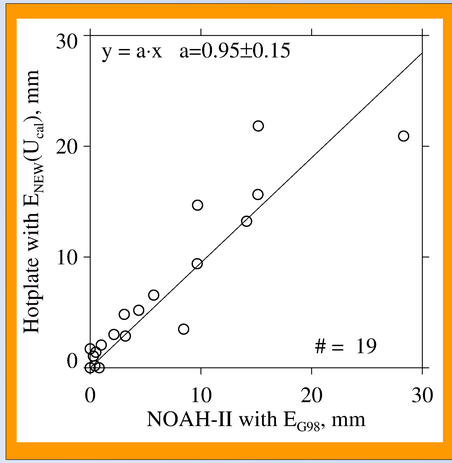
Personal communication, YES 2012 (Y12)

Adapted from R11 and Kochendorfer et al. 2017



a) **Sonic anemometer vs YES wind speed (U_{pro}) during WYCEHG (Noname Watershed site; Zelasko, 2017).**

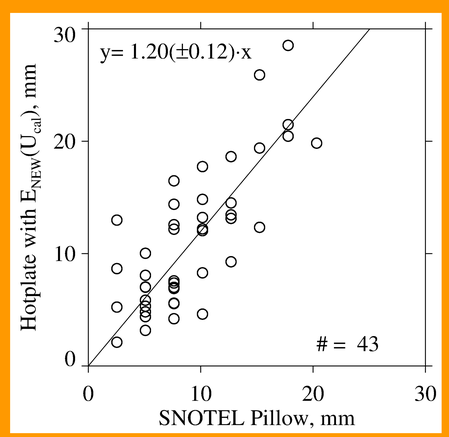
b) **Sonic anemometer vs calibrated wind speed (U_{cal}) during WYCEHG (Noname Watershed site; Zelasko 2017).**



Test of $E_{NEW}(U_{cal})$ on OWLeS snowfall events from Zelasko et al. (2018)

NOAH-II comparator is a wind-speed corrected weighing gauge

Reasonable agreement confirms method



Test of $E_{NEW}(U_{cal})$ on WYCEHG snowfall events from Zelasko (2017)

SNOTEL comparator is a weighing snow pillow

Discrepancy thought due to enhanced snow drift accumulation at easterly-exposed WYCEHG site