Wind lidar shows mountain-valley flows in high detail and an unexpected relationship between overstory u* and nocturnal canopy mixing

Objective

(1) identify and categorize dominant, non-local, above-canopy, nocturnal atmospheric phenomena by type and strength using the lidar wind profiles,

(2) calculate wind flow and turbulence (e.g., *TKE*, wind shear, u_*, σ_w) statistics according to atmospheric phenomenon to look for any atmospheric or canopy-related trends,

(3) compare the utility of using various nighttime turbulence filters (e.g., u_*, σ_w, etc.) to estimate vertical canopy mixing under different atmospheric phenomena events at an open and closed canopy, and

(4) evaluate the overall utility of co-locating a remote sensing device (here we used lidar) at woodland/forested flux tower sites.

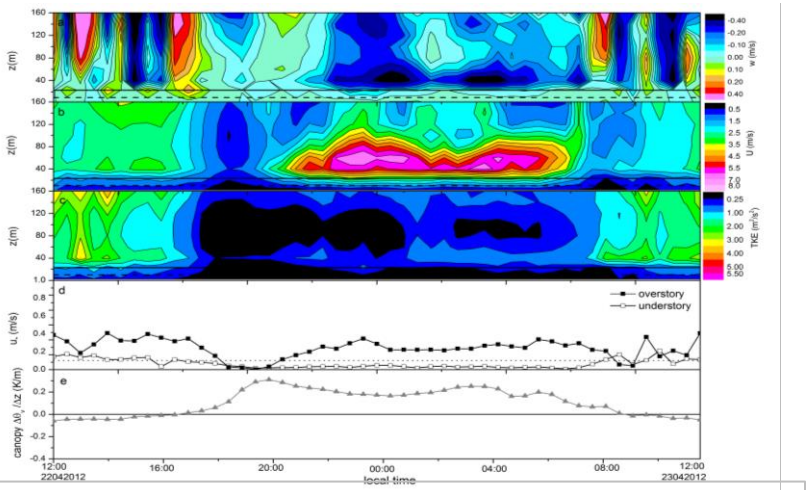

Figure: EC shows that friction velocity is not an accurate predictor of canopy mixing during mountain-valley flows at Tonzi AmeriFlux. Shown here is a strong, nocturnal downslope flow over the oak savannah canopy, observed by the lidar profile measurements, which coincides with high u* but a weak temp. gradient.

Research

Micrometeorological observations of the lower boundary layer and canopy air space collected on nearly 200 nights were obtained using a combination of atmospheric laser detection and ranging (lidar), eddy covariance (EC), and tower profiling instrumentation. Two AmeriFlux/Fluxnet sites in mountain-valley terrain in the Western U.S. were investigated: Wind River, a tall, dense conifer canopy, and Tonzi Ranch, a short, open oak canopy.

Impact

- Lidar measurements of above-canopy mountain-valley flows are presented in high detail
- Alternative turbulence parameters are evaluated for estimating canopy coupling
- Friction velocity fails to accurately estimate canopy mixing during downslope flow
- Relationship between turbulence and stability is not straightforward

Wharton, S., Ma, S., Baldocchi, D.D., Falk, M., Newman, J.F., Osuna, J.L., Bible, K. (2017) Influence of regional nighttime atmospheric regimes on canopy turbulence and gradients at a closed and open forest in mountain-valley terrain. Agricultural and Forest Meteorology 237: 18-29

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