NCAR
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

AMERIFLUX
MANAGEMENT PROJECT

Analysis of Flux Tower Data Combined with Single Point CLM Output: Lessons Learned

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with input from:

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Community Land Model (CLM/CTSM) Tutorial 2019

7 February 2019


Niwot Ridge AmeriFlux
Tower (US-NR1)
(photo credit: Bill Bowman)

Talk Outline/Details

- Influence of Warm-Season Precipitation on Ecosystem Fluxes at Niwot Ridge Forest, based on years 1999-2014 (Burns, et al 2018, JAMES)

➡ Conditional sampling (of the diel cycle)

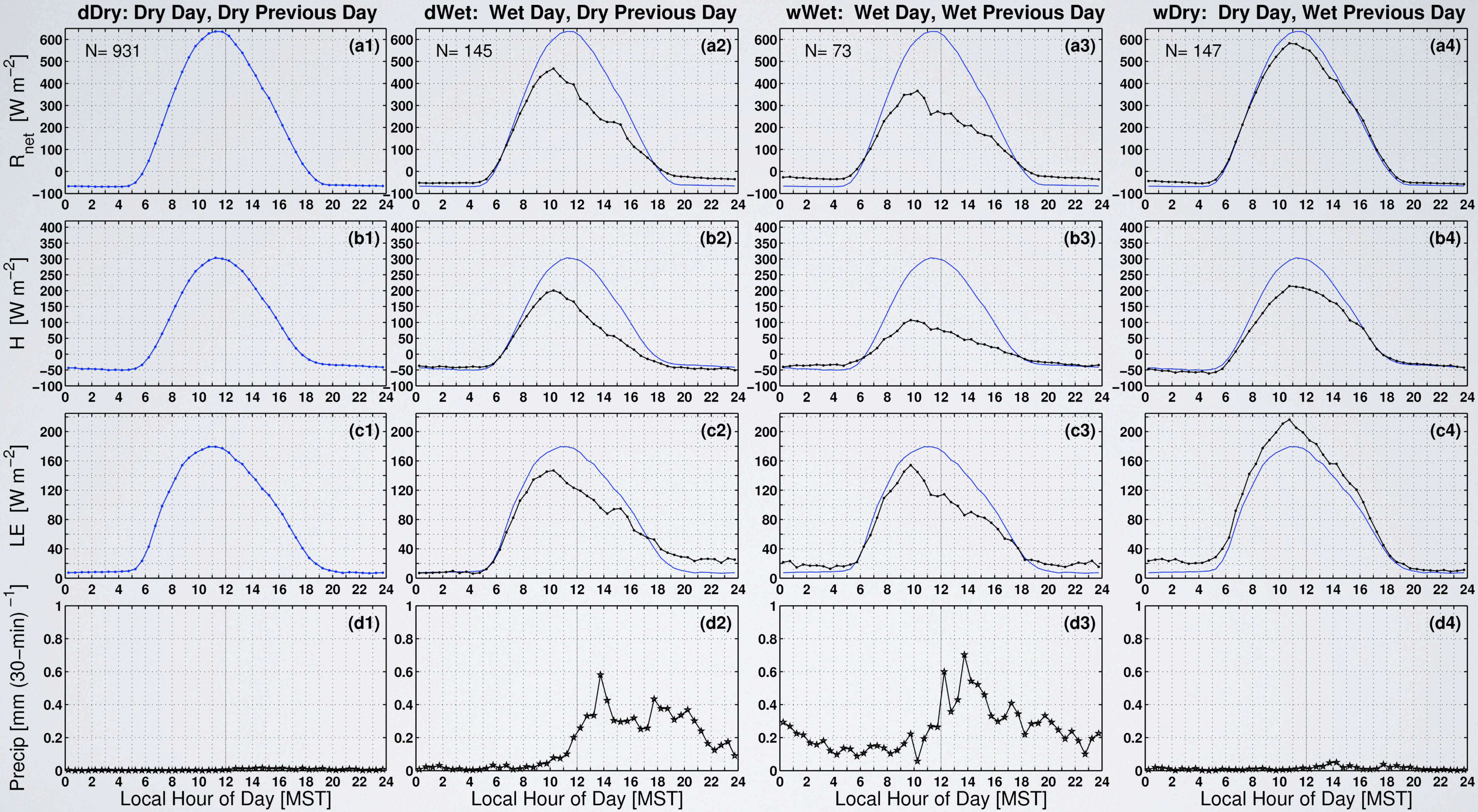
➡ Use CLM to look at processes which are difficult to measure

➡ Systematic variation of parameters/variables within CLM (e.g., Leaf Area Index (LAI) varied; here will show LAI= 2, 4, 6, US-NR1 forest has LAI approx 4).

➡ If possible--return to the physical processes

Warm-Season Precipitation, Conditional Sampling

dDry **dWet** **wWet** **wDry**



0:00 **Noon** **24:00**

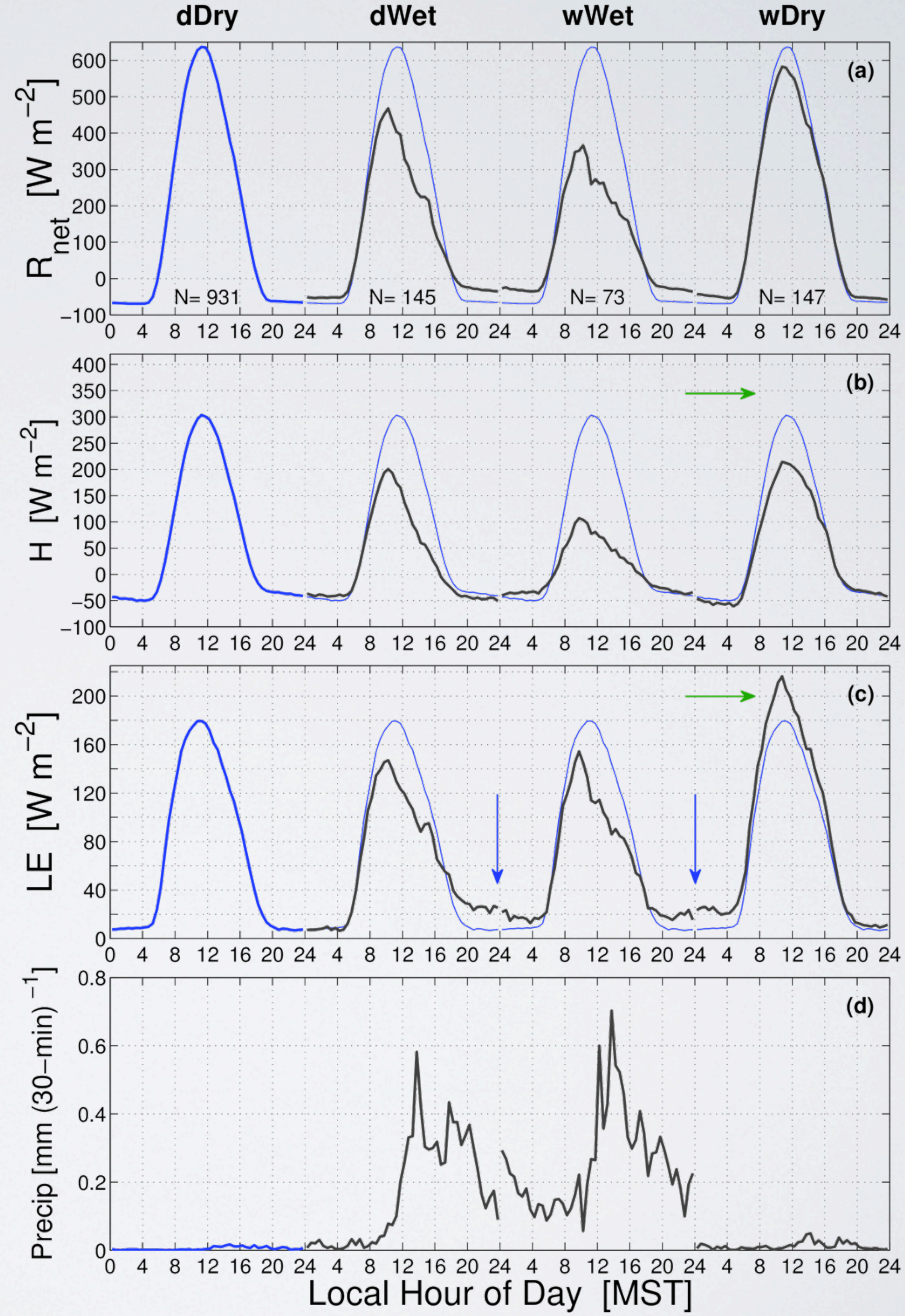
Warm-Season Ecosystem Fluxes, Conditional Sampling

Observations

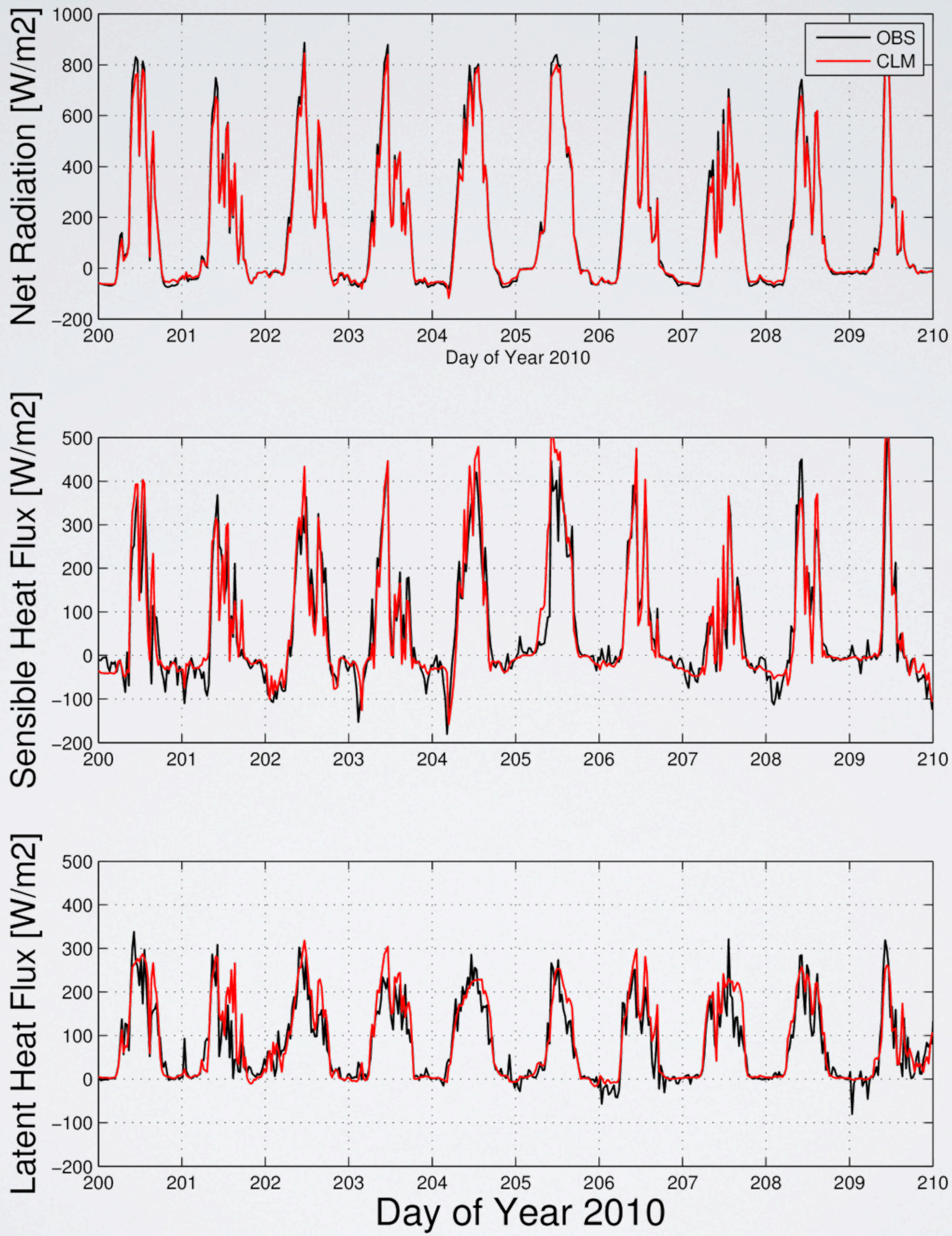
Summary

*** Increase in nocturnal λE during wet periods**

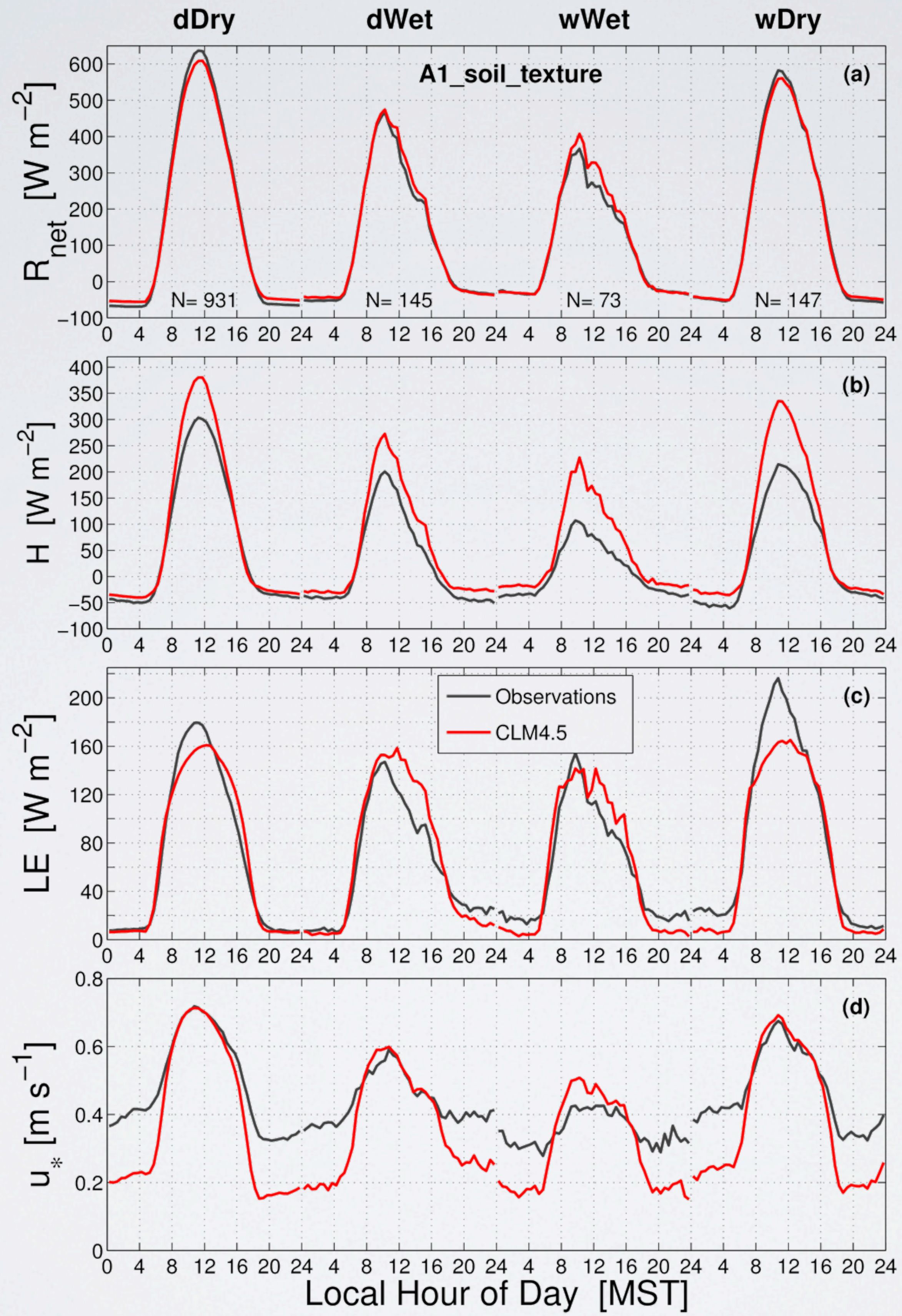
*** Increase in mid-day λE during wDry days**



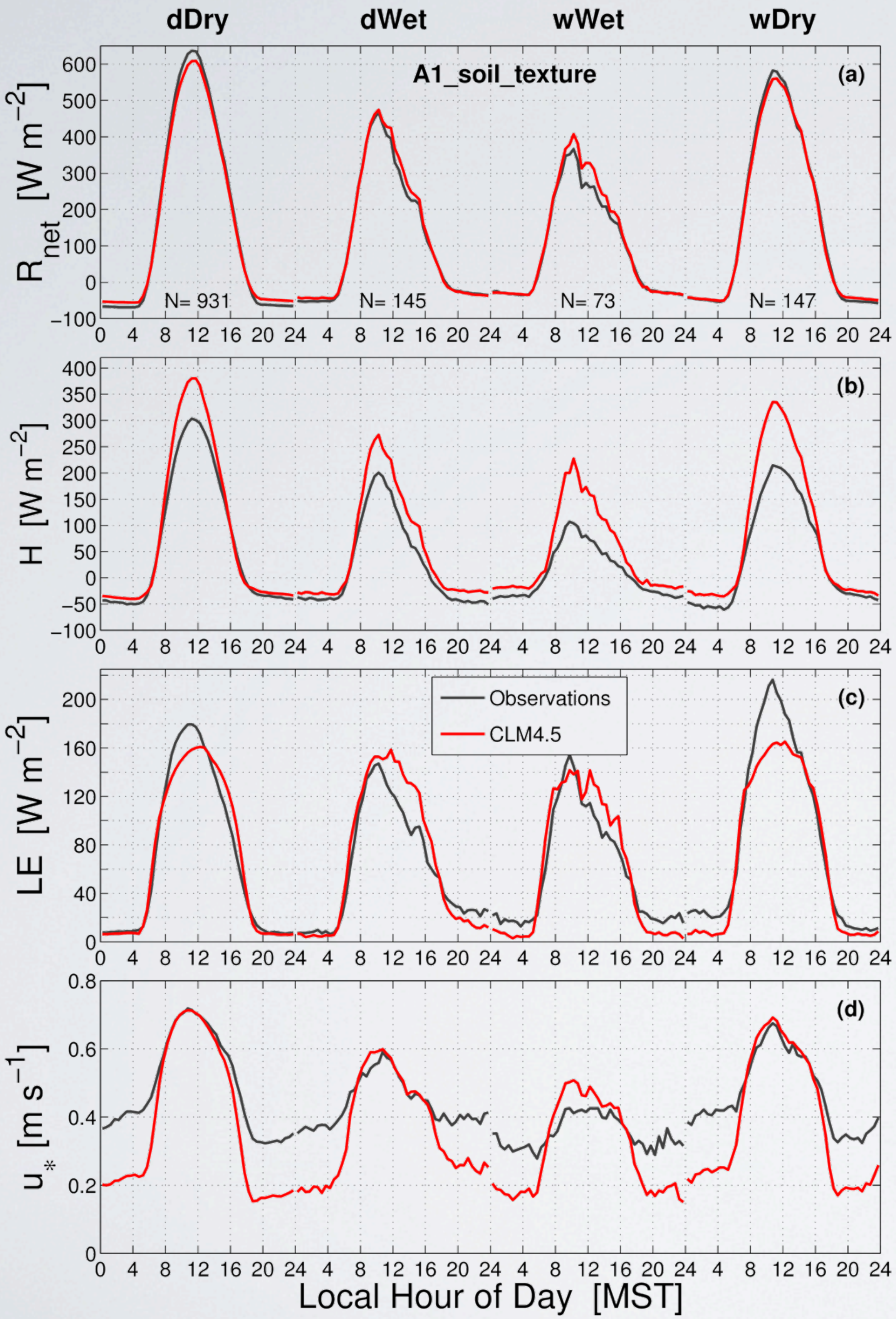
CLM vs Observed Fluxes (Time Series Comparison)

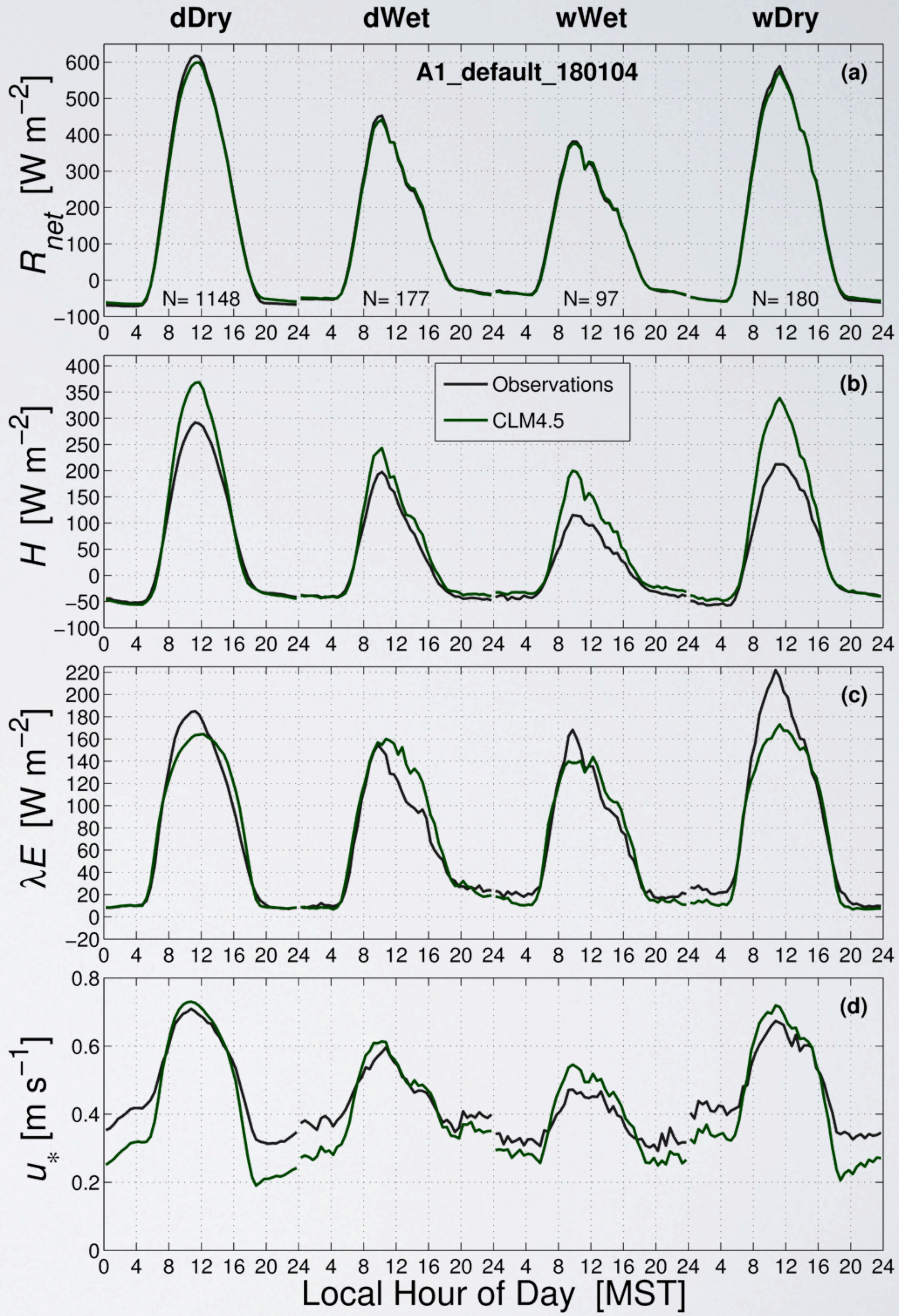


CLM vs Observed Fluxes (I)

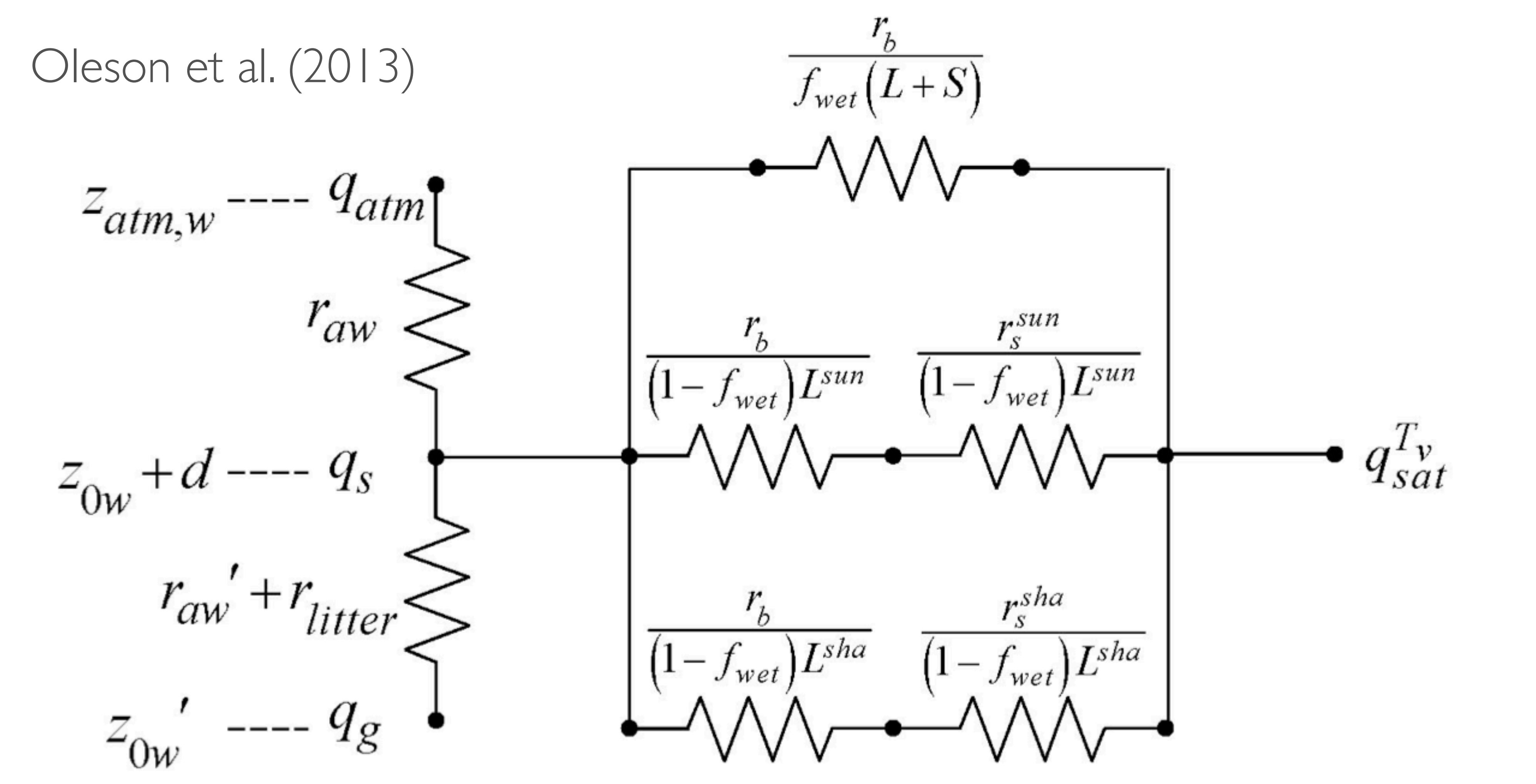


CLM vs Observed Fluxes (II)





CLM Water Vapor Transport



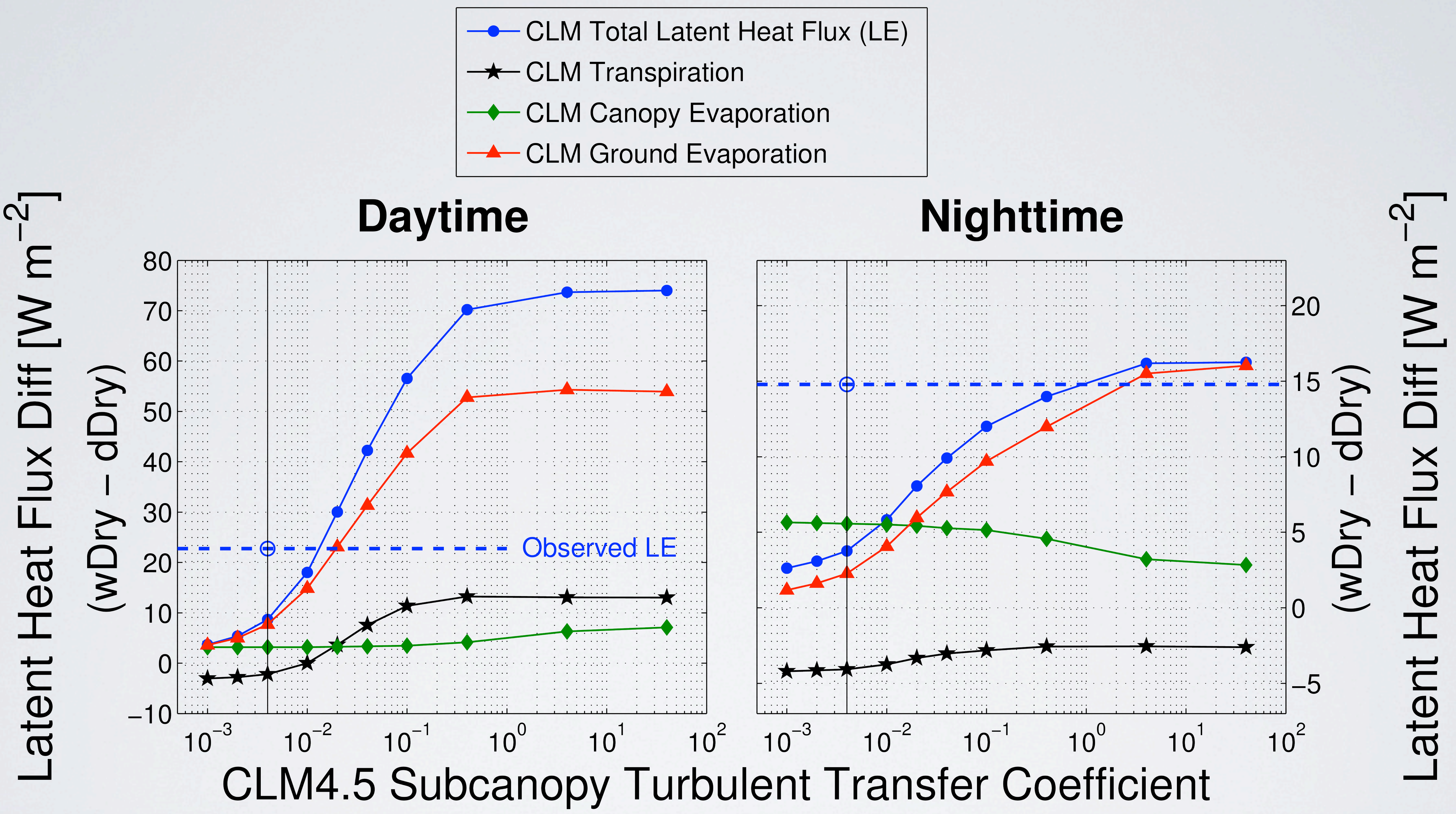
Aerodynamic resistances between the ground and subcanopy air for heat r_{ah}' and water vapor r_{aw}',

$$r_{ah}' = r_{aw}' = \frac{1}{C_s U_{av}}$$

$U_{av} \equiv$ **wind velocity on the vegetation**

$C_s \equiv$ **turbulent transfer coefficient between ground and canopy airspace ($C_s \leq 0.004$)**

Sensitivity of Latent Heat Flux Components to Cs

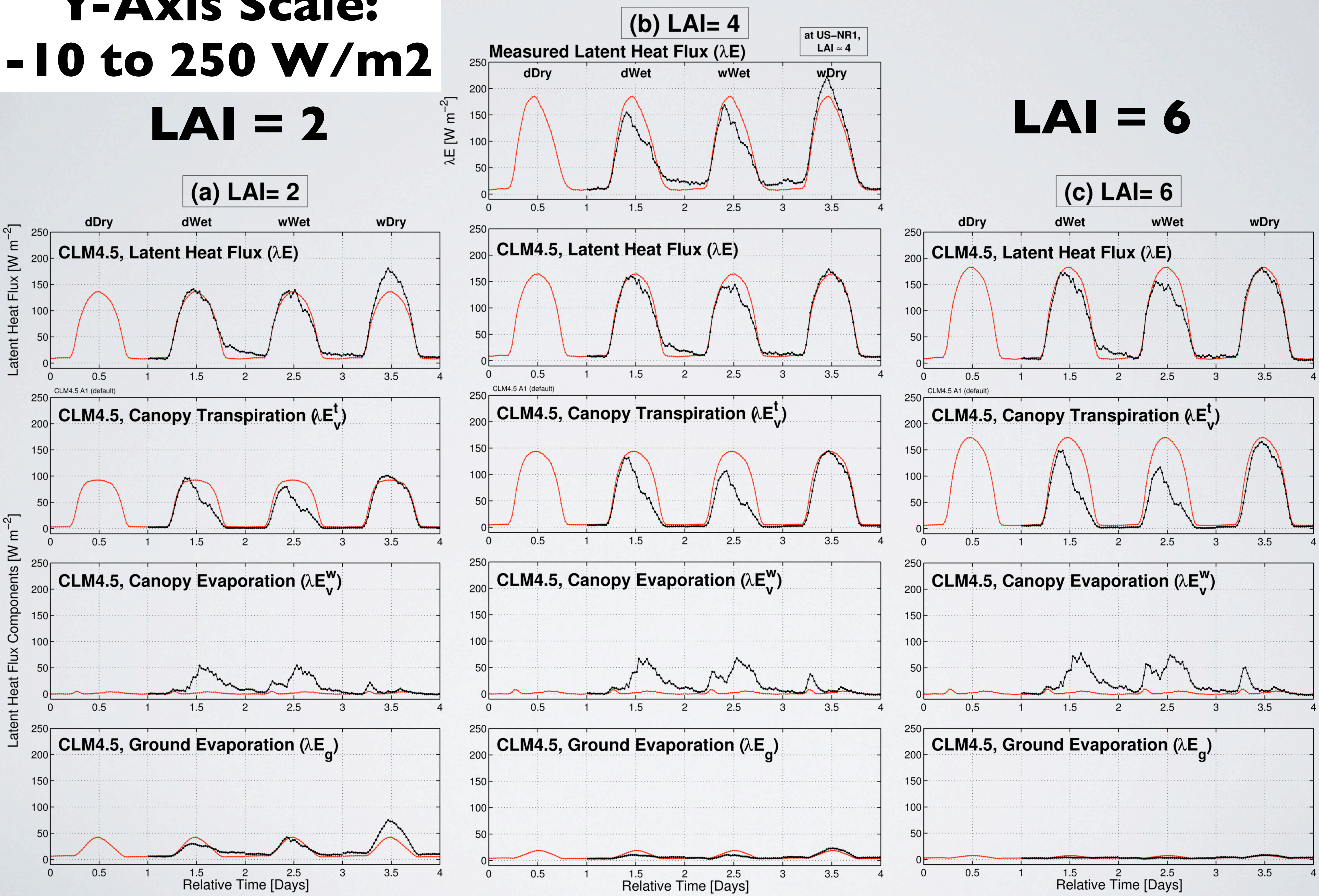


Latent Heat Flux Components of CLM4.5

Y-Axis Scale:
-10 to 250 W/m2

LAI = 2

LAI = 6



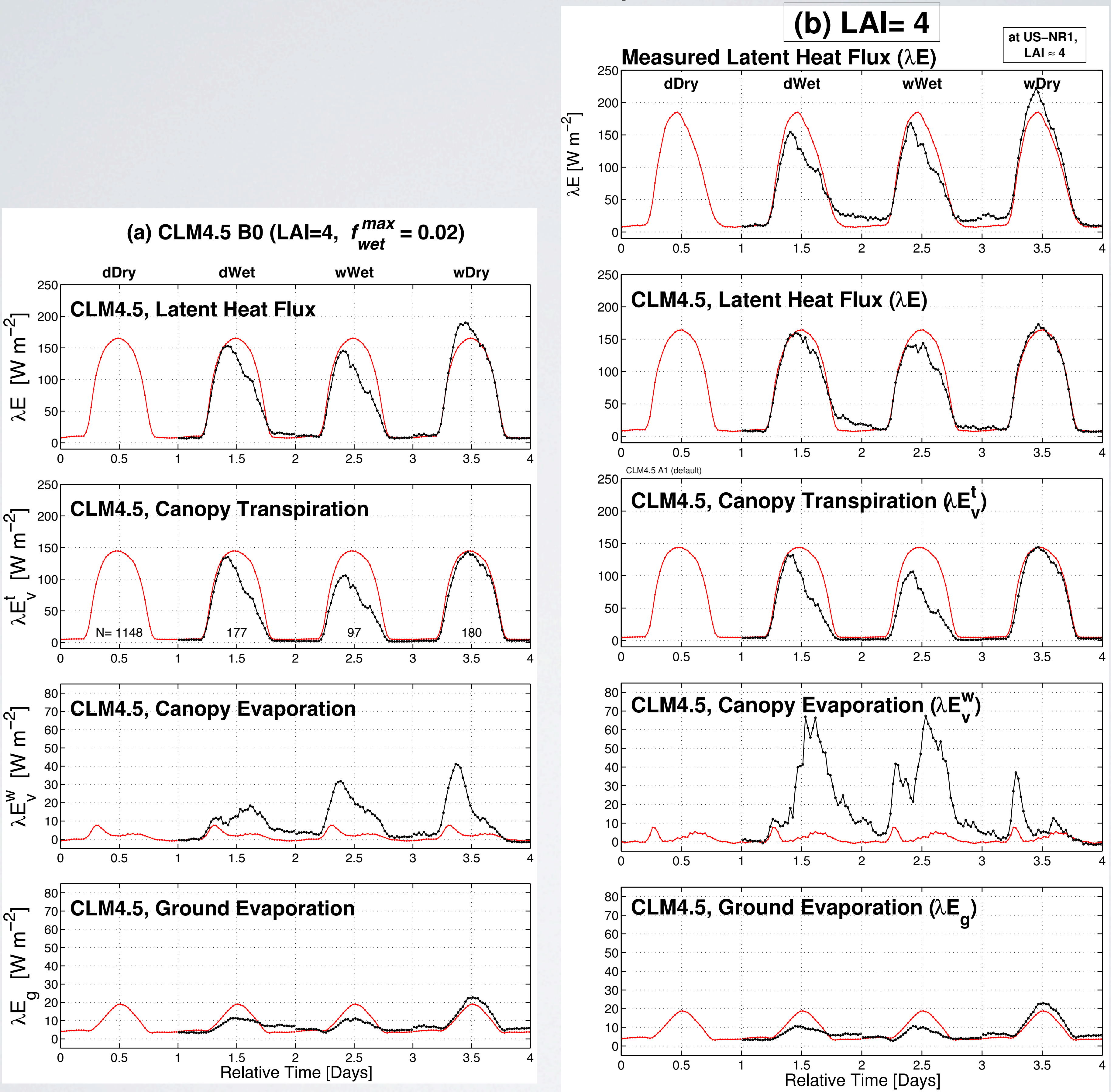
CLM Maximum Leaf Wetted Fraction

2.6. Evaporation of a "wet" forest Moors, E. J. (2012) **29**

Figure 2.4: *Picture on the left shows a thin layer of water covering the entire surface of the leaves during a light shower. Picture in the middle shows droplets of rain distributed on the leaf surface. Picture on the right shows needle leaves with droplets at their tips.*

CLM Default Value = 1
(water covers entire leaf)

Latent Heat Flux Components of CLM4.5



-10 to 250 W/m2

-5 to 85 W/m2

COMMENTS/QUESTIONS?

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AGU PUBLICATIONS

Journal of Advances in Modeling Earth Systems

RESEARCH ARTICLE

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Key Points:

- Warm-season rainfall increased observed latent heat flux that the Community Land Model (CLM) did not replicate without adjustments to the model parameterization
- Examples of sensitivity tests to land-surface model parameterizations and parameters are shown
- Drainage flows in complex terrain increased near-ground turbulence and enhanced nocturnal evaporation, which is a process typically not within land-surface models

Supporting Information:

- Supporting Information S1
- Data Set S1

A Comparison of the Diel Cycle of Modeled and Measured Latent Heat Flux During the Warm Season in a Colorado Subalpine Forest

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Abstract Precipitation changes the physiological characteristics of an ecosystem. Because land-surface models are often used to project changes in the hydrological cycle, modeling the effect of precipitation on the latent heat flux λE is an important aspect of land-surface models. Here we contrast conditionally sampled diel composites of the eddy-covariance fluxes from the Niwot Ridge Subalpine Forest AmeriFlux tower with the Community Land Model (CLM, version 4.5). With respect to measured λE during the warm season: for the day following above-average precipitation, λE was enhanced at midday by $\approx$40 W m^{-2} (relative to dry conditions), and nocturnal λE increased from $\approx$10 W m^{-2} in dry conditions to over 20 W m^{-2} in wet

Sensitivity of Latent Heat Flux Components to Cs