

Observational strategies to characterize the diurnal cycle of the convective boundary layer

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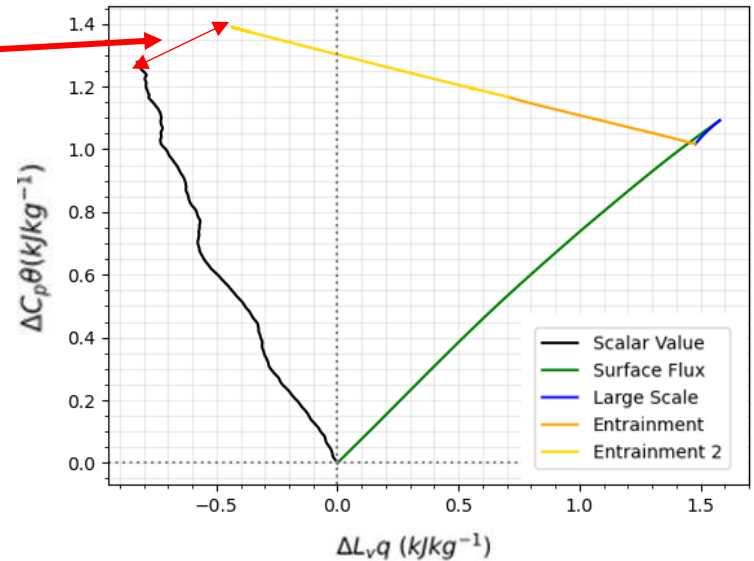
$$\frac{\partial \bar{\theta}_{ml}}{\partial t} = \frac{\partial \bar{\theta}_{ml}}{\partial t} \Big|_{LS} + \frac{\overline{w'\theta'}}{z_i} \Big|_{Surf} - \frac{\overline{w'\theta'}}{z_i} \Big|_{Entn} + \frac{dz_i}{dt} \frac{(\bar{\theta}_{i,top} - \bar{\theta}_{ml})}{z_i}$$

Large Scale (Advection) Surface Flux Entrainment 1 Entrainment 2

Goal: Use LES single columns to inform observational practices in studying the CBL heat and moisture budgets

(MicroHH: Van Heerwaarden et al. 2017)

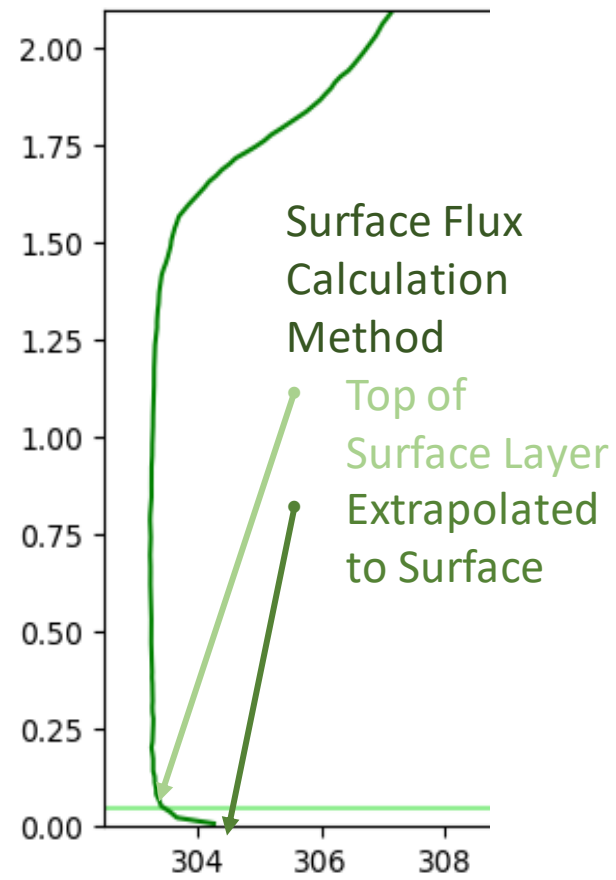
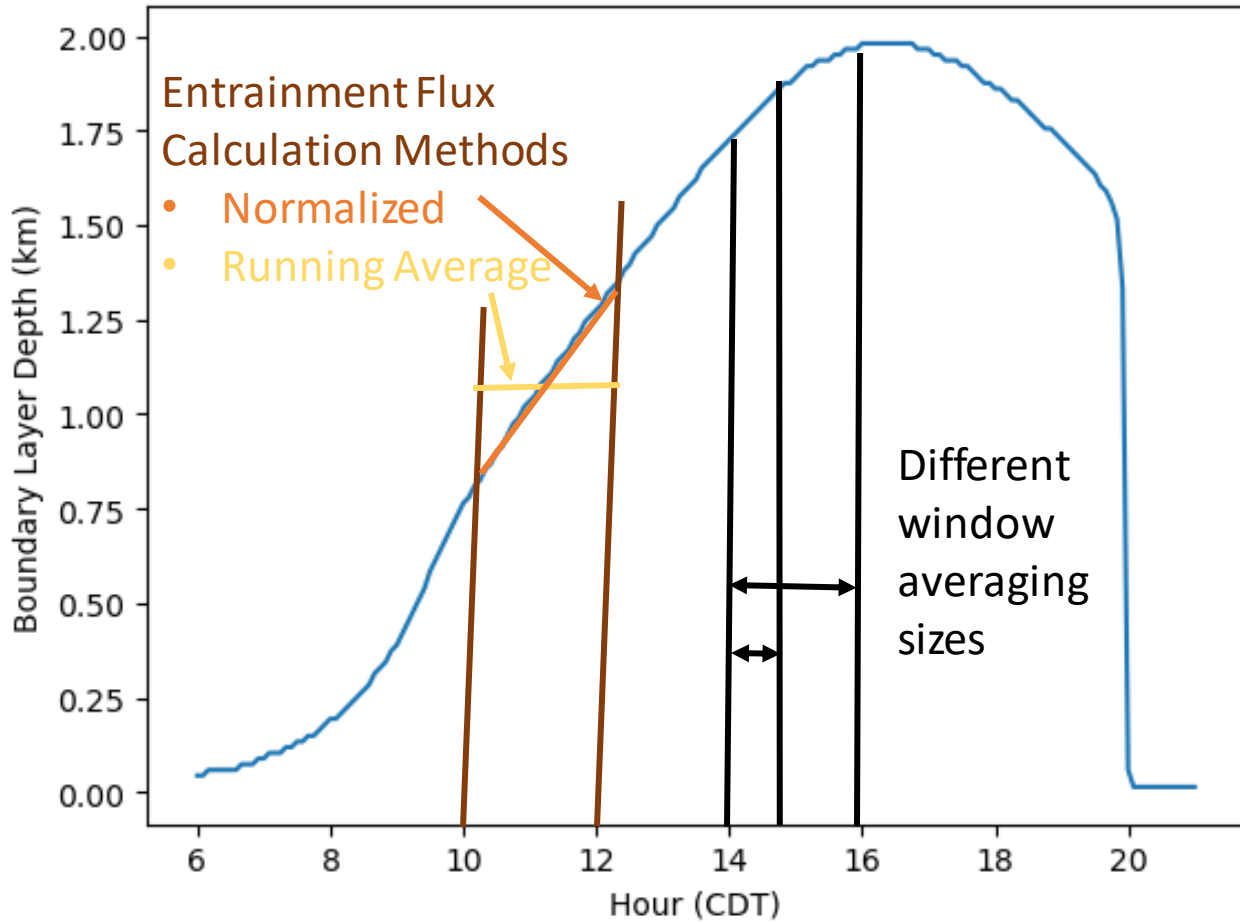
08 August 2017 1400 CDT – 1700 CDT
 From 64 Columns



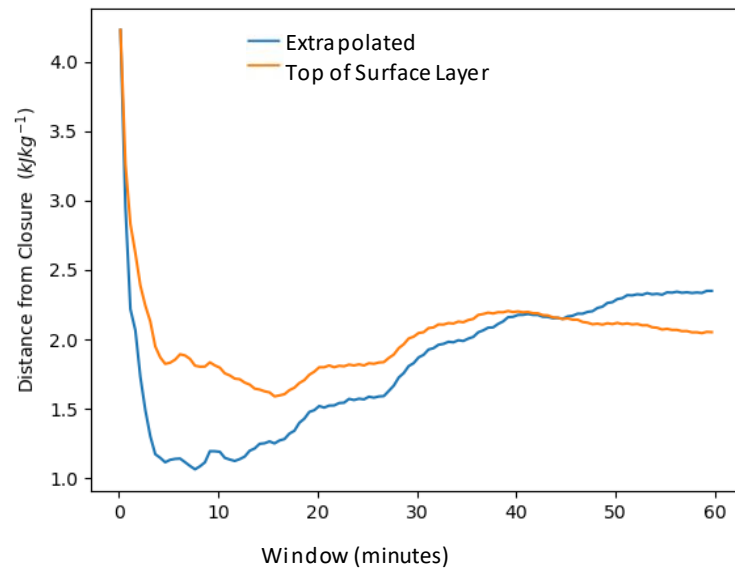
Minimize **Closure** of Mixing Diagram
 (Betts 1993; Santanello et al. 2009;
 Wakefield et al. 2023)

- Compare surface flux methods
 - Extrapolated
 - Surface layer value
- Entrainment Flux Methods
 - Normalized by z_i
 - Running average

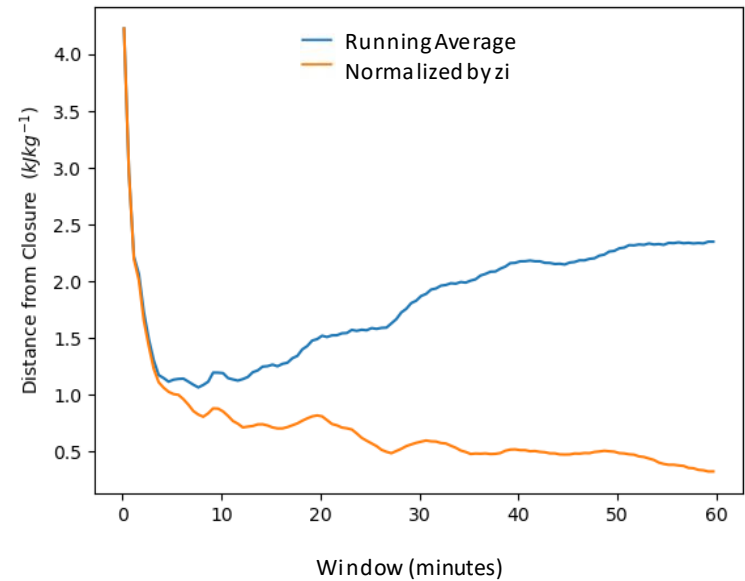




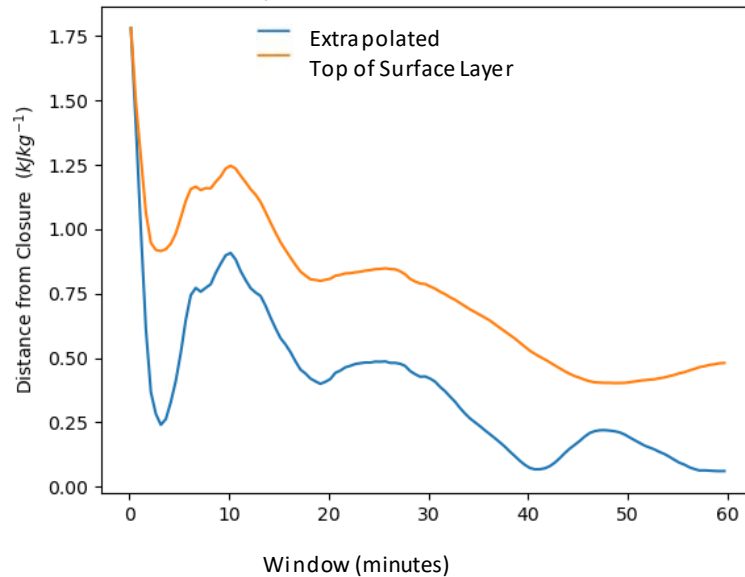
Morning (800 to 1200 CDT): Surface Flux Methods



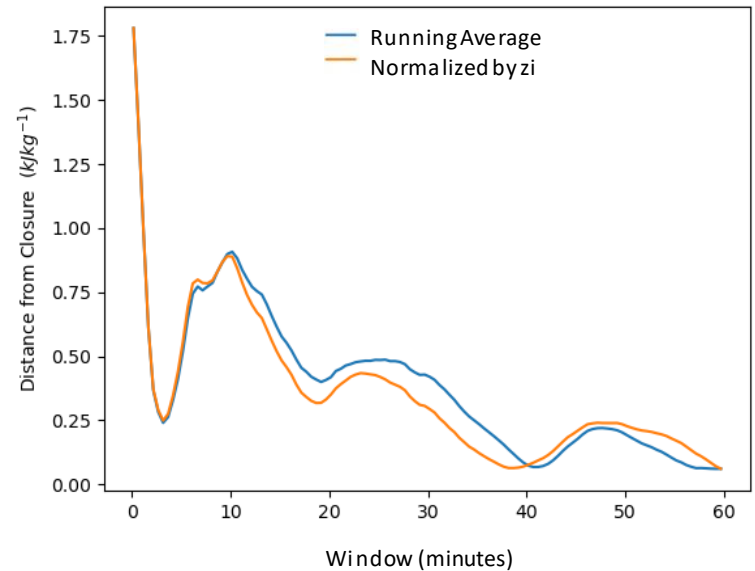
Entrainment Flux Methods



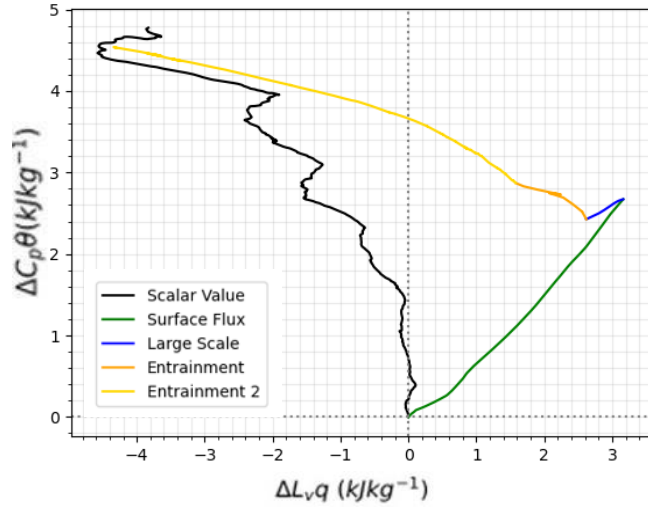
Afternoon (1400 to 1700 CDT): Surface Flux Methods



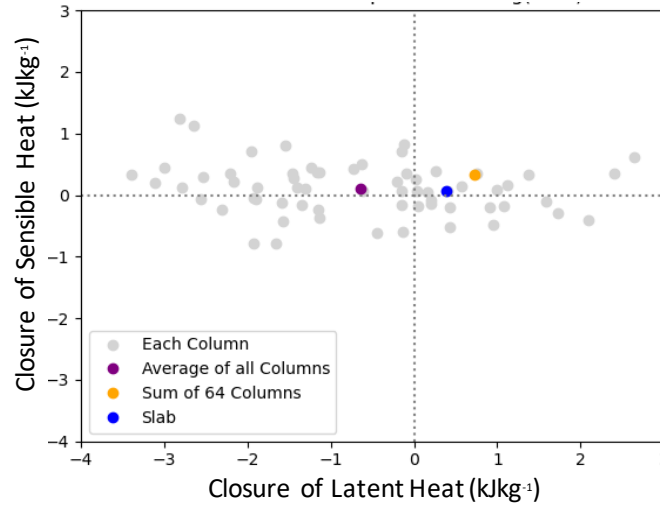
Entrainment Flux Methods



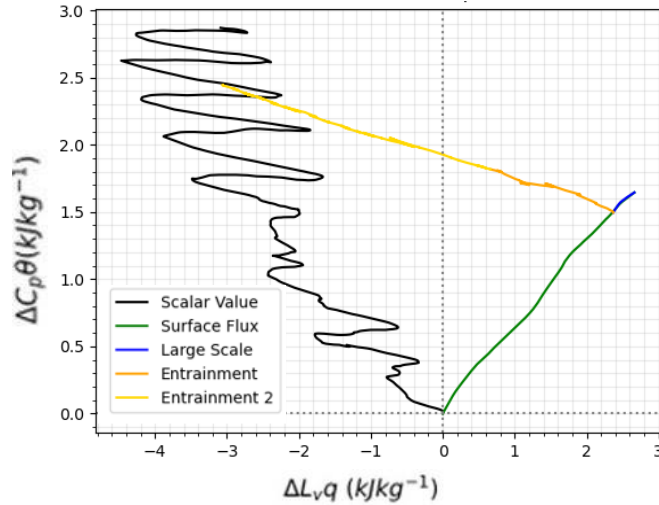
Morning – Single Column
Distance to Closure: 0.5309



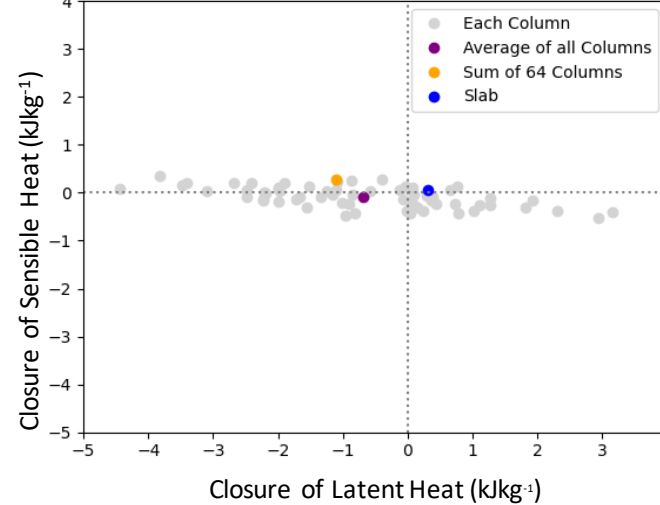
Closure of Sensible Heat vs. Closure of Latent Heat
Morning



Afternoon – Single Column
Distance to Closure: 0.4275



Closure of Sensible Heat vs. Closure of Latent Heat
Afternoon



Conclusions

- Normalized entrainment fluxes
- Extrapolated surface fluxes
- At least 10 min averaging window
- Average single column overestimates latent heat and underestimates sensible heat
- Significantly more variability in latent heat than in sensible heat

Future Work

- Evening
- Spacing and number of columns
- LSM

