Warm Boundary Layer Processes and Parameterization: the Synergy of Observation Analysis and Modeling

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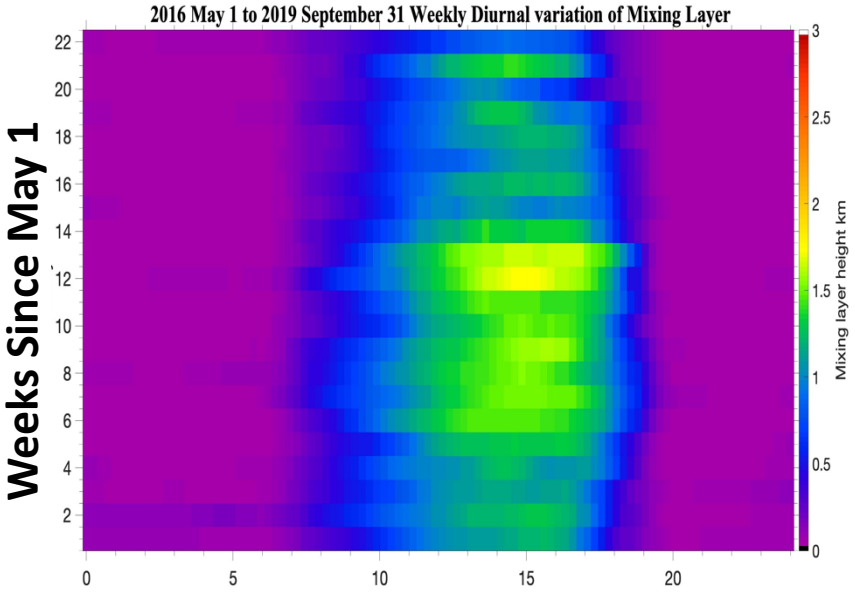
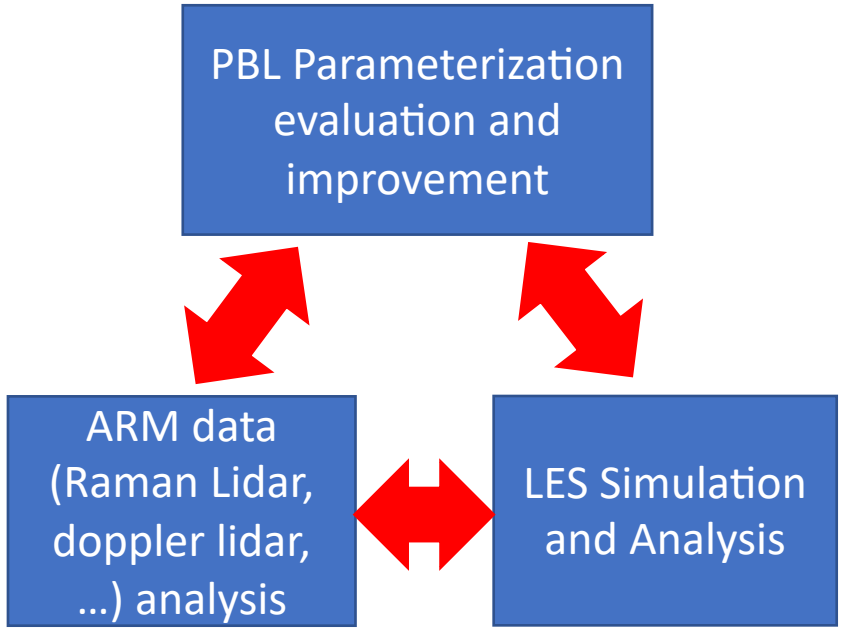
Seasonal and Diurnal Mixing Layer Height Evolution



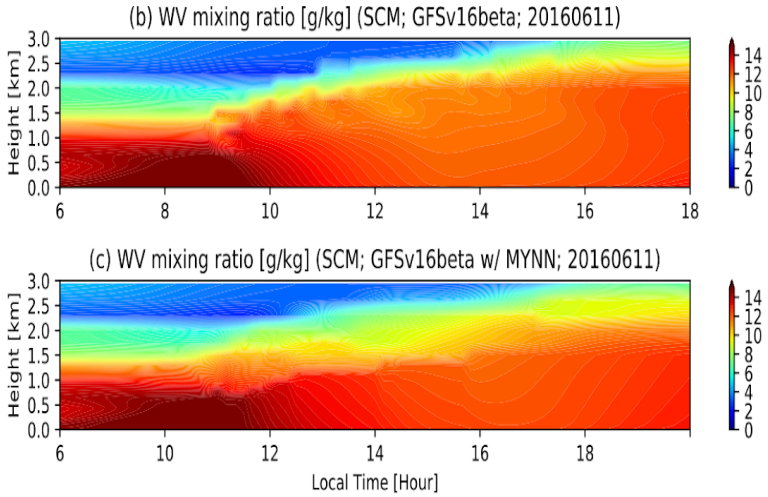
Doppler lidar measurements are used to derive mixing layer (ML) heights while Raman lidar measurements are used to determine PBL height.

Approach

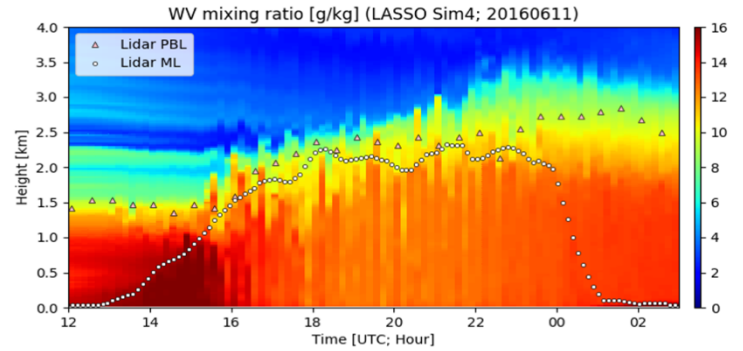


Moisture transport and evolution simulated by the SCM (top right) will be compared to the same LASSO results that are validated by the lidar and other observations (bottom right).

SCM PBL moisture evolution



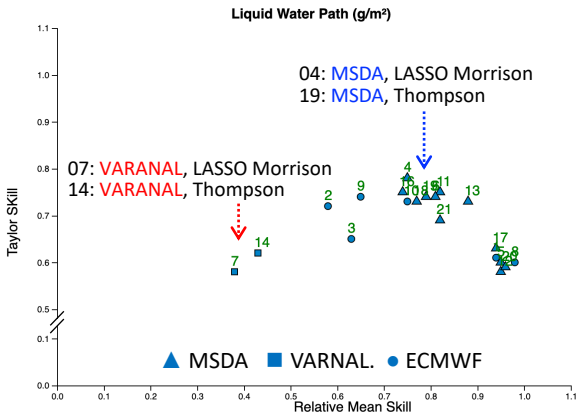
LASSO vs. Lidar PBL and ML height



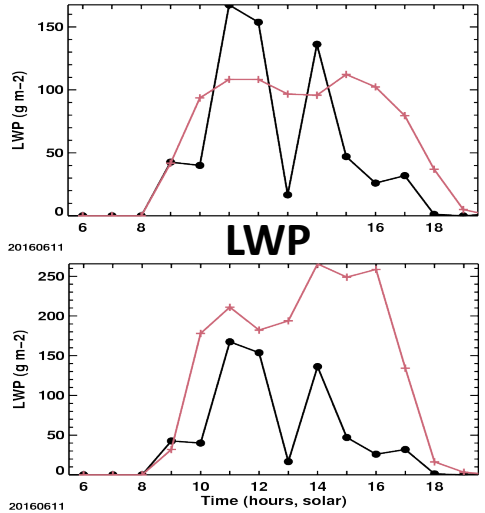
Role of large-scale forcing on the development of non-precipitating clouds revealed from LASSO simulations

Hyeyum (Hailey) Shin[1], Lulin Xue[1], Weiwei Li[1], Grant Firl[1], Yufei Chu[2] and Zhien Wang[2] ([1]NCAR, [2]CU-Boulder)

- **Motivation: same physics and surface, but different LS forcing**

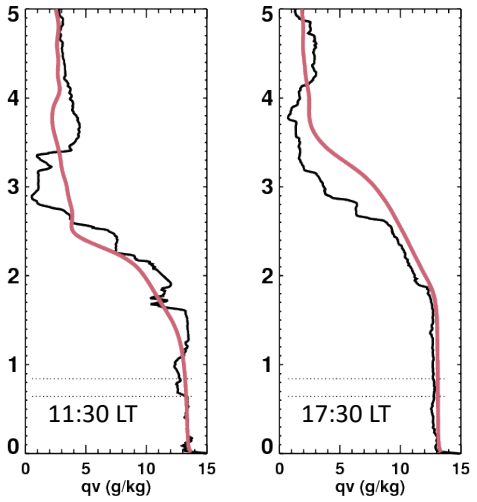


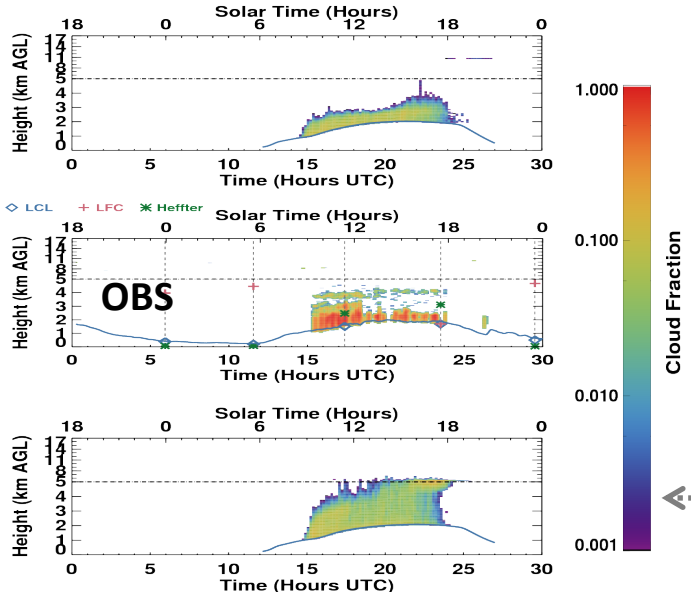
LS Forcing → **Mean Structure** → **Turbulence Statistics** → **Cloud Properties**



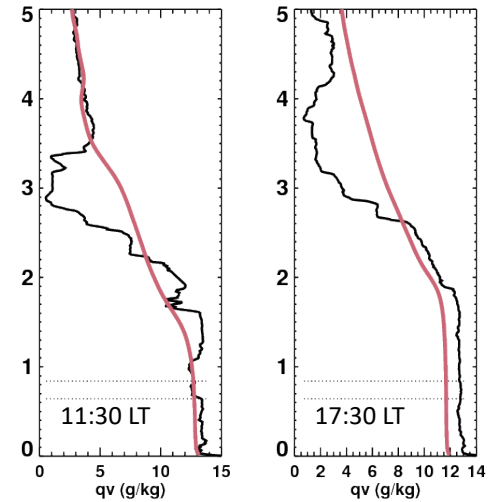
- **CASE 2016-06-11**

SIM4 (high skill scores)



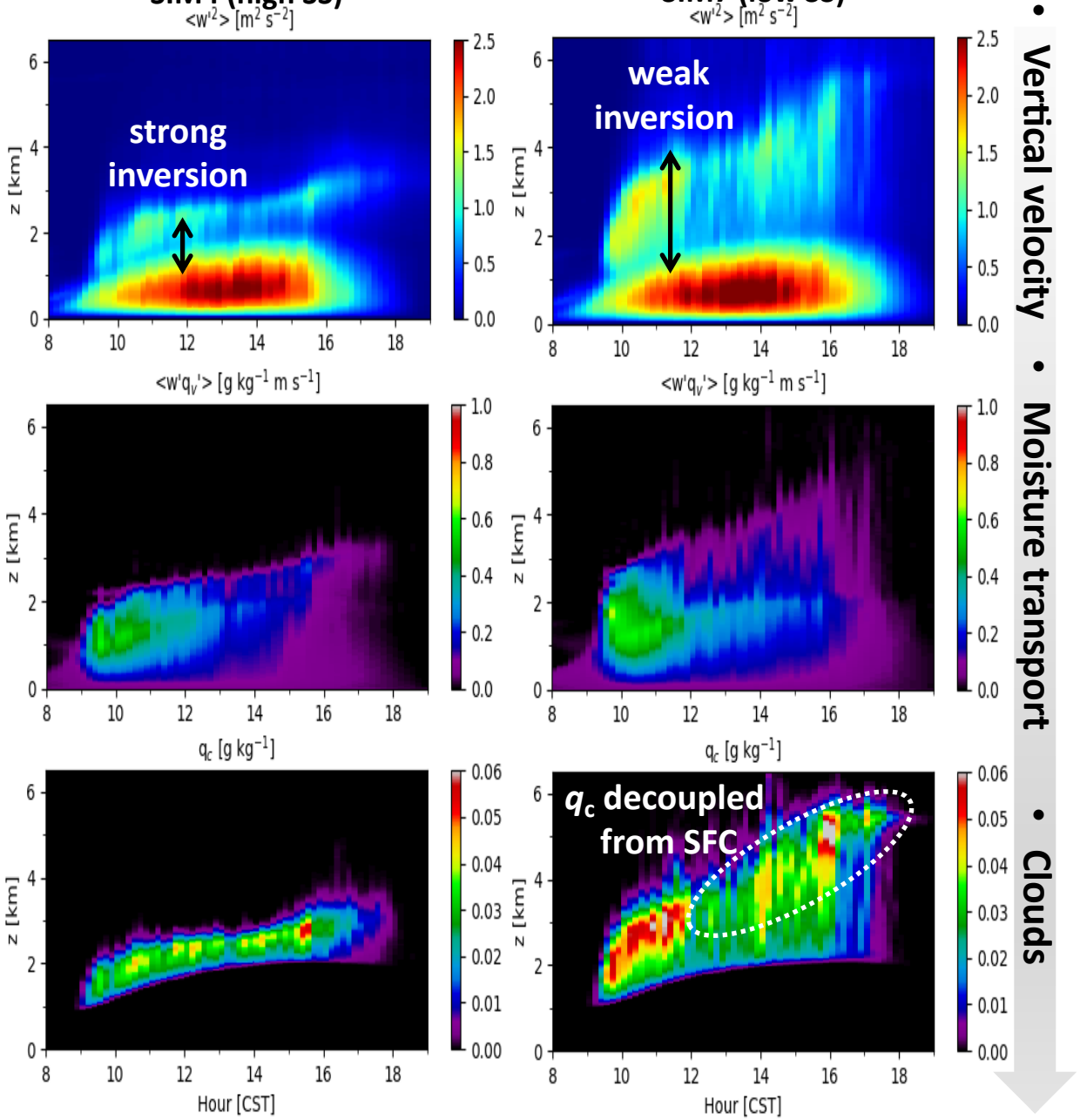


SIM7 (low skill scores)



High-Order Turbulence Statistics: Role of Inversion Strength

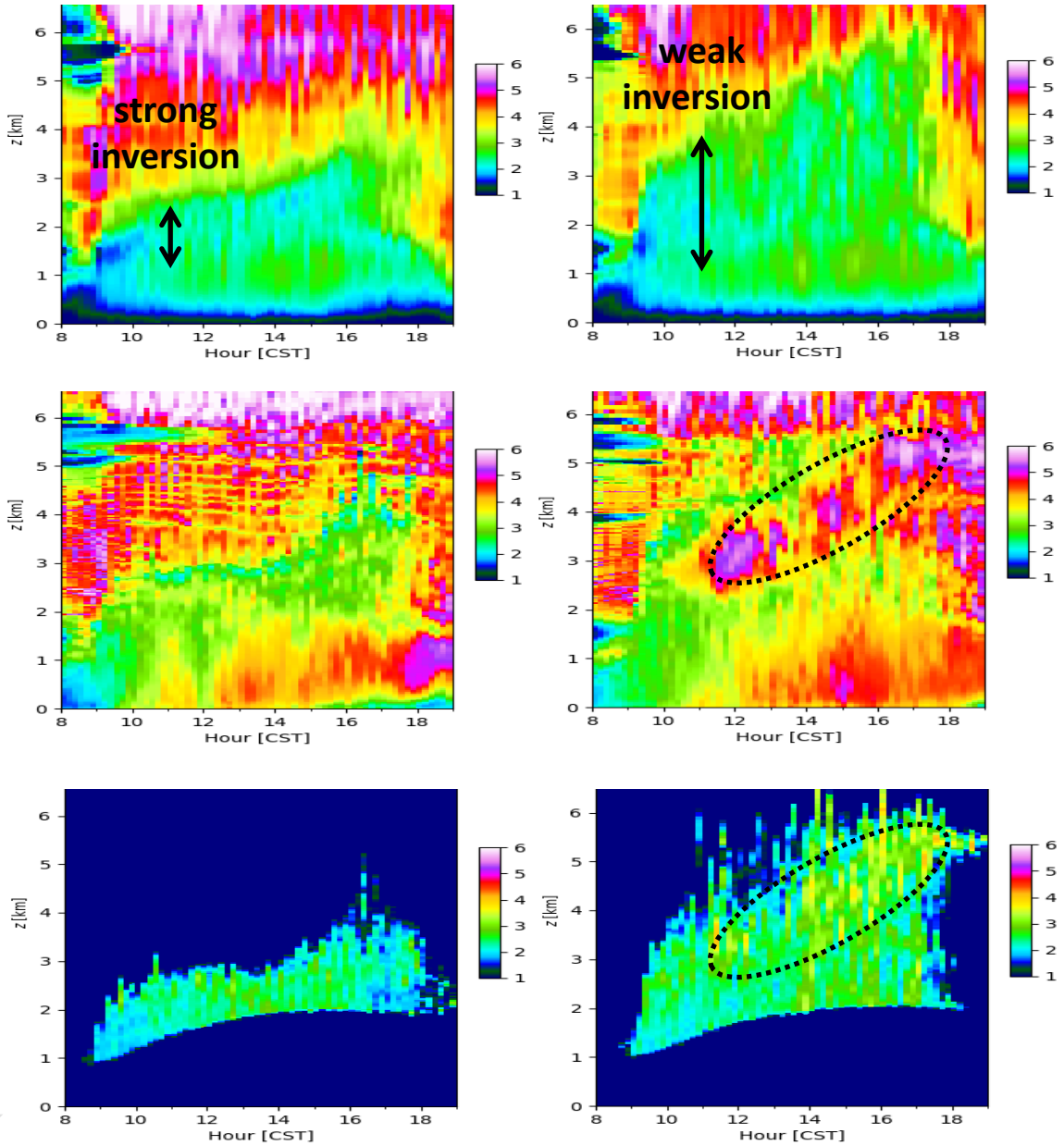
SIM4 (high SS) | SIM7 (low SS)



• Vertical velocity • Moisture transport • Clouds

Scales of Energy-Dominant Eddies: Role of Moisture Advection

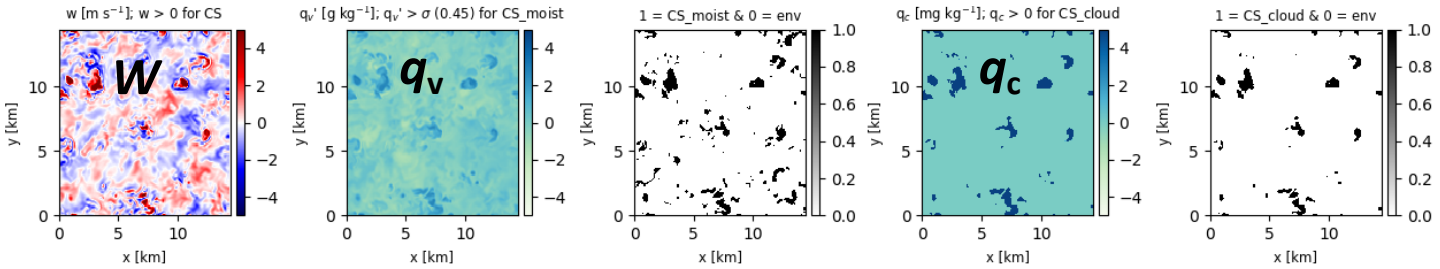
SIM4 (high SS) | SIM7 (low SS)

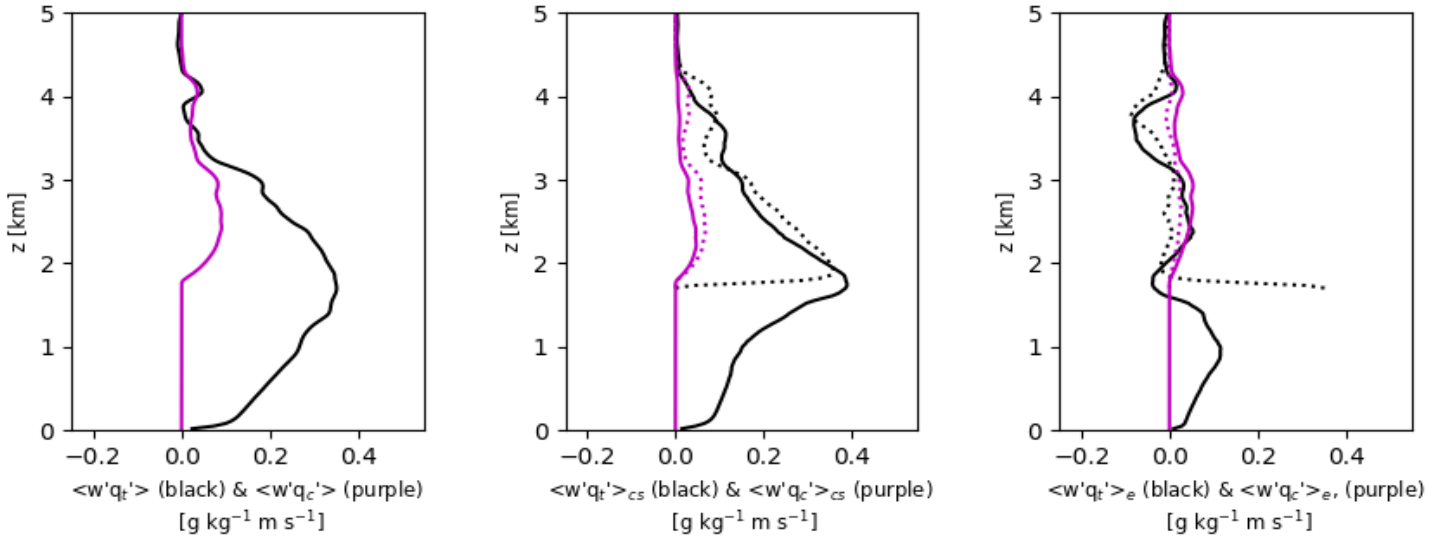


• L_{peak} W Spectra • L_{peak} q_v Spectra • L_{peak} q_c Spectra

Next Step: Linking LS Forcing, Turbulent Vertical Transport and PBL Parameterizations

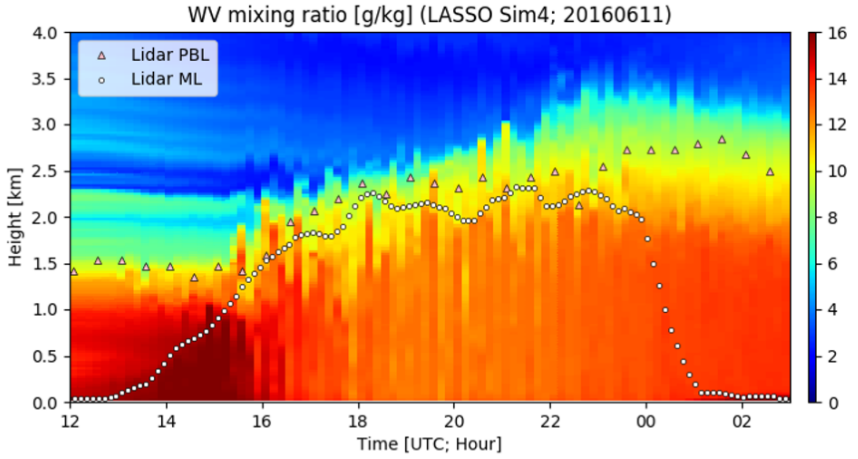
- Conditional Sampling (CS): Moist (or Cloudy) and Updraft Areas





q_{total} (black) or q_{cloud} (purple) Total transport = **by strong updrafts (~ by large eddies)** + **by environment (~ by small eddies)**

LASSO vs. Lidar PBL and ML height



SCM PBL moisture evolution