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

- PBL Parameterization evaluation and improvement
- ARM data (Raman Lidar, doppler lidar, ...) analysis
- LES Simulation and Analysis

SCM PBL moisture evolution

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

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• Motivation: same physics and surface, but different LS forcing

LS Forcing  Mean Structure  Turbulence Statistics  Cloud Properties

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SIM4 (high skill scores)

SIM7 (low skill scores)
High-Order Turbulence Statistics: Role of Inversion Strength

- Vertical velocity
- Moisture transport
- Clouds

Scales of Energy-Dominant Eddies: Role of Moisture Advection

- $L_{\text{peak}}$ W Spectra
- $L_{\text{peak}} q_v$ Spectra
- $L_{\text{peak}} q_c$ Spectra

SIM4 (high SS) vs. SIM7 (low SS)
Next Step: Linking LS Forcing, Turbulent Vertical Transport and PBL Parameterizations

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

\[ q_{\text{total}} \text{ (black) or } q_{\text{cloud}} \text{ (purple)} = \text{by strong updrafts (\~ by large eddies)} + \text{by environment (\~ by small eddies)} \]