Introduction

- The observed afternoon precipitation peak is not accurately simulated in most large-scale models that employ parameterizations for the boundary layer and convective processes.
- Land surface influences moist convection by means of the boundary layer, in which turbulence is ubiquitous.
- This study employs LES with realistic surface flux fields to examine the effect of surface dryness (or wetness) on the development of afternoon moist convection.

Model Setup & Run

- Model Configuration
  - Weather Research and Forecasting (WRF) model version 3.6 in an LES mode
  - The horizontal grid spacing is 50 m with a 10 km model top, about 30 m vertical grid spacing
- Periodic lateral boundary conditions are used in both directions
- Statistics of the Analytic Surface Sensible Heat Flux (H) Fields at 12LT

Mean CBL Structures

- Vertical profiles of potential temperature (θ) and specific humidity (q) at 12LT
- Vertical profiles of turbulence kinetic energy (TKE)
- Vertical profiles of turbulence kinetic energy (TKE)
- Vertical profiles of the time tendency of the TKE

Mechanism for Moist Convection

- Moist Static Energy (MSE; color shaded, vertical velocity w; contoured at 1400 LT)
- Convective Inhibition (CIN) and Vertical Velocity (w)
- Maximum vertical velocity (wmax)
- CBL Height (z) and Lifted Condensation Level (LCL)

Spectral Analyses

- The averaged 2D spectra (κ) of surface sensible heat flux (H) at 12LT
- Wave number-weighted spectra of potential temperature θ
- Wave number-weighted spectra of water vapor mixing ratio r
- Wave number-weighted spectra of vertical velocity w
- Cospectal Analyses

This cospectral analysis demonstrates that LES quickly produces the typical low-level CBL turbulence of positive (P) and negative (N) vertical velocity w'. The signs of Brunt (B06K3 and B18K3) and the Brunt (B06K0 and B18K0) are reversed in the low-level CBL, particularly on scales longer than 10 km. The contribution of negative (N) vertical velocity w' and negative (N) vertical velocity w' is negative. The results show a property of thermally induced mesoscale circulation. The different dominant length scales between C0 and C1 are basically caused by the differing roles of the entrainment. The entrainment of H reduces the vertical gradient between surface and the CBL top, but the entrainment of T enhances the gradient.