Drylines and Convection

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Introduction

- Characteristics
- Formation
- Movement
- Role in initiating convection
  - Large-scale along-dryline variability
  - Small-scale along-dryline variability
Characteristics

- Dewpoint difference
  - Change of 3°C at rate of .5°C per hour up to 18°C
- Wind shift
  - Sharp wind shift on west with weak winds to the east
- The zone between two air masses or boundary layers
  - Depth of boundary layers oscillate
Characteristics

• Doppler velocity used to study
  – Low level convergence and upper level divergence
  – Hot air from west overflowed to east
  – Secondary circulation with descent to the east
    • Driven by vertical potential temperature gradient
  – Westward tilt with height of vertical vorticity
Formation

- Negatively tilted longwave trough at 500 mb over western U.S.
- Weak jet at 500 mb across southern CO
- 850 mb southerly winds over Texas from Gulf
- Appearance of strong inversion at 1200Z
- Terrain slope, heat fluxes, and soil moisture affect formation and movement
Movement

• Warm dry air on west side overruns and forms cap
• Dry air creates higher PBL
• Moves by mixing and lowering dewpoint
• Can retrograde at night
Movement

- Move smoothly in morning and jump in afternoon
- Bulges can form
- Evidence of other boundaries forming near dryline with similar characteristics
  - Double dryline possible
Convective Initiation

- Large-scale along-dryline variability
  - Soil Moisture
  - Pressure Gradient Force
  - Cloud Streets
- Small-scale along-dryline variability
  - Horizontal Convective Rolls (HCRs)
  - Misocyclones
- Air Parcels
Horizontal Convective Rolls (HCRs)

• Tubes of horizontal vorticity
• Generated by convective instability and wind shear
• Aligned with boundary layer shear vector
• Cloud streets, reflectivity fine lines
• Near-Surface Moisture Convergence (modeled)
• Enhanced surface convergence → enhanced upward motion!
HCR Conceptual Model
From Xue and Martin (2006)
HCRs on Radar
HCRs on Radar (cont.)
HCRs on Satellite (Cloud Streets)
A Closer Look
Near-Surface Moisture Convergence
Misocyclones

- Vertical vorticity tubes < 4km in diameter
- Relationship near HCRs along boundary
  - Aid in bending boundary to wavelike shape
- Control where updrafts can exist due to downward-directed pressure gradient at core
- Can spawn non-supercell tornadoes when established updraft core/storm collocates with misocyclone
Fig. 21. Schematic model showing the relationship between misocyclones, updrafts, and the horizontal distribution of moisture that lead to the initiation of convection, and nonsupercell tornadogenesis.
Air Parcels
The “So what?” of it all

- Even in the presence of enhanced convergence and vertical motion, convection can still be rejected
  - Parcels need to be forced to their LFC
  - \( h_{lcl} \) and \( h_{lfc} \)
  - Large-scale subsidence at a ridge
  - Capping
  - CIN, and too much of it
References


