Advancements in the understanding and prediction of high-shear, low-CAPE tornadoes

Introduction

- **What are high-shear, low-CAPE environments?**
  - Low shear: Large change in wind speed and/or direction with height.
  - High shear: Relatively weak environmental buoyancy for updrafts.

- **When and where do they produce severe weather?**
  - High shear, low-CAPE (HSLC) environments produce the majority of tornadoes and damaging winds during the cool season, especially overnight.

Forecasting Advancements

**High shear, low-CAPE environments:**
- High shear: Large change in wind speed and/or direction with height.
- Low CAPE: Relatively weak environmental buoyancy for updrafts.

**Why are they a concern for forecasters and public?**
- High shear: Low CAPE environments? (km)
- Low CAPE: High shear environments?
- High shear, low CAPE: CAPE environments?

- Trajectory analysis will allow us to determine how strong near-surface vortices form and how they produce tornadoes or damaging winds.

Ongoing Work

Methodology: Using an idealized numerical modeling framework, systematically alter the strength of lower tropospheric shear and CAPE to determine their effects on resulting development and evolution of simulated convection.

- Decomposition of governing equations will allow us to determine dominant processes and how they are sensitive to changing environmental variables.
- Trajectory analysis will allow us to determine how strong near-surface vortices form and how they produce tornadoes or damaging winds.

Objective: Determine the dynamic differences between environments supporting convection that produces strong, long-lived, near-surface vortices capable of tornadoes or damaging straight-line winds and those that do not.

Preliminary Findings and Future Work

- The importance of low-shear vector magnitude appears to be tied to its role in the development of numerous strong low-shear updrafts. These updrafts are necessary for the development of strong near-surface vortices.
- Increased low-shear level leads to more strong low-shear updrafts and near-surface vortices. This, in turn, increases the probability of vortices strengthening and producing tornadoes or damaging winds.
- Ongoing work seeks to elucidate the importance of low-shear CAPE and mid-level shear vector magnitude.

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