FINAL EXAM REVIEW
METR 5403/4403: Applications of Meteorological Theory to Severe-Thunderstorm Forecasting
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Be able to update the tornado probabilities portion of a Day 1 Convective Outlook, provided unanalyzed and analyzed observational data, mesoanalysis output, soundings, hodographs, and model information. This builds upon concepts presented throughout the entire course.

Consider two environmental vertical-wind profiles, each associated with identical magnitudes of bulk shear in the 0-6-km layer. However, the shapes of their corresponding hodographs differ. In Profile 1, the hodograph consists of a straight line. In Profile 2, the hodograph is curved. Which profile would be associated with an environment supporting more efficient and rapid low-level mesocyclogenesis? Why? [*HINT: Consider the sources and ramifications of perturbation pressures in supercell thunderstorms.*]

What roles do hydrodynamic pressure perturbations play in influencing supercell intensity and motion? Be able to discuss the non-linear and linear contributions to perturbation pressure for a given hodograph, as covered in class and the homework. How does the background near-storm environment influence the eventual perturbation pressure distribution in deep convection?

Consider a shortwave trough preceded by midlevel height falls, and assume a steady-state, non-amplifying wave pattern characteristic of the midlevel geopotential height pattern. Use quasi-geostrophic theory to explain the relationship between trough-preceding height falls and ascent.

Describe the characteristic environment of tropical-cyclone tornadoes.

What is the primary motivation behind considering reversible convective available potential energy (RCAPE) in diagnosing buoyancy in tropical-cyclone tornado environments?

What is the importance of communication for critical severe weather warning operations.

How do personality types play a role in influencing the convective-warning process?

Be able to describe important aspects/considerations of the convective-warning decision-making process.

Describe the purpose and process of impact-based decision support services.

Explain the formulation of Theil's inequality coefficient. Explain why this coefficient is useful in characterizing errors among meteorological parameter values.

Describe the challenges of forecasting severe thunderstorms in low-CAPE high-shear environments. Describe behaviors of planetary boundary layer parameterization schemes for these environments.

What is radar sidelobe contamination, and what are signs that it is occurring? How does it impact convective-warning operations?

What is Stokes' Theorem? How can it be applied to the evaluation of vertical circulations resulting from a baroclinic atmosphere. How is Stokes' Theorem applicable to explaining sea-breeze-related thunderstorm development?

Suppose you are provided functional forms of pressure and density for an atmospheric fluid, each expressed as a function of spatial coordinates. Be able to use Stokes' Theorem to derive an equation for the rate of change of circulation with respect to time, in terms of the cross product between the gradients of pressure and density. Then, be able to mathematically determine whether this fluid would support baroclinic circulations, after taking the cross product between the gradient of density and the gradient of pressure. Finally, be able to draw conclusions regarding the propensity for the atmosphere to support thunderstorm development given the determination regarding the presence or absence of baroclinic circulations.

In what way does terrain play a role in influencing thunderstorm potential?

Understand the importance of convection-allowing model guidance, limitations of this guidance, how this guidance is incorporated into the forecast process, and what ensemble convection-allowing model guidance is often referenced by forecasters (model names and fields/simulated-storm attributes).