ATM 400: Potential Final Exam Topics

Weather analysis and forecasting process (Bosart 2003)

2D equation of motion/momentum equation
- Interpretation of terms
- Geostrophic scaling

Geostrophic approximation
- Drawing geostrophic wind vectors based upon geopotential height field
- Implication for vertical motion
- Rossby number: definition and use

Hydrostatic approximation: physical interpretation

Hypsometric equation: physical interpretation

Continuity equation: physical interpretation

Thermal wind
- Definition
- Implication for baroclinicity
- Drawing thermal wind vectors based upon thickness field

Jet streak circulations
- Ageostrophic wind: subgeostrophic and supergeostrophic
- Role in restoring geostrophic and thermal wind balance
- Vertical motion and divergence/convergence patterns associated with jet streaks
- Jet entrance and exit region cross sections
- Definition of thermally direct and indirect circulations

Thermal wind application: link between vertical wind profile and thermal advection

Ageostrophic wind equation
- Natural coordinates
- Isallobaric wind term: interpretation and applications
- Inertial-advective wind terms: interpretation and applications

Vorticity equation: interpretation and application
- Horizontal relative vorticity advection term
- Vertical relative vorticity advection term
- Planetary vorticity advection term
- Divergence/stretching term
- Tilting term

Conservation of potential vorticity

Quasi-geostrophic (QG) approximation

- Implication for vertical motion
- Interpretation of QG momentum equations

QG vorticity equation in pressure coordinates: interpretation and application

- Geostrophic relative vorticity advection term
- Divergence/stretching term

Thermal vorticity

- Definition
- Application to thermal structure of systems (warm/cold core)
- Warm core/cold core system cross sections

QG thermodynamic equation: interpretation and application

- Geostrophic temperature advection term
- Adiabatic cooling/warming term: importance of static stability
- Diabatic cooling/warming term: examples of diabatic processes
- QG thermodynamic equation expressed in terms of thickness

QG height tendency equation: interpretation and application

- LHS term (~3D Laplacian)
- Geostrophic relative vorticity term: mechanism for system movement
- Planetary vorticity term: mechanism for system movement
- Differential thickness advection term: cross sections, mechanism for system weakening/strengthening
- Diabatic heating term

QG omega equation: interpretation and application

- LHS term (~3D Laplacian)
- Concept of "QG forcing for ascent/descent"
- Differential vorticity advection term
- Horizontal Laplacian of temperature advection term
- Sutcliffe approximation (thickness, mid-layer absolute vorticity plots)
- Diabatic heating/cooling term

Cold air damming: extra credit question

- Physical explanation
- Role in Northeast snowstorms