EAS 4803/8803 YD: Atmospheric Dynamics II

Instructor: Dr. Yi Deng
Office: ES&T 3248
Phone: 404-385-1821
Email: yi.deng@eas.gatech.edu
Office Hours: by appointment

Prerequisites: EAS 4655 – Atmospheric Dynamics or EAS 6502 – Introductory Fluid Dynamics and Synoptic Meteorology

Course Goals: This course will introduce to students basic physical concepts and analytic techniques that are essential for understanding atmospheric motions at various temporal and spatial scales. The special emphasis will be on various types of atmospheric instabilities and their role in driving the extratropical general circulation.

Text Books:
1. *An Introduction to Dynamic Meteorology, 4th Edition*, James R. Holton. (Recommended)
2. *Atmospheric Dynamics, Mankin Mak* (Recommended)

Course Outline:
1. **Review of basic concepts and equations**: use of different reference frames and coordinate systems; governing equations; scale analysis; balanced flow; effects of rotation and stratification; static stability; circulation theorem; vorticity equation; potential vorticity conservation.

2. **Planetary boundary layer**: atmospheric turbulence; flux-gradient theory; mixing length hypothesis; Ekman layer; surface layer; secondary circulation and spin-down.

3. **Atmospheric waves**: perturbation method; properties of waves; sound waves; internal gravity waves; inertio-gravity waves; Rossby waves; dynamics of stationary waves.

4. **Atmospheric instabilities**: review of the quasi-geostrophic (QG) formulation; Kelvin-Helmholtz instability; barotropic and baroclinic instability; baroclinic instability in a two-layer model; energetics of baroclinic waves; the Eady problem; the Charney model.

5. **Storm tracks and low-frequency variability**: instability of a localized baroclinic jet; lifecycle and energetics of baroclinic eddies; formation and maintenance of a localized baroclinic jet; midlatitude wave-guide and organization of storm tracks; downstream development; intraseasonal variability of storm tracks; cross-frequency coupling of eddies; wave breaking and annular modes.

6. **Mesoscale circulations**: Q-vector and ageostrophic circulation; energy sources for mesoscale circulations; frontogenesis; symmetric instability; mountain waves; cumulus convection; convective storms; supercell thunderstorm and tornado genesis; hurricanes.

Coursework:
1. Homework will be given every two weeks.
2. Paper review: Each student needs to do a written-review of one recently published paper on a topic covered by the course and selected by himself/herself. Review should be no less than three pages and not exceeding five pages. Graduate students will be required to review more advanced papers.
3. Exam: one open-book exam will be given at the end of the class.

Grading:
Undergraduate and graduate students will be graded differently.

Class participation: 10%
Homework: 40%
Paper review: 20%
Final Exam: 30%