Atmospheric Sciences 336, Fall 2007
Final Exam Notes

The Rules: Each student can bring one-and-a-half pages of cheat sheet to the exam. And you can use these pages however you like. For instance, you could bring the two half pages from the previous two exams and then add a new half page for the material covered since exam 2. Or you could start over from scratch. Your call.

Some Topics Not Covered: The following subjects will not be tested by the exam (at least not explicitly):

- Thermodynamics [equations of state, the 1^{st} law, specific heats, the adiabatic constant and potential temperature]
- Math review topics [the Taylor series, integration in 2D, the scalar and vector products, path integrals, etc.]
- Material from the labs

But of course in many cases you still need to know this stuff for other things—for instance, to compute the circulation you would typically need to compute a path integral. And keep in mind that most of the lab material overlaps with lecture stuff. So it certainly wouldn't hurt to at least briefly go through the labs.

Words to the Wise: Make sure to review:

- Anything missed on the first two exams. Many of the concepts tested on the final will be the same concepts covered on exams 1 and 2.
- Vectors, vectors, vectors. Much of what we covered in the second half of the course depends on a solid understanding of vectors. So go back through the vector review, break out the calculus book, call your old math prof, spend some time with wikipedia .... whatever it takes.

New Stuff: The exam will be slightly weighted towards the material covered since the last exam—specifically, the material from geostrophic balance to the Eulerian and Lagrangian time derivatives. (And yes, the exam does cover the material from the last several lectures.) To outline the main topics:

- *The approximate force balance for large-scale flows.* This is certain to show up on the exam, and probably more than once. Why does the jet stream blow from west to east? Why does the circulation above a cold-core high become less anti-cyclonic with height? Look at the examples from lecture and it certainly wouldn't hurt to look at the last lab, either.
- *The balance conditions in pressure coordinates.* Why is knowing the pressure as good as knowing the height (for large-scale flows, at any rate)? How is the horizontal pressure gradient related to the slope of a pressure surface? How is the geostrophic wind vector related to the contours of constant height on a pressure surface?

- *Mass transport across a surface.* Make sure you understand the basic concepts behind the continuity equation. Suppose you have a rectangle of area $\Delta x \Delta z$ oriented perpendicular to the y-axis. At what rate does fluid mass cross this rectangle?

Older Material: Some notes on older material:

- *The hydrostatic balance and hydrostatic pressure* will surely show up in some form. The various guises covered include
  - the constant density (or ocean) form
  - the variable density (or atmosphere) form
  - the hypsometric equation

  Make sure you know how to find the pressure given the corresponding temperature or density profiles. And be sure to understand the temperature-thickness relation.

- *Static stability.* You've already had a pick-your-poison problem on this, so it probably won't show up as a long question. But it could show up as a short question. Make sure you understand the general concepts—that is, how the stability is related to the net restoring force on a disturbed particle.

- *Relative motion near a point.* We spent a lot of time reviewing velocity gradients and the associated kinematic quantities. So this will probably show up once or twice. Some things to review:
  - Given information about the velocity gradients, make sure you can sketch a consistent flow field (e.g., problem 3 from homework 3).
  - Make sure you could derive a flow field given the four kinematic quantities (i.e., vorticity, divergence and the two deformations).
  - Be sure you know how the kinematic properties relate to changes in size, shape and orientation of a particle

- *Vorticity and circulation.* This was conspicuously absent from exam 1, so I suspect it'll raise its ugly head this time around. Be sure that given a simple flow field and a simple path you could compute the circulation. (For the exam I'll only give straight line paths—no circles!) And of course review the relationship between circulation and vorticity.

- *Streamlines, streamfunctions and trajectories.* Be sure you understand (i) the relationship between streamfunctions and streamlines and (ii) the difference between streamlines and trajectories.

- *Rotating coordinates.* Between the homeworks (problem set 5) and the labs you've done a couple of rotating coordinate examples. So I'd expect something similar on the final. Make sure you understand the rotating coordinate transformation that gets you from the inertial to the rotating coordinates.

- *The centrifugal force and gravity.* Make sure that you understand the difference between Newton's gravitation and what we typically refer to as gravity. Which is perpendicular to the Earth's surface? And why?

- *Simple circular motion.* Review the definitions of scale in terms of the Rossby number, as well as the geostrophic wind relations for the high and low pressure cases.

Other Stuff: Of course I've probably forgotten something. So your safest bet is to study everything!

See you Monday!