Preliminary Syllabus
ATOC 312: Rotating Fluid Dynamics
Fall 2016

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Course objectives:
In this course, you will be introduced to geophysical fluid dynamics, which addresses fluid motion of the oceans and atmosphere (as well as planetary atmospheres). We will cover some basic principles and then move on to a reduced set of equations, the rotating shallow-water system. The shallow water equations give an accessible, yet relevant approximation to the large-scale dynamics of the atmosphere and oceans. The knowledge gained in this course will enable you to grasp the essentials of large-scale atmospheric and oceanic flows and prepare you for more advanced courses such as ATOC 512, 513, 515.

Outline:

1. Fundamentals of GFD (weeks 1-4)
    - Lagrangian and Eulerian time differentiation
    - Vorticity and divergence
    - Helmholtz decomposition
    - Equations of motion for a nonrotating fluid
    - Rotating coordinate frames
2. Balanced flow and other basic applications (weeks 5-7)
    - Incompressibility
    - Hydrostatic balance
    - Geostrophic balance
    - Thermal-wind balance
    - Inertial oscillations
3. Shallow-water theory (weeks 7-10)
    - Governing equations
    - Linear solutions: geostrophic balance and inertia-gravity waves
4. Quasi-geostrophy (weeks 10-13)
    - Quasi-geostrophic equations for the shallow-water system
    - Rossby waves
    - Barotropic instability

Textbooks:

There is no formal textbook for this course—the course notes are sufficient. However, for additional background reading the following textbooks may be useful: i) Marshall, J. and R. A. Plumb, 2008: *Atmosphere, Ocean, and Climate Dynamics: An Introductory Text*, Academic Press, ii) McWilliams, J. C., 2006: *Fundamentals of Geophysical Fluid Dynamics*, Cambridge, and iii) Cushman-Roisin, B. and J-M. Beckers, Introduction to Geophysical Fluid Dynamics, Elsevier

Grading:

- Homework assignments (3 or 4 total): 30%
- 2-3 midterm oral quizzes: 25%
- Final exam: 45%
- If desired, it may be possible to alter this evaluation structure to allow for optional student projects counting for up to a maximum of 20% of total grade.
- The final will be a take home exam (e.g., to be completed within a 24 hour period). The length of the exam is such that three hours should be sufficient. Collaboration on homework and projects is encouraged. Collaboration on the final is not.

Other:

- The format will be a mixture of prerecoded short lectures and participitory zoom sessions.
- In accordance with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.
- McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/students/srr/honest/ for more information).