AOS 310: Dynamics of Atmospheres and Oceans I

Instructor: Prof. Michael C. Morgan  
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Phone number: 608 262 1957

Meeting times: 11-11:50 MWF in AOSS Building, Room 811

Attendance: Your alert and engaged attendance is your “ticket” to my office hours. Let me emphasize that if you miss class due to circumstances beyond your control or if despite efforts you do not understand material covered in class, I am eager to provide additional help! If you can't meet during my office hours, feel free to contact me by phone or email to set up an appointment. On the other hand, if you choose to skip class or sleep through class, you should not expect me to provide private tutoring on the material you missed.

Office hours: Mondays 9:45 to 10:30 AM and Wednesdays 4:00 to 5:15PM.¹

Course description: Introduction to the dynamics underlying atmospheric and oceanic phenomena. The course begins with a survey of various types of atmospheric and oceanic phenomena and their associated scales of motion, as well as a description of fluid flows (kinematics). The remainder of the course is concerned with deriving and interpreting the relevant equations governing the evolution of geophysical fluid flows, followed by a simplification of these equations via a scale analysis. Fundamental force balances and relationships between the mass and motion fields are identified and applied to describe large-scale atmospheric and oceanic motions. Analysis of near real-time atmospheric data is performed to enhance physical understanding of dynamics concepts.

Exams and grading: A significant fraction of the final grade is determined from exam and quiz performance.

- Exams (4): 8 October, 5 November, 10 December, and final² 40%
- Quizzes (top 5): 30%
- Lab: 10%
- Problem Sets (about 5-7): 15%
- Class participation: 5%

In order to earn a passing grade in this class, you must earn > 60% on the final exam or on two of the in-class exams. This is a necessary but not sufficient requirement to pass this class. For each problem set, only a few, unspecified problems will be graded. Each student will be required to lead a discussion of a problem set question at least once during the term. This discussion will count towards your class participation grade.

Texts: An Introduction to Dynamic Meteorology (4th edition) by J. Holton is a required text. Mid-latitude Atmospheric Dynamics: A First Course by J. Martin is a reference text.

Class email list: aos-310@lists.students.wisc.edu

¹ Meeting times on 1st or 2nd Wednesday of month may be cancelled due to faculty meetings.
² The final exam will have twice the weight of an individual in-class exam. The final is scheduled for 12:25PM 20 December 2004.
<table>
<thead>
<tr>
<th>WEEK</th>
<th>DATES</th>
<th>TOPIC(S)</th>
<th>NOTES</th>
<th>READING</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>3 and 8 September</td>
<td>• Introduction; mathematics review, what is a fluid? atmospheric and oceanic phenomena</td>
<td></td>
<td>Martin: Intro and chapter 1</td>
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<tr>
<td>2</td>
<td>10, 13, and 17 September</td>
<td>• atmospheric and oceanic phenomena kinematics • Lagrangian vs. Eulerian descriptions of tendency</td>
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<td>3</td>
<td>20, 22, and 24 September</td>
<td>• kinematics</td>
<td>LAB 1: Analysis of 2-D wind field</td>
<td>Holton: Chapter 1</td>
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<td>4</td>
<td>27, 29, and 1 October</td>
<td>• Matlab kinematics exercise</td>
<td>PS1 due</td>
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<td>5</td>
<td>4, 6 and 8 October</td>
<td>• natural coordinate expressions for divergence and vorticity</td>
<td></td>
<td>Exam 1</td>
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<tr>
<td>6</td>
<td>11, 13, and 15 October</td>
<td>• Lagrangian vs. Eulerian descriptions of tendency</td>
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<td>7</td>
<td>18, 20 and 22 October</td>
<td>• Newton’s 2nd Law; fundamental forces</td>
<td>PS2 due</td>
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<td>8</td>
<td>25, 27 and 29 October</td>
<td>• fundamental forces; equations of motion</td>
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<td>9</td>
<td>1, 3, and 5 November</td>
<td>• equations of motion in a rotating frame; mechanical energy equation; mass continuity</td>
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<td>Exam 2</td>
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<tr>
<td>10</td>
<td>8, 10, and 12 November</td>
<td>• equation of state; thermodynamic equation; potential temperature • scaling of horizontal momentum equation (geostrophic balance)</td>
<td>PS 3 due</td>
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<tr>
<td>11</td>
<td>15, 17, and 19 November</td>
<td>• scaling of vertical momentum equation (hydrostatic balance) • generalized vertical coordinates</td>
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<tr>
<td>12</td>
<td>22 and 24 November</td>
<td>• governing equations in isobaric coordinates • thickness and thermal wind</td>
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3 Class may be rescheduled on the following dates: 15 September, 13 October, and 6-10 December.
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<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Topics</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>29 November, 1 and 3 December</td>
<td>• thermal wind and thickness</td>
<td>PS4 due</td>
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</table>
| 14   | 6, 8, and 10 December | • natural coordinate form of horizontal momentum equation  
• balanced vortical motions | Exam 3 |
| 15   | 13 and 15 December | • balanced motions | PS 5 due |
|      | 12:25 20 December | | Comprehensive final exam |