Dynamic Meteorology : ATSC 404, spring term 2016

30 Dec 2015

Calendar Entry
Dynamic principles governing atmospheric motions on a rotating planet. Simplified mathematical models of atmospheric flow based on scale analysis. Application to synoptic-scale and general circulation of the troposphere.

Course Purpose
The students completing this course will be able to explain physically flow structures of the atmosphere. They will be able to apply standard dynamical techniques to calculate properties of these flows.

Instructor
Valentina Radic
email: vradic at eos.ubc.ca, phone: 604-827-1446, Rm 3065 ESB
If you wish to see me, please make an appointment either after class or by phone or e-mail to save you waiting outside the office or not finding me in.

Meeting Times
Classes are scheduled for Monday, Wednesday, Friday 1 p.m. in Room 121 of Earth and Ocean Sciences Main (EOS Main). Each class is about 50 min long.

Textbook (required):
J.R. Holton "An Introduction to Dynamic Meteorology", 4th edition, Academic Press, 2004
Available for download:
http://www.staff.science.uu.nl/~delde102/Holton_2004.pdf

New textbook edition is also fine (but not required):
J.R. Holton & G. J. Hakim "An Introduction to Dynamic Meteorology", 5th edition, Academic Press, 2013. 532 pp)

Course Structure
The course is a hybrid between in class tutorials (Mondays and Wednesdays) and labs (problems solving) on Fridays. Comments on anything to do with the course: content, textbooks, lecture style etc., are welcome. There will be a formal course evaluation at the end of the term but if you give be your feedback earlier I can start doing something about it for this term.

Participation
Student participation in class is strongly encouraged and can add to 20% of total mark. The students are expected to do pre-reading of the chapters to be covered in the tutorials (see Schedule below), so that tutorials are more of a discussion (Q&A) rather than classical-style lectures. Each Friday a set of problems will be assigned of which some will be solved in class, while some problems will be given as a homework to be handed in on following Monday. The instructor will pass on the homework for a peer evaluation (grading), so that students can mark each others homework. The graded homework is to be handed in on following Friday (see Schedule for details of this scheme). Each Monday after class the keys to the homework problems from the previous week will be posted online.

Grades
- Participation/Homework (1 point for homework, 1 point for grading, total of 10 homework): 20%
- Math assignment: 5%
- Math quiz: 5%
- Mid-term Assignment (take home): 20%

• Final Exam: 50%

Topics
[...] indicates the corresponding sections in Holton, 4th edition.

Ch.1 Introduction
•Pressure gradient force [1.4.1]
•Viscous force [1.4.3]
•Hydrostatic balance [1.6.1]
•Pressure as vertical coordinate [1.6.2]
•Rotating frame of reference [2.1.1, 2.2]

Ch.2 Basic Conservation Laws
•Total differentiation [2.1]
•Momentum equation [2.2]
•Momentum equation in Cartesian coordinates
•Scale analysis of the momentum eqns. [2.4]
•Continuity equation [2.5]
•Thermodynamic energy equation [2.6]
•Thermodynamics of dry atmosphere [2.7]

Ch.3 Elementary Applications of Basic Equations
•Basic equations in isobaric coordinates [3.1]
•Balanced flow: Geostrophic flow, cyclostrophic flow, gradient wind [3.2]
•Trajectories and streamlines [3.3]
•Thermal wind [3.4]

Ch.4 Vorticity
•Vorticity[4.2]
•Scale analysis of the vorticity equation [4.4.3]
•Potential vorticity [4.3]
•Vorticity Equation [4.4]

Ch.6 Quasi-Geostrophic (QG) Analysis
•QG approximation [6.2]
•QG vorticity equation [6.2.2]

Ch.7 Waves
•Basic concepts
•Dispersion and group velocity [7.2.2]
•Shallow water gravity waves [7.3.2]
•Internal gravity waves in atm. [7.4]
•Rossby waves [7.7]
•Topographic Rossby waves

Ch.8 Baroclinic Instability
•Hydrodynamic instability [8.1]
•Baroclinic instability in a 2-layer model [8.2]

Schedule

Week	Date	Topics/Activities
Week 1	Jan 04	Intro (Math Assignment take home)
	Jan 06	Chapters 1.1 – 1.4
	Jan 08	Quiz (Math Assignment hand in)
Week 2	Jan 11	Chapter 1.5
	Jan 13	Chapter 1.6
	Jan 15	Problems/ Homework 1
Week 3	Jan 18	Chapter 2.1. - 2.2 (Homework 1 hand in)
	Jan 20	Chapter 2.3
	Jan 22	Problems/ Homework 2 (Homework 1 grades in)
Week 4	Jan 25	Chapter 2.4 (Homework 2 hand in)
	Jan 27	Chapter 2.5
	Jan 29	Problems/ Homework 3 (Homework 2 grades in)
Week 5	Feb 01	Chapter 2.6 (Homework 3 hand in)
	Feb 03	Chapter 2.7
	Feb 05	Problems/ Homework 4 (Homework 3 grades in)
Week 6	Feb 08	No class
	Feb 10	Chapter 3.1 (Homework 4 hand in)
	Feb 12	Problems on Chapter 3.2 / Homework 5 (Homework 4 grades in)
Break	Feb 15	No class
	Feb 17	No class
	Feb 19	No class
Week 7	Feb 22	Chapter 3.3 (Homework 5 hand in)
	Feb 24	Chapter 3.4
	Feb 26	Problems/ Homework 6 (Homework 5 grades in)
Week 8	Feb 29	Chapter 4.1 – 4.2 (Homework 6 hand in) (Mid-term assignment take home)
	Mar 02	Chapter 4.3
	Mar 04	Problems/ Homework 7 (Homework 6 grades in) (Mid-term assignment hand in)
Week 9	Mar 07	Chapter 4.4 (Homework 7 hand in)
	Mar 09	Chapter 6.2. - 6.2.2.
	Mar 11	Problems/ Homework 8 (Homework 7 grades in)
Week 10	Mar 14	Chapter 7.1 – 7.2. (Homework 8 hand in)
	Mar 16	Chapter 7.3.2 – 7.4
	Mar 18	Problems/ Homework 9 (Homework 8 grades in)
Week 11	Mar 21	Chapter 7.7 Rossby waves (Homework 9 hand in)
	Mar 23	Chapter 7.7 Topographic Rossby waves
	Mar 25	No class
Week 12	Mar 28	No class
	Mar 30	Chapter 8.1 (Homework 9 grades in)
	Apr 01	Problems/ Homework 10
Week 13	Apr 04	Chapter 8.2 (Homework 10 hand in)
	Apr 06	Chapter 8.2
	Apr 08	Summary/Problems (Homework 10 grades in)