# ATS 640 – Synoptic Meteorology
# Fall 2017

**Course description:**
The primary goals of ATS640 are as follows:

1. To introduce you to the dynamic and thermodynamic characteristics of synoptic-scale systems and the weather they produce
2. To provide practical applications of numerous meteorological principles and concepts
3. To introduce you to map analysis and interpretation

The course consists of two classes per week. Tuesday class will be comprised of a lecture (50 minutes) followed by a lab session (~35 minutes). Thursday class will be comprised of a lecture (50 minutes) followed by a feature discussion (15 minutes). Course topics are listed at the end of this document. A course schedule is available on the class website.

**Instructor:**
Professor Kristen Rasmussen
ATS 312
Email: kristenr@rams.colostate.edu
Office hours: Tuesday and Thursday from 2:30 – 3:30 pm; ATS 312

**Teaching Assistant:**
Ryan Riesenberg
ATS 308
Email: ryan.riesenberg@gmail.com
Office hours: Wednesday from 1:30 – 2:30 pm; third floor conference room in the main building (southeast side of the building)

**Meeting Times:**
Tuesday: Lecture - 1:00 to 1:50 pm, Lab Session - 1:50 to 2:25 pm; ATS 101
Thursday: Lecture - 1:00 to 1:50 pm, Feature Discussion - 1:50 to 2:05 pm; ATS 101

**Course Evaluation:**
25% Mid-term exam
35% Final exam
35% Labs
5% Feature discussions

**Required Reading:**
Lecture notes: Available on the course CANVAS website.

**Other Resources:**

- Atmospheric Science: An Introductory Survey by John Wallace and Peter Hobbs
- Mid-Latitude Atmospheric Dynamics: A First Course by Jonathan E. Martin
- Mid-Latitude Weather Systems by Toby Carlson
- Synoptic-Dynamic Meteorology in Midlatitudes Vol I and II by Howard Bluestein

- Midlatitude Synoptic Meteorology: Dynamics, Analysis, and Forecasting by Gary Lackmann

**Lab Information:**
The labs are designed to support the lectures by providing more in-depth analysis and examination of actual synoptic events.

Meeting Times:
Lectures will take place for the first 50 minutes of each class. Labs will begin a few minutes after the lecture section on Tuesdays.
Tuesdays: Assign and discuss the lab exercise
Thursdays: Feature discussions

Lab Exercises:
- Assigned every Tuesday.
- Due on Monday by 9:00 am (to be handed in to Ryan; ATS 308).
- Carry approximately the same weight (~25 points).

Feature Discussions:
- Given after the lecture on Thursdays.
- Goal: To present an example of a concept covered in class the previous week using current data.
- Limited to 15 minutes.
- Presented by students starting in the second week of the semester. Each student can expect to present twice.

Lab Grades
- Made up entirely of your lab exercises.
- For every weekday that an assignment is late, 10% will be taken off.

**Academic Integrity:**
All students are subject to the policies regarding academic integrity found in Section 1.6 of the 2010 – 2011 General Catalog, found at http://www.catalog.colostate.edu/Content/files/2012/FrontPDF/1.6POLICIES.pdf, and the student conduct code (http://www.conflictresolution.colostate.edu/conduct-code).

Other information on academic integrity can be found on the Learning@CSU website (http://learning.colostate.edu/integrity/index.cfm). Examples of academic dishonesty can be found in these sources. At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct
Services.

**Special Needs:**
Please see the instructor during the first two weeks of the semester, if you have special learning needs that should be accommodated in this class, and refer to http://rds.colostate.edu/csuinfo/accommodations.asp for more information.

| Topics | Subtopics | Labs | Classes |
|---|---|---|---|
| **Introduction** | • Basic variables | | 1 |
| **Instrumentation** | • In-situ and remotely-sensed measurements | • Station plots and surface analysis | 1 |
| **Thermodynamics** | • Gas laws<br>• Hydrostatic equation<br>• Geopotential height<br>• Thickness<br>• First law of thermodynamics<br>• Specific heats<br>• Potential and equivalent potential temperature<br>• Moisture parameters<br>• Lapse rates<br>• Static stability<br>• Thermodynamic diagrams | • Thickness<br>• Isentropic analysis<br>• Skew-T Ln-P analysis | 6 |
| **Cloud Types** | • Cloud type characteristics | | 1 |
| **Dynamics** | • Equations of motion<br>• Vertical coordinate systems<br>• Balance winds<br>• Continuity equation<br>• Thermal wind<br>• Vorticity<br>• Omega equation | • Balance winds<br>• Thermal wind<br>• Vorticity and the Omega equation | 7 |
| **Air Masses** | • Air mass characteristics | | 1 |
| **Fronts** | • Thermal wind implications<br>• Locating fronts<br>• Vertical cross sections<br>• Backdoor cold fronts<br>• Upper-level fronts<br>• Satellite imagery<br>• Other boundaries | • Frontogenesis | 2 |
| **Jets and Jet Streaks** | • Polar and subtropical jets<br>• Role in cyclogenesis<br>• Vertical motion associated with jet streaks | • Jets and jet streaks | 1 |

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| **Troughs and Ridges** | • Formation of upper-level systems<br>• Rossby wave dynamics and propagation<br>• Long and short waves<br>• Confluent and diffluent troughs<br>• Tilted troughs<br>• Blocking<br>• Lee troughs | • Troughs and ridge dyanmics | 2 |
| **Extratropical Cyclones** | • Cyclogenesis<br>• Conveyor belts and airstreams<br>• Role of jet streaks<br>• Favorable conditions<br>• Precipitation organization<br>• Orographic influences<br>• Explosive cyclogenesis<br>• Case studies | • Extratropical cyclones<br>• Detailed case study analysis | 5 |
| **Tropical Cyclones** | • Characteristics<br>• Formation<br>• Climatology<br>• Records | | 1 |
| **Miscellaneous Flows** | • Sea and land breezes<br>• Lake effect snow<br>• Mountain/valley winds<br>• Downslope winds<br>• Topographic blocking<br>• Polar lows<br>• Monsoons | | 1 |