ATS 640 – Synoptic Meteorology
Fall 2019

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 Introduction and Weather Discussion (25 minutes). Thursday class will be comprised of a lecture (50-60 minutes) followed by a Weather Discussion (10 minutes). Course topics are listed at the end of this document. A course schedule is available on the class CANVAS website.

Instructor:
Professor Kristen Rasmussen
ATS 312
Email: kristenr@rams.colostate.edu
Office hours: Monday from 1:00-2:00 pm and Tuesday from 2:30-3:30 pm. Note that students are welcome to stop by outside of office hours for additional help.

Teaching Assistant:
Ryan Gonzalez
ACRC 111
Email: Ryan.Gonzalez@colostate.edu
Office hours: Tuesday from 9:00-10:30 am and Friday from 10:00 am-12:00 pm. Note that students are welcome to stop by outside of office hours for additional help.

Meeting Times:
Tuesday: Lecture - 1:00 to 2:00 pm, Lab Introduction and Weather Discussion- 2:00 to 2:30 pm; ATS 101
Thursday: Lecture - 1:00 to 2:00 pm, Weather Discussion – 2:00 to 2:10 pm; ATS 101

Course Evaluation:
25% Mid-term exam
35% Final exam
35% Labs
5% Forecast competition participation

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. A class forecast competition will help students with a practical application of the course material by considering weather around the world.

Meeting Times:

Lectures will take place for the first 60 minutes of each class. Lab Introductions will begin a few minutes after the lecture section on Tuesdays followed by a Weather Discussion.
Tuesdays: Assign and discuss the lab exercise followed by a weather discussion
Thursdays: Weather discussion

Lab Exercises:

- Assigned every Tuesday
- Due on the following Tuesday at the beginning of class
- Carry approximately the same weight (~25 points)

Class Forecast Competition:

- Students will forecast the weather conditions at locations around the world on class days throughout the semester (Tuesdays and Thursdays).
- The course TA (Ryan Gonzalez) will select cites around the world and will be listed in the course schedule available on the CANVAS website.
- Forecasts will be entered into our class forecast competition website (http://rasmussen.atmos.colostate.edu/teaching/ATS640/Fall2019/forecast_contest/login.php)
- Participation in the competition will be ~5% of the course grade. Students will NOT be graded on their performance in the competition.

Weather Discussions:

- Given after the lecture
- Goal: Update on the current weather situation related to the Colorado region and the forecast city of the day.
- Time: 10-15 minutes
- Presented by students starting in the second or third week of the semester. Each student can expect to present approximately twice. The course TA will present the first few weather discussions to provide examples for the students.

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 the 2018 – 2019 General Catalog, found at http://catalog.colostate.edu/general-catalog/policies/students-responsibilities/#academic-integrity, and the student conduct code (https://resolutioncenter.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/accommodation-process/ for more information.

TOPICS	SUBTOPICS	LABS	CLASSES
Introduction	• Basic variables		1
Instrumentation	• In-situ and remotely-sensed measurements	• Station plots and surface analysis	
Thermodynamics	• Gas laws • Hydrostatic equation • Geopotential height • Thickness • First law of thermodynamics • Specific heats • Potential and equivalent potential temperature • Moisture parameters • Lapse rates • Static stability • Thermodynamic diagrams	• Thickness • Isentropic analysis • Skew-T Ln-P analysis	6
Cloud Types	• Cloud type characteristics		1
Dynamics	• Equations of motion • Vertical coordinate systems • Balance winds • Continuity equation • Thermal wind • Vorticity • Omega equation • PV thinking	• Balance winds • Thermal wind • Vorticity and the Omega equation	7
Air Masses	• Air mass characteristics		1
Fronts	• Thermal wind implications	• Frontogenesis	2

	• Locating fronts • Vertical cross sections • Backdoor cold fronts • Upper-level fronts • Satellite imagery • Other boundaries		
Jets and Jet Streaks	• Polar and subtropical jets • Role in cyclogenesis • Vertical motion associated with jet streaks	• Jets and jet streaks	1
Troughs and Ridges	• Formation of upper-level systems • Rossby wave dynamics and propagation • Long and short waves • Confluent and diffluent troughs • Tilted troughs • Blocking • Lee troughs	• Troughs and ridge dynamics	2
Extratropical Cyclones	• Cyclogenesis • Conveyor belts and airstreams • Role of jet streaks • Favorable conditions • Precipitation organization • Orographic influences • Explosive cyclogenesis • Case studies	• Extratropical cyclones • Detailed case study analysis	5
Tropical Cyclones	• Characteristics • Formation • Climatology • Records		1
Miscellaneous Flows	• Sea and land breezes • Lake effect snow • Mountain/valley winds • Downslope winds • Topographic blocking • Polar lows • Monsoons		1