Course Syllabus Geography 5942 Spring 2021
Synoptic Meteorology: Severe Storm Forecasting

Instructor: Jeff Rogers, Professor Emeritus
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Office Hours: appointments by e-mail
Course Prerequisites: Geography 5941, Physics 1250
Class Lectures on Zoom: M, W, 12:45 – 2:05 p.m. in Db 0140, or virtually on Zoom

Access to course lecture materials: http://carmen.osu.edu for recorded lectures, lecture pdf's, assignments, syllabus, and announcements.
Suggested Textbook: ***Mesoscale Meteorology in Midlatitudes*** by Paul Markowski and YvetteRichardson.

Course Objectives:
The aim of the course is to introduce students to the methods of analysis and techniques of forecasting mesoscale weather systems and severe weather. The course is divided into five components:
1. Overviews of the climatology of severe weather, Lake effect mesoscale weather, and basic cloud physics,
2. The meteorological ingredients for severe weather and the forecasting of severe weather,
3. Weather radar and satellites as tools in severe weather analysis,
4. Convection and the characteristics and features of mesoscale storms, and
5. Practice in severe weather forecasting through a series of exercises and assignments.

The initial course section focuses on the ingredients of, and synoptic setting in which, severe storms develop. The role of instability, moisture, low-level and upper-level synoptic scale uplift will be described as will means by which forecasters identify and categorize the importance of each of these. The subsequent segment of the course describes the ways in which weather radar and geostationary satellite imagery are used in the analysis and forecasting of severe weather. Some theory of radar and satellite imagery is covered but the emphasis is on the usage of these materials in preparing forecasts and in trying to understand the conditions that are ideal for severe weather development. In the final section of the course, we will describe the characteristics of air mass, multicell, and supercell thunderstorms as well as of mesoscale convective systems (MCSs, including squall lines) and mesoscale convective complexes (MCCs). We also examine features of these storms such as bow echoes, derechoes, tornadoes, macrobursts, microbursts, and lightning.

Course Requirements.
Your grade in this course will be determined based on the following:
1. One mid-term exams worth 30% of your grade.

2. The Final Examination worth 30% of your grade, Friday April 30 at noon

3. Course assignments and Laboratory assignments worth 40% of your grade. There will be small tasks (with a small point-value), to be completed over short time intervals, and longer assignments due within 1-2 weeks.
A final project, in which you evaluate the meteorological causes of a historical severe weather event, will also be part of the assignment grade. The historical events could be from 2019, 2020 or based on events occurring in previous years, using stored data at the Storm Prediction Center. More project detail in March.

Assignments will be graded as "zero" if they are not turned in by their due date. Medical excuses are needed in order to turn in late assignments or for a missed exam. Incompletes are issued only for extended medical illnesses late in the quarter (with proof).

Important Dates:
No Lecture/class on: Monday January 18; Wednesday February 24; Wednesday March 31
Lecture/Class *will* be held on: Friday April 2, the so-called "conversion date" created by OSU scheduling
Final Lecture/Class in 5942: Wednesday April 21
Final Project Due: Wednesday April 21, 2021 at 5:00 p.m.
Final Exam: Friday April 30, Noon

Course Outline

Lecture Topics	Markowski readings

Introductory Lectures:

Climatology of thunderstorms, hail, tornadoes & high winds, annual and diurnal cycle characteristics.	
Winter mesoscale Great Lakes weather: Lake effect precipitation, mesoscale cloud bands	Chap. 4.4 – 4.5
Evaporation, condensation, cloud and precipitation formation mechanisms. Curvature & solute effects.	
Ice crystals and their habits. Aggregation and riming processes; graupel and snowflakes. Wet and dry hailstone growth.	

Tools of mesoscale meteorology:

The hodograph	Chapter 2.7
Thermodynamic diagrams & stability analysis	Ch. 2.6; 2.1; 2.3.3, & 3.1
Atmospheric convection and parcel theory. Sounding analysis	
Convective initiation	Chap. 7.1, 7.2
Meteorological Radar; theory and applications	Appendix A pp. 369-387
Weather radar systems & components; anomalous propagation; radar equation.	
Equivalent reflectivity and Z-R relationships. Radar scanning strategies, NEXRAD data products,	
Doppler radial velocity and Dual Polarization products and interpretation	
Weather satellites in severe weather detection, analysis, & applications	

Meteorological Analysis of severe weather

Low level Moisture analysis: Gulf return flow, vertical mixing & evapotranspiration	Chap. 7.3 & 7.4
Synoptic-scale fronts & interactions in severe weather outbreaks; 1974, 2003	Chap. 5.1
Synoptic Upper level support mechanisms, jet streaks	Chap. 2.2
The dryline; appearance, climatology, its motion and role in convection	Chap. 5.2
Mesoscale outflow boundaries	Chap. 5.3
Sea breeze and coastal fronts	Chap. 5.4
Gravity waves in severe weather formation	Chap. 6.1 & 6.4
The Great Plains Low level jet: identification, other jets, causal factors, synoptics	Chap. 4.7

Severe Weather and Severe Storms: Processes and Prediction

Single cell and multicellular convection	Chap. 8.1 to 8.3
Heavy precipitation and flash flooding	Chap. 10.4
Squall lines: types, morphology, evolution, bow echoes & derechoes.	Chap. 9.1 to 9.4
Mesoscale Convective Complexes: basic characteristics and evolution; MCV's.	Chap. 9.5
Supercell thunderstorms: structure, evolution, supercell splitting & role of wind shear.	Chap. 8.4
Supercell Tornadoes: morphology, Fujita scale, evolution, physical processes.	Chap.10.1 & 10.3
Non-supercell tornadoes, gustnadoes, landspouts, waterspouts	
Downbursts, Macrobursts and microbursts.	Chap 10.2
Lightning, characteristics, causes, detection, effects on humans.	

FINAL EXAM: Friday April 30, 2020 at 12:00 p.m. to 1:45 p.m.