# Master Syllabus Department of Geography

**GEOG 449/549: Synoptic Meteorology** 

## **Course Description**

Investigation of synoptic- and mesobeta-scale atmospheric systems, with a focus on mathematical and physical theories of weather forecasting and application of those theories through the use of satellite, radar, and numerical weather prediction technology. (3 credit hours).

Prerequisite: GEOG 330; MATH 165; PHYS 120; or instructor permission

## **Course Objectives**

The primary objective of this course is to serve as an introduction to the fundamentals of, and techniques involved in, synoptic weather analysis and forecasting. This course is taught from a synoptic-dynamic meteorology perspective and will include mathematical and physical theory as well as application and analysis of those theories. Discussion of the fundamentals of weather forecasting includes evaluation of the physical processes that create temperature change, vertical motions, precipitation, and those which lead to cyclones and fronts, causing them to evolve and produce weather. Techniques of synoptic weather analysis revolve around weather maps and methods used to analyze them in order to make to predict horizontal and vertical motions and make weather forecasts. Analysis of forecast output will be evaluated in order to compare precipitation and vertical motion forecasts among different models. Students will develop an understanding of the conceptual models of wave cyclones, including those of their structure and evolution, and be able to explain the role of various physical processes, such as thermal and potential vorticity advection, atmospheric stability, and diabatic heating, in the development and evolution of mid-latitude wave cyclones.

#### **Course Rationale**

This course represents an application of the knowledge gained in basic meteorology courses, such as Geography 230 and 330, but it introduces new concepts and ideas directly applicable to synoptic scale weather forecasting. Upon successful completion of the course, students will be able to use synoptic weather charts and numerical forecasting products, along with knowledge gained in the course, in order to make forecasts of temperature, precipitation and other meteorological conditions for 1-2 days in advance. Geography 449 serves as a requirement for the Option IV: Meteorology and Climatology, Professional Track; Geography 549 partially fulfills the elective requirement. In addition, synoptic meteorology is one of the required courses for those seeking qualification for the title "meteorologist" by the American Meteorological Society

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(AMS) and for employment by the National Weather Service under the Federal Civil Service guidelines (GS-1340).

## **Course Content and Format**

Students will be presented material in a lecture style format that will include multimedia presentations and case study discussions. The following shows an example of a potential outline of topics for this course, with time allotment for each topic at the discretion of the instructor:

- I. Introduction to Synoptic Meteorology
- II. Temperature Forecasting
  - Α. Thermal wind, thickness and advection
  - B. Adiabatic and diabatic processes
- III. Thermal characteristics of the atmosphere
  - Α. Air masses
  - B. Isentropic analysis
- IV. Principles of atmospheric motion
  - Α. Scale analysis
  - B. Equations of motion
  - C. Geostrophic and gradient wind approximations
  - D. Ageostrophic motions
- V. Rossby waves and upper-tropospheric features
- VI. Streamlines and trajectory analysis
- VII. Atmospheric vorticity and baroclinic development
- VIII. Cyclogenesis and cyclolysis
  - A. Jet streaks
  - В. Fronts
  - C. Conveyor belt model
- IX. Regional weather systems

## **Textbook Suggestions**

Bluestein, H. B., 1993: Synoptic-Dynamic Meteorology in Midlatitudes, Vol. II: Observations and Theory of Weather Systems. Oxford, UK: Oxford University Press, 594 pp.

Carlson, T. N., 1998: Mid-latitude Weather Systems. Boston, MA: American Meteorological Society, 507 pp.

Djuric, D., 1994: Weather Analysis. Upper Saddle River, NJ: Prentice Hall, 304 pp.

# **Methods for Evaluating Student Performance:**

Forms of evaluation might include examinations, quizzes, homework problem sets, presentations and a case-study final project. Graduate students enrolled in the course as Geography 549 would be expected to accomplish an additional work load (e.g., more in-depth final project, additional problems on homework and exams, etc.).

### **Evaluation of the Course**

Student evaluation of the course using university (and departmental) course evaluation forms.