SAN FRANCISCO STATE UNIVERSITY FALL 2012
DEPARTMENT OF GEOSCIENCES

Meteorology 430
Weather Analysis and Forecasting I

Credit: 4 units; 2 units lecture, 2 units laboratory
Room/Time: TH 604 TTH 8:10-12:00
Prerequisites: Metr 201, Metr 301, Math 227 and Phys 220, completion of English 214 or its equivalent with a grade of "C-" or better and/or consent of instructor

Instructor: John P. Monteverdi
Office Hours: M 10-11; TTh 10-11

Daily Class Schedule:	8:10-9:00	Lecture
	9:10-10:45	Laboratory
	10:45-11:00	Briefing
	11:00-Noon	Spot Forecasts

A. Objectives of the Course and Student Learning Outcomes

All of you have taken (or are taking) coursework which has introduced you to: (1) some of the basic laws which govern atmospheric and oceanic behavior (Ocn 200 and Metr 201); (2) the fundamentals of the hydrostatics, thermodynamics and dynamics of the atmosphere and ocean (Metr. 201). Most of you have had some exposure to fundamental analysis techniques and map interpretation (Metr 301) and some have had the opportunity to do some forecasting (Metr 698), although not in a formal manner.

In many respects, the present course can be considered to be an applications course that will be your first inquiry into the theoretical knowledge and practical observational and analysis techniques needed in the field of weather forecasting. This is because modern synoptic meteorology is a essentially an application of the principles of dynamic meteorology to the operational environment, one that is dependent upon viewing circulation systems at the scale of maps and charts showing continental and subcontinental size areas (termed "synoptic" and "subsynoptic"). Hence, you will be getting your first look at "dynamics" here before you take Dave Dempsey's complete treatment at the majors level next year.

One strength of the program at SFSU is that it is small enough to be adaptable to the student needs which crop up on a semester to semester basis. The instructors, also, have a commitment to the students and try to maximize their flexibility. To a certain extent, the lecture portion of the course will be run in a graduate school seminar fashion. The readings in the text book and in various journals will be selected not only to amplify and show application of previous principles to the real world" of forecasting but to stimulate discussion. In some cases, discussion material will be relatively controversial (e.g., "is long range forecasting possible?"; "has computer-based technology "over-high-teched" weather forecasting?"; "should hand-analysis be reemphasized?") and relate to the future of the field.

The traditional tasks of the weather forecaster used to be collected under the heading SYNOPTIC METEOROLOGY. Today, it is probably more proper to designate this branch of the field OPERATIONAL METEOROLOGY since many practitioners of the field actively integrate processes that operate at many scales in producing an operational weather forecast. You will hear much about this in the course.

But the traditional tasks go far beyond simple analysis and forecasting. Meteorologists today must be able to effectively COMMUNICATE the science, both to their peers and the general public. A good portion of this course will be devoted to both, the former in the formal writing assignments (that meet the goals of the **Graduation Writing Assessment Requirement** [**GWAR**]) and the latter in the weather briefings and spot forecast contest.

Actually, the "quasi-geostrophic" theory to which you will be exposed in this class and Metr. 530, is nothing new and has been around since the 1940's. Those of you who took Metr. 302 or 356 know that surface pressure systems can be thought of as being caused either by thermal effects (THERMAL LOWS) or dynamic effects (i.e., divergence aloft not related to surface heating or cooling) (DYNAMIC LOWS) etc. That simple categorization falls out of what is known as quasi-geostrophic (QG) theory. The derivation of the QG equations has allowed teaching meteorologists to create such categories, but, in reality, nature doesn't strictly compartmentalize pressure systems into these categories. Your understanding of the equations you derive in M400 and M500 will help you see that many effects (leading to pressure system development) are operating simultaneously, and it is human interpretation that allows us to eliminate minor effects "on an order of magnitude basis". This allows for an easier physical interpretation.

At the conclusion of this course students will be able to:

- Sort through and identify the key factors influencing the development and evolution of mid-latitude weather systems on the basis of quasi-geostrophic thinking.

- Construct a hierarchy of the major influences on the weather phenomena common to the middle latitudes in general and California in particular.

- Identify the steps that go into a forecast, including assimilation of observations, oral weather briefings, numerical weather prediction, and statistical guidance.

- Make weather forecasts by applying concepts from lecture and lab to real world examples in the guise of a forecasting contest.

- Write and speak in the style demanded by the discipline.

B. Laboratory and Forecast Sessions

The laboratory session will really be broken into three portions: (1) lab exercises which will provide you with several more analysis techniques with which you need some familiarity; (2) exercises designed to illustrate or substantiate lecture material; (3) exercises which involve use and programming of the WGSL; (4) objective and subjective forecasting techniques. In the lab exercises, the philosophy is to LEARN THE CORRECT TECHNIQUES regardless of the immediate result. In other words, here I still will emphasize the it is better to be wrong for the right reasons than right for the wrong reasons.

Each individual will be responsible for two weeks worth of weather briefings. The briefings are expected to be highly-polished presentations tailored to aid the class in its spot forecasts which follow. It is up to the briefer to post maps, color maps, select topics, etc. appropriate for the level of Metr 430 and the needs of the class. He or she will be graded as such.

In addition, I often step in before or during the briefings if the weather situation affords an opportunity to use an "inquiry based" approach to explore current class topics. The material covered is fair-game for examinations and students are expected to participate in the inquiry. The weather briefings also allow the other students to critique the briefer, to hone his or her knowledge and presentation skills, so that when it is his/her turn to do the briefing, a better performance will occur. I should also point out that this is another facet of the GWAR's requirement of developing communication skills appropriate to the discipline.

In "the real world" where the advancement of scientific knowledge is not given high priority unless there are immediate practical results, the value of a weather forecast is its accuracy and not the validity of the method used to forrnulate it nor the skill of the individual making the forecast. You will find out, however, that there definitely is a relationship. In any case, the last 45 minutes of the class period will be devoted to making forecasts for 5 cities across the United States. The skill with which you forecast will be reflected in your grade for this course. In this portion of the class, you will be expected to integrate the theoretical knowledge you have obtained with your facility at map interpretation and INTUITION to produce a correct forecast. Exact scoring methodology and "rules of the game" will be explained in another handout.

C. Writing Component

This course is also designed to prepare meteorology majors to prepare a manuscript for submission to a refereed journal and is designated as the program's course that meets the **GWAR** mandates. Each student will complete a manuscript that summarizes the case study selected. The writing assignments in this course include four structured assignments staggered through the semester that form portions of the final research paper, which is to be written in the scientific style and format as defined in the Authors Guide of the American Meteorological Society.

Since quasi-geostrophic theory does in fact explain much that we see in the synoptic-scale atmosphere, the term paper for this course will consist of EVERYONE selecting one of these equations and applying it to an OPERATIONAL CASE STUDY. I would prefer that the OMEGA EQUATION be used for this, since this is what has been appearing in the literature lately. However, you may feel that one of the other equations is more accessible conceptually. This is fine with me. More about the research paper in another handout.

It is important that students begin to think about the paper early in the semester. Thus, maps and/or data for the particular cases you are interested in should be selected early in the semester. A proposal will be due October 1 and the first draft will serve as your term paper assignment for this semester. I will grade and correct (provide suggestions for revision) for all of the drafts and the final product will be the term paper due in December.

Some specific objectives of **the research paper experience** in this course are to:

- explore the steps in producing a publication quality manuscript for submission to a refereed journal
- improve ability to write clearly and succinctly
- practice presenting information in both written and oral formats
- gain information about publishing research
- sharpen critiquing and research evaluation skills

D. Grading Plan

The **GWAR** requires that 60% of the grade for the portion of the class related to research be attached to structured, reviewed, corrected, revised writing assignments. Since the portion of the class devoted to pure lecture is one unit, and three units devoted to research and lab work, 45% of the grade in this course will be related to the writing assignments.

<u>Exams</u>	
Examinations (2) at 10% each (October 12, Nov. 16)	20%
Quizzes (Two)	5%
Final (Lecture/Lab) at 10% (Dec. 18, 8:00 - 10:30 am)	10%
<u>Lab Work</u> (1 unit)	
Briefings	5%
Forecasts	10%
Homework	5%
<u>Research Paper and Associated Writing Assignments</u> **(GWAR)**	
Written Lab Reports	15%
Research Paper (Four Assignments with Final Version Due at end of the semester)	30%

TEXTBOOKS

Required:

Bluestein, Howard B., 1993: Synoptic-Dynamic Meteorology in Midlatitudes. Vol I. Principles of Kinematics and Dynamics. Oxford University Press. 431 pp. ISBN-0195062671.

Djuric, Dusan, 1994: Weather Analysis. Prentice-Hall. 304 pp. ISBN 0-13-501149-3

Recommended:

Chaston,,Peter R., 1997: Weather Maps: How to Read and Interpret all the Basic Weather Charts. Second Edition. Chaston Scientific, Inc.Kearney, MO. ISBN 0-9645172-4-8, 214 pp.

Stull, Roland, 2000: Meteorology for Scientists and Engineers, Second Edition, Brooks-Cole, ISBN-10: 0534372147, 528 pp.

Vasquez, Tim, 2002: Weather Forecasting Handbook. Weather Graphics Technologies. 198 pp. ISBN: 0-9706840-2-9

Vasquez, Tim, 2003: Weather Map Handbook. Weather Graphics Technologies. 167 pp. ISBN: 0-9706840-4-5.