GEOGRAPHY 362, WEATHER AND CLIMATE II

DR. L. R. DEXTER DEPARTMENT OF GEOGRAPHY SPRING, 2003

TIME/DAY: 12:40 to 1:30 MWF
ROOM: College of Ecosystem Science & Management, Building 82, Room 110
OFFICE: Room 205
HOURS: 10:00-11:00 and 1:30-3:00 M & W or by appointment
PHONE: 523-6535
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PREREQUISITES:

GGR 361 Weather and Climate I - Students wishing to enroll in this course without the prerequisite (or its equivalent) will need to sign an agreement form stating they are aware of the prerequisite. Students without the prerequisite must be willing to assume responsibility to do any additional make-up work needed to bring them to the level of understanding assumed from GGR 361.

COURSE OVERVIEW:

Weather and Climate II investigates longer-term weather processes and patterns commonly referred to as climate. This course builds on, and expands, weather-related concepts developed in GGR 361. The study of climate (climatology) can be broken into several sub-fields and we will survey most of these. In general, there are two large scale-based divisions within climatology. *Macroclimatology* looks at large-area (small-scale) patterns and processes while *microclimatology* focuses on very small area (large-scale) patterns and processes. We will devote about 1/3 of the course to each of those two topics with the remainder of the course devoted to climate instrumentation and field measurements for energy balance and other microclimate studies.

COURSE OBJECTIVES:

Students should anticipate a wide variety of learning situations including, lectures, readings, short field trips, computer based exercises (WWW browsers, spreadsheets, custom programs), long-hand exercises (graphing, computation, map interpretation and computations), hands on experience with electronics components, professional instrumentation, digital data loggers and finally the execution of original field research projects.

The specific objectives of the course are:

- To be able to analyze, describe and diagram the basic processes and patterns of the earth's climate system.

- To be able to describe various climate classification systems and classify a given locality.
- To be able explain how climates may be changing both naturally and as a consequence of human activity.
- To be able to describe, diagram and construct some simple electronics circuits pertinent to the construction of climate instrumentation.
- To be able to describe, diagram and operate basic instruments used in microclimate studies.
- To be able to wire, program, operate and retrieve data from digital electronic data loggers.
- To be able to conduct a complete micrometerological energy balance study.
- To be able to design and conduct simple but original research projects in climatology.

COURSE REQUIREMENTS:

- A high level of student cooperation and participation.
- Attendance of lectures with topics on background physics, climate factors and processes, climate instrumentation, climate nomenclature, data manipulation, and classification, and the spatial distribution of climate factors. Overhead transparencies, slides, videotapes will be used to enhance visualization of the subject matter.
- Assigned readings from the required text.
- Out-of-class homework exercises (about 6).
- An original independent student-designed climate study.
- A team-based field study involving full energy balance monitoring techniques.
- One or two half-day field trips.
- One mid-term exam about 90% lecture based; 10% text, videos etc.
- One final exam about 50% lecture based, 20% text/videos/etc, 30% exercise/lab/field based.

PROFESSOR'S PHILOSOPHY:

Across the spectrum of all of my professorial roles, my principal focus is teaching. I consider myself to be a dedicated and enthusiastic instructor. I am considered to be demanding in expectations but fair in grading and evaluation by most of my past students. My classes tend to be rich in content and I present a lot of material from which to learn. For a specific list of materials and learning approaches used in this class, see the teaching style attachment later in the syllabus.

In return for the amount of work I put into resource and class preparation, I expect you to be willing to work hard in absorbing as much of the material as you can. I would much rather work with an interested and enthusiastic C or D student than a bored and uncooperative A or B student. If you work from this attitude, you and I will get along just fine. If, on the other hand, you view your university experience as simply paid admission to a diploma, you and I may have conflicting objectives and attitudes.

To this end, some of the points awarded in this class reflect how seriously you approach the learning process as a cooperative endeavor. Items included in this group of points are attendance,

punctuality, enthusiasm and cooperation. Some of these points will be objectively tracked (e.g. attendance) and some are my subjective opinion. You will all start out with the maximum number of points pre-awarded in this area. As the end the class approaches, a demerit system will be used if you have been deficient in these areas.

COURSE POLICIES:

See the attached sheets on general NAU policies. Students are expected to attend each class meeting and tardiness is discouraged. To this end occasional spot attendance checks will be made and these checks will incorporated into the cooperation portion of your grade. While a certain amount of collaboration among students is encouraged in this class, each student is expected to complete his or her own assignments. Anyone found plagiarizing assignments or cheating on exams will fail the course.

MATERIALS:

Oke, T. R. (1987) *Boundary Layer Climates*. 2 ed. Routledge Publishing Co., London & New York. (Required reading).

Dexter, L.R. (2003) *Weather and Climate II Course Resource Supplement*. Scholargy Publishing. (Required note supplement).

Dexter, L.R. (2003) *Weather and Climate II Exercise and Practicum Supplement.* Scholargy Publishing. (Required).

Reliable access to a microcomputer and the Internet.
One 3 1/2 inch floppy disk.
A 3 ring notebook to contain the Kwik Kopy packet.
A number # pencil and clean eraser for the exams.
A few colored pencils, a ruler and a clean eraser for the in class exercises.
You will also be working with electronics components kits, instrumentation and data-loggers provided by the department.

GRADING:

- Mid-term exam, 100 points *
- Final exam 100 points **
- Approximately 5-6 out-of-class exercises 50 points each ***
- 1 original field project 100 points.
- 1 class/team energy balance project 100 points**
- Student cooperation 50 points

* Make-ups allowed only with valid excuse and prior instructor approval.

** Absolutely NO make-ups, all work must be done at the appointed time.
*** A declining point scale will be applied to work turned in late.

Total possible points, approximately 750 depending on the final number of in-class exercises completed. The following grade scale will be applied to the final point total:
A > 90%, B > 80%, C > 70%, D > 60% F < 60% total possible points
or curved to the class distribution if needed.

TENTATIVE SCHEDULE:

I have a very heavy field trip and conference schedule in the months of February and March. This will require that you be a bit more flexible with scheduling, time changes, room changes, project due dates etc.than would normally be expected. The following is a roughly sequential list of topics I would hope to cover and some equally rough benchmark dates:

DATE	TOPIC
Week #1, Jan 13-17	*Overview and introduction* *Physical climatiology*
Week #2, Jan 20-24 (Jan 20, no class)	*Synoptic climatology* *Statistical climatology*
Week #3, Jan 27-31	*Water balance climatology* (exercise) *Climate classification*
Week # 4, Feb 3-7	*Regional climates exercise*
Week #5, Feb 10-14	*Historical and paleoclimatology*
Week #6, Feb16-21	Silverton field trip (optional)
Week #7, Feb 24-28	*Climate change and climate prediction*
Week #8 Mar 3-7	Review and Exam #1, Dexter gone to AAG Mar 5 & 7
Week #9, Mar 10-14	*Energy balance of small areas* *Mesoscale and microscale processes*
Mar 17-21	Spring break, no class
Week #10, Mar 24-28	*Introductory electronics for climatology*
Week #11, Mar 31-Apr 4	*Microclimate instrumentation (exercise)*
Week #12, Apr 7-11	*Automated data loggers* Exercise #7: Glaciers

Week #13, Apr 14-18	*Full energy balance studies*
Sat Apr 19 FT	Exercise #8: (f): Inner Basin on skis (vans 113 & 114)
Week #14 Apr 21-25	*Full energy balance studies*
Week #15 Apr 28-May 2	*Presentations and wrap-up*
	Final exam

LIST OF TOPICS:

I. Macroclimates

A. Physical climatology
   1. Energy and temperature considerations
   2. Ocean and atmospheric circulation considerations
   3. Humidity and precipitation considerations

B. Water balance climatology
   1. Water balance elements
   2. Water balance calculations and plots

C. Synoptic climatology
   1. Concepts
   2. Mean pattern analysis
   3. Departure analysis
   4. Event frequency analysis
   5. Storm track analysis
   6. North American circulation types
   7. Forecasts (expanded in the "models" discussion later)

D. Macro-climate data, data archiving and data analysis
   1. Climate variables
   2. Climate data sources
   3. Some basic statistical concepts and tools
   4. Climographs and other graphical presentations

E. Climate Classification
   1. Koppen's classification
   2. Thornthwaite's classification
   3. Others

F. Regional climatology
   1. A climates
   2. B climates
   3. C climates
   4. D climates
   5. E and H climates

G. Historical/paleoclimatology
   1. The climate "record" vs. "proxies"
   2. The historical climate record

3. Establishing a timeframe for climate proxies
4. Biological proxies (tree rings, pollen, etc.)
5. Geological proxies (ocean, lake and bog sediments etc.)
6. Glaciological proxies (ice cores)
7. Estimates of past change

H. Climate change mechanisms
   1. Problems in interpretation
   2. The sun
   3. Earth's orbit
   4. Geological
   5. Extraterrestrial
   6. Biological
   7. Human influences
   8. Teleconnections
   9. Models of future climate change

II. Boundary Layer Climatology and Microclimates

A. Energy balance of small areas
B. Mesoscale processes and factors
   1. Land-sea
   2. Topography
   3. Lakes
C. Microscale processes and factors
   1. Microtopography and roughness
   2. Rock and soil surfaces
   3. Vegetation and animals
   4. Water, Snow and Ice surfaces
   5. Human influences

III. Instrumentation for Climatologists

A. Introduction to instruments and electronics
   1. Basic sensors
   2. Introduction to basic electronics
   3. Some useful circuitry for climatologists
B. Student-built examples
   1. Temperature
      a. Thermocouples
      b. Thermistors
   2. Radiation
      a. Shortwave energy sensors
      b. Allwave energy sensors

C. Professional grade examples
    1. Radiometers
    2. Temperature sensors
    3. Anemometers
    4. Humidity sensors
D. Logging climate data
    1. Introduction to microprocessor-based data loggers
    2. Sensor interfacing
    3. Programming
    4. Output formats and downloading
    5. Student practice using homebrew vs. professional sensors
E. Full energy balance studies
    1. Overview to full energy balance techniques
    2. Approaches
        a. Aerodynamic and modified aerodynamic
        b. Bowen ratio
        c. Combined
    3. Student run energy balance study
    4. 24 hr. field monitoring of Kd, Ku, K*, Q*, Lu , Allu, T0, T20, RH20, T80, RH80, W40, W80, and W160
        a. Data reduction and analysis by Bowen ratio techniques
        b. Appropriate Statistical analysis

DETAILS OF THE COURSE PROJECTS:

Project # 1, Individual original research project:

Each of you will identify and execute a small original research project. The project can be field based where you monitor and analyze one or two climate variables pertinent to some topic of interest to you then analyze the results and write up a short (about 5 page) report in as professional of style as possible. Alternately, the project can be data analysis based where you obtain pre-existing data then manipulate and analyze that data to come to some original result. As with the first option, you will write up a short (about 5 page) report in as professional of style as possible. Please be thinking about this early as your best opportunity to complete this project will be in March.

Project #2 Team-based full energy balance study.

Late in the term as a capstone project we will conduct a full energy balance study using professional instrumentation and data-loggers. This project will involve collection of data for about 14 microclimate variables over a 24 hour study run at about 10 minute sample intervals (about 2,016 data points). We will divide the class into two teams. Each team will decide:

1) what kind of surface to study,
2) where to conduct the study,
3) set up the equipment, provide security for and tend the equipment,
4) download the raw data,

5) mport the data into analytical software (spreadsheets, and a custom data analysis program called OMENBAL98),
6) analyze, graph and briefly discuss the results.

Each project is worth 100 class points graded as follows:

	#1	#2
Project design and execution	25 points.	20 points
Technical sophistication & data accuracy	25 points	20 points
Organization & writing	25 points.	20 points
Appropriate use of graphics	25 points	20 points
Oral presentation		20 points

NORTHERN ARIZONA UNIVERSITY POLICY STATEMENTS

SAFE ENVIRONMENT POLICY

NAU's Safe Working and Learning Environment Policy seeks to prohibit discrimination and promote the safety of all individuals within the university. The goal of this policy is to prevent the occurrence of discrimination on the basis of sex, race, color, age, national origin, religion, sexual orientation, disability, or veteran status and to prevent sexual harassment, sexual assault, or retaliation by anyone at this university. You may obtain a copy of this policy from the college dean's office. If you have concerns about this policy, it is important that you contact the departmental chair, dean's office, the Office of Student Life (523-5181), the academic ombudsperson (523-9368), or NAU's Office of Affirmative Action (523-3312).

STUDENTS WITH DISABILITIES

If you have a learning and/or physical disability, you are encouraged to make arrangements for class assignments/exams so your academic performance will not suffer because of the disability or handicap. If you have questions about special provisions for students with disabilities, contact the Counseling and Testing Center (523-2261). It is your responsibility to register with the Counseling and Testing Center. Application for services should be made at least eight weeks before the start of the semester. If the Counseling and Testing Center verifies your eligibility for special services, you should consult with your instructor during the first week in the semester so appropriate arrangements can be made. Concerns related to noncompliance with appropriate provisions should be directed to the Disability Support Services coordinator in the Counseling and Testing Center.

INSTITUTIONAL REVIEW BOARD

Any study involving observation of or interaction with human subjects that originates at NAU-including a course project, report, or research paper-must be reviewed and approved by the Institutional Review Board (IRB) for the protection of human subjects in research and research-related activities. The IRB meets once each month. Proposals must be submitted for review at least fifteen working days before the monthly meeting. You should consult with your course instructor early in the course to ascertain if your project needs to be reviewed by the IRB and/or to secure information or appropriate forms and procedures for the IRB review. Your instructor and department chair or college dean must sign the application for approval by the IRB. The IRB categorizes projects into three levels depending on the nature of the project: exempt from further review, expedited review, or full board review. If the IRB certifies that a project is exempt from further review, you need not resubmit the project for continuing IRB review as long as there are no modifications in the exempted procedures. A copy of the IRB Policy and Procedures Manual is available in each department's administrative office and each college dean's office. If you have questions, contact Carey Conover, Office of Grant and Contract Services, at 523-4889.

ACADEMIC INTEGRITY

The university takes an extremely serious view of violations of academic integrity. As members of the academic community, NAU's administration, faculty, staff, and students are dedicated to promoting an atmosphere of honesty and are committed to maintaining the academic integrity essential to the educational process. Inherent in this commitment is the belief that academic dishonesty in all forms violates the basic principles of integrity and impedes learning. Students are therefore responsible for conducting themselves in an academically honest manner. Individual students and faculty members are responsible for identifying instances of academic dishonesty. Faculty members then recommend penalties to the department chair or college dean in keeping with the severity of the violation. The complete policy on academic integrity is in Appendix F of NAU's Student Handbook.

AGREEMENT OF UNDERSTANDING:

I have read the course syllabus for GGR 362, Weather & Climate II. I have had the opportunity to ask questions about the syllabus and course. I understand the content of the syllabus and agree to be responsible for the requirements and course policies.

I further understand that GGR 362 carries a prerequisite of GGR 361, Weather & Climate I. My signature indicates that I have completed these courses or, in consideration for the instructors waiver of this requirement (if offered by the instructor), I agree to be responsible for any necessary background information and or knowledge equivalent to the content of GGR 361 needed to complete the requirements of this course, GGR 362.

Signature_____

Printed name_____

SSN_____

Detach and turn in before the end of the second week of class to avoid administrative drop.