



NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

Course Syllabus

Course Information

Course Number/Section	EES 885-1
Course Title	Mountain Meteorology
Term	Fall 2016
Days & Times	TR 2:00 – 3:15, 307 Gibbs Hall

Professor Contact Information

Professor	Dr. Yuh-Lang Lin
Office Phone	(336) 285-2127
Other Phone	
Email Address	ylin@ncat.edu
Office Location	302H Gibbs Hall
Office Hours	5:00 – 6:15 TWR, 2:00 – 3:00 W, or make appointment.
Other Information	MesoLab website: http://mesolab.org
Teaching Assistant	William Agyakwah and Chia-Hung Sheng

Course Pre-requisites, Co-requisites, and/or Other Restrictions

Dynamic Meteorology, Atmospheric Dynamics or equivalent

Course Description

Many well-known weather phenomena are directly related to flow over orography, such as mountain waves, lee waves and clouds, rotors and rotor clouds, severe downslope windstorms, lee vortices, lee cyclogenesis, frontal distortion across mountains, cold-air damming, track deflection of midlatitude and tropical cyclones, coastally trapped disturbances, orographically induced precipitation and flash flooding, and orographically influenced storm tracks. This course can be roughly divided into four parts, namely (I) basic dynamics of stratified fluid flow, (II) orographically forced flows, (III) thermally forced flow over orography, and (IV) orographic precipitation. In Part I, governing equations and linearization of them for basic dynamics of stratified fluid flow will be discussed. In Part II, linear and nonlinear dynamics associated with two-dimensional and three-dimensional stratified fluid flow over sinusoidal and/or isolated mountains will be studied. Applications of the mountain-wave theories included trapped lee waves, severe downslope winds, lee vortices, lee cyclogenesis, track deflection of cyclones and fronts by mountains, coastally trapped disturbances, cold-air damming, and gap flow. In part III, combined thermally and orographically forced flows will be discussed. Applications included heat island circulations, sea and land breezes, mountain-plain solenoidal circulations, density current generation and propagation, formation of thunderstorm cloud tops, as well as circulations and gravity waves that are generated by diabatic heating associated with coastal frontogenesis, moist convection, and orographic precipitation systems. In part IV, the dynamics of moist fluid flow over mountains will be studied. Topics in this part include orographic influence on climatological distribution of precipitation, orographic modification of pre-existing disturbances (e.g., troughs, midlatitude cyclones and fronts, tropical cyclones), common ingredients of orographic precipitation, formation and enhancement mechanisms, and control

parameters for moist flow over mountains and their associated flow regimes. In addition to the problems, several short projects, which involve idealized and real-case modeling, will be assigned to enhance the understanding of dry and moist flow theories and dynamics.

Student Learning Objectives/Outcomes

- Objective:** Use analytical thinking skills to evaluate information critically
- Outcome:** Students will demonstrate the ability to answer conceptual questions on examination questions.
- Objective:** Effectively relate basic ideas and concepts to more sophisticated atmospheric systems in tropics.
- Outcome:** Students will demonstrate the ability to employ critical thinking in answering short questions as well as solving problems on examinations.
- Objective:** Use a wide range of disparate information and knowledge to draw references and summarize various concepts, theories and observational evidence in the literature.
- Outcome:** Student will demonstrate the ability to absorb various concepts, theories and observations in assigned references and summarize and present them to the class.

Required Textbooks and Materials

Required Texts

Mesoscale Dynamics by Yuh-Lang Lin, Cambridge University Press, 2007

Required Materials

None

Suggested Course Materials

Suggested Readings/Texts

- (1) Mesoscale Dynamics (Ch. 1-7 and 11) by Y.-L. Lin, Cambridge Univ. Press, 2007
- (2) Mountain Meteorology, by C. David Whiteman, Oxford University Press, 2000
- (3) Mountain Weather Distance Learning Course, UCAR, MetEd (online)

Suggested Materials

None

Assignments & Academic Calendar

Topics, Reading Assignments, Due Dates, Exam Dates (optional: withdrawal dates, holidays, etc.)

Presentation Schedule

Date	Lec #	Presentation Title	Remarks <small>(based on Lin's textbook)</small>
1/9	1	Introduction	Ch. 1
1/11	2	Governing equations for mesoscale motions and their approximations	Ch. 2
1/16	3	Shallow-Water Wave Dynamics	Sec. 3.4
1/18	4	Pure Gravity Waves – I	Sec. 3.5
1/23	5	Pure Gravity Waves – II	Sec. 3.5
1/25	6	Inertia-Gravity Waves	Sec. 3.6
1/30	7	Reflection levels; Critical levels	Sec. 3.7-3.8
2/1	8	Wave Generation Mechanisms	Sec. 4.1-4.2
2/6	9	Wave Maintenance Mechanisms	Sec. 4.3
2/8	10	Energy Propagation & Momentum Flux	Sec. 4.4
2/13	11	Flow over 2D sinusoidal mountains	Sec. 5.1

2/15	12	Flow over 2D isolated mountains	Sec. 5.2
2/20	13	Nonlinear flow over 2D mountains (nonlinear flow regimes, generation of severe downslope winds)	Sec. 5.3
2/22	14	Flow over 3D mountains (linear theory & generation of lee vortices)	Sec. 5.4
2/27	15	Flow over large-scale mountains (rotational effects, lee cyclogenesis, orographic effects on cyclone tracks)	Sec. 5.5
3/1		Midterm	
3/5 – 3/9		Spring Break	
3/13	16	Other orographic effects (effects on frontal passage, coastal trapped disturbances, cold-air damming, gap flow)	Sec. 5.6
3/15		Other orographic effects (cont'd)	Sec. 5.6
3/20	17	Thermally Forced Flow - I	Sec. 6.1
3/22	18	Thermally Forced Flow - II	Sec. 6.2
3/27	19	Application of thermally forced flow theories to mesoscale circulations	Sec. 6.3
3/29	20	Effects of shear, 3D, and rotation on thermally forced flows	Sec. 6.4
4/3	21	Dynamics of sea and land breeze	Sec. 6.5
4/5	22	Dynamics of mountain-solenoidal circulations	Sec. 6.6
4/10	23	Mesoscale instabilities (static, conditional, potential instabilities & K-H instabilities)	Sec. 7.3
4/12	24	Orographic influence on climatological distribution of precipitation and preexisting disturbances	Sec. 11.1-11.2
4/17	25	Common ingredients of orographic precipitation	Sec. 11.2
4/19		Continuation of Lecture 25	
4/24	26	Formation and enhancement mechanisms, control parameters, and moist flow regimes of orographic precipitation	Sec. 11.3-11.4
4/26		Continuation of Lecture 26	
5/1	27	Influence of Orography on Climate	Note
5/3		Review	
5/7-11		Final Exam (May 8, T, 3:30-5:30pm)	

Grading Policy

(1) Homework	20%
(2) Midterm and Final Exams	50%
(3) Projects	30%

Grading Scale

Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	F
Scores	94-100	90-93	87-89	83-86	80-82	77-79	73-76	70-73	67-69	60-66	0-59

Course Policies

Make-up exams

Make-up for midterm must be done prior to the final examination.

Extra Credit

No Extra Credit

Late Work

Late submission of homework and model projects must be within a reasonable period of time permitted by the instructor.

Special Assignments

Not applicable

Academic Integrity

Enrollment in the class means that you agree to abide by the expectations of North Carolina A&T State University about academic integrity. For specific information refer to your Student Handbook. Also, refer to the most current Undergraduate Bulletin for the academic dishonesty policy. The North Carolina A&T State University's Academic Honor Code will be enforced.

Your responsibilities in the area of honor include, but are not limited to, avoidance of cheating, plagiarism and improper or illegal use of technology. Your presentations, assignments, and quizzes are expected to be your own work. Any questions about these should be directed to the professor. It is permissible to request assistance from a librarian when doing database research as long as the selection and organization of the research for the presentation is in your own work.

Class Attendance

The College of Arts and Sciences requires students to be on time for class and to attend class on a regular basis. If the student has unexcused absences, is late for class or leaves class early, the student's grade may be lowered.

(See attendance policy set forth by the instructor in the course syllabus.)

Excused absences will comply with the following university policy on make up work: "Sickness (verification needed); death of relative (immediate family); participation in an approved university related activity; acting in the capacity of a university representative (band, choir, sports, related travel, etc.); extraordinary circumstances including court appearances, family emergency~ at the discretion of the professor, etc. require a signed statement.

NOTE: "Other reasons for class absences are not acceptable."

Classroom Citizenship

Normal classroom decorum is expected.

Technical Support

If you experience any problems with your A&T account you may call Aggie Tech Support (formerly Help Desk) at 336.334.7195.

Field Trip Policies / Off-Campus Instruction and Course Activities

Not applicable

Student Affairs website <http://www.ncat.edu/~staffair/>;

Student Handbook: <http://www.ncat.edu/~deanofst/Handbook.htm>;

Student Travel Procedures and Student Travel Activity Waiver

<http://businessfinance.ncat.edu/policies%20and%20procedures%20index.htm>

*Off-campus, out-of-state, and foreign instruction and activities are subject to state law and University policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at the website address: **Student Travel Procedures and Student Travel Activity Waiver***

<http://businessfinance.ncat.edu/policies%20and%20procedures%20index.htm>.

Additional information is available from the office of Student Affairs, please check the website at <http://www.ncat.edu/~staffair/>.

Below is a description of any travel and/or risk-related activity associated with this course.

Other Policies (e.g., copyright guidelines, confidentiality, etc.)

Student Handbook: <http://www.ncat.edu/~deanofst/Handbook.htm>

Family Educational Rights and Privacy Act

http://www.ncat.edu/~registra/ferpa_info/index.htm

Student Conduct & Discipline

North Carolina A&T State University has rules and regulations that govern student conduct and discipline meant to ensure the orderly and efficient conduct of the educational enterprise. It is the responsibility of each student to be knowledgeable about these rules and regulations. Please consult the undergraduate

http://www.ncat.edu/~acdaffrs/Bulletin_2008-2010/2008-2010_Undergraduate_Bulletin.pdf

and graduate bulletins: 2008-2010 Graduate Catalog.doc

<http://www.ncat.edu/~gradsch/cstudents.html> and student handbook

<http://www.ncat.edu/~deanofst/Handbook.htm> for detailed information about specific policies such as academic dishonesty, cell phones, change of grade, disability services, disruptive behavior, general class attendance, grade appeal, incomplete grades, make up work, student grievance procedures, withdrawal, etc.

These descriptions and timelines are subject to change at the discretion of the Professor.

01.27.09 – Submitted to Faculty Senate by LEW