Introduction to Atmospheric Science

SYLLABUS

Class time: TR 11:30am to 1pm

Classroom: Murie 230, 2nd floor seminar room

Instructor: Carmen N. Moelders, aka Nicole Mölders

Email: cmoelders@alaska.edu

Office: Akasofu 309

Hours: Thursday 1-2 pm in Akasofu 319

Course Description: Introduction to Atmospheric Sciences comprises the physical, chemical and dynamical processes of the troposphere. The governing conservation (balance) equations for trace constituents, dry air, water substances, total mass (equation of continuity), energy (1st law of thermodynamics), entropy (2nd law of thermodynamics), and momentum (Newton's 2nd axiom) are presented and explained. This presentation includes basics of cloud physics, and simplifications like the hydrostatic and geostrophic approximations and their application in models. Static and conditional stability criteria are explained too. Phenomena discussed include, for instance, frontal systems, hurricanes, Föhn wind systems (Chinook), monsoon, El Nino Southern Oscillation (ENSO), ice fog. Chemical processes taking place in the atmosphere are analyzed based on kinetic processes, but thermodynamic equilibrium is also discussed. The discussion comprises, among other things, photolytical and gas phase oxidation processes, aqueous chemistry, as well as gas-to-particle conversion. Fundamentals of biogeochemical cycles (e.g., CO_2, H_2O, nitrogen, etc.) and the origin of the ozone layer are covered as well. The chapter on radiation includes solar and terrestrial radiation, major absorbers, radiation balance, radiative equilibrium, radiative-convective equilibrium, basics of molecular, aerosol, and cloud adsorption and scattering. Satellite imaginary, greenhouse gases (e.g., CO_2, H_2O, CH_4, etc.), and optical phenomena like rainbows, halos etc. are included. Interactions of the global energy, water, and trace gas cycles and their influence on general circulation and their role in the climate system are presented. Moreover, fundamentals in numerical modeling of atmospheric and hydro-meteorological processes are provided.

Course goal: By the end of the semester, all students will have the basic knowledge required to take other ATM classes and interpret chemical or other environmental measurements or model results in the framework of the meteorological situation. Students taking this class at the graduate level will be able to make atmospheric science based reasonable assumptions and judgements in their thesis research.

Student Learning Outcomes:

- Learn to discuss science in an effective manner
- Develop skills to read papers critically
- Apply material learned to new problems
- Improve the quality of your presentations

Course objective: By the end of the semester, you should be able to understand and explore the physical, chemical and dynamical processes of the atmosphere, and put them into equations, make reasonable assumptions about missing terms, values or data or under which circumstance you can neglect terms or processes. You should be able to solve fundamental problems related to the basics of atmospheric thermodynamics, the earth's radiation budget, atmospheric dynamics, cloud- and precipitation formation as well as atmospheric chemistry. You should be able to read and analyze weather maps or climate diagrams, interpret diagrams and satellite images, know the basics of general atmospheric circulation and climatology as well as atmospheric chemistry. Fundamental goals are that you develop skills to think as an atmospheric scientist and that you learn higher order thinking. This includes application of learned material to very different problems or putting learned material together in a new context to solve a problem. The goal of the course when taken by graduate students is to apply the knowledge of Atmospheric Sciences beyond the lines you applied it as an undergraduate.

Class delivery: Research showed that teaching someone and active learning else are the best ways to learn (e.g. here). Therefore, this class is taught in flipped mode.
Watch the video on the syllabus for more information

00:00 14:02

Unit 1

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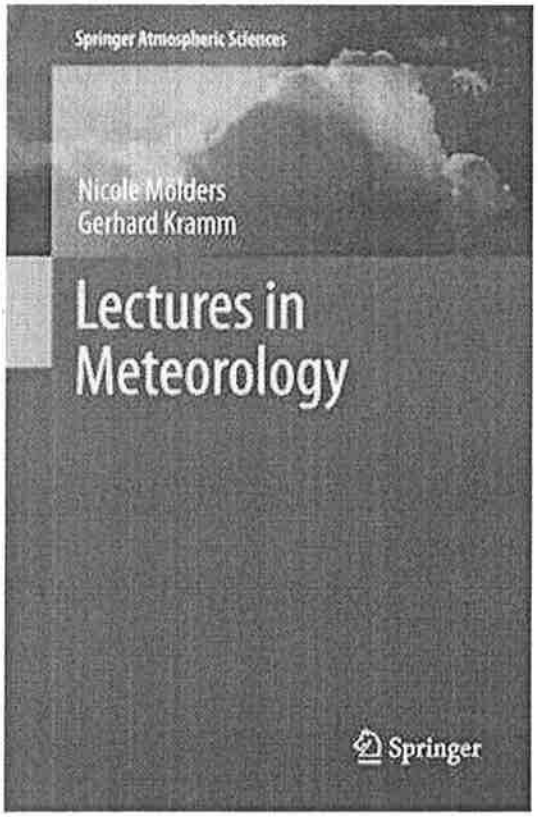
e equation sheet prior to class,
rk. Filling out the equation sheet,
ial are part of the grade. I will
mary as homework.

lass. Classes will start with a re-
stion and answer session where
you can seek clarification of the read material. Then an application session follows based on the material covered by the reading assignment. Depending on the type of application this will be either as individual work or in group assignments where I will work with a student or group at a time while the others work on the assignment. The application assignments may be tailored to the three different student groups (ATM401, ATM601, CHEM601). In such cases, when one of the groups has solved their assignment they are to join one of the other groups. In flipped mode, I will collect the application assignments occasionally (i.e. without prior announcement) for grading.

Suggested readings/textbooks: All reading assignments will require using

Mölders, N., Kramm, G. 2014. Lectures in Meteorology, Springer Atmospheric Sciences Series, Heidelberg



Reading the book, watching the video and taking notes are also homework assignment, i.e. inevitable. You will not be able to fill out the equation sheet, answer the questions and give the review/summary without having done the reading. You also will not be able to seek clarification, and will not be able to participate efficiently in the in-class application projects without having done the reading and watching the videos. It saves time and is safer to do the assignments using the recommended book. The final examination is open book and only this book will be allowed.

Other course resources: Please realize that when students enroll in university-level courses they may need to employ skills that are not directly related to the course content. As a student, you might be required to learn something new to succeed in class even though that skill/material will not specifically be on the final exam. Thus, students should expect to learn techniques/tools that are needed to fulfill the requirements listed in this course syllabus.

Attendance: You have to attend class regularly and do your reading and video assignments as posted and/or stated in class. Class attendance and participation in the in-class exercises are required and part of your grade. Excused absences are approved in advance or absences due to a documented emergency. Such documentation must be made immediately upon the student's return to class. However, unexcused absences lead to an **F** on popup quizzes that may occur on the day you missed. Please understand that this is a college course – you are expected to be on time for class and have all the required material unpacked.

Homework: There are **two different due dates**.

- Answering and submitting the questionnaires are due **on the day before class at 1500 AST**. I will not accept any late submissions unless approved in writing by me prior to the due date. Submitting the questionnaire **in time** is essential for your grade.
- You will be allowed to revise the submitted version **after class** and resubmit it. The submission of the final version of the questionnaire is due a week after the class. I will grade only **resubmitted versions** or when you did not revise your submission, the first submission. If you fail to submit the first (draft) version of the questionnaire in time (see above), you will get an F even when you submit the final version in time. This policy ensures that students are prepared for class to get the most out of the class.

I expect that each student is able to give a review of the material read and watched in front of the class. The contributions should be thorough and complete, reflecting the thought that you have put into your tasks. You will be picked randomly several times per semester for presenting the homework. You may excuse yourself prior to the start of the class once in a semester for not having your homework. I recommend taking notes while reading the book and/or watching the video.

No late homework can be accepted (except in excused absences to be approved before the event). Late homework has to be submitted in writing and in readable style. "Readable style" means typed, double-spaced, using at least a 12-point font, one-inch margins, and in hard copy format. It is simply too tricky to edit and make comments in single-spaced type. If you have not met these stipulations, I will return it to you ungraded. Late homework will not be accepted via e-mail or fax unless you make prior arrangements with me.

It is the student's responsibility to prepare homework in time. I strongly suggest that you plan and schedule your work and start working on your homework before it is due. I recommend having back-up systems in place so you can have all work completed on schedule. Getting work done on time is a key to early success in your business or scientific career. A major complaint of employers is that faculty do not instill a sense of responsibility in students.

It is part of your homework – even when not said explicitly – to read the assigned parts of the book in addition to watching the videos. This means that at the beginning of the class I will ask questions or ask to summarize the last class. You can offer to answer the questions or do the summary, but I also reserve the right to ask students randomly who do not volunteer. I will grade the review.

Class participation: encompasses to actively contributing to solving in-class application exercises, presenting the material read in form of a review in front of the class, participation in discussions and group-work, summarizing material learned and answering questions. Hint: It is better you ask the class or me a question than I ask you a question that you cannot answer.

In-class exercises: The in-class exercises (applications) may involve group work and are an important learning element to develop your ability to solve scientific questions, to improve your understanding by applying the material you learned in the videos and reading assignments, reviews, and application, and to present complex material. They are also preparation for the exams and your future education at UAF and professional life. Every group member must be able to answer questions.

I encourage teamwork, as teamwork will be the way to work in future work places. Research also showed that students working together typically become better presenters (a goal of this class) and are more successful in class. If you co-work in groups, everybody of the group must be able to present the work at the board in class. You are expected to present your group's or your in-class application work at the board when you are called to do so. In the presentations of in-class applications, I may randomly ask to switch from one teammate to the other to ensure that nobody takes group work as a free ride.

In-class presentations: You must always be able to present the material that you had to read and watch as a homework assignment in front of the class. This means that you will not be told in advance when you will be the person who gives the review in class. It is the student's responsibility to be

aware of and to be prepared for each assigned task when it is due. Give the person who is speaking your undivided attention. It is not only common courtesy, but scanning through pages of notes, whispering or talking can distract, annoy, and even intimidate students around you as well as myself. Essentially, you should treat classmates and me as you would like, and expect, to be treated yourself.

Pop-up quizzes: There may be unannounced popup quizzes. These quizzes cover material of **all** previous classes, results from applications, and reading homework assignments, and sometimes discussion or solving of a problem. Only in case of an emergency, I will allow you to start later on a quiz.

Examinations: There will be one major examination. It is the student's responsibility to find out when and where the examination will take place and to be there in time. Only in case of emergency, I will allow you to start later on the exam. There is usually another exam scheduled in this classroom right after your own exam so the room has to be free in time. This means that I cannot give you extra time if you arrive late. The exam is scheduled for finals week. It is open book. Only the *Lectures in Meteorology* are allowed as hard copy. However, if students bring a reasonable scheduling conflict to my attention by the **end of the first week of classes** (e.g., absence for field work, attendance of a conference during finals week) I will work with the student for arrangements. **I will not do the exam prior to AGU as that would take off 14 days of class material.**

Difference between CHEM601 and ATM601: There is no difference between the grading of the completeness, correctness, and understanding of quizzes and the exam. I try to balance the interests of chemistry and atmospheric sciences students and the importance of the material taught for their discipline by assigning applications relevant for their discipline as much as possible. Thus, I will occasionally assign ATM601 and CHEM601 students different kind applications, or parts of exams or quizzes. Students can gain extra credit for also doing the tasks not assigned to them. A difference on an application task could be that ATM601 students have to plot the results of a problem for various quantities, while CHEM601 students have to discuss what the results of the problem mean for the chemical distribution in the atmosphere.

Difference between ATM401 and ATM601: There is a distinct difference in the expectations of the completeness, correctness, and understanding of the homework, quizzes and examinations. I try to balance the interests of undergraduate and graduate students. Therefore, I will assign special tasks for undergraduates that probe the presented material at the undergraduate level. In the case of tasks that are assigned to all students or the atmospheric sciences students, undergraduate students will get the full credit possible on a task if they reach 80% of the points possible for a graduate student for the same grade, i.e. the grading is shifted towards lower expectations. The same is true for the questions and equation sheets. Moreover, there will be tasks that are ONLY designed for graduate students and these tasks are indicated as such. These tasks require skills that undergraduate students usually do not have yet (e.g., programming) or that are not an expected learning goal for them right

now (e.g. making reasonable assumptions, justify assumption). The undergraduate students will be assigned a task at the undergraduate level to work on at that time.

Additional policies:

1. No weapons allowed in class.
2. Due dates are firm, with the exceptions mentioned above as well as documented emergencies.
3. If you have a disability and require any auxiliary aids, services or accommodations under the Americans with Disabilities Act, please contact me after class, see me in the my office, or call me during the first week of the semester to be able to define specific accommodation needs and have enough time for any necessary preparation. If you have any kind of a physical or learning disability you must tell me about it. All disabilities are documented by UAF's Center for Health & Counseling and instructors receive a formal letter requesting that accommodation are made for any student with disabilities.
4. Any student who is an UAF sponsored athletic or who has other personal or situational difficulty that might affect class performance is invited to contact me in the first week of the semester (or as soon as such matters emerge) so that ways of accommodating the difficulty may be anticipated.
5. If you intend to go to AGU or another conference or on a field trip, you must tell me this in the first week of class. It is your responsibility to make up for the classes missed.
6. Switch your cell phones off and do not text in class.
7. Do not take photos of class material.
8. I do not answer emails Saturday to Monday, i.e. I answer within 24h to emails on Tuesday to Friday afternoon only. When I am on travel I do not answer to emails as I cannot guarantee email access.

All students in the class were informed about the policies at the beginning of the class and in the syllabus, and it would be unfair to everyone else to give one person an exception.

Other important information: It is essential that you (1) keep up with the reading of the book and video materials, (2) budget your time wisely to complete all of your reading and viewing assignments, and (3) seek clarification on any material, which you do not understand, during office or class hours. Note there is a **Quiz Your Professor** section on the right sidebar of our class page. If I am not covering subjects adequately, or the in-class exercises are confusing or difficult, or if you do not understand the questions in your homework, quiz or examination, please let me know. I want you to understand the material and that you can apply the material to solve problems. Please use the office hours or **one-minute quiz** to seek clarification. One-minute quizzes can be submitted at the end of each class or until 1500 AST on the day before class by slipping it under my office door. The intent of the one-minute quizzes is that you can stay anonymous with your clarification request.

Academic integrity, honor code and plagiarism: I expect students to submit own original work and reference all other work and intellectual ideas with appropriate reference and citation. You are subject to the Code of Conduct.

Grading Policy: This class is a success-oriented course. My aim is for all students to meet their individual learning and grade goals. Of course, this does not mean that you can avoid working hard or work hardly. Instead, it means that (1) all students who do well in the quizzes and examination will be rewarded accordingly and (2) the grade distribution will not be adjusted to make sure it fits a bell-shaped curve. I expect that (1) you aim to give your personal best in the course, and (2) use in-class exercises and questions, homework, quizzes and examination as an opportunity to demonstrate your understanding of the material. To obtain an "A" grade you will need to produce work that far exceeds my normal expectations. My normal expectations are regularly attending the classes, hard work evidence of time spent with the material and an ability to demonstrate understanding of all concepts.

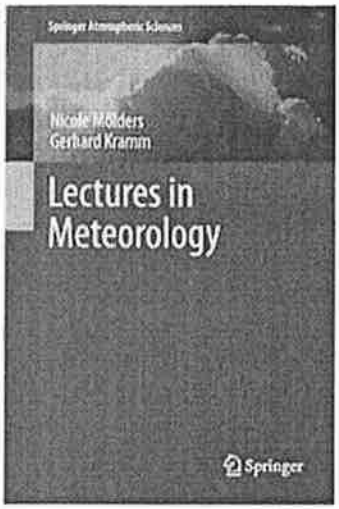
Grading for this class will follow the UAF guidelines. Your grade will be 30% homework (review, questionnaires), 30% in-class participation (quizzes, discussion contributions, application), and 30% final exam, and 10% attendance.

To get a "C" grade, 50% of the points in each category have to be earned. I will give +/- grades with the following UAF rules A 4.0, A- 3.7, B+ 3.3, B 3.0, B- 2.7, C+ 2.3, C 2.0, C- 1.7, D+ 1.3, D 1.0, D- 0.7, and F 0.0, respectively. Thus, 90% and better is an A, 85-89% is A-, 77-84% is B+, 70-76% is B, 64-69% is B-, 57-63% is C+, 50-56% is C, 44-49% is C-, 40-43% is D+, 39-42% is D, 30-38% is D-, less than 30% is F. Grades of "incomplete" will be given only in cases where an extraordinary, exceptional reason, submitted in writing by the student and judged valid by me. See UAF policies for details.

Tentative Schedule: Learning is an interactive process and each class is individual. Although I have put a lot of thought into the sequence of topics, this schedule is tentative by purpose and subject to change as necessary due to availability of support materials, adaptation to specific needs of the class, etc. The schedule for this class will remain an on-going construction in light of what is accomplished in each class meeting. Since this course will be attended by undergraduate and graduate students both it will be unavoidable to insert additional subjects or to explain subjects in more detail because of the different levels of the students. Moreover, to get a better understanding for atmospheric sciences it will be required to pick up subjects that are caused by actual weather events. Departures from the schedule, such as additional readings, assignments, deadline changes, and activities, may be announced in class. These changes will take priority over the printed schedule. It is your responsibility to be in class and to keep up-to-date on whatever changes I make, or the class negotiates.

Syllabus Introduction to

Atmospheric Sciences



Class time: TR 11:30am to 1pm
Classroom: Murie 230
Instructor: Nicole Mölders
Email: cmoelders@alaska.edu
Office: Aka 309,Tr 1-2 pm

Content

Among others, physical, chemical & dynamical processes of the troposphere; governing conservation equation; irreversible thermodynamics ; basics of cloud physic, gas, photo-, aqueous & aerosol chemistry; atmospheric radiation; optical phenomena; biogeochemical cycles; weather forecast

Objective

Explore physical, chemical and dynamical processes; solve fundamental problems related to atmospheric science; analyze weather maps or climate diagrams, satellite images

Delivery

Flipped class

https://intro-atmos-sci.community.uaf.edu

Difference CHEM601 ATM601

None in grading; discipline specific assignments on occasion

Difference ATM401 ATM601

Lower expectations on completeness, correctness, understanding on homework, quizzes, exam for ATM401

Major Policies

Academic integrity, honor code, no plagiarism; No weapons: due dates are firm; Americans with Disabilities Act: document at UAF's Center for Health & Counseling in 1st week; sponsored athletic &AGU/conference/field trip: tell me in 1st week; you are responsible to make up for missed classes; Switch cell phones off; no photos; no email answers F after EOB to M

Grading

30% homework (review, questionnaires), 30% in-class participation (quizzes, discussion contributions, application), and 30% final exam, and 10% attendance

Short version of syllabus as infographic

QUIZ YOUR PROFESSOR

Submit a question on a topic you did not understand or want clarification on