ATM401, ATM601, CHEM601
Introduction to Atmospheric Sciences
Fall 2013

Class time: TR 11:30am to 1pm

Classroom: Elvey Auditorium

Instructor: Carmen N. Moelders, aka Nicole Mölders

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Office: IARC 309

Hours: Thursday 1-2 pm in Akasofu 319 or Elvey

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, foehn 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., CO2, H2O, 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., CO2, H2O, CH4, 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.

Student Learning Outcomes:

- Learn to discuss science in an effective manner
- Develop skills to read papers critically
• 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.

Suggested readings/textbooks: The textbook I use for this class is still in press. I will distribute copies of chapters in class as far as the copyright laws permit me. Due to these restrictions, which are beyond my control, I recommend making use of the excellent libraries on campus and work with several books as you need them. Examples of textbooks that provide good material of what will be covered in class are:


I will give a short evaluation of these books in the first class. It is not required that you buy them all. If you want to buy one Wallace and Hobbs cover most of the material, however, not
at the depths needed for the interdisciplinary research in atmospheric sciences, climate studies, and environmental chemistry here at UAF. As these books are available in the library on reserve, you can have a look at them and decide whether your individual style of preparing, repeating and learning goes better with the one or the other book. If you want to order your books online, be aware that it takes 2-3 weeks to receive the shipping. Thus, order before the semester starts. I recommend to have a look at other books frequently. Experience says that students with no atmospheric sciences background graduate from this class with a better grade if they look at the material in a book on the 100 or 200 level first and then work on the material with a book at the graduate level.

If you never had any atmospheric sciences class before I also recommend that you read the material in a book at the 101 level before starting to study it at the higher level. Given the broad range and huge amount of material covered in this class, I cannot go back to the 101 level as this is a graduate class. However, if you fall into this category of students, please let me know as I can provide you with material that helps you to bridge this gap and to be successful in this class.

**Other course resources:** You should also read other printed material than the recommended books, even if not assigned. I will provide class material on Blackboard typically after a topic is finished. I expect you to download them from the web and to read them. They are subject of quizzes, homework assignments, and the exam. I also provide other reading material in class. This material is not intended to substitute for reading books. It is only to give you an idea, as to what I think, are the important issues of a topic. The material will only be available after a chapter is finished because scanning through the material in class could distract you in class; I want you to look at textbooks; and distributing material after finishing a chapter allows me to add special information on questions that may occur in class.

You will be hooked up automatically for access to Blackboard when you registered for CHEM601, ATM401 or ATM601. However, if problems occur with this automatic procedure (and to my experience they do occasionally) and you cannot log in, send me an email so that I can verify the email address, try to enroll you manually into Blackboard, and set up your Blackboard account.

**Attendance:** You should attend class regularly and use a book of your choice related to Introduction to Atmospheric Sciences. Class attendance and participation in the in-class exercises are recommended, but I will not monitor attendance. However, unexcused absences lead to an F on popup quizzes that may occur on the day you missed. 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. 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:** due at the start of class on Tuesdays. I will not grade homework assignments, but I expect that each student is able to present the tasks in front of the class. The contributions should be thorough and complete, reflecting the thought that you have put into your tasks. You are expected to present your homework at the board when you are called to do so. 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.

You can do your homework in groups of three. I encourage teamwork, as teamwork will be the way to work in future work places. Experience also taught that students working together on their homework typically become better presenters (a goal of this class) and are more successful in class. However, you have to declare at the beginning of the class who worked together and anyone of the group must be able to present the work. I may randomly ask to switch from one teammate to the other to ensure that nobody takes this offer as a free ride.

Since I do not grade presenting the homework and do not collect the homework, no late homework can be accepted (except in excused absences to be approved before the event). Late homework should be submitted 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 backup 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 parts of books on the subject discussed in the class, the class material and the draft book provided. 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.

Class participation: encompasses to actively contributing to solving in-class exercises, presenting homework, 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 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 class 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.

In-class presentations: You must always be able to present the tasks that you had been assigned as homework in front of the class. This means that you will not be told in advance when you will be the person who presents the homework in class. If you co-work in groups, everybody of the group must be able to calculate the homework at the board 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 as you would like, and expect, to be treated yourself.

**Pop-up quizzes:** There will be unannounced popup quizzes. These quizzes cover material of all previous classes, results from homework assignments, reading material related to the class, 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. 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 science students and the importance of the material taught for their discipline. Thus, I will occasionally assign ATM601 and CHEM601 students different kind homework or parts of exams or quizzes. Students can gain extra credit for also doing the tasks not assigned to them. A difference on a homework assignment 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 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. 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).

**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:** I will have to attend a UCAR meeting as UAF’s UCAR representative on Tuesday 10-8. I am an invited speaker at AGU and will miss classes on 12-10 or 12-12 or both days. I will provide that information as soon as I have it so that we can make arrangements. I will either ask Dr. Kramm to teach the classes on my behalf, reschedule the class, give a larger homework assignment to be done during class time or have a long quiz on the missed days.

It is essential that you (1) keep up with the reading of the books and class materials, (2) budget your time wisely to complete all of your assignments, and (3) seek clarification on any material, which you do not understand, during office or class hours. 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 solve the assigned 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 1800 AST on the day before class by slipping it under my office door.

**Academic integrity, honor code and plagiarism:** I expect students to submit own original
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 included in the following table:

<table>
<thead>
<tr>
<th>GRADE</th>
<th>UAF GUIDELINES</th>
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<tbody>
<tr>
<td>A</td>
<td>An honor grade indicates originality and independent work, a thorough mastery of the subject, and the satisfactory completion of more work than is regularly required.</td>
</tr>
<tr>
<td>B</td>
<td>Indicates outstanding ability above the average level of performance.</td>
</tr>
<tr>
<td>C</td>
<td>Indicates a satisfactory or average level of performance.</td>
</tr>
<tr>
<td>D</td>
<td>The lowest passing grade indicates work of below average quality and performance.</td>
</tr>
<tr>
<td>F</td>
<td>Indicates failure to meet lowest standards.</td>
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The grade will be 50% quizzes, and 50% exam. 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 Fall 2013 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.

**First day:** Discussion of class syllabus if required; Introduction to Blackboard if required; Discussion of Plagiarism if required; Introduction: "What we will do in this class?"; Expectations on the students; Basics of atmospheric sciences

**Week 1:** Brief review; Basics of atmospheric science (continued); Gas laws & Hydrostatics

**Week 2:** Brief review; In-class exercises; Gas laws & Hydrostatics (continued), Thermodynamics

**Week 3:** Brief review; In-class exercises; Thermodynamics (continued)

**Week 4:** Brief review; In-class exercises; Thermodynamics (continued)

**Week 5:** Brief review; In-class exercises; Clouds

**Week 6:** Brief review; In-class exercises; Clouds (continued); Atmospheric radiation

**Week 7:** Brief review; In-class exercises; Atmospheric radiation (continued)

**Week 8:** Brief review; In-class exercises; Air Chemistry

**Week 9:** Brief review; In-class exercises; Air Chemistry (continued)

**Week 10:** Brief review; In-class exercises; Air Chemistry (continued); Dynamics and Synoptic

**Week 11:** Brief review; In-class exercises; Dynamics and

**Week 12:** Brief review; In-class exercises; Dynamics and Synoptic (continued)

**Week 13:** In-class exercises; Dynamics and Synoptic (continued), Climatology, Review

**Week 14:** Climatology

**Finals week: Examination** (make yourself familiar with the classroom and time scheduled for the examination)