Course: ATM662, Numeric modeling and parameterization methods

Class hours: 11:30 am – 1 pm on Tuesdays and Thursdays, Elvey Auditorium, ARSC computer lab if announced in class

Instructor: Nicole Mölders
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Course Description: The class covers how models are built from the fundamental equations, and explains the necessity of parameterizations. It discusses numerical methods and parameterizations frequently applied in Atmospheric Sciences. Subjects addressed are simplification and discretization of equations, types of atmospheric model grids, physical and analytical modeling, boundary and initial conditions. Methods to parameterize averaged subgrid-scale atmospheric processes, and evaluate model results are introduced. The class elucidates scale dependency and limitations of parameterizations. It provides insight in coupled modeling relevant for climate modeling. The students learn to understand, and apply atmospheric models, and code aspects of models themselves.

Suggested readings/textbooks:


I will give a short evaluation of these books in the first class. You do not need to buy any of the books. It is recommended to have a look at other books on numerical modeling not
only occasionally. You should also read other printed material, and copies of articles as assigned. The books are on reserve at the Keith Mather library in the Akasofu building. The book by Pielke is also available as ebook at http://catalog.library.uaf.edu/uhtbin/cgisirsi.exe/x/0/0/57/5/3?searchdata1=1136292{CKEY}&searchfield1=GENERAL^SUBJECT^GENERAL^^&user_id=UAFRASWEB. The book by Jacobson book also available as ebook at http://catalog.library.uaf.edu/uhtbin/cgisirsi.exe/x/0/0/57/5/3?searchdata1=1112101{CKEY}&searchfield1=GENERAL^SUBJECT^GENERAL^^&user_id=UAFRASWEB.

Other course resources: I may put papers/notes/links/assignments on Blackboard and will announce that by email. I expect you to download them from the web and to read them. They are not intended to substitute for readings. They are only to give you an idea what I think are the important issues of the topic. It is your responsibility to have an UAF email account because Blackboard access is only available with an UAF account. You will be hooked up automatically for access to Blackboard when you registered for ATM662. However, if problems occur with this automatic procedure and you cannot log in, send me an email so that I can verify the email address, enroll you into Blackboard, and set up your Blackboard account.

Course objective: The course is to provide you with knowledge required for performing research in atmospheric modeling or related fields. At the beginning of the class, I will make a survey on your background and particular interest in this class. I will try to consider this information in the lectures, homework assignments and projects for an optimal learning experience and gain out of this class. At the end of the semester, you should be able to understand numerical models and be able to solve typical tasks in numerical modeling. You should be able to solve fundamental problems how to discretize fundamental equations of atmospheric sciences. You will learn when and when not to couple models. You should be able to analyze parameterizations, interpret model results, and know why parameterizations are required and what the consequences are for the model results. Fundamental goals are that you develop skills to think as a modeler and that you learn higher order thinking. This goal includes application of learnt material to very different problems or putting learnt material together to solve a problem.

Student Learning Outcomes:
- Learn to discuss science in an effective manner
- Develop skills to read papers critically
- Improve the quality of your presentations
- Understand the scientific review process
- Know how to write a research paper

Attendance: You should attend class regularly and use a book of your choice related to numerical modeling and parameterizations and read papers related to the theme. Class attendance and participation in the in-class exercises are required and will be a part of your grade. Unexcused absences lead to deduction of the attendance points and lessen your chances to accumulate points for presentation of your homework or quizzes that
would have been discussed and/or taken on the day of your absence. 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:** There will be homework assignments that are due at the start of class on the specified date. Each student is expected to be 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. This presentation will be graded for completeness, correctness, understanding and the way of presentation. You will be randomly picked several times per semester for presenting the homework. If you cannot present or do not have the homework, when you are chosen to be the presenter, you will get an F. Homework is to be presented in the form as given in the assignment.

No late homework will be accepted (except in excused absences or with my approval that you have to seek a week prior to the due date). 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. 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 of the class, the readings and the notes provided. At the beginning of the class I will ask questions and you can offer to answer them, but I also reserve the right to randomly ask students who do not volunteer. The answers are also part of your homework grade. There may be "pop quizzes" to examine your knowledge and they will be part of your homework grade. If you have an unexcused absence when a pop quiz occurs, you will lose points both on attendance and the quiz.

For some homework assignments you are allowed to work in teams of up to three students. These assignments will be indicated as such.

**In-class exercises:** These will often involve group work and are an important learning element to develop your ability to solve scientific questions, and to improve your understanding by applying the material you learned in class. The in-class exercises also include learning how to run a model. They are also preparation for the comprehensive exams (if you chose this class as one of your comps) and your future education at UAF.
and professional life. Class time will be set aside for developing numerical schemes. These classes may be in the ARSC computer lab when needed. The ARSC computer lab is also to be used for small coding tasks (in-class exercises) when needed. I will announce ahead of time when we will have class in the ARSC computer lab, i.e. if it is impossible to demonstrate the material from the PC in the auditorium.

**In-class presentations:** You must always be able to present the tasks that you provided 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. Should you not be able to explain and reproduce the homework you provided or the homework is incomplete or incorrect points will be deducted. 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.

You will have to present the results of your project in a 15 minutes powerpoint presentation that is followed by a 5 minute discussion. You will be graded upon scientific content, correctness, conciseness, and visual and oral quality of the presentation. It is the student’s responsibility to find out when and where the presentations will take place and to be there in time. Only in case of emergency I will allow you to give the presentation on another day in class or start the presentation later. I will not give you extra time if you arrive late.

Give the person who is speaking your undivided attention. It is not only common courtesy, but 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.

**Examinations:** There will be no examinations. Instead, there will be a written project paper. In finals week, we will have some of the presentations in the time slot allotted for the finals. Further presentations will be in the week before. We will draw tickets who is to present when unless volunteers are found for the earlier slot.

**Projects:** Students can either chose one of the modeling/parameterization related projects that I suggest at the beginning of the semester or propose a modeling/parameterization project of their choice to me in writing. If the project is doable and requires of similar amount of time, and has a similar degree of difficulty as the projects on my list, the students can do their own project. The project is to be presented in the week after spring break in form of a powerpoint presentation. The students will write a report about their project in form of a review research paper. Two students and I will review the paper anonymously. You will revise your paper according to the three reviews, write a list how you responded to the comments, questions and suggestions and resubmit the paper. I will grade the two reviews you have to make, your final paper and the response to the reviewer as well as the presentations.
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 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. 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. If you have any kind of a physical or learning disability, you must tell me about it so I can work with CHC to accommodate you.

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. I do not answer to emails Saturday to Monday, i.e. I answer within 24h to emails on Tuesday to Friday 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 assigned readings, (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 or quizzes, please let me know. I want you to understand the material and gain the most out of it and be able to solve tasks related to modeling.

Grading Policy: This 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. Instead it means that (1) all students who do well in the in-class exercises, homework presentation, presentation, review as reviewer and reviser, quizzes, and paper 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, homework, review, presentations and quizzes 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 ATM662 will follow the UAF guidelines.

The grade will be 10% attendance, 10% homework/quizzes and in-class presentations, 10% review, 10% response to the reviewers, 20% presentation and 40% project paper. To get a "C" grade, 50% of the points in each category have to be earned. This means, for instance, that you must pass both examinations with at least 50% of the points. 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.

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 interests and/or needs of the class, etc. The schedule for this class will remain an ongoing construction in light of what is accomplished in each class meeting. Since this course will be attended by students with different levels and/or background, it will be unavoidable to insert additional subjects or to explain subjects in more detail. Moreover, I intend to adjust the class material to the interest that you stated in the initial survey. 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.

Tentative Spring 2013 Schedule:

**Thursday 1/17:** Reading and discussion of class syllabus; Introduction to Blackboard; Discussion of Plagiarism; Survey; Introduction: "What is Numeric Modeling and parameterization methods?"; Basic set of equations atmospheric models build upon

**Tuesday 1/21 – Thursday 2/24:** In-class exercises; Simplification of the basic equations; Averaging of conservation relations

**Tuesday 1/29 – Thursday 1/31:** In-class exercises; Averaging of conservation relations; Physical and analytical modeling

**Tuesday 2/5 – Thursday 2/7:** In-class exercises; Physical and analytical modeling; Coordinate transformation and coordinate systems (model grids)
Tuesday 2/12 – Thursday 2/14: In-class exercises; Coordinate transformation and coordinate systems (model grids); Discretization

Tuesday 2/19 – Thursday 2/21: In-class exercises; Discretization

Tuesday 2/26 – Thursday 2/28: In-class exercises; Initialization and boundary conditions; How to do a presentation

Tuesday 3/5 – Thursday 3/7: In-class exercises; Parameterization of moist thermodynamic processes; How to write a research paper

3/11 – 3/15: Spring break

Tuesday 3/19 – Thursday 3/22: In-class exercises; Parameterization of moist thermodynamic processes; Parameterization of averaged subgrid-scale fluxes

Tuesday 3/26 – Thursday 3/28: In-class exercises; Parameterization of averaged subgrid-scale fluxes

Tuesday 4/2 – Thursday 4/4: In class exercises; Parameterization of averaged radiation flux divergence

Tuesday 4/9 – Thursday 4/11: In class exercises; Model evaluation methods

Tuesday 4/16 – Thursday 4/18: Model evaluation methods; Examples of models (LES models, mesoscale models, climate models, chemistry transport models, land-surface models, cloud models, hydrometeorological model, etc.)

Wednesday 4/17: First version of research project paper due

Tuesday 4/23: Reviews due

Tuesday 4/23 – Thursday 4/26: How to couple models

Tuesday 4/30: Revised version of project paper due

Tuesday 4/30 – Thursday 5/2: How to couple models; Presentations

Finals week: 10:15 a.m. - 12:15 p.m., Tuesday, May 7: Presentations