ATM 419/563 - Applications of Numerical Weather Prediction
Spring 2020

Instructor: Prof. Robert Fovell

Office: 313 Earth Sciences
Office hours: Whenever my door is ajar
Course page: [http://www.atmos.albany.edu/facstaff/rfovell/NWP/](http://www.atmos.albany.edu/facstaff/rfovell/NWP/)
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Credit: 3 hours
Class meetings: TuTh 4:15-5:35 PM in ES 333

Required text: None. Materials will be distributed in class and posted on website.

Useful references: Stensrud, Parameterization Schemes; Pielke, Mesoscale Meteorological Modeling; Markowski and Richardson, Mesoscale Meteorology in Midlatitudes; Houze, Cloud Dynamics.

Overview: This is a hands-on course in numerical weather prediction (NWP), focusing on mesoscale phenomena and dynamics. We will emphasize simulation of mesoscale weather systems (including thunderstorms, windstorms, and sea/land breezes), model verification, sensitivity (to initialization, resolution and other numerical aspects, and model physics), and how model physical parameterizations work. Our principal tool will be the Weather Research and Forecasting (WRF) model. The overarching goal is to understand how NWP models like WRF work, what their strengths and limitations are, and how and why they may fail. Each student is responsible for participating in a final capstone project that utilizes their knowledge and understanding of this class and its direct and indirect prerequisites.

Grading (A-E): Experiments (40%), Final project (50%), Class participation (10%). Tentative final project due date: Tuesday, May 12, 2020.

Topic list: Subject to revision/reordering.

- Planetary boundary layer (PBL) schemes. Example: PBL diurnal cycle. Demonstration: 1D column model.
- Modeling fundamentals, sources of error, and troubleshooting.
- Cloud microphysics schemes. Example: squall lines. Experiment: idealized 2D squall line.
- Cumulus parameterizations. Experiment: A precipitating real-data case.
- Model initialization. Experiment: varying and combining initialization data sources.
- Nonlinear instability.
- Model forecast verification. Experiment: verification against surface observations.
- Stochastic perturbations and nudging. Experiment: ensemble sensitivity.
Grading philosophy: A key component of the course grade is the final project. An “A” level project will have identified a viable topic, constructed thoughtful hypotheses and designed a reasonable experiment to test them, analyzed the results thoroughly and with care, crafted figures that are useful, clear, and attractive, and have produced a presentation that is well-organized, coherent, and displays what you did, how you did it, and what you learned. “B” level is high quality work that shows thoughtfulness and effort but reaches the “A” standards less fully or consistently.

Absences: Class attendance is expected. Unavoidable, anticipated absences should be discussed with the instructor in advance, and arrangements should be made to make up missing work. For information on medically necessary absences, refer to [http://www.albany.edu/health_center/medicalexcuse.shtml](http://www.albany.edu/health_center/medicalexcuse.shtml).

Academic integrity: Students are responsible for being familiar, and complying, with the University’s academic integrity standards. Refer to [http://www.albany.edu/undergraduate_bulletin/regulations.html](http://www.albany.edu/undergraduate_bulletin/regulations.html) for more information.

Shared resource information: This is a shared resource class. Undergraduate and graduate students will complete the same experiments, but the expectations regarding graduate student work will be higher, especially for the final project.