ATM/ENV 327: Meteorological and Environmental Measurement
(3 Credits) Spring 2017

1. Basic information

<table>
<thead>
<tr>
<th>Class #</th>
<th>AATM section (10297); AENV section (10296)</th>
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<tbody>
<tr>
<td>Room/Time</td>
<td>ES 232; T Th 2:45PM – 4:05PM</td>
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<td>Pre-reqs</td>
<td>AMAT 113 or 119 and APHY 105 or 140 or 141 and AATM 210</td>
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<td>Instructor</td>
<td>Junhong (June) Wang, ES339C, 442-3478, <a href="mailto:jwang20@albany.edu">jwang20@albany.edu</a> Office hours: Th 10:00am – noon; also, after class or by appointment.</td>
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<tr>
<td>TA</td>
<td>Brendan Wallace, ES332, <a href="mailto:bwallace3@albany.edu">bwallace3@albany.edu</a>, Office hours: MW 1:00-2:00pm</td>
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<td>Textbooks</td>
<td>Required:</td>
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<td></td>
<td>• Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, (2nd Ed.), John R. Taylor (Required)</td>
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<td></td>
<td>• Meteorological measurements and instrumentation, R.Giles Harrison ISBN:9781118745809</td>
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<td>References:</td>
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<td></td>
<td>• Meteorological Measurement Systems, Fred V. Brock and Scott J. Richardson</td>
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<tr>
<td>Contents</td>
<td>• Chapters 1 –7 of Introduction to Error Analysis</td>
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<td></td>
<td>• Selected chapters of Meteorological Measurements and Instrumentation</td>
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<td></td>
<td>• Other special topics, and lab &amp; field hands-on experiments</td>
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<td></td>
<td>• <a href="http://www.atmos.albany.edu/daes/atmclasses/env327/ENV327syllabus.pdf">http://www.atmos.albany.edu/daes/atmclasses/env327/ENV327syllabus.pdf</a></td>
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2. Course Objectives:

1) To acquire a basic understanding of the techniques used to properly acquire, express, analyze and interpret measurements;

2) To become aware of a wide range of instruments employed in atmospheric and environmental measurement, along with the fundamental principles upon which they operate;
3) To recognize the need for careful scrutiny of the type of errors present in data, especially the need to minimize systematic error;

4) To address three specific competencies of your General Education program: Critical Thinking, Advanced Writing, and Information Literacy. As such, there will be explicit mechanisms employed to develop your ability in each area, with assignments given that will often be at the intersection of all three competencies.

This course necessarily covers a lot of ground, spanning many topics within and related to atmospheric and environmental science. Correspondingly, it is paramount to appreciate that this course is all about being quantitative (i.e. not merely qualitative) and understanding the underlying physical principles of various measurement techniques and instruments. There also will be some statistical concepts developed and used.

The first part of the course will concentrate on the theory and application of error analysis. This is independent of any particular instrument used. It is admittedly fairly theoretical and mathematical, but very important. You will be provided numerous examples illustrating critical thinking relative to the concepts presented, and, of course, the application of mathematics in this context. The second part of the course will be oriented toward individual instruments. Here, the concepts of physics will be highly relevant, along with accessing information on the characteristics of specific instruments.

You will also write two papers during this course. There will be one short paper to allow you to receive feedback on your writing ability, with the second paper being more substantial, and contributing significantly to your grade (see “Research Paper” below). The writing style here will be scientific writing. A good, succinct resource for the principles of scientific writing is: http://cbc.arizona.edu/sites/default/files/marc/Sci-Writing.pdf

In the first writing assignment, you will be assigned a specific topic, with this paper, adhering to the style of scientific writing as much as possible. The first paper will be due Thursday, March 30th. Your second paper will be a research paper as described below. Both papers should also demonstrate your ability in information literacy, meaning that you could find and use data, background information, and literature relevant to the assignment.

3. Team research project, presentation and research paper

The students will be divided into several teams with 4-5 members for each team. You will work in teams for team projects during the semester and for your final research project. Each team will design, conduct and present the research project in team, but you will write your own final research paper based on your team research project. The topic of the team research project can be analyzing existing data to understand the measurement errors, designing a small field project to quantify instrument errors, study a specific phenomenon, or improving an existing instrument or developing a new one. The research will be presented in teams before the final on Thursday, May 4th and Tuesday May 9th.

The research paper is due on Thursday, May 11th. It will be based on your team research project. It should be at least six pages of text, excluding title page and references, and be written in double-spaced, 12-pt font (preferably Times New Roman). The overall paper format is the standard type. You may include pictures and/or figures embedded in the text or summarized as an appendix. It should have an
abstract and adhere closely to the style of scientific writing. You must submit it to me electronically, in either MSWord or PDF file format, and it must demonstrate a good set of citations, including some peer-reviewed journal articles, not just internet references! Some advice: Whatever the topic is, the likelihood of a good grade increases significantly if your paper has an explicit and solid quantitative component that utilizes some of the material we develop in the course.

4. **Grading:** Letter grade (A-E) format

Homework (15%)  
Mid-term exam (20%)  
First Writing assignment (10%)  
Team Research Project & Presentation (15%)  
Final research paper (20%)  
Final Exam (20%)  

Assignments submitted late, without a previously arranged excuse or subsequent medical (or equivalent) excuse, will incur a penalty of a 10% reduction in your grade for each such day.

The final exam is scheduled by the University for 10:30 – 12:30 on Tuesday, May 16\textsuperscript{th}, in your regular classroom.

5. **Class conduct:**

During class, especially in lecture format, I expect your behavior to be appropriate to that of a serious student. Excessive talking, distraction via cellphones (and their ringing), arriving late or leaving early, or any other inappropriate and disruptive behavior will not be tolerated.

**Course Outline:** (tentative)

1. **Error Analysis of Measurements**  
   1.1 1/24 Introduction (L#1)  
   1.2 1/26 Chapter 1: Preliminary description of error analysis (L#2)  
   1.3 1/31 Chapter 2: How to report and use uncertainties (L#3, HW#1)  
   1.4 2/2 Chapter 3: Propagation of uncertainties (L#4, HW#2)  
   1.5 2/7 Team project #1: Make measurements and report (TP#1)  
   1.6 2/14 Chapter 4: Statistical analysis of random uncertainties (L#5)  
   1.7 2/16 Chapter 5&6: The normal distribution & Rejection of data (L#6 HW#3)  
   1.8 2/21 Team Project #2 (TP#2 Data)  
   1.9 2/23 Review & HWs (Review & 1\textsuperscript{st} paper)  
   1.10 2/28 Mid-term (TA)

2. **Measurements:** (techniques, applications and hands-on activities)  
   2.1 3/2 Overview (L#8)  
   2.2 3/7 Pressure & Temperature & Humidity (L#9)  
   2.3 3/9 Team project #3 (HW#4)
2.4 3/21 Wind: Anemometry (L#10)
2.5 3/23 Precipitation measurement (L#11)
2.6 3/28 Team project #4: final research project (L#12)
2.7 3/30 Clouds & radiation (Paper #1 due, L#13)
2.8 4/4 Atmospheric sounding systems (#L14)
2.9 4/6 Team Project/Lab #4 (Radiosonde launch)
2.10 4/13 Lightning (Prof. Vince Idone, L#15)
2.11 4/18 “Eden 2.0. How farming with nature can save the planet and how science can show us how” (Prof. Gary Kleppel, Biobology, L#16)
2.12 4/20 “Water Treatment Processes” (Dr. John D. Paccione, NYS Department of Health L#17_1 & L#17_2)
2.13 4/25 Air quality (Dr. Jim Schwab, ASRC, L#18)
2.14 4/27 Mesonet site visit
2.15 5/2 Mesonet (L#19)
2.16 5/4 Team presentation (“Legion of Goofy”, “Measurement Maniacs”, “A-Squad”)
2.17 5/9 Team presentation (?, “Mouse Rat”, “Chainsaw Gang”)
2.18 5/11 Reading day (Paper #2 due)
2.19 5/16 Final exam (10:30-12:30)