

## **STUDENT LEARNING ASSESSMENT**

### **I. Program Mission Statement**

The Department of Atmospheric Sciences, part of the School of Ocean and Earth Science and Technology, conducts world-class research on climate and weather with an emphasis on the Tropics. Our educational mission is colored by that level of research; the following are goals for our students that we strive to achieve.

At the undergraduate level students must demonstrate an understanding of the guiding principles of atmospheric science and they must have the ability to apply this knowledge in the role of operations, both public and private, or to continue their training within a high caliber graduate program. The student has developed the requisite writing and oral communication skills to be successful in their chosen career.

At the graduate level the student meets or exceeds all the requirements of the undergraduate program and additionally has understanding of advanced atmospheric thermodynamic and dynamic concepts; they have the ability to apply these independently and lead others in an operational or research environment. The successful Ph.D. student would be a candidate for employment at a major research university or government research laboratory.

## II. Program Learning Objectives/Outcomes

*Undergraduate student learning outcomes:*

1. Know the horizontal and vertical variation of temperature, moisture and wind in the atmosphere.
2. Recognize the various scales of motion from turbulence to planetary scales.
3. Evaluate the accuracy and precision of standard meteorological instrumentation.
4. Apply basic atmospheric thermodynamic principles such as potential temperature, equivalent potential temperature, vapor pressure, mixing ratio and the first and second laws of thermodynamics to understand weather and climate issues.
5. Apply basic atmospheric dynamic principles including equations with partial derivatives such as the equation of motion, various approximations of that equation, conservation of a quantity and key kinematic concepts such as divergence and vorticity to understand weather and climate problems.
6. Predict the weather by diagnosing observations and interpreting guidance products.
7. Design and execute basic computer programs to determine desired variables from raw data.
8. Communicate study results and forecasts in both written and oral forms.

Table 1. undergraduate curriculum map (numbers pertain to learning outcomes)

<b>Courses</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
101	I	I	I		I	I		
101L	I	I	I	I	I	I		
200	E	E	I	E	E	I	I	
302	M	I	E	M	I	I	E	I
303	M	E	I	E	E	E	E	I
305	E	I	M&A	E	I		E	E
320	I	I	I	E	E	E	M&A	E
402	E	M	I	M&A	M&A	I	M	
405	M&A	M&A	M	E	E	M	M	M&A
406	M&A	M&A	E	E	E	M		M&A
412	M&A	E	M	M	M	M&A	M&A	M&A
416	M&A	E	M	M	M	M&A	M&A	M&A
499	M&A	M&A	M	M&A	M&A		M	M&A

Where the student would be introduced (I) to the concept, where the concept would be emphasized (E) and where the student would achieve mastery of the concept (M) appear in Table 1. While assessment of the student's understanding occurs for every course those classes that typically occur in the last year or two and require the student to integrate material from the entire program are marked (A).

Successful completion of the outcomes would result in: (1) being competitive for employment by the National Weather Service or a private corporation and (2) with appropriate grade point a competitive candidate for graduate school.

*Master's student learning outcomes:*

Meets or exceeds all the standards expected for the undergraduate student learning outcomes, plus:

1. Demonstrate expert knowledge of the weather and climate of the Tropics.
2. Apply advanced thermodynamic and dynamic concepts to understand atmospheric phenomena.
3. Create sophisticated computer programs and/or utilize those available on the web.
4. Work independently with an observational dataset or numerical simulation.
5. Demonstrate oral presentation skills in seminars, classes and defense situations.
6. Write clear, concise reports and/or thesis.

Table 2 that immediately follows shows which courses address the six learning outcomes identified in the M.S. program.

Table 2. graduate curriculum map (numbers pertain to learning outcomes)

<b>Courses</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
600	I	M&A	I			
601	E	M&A	E			
606	E	M&A		I	M&A	M
607	E	M&A		I	M&A	M
610	M&A	M		I	M&A	E
611	E	M	M	E	M&A	M&A
614	M&A	M&A	E	E	M&A	M
616	M&A	M	E	E	M&A	
620	I	M&A	M	E	M&A	M
628	E	M	M	E	M	M&A
631	E	E	M&A	E	M	E
632	E	E	M&A	M	M	E
665	I	E	M	M&A		
666	M	M	E	M&A		
702	M&A	M&A	E	E	M	
704	M&A	M&A	E	E	M	
706	M&A	M&A	E	E	M	
752	I	M	M			
765	I	I			M&A	E
700			M&A	M&A	M&A	M&A
800			M&A	M&A	M&A	M&A

Successful completion of the outcomes would result in the individual being: (1) highly competitive for employment by the National Weather Service or a private corporation beyond typical entry level and (2) potential candidacy to a Ph.D. program.

*Doctoral student learning outcomes:*

Meets all the standards expected for a Master's student learning outcomes, plus:

1. Design and execute a path of study resulting in the publication of original work that contributes to a sub-discipline in the atmospheric sciences.
2. Explain fundamental concepts to both undergraduate and graduate students.
3. Write clear, concise reports and a dissertation.
4. Become a viable candidate for employment at major operational centers, research laboratories and universities world-wide.

Classes for a doctoral student are no different from those pursuing an M.S. degree. The chief differentiation would be with the student completing the comprehensive exam, the presentation of a prospectus, and the defense of a dissertation. The dissertation must be original and of a quality to be published in a high quality refereed journal.

### **III. Learning Opportunities (where does the learning take place)**

Obviously this primarily occurs in the prescribed classes that constitute the major. The basic science skills are first developed when the student completes the requisite calculus, physics and chemistry classes. Within the program there are classes that are writing and/or oral intensive. There are classes in the program that emphasize writing skills (e.g., ATMO 405, ATMO 406, ATMO 412 and ATMO416) and there are those that are also rated as oral intensive (ATMO 412 and ATMO 416). Opportunities exist for even more extensive writing development in the form of the undergraduate thesis. An internship is possible for those interested in a broadcasting career. Internships are also possible with the National Weather Service that is collocated with us at Manoa. The undergraduate degree program is designed to accommodate a wide range of career paths, but the core set of classes meets the goals of the student learning outcomes.

### **IV. Assessment Process – how well are the students meeting the desired learning outcomes?**

The Department of Atmospheric Sciences is just embarking on assessing how well students are achieving the desired learning outcomes. Discussions among the faculty have resulted in course modifications so that the pyramid of steps toward any particular degree is more uniform. Issues with a topic in a given course are noted especially when the best students are struggling with a concept. This remains within the purview of the professor teaching that class. The faculty has not addressed such issues as a group as yet. The Department has polled the students and identified gaps with a particular program. These issues have resulted in the following changes over the last year or two:

ATMO 200 has become far less like ATMO 101 and much more like ATMO 302 with a greater use of derivatives and equations.

ATMO 406 has become a writing intensive course with a newly developed set of extensive notes.

ATMO 412 and 416: forecasting skill has been made more challenging. This class is now both writing and oral intensive.

New courses have been developed:

ATMO 320: The application of computer resources , in particular MATLAB for the undergraduates.

ATMO 495: Internship at a local TV station for those interested in broadcast meteorology.

ATMO 628: Radar theory and application to atmospheric phenomena.

ATMO 611: Applied Satellite Techniques. Students will work with large datasets and examine these with programs available on line.

ATMO 708: El Nino –Southern Oscillation: theory, observations and modelling.

At present the faculty does not view occasional undergraduate student failure as necessarily a problem with the program itself. A portion of the undergraduates who attempt to major in Atmospheric Sciences simply do not have the ability to compete at the level which the program demands. The faculty views this as weeding out the weaker students who would not be a credit to themselves or our program.

At the graduate level it is rare that a student gets into academic trouble with the courses. What is a more common issue is at the Master's level students either decide that Atmospheric Sciences is not what they wish to do for their career or they cannot work independently on their thesis. This is often a problem with the lack of writing skills developed during their undergraduate degree. We do see graduate students taking too much time to achieve their desired degree. Here the Chair has communicated this with the graduate students at large. In some cases the advisor has simply been too lax in monitoring their progress, in others the advisor is not allowing the student enough time to pursue his own work (rare), and more often than not the benefits of a research assistantship make the student feel little financial pressure to complete the degree in a timely way. The Chair and Graduate Chair are now applying more pressure on those slow-progressing students and enforcing the timing rules for the comprehensive and prospectus exams.

Perhaps the best evidence that the program is meeting its goals is the fate of the students who have completed their degree. Given our modest graduation rates at all levels we view this number of students working in the field as strong evidence that the program is achieving its goals. The list of students and their career choices is incomplete; however the initial estimates show a success rate of nearly 80% (percentage of students working in the field). Note that few of the students have simply chosen another career path; they didn't necessarily fail at achieving a position in the field of atmospheric sciences.

The following students are now employed by the National Weather Service:

Raymond Tanabe (Interim Regional Director)  
Andrew Nash (Meteorologist –in-Charge (MIC))  
Wes Browning (MIC)  
Kevin Kodama (Chief Hydrologist)  
Scott Spratt (Scientific Operations Officer)  
Derek Wroe (lead forecaster (LF))  
Ian Morrison (LF)  
Sean Daida (LF)  
Chris Mello (LF)  
Ryan Ellis (forecaster (F))  
Anthony Reynes- Figueroa (F)  
Paul Fuentes (F)  
Brook Bingaman (F)  
Trina Loos (F)  
Cynthia Palmer (F)  
Cindy Dettmer (F)  
Genki Kino (F)  
Dale Unruh (F)  
Robert B (F)  
Eric Lau (regional headquarters)  
Andrew Levine (analyst at TPC)  
Steve Caruso (TPC)  
Leigh Ann Eaton (newly hired (NH))  
Carl Barnes (NH)  
Rebecca Schneider (Canadian Weather Service)  
Sandra Richard (Malaysian Weather Service)

## 2. Students in a research or university faculty position

Tim Li  
Qinghua Ding  
JJ Wang  
Xiaqiong Zhou  
Bing Fu  
Klaus Dolling  
Jessica Schauer  
Chunhua Zhou

Patrick Goda  
Seon Kim  
Xin An Chen  
Ryan Lyman  
Shirley Murillo  
Hideki Okajima  
Sam Chen  
Bunmei Taguchi  
Chris Chambers  
Yongxin Zhang  
Xuyang Ge  
Zhibian Varner

3. Students who went on to graduate school:

Mark Croxford  
Manuel Lonfat  
Thomas Winning  
Doug Stolz  
Aaron Levine  
Matthew Sitkowski  
Kristine Tofte  
Chris Holloway  
Andrew Frambach  
Ahira Sanchez-Lugo  
Michael Murphy  
Alejandro Ludert  
Dayal Kavina  
David Hitzl

4. Students in private business related to the atmospheric sciences

Owen Tytell  
Andrew Desnoyers  
Mark Geldmeier  
Duncan Gifford  
Kelly Simek  
Antti Pessi  
Shannon McElhinney  
Tom Dunn

5. Students teaching at the high school level

Mark Croxford  
Sara DaSilva

6. students in the military



Cecilia Grindinger (captain)  
Jason Patla (colonel)

7. unknown or not working in the atmospheric sciences

Kirt Squires  
Paul Bogner  
Peng Wu  
I. Jayawardena  
Hiep Van Nguyen  
Beth Tu  
Jian Ma  
Jessica Garza  
Ying Ruan Chen  
Hiroyuki Ito  
Julie Kelly  
Chase Norton  
John Kealy  
Jia Hu  
Nathaniel Smith  
Kathleen Scanlon  
Kathryn Whitmire  
Justin Ventham  
Jeff Drohblav  
Marie Rakotondrafara  
Steve Owens