Department of Atmospheric and Oceanic Sciences – Spring 2006
Assessment of Student Learning in the Undergraduate Program

Overview of program

The undergraduate major in the Department of Atmospheric and Oceanic Sciences continues to produce graduates with the necessary skills to make meaningful contributions to research in the atmospheric, oceanic, and related sciences and effectively communicate results of analysis and diagnosis of atmospheric and oceanic problems to the scientific community as well as broader audiences. In the last four years, the major has annually served an average of 44 majors (Table 1). A review of the number of our declared majors over a longer period suggests increasing enrollment in the major. Over the last five years, the number of graduates from our program as averaged about 19 (Table 2), with a slight decrease in the number of graduates in the last couple of years. Of those graduating, an increasing number have chosen a path to post-graduate education either at UW – Madison, or at a number of other top-tier graduate atmospheric and oceanic programs across the country. In addition students have chosen employment in areas related to their degree including those that choose to serve as weather officers in the United States Air Force.

In our 1996 assessment plan, we identified a number of basic skills and knowledge goals for our students. The basic skills students are acquiring are in the interpretation of geophysical data, in use of computers to facilitate those interpretations, the effective communication of science issues, and the development of mathematical tools to analyze the fundamental equations governing geophysical fluids. The basic knowledge goals involve the development of a knowledge base with a foundation in the dynamics and thermodynamics of geophysical flow, knowledge of radiative transfer, and the dynamics of various oceanic and atmospheric circulation systems ranging from hundreds of meters to several thousand kilometers. Much of the foundational knowledge and skills are developed in the junior core classes.

Following the submission of the assessment plan for our undergraduate program in December 1996, the Department of Atmospheric and Oceanic Sciences (AOS) undertook a complete overhaul of the undergraduate core curriculum. We replaced the required sequence of three AOS core undergraduate courses: 321 (5 credits), 322 (5 credits), and 323 (3 credits), taken over three semesters, with a set of 4 core classes (AOS 310; 3 credits, AOS 330; 3 credits, AOS 311; 3 credits, AOS 340; 2 credits) in addition to one senior year elective (AOS 425; 3 credits). The department also created AOS 405 (Capstone Seminar) that was to be used in our subsequent assessment activities. These changes have been in place since fall 1997. Additionally, in order that our graduates possessed the required instrumentation skills for possible employment in the National Weather Service, in fall 2001 we developed a new course AOS 444 (Radar Meteorology). This course has since been combined with an exiting satellite meteorology course and is now listed as AOS 441 Satellite and Radar Meteorology.

In the AOS undergraduate career and education guide, four elective groupings (tracks) are identified: Weather Systems, Earth and Environmental Sciences, General AOS, and Applied Meteorology (air quality, measurements, and other applications). (These elective groupings are only suggested course sequences for students, not formal tracks that are identified on their degrees.) Most students (greater than 90%) elect to take the Weather Systems track. While this track has historically been a popular route for many undergraduate majors, an increasing number of students are taking courses outside of this track including AOS 535 (Atmospheric Dispersion and Air Pollution), AOS 660 (Physical Oceanography), and AOS 773 (Boundary Layer Meteorology). AOS 425 (Global Climate Processes) has also become a popular class as many students are considering climate research as a possible direction for graduate research.

The AOS Department maintains a state-of-the-art computer classroom which provides students with access to a wealth of *realtime* global atmospheric and oceanic data as well as robust software to interrogate that data. The department remains committed to ensuring that our facilities remain at the leading edge and that students are well trained in using these resources.

Evaluation of current assessment activities

The AOS departmental assessment plan calls for the use of exit questionnaires and periodic post-graduation questionnaires, as well as employment surveys for all degree recipients. Additionally, undergraduates are required to participate in a capstone course (AOS 405). To date, these assessment activities have been quite limited, and the results unsatisfactory. The only ongoing assessment activity that we have in place is an exit survey for graduating seniors (sent via email) in which we track their post-graduation plans (either employment or graduate school). This data was used to construct Table 2. Because we do not have a 100% response rate to this survey, it is a challenge to to determine what many of our students are doing 6 months to a year after graduating. An informal measure of the quality of our undergraduate program comes from solicited and unsolicited comments from our colleagues at peer institutions where our graduates are now graduate students. We find that most, if not all, of our former students are doing well in these programs, and our colleagues at these institutions are eager to get more students from our program.

While the capstone seminar (AOS 405) has not yet served as an assessment tool for our program, it does serve as a final opportunity for students to strengthen further their written and oral communication skills as well as gain a greater appreciation for the breadth of our field (the second of our “general goals”). Under the leadership of our new faculty, an additional component of the course has been the inclusion of UW writing fellows working with the students to improve drafts their research papers. The students find these interactions helpful and the quality of their scientific writing has improved.

Plans for future assessment activities

In light of the limited nature of our assessment activities, the AOS Department, over the next year, will be developing a new set of tools to assess the effectiveness of our program. Below is a brief description of our planned future activities:

1. Development of a standard method for conducting a semi-annual census of our undergraduate majors, by year. This will include our undeclared majors, usually students in the junior core who have not formally declared their major because one or more requirements have not yet been completed.
2. An end of semester student survey in which students evaluate the *whole of their coursework* from the end of first semester junior year to the end of the semester in which they are currently enrolled. This survey will differ from instructor evaluations as students will have been given our department's goals and objective for their learning at the beginning of their junior year and will, on a regular basis, asked to evaluate how each set of courses they take, matches with the established goals. We expect to find students' opinions changing over time as they begin to see the entirety of our program. We'll also ask our graduates to address the same questions two and five years from graduation. The results of these post-graduation surveys will allow us to assess the relevance of our program to the training of our graduates for employment and graduate school.
3. In support of activity two, we also plan to establish informal "career and science nights" – a semester long sequence of evening meetings in which faculty and guest speakers within the atmospheric, oceanic, and related sciences discuss their own career paths, their education and training, and their own current work and research. These "career and science nights" are intended to help students, particularly those in the junior year, to develop a broad perspective on the range of career possibilities for which their undergraduate core classes are preparing them.
4. The Chair for Undergraduate Affairs (CUA) will be the leader of this assessment effort. The CUA will develop and modidy the various questionnaires, collect and process the responses each semester, and make a report to the Department Chair. This report will be considered at a full faculty meeting and entered into the minutes. The CUA will, at his/her discretion, appoint a faculty subcommittee to assist in the development and implementation of any additional activities or programs that are called for by the faculty in light the results of each assessment report.

Updates to the 1996 assessment plan:

a) General goals:
It is our desire that students graduating from our program attain a level of general knowledge **that prepares them to make contributions to the atmospheric and oceanic sciences in terms of research and** allows their effective communication concerning a number of issues in the atmospheric/earth systems/oceanic sciences. This general knowledge is to be accompanied by a more specific knowledge in an identifiable subset of the atmospheric/earth systems/oceanic sciences.

b) Basic skills goals:
Acquisition of mathematic skills and techniques useful in analyzing fundamental governing equations of geophysical fluid flows.

Knowledge of the Earth’s climate system and the mechanisms which govern its dynamics.

Table 1: Junior and Senior majors

Spring 2003	42
Spring 2004	41
Spring 2005	51
Spring 2006	48

Table 2: Number of graduates over the last 5 years and their career paths

Period	# of graduates	grad.school	degree related employment
Sept. 2000- Aug. 2001	18	4	4
Sept. 2001- Aug. 2002	20	7	2 + 1 (U.S. Air Force)
Sept. 2002- Aug. 2003	23	3	1 + 2 (U.S. Air Force)
Sept. 2003- Aug. 2004	16	4	
Sept. 2004- Aug. 2005	18	9	2 + 1 (U.S. Air Force)

Department of Atmospheric and Oceanic Sciences – Spring 2006
Assessment of Student Learning in the Graduate Program

Overview of program

The graduate program in the Department of Atmospheric and Oceanic Sciences provides students with advanced theoretical training as well as practical research and communication skills related to atmospheric and oceanic physics and dynamics, climate and climate change, and operational and research monitoring of the atmospheric and oceanic environment.

We offer three degree options: (1) non-thesis M.S., (2) thesis M.S., and (3) Ph.D. The non-thesis M.S. option is used only rarely, usually by students without financial support in the form of a research assistantship. In recent years, we have conferred an average of 10 M.S. degrees and 5 Ph.Ds annually.

Learning objectives

Much of what our graduates learn is specific to their disciplinary focus. That knowledge is gained through a combination of elective coursework, immersion in the published literature, and hands-on research under the supervision of a faculty advisor.

Regardless of disciplinary specialty, there is a foundation of "core" knowledge and skills that we expect *all* of our students to acquire as part of their education and scholarly development. These include familiarity with the theory, terminology, and mathematics relevant to

- the fundamental physical properties and thermodynamics of air, phase changes of water, basic cloud and precipitation physics.
- the fundamentals of geophysical fluid dynamics, from the basic governing equations to real-world manifestations of those equations in the atmosphere and ocean.
- the role of electromagnetic radiation in (a) the energy budget of the atmosphere, (b) the remote sensing of atmospheric properties and variables, and (c) photochemical processes.
- the physics, fluid dynamics and observed circulations of the ocean as these relate to global and regional climate.
- the structure and evolution of weather systems on scales ranging from thunderstorms to synoptic-scale cyclones and planetary waves.

In addition to the above topics which are specific to atmospheric and oceanic science, we expect our students to leave our program with the following more generic skills and experience

- Substantial facility with the use of computers to undertake scientific computations, analyze data, and visually display key results.

- The ability to effectively communicate scientific ideas and results orally and in writing.

We have additional objectives specifically for our Ph.D. students. These include

- The ability to identify key problems in their area of specialty, formulate a research plan, and successfully execute the research with limited direct supervision.

Ongoing Assessment Activities

The vast majority of assessment of student learning at the graduate level currently takes place in the following contexts:

- Formal coursework
- Participation in research seminars
- Qualifying examination (Ph.D. students only)
- Preliminary examination (Ph.D. only)
- Annual Ph.D. Advisory Committee meetings
- Thesis or dissertation review by faculty advisor, by Reading Committee (M.S. students), and/or by Advisory Committee (Ph.D students).
- Final oral defense (Ph.D. students)

We believe that all of the above are highly effective and appropriate tools for assessing learning in our graduate students, especially in view of the favorable ratio of faculty to students in this department and, consequently, the ease with which the faculty get to know the students and their scholarly development individually.

In addition, we make an effort to track the subsequent employment of our students, especially our Ph.D. students. Their ability to compete for faculty positions and research positions at prestigious labs is perhaps the best indicator of the preparation they received from our program.

Notwithstanding the value of the above routine activities, we recognize the need for additional focused assessment activities designed to answer specific questions about the effectiveness of various elements of our program. In particular, we have previously included in our Assessment Plan the intent to initiate exit interviews for our graduating students. The purpose would be to learn where the students perceive strengths and weaknesses in our curriculum, advising, etc.

Regrettably, good intentions have not yet translated into action. Presumably due to a lack of clear lines of responsibility for overseeing specific new activities, they simply have not occurred on the promised schedule.

Next steps

In order to overcome the inevitable inertia that can result when already-busy faculty are asked to take on new responsibilities, it is essential that specific individuals be given formal responsibility for

- formulating assessment projects having clear, well-defined objectives and manageable scope;
- reporting progress on specific milestones to the Chair and Administrative Assistant according to a previously agreed-upon timeline.

The immediate next step, therefore, will be to establish a permanent Assessment Committee consisting of two to three faculty who will be charged with fulfilling the above responsibilities for the Graduate Program. The Graduate Program Chair will serve as Chair of this committee. The committee may or may not overlap any committee designated to assess learning in the Undergraduate program. If it does, the Undergraduate Program Chair may serve as the second member.

The AOS Chair shall be responsible for ensuring that the above committee has been established by the end of the Spring semester, 2006. He will charge them with formulating, and reporting to the faculty by early Fall 2006, the plans for a specific, narrowly focused assessment project. The proposed plan should have a specific start date and end date, and the Assessment Committee should expect to be ready with a new assessment project when the previous one has run its course and appropriate conclusions drawn.

As a proposed first assessment project, we are considering development and implementation of an exit interview/questionnaire (modeled on a previously designed such document) for our graduates. The Graduate Chair will administer this questionnaire in Spring 2007, compile and analyze the results in time to prepare a report for the Executive Committee by early Fall 2007. At that time adjustments and extensions to this preliminary assessment instrument will be made as warranted.