BOARD OF REGENTS

SUMMARY OF ITEM FOR ACTION,
INFORMATION OR DISCUSSION

TOPIC: University of Maryland, College Park: Bachelor of Science in Atmospheric and Oceanic Science

COMMITTEE: Education Policy

DATE OF COMMITTEE MEETING: June 1, 2011

SUMMARY: The rapid development of atmospheric and oceanic science; the increased recognition of the magnitude of human impacts on the atmosphere and ocean; the University's location in the Washington DC area and its position as a leader in environmental research; the need to fill associated local job opportunities; and the availability of a world class faculty are among the reasons for the development of the proposed program. A survey of the Maryland Academic Program Inventory indicates that this would be the only program of its kind in the State.

The proposed program builds on strong basic training in mathematics, physics, chemistry, and computer science introduced in the first two years. In the final two years majors will receive basic training in the physics and dynamics of the atmosphere and ocean as well as related topics such as air chemistry, physical oceanography, and remote sensing. The program exploits the University's location within the Washington area research community to provide guided research opportunities/internships during the senior year. Additionally, majors will be encouraged to attend climate briefings held regularly in the US Senate, the National Academy of Sciences, the Carnegie Institution, the American Geophysical Union, and the American Association of Arts and Sciences.

The proposed program seeks to educate majors in the basic principles that control our weather, ocean circulation, and the interactions between atmosphere and ocean that regulate the Earth's climate, building on a sound foundation in mathematics, physics, chemistry, and computer science. Students will be provided with practical experience as researchers and creators of knowledge and will be prepared to enter a wide range of careers in atmospheric and oceanic science, in fields as diverse as education, media, research, prediction, or environmental impacts and mitigation, offered by an equally diverse array of public and private nonprofit/for-profit organizations. Graduates may easily satisfy the General Services Administration requirements for certification as 'meteorologist' and 'oceanographer' or acquire appropriate additional coursework for certification to teach earth system science at the secondary level.

ALTERNATIVE(S): The Regents may not approve the program or may request further information.

FISCAL IMPACT: No additional funding is necessary. The program will be supported through reallocated funds.

CHANCELLOR'S RECOMMENDATION: That the Committee on Education Policy recommend that the Board of Regents approve the proposal from the University of Maryland, College Park to offer the Bachelor of Science in Atmospheric and Oceanic Science.

COMMITTEE RECOMMENDATION: DATE:

BOARD ACTION: DATE:

SUBMITTED BY: Irwin Goldstein (301) 445-1992 irv@usmd.edu

I. Mission

This is a proposal to create a new Bachelor of Science program at the University of Maryland in Atmospheric and Oceanic Science (AOSC). The program seeks to educate majors in the basic principles that control our weather, ocean circulation, and the interactions between atmosphere and ocean that regulate the Earth's climate, building on a sound foundation in mathematics, physics, chemistry, and computer science. Students will be provided with practical experience as researchers and creators of knowledge, and will prepared to enter a wide range of careers in atmospheric and oceanic science, in fields as diverse as education, media, research, prediction, or environmental impacts and mitigation, offered by an equally diverse array of public and private nonprofit/for-profit organizations.

Motivation to develop this new undergraduate major includes the rapid development of atmospheric and oceanic science; the increased recognition of the magnitude of human impacts on the atmosphere and ocean; our location in the Washington DC area, a world leader in environmental research; the need to fill associated local job opportunities; and the availability of a world class faculty at UM. Examination of the Maryland Higher Education Commission website[1] reveals that the State currently has no undergraduate degree programs with 'meteorology', 'atmospheric', 'ocean', 'oceanography', or 'climate' in their titles. By providing an opportunity for Maryland students to pursue interests in meteorology, physical oceanography, and global climate without leaving the State this proposal addresses the Mission of UM to remain the institution of choice for Maryland's undergraduates of exceptional ability and promise. By creating a new integrative science major this proposal will address our mission to provide challenging academic curricula in STEM disciplines. The proposal will leverage the tremendous resources of the Washington DC area to provide research opportunities for all the AOSC majors, thus answering the UM Strategic Plan's call to increase the number of academically-based internship and fellowship opportunities that leverage our geographical advantage in the Baltimore-Washington region.

II. Characteristics of the Proposed Program

a. Educational Objectives

The program builds on strong basic training in mathematics, physics, chemistry, and computer science introduced in the first two years. In the final two years majors will receive basic training in the physics and dynamics of the atmosphere and ocean as well as related topics such as air chemistry, physical oceanography, and remote sensing. The program exploits our location within the huge Washington area research community to provide guided research opportunities/internships during the senior year as well as individual faculty advising for all Department majors (consistent with the goals of the *Strategic Plan*). Majors will be encouraged to attend climate briefings held regularly in the US Senate, the National Academy of Sciences, the Carnegie Institution, the American Geophysical Union, and the American Association of Arts and Sciences downtown, and in other ways explore the numerous resources available in the Washington area. Graduates may easily satisfy the General Services Administration requirements for certification as 'meteorologist' and 'oceanographer' or acquire appropriate additional background certification to teach earth system science at the high school level.

b. Catalog Description

Fundamental concepts from mathematics, chemistry, physics, and computer science are applied to understand the basic principles that control our weather and climate, from extreme events like tornadoes to the millennial changes of ice ages and the results of human modification of our environment.

[1] www.mhec.state.md.us/utilities/search_major.asp (7-13-2010)

Coursework in the first two years emphasizes mastery of these fundamentals. Coursework in the last two years provides a comprehensive survey of atmospheric and oceanic science, while specialty courses and guided research allow the student to develop expertise in an area of concentration. The Department has particular strengths in computer modeling and remote sensing of the atmosphere and ocean, atmospheric chemistry, and climate studies. In addition to the Department, nearby research laboratories such as the National Oceanic and Atmospheric Association (NOAA) National Centers for Environmental Prediction and NASA Goddard Space Flight Center offer the student many research opportunities.

c. General Requirements for Degree

In addition to fulfilling the General Education requirements as well as the 120 credit requirement students must:

- Complete the background requirements in mathematics, physics, chemistry, and computer science.
- Complete the AOSC department required and elective courses. Students must achieve a grade of C or higher in all courses applied to the major.
- Complete the senior research requirement, including presentation of results.

AOSC Honors

Each year, the AOSC Honors Program Committee will review the academic records of AOSC majors. Students with a minimum 3.00 overall GPA and a minimum 3.30 major GPA will be added to the AOSC Honors List. For students on the AOSC Honors list certain graduate courses are open. To receive a citation of "with honors in atmospheric and oceanic science" the student must:

- Have earned a 3.00 or higher overall GPA and a 3.30 or higher GPA for all AOSC major required courses at graduation time
- Pass two approved AOSC graduate level classes
- Pass an Honors Oral Examination in his or her senior year.

To receive a citation of "with *high* honors in atmospheric and oceanic science", s/he must complete the requirements for honors and receive a high pass for the thesis.

d. Total Number of Credits and Their Distribution

A student must complete 120 credits in order to graduate from the University with a BS degree. Of these the University requires students to take 40-46 credits of General Education/CORE courses[2]. The AOSC Department major requires that the students take either 69 or 70 credits. Under special circumstances such as transfer from another program, a waiver may be requested and approved by the Director of Undergraduate Studies. However, we believe that the major requirements will satisfy 25 of the General Education/CORE requirements leaving a minimum of 120 – (69+46-25) = 30 credits available for electives.

1) Required Courses Provided by AOSC: 17 credits
2) Required Additional Courses Provided by AOSC: 12 credits
3) Required Computer/Computational Course: 4 credits
4) Required Courses Provided by Mathematics and Chemistry: 12 credits
5) Additional Required Mathematics Courses: 6-7 credits

[2] http://www.ugst.umd.edu/GenEdChart.pdf. General Ed requirements we believe will be satisfied: Math (3), Analytic Reasoning (3), I-Series (3), Natural Sciences (7), Scholarship in Practice (3), and Experiential Learning (3).

6) Required Physics Courses: 12 credits
7) Required Elective Courses: 6 credits
Total accumulated credits: 69-70

f. Expected Student Learning Outcomes

(Assessment Schedule has been summarized to save space. The full requirements are appended.)

Student Learning Outcomes	Assessment Measures and Criteria
1. Students will demonstrate competence in the design and execution of research in AOSC	Measure: AOSC 493-and AOSC498 *Senior Research Project* I,II forms a two-semester required senior project
2. Students will demonstrate a competence in the standard media of professional communications in AOSC	Measure: Work for the senior research project includes a final oral presentation, using appropriate audio-visual aids. The final presentation for AOSC 489 consists of a poster and research paper.
3. Students will demonstrate competent knowledge of a broad cross-section of AOSC subject material.	Measure: The "General subject knowledge" component of senior research project will assess the student's command of general Atmospheric and Oceanic Science.

g. Demonstrable Quality of Program Faculty

The 13 academic faculty of AOSC (11 FTEs because of split appointments) include three honorary Fellows of the American Geophysical Union, three honorary Fellows of the AAAS, five honorary Fellows of the American Meteorological Society, a Distinguished University Professor, and a member of the National Academy of Engineering. A second member of the NAE heads a distinguished set of 16 research faculty. The academic and research faculty have received a broad array of awards including the Charney and Meisinger Awards of the American Meteorological Society and the International Meteorological Organization Prize, the top award of the World Meteorological Organization. Faculty members hold leadership positions in a variety of national and international scientific organizations, including Chairmanship of the Joint Scientific Committee of the World Climate Research Program. One measure of the impact of Department research is the number of citations garnered by Department publications. AOSC faculty have produced many highly cited papers including the most highly cited paper in earth science (Kalnay et al., 1996). Recently the National Research Council ranked AOSC sixth in the country relative to the combined group of all graduate programs in meteorology, atmospheric, and oceanic sciences.

h. Student Audience to be Served and Enrollment Estimates

One possible career direction is teaching earth science at the high school level (requiring additional coursework in education), for which there is strong demand. A second would lead to a major which fulfills the Federal GSA requirements for the positions of ‘meteorologist’ and ‘oceanographer’ and is suitable for students interested in working as practicing professionals in these areas. An online career guide maintained by the American Meteorological Society (www.ametsoc.org/atmoscareers/) lists a wide variety of professional opportunities: video, audio, and print media, non-media weather forecasting

(public, military, private, and aviation), specialized environmental services (e.g. air quality, water pollution), marketing and sales, and measurements and instrumentation. For many such occupations the career advancement of the student will be strongly enhanced with graduate training either in atmospheric and oceanic science or in a complimentary field (e.g. computer engineering, law, etc.). National job placement statistics for the year 2008 are available from the Federal Bureau of Labor Statistics. The BLS estimates the total employment of atmospheric scientists in 2008 to have been 9,400 and they project an above-average job growth of 15% over the next decade. The Wall Street Journal (4 January, 2011) lists 'meteorologist' among the top ten jobs for 2011 based on estimated income, demand, job stress, etc. A more cautious picture of the job market for undergraduate meteorologists and oceanographers was put forward by Professor John Knox, University of Georgia, at a national meeting of Department Chairs in 2008[3]. In that presentation Knox emphasizes that graduates face an increasingly competitive environment in which a strong grounding in basic mathematics, physics, and chemistry as well as internships and research experience are crucial.

To estimate the expected size of the program we examined the other programs in the mid-Atlantic region. Here at UM the Meteorology Physics track within Physics typically enrolls less than 5 majors per year, we do not believe that it exploits the potential demand for an undergraduate AOSC degree (it will disappear, we understand, when the new major is approved). The Department of Meteorology at Penn State University has 300 students, the Department of Environmental Sciences meteorology program at Rutgers University has 60 students, the Marine, Earth and Atmospheric Sciences Department Meteorology Program at North Carolina State University has 50 students, while the Department of Earth Sciences Meteorology Program at Millersville University has 130 students. One of our aspirational peers, the University of Illinois, created an undergraduate major in 2007 that is now flourishing. Further away, but perhaps most analogous to our situation, the University of Oklahoma's Department of Meteorology, located adjacent to NOAA's Severe Storms Lab, has 320 undergraduate majors. Based on these examples and considering our locational advantage, we estimate that within a few years the number of undergraduate majors will be 60+, and expect an initial enrollment of approximately 15 (the impact of numbers of majors on resource requirements is discussed below).

i. Impact on Student's Technology Fluency

Students graduating from this program will have a strong background in science/technology including computational science and instrumentation.

j. Library Requirements

The impact on library facilities will be limited to a fairly limited handful of textbooks since this program represents an extension of the current graduate program.

k. Facilities and Equipment

AOSC will provide 2 FTE for program (with an additional 1/2-time position coming in the form of the Associate Director for Undergraduate Studies) and course development, and approximately 2000 ft^2 lab space for the instructional lab. The Computer Lab is already developed and maintained as part of our non-degree undergraduate instruction. Administration of the undergraduate student files will be handled in parallel with the AOSC graduate student files by the AOSC graduate secretary.

[3] http://www.ucar.edu/governance/meetings/oct08/followup/head_and_chairs/john_knox.pdf

III. Finance

As indicated above, a guiding principle in designing the program is to minimize our requirements for additional resources, while still ensuring a high quality educational experience for the student majors. As a result, the new undergraduate program leverages off the current graduate program and undergraduate course offerings and is financed largely through reallocation within the department and the college. Details regarding the reallocation of resources are provided following the financial tables below. The overall impact will be to expand educational opportunities for undergraduate students in the areas of atmospheric and oceanic science, and to open up new opportunities for graduate students to get exposure to undergraduate education. The impact on existing programs will be a slight increase in demand for seats in introductory courses in, e.g. mathematics, physics, chemistry, and computer science.

TABLE 1: RESOURCES					
Resources Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1.Reallocated Funds[1]	504,498	552,598	552,598	597,057	621,787
2. Tuition/Fee Revenue[2] (c+g below)	n/a	n/a	n/a	n/a	n/a
a. #F.T Students	15	25	40	50	60
b. Annual Tuition/Fee Rate (assumes 70% instate, 30% out-of-state, 3% tuition increase each year)					
c. Annual Full Time Revenue (a x b) Note: a=((add current yr students + previous yr students X b.) * 70% for amt of AOSC classes)					
d. # Part Time Students					
e. Credit Hour Rate (same assumptions as in b.)					
f. Annual Credit Hours					
g. Total Part Time Revenue (d x e x f) (@ 70& AOSC classes)					
3. Grants, Contracts, & Other External Sources[3]	0	0	0	0	0
4. Other Sources	0	0	0	0	0
TOTAL (Add 1 - 4)	504,498	552,598	552,598	597,057	621,787

TABLE 2: EXPENDITURES					
Expenditure Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1. Total Faculty Expenses (b + c below)	366,600	366,600	366,600	366,600	366,600
a. # FTE	2	2	2	2	2
b. Total Salary	282,000	282,000	282,000	282,000	282,000
c. Total Benefits	84,600	84,600	84,600	84,600	84,600
2. Total Assoc. Director of UG expenses (b + c below)	6,500	54,600	54,600	54,600	54,600
a. # FTE	0.5	0.5	0.5	0.5	0.5
b. Total Salary	5,000	42,000	42,000	42,000	42,000
c. Total Benefits	1,500	12,600	12,600	12,600	12,600
3. Total Administrative Staff expenses (b + c below)	27,479	27,479	27,479	27,479	27,479
a. # FTE	0.5	0.5	0.5	0.5	0.5
b. Total Salary	21,138	21,138	21,138	21,138	21,138
c. Total Benefits	6,341	6,341	6,341	6,341	6,341
4. Total Teaching Assistants expenses (b + c below)	98,918	98,918	98,918	148,378	173,107
a. # FTE	4	4	4	6	7
b. Total Salary	77,280	77,280	77,280	115,920	135,240
c. Total Benefits	21,638	21,638	21,638	32,458	37,867
5. Equipment	0	0	0	0	0
6. Library	0	0	0	0	0
7. New or Renovated Space	5,000	5,000	5,000	0	0
8. Other Expenses	0	0	0	0	0
TOTAL (Add 1 - 8)	504,498	552,598	552,598	597,057	621,787

Budget Narrative: notes

Resources

1. The origin of the reallocated funds is primarily reassigned Instructional Tenure Faculty, taking into account two new hires. Additional reallocated funds come from the assumption of redistribution of funds associated with one faculty retirement and restructuring of the duties of an office staff member to include the role of undergraduate secretary. Reduction in teaching at the graduate level will result in several low enrollment graduate courses being taught, e.g., every other year instead of every year, which we do not expect to significantly impact graduate student progress. The impact on the existing graduate program will be positive in net due to the expansion of teaching opportunities for AOSC graduate students.

2. Tuition/fee revenue is not included in the budget. We estimate a steady state enrollment of 60 majors, with a starting enrollment of about 15 students. While we expect that some students will migrate into the program from similar majors on campus, we also expect that many will be students who might not otherwise attend UM. Overall, the program is small enough that we do not, at this time, anticipate it to grow the overall enrollment at the university and thus do not include new tuition revenue as part of the available resources.

Expenditures

1-3. Faculty expenses are estimated based on an average faculty salary for the equivalent of two faculty dedicated to the major. Additional expenses include funds to support an Associate Director of the Undergraduate Program (with reduced duties in the first year) and administrative staff support.

4. Support is included for Teaching Assistants, the need for whom will grow as the program expands.

5. The department currently supports a computer laboratory. No additional equipment is budgeted for the undergraduate program.

6. No expansion of library resources is anticipated.

7. $5,000 is allocated for each of the first three years for renovation of space to allow for student space.

Appendix A: List of required courses

In order to meet the requirements of the AOSC major, students must achieve a grade of C or higher in all courses applied to the major.

1) Required Courses Provided by AOSC

AOSC course at the 200 level		3 credits
AOSC 201	Weather and Climate Laboratory	1 credit
AOSC 431	Atmospheric Thermodynamics	3 credits
AOSC 432	Dynamics of the Atmosphere and Oceans I	3 credits
AOSC 494	Seminar	1 credit
AOSC 493	Senior Research Project I	3 credits
AOSC 498	Senior Research Project II	3credits

Accumulated total credits **17**

2) Required Additional Courses Provided by AOSC

12 credits at the 400 level chosen from among:

AOSC 400	Physical Meteorology of the Atmosphere	3 credits
AOSC 401	Climate and Earth System Science	3 credits
AOSC 424	Remote sensing	3 credits
AOSC 433	Dynamics of the Atmosphere and Oceans II	3 credits
AOSC 434	Air Pollution	3 credits
AOSC 470	Synoptic Meteorology	3 credits

Accumulated total credits **29**

3) Required Computer/Computational Course

(One of the following or equivalent)

CMSC 106	Introduction to C Programming	4 credits
CMSC 131	Object-Oriented Programming I	4 credits

Accumulated total credits **33**

4) *Required Courses Provided by Mathematics and Chemistry*

CHEM 135 & CHEM 132 or CHEM 136	General Chemistry &Laboratory	4 credits
MATH 140	Calculus I	4 credits
MATH 141	Calculus II	4 credits

Total credits **45**

5) Additional Required Mathematics Courses*

Either Block 1

MATH 241	Calculus III	4 credits
MATH 246	Differential Equations	3 credits

Or Block 2

MATH 340	Multivariable Calculus, Linear Algebra and Differential equations I	3 credits
MATH 341	Multivariable Calculus, Linear Algebra and Differential Equations II	3 credits

Total credits **51-52**

*Block 1 includes courses frequently taken by non-majors, while Block 2 includes somewhat more rigorous courses taken by math majors.

6) Required Physics Courses*

Either Block 1

PHYS 161& PHYS 174	General physics: Mechanics and Particle Dynamics & Laboratory	4 credits
PHYS 260& PHYS 261	General Physics: Vibration, Waves, Heat Electricity& Laboratory	4 credits
PHYS 270& PHYS 271	General Physics: Electrodynamics, Light Relativity& Laboratory	4 credits

Or Block 2

PHYS 171& PHYS 174	Introductory physics: Mechanics & Laboratory	4 credits
PHYS 272& PHYS 275	Introductory Physics: Fields& Laboratory	5 credits
PHYS 273	Introductory Physics: Waves	3 credits

Accumulated total credits **63-64**

*Block 1 includes courses frequently taken by non-majors, while block 2 includes somewhat more rigorous courses taken by physics majors.

7) Required Elective Courses

(6 credits. May not be satisfied by the courses used to fulfill the previous requirements).

	AOSC346	Cycles in the Earth System	3 credits
	AOSC 375	Introduction to the Blue Ocean	3 credits
	AOSC 400	Physical Meteorology of the Atmosphere	3 credits
	AOSC 401	Climate and Earth System Science	3 credits
	AOSC 424	Remote Sensing	3 credits
	AOSC 433	Dynamics of the Atmosphere and Oceans II	3 credits
	AOSC 434	Air Pollution	3 credits
	AOSC 470	Synoptic Meteorology	3 credits
	CMSC206	Introduction to Matlab	1 credit
either	CMSC/AMSC 460	Computational Methods	3 credits
or	CMSC466	Introduction to Numerical Analysis I	3 credits
	BSCI 106	Principles of Biology II	4 credits
	BSCI373	Natural History of the Chesapeake Bay	3 credits
	BSCI 375	Biological Oceanography (not offered every year)	3 credits
	CHEM 231	Organic Chemistry I	3 credits

	GEOG 201	Geography of Environmental Systems	3 credits
	GEOG 472	Remote Sensing: Digital Processing and Analysis	3 credits
	GEOG 415	Land Use Climate Change and Sustainability	3 credits
	GEOL 120	Environmental Geology	3 credits
	GEOL 437	Global Climate Change: Past and Present	3 credits
	GEOL 451	Groundwater	3 credits
	GEOL 452	Watershed and Wetland Hydrology	3 credits
either	MATH 240	Linear Algebra	3 credits
or	MATH 461	Linear Algebra for Scientists and Engineers	3 credits
	MATH 416	Applied Harmonic Analysis: An Introduction to Signal Processing	3 credits
	MATH 452	Introduction to Dynamics and Chaos	3 credits
	MATH 462	Partial Differential Equations for Scientists and Engineers	3 credits
	STAT 400	Applied Probability and Statistics I	3 credits
	STAT 401	Applied Probability and Statistics II	3 credits

Accumulated total credits **69-70**

Appendix B: Learning outcomes

Student Learning Outcomes	Assessment Measures and Criteria	Assessment Schedule
1. Students will demonstrate competence in the design and execution of research in Atmospheric and Oceanic Science	**Measure:** AOSC 493, AOSC498 *Senior Research Project* I, II forms the two-semester required senior project in which the student writes a formal proposal of research and at the conclusion presents a final oral and written presentation. This project represents the capstone of the Atmospheric and Oceanic Science Major and aims to test the full range of a student's professional skills. The sequence, therefore, ideally suits the need for the evaluation of programmatic learning outcomes. We will assess performance in the senior research project using a rubric that independently evaluates the following aspects of the student's thesis work: • Research Design: Knowledge and implementation of proper methods of research design • Research subject knowledge: Depth and quality of specific research-related knowledge Research methodology competence will be addressed through the first of these components. **Criteria:** At least 75% of students attempting to complete AOSC 493/498 receive at least a satisfactory evaluation in the "research design" component of their senior thesis evaluation.	Satisfactory completion rate is analyzed annually beginning in 2012 for all students completing the major. Results to be shared with departmental faculty
2. Students will demonstrate a competence in the standard media of professional communications in the Atmospheric and Oceanic Sciences, including written manuscripts, oral presentations, and poster presentations.	**Measure:** Work for the senior research project includes oral presentations in AOSC493 as well as a written prospectus. The final presentation for AOSC 498 consists of a poster and research paper. Together, these form a broad and substantive basis for the evaluation of student communication proficiency. Evaluations will focus on the prospectus and final presentations to facilitate a longitudinal assessment of student improvement during the thesis sequence.	Satisfactory completion rate is analyzed annually beginning in 2012 for all students completing the major. Results to be shared with departmental faculty

	Criterion: At least 75% of all presentations in AOSC 498 will receive a satisfactory evaluation in the “Presentation Skills" component of their senior project evaluation.	
3. Students will demonstrate competent knowledge of a broad cross-section of Atmospheric and Oceanic science subject material.	**Measure:** Although students pursue specialized research topics during AOSC493 and AOSC 498, success demands general familiarity with the broad range of concepts in Atmospheric and Oceanic science, and a substantial depth of general factual knowledge *a priori*. The typical student creatively integrates and recombines this knowledge while pursuing their final presentation. Evaluations will focus on the initial proposal presentation and the final presentations in AOSC 498 to facilitate a longitudinal assessment of student improvement during the thesis sequence. **Criterion:** At least 75% of all proposal presentations and 65% in the final presentation for AOSC 498 will receive a satisfactory evaluation in the "General subject knowledge" component of their senior project evaluation.	Satisfactory completion rate is analyzed annually beginning in 2012 for all students completing the major. Results to be shared with departmental faculty
4. Students will demonstrate the ability to gain in-depth knowledge of a specific area of Atmospheric and Oceanic science in the context of active research.	The "research subject knowledge" component of the senior project evaluations will assess the student's command of this specialized knowledge. Evaluations will focus on initial presentations of the proposal of AOSC493 and final presentations of AOSC498 in to facilitate a longitudinal assessment of student improvement during the thesis sequence. **Criterion:** At least 75% of all presentations of the proposals and 65% in the final presentation will receive a satisfactory evaluation in the "Research subject knowledge" component of their senior thesis evaluation	Satisfactory completion rate is analyzed annually beginning in 2012. Results to be shared with departmental faculty