UNIVERSITY
OF MIAMI
FACULTY SENATE

Faculty Senate Office
Ashe Administration Building, #325
1252 Memorial Drive
Coral Gables, FL 33146

facsen@miami.edu
web site: www.miami.edu/fs
P: 305-284-3721
F: 305-284-5515

MEMORANDUM

To: Donna E. Shalala, President

From: Tomas A. Salerno
Chair, Faculty Senate

Date: February 27, 2015

Subject: Faculty Senate Legislation #2014-24(B) – Establish a Master of Science (M.S.), and Doctor of Philosophy (Ph.D.) in Atmospheric Sciences (ATM), and Change the name of the Master of Professional Science (M.P.S.) in Meteorology and Physical Oceanography (MPO) to MPS in Atmospheric Sciences (ATM), Rosenstiel School of Marine and Atmospheric Science

****

The Faculty Senate, at its February 25, 2015 meeting, voted by majority with 1 abstention to approve the restructure of the graduate programs at the Rosenstiel School of Marine and Atmospheric Science as amended. Each department's proposal is written as separate legislation for administrative purposes and includes the proviso that the School will give a report to the Senate in two years after the programs' implementation.

As noted in the proposal, the broad purpose of these degrees is to advance students' knowledge and understanding of the science of the atmosphere, primarily through class instruction and dissertation research.

This legislation is now forwarded to you for your action.

TAS/rh

Enclosure

cc: Thomas LeBlanc, Executive Vice President and Provost
Roni Avissar, Dean, Rosenstiel School of Marine and Atmospheric Science
Amy Clement, Associate Dean, Rosenstiel School of Marine and Atmospheric Science
Sharanya Majumdar, Program Director, Rosenstiel School of Marine and Atmospheric Science
David S. Nolan, Chair, Department of Atmospheric Sciences, Rosenstiel School of Marine and Atmospheric Science

CAPSULE: Faculty Senate Legislation #2014-24(B) – Establish a Master of Science (M.S.), Master of Professional Science (M.P.S.), and Doctor of Philosophy (Ph.D.) in Atmospheric Sciences (ATM), Rosenstiel School of Marine and Atmospheric Science

APPROVED: _____ DATE: 03/06/2015
(President's Signature)

OFFICE OR INDIVIDUAL TO IMPLEMENT: Dean Avissar

EFFECTIVE DATE OF LEGISLATION: IMMEDIATELY
(if other than June 1 next following)

NOT APPROVED AND REFERRED TO: _____

REMARKS (IF NOT APPROVED): _____

UNIVERSITY OF MIAMI
ROSENSTIEL
SCHOOL of MARINE &
ATMOSPHERIC SCIENCE

Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149, USA

Table of Contents

Memoranda

Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149, USA

MEMORANDUM

TO: Professor Brian Blake (Dean, University of Miami Graduate School)
FROM: Sharan Majumdar (Assoc. Professor and Chair, Academic Committee, Rosenstiel School)
Amy Clement (Professor and Associate Dean of Graduate Studies, Rosenstiel School)
DATE: November 10, 2014
SUBJECT: **Graduate Program Restructuring at the Rosenstiel School**

The Rosenstiel School of Marine and Atmospheric Science has entered an exciting phase of its evolution, with externally funded new buildings and research facilities, a major investment by UM in renovating infrastructure, new business models for faculty and graduate students aligned with national models, and plans to hire the next generation of faculty. On June 1, 2014, the Rosenstiel School was restructured from 6 divisions into 5 new departments, following approval by the Faculty Senate on March 26, 2014. The main reason for this restructure has been to develop the School into academic units that can be administered more autonomously.

The establishment of the new departments has provided an opportunity to rethink and revitalize our graduate programs into new or improved programs. Currently, there exist 6 programs with the names of the 6 former divisions. We are proposing a new structure in which 5 graduate programs are aligned with the 5 new departments, and one existing program will continue as an inter-departmental program. The package presented here describes how we will transition to this new structure, which includes the development of 3 new Ph.D. programs, 3 program name changes, 1 new certificate program, and the phasing out of 2 existing programs. A schematic showing the old divisions/programs, new departments, and new proposed structure is on the next page. We wish for this package to be considered holistically, since the various actions of developing, renaming and phasing out programs are interdependent.

The contents of the package together with results from faculty votes are as follows:

School-wide Memos

S1. This cover letter, explaining the programmatic restructure from a School-wide perspective.
S2. Dean of the Rosenstiel School.
S3. Vice Chair of the Rosenstiel School Council.
S4. Associate Dean of Master of Professional Science (MPS), on the transfer of MPS degree programs.

Departments

D1. Department of Ocean Sciences (OCE)
- New M.S. and Ph.D. program proposal in Ocean Sciences. **Supported 19-1** (1 abstain)

D2. Department of Atmospheric Sciences (ATM)
- New M.S. and Ph.D. program proposal in Atmospheric Sciences. **Supported 11-0.**

D3. Department of Marine Ecosystems and Society (MES)
- New Ph.D. program proposal in Marine Ecosystems and Society. **Supported 10-0.**
- M.S. program name change from Marine Affairs and Policy (MAF) to Marine Ecosystems and Society (MES). **Supported 10-0.**

D4. Department of Marine Biology and Ecology (MBE)
- M.S. and Ph.D. program name change from Marine Biology and Fisheries (MBF) to Marine Biology and Ecology (MBE). **Supported 14-0.**

D5. Department of Marine Geosciences (MGS)

- Proposal for new Certificate Program in Applied Carbonate Geology. **Supported 8-0.**
- M.S. and Ph.D. program name change from Marine Geology and Geophysics (MGG) to Marine Geosciences (MGS). **Supported 8-0.**

Existing Programs

E1. Applied Marine Physics (AMP)

- Memo stating faculty intention to admit new graduate students solely into the new programs in 2016. **Supported 6-0.**

E2. Marine and Atmospheric Chemistry (MAC)

- Memo stating faculty intention to admit new graduate students solely into the new programs in 2016. **Supported 7-0.**

E3. Meteorology and Physical Oceanography (MPO)

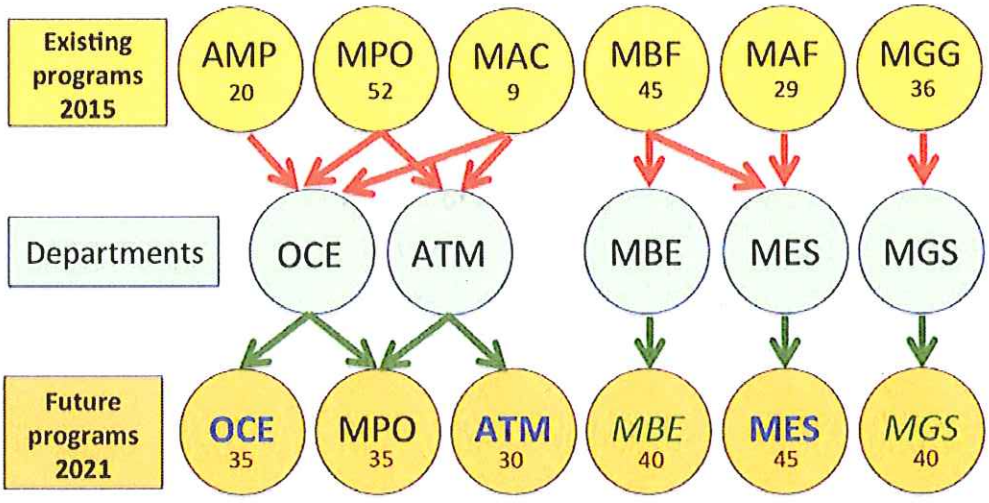
- Memo stating support for new programs and long-term continuation of MPO. **Supported 14-6.**

E4. Abess Center for Ecosystem Science and Policy

- Memo stating support from the Director of the Abess Center.

Each new program aligned with the new departments will offer M.S. and Ph.D. degrees with the degree title matching the program name. The three departments that are proposing new graduate programs: OCE, ATM, and MES, are proposed to begin in Fall 2015. The MBE and MGS departments, and the MES Master's Program, are proposing a name change to their existing programs. We propose that students in the existing programs will be allowed to transfer into the new programs beginning in Fall 2015. Current MPS tracks will be transferred into new departments, but will otherwise remain unchanged.

This diagram illustrates the 6 existing graduate programs (M.S. and Ph.D. combined, except MAF which is M.S. only) and student populations in each program (yellow circles). The red arrows illustrate how the existing graduate programs are mapped onto the 5 departments (green circles). The orange circles list the 6 proposed graduate programs with conservatively projected student populations in 2021, five years after the enrollment of new students in the new programs. These numbers are based on polls of faculty on their projected student intake, and average graduation rates. The green arrows illustrate the alignment between the new departments and the future programs. The programs listed in blue are new programs, while the two programs listed in green are renamed programs. The MPO program will continue as is and will be maintained as an interdepartmental program served by faculty from OCE and ATM.



School-wide Rationale

An overview of the rationale for the establishment of the new programs is summarized here, with explanations in further depth provided in each of the individual program proposals.

In the UM Strategic Plan (2008), the need was stated for UM to advance up the National Research Council (NRC) rankings, and in turn reach the highest echelon of national research universities: the private institutions of the Association of American Universities (AAU). This intention included aiming for a top-10 ranking for the Rosenstiel School with nationally prominent graduate programs that are distinguished by their breadth and depth, and quality of the student body that matches that on the campuses of private AAU institutions. In the 2010 NRC Rankings, the 5th & 95th percentile rankings for the Rosenstiel School out of 50 comparable schools and departments were 11 & 40 respectively in criteria deemed important for scholars, and 10 & 42 respectively in research rankings. These numbers suggest that the Rosenstiel School is on average in the middle, with most opinions ranging from the highest 20% to the lowest 20%. Our goal is to elevate the Rosenstiel School's graduate education into the top tier.

The improvement of our graduate programs relies on our ability to recruit top-class students. Currently, the number and quality of applicants especially in the physical and chemical sciences are sub-optimal, even with highly competitive stipends and 5-year research assistantships. The faculty have expressed a need to offer broader opportunities to prospective graduate students, and the proposed programs are designed to meet this need. In developing our new proposed programs, the core curricular structures have been revisited (something that has not been done in existing programs for decades), and the result is more curricular options offering greater flexibility for students, and adding more prominence in attractive areas including interdisciplinary studies. We expect that the programs will be more visible to high-caliber students in the oceanic and atmospheric sciences via the identity of the departments. This increased visibility will also serve to enhance the pool of high quality students in the retained program (MPO).

The 6 programs that used to reside within the old divisions have been in existence for several decades (yellow circles in diagram). As is indicated by the red arrows in the diagram, these programs are presently not well aligned with the 5 new departments (green circles). The new graduate program structure aligns cleanly with the 5 departments (green arrows). The MPO program will continue as an inter-departmental program that attracts students with interests in the physical processes of both the atmospheric and oceanic media, a core strength at UM that will continue to contribute to the overall growth in the graduate student population. All the main 6 programs (5 departments and MPO) will be of comparable size to each other, with a conservative projection of at least 30 graduate students in each program in the long-term (2021). The new programmatic structure will align with our parallel undergraduate and MPS programs, which are also expected to align with the departments moving forward. The proposed structure will also enable opportunities for joint programs or concentrations across both the Rosenstiel School and UM (such as the recently revived Ocean Engineering program).

The reorganization into new departments has left some important disciplines without a distinctive 'home'. Chief among these are fisheries, marine physics, marine chemistry, and atmospheric chemistry. The new M.S. and Ph.D. program in Marine Ecosystems and Society is designed to accommodate fisheries. Faculty in the other three disciplines have had difficulty recruiting into the existing small programs, and have formally stated their interest in recruiting new students solely into the new OCE and ATM programs. One top priority is to expand our programmatic structure in the well-funded physical and chemical sciences from one large program (MPO) and two small programs (AMP, MAC) into three thriving complementary programs that accommodate the diverse range of research expertise across the faculty in the OCE and ATM departments. This reorganization ensures that all graduate programs have critical mass – a robust cohort class is important for attracting students and for a collaborative learning environment.

The equilibrium faculty size of the Rosenstiel School in the Provost's business model is 68. Working within this number, there is a robust plan to recruit up to 16 new faculty in the School by 2020. The announcements for hiring 5 new faculty members (1 in each department) have recently been advertised. The presence of exciting new and diverse *research-enhancing* graduate programs with high visibility is expected to be more attractive to top faculty applicants than the existing uneven structure, together with the incentive for future and current faculty to make a substantial contribution to their development. Furthermore, the School contains a large core of internationally recognized, well-published and funded mid-career faculty who maintain large research programs and advise many graduate students, who also contribute substantially to the educational mission of UM. The 'positive feedback' through the recruitment of high-quality students remains an important factor in the retention of top faculty. Many faculty have expressed the need for the new programs to enhance their student recruitment.

We anticipate that the new programs will overall be more *reputation-enhancing* than is possible with the current structure, with an excellent student body, placements among top academic and research institutions, faculty highly committed to advancing course offerings and mentoring students one-on-one, and providing financial and research support to students. The ultimate goal is to develop a culture of academic excellence and long-term stability in all 6 M.S. and Ph.D. programs.

Budget and Student Numbers

A standard business model exists for all students in 5-year Ph.D. programs who are not on Fellowships. Each student's annual stipend, tuition and health insurance are supported for 3 years on the advisor's extramurally funded research grant. In the remaining 2 years, the student is fully supported by the School. The M.S. students have their stipend and tuition supported by the advisor. Additionally, several M.S. students are self-funded. This School-wide model will continue for students entering the proposed new programs.

This business model for graduate students is in line with the principles in the UM Strategic Plan, which suggests a strategy for building nationally prominent Ph.D. programs within resource constraints. These principles include competitive stipends, leveraging external funds wherever possible, and graduate students playing important roles in undergraduate education. The annual stipend will be approximately $30,000 per year in Fall 2016, higher than most comparable programs nationwide (which are generally $20,000-$28,000). External grants come from federal agencies such as the National Science Foundation, NASA, NOAA, Department of Energy, Department of Defense, National Institute of Health etc. While the student intake is in part dependent on the available funding in the field and the faculty members' success in winning grants, this funding has generally been steady both nationally and at the School in recent years, and it is expected to remain steady over the next decade. Another method of leveraging funds is to be more aggressive in pursuing external fellowships, through initiatives such as those developed by the UM Graduate School and guidance from advisors. A new model for self-funded M.S. students across the School has recently been introduced.

There currently are 191 M.S. and Ph.D. students in the 6 programs. For the new faculty, it is anticipated that the start-up package for each new hire would include two new graduate students. Based on the new hires, steady national funding levels, and modestly improved recruitment of students within the new programs, a conservative projection is for 220 M.S. and Ph.D. students by 2021. The majority of students (80-90%) in OCE, ATM, MGS and MBE will be Ph.D. students. In MES, at least 15 Ph.D. students are anticipated around 2021, with most of the remainder being self-funded M.S. students as exists now. Hence, the projected 220 students may be divided into 50 M.S. students and 170 Ph.D. students in 2021.

Impact on Existing Programs

The faculty in the **AMP** and **MAC** programs have voted that they do not intend to recruit into these programs after the new OCE and ATM programs have been formally established. AMP and MAC will continue as long as students remain in the programs, with few students expected to remain by 2021.

The existing programs in **MAF**, **MBF** and **MGG** are being renamed to align with the MES, MBE and MGS departments. The fisheries component of MBF will become part of the new MES program.

The only existing program that will continue is **MPO**, which houses about 50 students advised by faculty belonging to the former MPO division. This program will remain as is, governed by a Program Director and an Academic Committee across the ATM and OCE departments. The programmatic structure of MPO will remain as is, including the same required courses and suite of elective courses taught by faculty in the ATM and OCE departments. The new programs are designed so as not to increase the graduate or undergraduate teaching loads of faculty involved in any of the programs, including MPO. Students enrolled in the MPO program will share several courses and seminars with students enrolled in the ATM and OCE programs, and therefore there will be broader student camaraderie and a cohort that extends beyond each individual program. There will be no impact on the existing program budget, which is largely handled by the School, and there will be no impact on facilities or space.

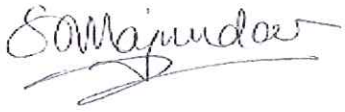
The main impact on MPO will be a reduction in the number of students pursuing a degree in MPO. The current number of about 50 is expected to decrease slowly to an equilibrium of about 35 over the next 7 years, as students begin to enroll in the new programs. Several faculty in ATM and OCE have expressed their desire to continue to recruit students in MPO. Therefore, it is expected that MPO will have a stable future. The program will admit students in the same way as the other programs.

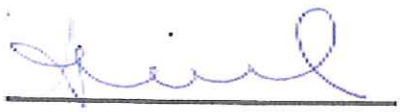
Given the natural connections between the atmosphere and ocean, there will be some common ground across ATM, OCE and MPO. At the same time, each program will also possess a distinct identity and be complementary to each other. ATM will focus on the dynamics, physics, and chemistry of the atmosphere, with extensions to other relevant areas (e.g. atmospheric science policy). OCE will include studies of the dynamics, physics, chemistry and biology in the ocean, with interdisciplinary connections. MPO will continue to admit students interested in weather, climate, ocean circulation and physical processes, and air-sea interactions. The establishment of the new programs will also be necessary in order to extend beyond the scope and reach of MPO that could not be achieved by simply reorganizing MPO. Therefore, we are confident that the three complementary programs will all thrive, and synergies between each of them will be exploited through coordination and inclusivity across the programs.

The programs and budgets are self-contained, being handled internally within the Rosenstiel School. Therefore, no other programs at UM will be impacted. The new programs will complement those within the **Abess Center** of Ecosystem Science and Policy, as stated in a separate memo by their Director.

We thank you and the Graduate Council for your consideration.

Sincerely,





Sharanya J. Majumdar

Amy C. Clement

UNIVERSITY
OF MIAMI

Office of Planning, Institutional Research, and Assessment

P.O. Box 248285
Coral Gables, FL 33124-2923
Phone: 305-284-3856

Gables One Tower, Suite 260, Locator 2923
1320 S. Dixie Hwy., Coral Gables, FL 33146
Fax: 305-284-4081 • pira@miami.edu

MEMORANDUM

DATE: January 27, 2015

TO: Dr. Sharan Majumdar
Associate Professor and Chair, Academic Committee
Rosenstiel School of Marine and Atmospheric Science

FROM: David E. Wiles, Executive Director
Assessment and Accreditation

SUBJECT: Graduate Program Restructuring/New Programs and Program Changes

On December 16, 2014, the Rosenstiel School of Marine and Atmospheric Science submitted a proposal notifying our office of its intent to restructure its graduate departments; create five new graduate degree programs and one certificate program; rename eight other existing degree programs; the planned phase-out of four existing degree programs, although students presently enrolled these programs will be allowed to complete their studies under the existing curriculum or to transfer to the corresponding new degree program. The changes are scheduled to take effect beginning in the fall of 2015 and are summarized in the chart below.

Credential	Level	Program *=courtesy master's awarded to doctoral student **=inactive program	Changes in 2015-16
		Rosenstiel School of Marine and Atmospheric Science	
Certificate		Applied Carbonate Geology -- Graduate Credit	new
M.S.	M	Applied Marine Physics	phase out
Ph.D.	D	Applied Marine Physics	phase out
M.S.	M	Atmospheric Sciences	new
Ph.D.	D	Atmospheric Sciences	new
B.A.M.A.	B	Marine Affairs	
M.P.S.	M	Marine Affairs and Policy rename "Marine Ecosystems and Society"	rename
M.S.	M	Marine Affairs and Policy rename "Marine Ecosystems and Society"	rename
M.S.	M	Marine and Atmospheric Chemistry	phase out
Ph.D.	D	Marine and Atmospheric Chemistry	phase out
M.P.S.	M	Marine Biology and Fisheries rename "Marine Biology and Ecology"	rename
M.S.	M	Marine Biology and Fisheries rename "Marine Biology and Ecology"	rename
Ph.D.	D	Marine Biology and Fisheries rename "Marine Biology and Ecology"	rename
Ph.D.	D	Marine Ecosystems and Society	new
M.S.	M	Marine Geology and Geophysics rename "Marine Geosciences"	rename
Ph.D.	D	Marine Geology and Geophysics rename "Marine Geosciences"	rename
B.S.M.A.S.	B	Marine Science (all tracks)	
B.S.M.A.S.	B	Meteorology (all tracks)	
M.P.S.	M	Meteorology and Physical Oceanography rename "Atmospheric Science(-s)?"	rename
M.S.	M	Meteorology and Physical Oceanography	
Ph.D.	D	Meteorology and Physical Oceanography	
M.S.	M	Ocean Sciences	new
Ph.D.	D	Ocean Sciences	new

The proposal also mentions the recruitment of 16 new faculty members, including the immediate hiring of five new faculty members, and an expanded curriculum. Although our office will need to submit the changes and new program additions as a notification to the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC), please provide written clarification on the following matters:

- Specify the minimum number of **post-baccalaureate** credit hours for each new graduate degree program (should be at least 30 credits for a master's degree and 60 for the Ph.D.).
- For each of the five new faculty currently sought, please indicate whether the hire will be (1) teaching new courses, (2) minimum qualifications for the appointment or provide the C.V. (if already hired), and (3) whether the hire will be an addition to the faculty or will fill a vacancy.
- The exact new name for the existing M.P.S. in Meteorology and Physical Oceanography.
- For the five new courses that will be offered as part of the Certificate in Applied Carbonate Geology, whether these courses will be a subset of the curriculum for an existing graduate degree program at RSMAS—if so, which program(s)?
- Student Learning Outcomes (SLOs) should be stated in terms of the knowledge, skills, values, or behaviors students will develop; should be worded in active voice (e.g., "Students will demonstrate…" or "Graduates will be able to…"); and include at least **two** measures.
- Where standardized examinations are used for admission, minimum scores should be reported on the current exam scale (e.g., 0-120 for the TOEFL iBT).
- Finally, it would be helpful if all pages of the proposal were numbered.

Please allow six months for review by the SACSCOC once the notifications are submitted by our office. Feel free to contact us should you have any further questions (305) 284-9431.

cc: Faculty Senate
Dr. M. Brian Blake, Vice Provost and Graduate School Dean
Dr. Roni Avissar, Dean, RSMAS
Dr. Amy Clement, Professor and Associate Dean of Graduate Studies, RSMAS

MEMORANDUM

DATE: February 4, 2015

TO: Tomas Salerno
Chair, Faculty Senate

FROM: M. Brian Blake
Dean, The Graduate School

SUBJECT: Revised Memo - Restructuring of the Graduate Programs in RSMAS

The Rosenstiel School of Marine and Atmospheric Sciences submitted a proposal to restructure the graduate programs in RSMAS. The proposal was discussed at the meeting of the Graduate Council on Tuesday, January 20, 2015, and was approved by those present. The second reading was waived.

Several discussions from the meeting are notable:

1. The Graduate Council received concerns from member(s) of the Graduate Faculty that the program would cause undue competition and that the new divisions would weaken the overall program. The proposers provided a rationale to explain the material differences between ATM/OCE/MPO vs. OCE/MPO. The Graduate Council discussed the concerns and the rationale in detail. The Graduate Council found favorable the ability for the programs to evolve separately with the changing faculty. The Council also appreciated that there might be some overlap in the programs but found it acceptable. The Graduate Council did not perceive a sense of competition between the two programs considering material differences and the nature of graduate programs in general.
2. The Graduate Council requested that the proposers prepare a 1-page document with a projected synopsis of graduate programs that will retire in addition to a date when the Graduate Council should revisit the status of those retirements.
3. The proposers favorably distinguished between MES and the ABESS program in response to a question from the Council.

cc: Roni Avissar, Dean, RSMAS
Amy Clement, Associate Dean of Graduate Studies, RSMAS
Sharan Majumdar, Graduate Academic Committee Chair, RSMAS
Office of Planning, Institutional Research and Assessment

UNIVERSITY OF MIAMI
ROSENSTIEL
SCHOOL of MARINE &
ATMOSPHERIC SCIENCE

Office of the Dean
Science and Administration Building 107
4600 Rickenbacker Causeway
Miami, Florida 33149-1031
Phone: 1 305 421-4000
Fax: 1 305 421-4711
Web Site: http://www.rsmas.miami.edu

MEMORANDUM

TO: Professor Brian Blake, Dean, UM Graduate School
FROM: Roni Avissar, Dean
DATE: November 10, 2014
SUBJECT: **Graduate Program Restructuring at RSMAS**

The Rosenstiel School of Marine and Atmospheric Science (RSMAS) has recently reorganized into five departments: (1) Ocean Sciences (OCE); (2) Atmospheric Sciences (ATM); (3) Marine Biology and Ecology (MBE); (4) Marine Geosciences (MGS); and (5) Marine Ecosystems and Society (MES). Previously, RSMAS was organized into six divisions: (1) Meteorology and Physical Oceanography (MPO); (2) Marine and Atmospheric Chemistry (MAC); (3) Applied Marine Physics (AMP); (4) Marine Biology and Fisheries (MBF); (5) Marine Geology and Geophysics (MGG); and (6) Marine Affairs (MAF). This evolution of RSMAS was required due to the combination of multiple factors, including the needs to reduce the size of the faculty that was unable to sustain itself financially because of the disproportion between its size and its teaching portfolio, and also because of its lack of competitiveness in some of its programs that were clearly not visible to many potentially interested students. Indeed, priorities and interest of potential students have changed over the past few decades, but RSMAS maintained its organization and academic offerings during that same period.

Following this reorganization and the multiple discussions that took place before, during and after its implementation, the overwhelming majority of faculty members at RSMAS (see all attached memos summarizing all anonymous votes) believe that now is the right time (and unique opportunity) to reconsider our graduate program portfolio. The attached proposal, and especially the memo of Professor Sharan Majumdar (Chair of our Graduate Academic Committee) and Professor Amy Clement (Associate Dean for Graduate Programs) provides an excellent summary of the issues that we are trying to resolve by proposing to restructure our graduate programs. This includes a net gain in the number of graduate students that we could easily absorb with our existing research funds available for fellowships, but we are unable to recruit within the inadequate current programs. Very conservatively, we anticipate a growth of about 20% in our student population and not less importantly, we anticipate in at least some of the programs a considerable increase in the quality of the students applying to our programs. This would be achieved without increasing the total number of our graduate programs at no additional cost to the School. Thus, the income realized by the additional students would in fact increase the net revenues of the School and, as a result, of the University.

There is no point for me to repeat here the arguments provided in the memo of Professors Majumdar and Clement. Rather, **the purpose of this memo is to emphasize my unambiguous and enthusiastic support for this proposal, which was put together by the faculty in their new departments led by the Graduate Academic Committee**. It was reviewed carefully and approved by the School Council (see attached memo of the School Council Vice Chair, Professor

Roni Avissar, Ph.D.
Professor and Dean
Phone: 1 305 421-4000 • Fax: 1 305 421-4711 • E-mail: ravissar@rsmas.miami.edu

Rana Fine) and was unanimously approved by the School Leadership (which at RSMAS consists of the five department chairs, the five associate deans, and the VC of the School Council).

But I would like also to emphasize the importance of considering this proposal in its entirety, rather than each program separately. This is because any of the programs is interconnected directly or indirectly to the five others and modifying only part of them would necessarily leave out some of our faculty members. Indeed, two of our current programs that the faculty has decided to abandon (AMP and MAC) would have no home for their graduate students if ATM and/or OCE were not approved, and faculty members formerly in the MBF Division who joined the former MAF Division to create the new MES Department would not have a home for their students. The Graduate Academic Committee together with the faculty in the newly created departments choreographed very carefully the entire proposal and it is key to the success of this initiative to move forward as a single proposal for restructuring.

In this proposal we are requesting to restructure the existing six graduate programs that were associated with the six former divisions into six programs, five of them aligned with the five new departments and one of them, MPO, the largest of the existing programs becoming a cross-departmental program that will serve students interested in both the ocean and the atmosphere, and their interactions. The support for the alignment between new departments and their own graduate program is overwhelmingly positive. Indeed, from all five departments, only one single vote rejects the proposal to create a new OCE graduate program (see summary of confidential votes provided in the document). The only minor disagreement to this entire proposal is regarding the future of the MPO program jointly with the ATM and OCE programs. Yet even in that case, it is essential to appreciate that 70% of the faculty are in favor of moving forward with the three programs (see faculty vote of MPO, ATM and OCE).

Last but not least, with expected retirements that will occur at RSMAS during the next 5-7 years, we anticipate a recruitment of 16 new faculty members to maintain the total number of tenured and tenure-track faculty at 68 (we are in the process of recruiting a first wave of five faculty). The restructuring proposed here will facilitate the integration of these new faculty members in their department. Indeed, the alignment of programs with departments is quite typical in academia and the confusion of six programs aligned with previously existing divisions would not be helpful in recruiting top faculty members. We anticipate this new faculty recruitment to significantly impact in a very positive way the newly created programs.

I hope that the Graduate School will appreciate the tremendous effort put together by the Graduate Academic Committee, the School Council, the School Leadership and the entire RSMAS faculty to develop this very exciting proposal, which is very considerate for the interest of all faculty at the School while enhancing the benefits for the School and the University. It is extremely well thought, it will contribute to the quality and the population of graduate students at UM, and I strongly urge you to support RSMAS' effort to improve and to contribute to the Graduate School.

UNIVERSITY OF Miami

February 4, 2015

To: Dr. Amy Clement, Associate Dean Graduate Studies

From: Rana Fine, Professor and Vice Chair RSMAS School Council

This is written in enthusiastic support of the graduate program restructuring package submitted to the Graduate School for the Rosenstiel School. On 3 February the School Council met and **unanimously approved** the entire package with a vote of 5-0. The wording of the resolution was:

"I approve the entire package, including all of the individual proposals to establish new programs, together with the renaming of other programs."

At RSMAS, there is widespread support for the restructuring, which basically involves name changes for two of the existing programs and three new programs. The proposed new programs for Marine Ecosystems and Society, Ocean Sciences and Atmospheric Sciences have strong support within their departments for starting them as evidenced by the near unanimous votes of approval they received. Also, there is unanimous support for a new Certificate Program in Applied Carbonate Geology. There is strong support for continuing the existing academic program in Meteorology and Physical Oceanography. It is the full intension of the School to continue other existing graduate programs at least until the last student graduates, and many of the faculty involved have indicated a preference for recruiting into new programs instead of existing programs.

Cc: Dean Avissar, Dr. Sharan Majumdar, Ms. Cassandra Wiggins

UNIVERSITY OF MIAMI
ROSENSTIEL
SCHOOL of MARINE &
ATMOSPHERIC SCIENCE

Office of Professional Studies
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149, USA

Phone: 305-421-4930 Email: bsoden@rsmas.miami.edu

Memorandum

To: M. Brian Blake, Dean of the Graduate School
Cc: Roni Avissar, Dean of RSMAS

From: Brian J. Soden, Associate Dean for Professional Studies

Date: November 9, 2014

Re: Proposed transferring of the M.P.S. degree programs

The purpose of this memorandum is to indicate our intentions to transfer the degree programs with the RSMAS Master of Professional Science (M.P.S.) from their legacy divisional names to align with the current departmental structure at RSMAS.

There are currently 3 M.P.S. degree programs with a total of 14 tracks in the following divisions: Marine Biology and Fisheries (MBF), Marine Affairs (MAF), Meteorology and Physical Oceanography (MPO). We wish to transfer these programs to coincide with their respective departments where the majority of faculty and courses reside. The attached tables outline the proposed renaming for each of the current tracks.

Faculty in each of the departments where the M.P.S. degrees will reside have been asked to vote on the transfer of the programs The vote in MBE was 13-1 in favor of the transfer; the vote in MES was 8-0 in favor of the transfer; and the vote in ATM was 7-0 in favor of the transfer.

UNIVERSITY OF MIAMI
ROSENSTIEL
SCHOOL of MARINE &
ATMOSPHERIC SCIENCE

Department of Ocean Sciences
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149, USA
Phone: 305-421-4647 Email: jolascoaga@rsmas.miami.edu

Memorandum

To: M. Brian Blake, Dean of the Graduate School
Cc: Amy Clement, Associate Dean of Graduate Studies, RSMAS
Roni Avissar, Dean of RSMAS

From: M. J. Olascoaga and William Drennan (Applied Marine Physics Academic Committee)

Date: November 6, 2014

Re: Applied Marine Physics Graduate Program

The Applied Marine Physics (AMP) Graduate Program was housed in the academic division of the same name. On June 1, 2014, as part of the restructuring at RSMAS, the AMP division ceased to exist and all graduate faculty but one became members of the Ocean Sciences department (OCE).

In a vote conducted anonymously by the RSMAS School Council, 6 faculty in the AMP program voted upon and unanimously approved 6-0 the following statement:

"As a faculty member in the AMP program, I support the establishment of the new OCE and ATM graduate programs. My future students will not be recruited into the AMP program. The AMP program will continue to function for existing students until they graduate and/or transfer to the new programs."

M. Josefina Olascoaga

William M. Drennan

UNIVERSITY OF MIAMI
ROSENSTIEL
SCHOOL of MARINE &
ATMOSPHERIC SCIENCE

Department of Ocean Sciences
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149, USA
Phone: 305-421-4714 Email: jwu@rsmas.miami.edu

Memorandum

To: M. Brian Blake, Dean of the Graduate School
Cc: Amy Clement, Associate Dean of Graduate Studies, RSMAS
Roni Avissar, Dean of RSMAS

From: Jingfeng Wu, Associate Professor, Department of Ocean Sciences
and Program Director, Marine and Atmospheric Chemistry

Date: November 6, 2014

Re: **Marine and Atmospheric Chemistry Graduate Program**

The Marine and Atmospheric Chemistry (MAC) Graduate Program was housed in the academic division of the same name. On June 1, 2014, as part of the restructuring at RSMAS, the MAC division ceased to exist and all graduate faculty became members of the new Ocean Sciences (OCE) and Atmospheric Sciences (ATM) departments.

In a vote conducted anonymously by the RSMAS School Council, the faculty in the MAC program voted upon and unanimously approved 7-0 the following statement:

"As a faculty member in the MAC program, I support the establishment of the new OCE and ATM graduate programs. My future students will not be recruited into the MAC program. The MAC program will continue to function for existing students until they graduate and/or transfer to the new programs."

UNIVERSITY OF MIAMI
ROSENSTIEL
SCHOOL of MARINE &
ATMOSPHERIC SCIENCE

Department of Atmospheric Sciences
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149, USA

Phone: 305-421-4779 Email: smajumdar@rsmas.miami.edu

Memorandum

To: M. Brian Blake, Dean of the Graduate School
Cc: Amy Clement, Associate Dean of Graduate Studies, RSMAS
Roni Avissar, Dean of RSMAS

From: Sharanya J. Majumdar, Associate Professor, Department of Atmospheric Sciences and Program Director, Meteorology and Physical Oceanography

Date: November 6, 2014

Re: **Meteorology and Physical Oceanography Graduate Program**

The Meteorology and Physical Oceanography (MPO) Graduate Program was housed in the academic division of the same name. On June 1, 2014, as part of the restructuring at RSMAS, the MPO division ceased to exist and all graduate faculty became members of the new Ocean Sciences (OCE) and Atmospheric Sciences (ATM) departments.

Through a meeting of faculty in the MPO program and additional e-mail discussions, the future of MPO in the new programmatic structure was discussed. In a vote conducted anonymously by the RSMAS School Council, the MPO program faculty were polled on the following statement:

"As a faculty member in the MPO program, I support the establishment of the new OCE and ATM programs that are being developed within their respective departments, together with the long-term continuation of the MPO program."

14 faculty supported this statement. 6 faculty did not support this statement.

UNIVERSITY OF MIAMI
ROSENSTIEL
SCHOOL of MARINE &
ATMOSPHERIC SCIENCE

Department of Marine Ecosystem and Society
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149, USA

Phone: 305-421-4851 Email: kbroad@rsmas.miami.edu

Memorandum

TO: M. Brian Blake, Dean of the Graduate School

CC: Roni Avissar, Dean of RSMAS
Amy Clement, Associate Dean of Graduate Studies, RSMAS

FROM: Kenny Broad, Director, Abess Center for Ecosystem Science and Policy

DATE: November 7, 2014

RE: **Support for Marine Ecosystems and Policy M.S. and Ph.D. program**

The proposed Marine Ecosystems and Society (MES) M.S. and Ph.D. Program will complement the current Abess Center program along several dimensions:

(a) it will provide options for Abess Center's advanced undergrad and PhD students for additional courses at the 500 and 600 levels that address human-environment interaction related to use of scientific information to inform policy decisions;

(b) it will likely increase the size of current Abess Center core courses which tend to only have 3-5 PhD students (the courses are required for incoming PhD students only, but would be open to MES PhD students;

(c) The MES program will allow Abess students who want to go into further depth (no pun intended) in linking their research to marine science themes additional opportunities and will allow MES PhD students access to courses in terrestrial and decision science courses that are not part of the MES formal curriculum.

It should also be noted that the Abess Center does not have a master's degree program.

In summary, the MES program would complement the existing Abess Center mission

February 19 2015
To: General Welfare Committee
From: David J. Die Program Director, MAF (on behalf of MES Department Chair who is absent)
Subject: Impact of proposed graduate programs in OCE on existing graduate programs

Summary:

M.S. and Ph.D. programs in Marine Ecosystems and Society are proposed, with the program governed by an academic committee of Graduate Faculty within the department Marine Ecosystems and Society. This program will serve the needs of the students and faculty of that department by providing a challenging and flexible curriculum that encompasses the breath of research areas in the social and ecological sciences related to the marine environment. MES faculty voted unanimously and enthusiastically to support the establishment of this program.

Impact on Existing programs:

Currently, RSMAS offers a PhD program for students interested in fisheries science through the Marine Biology and Fisheries program but it does not offer such possibility to students interested in other aspects of marine resource management research. Such students are limited to an MSc degree within the existing Marine Affairs Program.

The existing MSc program in MAF, however, has traditionally attracted large number of students, many of whom have expressed in the past their interest in pursuing a PhD. A reason behind this demand for a PhD is the increasing number of opportunities for careers in government institutions and NGOs that work in the interface between social and ecological sciences applied to the ocean. Increasingly, graduates are seeking to differentiate themselves in the market by having an interdisciplinary PhD.

The existing Marine Biology and Fisheries program has serviced well students interested in an MSc and PhD in fisheries science as proven by the number of PhD graduates and their professional success. The program, however, has always been constrained by the requirements of a traditional marine biology program. Today's more fishery students are seeking an academic experience that includes social sciences than those that seek other areas of marine biology. The creation of the MES department and the proposal for a new academic program on MES will greatly enhance the opportunities for enhancing the academic experience of such students to match the new needs of the current fisheries professional market place. Faculty in the Marine Biology and Ecology Department, with

interests in fisheries and marine ecology, will also be involved and support the new MES program.

The University of Miami also has a PhD program in Ecosystem Science as part of the Abess Center. Such program, however, has a larger emphasis on land-based ecosystem science and on research in support of ecosystem services derived from land ecosystems. The new MES program will not compete with the Abess center program[1] because of its emphasis on marine resources, moreover, the new program is likely to enhance academic programs at the University of Miami that offer graduate level education in support of natural resource management.

In summary, the proposed MES program will greatly increase opportunities for recruiting graduate students to interdisciplinary research teams in the interface between fisheries, ecology, oceanography, policy, anthropology and economics at both the MSc and PhD level. The program is likely to support in the order of 30 to 40 students and have 15 faculty actively engaged in it. All of the faculty currently in MES or that are planned to be recruited into the department will have one thing in common: an emphasis of translating scientific products into practical management of ocean and coastal natural resources. Such emphasis, highlighted in the department's strategic plan, should ensure the success of the new proposed MES program.

[1] See memo from Abess Center Director

MEMORANDUM

TO: Professor Thomas Salerno (Chair, Faculty Senate)
FROM: Sharan Majumdar (Assoc. Professor and Chair, Academic Committee, Rosenstiel School)
Amy Clement (Professor and Associate Dean of Graduate Studies, Rosenstiel School)
Roni Avissar (Dean, Rosenstiel School)
DATE: January 21, 2015
SUBJECT: **Responses to questions and comments from Senate Chair, Vice Chairs and General Welfare Committee Re: Graduate Program Restructuring at the Rosenstiel School**

Since the package on the restructuring of the graduate programs at the Rosenstiel School was submitted to the UM Graduate School on November 10, 2014, the following meetings have taken place:

- Graduate Council: First Reading held on November 18, 2014.
- Graduate Council: Second Reading held on January 20, 2015. (Program Restructuring Approved)

- Meeting with Senate Chair and Vice Chairs held on December 8, 2014.
- General Welfare Committee (Discussion only) held on January 14, 2015.

Except for the Second Reading of the Graduate Council, Professors Majumdar, Clement and Avissar were present at each meeting. This memorandum serves as a written response to the questions and comments raised at the latter two meetings. We thank the Senate Chair, Vice Chairs, and General Welfare Committee for their questions, and for the opportunity to respond both in person and here in writing.

Q1: Describe the process so far in the development of the programs.

In June 2014, shortly after the Rosenstiel School was reformed into new Departments, Brian Blake (Dean, Graduate School) met with Associate Dean Clement and the Rosenstiel School Graduate Academic Committee (GAC). Dean Blake recommended that the introduction of new programs, closing of some programs, and any changes to existing programs be considered holistically, and submitted as one coherent package at one time as opposed to a series of individual proposals. The timeline of early November 2014 was suggested for the submission to the Graduate School. The GAC, comprising Directors of the existing and proposed new programs, was charged with leading the development of a coordinated package.

Between June and November 2014, each of the Departments met several times to discuss the graduate programs, in formal meetings called by their Chairs. Other informal meetings and in-person and e-mail discussions were initiated by the relevant Program Directors. For the Departments proposing new programs, several drafts of their new program proposals were shared with the Department faculty for comments and suggested revisions. In parallel, the faculty in the individual AMP, MAC and MPO programs also had meetings and were engaged in e-mail discussions across their respective mailing lists. The proposed restructure across the School was presented and discussed at a School-wide faculty meeting on October 10, 2014. Following this, two meetings were held with the Rosenstiel School Council, in which the voting process was formalized. Further meetings were held with the Rosenstiel Leadership Group (comprising the Dean, all Chairs and Associate Deans, and the Vice Chair of the School Council).

The Provost attended one of these Leadership Group meetings and was briefed on the proposed restructure.
All votes were conducted anonymously via e-mail. The Departmental votes were administered by their respective Chairs. The Program votes were administered by the Vice Chair of the School Council, in which only those faculty belonging to the program were eligible to vote. The language in the program votes was determined by the School Council, in consultation with the Program Academic Committees and faculty.

The 5-page cover memo, presented at the front of the full package, was distributed among all Rosenstiel School faculty for comments and revisions. Following the input from faculty and the collection of memos from the Dean, School Council, and all Chairs and Program Directors, the full package was finalized and submitted to the Graduate School on November 10, 2014.

Q2: Describe the process so far with the Graduate School.

The first reading with the Graduate Council was held on November 18, 2014. A presentation of the full package was given, and questions by the Graduate School Dean and Graduate Council were responded to at the meeting. The personnel leading the development of each of the three proposed new M.S. and Ph.D. programs (ATM, MES, OCE) were present to respond to questions.

The second reading with the Graduate Council will be held on January 20, 2015. Graduate School Dean Brian Blake notified us that the program restructuring was all approved, and that a formal memorandum and minor comments would be forthcoming.

The process with PIRA has also been initiated, as per the guidelines on new programs from the Senate.

Q3: Describe the governance process for the new programs.

The new programs will be governed following the UM Faculty Manual and the Bylaws of the Rosenstiel School. In each of the five Departments, the respective program will be led by a Program Director who is appointed by the Department Chair, in consultation with the Department faculty. In an inter-departmental program such as MPO, the Director is appointed by the Associate Dean of Graduate Studies, in consultation with the relevant Department Chairs and the program's faculty. Each program will have its own Academic Committee. All academic matters relevant to most or all of the School will be handled through the Graduate Academic Committee, which will comprise the Directors in each program, as well the Associate Deans of Graduate Studies.

In situations where there is common ground across two or more programs, there will also be careful coordination between the Program Directors and Academic Committees of the respective programs and the relevant Department Chairs when needed. As is done presently in programs that currently share common ground, the programs will collaborate on preparing materials to attract prospective graduate students, and to present at other universities and at conferences. Student applications to different programs will continue to be shared between programs, consistent with the current practice. The coordination of courses, seminars, awards etc. will be conducted by the Program Directors, seminar chairs etc. as is relevant, in consultation with the relevant Department Chairs.

Q4: What is the financial model and impact on the University?

There will be no need for additional financial support from the University.

There will be no proposed changes to the current financial model. The activities of graduate students are supported by graduate tuition income. The following standard models exist for most Ph.D. and M.S. students (there is a little variability for students with Fellowships):

- Ph.D. Students
  - Years 1-3: Annual stipend, tuition, health insurance, conference travel etc. supported on extramurally funded research grant
  - Years 4-5: Student supported by School
- M.S. Students
  - Supported by extramural grants or self-supported

The projected number of M.S. and Ph.D. students is conservatively projected to increase by about 15% by 2021. Therefore, the financial impact on the School is expected to be positive, through increased tuition revenue.

Q5: What is the impact on undergraduate teaching?

There will be no net change to the undergraduate teaching or advising load.

At the Rosenstiel School, there is a need to increase the efficiency of some courses (e.g. those with small class sizes). The proposed programmatic restructure offers the opportunity to restructure both the graduate and undergraduate courses. There are under-utilized faculty resources at the Rosenstiel School to teach, especially in Ocean Sciences who have a large faculty body and no undergraduate program yet.

A few revised or new graduate courses will be made available to suitably qualified senior-level undergraduate students, thereby enhancing the undergraduate program.

The introduction of the new graduate programs will not necessitate a proliferation of new courses, unless there are available faculty resources for teaching. Several courses (such as Geophysical Fluid Dynamics and Climate Dynamics) will be shared by students belonging to the ATM, OCE and MPO programs, thereby enhancing the cohort across the different programs. The faculty teaching resources committed to the existing programs at both graduate and undergraduate level will not be reduced.

Q6: For the two programs that are proposed to be phased out (AMP and MAC), what is the plan for the programs and the current students enrolled in these programs?

The AMP and MAC programs will continue, for as long as students are enrolled in the programs. Each program will remain on the books until after the last student has graduated.

There will be no impact on the current students who elect to remain in the AMP and MAC programs. The relevant core courses will still be taught, and there will be no substantial changes to key elective courses.

All students will be given the opportunity to transfer into the new programs.

Q7: There are currently 3 programs in the physical and chemical sciences (AMP, MAC, MPO), and the proposal is for MPO to continue and for two new programs (ATM, OCE) to be established. What do the new programs bring to the table in addition to what is already offered in MPO?

The inter-departmental MPO program reflects an existing strength at the Rosenstiel School, in which students are educated in the physical processes of both the atmosphere and ocean. There is student demand in this area, and interest from many MPO program faculty in preserving the program with no changes. The new ATM and OCE programs provide the opportunity to expand beyond this scope. For

example, many students are interested in studying either the atmospheric medium or the ocean medium, each of which can be inter-disciplinary in its own right (e.g. chemistry and physics and biology intertwined). Some students prefer a specific focus in only one discipline (e.g. atmospheric dynamics). The expansion of opportunities provided by these new programs is expected to attract a broader range of talented students, together with top faculty applicants. The new programs are also expected to raise the visibility worldwide, through distinctive identities aligned with the departments that students can easily find.

The new ATM and OCE programs will also be aligned with the relevant Master of Professional Science tracks housed in the respective departments, and respectively with the ATM undergraduate program and a future OCE undergraduate program that is under development.

Q8: How is inter-disciplinary education handled within the new programmatic structure?

The MPO program offers an inter-disciplinary education in the physical sciences, across both the atmosphere and ocean. The OCE program will be inter-disciplinary in its own right, with students interested in the physics, chemistry, biology and geosciences of the ocean being able to take a diverse range of courses and organize dissertation committees that span these disciplines. Similarly, students in ATM interested in inter-disciplinary studies of the atmosphere would be able to engage in the physics, chemistry and dynamics of the atmosphere, and opportunities will be provided for them to also engage in atmospheric science policy and other potential disciplines such as communication and sustainability.

Additionally, some scientific areas are inter-disciplinary across several programs. One example is climate. While the student would obtain a M.S. or Ph.D. degree in a 'home' program, meeting the requirements of that program, they would simultaneously engage in a new 'concentration' in climate. This concentration would involve a climate seminar series, an annual Colloquium with invited experts from outside Miami, and recommended courses that expand beyond the student's home program, thereby building a cohort of climate-oriented students in several different core disciplines. For example, a student in the MPO program can take courses on the effects of climate change on coral reefs (MBE) and climate policy (MES), and others if they are interested. Hence, while the programs are proposed to be more cleanly aligned with the departments in the new structure than is presently the case, opportunities for inter-disciplinary studies will be emphasized more formally than is presently being done.

Q9: The vote by MPO program was 14-6 in favor; what was the thinking behind the votes against?

The language in the MPO vote, as recommended by the Rosenstiel School Council, was the following: "As a faculty member in the MPO program, I support the establishment of the new OCE and ATM programs that are being developed within their respective departments, together with the long-term continuation of the MPO program." An interpretation of the six "No" votes could represent a lack of support for the new OCE and ATM programs, or a lack of support for the long-term continuation of the MPO program. Since the voting process was anonymous, the precise interpretation is unknown. There have been numerous faculty meetings (within departments, programs, and RSMAS-wide) in which concerns have been discussed. In particular, the question of overlap between MPO and the two other new programs (ATM and OCE) has been extensively discussed. Moving forward, this concern will be addressed by continuing with our practices of coordination (through the Graduate Studies Office and through the Graduate Academic Committee) among programs that currently overlap (see response to Q3).

Overall, 70% of the faculty in the MPO program were in favor of both the establishment of the new programs and the long-term continuation of the MPO program.

Q10: How will we evaluate the success of the new programs?

The success of the new programs will be evaluated both in the short-term and long-term, comparing against previous years in our programs, and also against comparable national programs.

The number of applicants, and the quality of applicants (via GPA, GRE and undergraduate program strengths) will be evaluated against previous years. For example, the combination of ATM, MPO and OCE applicants from 2016 will be evaluated against AMP, MPO and MAC applicants up to and including 2015. The ratio of students given offers by the programs to students enrolling in the programs will also be assessed. The quality of the students enrolled in the new programs will be monitored each year.

The assessment measures related to the learning outcomes in the annual SACS assessments provide another metric for evaluation, for students at different stages in the program. These measures include: success in the comprehensive and qualifying exams, quality of student seminar presentations, and the quality of the defense. Additionally, the quality and quantity of papers published in the peer-reviewed literature are an important metric, and any prestigious awards won at conferences will also be counted. Finally, the number of students receiving national scholarships and UM fellowships will be documented.

In the long-term, the career paths of M.S. and Ph.D. graduates will be monitored and compared with the career paths of students who have graduated in the past 5 years, whom we have been in contact with. In particular, the ability of our graduates to attain high-profile positions such as a faculty member at a top university, a researcher being a principal investigator of their own funded projects, or an influential figure in science policy will be recorded.

Q11: There is a typo on the third line from the bottom on Page 4 of the cover memo in regard to the number of Ph.D. students expected to be enrolled in MES by 2021. How many students are expected?

From discussions with the MES faculty, a conservative total of about 15 Ph.D. students enrolled in MES by 2021 are expected. The MES program will remain largely comprised of M.S. students, whose body is presently enrolled in the Marine Affairs and Policy M.S. program (about 30).

[End Memorandum]

Voting Process and Results

The Voting Process and Results

School Council Votes

On the advice of the Chair and Vice Chairs of the Senate, a vote on all the different actions was conducted by the Rosenstiel School Council, on behalf of the School. The School Council discussed and voted on the following statement at a School Council meeting on February 3rd, 2015: "I approve the entire package, including all of the individual proposals to establish new programs, together with the renaming of other programs." This statement was **supported 5-0** by the voting School Council members.

Departmental Votes

Voting on the 5 departmental programs was conducted in October 2014, led by the respective department Chair. In the MES, MBE and MGS departments, the votes were conducted and counted at their respective faculty meetings. In the OCE and ATM departments, the votes were conducted via e-mail, in a process organized by their respective Chair. Each faculty member casted their vote anonymously via e-mail to the Secretary. For each of the 5 departments, their Chair reported the results in a Memorandum, contained within this package.

D1. Department of Ocean Sciences (OCE)

- New M.S. and Ph.D. program proposal in Ocean Sciences. **Supported 19-1** (1 abstain)

D2. Department of Atmospheric Sciences (ATM)

- New M.S. and Ph.D. program proposal in Atmospheric Sciences. **Supported 11-0.**

D3. Department of Marine Ecosystems and Society (MES)

- New Ph.D. program proposal in Marine Ecosystems and Society. **Supported 10-0.**
- M.S. program name change from Marine Affairs and Policy (MAF) to Marine Ecosystems and Society (MES). **Supported 10-0.**

D4. Department of Marine Biology and Ecology (MBE)

- M.S. and Ph.D. program name change from Marine Biology and Fisheries (MBF) to Marine Biology and Ecology (MBE). **Supported 14-0.**

D5. Department of Marine Geosciences (MGS)

- Proposal for new Certificate Program in Applied Carbonate Geology. **Supported 8-0.**
- M.S. and Ph.D. program name change from Marine Geology and Geophysics (MGG) to Marine Geosciences (MGS). **Supported 8-0.**

Existing Program Votes

All votes pertaining to the 3 existing programs in the physical and chemical sciences (AMP, MAC, MPO) were conducted by the Rosenstiel School Council between October 30 – November 3 2014. The process and the language of the votes were formalized by the School Council together with the faculty in the respective programs. The proposals for the new OCE and ATM programs were distributed to all faculty in these programs prior to the initiation of the voting, which was held at the same time as the departmental voting. All votes were made anonymously via e-mail to an account handled solely by the Library staff. The Vice Chair of the Rosenstiel School Council reported the results to the Faculty. The results from each program are reported in Memoranda from the respective Program Directors, which are included in this package.

E1. Applied Marine Physics (AMP)

- "As a faculty member in the AMP program, I support the establishment of the new OCE and ATM graduate programs. My future students will not be recruited into the AMP program. The AMP program will continue to function for existing students until they graduate and/or transfer to the new programs."
  Supported 6-0.

E2. Marine and Atmospheric Chemistry (MAC)

- "As a faculty member in the MAC program, I support the establishment of the new OCE and ATM graduate programs. My future students will not be recruited into the MAC program. The MAC program will continue to function for existing students until they graduate and/or transfer to the new programs."
  Supported 7-0.

E3. Meteorology and Physical Oceanography (MPO)

"As a faculty member in the MPO program, I support the establishment of the new OCE and ATM programs that are being developed within their respective departments, together with the long-term continuation of the MPO program."
Supported 14-6.

NOTE: Each faculty member with voting rights in the OCE and ATM departments was eligible to vote only once for their department, and only once for the existing program that they presently belong to. No faculty member voted in more than one department. No faculty member voted in more than one existing program.

Department of Atmospheric Sciences

Memorandum

To: The General Welfare Committee of the Faculty Senate, University of Miami

From: David S. Nolan, Chair, Department of Atmospheric Sciences

David S Nolan

Date: February 18, 2015

Re: The formation of an ATM graduate program and its impact on existing programs

---

The Department of Atmospheric Sciences proposes the formation of M.S. and Ph.D. programs in Atmospheric Sciences, governed by an academic committee of Graduate Faculty within the department. This program will serve the needs of the faculty and students of our department by providing a flexible curriculum that can accommodate current and future research areas in the physics and chemistry of the atmosphere. The ATM faculty voted unanimously to support the establishment of this program.

Impact on Existing programs:

Some faculty members who presently recruit students into the Meteorology and Physical Oceanography (MPO) program will now have expanded opportunities for student recruitment. We expect that ATM faculty will recruit new graduate students into either the ATM or MPO programs, by taking into consideration each student's strengths, their interests, and the emphasis of their anticipated research projects. Based on the research and recruitment activity of the current ATM faculty, we expect the number of ATM graduate students to reach about 30 students within 5 years. The total number of students

in MPO will decrease as faculty recruit into ATM, but based on faculty surveys in ATM and OCE, we project that in the number of MPO graduate students will equilibrate to 35 by year 2021. This will be the only impact on the MPO program, as the courses and all other aspects of the program will remain as is. The students that remain in the MPO program will be expected to develop a level of expertise in both oceanography and meteorology, which is the central concept and uniqueness of that program.

One of the top priorities at RSMAS and in every department is to recruit the highest caliber students, including students with externally funded fellowships. The addition of the ATM program will provide more exposure for graduate programs at RSMAS by emphasizing, for interested students, more areas of research. This improved exposure may serve to further strengthen recruitment for both MPO and ATM.

Some of the required courses for students in the new MS and PhD programs of ATM overlap with the existing required MPO courses. Therefore our department has a vested interest in maintaining the current course offerings that serve both the MPO and ATM programs. Finally, a number of our faculty members in the ATM department remain committed to the MPO program since their students are served well by that curriculum. As long as those faculty continue to recruit into that program, the Department of Atmospheric Sciences will continue to support it.

The existing Atmospheric Chemistry component of the Marine and Atmospheric Chemistry program will eventually be entirely contained in the ATM graduate program. This is reflected in the memo by the MAC faculty who have voted unanimously to discontinue recruitment into that program. The formation of the ATM graduate programs will ensure that current and future faculty in atmospheric chemistry and related fields will have a suitable curriculum for their graduate students, while at the same time those students will be part of a larger cohort of incoming peers.

UNIVERSITY OF MIAMI
ROSENSTIEL
SCHOOL of MARINE &
ATMOSPHERIC SCIENCE

Department of Atmospheric Sciences
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149, USA

Phone: 305-421-4930 Email: dnolan@rsmas.miami.edu

Memorandum

To: M. Brian Blake, Dean of the Graduate School
Cc: Amy Clement, Associate Dean of Graduate Studies, RSMAS
Roni Avissar, Dean of RSMAS

From: David S. Nolan, Chair, Department of Atmospheric Sciences

David S Nolan

Date: November 5, 2014

Re: Faculty support for the proposed M.S. and Ph.D. program in Atmospheric Sciences

-

The purpose of this memorandum is to report on the level of support within the Department of Atmospheric Sciences for the creation of a new M.S. and Ph.D. program in Atmospheric Sciences.

A secret-ballot vote, managed by the department administrator, was taken of the eligible ATM faculty as to whether they supported the content and spirit of the proposal for the ATM graduate program. Faculty were asked to vote, yes, no, or abstain to the following proposition:

"I support the proposal for the establishment of the new ATM M.S. and Ph.D. program."

The vote was 11-0 in favor, with no abstentions.

Department of Atmospheric Sciences

Proposal to Offer the Degree

Doctor of Philosophy and Master of Science

1. RATIONALE – *Summary of intellectual and academic need for each proposed degree*

The global society and economy are profoundly affected by the behavior of the atmosphere. The impacts of weather events such as hurricanes and severe storms cause unacceptable losses of life and property. Changes to the chemical and biological composition of the atmosphere affect human health and also have long-term impacts on the earth's climate. The physics of clouds and many other atmospheric processes are essential to advancing our understanding of weather and climate, and the future of the atmosphere in which we live and breathe. Assessing human impacts, vulnerability and risk, and communicating these effectively with users, is a critical challenge. With the need to build society's resilience to high-impact events, it is necessary to train the next generation of scientists, communicators and policy makers at an advanced level to make a difference in solving critical problems that affect mankind.

In recognition of these major challenges to society, and given the expertise of a core of faculty at the Rosenstiel School of Marine and Atmospheric Science (RSMAS), a new Department of Atmospheric Sciences (ATM) was established in June 2014 as part of the restructuring of RSMAS into departments. A new ATM graduate program is important for several reasons:

- The distinct identity and promotion of a nationally prominent ATM program is essential to make UM more competitive in attracting students of higher caliber than is currently realized given the low profile of the atmospheric sciences in the existing programs. Even with superior stipends and the provision of 5-year Ph.D. research assistantships, the number and quality of applicants to UM is substantially inferior to those in leading national programs in atmospheric science. With the visibility of a new ATM program, the added variety of research and educational activities and opportunities would be better exposed to the outside world, with the intention to attract strong students who may not consider applying to the existing programs. An immediately recognizable program would provide a 'positive feedback' effect with successful students and graduates leading to superior future generations of applicants and enrollments. In addition to attracting students, the high profile and excitement of a new ATM program would appeal to rising stars applying for faculty positions and research fellowships in the department, and employers seeking to hire advanced graduates. The opportunity to help take 'ownership' of a new program and contribute to its development is expected to be appealing to faculty applicants.

- The creation of an ATM program will offer the flexibility to push the boundaries of educational capabilities in emerging areas of the atmospheric sciences, as faculty interests diversify and as new faculty are hired. As the departmental strategic plan is developed and periodically revised, the new programmatic structure will be equipped to respond to the adjustment to the new strategic priorities, which will also map onto top priorities in national agencies, the American Meteorological Society, and the World Meteorological Organization. Some diverse priorities in atmospheric science over the next decade include understanding the physics and chemistry of atmospheric aerosols, improving predictions of and responses to extreme events on the time scales of minutes to seasonal, understanding climate change to build sustainability, and further advancing our understanding of the whole Earth system via atmospheric interactions with the land surface and oceans.

- The recent reformation into departments has left atmospheric chemistry without a programmatic home. Due to its small size (less than ten students), the Marine and Atmospheric Chemistry program was not successful at recruiting new students, and their faculty have agreed to recruit students into the new programs including ATM. The introduction of chemistry as a prominent discipline in a visible and substantial ATM program will help revitalize atmospheric chemistry education and add an extra dimension to the atmospheric sciences at UM. Important topics over the next decade in which chemistry is critical include air pollution in tropical megacities and climate change. Chemistry has proven to be successful in atmospheric sciences programs around the nation (e.g. Washington, Colorado State, Penn State).

- The establishment of an ATM graduate program will provide a clean programmatic mechanism for aligning directly and coordinating with the successful ATM undergraduate program, and the Master of Professional Science tracks housed within the ATM department. An exciting and coherent portfolio of courses and activities will emerge as a result. In parallel, collaborations across UM that have not been accomplished to date would be achievable, for example with UM experts in engineering, sustainability, communication, economics, policy, and ecology.

- The uniqueness of UM in its core expertise of tropical meteorology, climate physics and dynamics will also be given higher visibility within an ATM graduate program. The geographical location of Miami is unique in the United States for students to live, breathe, and investigate the tropical atmosphere in a changing climate. With its increased exposure, ATM at UM would emerge as the national focal point for the science of the tropical atmosphere, attracting a diverse array of distinguished visitors, public and media interest, and linkages with policy-makers and industry.

The above reasons are consistent with the UM strategic plan, which states that UM has been lacking "the breadth and depth of faculty, research, and graduate programs that mark the AAU institutions." The faculty of ATM will commit to developing a high-quality, *reputation-enhancing* program that is characterized in the UM strategic plan by (a) an excellent student body that has been recruited around the world, (b) a history of placement among top institutions of higher education or other appropriate scholarly or research settings, (c) a high level of commitment by the faculty to the graduate program, including graduate course offerings and one-on-one mentoring, and (d) the high cost associated with the tuition waivers and student stipends generally required to mount such a program. All these characteristics exist somewhat in the existing programs, but there is considerable room for improvement (e.g. a lack of Ph.D. graduates from the past decade presently in faculty positions). Additionally, ATM will strive to be a *research-enhancing* program that attracts top research faculty. A new, vibrant Ph.D. program with strong students will appeal to the best faculty candidates. Finally, the existing and new programs are *revenue-enhancing*, via student tuition raised through extramural grants, and indirect cost recovery. Moreover, the Master of Professional Science tracks, which are being moved into the new ATM departments, bring in revenue that contributes to improving the overall educational capability in ATM.

An M.S. and Ph.D. program under one umbrella is proposed, with the program governed by an academic committee of Graduate Faculty within the ATM department.

a. Exact degree title

- Master of Science in Atmospheric Sciences
- Doctor of Philosophy in Atmospheric Sciences

b. Purpose and goals of the degree

The broad purpose of the degree is to advance students' knowledge and understanding of the science of the atmosphere, primarily through class instruction and dissertation research. Through a carefully designed portfolio of graduate-level courses, students are expected to formalize their knowledge of the fundamentals within their own sub-discipline (e.g. physics of climate) and related disciplines within and outside atmospheric science. In parallel, students will be trained to conduct leading-edge research in their chosen area, developing the skills to pursue independent research while experiencing all the steps of the research process. The process involves designing research ideas, testing these ideas, and communicating the results through the peer-reviewed literature, and through seminars and conferences. Additionally, all Ph.D. students will be trained in education and communication, via serving as Teaching Assistants for the undergraduate ATM program.

The ultimate goal is for our graduates to develop into leaders in the atmospheric sciences and related fields, and thereby contribute to better informing the public and policy makers on how to prepare for hazards and changes in the weather-climate system.

c. Level of Demand for the Program

i. Job market outlook

The job market for M.S. and Ph.D. graduates in the atmospheric sciences is healthy and diverse. There are several successful programs in atmospheric sciences around the nation, and graduates in the field have entered into the following markets:

- **Research:** Graduates in atmospheric science often pursue a research career, either at a university or a government research lab, or in the private sector. Government agencies include NASA, NOAA, US Navy, Department of Energy and several others.
- **Education:** Over 100 universities nationwide include a component of atmospheric science in their undergraduate degree, as a major, minor, or as cognate-type courses. Over the past decade, there has been growing demand by undergraduates to study atmospheric sciences, and universities are continuing to hire faculty in this area.
- **Outreach and Communication:** There is a growing need to communicate aspects of extreme weather, climate, air pollution, etc. to policy-makers, media, and society.
- **Industry:** Advanced graduates in atmospheric science are hired by the reinsurance industry (weather and climate risk), instrument manufacturers, graphical product developers, weather- and climate-sensitive sectors such as water, oil and energy companies, and prediction companies that tailor to clients with specific needs.

The most recent 25 M.S. and Ph.D. graduates advised by ATM faculty in the past 5 years have taken up the following positions:

- Academia
  - Assistant Professor of Chemistry, Lawrence University
  - Lecturer in Environmental Sciences, Emory University
  - Postdoctoral Scientists at the following institutions: Max Planck Institute for Chemistry, University of Hawaii, National Center for Atmospheric Research (NCAR), University of Miami, University of Oklahoma, Colorado State University, Rutgers University, NASA, Naval Research New York University
- Research Laboratories

- Research Scientist, National Institute of Standards and Technology (NIST)
- Research Scientist, NASA
- Assistant Atmospheric Scientist, Argonne National Laboratory
- Research Meteorologist, Japan Meteorological Agency

- Private Sector
  - Meteorologist, ImpactWeather Inc.

- Outreach and K-12 Education
  - TV Weather Presenter
  - Science Curator
  - High School Teacher

ii. Similar programs at other universities

There is a broad spectrum of graduate programs in the atmospheric sciences across the United States, virtually all at state universities. These programs can be divided into approximate tiers (number of tenured or tenure-track faculty and graduate students in parentheses):

- **Large graduate programs:** Atmospheric Sciences departments at six state universities housing undergraduate and graduate programs:

SUNY Albany (19 faculty, 64 graduate students), Colorado State (19, 85), Oklahoma (25, 88), Penn State (25, 71), Texas A&M (21, 60), Washington (19, 65)

These departments also employ several non-tenured instructors, mostly for undergraduate programs. The research interests of their faculty span a broad spectrum in atmospheric sciences, from polar to tropical meteorology and climate, in the physical, chemical and biological disciplines.

At these universities, many graduate students in the atmospheric sciences (particularly at the M.S. level) are funded by Teaching Assistantships provided by the state. This is a very different model from UM, in which all students in ATM would be funded through research assistantships or fellowships.

The level of demand for these programs in the atmospheric sciences is high and increasing:

- At Albany, the number of applicants to the graduate program has risen from about **50 to 100** over the past 5 years. 15-20 students are admitted each year.
- At Oklahoma, the number of applicants to the graduate program has risen from about **80 to 140** over the past 5 years. 15-20 students are admitted each year.

- At Penn State, there are around **100** applicants per year. Around 12 students are admitted each year.
- At Washington, there were around **175** applicants last year. 10-15 students are admitted each year.

In contrast, the existing Meteorology and Physical Oceanography (MPO) program at UM, which comprises 25 faculty, has about 75 applicants per year. About **40** of these are applying to study the atmospheric sciences, though the quality of many of these applicants is low. Hence, the *applications to UM lag substantially behind the leading programs*.

- **Medium-sized programs:** Departments at mostly state universities, with some variance in the sizes of their undergraduate versus graduate programs. Some of these graduate programs are housed within a Department of Atmospheric Sciences (underlined), as would be the model at UM. Other graduate programs in Atmospheric Sciences are housed within larger departments with multiple disciplines (e.g. Department of Marine, Earth and Atmospheric Sciences). All these programs have been in existence for at least 20 years, demonstrating sustainability. Comparable examples include:

Arizona (9 faculty), Colorado at Boulder (13), Cornell (6), Florida State (14), Georgia Tech (16), Hawaii (13), Illinois (13 faculty, 48 students), Maryland (14), MIT (8), Naval Postgraduate School (7), North Carolina State (10), Purdue (8), Rutgers (12), UCLA (13), Utah (11), Virginia (9), Wisconsin (13).

The breadth of faculty interests in these programs is not as comprehensive as in the large programs. Some programs have distinct specialties (e.g. atmospheric chemistry and climate at Georgia Tech, and satellite meteorology at Wisconsin). The number of students in atmospheric sciences in these departments is less clear, since the listings are either unavailable or include students in disciplines outside atmospheric sciences (e.g. geophysics). In most of these programs, the number is about 30, plus or minus 10.

- **Small programs:** Atmospheric Sciences graduate programs which are housed either in a small Atmospheric Sciences department or within a multi-disciplinary department, with either a small undergraduate major or no major in Meteorology / Atmospheric Sciences. Examples of these programs, which have fewer than 10 faculty specializing in atmospheric sciences, include Alaska, Alabama at Huntsville, Arizona, California at Davis, Iowa State, Naval Postgraduate School, SUNY Stony Brook, Texas Tech, Wyoming.

Our new ATM program will be expected to establish itself within the upper echelon of the second, medium-sized tier. Our program would build on its core strengths of tropical weather

and climate, and will build in the flexibility to accommodate new areas of atmospheric science beginning with chemistry, culminating in a top-10 program nationally.

Student applicants to all M.S. and especially Ph.D. programs come from a large national and international pool, with no significant demographic based on the state. Of the 26 current M.S. and Ph.D. students advised by faculty in the ATM department, 12 are from overseas. Only one of the 26 students is from Florida.

The following programs are selected for comparison in Section 8: Colorado State, Cornell, Washington, Illinois, Utah. These were chosen to include arguably the two strongest programs in the country (Colorado State and Washington), one program within a leading private university (Cornell), and two programs hosted within departments of comparable size.

d. Relationship of proposed program to other cognate fields

The proposed ATM program will be complementary to three programs at the University of Miami, and also a relevant program at Florida International University:

- **Oceanography (OCE)** – another new M.S. and Ph.D. program in the Ocean Sciences department that is concurrently being proposed at the Rosenstiel School of Marine and Atmospheric Science (RSMAS).

- **Meteorology and Physical Oceanography (MPO)** – an existing inter-departmental M.S. and Ph.D. program at RSMAS. This program will continue to accept students.

- **Marine and Atmospheric Chemistry (MAC)** – an existing M.S. and Ph.D. program at RSMAS that focuses on chemical aspects of the atmosphere-ocean system. This small program will continue for as long as there are students in the program, though the MAC faculty will be recruiting into the ATM and OCE programs once they are established.

- **Florida International University (FIU) Earth and Environment** – UM has an agreement with FIU, which enables students in each university to take up to 2 courses in the other university. FIU has complementary strengths, for example in impacts and catastrophe modeling. The Department of Atmospheric Sciences has close ties with faculty at FIU, including Professors Rob Burgman, Hugh Willoughby and Ping Zhu.

All graduate students studying the physical and dynamical aspects of atmospheric sciences currently belong to the MPO program. Students in the MPO program who meet all their program requirements will be able to transfer into the ATM program if they choose to do so, as they will have simultaneously met the ATM program requirements. Similarly, students in the MAC program will be able to transfer into the ATM program if they choose to do so.

Relation to and impact on existing programs

The only existing program that will continue is **MPO**, which houses about 50 students advised by faculty belonging to the former MPO division. This program will remain as is, governed by a Program Director and an Academic Committee across the ATM and OCE departments. The Program Director is appointed by the dean or delegated associated dean of graduate studies in consultation with the relevant department chairs and the program's faculty. The programmatic structure of MPO will remain as is, including the same required courses and suite of elective courses taught by faculty in the ATM and OCE departments. The new programs are designed so as not to increase the graduate or undergraduate teaching loads of faculty involved in any of the programs, including MPO. Students enrolled in the MPO program will share several courses and seminars with students enrolled in the ATM and OCE programs, and therefore there will be broader student camaraderie and a 'cohort' extending beyond each individual program. There will be no impact on the existing program budget, which is largely handled by the School, and there will be no impact on facilities or space.

The main impact on MPO will be a reduction in the number of students pursuing a degree in MPO. The current number of about 50 is expected to decrease slowly to an equilibrium of about 35 over the next 7 years, as students begin to enroll in the new programs. Several faculty in ATM and OCE have expressed their desire to continue to recruit students in MPO. Therefore, it is expected that MPO will have a stable future. The program will admit students in the same way as the other programs.

Given the natural connections between the atmosphere and ocean, there will be some common ground across ATM, OCE and MPO. At the same time, each program will also possess a distinct identity and be complementary to each other. ATM will focus on the dynamics, physics, and chemistry of the atmosphere, with extensions to other relevant areas (e.g. atmospheric science policy). OCE will include studies of the dynamics, physics, chemistry and biology in the ocean, with interdisciplinary connections. MPO will continue to admit students interested in weather, climate, ocean circulation and physical processes, and air-sea interactions. Given that faculty in the AMP and MAC programs have stated that they are not planning to continue admitting students in those programs, the establishment of the new programs will also be necessary in order to extend beyond the scope and reach of MPO that could not be achieved by simply reorganizing MPO. Therefore, we are confident that the three complementary programs will all thrive, and synergies between each of them will be exploited through coordination and inclusivity across the programs.

Through coordination by the RSMAS Graduate Academic Committee and the respective Program Directors and committees of the respective programs, the programs will be reviewed, revised and marketed in order for each of them to reach their potential.

e. Relationship of proposed program to undergraduate and professional programs

The establishment of a new ATM graduate program will provide a necessary direct alignment with the existing undergraduate ATM program and the Master of Professional Science tracks housed in ATM. The coordination of activities listed below will be facilitated via unified overarching governance of and communication between the separate programs.

- **Undergraduate Meteorology program (code: ATM):** http://www.rsmas.miami.edu/academics/undergraduate/meteorology-program/

  The graduate and undergraduate programs would be connected in several ways:

  - **Courses**: Some courses can be taken as electives by senior-level ATM undergraduates and by graduate students in their first or second years. Examples include Mesoscale Meteorology, Climate Change and a new course on Hurricanes.

  - **National Honor Society**: The Chi Epsilon Pi chapter at UM comprises accomplished undergraduate and graduate students to promote the field, and to advance extracurricular learning via inviting speakers, field trips to weather and emergency offices, and activities through the American Meteorological Society.

  - **Teaching Assistants**: The educational training program at RSMAS enables graduate students to serve as teaching assistants for undergraduate ATM courses on Coral Gables campus.

  - **Research**: Undergraduate students frequently participate in the research programs of the ATM faculty. Graduate students interact with undergraduates through these research projects, giving graduate students an opportunity to develop skills in informal mentoring and training.

- **Master of Professional Science (MPS):** http://mps.rsmas.miami.edu/

  The growing MPS program is for students seeking a 1-year degree and simultaneous experience (via an internship) within the profession of their choice. These students are self-funded. The program contains several tracks in Atmospheric Sciences, presently including (a) Broadcast Meteorology, (b) Computational Meteorology and Oceanography, (c) Weather, Climate and Society, and (d) Weather Forecasting. These existing tracks will be transferred into the ATM department. The new M.S. and Ph.D. programs in ATM would be connected to the MPS program in several ways:

- **Courses**: MPS students would take several graduate courses in common with first- and second-year M.S. and Ph.D. students in Atmospheric Sciences.

- **Seminars and Activities**: MPS, M.S. and Ph.D. students would participate together in regular Departmental Seminars, and other activities such as public outreach (e.g. talks on hurricanes), radio and television programs (e.g. Weather Channel), and inviting external speakers (e.g. a well-known climate policy analyst).

- **Transfer into M.S. and Ph.D. Program**: Outstanding MPS students who are interested in pursuing research are eligible for admission into the M.S. and Ph.D. programs.

2. ***RESOURCES*** – *List and evaluate all of the physical resources available and what will be needed in addition to implement the proposed program.*

   a. *Library. Survey of library print and electronic resources, collections, documents, major sets, data, and tools in all formats*
      i. *Special or unique resources the UM libraries currently have*
      ii. *Additional library resources needed and their estimated cost*
      iii. *Estimate of incremental library needs per year*
      iv. *Demonstrate that library resources are adequate not only for instruction, but for the research of faculty recruited as part of the program*

The proposed program will not require any additions to the library at RSMAS. The Library holds more than 125,000 volumes and has 537 current journals through subscription, gift, or exchange. Over sixty percent of the journals are in electronic format. In addition to journals and books, library holdings also include reports from private, state, federal, and international agencies and organizations. Other library holdings include several thousand maps and nautical charts, atlases, expedition reports, and rare books. The online catalog, IBISWEB, provides access to the resources of the University of Miami Libraries as well as the holdings of the RSMAS Library; through university-wide resource sharing, RSMAS Library patrons are able to access hundreds of databases and thousands of electronic journals and books.

Laboratory Facilities, Equipment and Space

   v. *Existing laboratory facilities and equipment*

- **Computing Facilities**

All graduate students have access to a nationally leading Center for Computational Science (CCS) at UM. Many students in the atmospheric sciences use this high-performance

supercomputing facility. CCS maintains one of the largest centralized academic cyber-infrastructures in the country with numerous assets. The High Performance Computing team has been in operation for the past five years. Over that time, the core has grown from zero cyber-infrastructure to a high-performance computing environment that currently supports more than 1,200 users, 220 TFlops of computational power, and more than 3 Petabytes of disk storage. The center's latest system acquisition, an IBM IDataPlex system, has been ranked at number 389 on the November 2012 Top 500 Supercomputer Sites list and has over 6000 x86 computational cores. Currently CCS supports the Nation's leading weather (Weather Research and Forecasting model; WRF) and climate (Community Earth System Model; CESM1) simulation systems, and regular training sessions in the use of these models on CCS HPC systems.

- **Cloud Observatory**

The Cloud-Aerosol Rain Observatory (CARObb) observatory has been built to improve our understanding of low cloud behavior and cloud-aerosol interactions through routine, frequent, and multi-year measurements. This laboratory is already used by students for research and will be incorporated into coursework for M.S. and Ph.D. students in Atmospheric Sciences.

- **Atmospheric Chemistry**

Approximately 2000 square feet of lab space already exists at RSMAS, with a large amount of instrumentation for trace gas analysis.

- **UM Helicopter Observation Platform**

UM has acquired a commercial helicopter (Airbus Helicopter AS350 B3e) that has been transformed into a one-of-a-kind Helicopter Observation Platform (HOP). This new research tool, which fills critical gaps in observations of the atmosphere, is designed to carry scientific sensors and instrument inlets in the undisturbed air in front of the aircraft at low airspeed and at various altitudes. Such observations are essential for quantifying the exchanges of gases and energy at the Earth surface, as well as aerosol properties that affect the environment, the climate system, and human health. The hovering capability of the HOP is also attractive for remote sensing detection and imaging. The HOP is based at Tamiami Airport. An electronic lab for the maintenance, testing and calibration of all sensors and scientific equipment available on the aircraft is located inside the hangar. This facility will be used for teaching and research. The airport is equipped with its own meteorological observing station, and students will also be given the opportunity to learn about this type of facility and aviation weather. Scientific data collected with the HOP will be processed and analyzed at RSMAS in existing classrooms (no special lab required). Calibration of some of the scientific equipment will be carried out in the Surge-Structure-Atmosphere Interaction Facility (SUSTAIN).

- **Surge-Structure-Atmosphere Interaction Facility (SUSTAIN)**

The cornerstone of the new building at RSMAS, SUSTAIN, will be a unique facility to study atmospheric processes at the ocean surface under high wind and high waves. This is a key element in understanding energy transfer into strengthening or decaying hurricanes.

- **Field Observations**

Another substantial strength of ATM is the participation in national and international field campaigns, and collection of and access to field observations. Students in the atmospheric sciences participate in these experiments. Examples in the past 4 years include:

- CONTRAST (Convective Transport of Active Species in the Tropics, 2014), focusing on understanding the climate impact of trace gases.
- TCI-14 (Tropical Cyclone Intensity, 2014), focusing on the role of 'outflow' processes in hurricane intensity change.
- KWACEX (Key West Aerosol Cloud Experiment, 2012), focusing on shallow marine cumulus clouds in the tropics.
- PREDICT (PRE-Depression Investigation of Cloud Systems in the Tropics, 2010), focusing on tropical weather disturbances that ultimately form into hurricanes.
- Annual NOAA Hurricane Field Program. Faculty and students are given opportunities each year to fly in NOAA's "Hurricane Hunter" aircraft.

Students in the ATM program will continue to be given opportunities to participate in field experiments.

- **Future Technologies**

Unmanned aircraft are an emerging technology of the future, and ATM faculty have recently received research grants in this area. Two different types of unmanned aircraft systems have been flown in hurricanes in 2014, and subject to Federal Aviation Administration (FAA) regulations they will potentially be deployed for sampling exchange processes at the land surface. The procurement of small unmanned aircraft by ATM faculty will be explored.

vi. Laboratory facilities and equipment that will be needed

vii. Incremental laboratory equipment needs for succeeding years and estimated costs

viii. Evaluation of adequacy of existing laboratory space

ix. Estimated cost of incremental need for space for any proposed work

The existing laboratory space is mostly adequate for the needs of the M.S. and Ph.D. programs in ATM. As new types of equipment are brought in as part of the ATM faculty's funded research, they will be entrained into graduate-level education as appropriate.

b. Other Resources.

i. Other physical resources, such as office equipment and student support services, that are necessary to the proposal
ii. Estimated cost of the addition of such resources

The regular physical resources granted to the ATM department, including classrooms, office equipment, and support services, are sufficient for the graduate program.

- **"Virtual Classroom" across campuses**

In the new ATM program, several 500-level graduate courses will be made available to senior-level undergraduate students as 'capstone' elective courses to round off their education. These include popular topics such as Mesoscale Meteorology, Climate Change, and Hurricanes. To date, the constraints of commuting between the Coral Gables and Rosenstiel campuses have hindered the ability of our top undergraduates to take these courses. A proposed solution is to acquire technology to enable undergraduates to take graduate level courses remotely. Through UM's recent initiatives in online education, it is anticipated that similar resources will be available for undergraduates to participate in graduate-level classes. Such resources could include a 'virtual classroom' environment, via which students are able to follow the instructor's delivery of notes on the white board, and instructional materials using software such as Powerpoint, GoToMeeting or Blackboard Collaborate. These resources are of low cost.

3. CURRICULUM

a. Major division or divisions of the discipline in which the proposed graduate work will be offered

The ATM program will not have divisions. The core scientific disciplines presently include:

- Atmospheric Physics: cloud physics, radiative transfer, aerosol physics.
- Atmospheric Chemistry: trace gases, chemical transport, plasma and combustion chemistry
- Atmospheric Dynamics: classical fluid dynamics, vortex dynamics
- Climate Dynamics: Interaction of the atmosphere with other components of the Earth system, climate variability and change
- Atmospheric Observations: technologies for observations, data processing and analysis

- Atmospheric Modeling: components of atmospheric models, modeling techniques for weather and climate systems, atmospheric data assimilation

Future thrust areas are likely to include weather and climate policy, and may extend further to include sustainability, and associated links to ecology, engineering etc.

Additionally, there will be inter-program 'concentrations' that span across multiple programs, and which are recognizable as core strengths at UM. The two inter-program concentrations pertinent to ATM are in Climate and Hurricanes. Further details are provided in Section 3.e.

b. Evaluation of adequacy of our present undergraduate and graduate curricular structure for the proposed program

The present undergraduate curriculum is designed at a different level to that required for M.S. and Ph.D. students, though seniors will be able to take 500-level electives together with our graduate students. Via evidence from the past decade of UM B.S. graduates in meteorology/ATM who have entered graduate school, our undergraduate program does provide students with an especially strong preparation for entrance into graduate school. Seniors in our undergraduate program will be encouraged to apply to our graduate program.

Overall, about 80-90% of the core material for the new ATM program is already being routinely taught. The bulk of the proposed graduate curriculum will initially be drawn from the existing inter-departmental M.S. and Ph.D. programs in Meteorology and Physical Oceanography (MPO), and Marine and Atmospheric Chemistry (MAC). However, as suggested by our current students, there are several gaps in the graduate curriculum for students in the atmospheric sciences. The proposed ATM program will aim to address these gaps in the curricular structure, via revisions to and revitalization of existing courses and the introduction of new courses.

c. List of anticipated additions, deletions and changes in current curricular structure resulting from the new program (involved faculty listed for each item)

Overview

The establishment of the new ATM program will provide an overdue opportunity to rethink the course structure, which has not undergone a major change in two decades. Given that nearly all ATM faculty have been hired after 2001, the course structure will be adapted to allow for a range of courses that leverages the strengths of the faculty, modern research needs and new resources at the Rosenstiel School. While the core courses cover traditional fundamentals in atmospheric dynamics, physics and chemistry, which all students in their respective areas need to learn rigorously, the other courses are being revitalized in several ways, described below.

The philosophy is to begin with existing courses that are on the books in the MPO and MAC programs, and which will continue to be taught by faculty in the ATM and OCE departments. Given the differences between the backgrounds of students in dynamics and physics versus those in chemistry, the respective sets of students will have course requirements.

Required Courses

Currently, the majority of M.S. and Ph.D. students in the atmospheric sciences are enrolled in the MPO program, with a few in the MAC program. A few required courses are taken in the first year. All current students in the atmospheric sciences enrolled in MPO are currently required to take the following five courses in their first academic year:

- **Introduction to Atmospheric Science (all ATM faculty can teach this) (currently MPO 551)**
- **Geophysical Fluid Dynamics I (OCE or ATM faculty can teach this) (currently MPO 511)**
- **General Circulation of the Atmosphere (Nolan, Kirtman, others) (currently MPO 665)**
- *Principles of Physical Oceanography (currently MPO 503)*
- *Geophysical Fluid Dynamics II (currently MPO 611, required for Ph.D. students only)*

For future ATM students who focus on atmospheric dynamics and physics, there will be fewer required courses. Only the three **bolded** courses will be required in the new system. The other two courses will be electives.

For ATM students who focus on chemistry, the following courses will be required:

- **Introduction to Atmospheric Science (all ATM faculty can teach this) (currently MPO 551)**
- **Tropospheric Chemistry (Hynes, Atlas)**

The similarity of the required courses to those in the existing programs is to allow students who wish to transfer from MPO or MAC into ATM to do so seamlessly. Students in ATM who then decide to obtain a higher degree in MPO will be able to switch into the MPO program, subject to meeting the requirements of that program.

The one common course to be taken by all students in ATM is Introduction to Atmospheric Science. This course represents a survey across the entire field of atmospheric science. In order to accommodate students in atmospheric chemistry and other non-dynamical aspects of atmospheric science, the course syllabus will be altered in order to focus more on the concepts across the wide breadth of atmospheric science, and less on the fluid dynamical equations.

Our plan is to have a gradual transition between the existing programs and the new ATM program, instead of an abrupt one with unnecessary barriers. As the ATM program develops, the faculty will periodically review the required courses and the Comprehensive Exam process.

Electives

Several substantive changes are proposed to provide graduate students with the fundamentals in specialty areas of the faculty; to exploit newly available resources; and to create a unique curriculum that will make UM stand out to prospective applicants and current students.

(a) Restructuring of climate courses

Currently, there exist two undergraduate courses on climate (200-level Global Climate Change and 300-level Physics of Climate), and two graduate courses (500-level Climate Change; 600-level ENSO). ATM faculty are engaged in discussions on consolidating these courses, including the introduction of a new 600-level course on Climate Dynamics, and possibly a new course on Tropical Weather and Climate that would have widespread appeal and be unique to UM.

(b) New course on Hurricanes

Given that Miami is synonymous with hurricanes, and student demand is high and the faculty are enthusiastic about the concept, a new 500-level course on hurricanes is proposed to begin in 2016. This course would appeal to senior undergraduates, MPS students, and M.S. and Ph.D. students. It would cover many aspects, from hurricane structure, thermodynamics and dynamics, to hurricane observations and modeling, through to forecasting and impacts. The course would be largely taught by ATM faculty though there will be modules taught by scientists at NOAA's Hurricane Research Division (on Virginia Key), the National Hurricane Center, and Florida International University. Discussions are under way with each institution.

(c) Atmospheric Boundary Layer course

The "Marine Atmospheric Boundary Layer" course will be reformulated into a new "Atmospheric Boundary Layer" course with a revised curriculum. A unique segment of this course will involve observations from UM's brand new Helicopter Observation Platform.

Either within this course, or combined with chemistry, or as a stand-alone course, new material on air pollution may be included. Especially with the focus on tropical meteorology and climate at UM, and the fact that most megacities around the globe lie in the tropics, UM would be uniquely positioned to advance the field in this subject that is recognized as a critical priority over the next decade by the World Meteorological Organization.

(d) Atmospheric Chemistry courses

One elective course that will be offered is Reaction Kinetics and Molecular Dynamics.

With aerosols being widely recognized as a major priority area over the next decade, the potential exists for the development of a new course that covers the physics, chemistry and transport processes of aerosols.

(e) Potential Atmospheric Modeling course

Using UM's CCS facility described in Section 2(v) in addition to large national facilities, a core strength of ATM is modeling of weather and climate processes in the atmosphere. A course that trains students on the inner workings of these models, and modeling techniques, is up for discussion in ATM. Faculty from UM Computer Science may participate in such a course.

(f) Potential Atmospheric Observations course

Another core strength in ATM is atmospheric observations. A course that provides a formal training in current and emerging technologies for observations, data processing and analysis is under consideration. Observing platforms include many types of satellites, radar, manned and unmanned aircraft. Faculty from UM Engineering may participate in such a course.

(g) Potential Weather and Climate Policy course

Several ATM faculty are involved in shaping national and international policies and priorities in the weather and climate arenas. Recently, a school-wide course on Science Policy has been introduced in conjunction with the American Meteorological Society, who are enthusiastic about sustaining and advancing the course. There exists the potential for a follow-on course that focuses on weather and climate, which would involve external instructors involved in policy making and review. This course would also appeal to undergraduate and MPS students.

(h) Joint courses with UM

In addition to the courses taught by faculty in OCE (for the oceanography and MPO programs) and elsewhere at RSMAS, several exciting new courses in conjunction with faculty at UM can be considered. These could include the following:

- Atmospheric Biology and Ecology (e.g. propagation of species in the atmosphere)
- Communicating Weather and Climate Risk (with Economics / MES departments)
- Sustainability to Weather and Climate Impacts (e.g. with engineering)

Credit Requirements

The new ATM program will require a minimum of 24-27 course credits (to be decided by a faculty vote), to be taken by Ph.D. students. The minimum number of course credits required for M.S. students will remain at 24, as per existing RSMAS regulations.

Summary of additions, deletions, and changes:

The following changes are proposed for the first year of the ATM graduate program (Academic Year 2016-17), with more to follow in subsequent years:

Additions: New courses on Tropospheric Chemistry and Hurricanes.

Deletions: Principles of Physical Oceanography, Geophysical Fluid Dynamics II as required courses (though the courses will still be available as electives).

Changes: Curricular changes to Introduction to Atmospheric Science, revitalization of Atmospheric Boundary Layer course. Some existing courses will be renamed and restructured.

d. List of current, anticipated, or agreed upon cooperative or interdisciplinary work with other components of the University, or with an extramural agency as pertinent to the proposed program

The ATM program will maintain a close link to the existing interdisciplinary MPO program and with the Oceanography program. Students in the ATM, MPO and OCE programs will take several courses and attend common seminars together.

Concentrations

New inter-program 'concentrations' are anticipated in two core strength disciplines at UM. In addition to increasing the visibility of these unique strengths, the purpose of the concentrations is to enable interdisciplinary education in relevant courses across the programs, and to provide students with a broader and more fulfilling experience outside the classroom in their area of interest. These concentrations will be coordinated through a committee involving a faculty member from ATM and faculty members in other programs across RSMAS and at UM, so that students will have available to them a portfolio of graduate-level courses that educate not only from the atmospheric perspective, but also, for example, the ocean, earth science, policy, and economics. The required courses for ATM students in these concentrations will be the same as those required for all other students in atmospheric physics and dynamics in ATM. Additional courses within and outside ATM will be coordinated by the student, their major advisor, and the committee. A website will be maintained for each concentration, listing courses and events, and showcasing relevant activities to the external world. Many of the activities listed below already take place on an informal basis, and would improve the experience of current students and the recruitment of future students with a well-defined structure.

The two potential inter-program concentrations are

- **Climate**

- A broad range of expertise: http://www.rsmas.miami.edu/groups/climate/
- Selection of courses across multiple programs
- Monthly climate seminar series
- Annual Colloquium (at least one day) on climate
- Invited speaker program
- Community outreach
- Draws a parallel with the undergraduate minor in climate

- **Hurricanes**
  - A broad range of expertise: http://hurricanes.rsmas.miami.edu
  - Selection of courses across multiple programs
  - Monthly hurricane seminar series
  - Annual Colloquium (at least one day) on hurricanes
  - Invited speaker program
  - Students give briefings and presentations at NOAA's Hurricane Research Division and National Hurricane Center in Miami
  - Field Experiment opportunities
  - Experiences in using SUSTAIN wave tank and analyzing data
  - Community outreach

Linkages with Extramural Agencies

While there is no current formal educational linkage with an extramural agency, multi-faculty proposals will be written to agencies such as the National Science Foundation (NSF) to advance graduate education. An example is the Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE) initiative, in which ATM and other faculty would collaborate on submitting a big-picture proposal on a theme such as weather, climate and society. The streamlining of graduate, MPS and undergraduate programs within ATM would facilitate the development of proposals to large-scale funding opportunities such as INSPIRE.

e. Detailed description of the proposed program

Unless otherwise stated, the following description is presented for the 5-year Ph.D. program, in which 80-90% of the students are expected to be enrolled. For the M.S. program, the UM and RSMAS graduate handbook regulations will be followed, with a requirement of 24 course credits and a M.S. thesis that will typically be completed within two years.

These expectations are based on the following statistics:

47 of the current 52 students in the MPO program are enrolled in the Ph.D. program, with the remaining 5 students enrolled in the M.S. program.

The average time to graduation of Ph.D. students is 5.5 years, though under the new business model at RSMAS (implemented in 2010), this average time is expected to reduce further.

Program Requirements (consistent with a graduate bulletin masthead)

M.S. Degree

- Credit Requirements
  - At least 24 ATM graduate-level course credits.
- Course Requirements
  - Students in atmospheric dynamics and physics will be required to take courses in Introduction to Atmospheric Science, Geophysical Fluid Dynamics I, and General Circulation of the Atmosphere.
  - Students in atmospheric chemistry will be required to take courses in Introduction to Atmospheric Science and Tropospheric Chemistry.
- Thesis Committee
  - As per the UM Graduate Handbook.
- Comprehensive Examination
  - At the end of May in their first year, after completing at least 18 course credits, the student will take a written comprehensive examination. The student will be required to answer 4 of 6 questions in the written exam.
- Thesis Proposal
- Thesis
  - A thesis is required, and a public oral defense of the thesis must take place.

Ph.D. Degree

- Credit Requirements
  - At least 24-27 ATM graduate-level course credits (number to be voted upon)
  - No less than half of the total credits must be in coursework open only to graduate students (600-level or above).
- Course Requirements
  - Students in atmospheric dynamics and physics will be required to take courses in Introduction to Atmospheric Science, Geophysical Fluid Dynamics I, and General Circulation of the Atmosphere.
  - Students in atmospheric chemistry will be required to take courses in Introduction to Atmospheric Science and Tropospheric Chemistry.

- Dissertation Committee
  - As per the UM Graduate Handbook.
- Comprehensive Examination
  - At the end of May in their first year, after completing at least 18 course credits, the student will take a written and oral comprehensive examination. The student will be required to answer 4 of 6 questions in the written exam, and will be prepared to answer questions from any of the courses taken in the oral exam.
- Qualifying Examination
  - A written qualifying examination is required of all students admitted to the doctoral program. It is normally administered around the time of the proposal defense. In addition, an oral qualifying exam will be required in the ATM program. The student's committee will prepare and administer both the written and oral examinations.
    - Written exam: written answers judged by each Committee member to demonstrate that the student has the ability to understand and investigate the concept asked in the question. The questions are usually related to the research described in the dissertation proposal.
    - Oral Exam – demonstration of oral communication skills in responding satisfactorily to questions raised by the Committee in relation to the written questions, and any other questions asked by the Committee.
- Dissertation Proposal
  - The proposal should demonstrate the capability of the student to produce and present research that is of the quality suitable for a journal Article. Emphasis is placed on the proposed research: the questions and hypotheses to be tested, the data and methodology used to test the hypotheses, and some anticipated results (which may or may not be realized).
- Admission to Candidacy
  - Upon completion of the following requirements, the student is admitted to candidacy:
    - Have an approved committee on file in Graduate Studies
    - Passed the Comprehensive Examination
    - Passed the Qualifying Examination
    - Passed the Dissertation Proposal
    - Have a 3.0 average in all credits earned
    - Remove all "I" or deficiencies
  - All doctoral students must be admitted to candidacy at least one semester prior to the one they intend to graduate.
- Dissertation

- A dissertation is required of all doctoral students. A public oral defense of the dissertation is required.

Anticipated program mission and learning outcomes

Mission: "To advance students' knowledge and understanding of the physical, chemical, and dynamical processes that determine our weather, our climate, and their interactions with the oceans and the continents. The goal is for our graduates to develop into leaders in the atmospheric sciences and related fields, and thereby contribute to better informing the public and policy makers on how to prepare for hazards and changes in the weather-climate system."

Student Learning Outcome 1: *Students gain a broad knowledge of atmospheric science and an awareness of how scientific research in their topical areas bears on current human and societal issues.*

Student Learning Outcome 2: *Students learn how to critically evaluate scientific literature, study the previous knowledge on a topic, formulate testable hypotheses, and skillfully use available data and tools to advance the knowledge in a topical area.*

Student Learning Outcome 3: *Students learn oral and written communication skills, and are able to effectively communicate and defend their scientific findings to a peer audience.*

- Tracks for degree

The ATM program will not officially have tracks. The only major delineation within the program is the list of required courses in the first year. All other program requirements are identical.

Course descriptions for each new course

The majority of courses are already on the books and taught frequently. The outlines of some new courses are described in Appendix A.

Prerequisites, Courses, Examinations, Core courses, Graduate Level Electives, Seminar

- Prerequisites: a strong background in mathematics, physics or chemistry, as evaluated during the admissions process
- Courses: divided into required courses and graduate level electives.
- Examinations
  - Most courses will have their own examinations (mid-term and/or final)
  - Comprehensive Examination at end of first year (end of May)
  - Ph.D. Qualifying Examination, typically in the third year

All the 500-level courses can be taken by suitably qualified undergraduate students, based on advice from the Director of the Undergraduate ATM Program.

All the 600-level courses are for graduate students only.

- **Required courses (all 3 credits)**

As is common in other atmospheric science programs, the course requirements are different for those students in atmospheric chemistry, versus students who are not specializing in chemistry. The reasoning is that students in atmospheric chemistry commonly have a significantly different background to the more traditional fluid dynamical and physical backgrounds.

Atmospheric Dynamics and Physics Students

Course Name	#	X	Required by students in
Introduction to Atmospheric Science	551	1	All
General Circulation of the Atmosphere	665	1	Dynamics and Physics
Geophysical Fluid Dynamics I *	511	1	Dynamics and Physics

Atmospheric Chemistry Students

Course Name	#	X	Required by students in
Introduction to Atmospheric Science	551	1	All
Tropospheric Chemistry	New		Chemistry

= Course Number (if an existing course). All courses except for "Introduction to Science Policy" (a RSMAS-wide course) are currently offered as MPO or MAC courses.

X = Frequency (taught every X years)

* = Can be taught by faculty in another Department or by non-Regular faculty.

- **Graduate Level Electives (all 3 credits except for Directed Readings)**

The following table represents the electives that are already on the books or will be proposed for approval by 2016:

Course Name	#	X	Useful for students in
Applied Data Analysis	524	2	All
Broadcast Meteorology *	532	1	MPS
Physics of Remote Sensing *	542	2	All
Tropical Atmosphere and Ocean *	561	3	All

Mesoscale Meteorology	563	2	MPS, Hurricanes
Introduction to Science Policy	572	2	MPS, Hurricanes, Climate
Climate Change	581	1	MPS, Climate
Scientific Programming *	582	2	MPS, All
Directed Readings: Climate Dynamics	583	2	Dynamics, Climate
Advanced Weather Forecasting *	585	1	MPS
Hurricanes	New	2	MPS, Hurricanes
Tropospheric Chemistry	New	1	Chemistry
Geophysical Fluid Dynamics II *	611	1	Dynamics, Hurricanes
Air-Sea Interaction *	631	1	Hurricanes
Atmospheric Boundary Layer	633	2	Physics, Dynamics, Hurricanes
Cloud Physics and Radiative Transfer	634	2	Physics, Chemistry
Vortex Dynamics	652	2	Dynamics, Hurricanes
Computer Models of Fluid Dynamics *	662	1	Dynamics, Hurricanes, Climate
ENSO Dynamics, Prediction & Predictability	668	2	Dynamics, Climate
Predictability	674	3	Dynamics, Hurricanes, Climate
Directed Readings: Cloud Physics	681	2	Physics

Several of these courses will be cross-listed with OCE and MPO.

Over the past decade, the ATM faculty have demonstrated the commitment to invest time in developing new elective courses. Chief among these are the recently introduced courses in data analysis, mesoscale meteorology, science policy, climate change, climate dynamics, hurricanes, cloud physics and radiative transfer, vortex dynamics, ENSO, and predictability. These courses have been received positively by the growing body of students in the atmospheric sciences (currently in the MPO program). In the ATM program, it will be easier to review and modify these courses (if needed), together with prioritizing additional courses in a coherent curricular structure. Several of these courses would also appeal to students in other programs in the physical and chemical sciences. Many courses at the 500-level will also be taken by undergraduate and MPS students.

Some 500-level courses, such as Broadcast Meteorology and Advanced Weather Forecasting, are taught by instructors who are renowned meteorologists in their professions. The credentials of these instructors are evaluated by the faculty and the Graduate Academic Committee.

The Comprehensive Exam, mandated in the UM Graduate Handbook, will be conducted in a similar manner to the present structure. In May, after the end of the Spring Semester, all first year students in ATM will take written and oral questions on the courses they have taken in their first year.

Thesis Research, Additional Coursework, Dissertation

The top students are eager to begin their thesis or dissertation research from the day they arrive at UM. In the first year, while they are focusing mostly on classes, they also begin a survey of their research area of interest and learn some fundamental skills (e.g. analysis of observations, modeling of hurricanes or climate). Their thesis/dissertation research progresses more rapidly after the Comprehensive exam. M.S. students take two more courses in their second year, and otherwise are solely focused on thesis research with the normal plan being to defend their thesis and graduate by the end of their second year. Ph.D. students take additional coursework in their second year, in additional to Educational Training. By the third year, they have developed a firm idea of their dissertation research, and are ready to form their Dissertation Committee, submit and defend a dissertation proposal, and take their Ph.D. Qualifying Exam. Before the start of their fourth year, they should have a first manuscript submitted to the peer-reviewed literature, which also forms one of the main results chapters in the Dissertation. The final two years are spent solely on research, of the quality and quantity equivalent to two more papers in the peer-reviewed literature.

The number of required courses, and the minimum number of course credits required in the ATM program will be lower than that required by the MPO program, to allow more flexibility and focus on the dissertation research.

At all times, the regulations in the UM Graduate Handbook will be conformed to.

- *Proposed schedule of course offerings for the first three years*
    - *For each course, list the faculty who will be teaching the course.*

The proposed schedule of graduate course offerings for the first three years is as follows:

Fall Semester – Year 1 (2016)	**Spring Semester – Year 1 (2017)**
Intro to Atmospheric Science (Majumdar)	General Circulation (Kirtman)
Geophysical Fluid Dynamics I (OCE Faculty)	Geophysical Fluid Dynamics II (OCE Faculty)
Atmospheric Chemistry I (Atlas)	Atmospheric Chemistry II (Hynes)
Climate Change (Soden)	Cloud Physics & Radiative Transfer (Zuidema)
Atmospheric Boundary Layer (Avissar)	Mesoscale Meteorology (Mapes)
Introduction to Science Policy (Clement)	Vortex Dynamics (Nolan)
Fall Semester – Year 2 (2017)	**Spring Semester – Year 2 (2018)**
Intro to Atmospheric Science (Majumdar)	General Circulation (Nolan)
Geophysical Fluid Dynamics I (OCE Faculty)	Geophysical Fluid Dynamics II (OCE Faculty)
Atmospheric Chemistry I (Atlas)	Atmospheric Chemistry II (Hynes)

ENSO Dynamics (Kirtman)	Hurricanes (Majumdar)
Physics of Remote Sensing (OCE Faculty)	Applied Data Analysis (Mapes)
Fall Semester – Year 3 (2018)	**Spring Semester – Year 3 (2019)**
Intro to Atmospheric Science (Majumdar)	General Circulation (Kirtman)
Geophysical Fluid Dynamics I (OCE Faculty)	Geophysical Fluid Dynamics II (OCE Faculty)
Atmospheric Chemistry I (Atlas)	Atmospheric Chemistry II (Hynes)
Climate Change (Soden)	Cloud Physics & Radiative Transfer (Zuidema)
Atmospheric Boundary Layer (Avissar)	Mesoscale Meteorology (Mapes)
Introduction to Science Policy (Clement)	Vortex Dynamics (Nolan)
	Predictability (Majumdar)

- *Estimated teaching load for each member of the faculty who will be involved with the program when it is in place.*

Each ATM faculty member currently teaches an average of one graduate course per year and one undergraduate course per year (an average of 6 total credits per year, Appendix F), and this will continue. The graduate and undergraduate courses taught by ATM faculty during the past 4 years are provided in Appendix D and Appendix E respectively. The graduate courses listed above will be taught sufficiently regularly to meet student demands, and at a frequency such that the average teaching load does not change.

As new ATM faculty members are hired and as the educational interests of existing faculty evolve, other courses will be developed. A first example may be Atmospheric Observations, since the new search for an ATM faculty member, to begin in Fall 2015, seeks candidates with expertise in observations. Future examples include Atmospheric Modeling, Atmospheric Science Policy, Atmospheric Biology, Aerosols, and additional courses in Chemistry. During monthly ATM faculty meetings, the course sequences, the faculty teaching the courses, and potential new courses will be discussed.

f. Teaching

What kinds of teaching will prevail in the program (i.e. clinical, classroom, independent research, seminars, online etc.), and in what proportion?

Most of the formal coursework will be conducted in the classroom, through a combination of lecture notes and visual tools. Many courses include small research projects.

While the student seminar series (described in part h below) is not formally part of a course, it represents a vital part of the teaching mission.

The teaching resources are sufficient for the ATM program. Initially, the courses taught in the new program will be the same as those presently being taught in MPO and MAC, and the undergraduate teaching commitments will remain the same.

g. Expected distribution of graduate students among advisors

An average of 3 graduate students per advisor on the tenure track is expected, with a generally uniform distribution.

These numbers are based on the present distribution of students among ATM faculty, listed in Appendix G.

h. Colloquia series, special seminars, or conferences that will be held

A weekly ATM departmental seminar series will be held each semester. Some seminars will be held jointly with other programs (e.g. OCE, MPO), depending on the topic. Seminars will comprise external speakers, faculty and research staff from UM, and every graduate student in their second year or above will give either a 15-minute seminar or a 1-hour (pre-Ph.D. defense) seminar.

Each of the inter-departmental concentrations in Climate and Hurricanes propose to host an annual 1-day colloquium at RSMAS, comprising faculty, staff and students from UM and external visitors.

ATM graduate students will also be invited to participate in other colloquia and workshops hosted by ATM faculty, wherever appropriate.

i. Learning Outcomes Assessment Plan

See Appendix B.

4. FACULTY

a. Complete C.V. for each member of the department who will participate in each program.

All the faculty members in the Department of Atmospheric Sciences have a Ph.D. as their terminal degree. All the ATM faculty on the tenure-track have at least 10 years experience teaching at both graduate and undergraduate levels, a long record of sustaining an active research program and advising Ph.D. students, and a strong publication record. Most of the ATM faculty have introduced new courses and educational initiatives over the past decade.

CVs of all ATM faculty are provided in a separate document in Appendix C.

Faculty Member	*Field*	*Rank*
David Nolan (Chair)	Dynamics and Modeling; tropical cyclones	Professor
Elliot Atlas	Chemistry; atmospheric trace gases	Professor
Roni Avissar	Hydroclimatology; Modeling; Sensor Systems	Professor
Francisco Beron-Vera	Dynamics; transport and mixing processes	Res. Associate Professor
Amy Clement	Climate dynamics; modeling; paleoclimate	Professor
Anthony Hynes	Chemistry; laser diagnostics	Professor
Benjamin Kirtman	Seasonal and climate prediction	Professor
Sharanya Majumdar	Predictability; tropical cyclones	Associate Professor
Brian Mapes	Tropical meteorology; convection; dynamics	Professor
Brian Soden	Climate change; modeling, remote sensing	Professor
Paquita Zuidema	Cloud physics; radiation; remote sensing	Associate Professor

b. Estimate the need for additional faculty, including in each instance

i. Specialization desired

ii. Degree of experience desired

iii. Salary anticipated

It is largely recognized across ATM that a new faculty hire with a teaching specialization in graduate and undergraduate-level courses in the physical aspects of atmospheric science is essential, in part to replace Bruce Albrecht who will be fully retired by Fall 2016. A Ph.D. and a strong research record and potential will be essential. The anticipated salary would be commensurate with salaries of comparable faculty at the Rosenstiel School, likely in the range of $80-100K. A new search for this position has recently been approved by the Provost, with the incumbent expected to begin in Fall 2015. Candidates with expertise in one or more of the research areas of boundary layer meteorology, cloud and aerosol processes, radar meteorology, and other types of remote and in-situ observations will be given priority.

Future faculty hires will be proposed in line with the ATM strategic plan, which is under development.

There is a growing enrollment of students studying for the Master in Professional Science in the following tracks housed in the ATM department: (a) Broadcast Meteorology, (b) Computational Meteorology and Oceanography, (c) Weather, Climate and Society, and (d) Weather Forecasting. There is a corresponding demand by society for a different quantitative skill set than that traditionally taught in graduate programs (e.g. dynamical equations). This places a demand on more descriptive courses in atmospheric science, which are not presently offered. These courses may also appeal to some students in the graduate program, particularly at the M.S. level. New instructors will need to be hired if these courses are to be offered.

c. Interaction of proposed program with other graduate programs, e.g. thesis and dissertation committees.

Courses: As indicated above, the ATM program will have linkages with the inter-departmental MPO program in terms of common courses taught. Some courses taken by ATM students (such as Geophysical Fluid Dynamics I) may be taught by faculty in the Ocean Sciences Department, and taken by students in the ATM, OCE and MPO programs.

Committees: It is anticipated that several faculty in other departments within RSMAS and UM will serve on thesis and dissertation committees of ATM students. Examples of the expertise provided by faculty from other departments include the interplay between climate and geosciences, and the role of the ocean in hurricanes.

Seminars: Students in ATM, OCE and MPO will be encouraged to attend seminars in other departments and programs as part of their broader development.

Concentrations: The two inter-program concentrations (Hurricanes, Climate) described above are expected to be featured in multiple graduate programs at the Rosenstiel School. These will provide opportunities for formal (courses, seminars, advising) and informal (annual meetings, events) interactions among students and faculty in different programs.

5. STUDENTS

a. Estimated number of students in the program and the pool from which they will be selected

The projected number of students in the ATM program five years after its inception is 30, based solely on the current faculty in the department. At least 80% of all students in the ATM program are expected to be Ph.D. students, with the remainder being M.S. students.

This conservative estimate of 30 is based on the current number of 26 students advised by ATM faculty (Appendix H), together with at least 9 new research grants committed with available 5-year Ph.D. research assistantships for students to be admitted in Fall 2015. Several of these students listed in Appendix H plus the 2015 intake are likely to transfer into ATM.

The hiring of one new faculty member has recently been committed by UM to ATM, and Professor Roni Avissar has stated that he will maintain a research group with 2-3 new students after he transitions from Dean to regular faculty. With another potential new faculty hire in ATM anticipated by 2018, the number of students is expected to increase by 6-10. It is also expected that a few students advised by ATM faculty with a strong interest in oceanography will enroll in the MPO program.

Based on applications to the MPO program in recent years with stated interests in atmospheric sciences, we expect that the ATM students will be selected from a worldwide application pool, with a target number of applicants exceeding 60 to compete for an average of 6 new graduate assistantships per year (currently, this number of applicants is about 40, with a small top tier). The application pool is expected to comprise largely of students with an undergraduate background in any of atmospheric sciences, mathematics, physics, chemistry, and engineering.

With the improved visibility of a new and cohesive ATM program, and a more aggressive recruitment campaign than has been possible to date, we expect the quality and quantity of applicants to improve markedly.

b. Requirements for admission to and expected retention of students in the proposed program

The number of students admitted in the past 5 years with ATM faculty as their primary advisor is listed in Appendix I. An average of 6 students has been admitted per year.

The following criteria will be used in the admission process:

- Strong GPA, especially in advanced quantitative courses from well-regarded programs
- Some research experience, including programming
- Strong reference letters
- Quantitative GRE score above the 70th percentile of all GRE takers
- Strong interview with faculty (in person or online)

Most students, when admitted, are expected to be capable of pursuing the Ph.D. degree. The Comprehensive Exam (end of Year 1) and Ph.D. Qualifying Exam (typically Year 3) will serve to judge the progress of the student and ultimately whether they are qualified to pursue the Ph.D. The expected retention rate is over 90%, though some students may graduate with a M.S. instead of a Ph.D. A smaller number of students will be recruited with the plan to complete a terminal M.S., and the retention rate for these students is again expected to exceed 90%. As has been the case over the past 5 years (see Appendix I), an average of at least 6 students per year are expected to graduate with a M.S. or Ph.D. in Atmospheric Sciences.

c. Anticipated need for and specific use of teaching assistants and research assistants in the program. Include the number and estimated stipends for each assistant (indicate stipend level and whether 9-month or 12-month).

All Ph.D. students will be admitted on a graduate research assistantship. The estimated stipend for 2016 is approximately $30,000 per year (12 months), and is governed by the standard rate at RSMAS. All Ph.D. students, except when on Fellowships, will receive this stipend. The

number of incoming students per year will be driven by the number of research grants obtained by faculty with full stipend and tuition, in addition to high-caliber students who are self-funded through Fellowships. The estimated average number of available stipends per year is about 6.

Although no graduate students at RSMAS are enrolled specifically as Teaching Assistants (TA), all Ph.D. students are expected to be a TA for two courses while pursuing their degree. This is as part of their 'Educational Training', which is an integral part of the Ph.D. program at RSMAS. The student performs their TA duties in their second and/or third years. The TAs are required to take a 1-credit training workshop, and will be enrolled in a 3-credit Educational Training course in each semester that they serve as a TA. Students in the ATM Ph.D. program would mostly serve as TAs for courses in the undergraduate ATM program, as well as other suitable undergraduate courses administered by RSMAS. The allocation of TAs is determined largely by the size of the class, and therefore most undergraduate classes are offered priority over graduate classes. However, on occasion, a senior-level graduate student may TA for one of the introductory graduate courses that has a particularly large enrollment. There is no financial tie to the TA program at RSMAS.

6. ADMINISTRATION

a. Estimated administrative increments imposed by addition of this program

i. Need for administrative help

The Graduate Studies Office will provide administration support for the program on: recruitment, admissions, student academic tracking, student pay/tuition/health insurance, TA-ships, student research awards, course and classroom coordination, interactions with the UM graduate school. Additional administrative help is expected to be handled by the departmental Administrative Assistant.

ii. Need for additional office equipment and supplies

Office equipment and supplies will be in the departmental budget. These are not expected to exceed the corresponding budget for the existing programs.

iii. Need for additional travel, publication, costs and other funds

The budget for student recruitment is currently handled by the School. If recruitment duties are instead delegated to the department, then an additional budget would be necessary for recruitment. The budget would need to cover additional staff time to conduct a variety of activities: these include communication with program directors and prospective students in undergraduate programs, preparing materials, frequently updating the web site, attending

career fairs and conferences, and giving presentations at universities when opportunities present themselves. An additional budget would be needed to invite the top prospective students to Miami for the annual Open House and interviews.

The School also offers a Graduate Career Development that students can apply to. The funds provide partial support for Doctoral and Masters related independent research, and also activities that will enhance the career prospects for graduate students. This may include activities related to development of professional skills in scientific research (e.g. oral or written communication, management, budgets, negotiation, mentoring... etc), and serve the individual student as well as the RSMAS community.

b. Arrangements for administration and for academic direction of the program as it pertains to

i. The day-to-day administration of the program.

The day-to-day administration and oversight of academic direction will be provided by the program director, who will be appointed by the department chair. The director and chair will nominate a program academic committee. Among the duties of the director are the following:

- Chair the program academic committee
- Communicate to students in the program (e.g., career development opportunities)
- Hold an annual town hall meeting with the students in the program
- Maintain office hours or availability by appointment with students
- Organize nominees for school-wide awards, and any awards within the program
- Coordinate courses to be offered in each semester
- Coordinate annual Comprehensive Exams
- Coordinate faculty teaching responsibilities with relevant department chairs (though only the chairs have authority)
- Coordinate TA assignments with relevant department chairs and program directors; and recommend them to the associate dean for graduate education
- Coordinate recruitment activities for the program
- Coordinate the nomination of UM fellowships and other fellowships for students
- Collect annual progress reports and coordinate the annual student review
- Review the student evaluations of courses in the program;
- Coordinate the admissions for the program
- Sign the form for admission of new students into the program prior to final approval by the delegated associate dean
- Attend and vote in School Graduate Academic Committee (GAC) meetings
- Delegate a member of the program academic committee to attend GAC meetings if the director is absent
- Report on items from GAC and items relevant to the program in department faculty meetings
- Prepare annual Program Assessment Reports for SACS.

ii. The academic policy-making mechanisms used to implement the program, including criteria for membership in the faculty of the program.

The program director and academic committee are responsible for proposing policies in the program. The general academic policies will follow the UM graduate handbook, followed by the RSMAS graduate handbook. Any policies that are not covered in these handbooks will be prepared by the program academic committee, and will be voted upon by the faculty.

Faculty from other departments with joint appointments with the ATM department can be members of the program, if it is written in the terms of their appointment.

7. BUDGET

Provide a three-year projected budget commencing with the year the program gets under way. Each year's budget should include all anticipated income (use current year tuition credit costs and projected overhead) and all anticipated incremental costs, e.g. new faculty with fringe, library additions, teaching assistantships, laboratory equipment, staff, travel funds, etc.

The primary component of the budget is student income. The new program will operate under the same business model of student funding and it will not require additional support from UM.

At RSMAS, the budgets and overhead are handled centrally by the School, and not within each individual department or program. The budget in the first table is for one Ph.D. student starting in FY 2017. The financial package for a Ph.D. student is for 5 years, with significant differences between years 1-3 and years 4-5. Hence, the full five-year projected budget is provided here.

The indirect cost rate at RSMAS is 57.0%.

COST PER PH.D. STUDENT	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2018**	**FY 2019**
Ph.D. Student Stipends					
University Coverage				$ 30000	$ 30000
Coverage from Grants	$ 30000	$ 30000	$ 30000		
Student Health Insurance					
University Coverage				$ 2500	$ 2500
Coverage from grants	$ 2500	$ 2500	$ 2500		
Other Expenses					
Student Travel Funds from	$ 4000	$ 4000	$ 4000		

Grants					
Supplies and Computers from Grants	$ 3000				
Publication Costs	$ 3000	$ 3500	$ 3500		
Direct Costs from Grants	$ 42500	$ 40000	$ 40000		
Indirect Cost (Years 1-3)					
0.57 * above costs	$ 24225	$ 22800	$ 22800		
Tuition (no indirect cost)					
University Coverage				$20000	$20000
Coverage from grants	$20000	$20000	$20000		
Cost from Grants	$86725	$82800	$82800		
Cost from School				$52500	$52500
Total Cost Per Student	**$86725**	**$82800**	**$82800**	**$52500**	**$52500**

The precise accounting for the departments has not been confirmed yet. The following minor expenses will either be in the departmental budget or the School budget. There are no staffing costs, since the administrative work will be conducted by the full-time Department Administrative Assistant in conjunction with the Program Director and Academic Committee.

DEPARTMENT COST	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2018**	**FY 2019**
Recruitment Costs	$ 1500	$ 1500	$ 1500	$ 1500	$ 1500
Student Prizes	$ 1000	$ 1000	$ 1000	$ 1000	$ 1000
Miscellaneous Expenses	$ 500	$ 500	$ 500	$ 500	$ 500
Department Costs	**$ 3000**	**$ 3000**	**$ 3000**	**$ 3000**	**$ 3000**

Miscellaneous expenses include classroom supplies, stationery for students, subscriptions to 'virtual classroom' software, small items such as computer cables etc.

Note that several students from MPO on this business model at different stages of their tenure will very likely transfer into ATM beginning in Fall 2016. Some will be supported by their advisor's grants at that time, whereas others will be supported by RSMAS.

The number of students admitted, and therefore the overall budget and the number of Ph.D. degrees granted, is determined by the number of grants obtained by ATM faculty, and also the number of external fellowships. ATM faculty regularly obtain grants from national agencies including the National Science Foundation (NSF), NASA, NOAA, the Office of Naval Research, and the Department of Energy. The funding climate has been stable over the past decade, with

no downturn in ATM funding during the recent national budgetary problems. Given the national importance of the scientific areas explored by ATM faculty (such as climate, weather and its impacts etc), the extramural funding base is expected to remain stable over the next decade. Currently, a few students of ATM faculty are funded by national fellowships (e.g. two have NSF graduate fellowships, and one has a National Defense Science and Engineering graduate fellowship). Additionally, as was recently granted by the National Science Foundation, outstanding students may write proposals to obtain their own funding, though the purpose here is strictly for the student's career development and not as a condition to remain in the program. Overall, the total budget is expected to increase gradually, due to new faculty hires, and a renewed focus on aggressively recruiting graduate students into the new program.

While much of the focus is on the Ph.D. program, there is also an increased number of applicants in who wish to pursue a M.S. degree and then enter the profession. M.S. students at the Rosenstiel School are on two different types of business model:

(i) The traditional and most common business model for M.S. students is to be funded by research grants, with their budget being identical to that of years 1-3 in the table for Ph.D. students, for as long as they are in the program. Only a relatively small number of students are expected to be accepted in this model, given that there are strong research and financial incentives for faculty to recruit Ph.D. students.

(ii) To accommodate the increasing application pool of students who are seeking a M.S., a new business model introduced at the Rosenstiel School in 2014 allows self-funded M.S. students to pay tuition and enroll in the program, subject to acceptance by a faculty advisor.

8. ***COMPARISONS*** – Compare the proposed program at the University of Miami with five high-quality, established programs at comparable universities. In the comparisons, include only the sections and subsections from items #1 through #7 above that are appropriate.

There are many successful, long-lived programs in Atmospheric Sciences around the country. Funding for research grants, including graduate research assistantships has been stable over the past decades. There is considerable demand by prospective students seeking research assistantships in the atmospheric sciences (over 100 applicants per year in the larger departments), and a healthy job market as described in Section 1c.

In this comparison, we summarize five comparable programs:

i) Colorado State – arguably one of the three leading programs nationwide
ii) Washington – regarded at the same level as Colorado State
iii) Cornell – one of few private universities with an atmospheric sciences program
iv) Illinois – 40+ year old program of comparable size
v) Utah – 40+ year old program of comparable size

The comparison reveals that other atmospheric sciences programs have comparable missions, resources, business models and curricula.

RATIONALE

All 5 programs: prepare M.S. and Ph.D. students for careers in academia, research labs, government agencies, and industry in the atmospheric sciences, through course instruction and dissertation research guided by a faculty advisor and dissertation committee.

Colorado State has no undergraduate program in Atmospheric Sciences. Washington has a small program. Cornell, Illinois and Utah all offer B.S. degrees in Atmospheric Sciences.

RESOURCES

Each program possesses comparable library resources.

UM stands out with a wide range of laboratory resources compared with many programs (CAROb, SUSTAIN, Helicopter, multiple field campaigns including NOAA Hurricane Hunters).

CURRICULUM

Each program has a group of core courses that focus on the basic dynamics, physics, and chemistry in the atmospheric sciences, and a wide range of elective courses that reflect the research interests of the faculty and the identity of the program. Details of the courses at each program are provided on the following pages.

At UM, we propose a relatively small number of core courses, and electives that reflect the department's strengths in tropical atmospheric dynamics and physics, and climate dynamics and change.

The programs all have the equivalent of the Comprehensive and Qualifying Exams at UM, and the dissertation proposal and admission to candidacy.

All programs require a written thesis or dissertation, and an oral defense.

In a few universities such as Colorado State, students complete a M.S. degree before progressing towards the Ph.D. This is possible in the ATM program, though it is not required, and many of the top students prefer to focus on Ph.D. studies immediately after enrollment.

All programs have a weekly Colloquium series.

FACULTY

Current number of teaching faculty within ATM = 10 (including Avissar), and this is expected to expand to 12 by 2018 with new hires. OCE faculty also teach relevant courses such as Geophysical Fluid Dynamics.

Number of tenure-line faculty at the five universities:

Colorado State: 19. Washington: 19. Cornell: 13. Illinois: 14. Utah: 11.

STUDENTS

Number of M.S. and Ph.D. students:

Colorado State: 85. Washington: 65. Cornell: 50 (about half of these in geological sciences). Illinois: 50. Utah: 34.

The proportion of M.S. students to Ph.D. students is generally higher in these universities (Cornell being an exception).

Admissions criteria for students are similar to those at UM: high GRE and GPA scores, TOEFL, high credentials in atmospheric science, mathematics, physics, chemistry.

ADMINISTRATION

The programs are run within each department, administered by a faculty program director (whose position rotates) with assistance from the administrative assistant.

BUDGET

The business model for graduate students in most atmospheric sciences programs is normally a combination of Teaching Assistantships and Research Assistantships. At the Rosenstiel School, the business model differs slightly, in that 3-year Research Assistantships are accompanied by tuition and health insurance coverage from the extramural grant, and the School then covers the student's stipend, tuition and health insurance in Years 4 and 5 of the Ph.D. The stipend at UM is at or above that at the listed universities.

Additional details about each program

(i) Colorado State University: Atmospheric Sciences

Summary: an outstanding department of atmospheric sciences, with Ph.D. graduates who have become leaders in the field. Large and famous graduate program.

http://www.atmos.colostate.edu/gradprog/phd.php

Lower level graduate courses (equivalent to 500-level courses at UM)
Atmospheric Dynamics I, Atmospheric Dynamics II, Atmospheric Modeling, Atmospheric Circulations,
Introduction to Climate, Computational Methods for Atmospheric Science, Thermodynamics and Cloud Physics, Atmospheric Chemistry, Atmospheric Radiation, Atmospheric Boundary Layer, Introduction to Atmospheric Aerosols, Synoptic Meteorology, Mesoscale Meteorology, Measurement Systems and Theory, Atmospheric Remote Sensing, Objective Analysis in the Atmospheric Sciences

Nearly all the following courses are offered once every 2 years, Ph.D. students only
Numerical Weather Prediction, Large-scale Atmospheric Dynamics, Atmospheric Waves and Vortices, Middle Atmospheric Dynamics, Geophysical Vortices, Dynamics of Clouds, Atmospheric Oxidation Processes, Air Quality Characterization, Theoretical Topics in Radiative Transfer, Atmospheric Radiation and Energetics, Cloud Microphysics, Mesoscale Modeling, Mesoscale Dynamics, Satellite Observations of Atmosphere and Earth, Radar Meteorology, Tropical Meteorology, Interaction of the Ocean and Atmosphere, Atmospheric General Circulation Modeling, Climate Dynamics: Atmospheric Variability, Inverse Methods in Atmospheric Science. Global Hydrologic Cycle, Theoretical and Applied Climatology, Global Carbon Cycle, Biosphere-Chemistry-Climate Interactions, Aerosol Chemistry.

(ii) University of Washington: Atmospheric Sciences

Summary: an outstanding department of atmospheric sciences, with Ph.D. graduates who became leaders in the field. Long-standing undergraduate and graduate programs.
http://www.atmos.washington.edu/academics/graduates.shtml
The required classes for all entering graduate students are:
ATM S 501 (5) Fundamentals of Physical Meteorology. (A)
ATM S 502 (3) Introduction to Synoptic Meteorology. (A)
ATM S 532 (3) Atmospheric Radiation: Introductory (W)
ATM S 535 (3) Cloud Physics (Sp)
ATM S 558 (3) Atmospheric Chemistry (Sp)

and either of the following sequences

ATM S 505 (4) Introduction to Fluid Dynamics. (A)
ATM S 509 (4) Geophysical Fluid Dynamics (W)
ATM S 542 (3) Synoptic and Mesoscale Dynamics (Sp)
or
ATM S 503 (3) Atmospheric Motions I (A)
ATM S 504 (5) Atmospheric Motions II (W)

(iii) Cornell University: Atmospheric Sciences

Summary: only comparable private university with an undergraduate and graduate program in atmospheric sciences. Housed in a department of Earth and Atmospheric Sciences.

http://www.eas.cornell.edu/academics/graduate/atmospheric_sciences/index.cfm

Graduate-level courses in atmospheric sciences:
Climate Dynamics, Statistical Methods in Meteorology and Climatology, Planetary Atmospheres, Global Atmospheric Circulation and Transport, Air Quality and Atmospheric Chemistry, Advanced Atmospheric Dynamics, Applied Multivariate Statistics, Modeling the Soil-Plant-Atmosphere System, Understanding Tropical Meteorology on Hourly to Interannual Timescales, Upper Atmospheric and Space Physics, Advanced Topics in Oceanography

(iv) University of Illinois at Urbana-Champaign (UIUC): Atmospheric Sciences

Summary: a department with a comparable size to ATM. Long-standing undergraduate and graduate programs within the department (the first Ph.D. graduated in 1975).

http://www.atmos.illinois.edu/
Research areas: Climate and Climate Change, Biosphere-Atmosphere Interactions and Micrometeorology, Regional to Global Ecosystem-Climate Dynamics, Arctic Meteorology and Climate, Clouds and Radiation, Satellite and Radar Remote Sensing, Atmospheric Gases and Particles, Storm Structure, Dynamics, and Mesoscale Meteorology, Atmospheric Dynamics, Tropical Meteorology.

Lower-level courses taken by graduate students

Boundary Layer Processes, Tropical Meteorology, Radar Meteorology, Satellite Remote Sensing, Atmospheric Chemistry, Earth System Modeling, Air Quality Modeling, Arctic Meteorology and Climate, Climate Change Assessment, Climate and Climate Change, Biogeochemical Cycles, Optics Remote Sensing (EE)

Higher-level courses

Synoptic-Dynamic Meteorology, Mesoscale Dynamics, Numerical Fluid Dynamics, Physical Meteorology, Weather Systems, Precipitation Physics, Atmospheric Radiation, Clouds and Climate, General Circulation, Advanced Atmospheric Dynamics, Global Atmospheric Modeling, Aerosol Sampling and Analysis, Teaching Higher Education in the Earth and Environ. Sci., Professional Development

(v) University of Utah: Atmospheric Sciences

Summary: a department with a comparable size to ours. Long-standing undergraduate and graduate programs within the department.

Ph.D. program home page: http://www.atmos.utah.edu/graduate/doctorate.php

Required courses: Fundamentals of Dynamic Meteorology, Fundamentals of Physical Meteorology, Climate Dynamics, Graduate Seminar

Elective courses: Environmental statistics, environmental instrumentation, atmospheric chemistry, synoptic-dynamic meteorology I, weather discussion, cloud system modeling, atmospheric radiation, synoptic-dynamic meteorology II, boundary layer meteorology, mesoscale meteorology, mountain meteorology, wind power meteorology, advanced cloud microphysics, advanced dynamic meteorology, numerical weather prediction, tropical meteorology, remote sensing of the environment. Most courses offered every 1-2 years.

9. Online and distant degree and certificate programs only

N/A

10. Transfer of coursework to graduate degree programs

a. Indicate if the courses taken in the certificate program can be substituted for courses in a graduate degree program.

A course taken in the certificate program (MPS) cannot be substituted for required courses in the ATM graduate program. All students in the ATM graduate program will be required to complete the minimum graduate ATM course credits. It is worth noting that students in the MPS program will take several of the ATM graduate courses.

b. Indicate if the courses can be transferred to a graduate degree program after the certificate is completed.

If a student in the MPS program is accepted into the M.S. or Ph.D. program in ATM, then they will be able to transfer the credits from the ATM graduate courses that they had already taken during their tenure as a MPS student.

Appendix A

Syllabus for new courses and main courses with substantial changes

Syllabi for all other courses are available from the UM website.

Introduction to Atmospheric Science (3 credits, core course)

Course objectives: to survey the large field of atmospheric science including key concepts.

Required by all students in atmospheric science. The syllabus for the present course of the same title (MPO 551) will be modified to include a range of important topics in atmospheric science suitable for a broader group of students.

Syllabus: Weather Systems (including hurricanes and thunderstorms), Atmospheric Thermodynamics, Radiative Transfer, Atmospheric Chemistry, Cloud Physics, Atmospheric Dynamics, Atmospheric Boundary Layer, Climate Dynamics.

Tropospheric Chemistry (3 credits, new course)

Course objectives: To develop the tools necessary to think about atmospheric chemistry. To learn the atmospheric chemistry behind well-known phenomena such as smog, acid rain, and stratospheric ozone depletion.

Syllabus: Atmospheric chemistry timeline and constituents, the troposphere, tropospheric photochemistry, tropospheric gas-phase chemistry, aqueous phase chemistry, stratospheric chemistry, atmospheric chemistry and climate.

A course to be taken by students specializing in chemistry. Other students in atmospheric science will be encouraged to take it.

Hurricanes (3 credits, new course)

Course objectives: To develop an understanding of the fundamentals of tropical cyclones.

Syllabus: structure of tropical cyclones, activity in different basins, dynamics of tropical cyclones, thermodynamic processes, ocean and environmental interactions, hurricane observations, hurricane modeling, hurricane forecasting, hurricane policy, risk and impacts.

Appendix B

Learning Outcomes Assessment Plan

Student Learning Outcome 1: *Students gain a broad knowledge of atmospheric science and an awareness of how scientific research in their topical areas bears on current human and societal issues.*

- **Assessment Measure 1:** All students take a Comprehensive Exam at the end of their first year of study to assess their basic knowledge and ability to convey learned concepts clearly. The Director of the graduate program administers the exam with participation from all teaching faculty. A rubric will be used to quantitatively evaluate student performance on the oral and written components of the exam. The final score and grade of High Pass, Pass and Fail are then computed as a weighted average of an adjusted GPA (20%) and the oral and written Comprehensive Exam scores (40% each). The effectiveness of the Comprehensive Exams and the way they are administered are reviewed each year by the Academic Committee and in Faculty Meetings.

- **Assessment Measure 2:** Ph.D. students subsequently take a Qualifying Exam to enter Ph.D. candidacy to thoroughly assess their breadth of knowledge and scientific competency in their area of specialization. The exam is tailored to the research problem the student is addressing, and is administered by the Dissertation Committee Chairperson with participation from all members of the Dissertation Committee. Each member of the Committee submits one question and takes the lead in assessing the written answer, though all members of the Committee see all answers and all participate in the oral component of the exam. The exam result is Pass or Fail. Guidelines and a rubric for assessment of student performance on the exam are distributed to all students.

Student Learning Outcome 2: *Students learn how to critically evaluate scientific literature, study the previous knowledge on a topic, formulate testable hypotheses, and skillfully use available data and tools to advance the knowledge in a topical area.*

- **Assessment Measure 1:** Each year, advisors make an evaluation of the progress of each student in their research and the areas where students are excelling or need to improve. The students also report on the planned timing and completion of academic benchmarks (comprehensive exam, student committee establishment, qualifying exam, dissertation proposal, presentations at conferences, submission of papers to the peer-reviewed literature, etc). All faculty meet for half a day to discuss every student in the program (excluding first year students), whether they have met their milestones and are on track,

and to offer ideas on how to handle problems in a timely way. The Program Director notifies each student individually of their progress and specific recommendations from the faculty.

- **Assessment Measure 2:** Ph.D. students produce a dissertation proposal that outlines their planned research, including background, hypotheses, analysis methods, and anticipated results. Each proposal is formally reviewed by an appointed Dissertation Committee of at least 4 members, three of whom must be members of the Graduate Faculty. The criteria for assessment of the proposal include (i) Sufficient knowledge of the broad scientific problem including a literature review; (ii) promising preliminary results, ready to be submitted to the peer-reviewed literature; (iii) well-posed scientific hypotheses; (iv) adequate description of proposed methods to test the hypotheses; and (v) a realistic timeline and summary of the work plan. The committee uses these criteria to review the proposal, and the outcome is then either to accept the proposal, or to suggest, or require, revisions to any number of the above criteria prior to the student's admission to Ph.D. candidacy.

Student Learning Outcome 3: *Students learn oral and written communication skills, and are able to effectively communicate and defend their scientific findings to a peer audience.*

- **Assessment Measure 1:** Students deliver a seminar annually on their research, which must be intelligible to non-specialists and explain the broad motivation of the research. An extended abstract of the presentation is also required. These requirements, and the format of the presentation, follow those used for conferences, such as those held by the American Meteorological Society. Written guidelines are provided to the students on the preparation of abstracts and on qualities of a good presentation.

- **Assessment Measure 2:** Students conduct a formal defense of their doctoral dissertation in front of the school-wide faculty and students. A rubric is used for assessing the dissertation and defense.

Appendix C

Complete CV of each faculty member who will participate in the program

The CVs of all ATM faculty are appended in a separate document.

Appendix D

All graduate courses taught by full-time ATM faculty between 2011-14

All courses are 3 credits, unless otherwise stated. Semester code: "F11" = "Fall 2011", "S12" = "Spring 2012" etc.

MPO 551 Introduction to Atmospheric Science		F11	F12	F13	F14
Enrollment		14	15	6	14
(Zuidema F11, Clement F12 and F13 (50%), Majumdar F13 (50%) and F14)					
MPO 665 General Circulation of the Atmosphere	S11	S12	S13	S14	S15
Enrollment	12	12	11		
(Kirtman S11, S12, S13, S15, Nolan S14)					
MPO 524 Applied Data Analysis	S11	S12	S13	S14	
Enrollment		14	6	9	
(Mapes)					
MPO 563 Mesoscale Meteorology	S11		S13		S15
Enrollment	7		11		
(Mapes)					
MPO 581 Climate Change		F11		F13	
Enrollment		6		6	
(Soden)					
MPO 583 Topics in Climate Dynamics (1 credit)	S13	S14			
Enrollment					
(Clement)					
RSM 572 Introduction to Science Policy					F14
Enrollment					
(Clement)					
MPO 634 Cloud Physics and Radiative Transfer		S12			S15
Enrollment		3			
(Zuidema)					
MPO 652 Vortex Dynamics	S11		S13		
Enrollment	4		5		
(Nolan)					

MPO 668 ENSO Dynamics, Prediction and Predictability	F11	F13	
Enrollment		7	
(Kirtman)			
MPO 674 Predictability	S12		S15
Enrollment	8		
(Majumdar)			
MPO/RSM 681 Directed Readings: Cloud Physics (1 credit)		F13	
Enrollment		1	
(Zuidema)			

Appendix E

Undergraduate courses taught by ATM faculty between 2011-14

On average, each ATM faculty member teaches one undergraduate course per year.
Courses coded MSC or ATM.

102 Weather and Climate (non-majors) (Soden)	F11/S12 89		F12/S13 62		F13/S14/F14 58/63/56
118 Current Weather and Climate Topics (Team Taught)	S12 42	S13 37	S14 41		
243 Weather Forecasting (Majumdar: F11, F12, F13) (Setzer (instructor): F14)	F11 12	F12 15	F13 9	F14 11	
265 Atmospheric Chemistry (Hynes)			S14 16		
303 Atmospheric Observations (Albrecht (retiring in 2016): each year)	S12 12	S13 8	S14 5		
305 Atmospheric Thermodynamics (Clement, Albrecht)	F11 9	F12 13	F13 6	F14 5	
307 Physics of Climate (Kirtman, Zuidema, Clement)	S12 6		S14 4		
405 Atmospheric Dynamics I (Mapes, Nolan)	S12 8	S13 12	S14 7		
406 Atmospheric Dynamics II (Kirtman, Zhang (OCE))	F11 5	F12 8	F13 11	F14 7	
407 Weather Analysis (Nolan, Mapes)	F11 6	F12 9	F13 9	F14 7	
409 Physical Meteorology (Zuidema every year)	S12 5	S13 9	S14 7		

Appendix F

Teaching load of ATM faculty in Academic Year 2013-14

Avissar (Dean) and Beron-Vera (Research Faculty) not listed.

Faculty	Undergraduate Courses	Undergraduate Course Credits	Graduate Courses	Graduate Course Credits
Atlas, Elliot	1	3	1	3
Clement, Amy	0	0	1.5	2.5
Hynes, Anthony	3	7.5	0	0
Kirtman, Benjamin	1	3	1	3
Majumdar, Sharanya	1	3	1	1.5
Mapes, Brian	1	3	1	4
Nolan, David	1	3	1	3
Soden, Brian	1	3	2	2
Zuidema, Paquita	4	8	2	2
Total	13	33.5	10.5	21
Average	1.44	3.72	1.17	2.33

Appendix G

Number of graduate students per ATM advisor cumulative over 2010-14

Atlas	2	(2 Ph.D.)
Clement	6	(5 Ph.D., 1 M.S.)
Hynes	1	(1 Ph.D.)
Kirtman	6	(6 Ph.D.)
Majumdar	9	(6 Ph.D., 3 M.S.)
Mapes	5	(5 Ph.D.)
Nolan	6	(5 Ph.D., 1 M.S.)
Soden	7	(4 Ph.D., 3 M.S.)
Zuidema	5	(5 Ph.D.)

Appendix H

Current graduate students advised by ATM faculty (October 2014)

26 students. 23 in Ph.D. program, 3 in M.S. program.

Student	Degree	Advisor
Adebiyi, Yemi	Ph.D.	Zuidema
Allen, Teddy	Ph.D.	Mapes
Bellomo, Katinka	Ph.D.	Clement
Bhatia, Kieran	Ph.D.	Nolan
Blanco, Joaquin	M.S.	Nolan
Bucci, Lisa	Ph.D.	Majumdar
Cespedes, Roque	Ph.D.	Soden
Chen, Gino	Ph.D.	Kirtman
Dai, Yi	Ph.D.	Majumdar
Donets, Valerie	Ph.D.	Atlas
Finocchio, Peter	Ph.D.	Majumdar
Galfond, Ben	Ph.D.	Riemer
Godwin, Jason	M.S.	Majumdar
He, Jie	Ph.D.	Soden
Hu, I-Kuan	Ph.D.	Mapes
Infanti, Johnna	Ph.D.	Kirtman
Koch, Douglas	M.S.	Majumdar
Kramer, Ryan	Ph.D.	Soden
Larson, Sarah	Ph.D.	Kirtman
Middlemas, Eleanor	Ph.D.	Clement
Onderlinde, Matt	Ph.D.	Nolan
Palko, Diane	Ph.D.	Kirtman
Sarkar, Mampi	Ph.D.	Zuidema
Song, Si Won	Ph.D.	Mapes
Zhang, Honghai	Ph.D.	Clement
Zhang, Jianhao	Ph.D.	Zuidema

Appendix I

Admissions of graduate students of ATM faculty in past 5 years

2008: 6
2009: 7
2010: 7
2011: 6
2012: 5
2013: 4
2014: 4
2015: 9 (expected, based on committed funds for 5-year research assistantships)

Graduation statistics of students of ATM faculty in past 5 years

2010: 6
2011: 4
2012: 7
2013: 6
2014: 4