UNIVERSITY
OF MIAMI
FACULTY SENATE

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MEMORANDUM

To: Donna E. Shalala, President

From: Tomas A. Salerno
Chair, Faculty Senate

Date: February 27, 2015

Subject: Faculty Senate Legislation #2014-25(B) – Establish a Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) in Ocean Sciences (OCE), and
Phase-out of the Applied Marine Physics (AMP), and
Marine and Atmospheric Chemistry (MAC) Master of Science (M.S.) and Doctor of Philosophy (Ph.D.), Rosenstiel School of Marine and Atmospheric Science

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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 new Ocean Sciences department brings together the diversity of the faculty and research programs needed to develop a multidisciplinary graduate program for the first time at the Rosenstiel School; one that can meet the scientific challenges presented by oceanic and climate change. This new graduate program will be a national leader in the field of oceanography, removing the barriers between marine physics, biology, and chemistry and giving their students the opportunity to become multidisciplinary experts.

Additionally, no future students will be recruited into the Applied Marine Physics (AMP) or the Marine and Atmospheric Chemistry (MAC) M.S. and Ph.D. programs. The AMP and MAC will continue to function for existing students until they graduate and/or transfer to the new programs.

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
Dennis Hansell, Chair, Department of Ocean Sciences, Rosenstiel School of Marine and Atmospheric Science

CAPSULE: Faculty Senate Legislation #2014-25(B) – Establish a Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) in Ocean Sciences (OCE), and Phase-out of the Applied Marine Physics (AMP), and Marine and Atmospheric Chemistry (MAC) Master of Science (M.S.) and Doctor of Philosophy (Ph.D.), 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
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Memoranda

Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
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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)

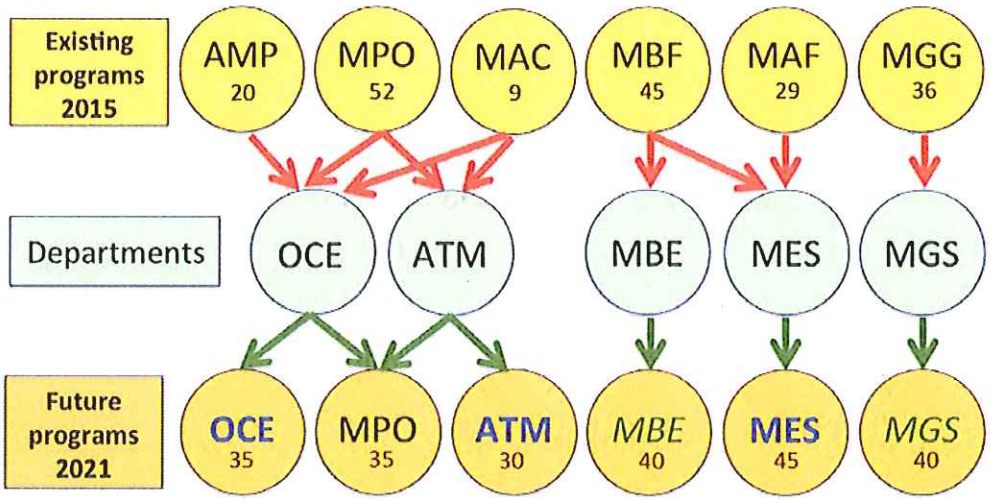
- Memo stating support for new programs and long-term continuation of MPO. **Supported 14-6.**

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.

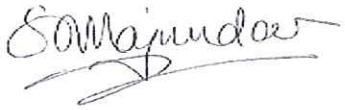
The main impact on MPO will be a reduction in the number of students pursuing a degree in MPO. The current number of about 50 is expected to decrease slowly to an equilibrium of about 35 over the next 7 years, as students begin to enroll in the new programs. Several faculty in ATM and OCE have expressed 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.

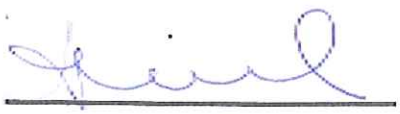
Given the natural connections between the atmosphere and ocean, there will be some common ground across ATM, OCE and MPO. At the same time, each program will also possess a distinct identity and be complementary to each other. ATM will focus on the dynamics, physics, and chemistry of the atmosphere, 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

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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
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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

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SCHOOL of MARINE &
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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.

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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

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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."

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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

SJMajumdar

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.

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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 Ocean Sciences

MEMO

To: General Welfare Committee

From: Dennis A. Hansell, Chairman, Department of Ocean Sciences (OCE)

Subject: Impact of proposed graduate programs in OCE on existing graduate programs

Date: Feb 18, 2015

Dennis A. Hansell

Summary:

M.S. and Ph.D. programs in Ocean Sciences (OCE) are proposed, governed by an academic committee of Graduate Faculty within the Ocean Sciences department. These programs will serve the needs of the faculty of that department by providing a flexible curriculum that can accommodate current and future faculty research and academics in and at the interfaces of the biology, chemistry and physics of the ocean. OCE faculty voted positively for the establishment of this program as the majority of them require its existence for the training of their future graduate students. A subset of our faculty have a strong desire to continue placing some or all of their students in MPO, hence the requirement that it remain healthy and supported.

Impact on Existing Programs:

The original 30 faculty in OCE came from 3 divisions: Applied Marine Physics (AMP; 11 members), Marine and Atmospheric Chemistry (MAC; 5 members), and Meteorology and Physical Oceanography (MPO; 14 members), with members of those divisions largely working in the ocean realm moving into OCE and those working in the atmospheric realm moving into ATM. Our 16 members who were in AMP and MAC have elected to close-out the academic programs associated with those divisions, placing future students into the proposed OCE graduate programs and/or the MPO program. As such, there is no impact on the MAC and AMP programs that is inconsistent with the wishes of those affiliated faculty. As for MPO, the academic program, OCE faculty will continue to place students there if it suites the student's and advisor's academic needs, or they can be placed in OCE's academic program. The OCE academic program considers the entirety of ocean science, from biology to chemistry to physics and their interactions, while MPO lies largely in the physical system, from the ocean to the atmosphere to climate. MPO cannot accommodate all OCE faculty's academic requirements, but it does support a

subset of interests in OCE. As such, some faculty members that have historically recruited students into MPO will continue to do so, while also having expanded opportunities for students who wish to study oceanography but not the separate discipline of meteorology. The total number of students in MPO will likely decrease as faculty recruit into OCE. Based on faculty surveys we project that the steady-state number of MPO graduate students will be 35 by year 2021, a viable size for a graduate program; we expect a similar number in OCE. This rebalancing will be the only impact on the MPO program, as MPO's courses and all other aspects of the program will remain as is. The students that remain in the MPO program will be more truly focused on the 'M' *and* 'PO', which is the central concept and uniqueness of that program; students in OCE will have much broader coverage in the biology, chemistry and physics of the ocean. A number of our OCE faculty members remain committed to the MPO program since their students are well served by that curriculum; a majority of our faculty though require the development of the OCE MS and PhD programs to meet the needs of their students. As long as OCE faculty continue to recruit into the MPO program, the Ocean Sciences Department will be a strong and active supporter of the program.

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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: Dennis A. Hansell, Chair, Department of Ocean Sciences

Dennis A. Hansell

Date: November 6, 2014

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

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

A secret-ballot vote, managed by the department administrator, was taken of the OCE faculty as to whether they "support" or "do not support" the content and spirit of the proposal for the proposed OCE M.S. and Ph.D. graduate program.

The result of the vote was 19 "support", 1 "do not support", and 1 abstain.

Department of Ocean Sciences

Proposal to Offer the Degrees

Doctor of Philosophy and *Master of Science*

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

The ocean is a key part of Earth's climate system, storing and transporting heat, freshwater and carbon, the three most important drivers of climate change. Currently, the ocean is undergoing unprecedented changes due to human-environmental pressures and global warming. These include acidification, sea level rise, chemical pollution, oxygen depletion, red tides, fisheries collapse, and modification of ocean currents and the carbon cycle. Many of these changes involve complex interactions and feedbacks between physical, chemical, and biological processes within the ocean. To better understand these processes and predict future changes requires the application of diverse disciplines to solve important problems. Hence, we need to educate a new generation of oceanographers with greater interdisciplinary knowledge and skills.

Our new Ocean Sciences (OCE) department brings together the diversity of faculty and research programs needed to develop a multidisciplinary graduate program for the first time at the Rosenstiel School; one that can meet the scientific challenges presented by oceanic and climate change. This new graduate program will be a national leader in the field of oceanography, removing the barriers between marine physics, biology, and chemistry and giving our students the opportunity to become multidisciplinary experts.

The OCE department proposes the establishment of M.S. and Ph.D. programs in Ocean Sciences under one umbrella, with the program being governed by an academic committee within the department. To begin, we propose four science themes within the program, reflecting the current research strengths of our faculty and students. These are: (1) Ocean Dynamics, (2) Biophysical Interactions, (3) Air-sea Interaction and Remote Sensing, and (4) Marine Biogeochemistry. Over time, as the department enables scientific problems to be redefined outside of normal disciplinary boundaries, we anticipate the development of additional multidisciplinary concentrations.

a. Exact degree title

- Master of Science in Ocean Sciences

- Doctor of Philosophy in Ocean Sciences

b. Purpose and goals of the degree

The goal of the proposed program is for our students to understand the ocean as a system. Our students will advance in their understanding of the physical, chemical and biological processes in the ocean and their interactions. They will learn about instrumentation and methods to observe the ocean, both in-situ and space-based sensors, and about conceptual, analytical and numerical models to understand oceanic processes. Our graduates will develop into international leaders of ocean research, into teachers and communicators of ocean sciences, and into leaders and advisors of marine education, policy, and conservation.

c. Level of Demand for the Program

i. Job market outlook

- **Research:** Graduates in oceanography often pursue a research career, either at a university or a government research lab. Government agencies include NASA, NOAA, BOEM, EPA, US Navy, Department of Energy and several others.
- **Education:** Several universities nationwide include a component of marine science in their undergraduate curricula, as a major, minor, or as cognate-type courses.
- **Technical Support**: Skilled workforce to operate and maintain equipment in the laboratories or at sea often requires an M.S. degree.
- **Communication and Policy:** There is a growing need to communicate aspects of extreme weather, climate, pollution, coastal hazards, etc., to policy-makers, media, and society.
- **Private Sector:** Oceanographers have found a number of opportunities in the private sector, including oil and insurance companies, consulting firms, and oceanographic equipment manufacturing companies.

The most recent 15 Ph.D. graduates advised by OCE faculty in the past 5 years have taken up the following positions:

- Academia
  - Professor at South China Institute of Oceanology, Chinese Academy of Science, at Guangzhou China.
  - Assistant Professor Coastal Carolina University.

- Research Assistant Professor - Physics Department - University of New Orleans.
- Postdoctoral Scientists at the following institutions: Woods Hole Oceanographic Institution, University of California Irvine Max Planck Institute for Chemistry, Oceanography Division at Naval Research Laboratory - Stennis Space Center, Remote Sensing Division at Naval Research Laboratory – Washington DC, Large Lakes Observatory at University of Minnesota, RSMAS - University of Miami.

- Research Laboratories
  - Director Acoustics Division - Brazilian Navy - Naval Research Laboratory, Rio de Janeiro, Brazil.
  - Research Scientist at National Institute of Standard and Technology.
  - Research Scientist at NASA.
  - Research Scientist at NOAA Pacific Marine Environmental Laboratory.
  - Research Scientist at Global Change Research Institute of the Pacific Northwest National Laboratory.
  - Research Scientist at Naval Research Laboratory Washington DC.

ii. Similar programs at other universities

Several universities offer ocean science-related M.S. and Ph.D. programs, but cross-disciplinary graduate programs exist in few oceanography institutes. A detailed description of five of these programs is given in Section 8.

d. Relationship of proposed program to other cognate fields

RSMAS has other disciplinary and interdisciplinary M.S. and Ph.D. programs, but none combine physics with marine chemistry and ocean biology. The proposed program will be complementary to (but not conflicting with) the following programs at the University of Miami:

- **Atmospheric Sciences (ATM)** – An M.S. and Ph.D. program that is concurrently being proposed at RSMAS.
- **Marine Ecosystems and Society (MES)** – A proposed Ph.D. program concurrently under consideration at RSMAS.
- **Marine Affairs and Policy (MAF)** – An existing M.S. focusing on policy development and management of marine resources.

- **Marine Biology and Ecology (MBE;** previously MBF) – An existing M.S. and Ph.D. program at RSMAS that focuses on a wide range of field, laboratory, and theoretical work in a range of research areas, such as coral reef studies, biological oceanography and marine biology, and the biology and behavior of marine animals.

- **Marine Geosciences (MGS;** previously MGG) – An existing M.S. and Ph.D. program at RSMAS that focuses on the geology, geophysics and geochemistry of the earth system, beneath, within, and above the oceans.

- **Meteorology and Physical Oceanography (MPO)** – An existing inter-departmental M.S. and Ph.D. program at RSMAS that focuses on physical aspects of the coupled atmosphere-ocean system. This program will continue to accept students and is expected to maintain its identity as one of the world's leading interdisciplinary programs in the physical processes of the atmosphere and ocean and their interactions.

- **Marine and Atmospheric Chemistry (MAC)** – An existing M.S. and Ph.D. program that focuses on the chemistry of the atmosphere and marine and ground waters, and processes within and between those spheres. This program will continue for existing students until they have graduated.

- **Applied Marine Physics (AMP)** – An existing M.S. and Ph.D. program that focuses on fundamental and applied fluid mechanics in the ocean, especially near the air-sea interface and in coastal regions, and the study and application of acoustic and electromagnetic ocean remote-sensing techniques. This program will continue for existing students until they have graduated.

- **Ocean Engineering** – An existing inter-school M.S. program. RSMAS and the College of Engineering collaborate to offer this Master of Science degree in Ocean Engineering. The program has two tracks: remote sensing and maritime security, and fluid-structure interactions.

e. Relationship of proposed program to undergraduate and professional programs

- **Undergraduate Marine Science program (code: MSC):**
http://www.rsmas.miami.edu/academics/undergraduate/marine-science-program/

Graduate and undergraduate programs would be connected in several ways:

- **Courses**: Some graduate courses can be taken as electives by senior-level undergraduates.
- **Teaching Assistants**: The graduate education program at RSMAS enables graduate students to be teaching assistants for undergraduate MSC courses.

- **Master of Professional Science (MPS):**

http://mps.rsmas.miami.edu/degree-program/

The MPS program is working on two new tracks in Ocean Sciences: (a) Natural Hazards and Catastrophes, and (b) Remote Sensing. The new M.S. and Ph.D. programs in Ocean Sciences 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.
- **Seminars**: MPS, M.S. and Ph.D. students would participate together in regular OCE department seminars.
- **Transfer into M.S. and Ph.D. Program**: 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.

b. *Laboratory Facilities, Equipment and Space*
   i. *Existing laboratory facilities and equipment*
   ii. *Laboratory facilities and equipment that will be needed*
   iii. *Incremental laboratory equipment needs for succeeding years and estimated costs*
   iv. *Evaluation of adequacy of existing laboratory space*
   v. *Estimated cost of incremental need for space for any proposed work*

- Research Vessel: The Rosenstiel School's primary oceanographic research vessel is the F.G. WALTON SMITH, named in honor of the school's founder. The Smith, which was designed to the school's specifications, was built in 1999 and placed in service in February 2000. The state-of-the-art 96-foot-long catamaran is capable of reaching speeds of over 10 knots and has a draft of only 7 feet. This shallow draft enables it to explore inaccessible areas such as reefs, mangroves, grass beds, and other shallow environments. The vessel accommodates 20 people in its ten 2-person staterooms and encompasses 800 square feet of laboratory space, as well as an additional 800 square feet of multi-use space astern. The vessel has the capability of dynamic positioning for precise station keeping, using bow thrusters, controllable pitch propellers, and independent rudders. Other specialized instruments include a transducer suite that includes ADCP transducers for measuring ocean currents; a moon pool between the hulls for drilling or coring operations; and a notched stern to facilitate maneuvering equipment into the water using the A-frame. The ship is also now outfitted with a Nitrox dive compressor.

- Supercomputing facility (Center for Computational Science): All graduate students have access to a nationally leading Center for Computational Science (CCS) at UM. Several students, especially for connectivity, climate and ocean circulation modeling, use the high-performance supercomputing facility. CCS maintains one of the largest centralized academic cyber infrastructures in the country with numerous assets. The High Performance Computing (HPC) team has been in operation for the past five years. Over that time, the core has grown to a regional 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 for Southeastern Tropical Advanced Remote Sensing (CSTARS) is a high-capability receiving and near-real-time analysis facility for low earth orbiting (LEO) satellite data. CSTARS permits a rapid use of civilian synthetic aperture radar (SAR), electro-optical (EO), and other remote sensing satellite data for a variety of users (including government agencies) and applications. CSTARS utilizes rapid data access to enable fast response for time-critical operations and asset allocations. It enhances the nation's homeland defense and environmental security by enabling advanced ship detection and classification capabilities, rapid assessment of damage from storms and other natural disasters, and the detection and locating of sources of pollutants and targets in specific areas of interest. CSTARS can provide timely information on environmental conditions during severe storms such as hurricanes, extensive flooding of rivers and coastal regions, and other natural hazards. As leading center for environmental remote sensing in the southeastern U.S., CSTARS is capable of receiving, processing, and providing large volumes of satellite data, in particular SAR images covering more than 2,500 km on the ground in single-beam mode or combinations of multiple scenes with different beam modes, within 30 minutes of capture. CSTARS can receive data from satellites about 2.5° above the horizon. While images of this direct visibility domain can be downlinked as they are acquired, images of other regions around the world can be obtained by using a "store and forward" concept. The variety of data available through CSTARS and of the related research projects give RSMAS graduate students a great opportunity to get involved in the latest developments in the field of ocean and ice remote sensing and to get in touch with research partners and users from all over the world.

- SUrge-STructure-Atmosphere-Interaction (SUSTAN) laboratory: SUSTAIN includes three wind-wave test tanks for studying the air-sea interface and coastal impacts in extreme winds, oiled-water surface dynamics, waves and turbulence. The water in SUSTAIN can be fresh or saltwater in any proportion and the water temperature can be controlled in the range of 5-40 °C. The largest, wind-wave tank has a test section that is 18x6x2-m. It has the capability of generating scaled boundary layer wind speeds from zero up to ~100-m/s. It has a 12-paddle directional wave generator to produce a realistic surface wave field for Langmuir circulation, upper ocean turbulence and mixing studies. A second, medium-sized (15x1x1-m) wind-water tank will be used for studies of the interaction between

winds-waves and currents. Scaled winds of up to 50 m/s may be generated in the test section. Mean currents up to 40 cm/s may be generated at maximum water depth. Mechanically generated, long-crested waves may be produced by a computer-controlled hydraulic wave-maker, which may be installed either aligned or in opposition to the wind and currents. A third, small (0.4x0.25x0.2-m) tank will be used for studies of the air-water-oil interface for the purposes of CFD model validation. Measurement capabilities for all three test tanks include laser elevation gauges, multiple wave gauges to allow removal of reflected waves at the paddles, laser slope gauges, stereo particle image velocimetry, hot-film anemometry, laser spray imaging system, a fast response wave follower an profiler system, infrared and polarimetric cameras.

- Ocean Acoustic Observatory: A semi-permanent acoustic range installed off the coast of Dania, Fla. that is hard-wired to a shore station. The range has both active and passive modes, providing real time, continuous records of acoustic fluctuations for basic studies of sound propagation and scattering, and applications to surveillance and monitoring.

- Upper Ocean Dynamics Laboratory: The laboratory conducts experimental studies of coastal circulation processes and ocean-atmosphere interactions during hurricane passage. The laboratory uses a combination of satellite (altimetry), aircraft and *in situ* measurement and analysis techniques. Personnel (including students) are involved deploying oceanographic and atmospheric sensors such as profiling floats and expendables from research aircraft during hurricanes and non-hurricane conditions (e.g., Deep Water Horizon). The laboratory operates three high-frequency radars (HFR) to map the real time surface currents, winds and waves with a fourth radar to be deployed in North Key Largo in the near future. These radars, working 24/7, provide data to the HFR national network. In addition to providing data for student research topics, these real time measurements address a spectrum of societally relevant issues related to the coastal ocean on: search and rescue operations by the United States Coast Guard; ship tracking by the Department of Homeland Security; dispersion of toxins such as harmful algae blooms in the surface layer (e.g., beach closures); predicting and mitigating the effects of an oil spill (e.g., Deep Water Horizon); improving storm surge and inundation models; providing data to improve rip current predictions; and linking fisheries and biological data to coastal ocean circulation processes.

- The Physical-Biological Interactions Laboratory is located in the new Marine Technology and Life Sciences (MTLS) Building on RSMAS campus. The PBI Laboratory includes a dry lab (670 sq ft) and a seawater (wet) lab (325 sq ft). The dry lab is dedicated to instrument development and data analyses, including bio-acoustic data and three-dimension image analyses from observations and numerical modeling. It is also equipped with pelagic sampling systems, passive acoustic instruments, and is home of the Drifting In Situ Chamber (DISC), a Lagrangian device developed to track the movement of pelagic larvae and record environmental signals in the field. The seawater lab hosts breeding and larval-rearing tanks, a flume choice tank for olfactory experiments, and a unique clear polymer cylindrical tank (66 inch height x 43 inch diameter). This aquarium is a large behavioral chamber designed to examine biophysical interactions in controlled settings. The concept of the design is a combination of a tall water column with a circular arena to observe the swimming behavior of larvae and test and quantify their navigational skills. The seawater lab is equipped with a computer-controlled led lighting system that has the capability of generating skylight patterns, reproduce natural downwelling light, and vary wavelengths. The system can reproduce conditions observed in situ while controlling and manipulating a series of environmental cues. These laboratory experiments will be used for studies of larval dispersal and migration for the purposes of model parameterization and validation, e.g., of the Connectivity Modeling System (CMS), an open-source Lagrangian stochastic model developed by the PBI lab at RSMAS.

- The Ocean Technology Group (OTECH) provides technical and personnel support for sea-going experiments locally, nationally, and around the globe. OTECH maintains a large inventory of standard equipment, including approximately 30 Aanderaa, 45 vector-averaging (VACM) and 6 vector-measuring (VMCM) current meters, 6 acoustic Doppler current profilers (ADCPs), 30 acoustic mooring releases and 3 PEGASUS acoustic current profilers. In addition, the group is involved in the development or expanded use of new instrumentation, including RAFOS (autonomous, acoustically tracked subsurface) floats, and satellite based (using Global Positioning System or GPS) acoustic current profilers.

- Chemistry laboratories. The analytical instruments in the chemistry labs allow for quantifying the following parameters: 1) inorganic nitrogen, phosphate and silicic acid; 2) dissolved organic carbon and nitrogen; 3) carbonate species; 4)

alkalinity, salinity, pH and density; 5) tritium, CFCs and SF6; and 7) trace elements and their stable isotopes.

- Multi-Collector ICP-MS: Thermo NEPTUNE. The Thermo Scientific NEPTUNE Multi Collector (MC) ICP-MS offers high sensitivity and wide-ranging measurement capability. It is equipped with 9 Faraday detectors with one $10^{10}\Omega$ and one $10^{12}\Omega$ resistor to permit a dynamic range in Faraday detection. The instrument has 5 ion counters with one RPQ filter for study of isotopes with very low signal intensities, and permits a wide range of isotope systems to be analyzed at high precision. The instrument is equipped with many sample introduction systems that can be tailored for each application. The Neptune can analyze solutions via quartz spray chamber, PFA barrel spray chamber, desolvating nebuliser ESI Apex Q with 24 hours operation achieved using autosamplers ESI DX2. Solid samples can be analyzed by the New Wave Excimer 193 nm Laser Ablation (LA) system. The capability of the NEPTUNE to measure isotopic ratios across a wide range of elements allows applications in earth sciences, palaeoceanography, medical research and environmental studies. This instrument is routinely used for isotope dilution analysis of low level Fe, Mn, Cd, Zn and Cu in oceanic waters and the measurements of precise isotopic ratios of Li, B, Mg, Ca, Hf, Fe, Zn, Cd, Sr, Sc, Y, Rare Earth Elements in seawater and geological samples, and U-Th geochronology of carbonate rocks, including corals and speleothems. In addition to carrying out analyses to support research projects at the University of Miami, we also analyze samples through collaborations with other research institutions and for commercial purposes. A. Pourmand and J. Wu who are responsible for the day-to-day running of the instrument oversee the MC ICP-MS facility.

c. *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 Department of Ocean Sciences, including classrooms, office equipment, and support services, are sufficient to support the proposed graduate program.

3. *CURRICULUM*

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

We propose four sciences themes within the OCE program, reflecting the current research strengths of our faculty and students. These are:

1. Ocean Dynamics: This concentration covers the study of how the ocean moves, on all scales from turbulence and eddies, to ocean gyres and the global thermohaline circulation. Topics include the dynamics and variability of boundary currents, meridional overturning and tropical circulations, coastal and shelf processes, as well as interactions between large-scale, mesoscale, and submesoscale motions. We approach these studies through sea-going experimentation, numerical modeling using both comprehensive and conceptual models, data analysis and assimilation, and theoretical studies. While some overlap with the existing MPO program may be seen in this specific science theme, the emphasis of the OCE program is on the ocean as a system of interacting physical, chemical and biological components; MPO focuses on the interactions between the physical ocean and the atmosphere. We expect that OCE faculty continue recruiting students with interests in coupling oceanic-atmospheric to the MPO program, as reflected in Appendix D.

2. Biophysical Interactions: This concentration addresses the study of ocean productivity, the distribution, transport and behavior of planktonic organisms and their complex interactions with higher trophic levels. We take a multi-prong approach, coupling the development of biophysical models with experimental field and laboratory work. Topics include the study of, e.g., harmful algal blooms; plankton distribution and patchiness; trophic interactions (NPZD) and energy and transfer; larval dispersal and population connectivity; biological control of physical constraints; microbial dynamics; bioacoustics and animal navigation. Innovative techniques and instruments are also developed for the in-situ observation of planktonic organisms behavior and their response to environmental signals.

3. Air-sea Interaction and Remote Sensing: The focus is on small-scale to mesoscale interfacial processes critical to understanding submesoscale ocean physics, large-scale weather events, and climate dynamics, as well as the scattering of electromagnetic and acoustic signals from the water surface. The department facilities are three-fold: First, SUSTAIN, a world-class wind-wave tank, is the only wind-wave facility capable of generating hurricane-force winds. The second facility, CSTARS, hosts a real-time satellite

reception and analysis facility that downloads high-resolution imagery and data. Finally, these facilities are complemented by a strong experimental component using ship, buoy, land, and aircraft-based platforms capable of measuring the physics and chemistry of the atmospheric boundary layer, the air-sea interface, the oceanic mixed layer, and thermocline processes using state-of-the-art sensing capabilities. This trifecta of strong experimental, laboratory, and remote sensing capabilities sets RSMAS apart globally in addressing air-sea interaction issues such as climate research, weather and wave forecasting, disaster monitoring and response, renewable energy developments, and in support of applications of the Navy and of the Department of Homeland Security. While some overlap with the existing MPO program may be seen in this specific science theme, the emphasis of the OCE program is on the observational aspects of air-sea interactions. We expect that OCE faculty will continue recruiting into the MPO program students with interests in modeling aspects of the atmosphere-ocean coupled system, as in Appendix D.

4. Marine biogeochemistry: Studies focus on the processes controlling the biogeochemical cycling of macronutrients (N, P and Si), carbon and trace elements via field measurements and modeling of concentrations and isotopes of these elements in the global ocean. Topics include ocean acidification, nutrient limitation of productivity, global distributions of biogeochemical variables, tracers of ocean processes, air/sea exchange of materials, and impacts on physical chemistry and organic geochemistry.

Over time, as our new department enables scientific problems to be redefined outside of normal disciplinary boundaries, we anticipate the development of additional multidisciplinary sciences themes.

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.

Overall, about 80-90% of the core material for the proposed program is already being routinely taught. The bulk of the proposed graduate curriculum will initially be drawn from the existing M.S. and Ph.D. programs in AMP, MPO, and MAC. However, we identified several gaps in the graduate curriculum that the proposed OCE program will aim to

address, 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)*

Anticipated Additions (we have identified faculty that could teach the courses but others may teach them too):

1) OCE XXX: Ocean Systems. Introductory Course to understand the ocean as a system. It will cover the interactions between biological, chemical, and geological processes in the environment, all within the context of physical controls. In the ocean, biogeochemistry includes the cycling of both major (e.g., C, N, P, Si, O) and minor elements (such as Fe). Tracing the spatial and temporal variability of these elements provides insights on the biological and geochemical processes at work, as well as the hydrographic and other controls on those processes. In this course, the physical ocean system is introduced in the context of its controls on the biological system, which in turn controls distributions of bioactive elements. Considered here are the major processes controlling ocean productivity, its roles as a carbon sink, organic matter production and consumption, the cycling of nutrients, the inorganic carbon system, and biogeochemistry of the sediments. (Hansell).

2) OCE XXX: Introduction to Biological Oceanography: The Abiotic Environment; Surface Circulation; Phytoplankton, Photosynthesis, and Respiration; Physical Controls of Primary Production; Distribution of Primary Production; Zooplankton Systematics & Distributions; Biological Pump I: Energy and Food Webs, Biogeochemical Cycles; Biological Pump II: Decomposition and Remineralization; Deep-Sea Benthic Ecology; Tide Pools, Rocky and Sandy Shores; Estuaries, Coral Reefs and Mangroves; Human Impacts on the Marine Environments; Glacial Iron Hypothesis and Glacial-Interglacial CO2 Change: The Iron Hypotheses. (Paris/Hansell).

3) OCE XXX: Introduction to Chemical Oceanography: Introduction and Major Components of Seawater; Controls on Major Sea Salt Components; Nutrients and Dissolved Oxygen; Trace Elements I: Introduction and Effect on Algal Growth; Trace Elements II: Ion-Ion Interaction and Speciation; Trace Elements III: Oceanic Distribution; Stable Isotopes; Radioactive Isotopes; Sediment Deposits; DIC, pH and Alkalinity; Atmospheric Carbon Dioxide; Chemical Tracers in paleoceanography. (Wu/Hansell).

4) OCE XXX: Introduction to Geological Oceanography: Introduction to basic plate tectonic theory; The "New" plate tectonics; The Wilson Cycle and Ocean Evolution; Hydrothermal vents and Proterozoic Geology; Snowball Earth and BIFs; Archean Oceans and Ediacarin Fauna; Proterozoic Evolution (Isabella) and Sedimentary Facies; Shelves and Submarine Fans; Seawater and Greenhouse versus Icehouse Earths; Paleoclimatology and Sea level changes; Coral Reef and Triassic extinction; Isotopes. (Wu).

5) OCE XXX: Math for Biophysical Interactions: Review of linear algebra; review of vector calculus; review of ordinary differential equations; dynamical systems; phase space; fixed points and equilibria; local stability analysis. (Olascoaga).

6) OCE XXX: Life in Moving Fluids: Introduction to the physical properties of water in relation to biological form and functions and evolutionary adaptations. Fluid characteristics are described in relation to various flow phenomena that play a part in life functions, e.g., fluid dynamics at small scales; diffusion, density, and viscosity; thermal properties; light and sound propagation; energy conservation, transfer limitations, and survival strategies. (Paris).

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

- OCE's faculty will continue teaching in the existing MPO program.
- The OCE program will also coordinate courses and special seminars with the other programs offered by RSMAS.
- School-wide 'concentrations' (across RSMAS departments) will provide the students with a broader interdisciplinary education and more fulfilling experience outside the classroom in their area of interest (e.g. concentration of (1) 'climate' with all RSMAS departments; (2) 'hurricanes' with ATM; etc).

e. Detailed description of the proposed program

- Program Requirements (consistent with a graduate bulletin masthead)

Ph.D. Degree

- Credit Requirements

- At least 28 OCE graduate-level course credits. No less than half of the total credits must be in coursework open only to graduate students (700-level or above, in the new course numbering system).

- Dissertation Committee
  - As per the UM Graduate Handbook.
- Comprehensive Examination
  - At the end of May in their first year, or after completing the core courses, the student will take a written and oral comprehensive examination. The faculty members, who taught the core courses, the program director, and the student's adviser will normally prepare and administer the examination within the guidelines established by the School.
- Qualifying Examination
  - A written and oral qualifying examination is required of all students admitted to the doctoral program. The student's committee will normally prepare and administer the examination within the guidelines established by the school. It is normally administered in the Spring term of the third academic year, or upon completion of the masters program.
- Dissertation Proposal
  - An outline of the dissertation proposal must be available to the committee before the qualifying examination. This proposal must be completed, and presented to the dissertation committee for approval within one semester of successfully passing the qualifying examination.
- 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.
- Publications
  - One first-author paper with at least one round of reviews received, plus a second first-author paper submitted.
- Dissertation

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

M.S. Degree

- Credit Requirements
  - At least 24 OCE graduate-level course credits.
- Thesis Committee
  - As per the UM Graduate Handbook.
- Comprehensive Examination
  - At the end of May in their first year, or after completing the core courses, the student will take a written and oral comprehensive examination. The faculty members, who taught the core, the program director and the student's adviser will normally prepare and administer the examination within the guidelines established by the School.
- Thesis
  - A thesis is required, and a public oral defense of the thesis must take place.

- Anticipated program mission and learning outcomes

  Mission: The goal of the proposed program is for our students to understand the ocean as a key component to the broader Earth Systems Science since over 70% of the planet is covered by ocean. Our students will advance the understanding of the physical, chemical, and biological processes in the ocean system and their interactions. They will learn first-hand about instrumentation and methods to measure the ocean, from both in-situ and from space-based sensors, and about conceptual, analytical, and numerical models to understand oceanic processes. Our graduates will develop into international leaders of ocean research, into teachers and communicators of ocean sciences, and into leaders and advisors of marine education, policy, and conservation.

  Learning Outcome 1: Students will demonstrate a broad knowledge of ocean sciences and an awareness of how scientific research in their topical areas addresses current human and societal issues.

  Learning Outcome 2: Students must demonstrate the ability to verbally communicate scientific techniques and results.

  Learning Outcome 3: Students must demonstrate the ability to clearly communicate scientific ideas in written documents.

- Assessment methods (qualitative and quantitative) intended to measure student attainment of learning outcomes

Learning Outcome 1: *Students will demonstrate a broad knowledge of ocean sciences and an awareness of how scientific research in their topical areas addressing current human and societal issues.*

Assessment Measure 1: All students must pass a Comprehensive Exam at the end of their first year of study. The Comprehensive Exam tests the student's knowledge of fundamental concepts and the ability of the student to assimilate and apply material taught in different courses. During the oral part of the exam the students are also evaluated on their awareness of how their research topic could benefit human and societal issues. The Comprehensive Exam has three different categories of scores (fail, pass and high pass). A "high pass" allows the student to bypass the M.S. degree. A "pass" permits the student to pursue a M.S. degree. A "fail" does not entitle the student to continue in the program.

Assessment Measure 2: Each Ph.D. student must write and submit a dissertation proposal. The Ph.D. dissertation proposal should: 1) formulate a novel testable scientific idea, possibly in the form of a hypothesis test; and 2) demonstrate a mastery of the scientific knowledge on which the idea/hypothesis is based. The thesis proposal is evaluated and approved by the students thesis committee.

Learning Outcome 2: *Students must demonstrate the ability to verbally communicate scientific techniques and results.*

Assessment Measure 1: Students must present at least one seminar each year, beginning the second year of study, describing some aspect of their research. Faculty members and peers provide feedback to the student relating to both presentation style and content in writing after each seminar.

Assessment Measure 2: All students must present a public seminar, as part of the thesis defense at the completion of their studies, which gives an overview of their research. Thesis committee members using a rubric designed by the Graduate School, rate the presentations on their ability to verbally present scientific ideas.

Learning Outcome 3: *Students must demonstrate the ability to clearly communicate scientific ideas in written documents.*

Assessment Measure 1: A preliminary step towards earning the Ph.D. degree is submission of an approved written dissertation proposal. Evaluation of student writing skills, including suggested edits, is provided by faculty members who serve on the student's PhD dissertation committee. This will also be evaluated with the Ph.D.

requirement of two first author journal papers (one with at least one round of reviews received, plus a second submitted).

Assessment Measure 2: To earn a degree, students must write and defend before the school's faculty a Ph.D. dissertation that describes their research and is approved by their advisor and dissertation committee. Each faculty member on the Ph.D. dissertation committee provides corrections and other feedback. Committee members using a rubric designed by the Graduate School to assess the students' ability to communicate scientific techniques and results rate the theses.

- Tracks for degree
  N/A
- Course descriptions for each new course (Syllabus for each course in Appendix A)
  A description of six new courses is given in Section 3c.

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

- Prerequisites: Students applying for admission should have an undergraduate degree in mathematics, physics, chemistry, biology, geophysics, marine science or engineering. Applicants must take the GRE, and those whose first language is not English must pass the Test of English as a Foreign Language (TOEFL) with a score of at least 550.

- Examinations
  - Many 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 within the third year

- All students are required to take 2 OCE core courses, plus the 2 additional core courses from their sciences theme (12 credits total) in their first year. The Comprehensive Examination will be based on these courses.

- All OCE students will take 2 of the following 3 core courses (each 3 credits; we have identified faculty that could teach the courses but others may teach them too):
  - OCE XXX Ocean Systems (Hansell)
  - MPO 503/OCE XXX Principles of Physical Oceanography (Beal/ Mariano/Johns)
  - AMP 601/OCE XXX Analytical Methods (Brown/ Drennan)

  For the students who focus on marine biogeochemistry, the following courses will be required:

- OCE XXX Introduction to Chemical Oceanography (Wu/Hansell)
- OCE XXX Introduction to Biological Oceanography (Paris/Hansell)

For the students who focus on the biophysical interactions in the ocean, the following courses will be required:

- OCE XXX Introduction to Biological Oceanography (Paris/Hansell)
- OCE XXX Math for Biophysical Interactions (Olascoaga) or AMP 601

For the students who focus on ocean dynamics, the following courses will be required:

- MPO 511 Geophysical Fluid Dynamics I (Ozgokmen)
- MPO 611 Geophysical Fluid Dynamics II (Kamenkovich)

For the students who focus on air-sea interaction and remote sensing, the following courses will be required:

- AMP 575 Applied Ocean Hydrodynamics (Willemsen)
- AMP 576 Wave Propagation in the Ocean Environment (Romeiser)

- A Manuscript Writing Skill (1 credit) course is required to be taken by all OCE students before the end of the third year.

- The remaining course credits are selected in conjunction with the student's advisor. Below is a list with the available elective courses taught by OCE faculty, but elective courses could be taken in other departments and programs within RSMAS and UM as part of the student broader development. For example, students within the Biophysical Interactions sciences theme are expected to take courses taught by MBE.

- Graduate Level Electives (all 3 credits unless otherwise noted)

Course Name	Course #	Who could teach it?
Introduction to Geological Oceanography	OCE600 level	Wu
Life in Moving Fluids	OCE600 level	Paris
Inductively Coupled Plasma Mass Spectrometry	MAC 581	Wu
Ross Sea Dynamics	MAC 584	Hansell
Chemical Oceanography	MAC 605	Fine (team teach)

Marine Trace Element Geochemistry	MAC 681	Wu
Coastal Engineering	AMP 509	Haus/ Van de Kreeke
Ocean Measurements	AMP 531	DeFerrari
Introduction to Underwater Acoustics	AMP 535	Brown/DeFerrari
Modeling of Physical-Biological Interactions	AMP 536	Paris/Olascoaga
Physics of Remote Sensing- II Active Systems	AMP 542	Romeiser/Graber/Minnett
Air-Sea Interaction	AMP/MPO 631	Haus/Graber/Drennan/Shay
Coastal Ocean Circulation	AMP/MPO 650	Haus/ Kourafalou/Shay
Advanced Underwater Acoustics	AMP 672	DeFerrari/Brown
Advanced Ocean Measurements	AMP 686	DeFerrari
Mechanics and Thermodynamics of the Air-Sea Interface	AMP 690	Haus/Graber/Drennan
Field observations of coastal and air-sea	AMP 698	Haus/Graber/Drennan
Oceanography 2 (Physical)	MPO 502	Van Leer
Geophysical Fluid Dynamics I	MPO 511	Ozgokmen
Physics of Remote Sensing I - Passive Systems	MPO 542	Minnett,/Romeiser/Graber
Scientific Programming	MPO 582	Iskandarani
Geophysical Fluid Dynamics II	MPO 611	Kamenkovich
Large-Scale Ocean Circulation	MPO 612	Johns
Waves and Tides I	MPO 621	Leaman
Statistical Analysis of Geophysical Data	MP0 623	Leaman
Statistical Modeling of Geophysical Fields	MPO 624	Mariano

Numerical Methods in Fluid Dynamics	MPO 662	Iskandarani
Spectral and Finite Element Methods in Computational Fluid Dynamics	MPO 663	Iskandarani
Atmospheric and Oceanic Turbulence	MPO 664	Ozgokmen
Long-term climate variability and abrupt climate change	MPO 671	Kamenkovich
Mesoscale Oceanography	MPO 675	Kamenkovich/Mariano / Olson
Manuscript Writings Skills (1 credit)	RSM 680	Paris
Polar Science	RSM 571	Minnett
Carbon and Climate	RSM 570	Drennan
Lagrangian fluid dynamics and predictability	RSM 671	Olascoaga/Mariano
Sustainability	RSM 571	Van Leer

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. 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. The last two years are spent solely on research. It is expected that during 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. A second research peer-reviewed paper is expected to be submitted in the final in the final year.

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

The estimated average teaching load for each member is one graduate course, and two undergraduate courses per year. About 80-90% of the core material for the proposed program is already being routinely taught, so the new program will not increase significantly the teaching load. (See Appendix C for teaching load information for each faculty during the last year.)

Fall Semester – Year 1 (2016)	**Spring Semester – Year 1 (2017)**
Ocean Systems (Hansell)	Introduction to Biological Oceanography (Paris/Hansell)
Analytical Methods (Brown)	Wave Propagation in the Ocean Environment (Romeiser)
Principles of Physical Oceanography (Beal/ Mariano/Johns)	Geophysical Fluid Dynamics II (Kamenkovich)
Introduction to Chemical Oceanography (Wu/Hansell)	Electives
Math for Biophysical Interactions (Olascoaga)	
Applied Ocean Hydrodynamics (Willemsen)	
Geophysical Fluid Dynamics I (Ozgokmen)	
Electives	
Fall Semester – Year 2 (2017)	**Spring Semester – Year 2 (2018)**
Ocean Systems (Hansell)	Introduction to Biological Oceanography (Paris/Hansell)
Analytical Methods (Brown)	Wave Propagation in the Ocean Environment (Romeiser)
Principles of Physical Oceanography (Beal/ Mariano/Johns)	Geophysical Fluid Dynamics II (Kamenkovich)
Introduction to Chemical Oceanography (Wu/Hansell)	Electives

Math for Biophysical Interactions (Olascoaga)	
Applied Ocean Hydrodynamics (Willemsen)	
Geophysical Fluid Dynamics I (Ozgokmen)	
Electives	
Fall Semester – Year 3 (2018)	**Spring Semester – Year 3 (2019)**
Ocean Systems (Hansell)	Introduction to Biological Oceanography (Paris/Hansell)
Analytical Methods (Brown)	Wave Propagation in the Ocean Environment (Romeiser)
Principles of Physical Oceanography (Beal/ Mariano/Johns)	Geophysical Fluid Dynamics II (Kamenkovich)
Introduction to Chemical Oceanography (Wu/Hansell)	Manuscript Writings Skills (Paris)
Math for Biophysical Interactions (Olascoaga)	Electives
Applied Ocean Hydrodynamics (Willemsen)	
Geophysical Fluid Dynamics I (Ozgokmen)	
Manuscript Writings Skills (Paris)	
Electives	

Electives will depend on student's interest. Some will be taught every year, but others less frequently.

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, with some of them including laboratory work. Several 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.

g. Expected distribution of graduate students among advisors

On average, two or three graduate students per advisor on the tenure track are expected. See Appendix D information on the average number of students in the last 5 years, current number of students, and plans for recruitment for each OCE faculty.

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

A weekly seminar series will be held each semester. It will be hosted as OCE departmental seminars. 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 usually held about 6-months in advance of their respective defense/graduation date.

i. Learning Outcomes Assessment Plan (Appendix B)

4. FACULTY

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

FACULTY MEMBER		FIELD	TERMINAL DEGREE	RANK
Beal	Lisa	Physical Oceanography	Ph.D.	Professor
Brown	Mike	Ocean Physics	Ph.D.	Professor
Chen	Shuyi	Air-Sea Interaction	Ph.D.	Professor
DeFerrari	Harry	Acoustical Oceanography	Ph.D.	Professor
Drennan	Will	Air-sea interaction, surface waves, boundary layers, turbulence	Ph.D.	Professor/Associate Dean Undergrad Education
Fine	Rana	Oceanography	Ph.D.	Professor
Graber	Hans	Surface wave dynamics, satellite oceanography and radar remote sensing	Ph.D.	Professor
Hansell	Dennis	Chemical Oceanography	Ph.D.	Professor/Chair
Happell	Jim	Measurements of tritium, CFCs and sulfur hexafluoride for use as ocean and groundwater tracers.	Ph.D.	Associate Professor (Research)
Haus	Brian	Air-sea interaction and coastal engineering	Ph.D.	Professor
Iskandarani	Mohamed	Physical Oceanography	Ph.D.	Associate Professor
Johns	Bill	Physical Oceanography	Ph.D.	Professor
Kamenkovich	Igor	Physical Oceanography	Ph.D.	Associate Professor
Kourafalou	Villy	Physical Oceanography	Ph.D.	Professor

				(Research)
Leaman	Kevin	Physical Oceanography	Ph.D.	Professor
Mariano	Arthur	Physical Oceanography	Ph.D.	Professor
Millero	Frank	Marine Physical Chemistry	Ph.D.	Professor
Minnett	Peter	Physical Oceanography	Ph.D.	Professor
Olascoaga	Josefina	Physical Oceanography	Ph.D.	Associate Professor
Olson	Don	Physical Oceanography	Ph.D.	Professor
Ozgokmen	Tamay	Ocean Modeling	Ph.D.	Professor
Paris	Claire	Biophysical Oceanography	Ph.D.	Associate Professor
Podesta	Guillermo	Biological Oceanography	Ph.D.	Professor (Research)
Romeiser	Roland	Ocean Remote Sensing	Dr.rer.nat.	Associate Professor
Shay	Nick	Ocean -Atmospheric Interactions	Ph.D.	Professor
Van Leer	John	Physical Oceanography	Ph.D.	Associate Professor
Vincent	Linwood	Environmental Sciences	Ph.D.	Professor (Research)
Willemsen	Jorge	Ocean Physics	Ph.D.	Professor
Wu	Jing Feng	Chemical Oceanography	Ph.D.	Associate Professor
Zhang	Chidong	Air-Sea Interaction	Ph.D.	Professor

b. *Estimate the need for additional faculty, including in each instance*
   i. *Specialization desired*
   ii. *Degree of experience desired*
   iii. *Salary anticipated*

These potential new hires are subject to the final approval of the OCE Strategic Plan which is currently under development.

Chemical Oceanographer

OCE will recruit a doctoral scientist at the Assistant Professor rank working in chemical oceanography, marine biogeochemistry, and/or marine chemistry, with a focus on understanding fundamental processes and climate change, along with its variability and

impacts. Current departmental strengths in chemistry include trace element chemistry, physical chemistry, biogeochemistry, and tracer oceanography. We are particularly interested in recruiting a sea-going observationalist who complements our existing strengths. Teaching contributions will be primarily to our chemistry classes in MSC (i.e., "Chemical Oceanography" MSC 215 lecture and MSC 216 laboratory) and to OCE's M.S./Ph.D. academic program. Salary commensurate with rank and experience.

Climate Change Oceanographer

OCE will recruit a scientist at the Assistant Professor rank with a Ph.D. in oceanography or a related field and with a strong background in mathematical and computational science. The faculty member will conduct research with relevance to understanding oceanic processes associated with climate and climate change through the use of mathematical tools that can exploit the growing range and availability of "big data" in oceanography. The scientist will conduct an active research program with a commitment to collaborative research and to developing courses for an interdisciplinary academic program for graduate and undergraduate students. The person will collaborate with OCE's biological, geochemical, and physical oceanographers to address complex ocean-climate problems. Teaching contributions will be to the MSC undergraduate program (B.S.), the Natural Hazard and Catastrophe Analytics program (M.P.S.), and OCE's graduate program (M.S., Ph.D.). Salary commensurate with rank and experience.

Microbial Biogeochemist

OCE will recruit a scientist at the Assistant Professor rank with a Ph.D. in oceanography or a related field and with a strong background in marine microbial ecology and biogeochemistry. The faculty member will conduct research with relevance to understanding oceanic processes associated with microbes and their interactions with climate and climate change through the use of molecular and biogeochemical tools that can exploit the growing range and availability such tools in oceanography. The scientist will conduct an active research program with a commitment to collaborative research and to developing courses for an interdisciplinary academic program for graduate and undergraduate students. The person will collaborate with OCE's biological, geochemical, and physical oceanographers to address complex ocean system problems. Teaching contributions will be to the MSC undergraduate program (B.S.) and OCE's graduate program (M.S., Ph.D.). Salary commensurate with rank and experience.

Coastal Engineering

OCE will recruit a scientist at the Assistant Professor rank with a Ph.D. in coastal engineering, oceanography, civil engineering or a related field and with a strong background in coastal hydrodynamics, structures and soils. The faculty member will conduct research with relevance to improving coastal community resilience to forcing from climate change, storm surges and other stressors through the use of experimental and computational studies. The scientist will conduct an active research program with a commitment to collaborative research and to developing courses for an interdisciplinary academic program for graduate and undergraduate

students. The person will collaborate with the College of Engineering Civil Architectural and Environmental Engineering faculty, and OCE's biological, geochemical, and physical oceanographers to address complex community-ocean-climate problems. Teaching contributions will be to the MSC undergraduate program (B.S.), the Natural Hazard and Catastrophe Analytics program (M.P.S.), the Ocean Engineering joint program (M.S) and OCE's graduate program (M.S., Ph.D.). Salary commensurate with rank and experience.

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

Committees: It is anticipated that faculty in other departments within RSMAS will serve on thesis and dissertation committees of OCE students.

Courses: The OCE program will have linkages with the inter-departmental MPO program in terms of common courses taught. Also, some OCE students (for example, students within the *Air-sea interaction* or *Biological-Physical interactions* tracks) will take courses taught by the ATM, MBE and/or MGS departments.

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

Concentrations: interdisciplinary, interdepartmental concentrations are being developed, and will be listed 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*

On average, more than graduate 30 students are expected in OCE (see Appendix D). Some students with OCE advisors may elect to join the MPO program if there is a significant atmospheric component in their research. At least 90% of all students in the OCE program are expected to be Ph.D. students, with the remainder being M.S. students.

The students will be selected from a worldwide application pool, with a target number of applicants exceeding 100 to compete for an average of 6 new graduate assistantships per year. The application pool is expected to composed largely of students with undergraduate backgrounds in marine science, mathematics, physics, chemistry, biology, or engineering.

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

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 small minority 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%.

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 OCE Ph.D. program would mostly serve as TAs for courses in the MSC and ATM undergraduate programs, 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 department's current administrative assistants will absorb the necessary workload.

ii. *Need for additional office equipment and supplies*

Office equipment and supplies will be in the department 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 School currently handles the budget for student recruitment. If recruitment duties were 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.

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 department faculty.

7. BUDGET (three-year)

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 new program will operate under the same business model of students funding and it will not require additional support from UM.

Ph.D. PROGRAM COST	**FY 2017**	**FY 2018**	**FY 2019**
Ph.D. Student Expenses	per student	per student	per student
Tuition-(12 credits/yr)	22,787	23,470	24,174
Total Ph.D. Student Stipends	30,910	31,837	32,792
Health insurance	2,446	2,519	2,594
Administrative Expenses			
Student Travel Funds			
Office Furniture, Supplies, Computers			
Recruiting, Publications, Speakers, etc.			
Additional Course Costs			
Total Administrative Expenses			
Total Program Cost			

Note that 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 if not on external fellowships. The M.S. students who are not self-funded have their stipend and tuition supported by the 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.

No cross-disciplinary M.S. and Ph.D. program with the unique aspects of that one proposed here currently exists in any of the largest oceanographic schools in the country. If approved, the proposed program will lead the nation in removing the educational boundary between marine physics, biology, and chemistry, training our next generations of scientists to be truly multidisciplinary experts. A summary of five selected comparable programs is below tables.

The comparison reveals that other ocean 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, through course instruction and dissertation research guided by a faculty advisor and dissertation committee.

RESOURCES

Each program possesses comparable library resources. UM stands out with a wide range of laboratory resources compared with many programs (See section 2.b for a detailed description).

CURRICULUM

Each program has a group of core courses that focus on the basic physics, biology and chemistry in ocean sciences, and a wide range of elective courses that reflect the research interests of the faculty and the identity of the program.

At UM, we propose a relatively small number of core courses, and electives that reflect the department's strengths in (1) Ocean Dynamics, (2) Biophysical Interactions, (3) Air-sea Interaction and Remote Sensing, and (4) Marine Biogeochemistry.

One of the programs requires also a Scientific Communication course.

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.

All programs have a weekly Colloquium series.

FACULTY

Current number of teaching faculty within OCE is 30. The number of faculty is comparable with the programs described below.

STUDENTS

Current number of students within OCE is around 30 (See Appendix D). The number of students (in proportion to faculty) is comparable (or higher) with the programs described below.

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

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.

a. **Georgia Institute of Technology** (Dept. of Earth and Atmospheric Sciences; http://www.eas.gatech.edu/; 34 faculty and 94 students). Focal themes: Oceanography, Biogeochemistry, and Remote Sensing (24 faculty and 24 students).

Major(s)	Requirements	Exams	Doctoral Exam
Earth and Atmospheric Sciences	Coursework: 15 credit hours from courses in research area; and 9 credit related	Comps Exam. Thesis proposal, written and oral	Dissertation and oral defense

	courses, outside research area. Other: TA'ship or complete a minor, or 2 or more unrelated courses outside research area. Presentations: 1 oral + 1 poster (or 2 orals) with one at national or international conference Publications: One 1st author with at least one round of reviews received, plus a second 1st author paper submitted.	exam by fall of 3rd year	

b. **Rutgers University** (Institute of Marine and Coastal Sciences; http://marine.rutgers.edu/main/IMCS-Academics/Graduate-Program-in-Oceanography.html; 45 faculty and students 33).

Major(s)	Requirements	Exams	Doctoral Exam
Oceanography	Coursework: 30 credits Other: 42 credits of research	Qualifying Exam: Written and oral exam (target, end 2nd year, no later than end 3rd year). Defense of research proposal (before end 3rd year)	Dissertation and oral defense

c. **University of Delaware** (College of Earth, Ocean, and Environment; School of Marine Sciences and Policy; http://www.ceoe.udel.edu/schools-departments/school-of-marine-science-and-policy; Programs of Oceanography and Physical Ocean Science and Engineering; 22 faculty, 15 students)

Major(s)	Requirements	Exams	Doctoral Exam
Oceanography Physical Ocean Science and Engineering	Coursework: 34 credits Other: Seminar (1 credit; once/year; a total of 5 credits) One 3 credit course in Marine Policy or one three credit course outside of the student's declared sub-discipline of interest Additional courses required by the student's advisory committee	Written and oral qualifying exam	Dissertation and oral defense

d. **University of Rhode Island** (School of Oceanography; http://www.gso.uri.edu/; 28 faculty; 50 students)

Major(s)	Requirements	Exams	Doctoral Exam
Oceanography	Coursework: 42 course credits Between 3 and 5 core courses (different requirements for different tracks) Six credits of Oceanography 600 level courses. Other: Seminar Participation in a regular ocean	Comprehensive and Qualifying exam.	Dissertation and oral defense

	research cruise. One 3 credit course in Marine Policy or one three credit course outside of the student's declared sub-discipline of interest Additional courses required by the student's advisory committee.		

e. **SUNY Stony Brook** (School of Marine and Atmospheric Sciences; http://www.somas.stonybrook.edu/education/graduate.html; Marine Science Track)

Major(s)	Requirements	Exams	Doctoral Exam
Marine and Atmospheric Sciences	Coursework: 3 core courses. Students will be free to emphasize their own interests in oceanography but are expected to acquire a broad base of interdisciplinary knowledge. Other: One 3 credit Quantitative Course Two semesters of Seminar Scientific Communication course 4 credits of seminar courses (taught primarily in discussion	Written and oral qualifying exam	Dissertation and oral defense

	as opposed to lecture format).		

9. Online and distant degree and certificate programs only

N/A

Instructional support benchmarks
Course development benchmarks
Teaching/learning benchmarks
Course structure benchmarks
Student support benchmarks
Faculty support benchmarks
Evaluation and assessment benchmarks

***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 MPS cannot be substituted for core courses in the OCE graduate program. However, MPS course credits can be used toward elective OCE course credits. All students in the OCE graduate program will be required to complete a minimum of 24 (M.S.) or 28 (Ph.D.) graduate course credits.

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

APPENDIX A: Syllabus for each course

APPENDIX B: Learning Outcomes Assessment Plan

Learning Outcome 1: *Students will demonstrate a broad knowledge of ocean sciences and an awareness of how scientific research in their topical areas addressing current human and societal issues.*

Assessment Measure 1: All students must pass a Comprehensive Exam at the end of their first year of study. The Comprehensive Exam tests the student's knowledge of fundamental concepts and the ability of the student to assimilate and apply material taught in different courses. During the oral part of the exam the students are also evaluated on their awareness of how their research topic could benefit human and societal issues. The Comprehensive Exam has three different categories of scores (fail, pass and high pass). A "high pass" allows the student to bypass the M.S. degree. A "pass" permits the student to pursue a M.S. degree. A "fail" does not entitle the student to continue in the program.

Assessment Measure 2: Each Ph.D. student must write and submit a dissertation proposal. The Ph.D. dissertation proposal should: 1) formulate a novel testable scientific idea, possibly in the form of a hypothesis test; and 2) demonstrate a mastery of the scientific knowledge on which the idea/hypothesis is based. The thesis proposal is evaluated and approved by the students thesis committee.

Learning Outcome 2: *Students must demonstrate the ability to verbally communicate scientific techniques and results.*

Assessment Measure 1: Students must present at least one seminar each year, beginning the second year of study, describing some aspect of their research. Faculty members and peers provide feedback to the student relating to both presentation style and content in writing after each seminar.

Assessment Measure 2: All students must present a public seminar, as part of the thesis defense at the completion of their studies, which gives an overview of their research. Thesis committee members using a rubric designed by the Graduate School, rate the presentations on their ability to verbally present scientific ideas.

Learning Outcome 3*: Students must demonstrate the ability to clearly communicate scientific ideas in written documents.*

Assessment Measure 1: A preliminary step towards earning the Ph.D. degree is submission of an approved written dissertation proposal. Evaluation of student

writing skills, including suggested edits, is provided by faculty members who serve on the student's PhD dissertation committee. This will also be evaluated with the Ph.D. requirement of two first author journal papers (one with at least one round of reviews received, plus a second submitted).

Assessment Measure 2: To earn a degree, students must write and defend before the school's faculty a Ph.D. dissertation that describes their research and is approved by their advisor and dissertation committee. Each faculty member on the Ph.D. dissertation committee provides corrections and other feedback. Committee members using a rubric designed by the Graduate School to assess the students' ability to communicate scientific techniques and results rate the theses.

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

Graduate teaching experience and grants received of the person concerned should be included in each CV.

APPENDIX D: Graduate students among advisors. (Data from Graduates Students Offices and as expressed from faculty for the future.)

NUMBER OF STUDENTS / FACULTY MEMBER	Mean 5 years	F2014	Plan for OCE	Plan for MPO
Beal	2	2	1	1
Brown	2	3	2	0
Chen	4	4	0	5
DeFerrari	2	1	3	0
Drennan	1	0	1	0
Fine	2	2	2	0
Graber	4	4	4	0
Hansell	3	3	3	0
Haus	1	4	3	0
Iskandarani	1	2	0	3
Johns	2	3	0	3
Kourafalou	1	0	0	0
Kamenkovich	2	2	1	1
Mariano	1	1	0	1

Millero	2	1	0	0
Minnett	3	3	0	2
Olascoaga	3	2	2	0
Ozgokmen	3	3	0	4
Paris	4	3	3	0
Romeiser	1	3	3	0
Shay	3	3	1	3
Wu	1	2	2	0
Zhang	4	4	0	5
Total: 23	52 (24 MPO)	54 (22 MPO)	31	28

APPENDIX E: Teaching load for each member of the faculty. (Data from Undergraduate and Graduates Students Offices.)

Faculty	Undergraduate Courses	Undergraduate Course Credits	Graduate Courses	Graduate Course Credits
Beal, Lisa	1	3	0	0
Brown,Michael	3	4	1	3
Chen, Shuyi	1	3	0	0
DeFerrari, Harry	1	3	2	6
Drennan, William	8	24	0	0
Fine, Rana	3	5	1	3
Graber, Hans	0	0	2	6
Hansell, Dennis	3	5	1	3
Haus, Brian	1	3	1	3
Iskandarani, Mo	0	0	2	6
William, Johns	0	0	1	3
Kamenkovich, Igor	0	0	1	3
Leaman, Kevin	2	6	1	3
Mariano, Arthur	1	3	2	6
Millero, Frank	1	1	2	6
Minnett, Peter	0	0	3	9
Olascoaga, Maria	3	4.5	1	3
Olson, Donald	6	8	1	1
Ozgokmen, Tamay	0	0	2	6
Paris, Claire	2	4	2	5
Romeiser, Roland	0	0	3	9
Shay, Lynn	0	0	1	3
Van Leer, John	1	3	1	2

Willemsen, Jorge	7	21	0	0
Wu, Jingfeng	7	11	1	0
Zhang, Chidong	2	5	0	0
Total	53	115.5	32	89
Average	2	4.4	1.2	3.4