

External Review Committee Report of the MIT-WHOI Joint Program



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Introduction

In 1968, MIT and WHOI created the Joint Program as a five-year doctoral degree program. This was a revolutionary marriage to bridge the combined strengths at MIT and WHOI and to provide a pathway to training leaders in both disciplinary and interdisciplinary oceanographic research. The program offers a world-class education for students and professionals in the ocean sciences. The MIT-WHOI JP degrees are recognized internationally as the top in the world for ocean science and technology. This is illustrated by the thousands of graduates who are now leaders in ocean research, policy, management, and technology across industry, non-profits, academia, philanthropy and government. Yet, the JP finds itself at a true inflection point as it assesses the partnership, program requirements, and opportunities as it approaches its sixth decade.

A prominent driver of this inflection point is the fact that oceans are changing at a profound rate owing to human-driven climate change. Adverse impacts from changes in Earth's climate will continue to intensify, putting ocean resources at risk; yet our oceans remain largely unexplored and unknown. New research, technology, and solutions must be investigated to address the grand scientific challenges of our time, including how to sustainably manage and foster a 21st century global blue economy. To achieve these goals requires the training of a large cohort of future leaders with the educational background and research skills to critically examine the ocean's role in the Earth system and its interfaces. Student and professional training programs need to combine experiential learning and entrepreneurial skills to identify and take advantage of the ocean opportunities that lie before us.

In the above context of a changing landscape of oceanographic research, policy and industrial partnerships, the External Review Committee examined the MIT-WHOI JP structure and goals to recommend pathways to modernization. The recommendations here are aimed at allowing the JP to evolve its processes and requirements and to homogenize program structure while allowing unique, interdisciplinary aspects to grow. The recommendations seek to better align how students are trained and mentored in the JP with Earth's profound scientific grand challenges, while also meeting student desires and employer needs.

The JP is exiting a particularly eventful five-year period of change, which included the coronavirus pandemic, a revolution in AI computational technology, graduate student unionization at both institutions, announcement of a major new climate initiative at MIT, a new MIT president, and a new WHOI director. In parallel to these events, applications to the JP have steadily increased, student morale is generally high, and students perceive a diversifying range of career options post graduation. While MIT and WHOI both acknowledge the importance of elucidating the underlying physical, chemical and biological processes that will impact the ocean in a changing climate, both institutions are also aligning themselves to provide leadership in the discovery and development of climate solutions. The importance of these topics means that the JP will likely continue to have access to the worlds' brightest and most creative graduate students wanting to contribute to these solutions.

This is also a critical juncture for the JP as the scientific questions that are most pressing are becoming increasingly inter-disciplinary and require new tools, facilities, and faculty to effectively train students. The state of the science may require large computational resources, the creative use of machine learning to leverage large data sets, an improved understanding of societal challenges, and the application of new engineering techniques for ocean exploration. The evolution of the field and desired skill sets of the students and employers is happening rapidly and despite the JP's current standing, the committee sees the potential for erosion of the JP's impact without continued review of the program's goals and metrics, and alignment of institutional resources with these goals.

The Joint Program is organized within five disciplines, each administered by a Joint Committee consisting of MIT and WHOI faculty members. Joint program disciplines include: Applied Ocean Science and Engineering (AOSE), Biological Oceanography (BO), Chemical Oceanography (CO), Marine Geology and Geophysics (MG&G), and Physical Oceanography (PO). Counterparts exist for MIT within specific departments. Students are encouraged to explore research projects that extend beyond ocean science into Earth science, hydrology, glaciology, marine conservation, and environmental chemistry, truly exploring the interconnectivity of the Earth science disciplines and their interfaces related to the ocean, as well as the ocean's role in the Earth system. There are unique aspects of both the MIT and WHOI campuses, including specialized centers and institutes in complementary areas such as marine policy.

The JP external review committee's visit occurred on September 10-12, 2024 with one day at the MIT Campus in Cambridge, MA, and two days at WHOI in Falmouth, MA.

The charge to the committee was as follows:

1. Is the Joint Program preparing students for careers in the current environment? We increasingly hear from students that they want to explore avenues other than academia upon graduation. Are our curriculum, program structure, and professional development opportunities optimized for the needs of today's students?
2. How can we better integrate over-arching research themes and tools (e.g. AI, policy, climate) to provide a more coherent experience in the program and potentially attract new students?
3. Is our program attractive to a diverse student population? Are our programs and structures well-suited for the support of students from non-traditional backgrounds?
4. Are there areas of opportunity for the Joint-Program to connect with more faculty and a broader range of departments at MIT?

This report examines different areas of the program, and we present detailed suggestions to enhance various elements of the JP. However, three overarching themes of this report include:

1. The JP would benefit from a stronger alignment with the strategic institutional goals of MIT and WHOI, which will energize the graduate program and channel resources that will strengthen the program.
2. Structural changes to the JP that eliminates some of the disciplinary rigidity of the program will simplify organization and enhance impactful interdisciplinary work.
3. Incentivize engagement of new faculty in teaching JP courses (WHOI faculty) and mentoring JP students (MIT faculty) to establish an appropriate balance of participation from both institutions.

Alignment of the Joint Program with MIT and WHOI Missions

Observation: Both MIT (The Climate Project) and WHOI (Vision 2030) are embarking on ambitious and potentially transformational programs related to climate science and climate solutions. The success of these programs will rely heavily on research carried out by graduate students in the JP. However, the committee did not receive much direct information about how the JP would respond to these new initiatives. The committee sees the JP as a foundational component of any success of future climate efforts and therefore should be prepared to leverage opportunities that arise from these initiatives.

Overall recommendation: The committee recognizes that both MIT and WHOI climate initiatives are at their early stages. Nevertheless, we encourage student engagement in the development of these new programs to ensure they respond to student needs and contributions. The long-lasting impact of these efforts will, in part, occur through the training of the next generation of ocean leaders. Support for graduate students should be considered as part of fundraising activities to allow students to participate in novel, risky, and potentially transformational research. Involvement of the JP may also provide a mechanism for identifying new collaborations and strategic alignment of each institution's goals.

Recommendation: The committee recommends the drafting of a JP mission statement that is re-visited on a regular (5-year) basis that clearly outlines the goals of the educational program and how that relates to the larger goals and aims of both MIT and WHOI.

Recommendation: Future hires at both MIT and WHOI should consider how candidates will potentially contribute to the JP, in terms of developing a stronger research ecosystem, broader recruitment of students, and strengthening course offerings and skill development among students. Representation from both institutions on search committees should be considered.

Structure of the Joint Program

Observation: The JP continues to be organized around five disciplines (four science and one engineering) that reflect the traditional structure of ocean sciences at the time that the JP was founded in the 1960s. Students choose a home within one JP discipline and follow the guidelines, milestones, and academic requirements established by each discipline's Joint Committee (JC). Each JC has considerable autonomy, leading to different pathways for students that tend to emphasize depth of disciplinary knowledge. However, the focus on individual disciplines within the JP may be holding back the modernization of the program structure and even institutional flexibility.

Over the years, each JC has responded to recommendations from external reviews and to the increasingly interdisciplinary nature of many modern scientific questions by relaxing (to various degrees) the disciplinary requirements to allow more flexibility within each discipline's structure. Indeed, it is increasingly difficult to define a set of core courses within a discipline given the diversity and interdisciplinary nature of many students' research projects. Furthermore, three of the four science disciplines no longer have written exams that cover disciplinary general knowledge as part of their general exams. While there is some convergent evolution among the science disciplines towards structures that accommodate interdisciplinary work, the committee feels that program requirements could be further simplified and harmonized, and that the current heterogeneity in requirements by each discipline presents several unnecessary barriers.

1. Complex and heterogeneous program requirements prevents the JP from responding nimbly to changes in the current environment (see Charges 1 and 2). Central planning at the overall JP level to offer professional development and broader skills training (e.g., policy, entrepreneurship, computation) is hindered by the need to navigate five different program requirements.
2. Heterogeneity between discipline requirements reduces the cohesion amongst JP students, hindering informal and formal peer mentorship and support that is particularly important for providing a sense of belonging for minoritized students (see Charge 3).
3. Greater (real or perceived) complexity of JP program requirements, compared to analogous MIT-only program requirements, are a disincentive for MIT faculty to engage with the JP and a barrier to recruiting new MIT faculty to the JP (see Charge 4).

Recommendation: Each JP discipline should, where possible, work towards harmonizing its requirements with those of their MIT-only counterparts to facilitate and encourage participation of MIT faculty in the JP.

Recommendation: To the extent possible, we recommend that the JCs work towards defining a more common pathway for all students in the JP that is codified in a single handbook. While details will surely need to be hammered out by the JCs, the following could be a model:

- Classwork: all incoming JP students take an oceanographic breadth class (similar to the “Elements of Modern Oceanography” class) as well as one or more disciplinary class(es) common to all JP students within that discipline. Elective courses that strengthen research capabilities will remain discipline specific and should be selected with guidance from thesis mentors and JC members.
- General exam (modeled on the MIT EAPS general exam): all non-engineering JP students complete 2 research projects prior to the general exam. The exam consists of a written portion, which is a research paper describing each project, and an oral portion, in which the projects are presented, and in which general and disciplinary knowledge is examined. The goals and criteria for a successful research paper should be explicitly articulated. Requirements are likely to differ for science/engineering students.
- Thesis proposal: within 6 months of the successful completion of the general exam, students submit a written thesis proposal and present it orally to their thesis committee.

Regardless of the final form, the committee believes that a streamlined and common pathway through the JP will better allow students to learn from each other, provide the flexibility needed to access professional development resources and training for non-academic careers (charge 1), better engage with cross-cutting themes such as climate and AI (charge 2), facilitate cohort building across the JP amongst minoritized students (charge 3), and simplify the pathways so that prospective MIT faculty to the JP are not turned away by needing to navigate complex and heterogeneous requirements (charge 4). We recognize that harmonizing across disciplines is likely to be a difficult process, but we believe the benefits outweigh the costs and urge the JCs to work towards this goal.

Recommendation: The JP should consider the formation of a single Academic Committee with a Chair that rotates between the disciplines and has representation from all JC’s. This Academic Committee could meet more frequently in the beginning (e.g., quarterly) as the details for a common pathway are negotiated, and then occasionally to share lessons learned on what works well in each program. An initial goal of a JP Academic Committee would be to integrate existing documentation into a single handbook for the JP; this handbook may have separate sections for each of disciplines.

Resources

Observation: The questions that are most pressing for JP students to tackle are becoming increasingly interdisciplinary and require new tools, facilities, faculty, skills, and knowledge, which includes more computational resources, the knowledgeable use of machine learning techniques, improved understanding of societal challenges, and the application of new engineering technologies for ocean exploration and research.

Researchers in all fields across science and engineering are deriving significant insights from using AI, data science, and computing platforms. This has become possible due to the rapid increase in data availability from remote sensing and autonomous vehicles. The explosion of open-source scientific data, coupled with existing and emerging data science and AI tools, is leading to a broader set of research institutions being able to participate in cutting edge oceanographic science. At present, the committee perceived an imbalance between MIT and WHOI in the readiness to leverage these new tools. MIT has the crucial expertise and access to a wide array of institutional resources; there is a need to ensure that faculty, research staff and students at WHOI have similar capabilities. WHOI has significant depth in domain expertise as well as insight into application of data sets that need to be considered when leveraging tools such as AI. Combining the complementary strengths of MIT and WHOI presents a unique opportunity for both institutions.

For WHOI to take advantage of the new developments in computing, aside from learning from and collaborating with their counterparts at MIT, they need computational and software engineer resources. There is also an overall need to improve computational resources and fluency within the JP. Students indicated that MIT HPC resources and computational support were critical to their research success. We acknowledge the JP students have free access to WHOI's Poseidon HPC cluster, but we are aware that it is nearing the end of its initial life cycle; all JP students have MIT Kerberos accounts and access to HPC resources at MIT through the "engaging" cluster.

Recommendation: Over the next year, a small committee should complete a WHOI-wide survey of current computational needs and AI training opportunities relevant to both graduate students and faculty. This should focus on (i) required support for taking advantage of the AI revolution and modern software tools and techniques; (ii) resources required for analysis of large data sets, including consolidating data and leveraging machine learning and other computationally intensive analysis tools; and (iii) HPC resources for running numerical models. This committee should consider past efforts such as Scylla (an institution-wide, shared HPC resource designed for numerical modeling established ca. 2010) as well as the CMIP5 storage server (established ca. 2013). This committee should provide recommendations on computational and related educational needs (for both students and faculty) to develop the skills and knowledge to take advantage of powerful new AI and data analysis tools. The recommendation should be made to the JP administration by the end of the academic year.

Recommendation: As current and future JP students are likely to use HPC resources at MIT that involve collaborations with WHOI scientists, consider requesting and/or adding WHOI faculty representation on the Massachusetts Green High Performance Computing Center. Alternatively, future improvements in the Poseidon HPC cluster or a cloud computing option may be necessary.

Recommendation: The JP should identify courses offered at MIT that would benefit current JP students and provide a synopsis of how they would most effectively support various research backgrounds. The JP could consider adding proficiency in modern data analysis as a requirement of the graduate program. This could possibly be fulfilled through coursework or demonstrated use in one's research.

Recommendation: Financial resources should be made available to further the above goals. Graduate student fellowships for new projects that are aimed at exploring collaborative opportunities that leverage computational facilities between MIT and WHOI in these areas would help to accelerate progress.

Recommendation: There is an opportunity to consolidate ocean data and process it so that it can be easily leveraged across groups, read into data analysis software, and used to e.g., train large language models. This would be valuable for researchers at both MIT and WHOI. For example, WHOI has deep water observations that are inaccessible to satellite remote sensing.

Observation:

Joint Program students are becoming increasingly interested in marine policy and how it relates to their research, even though it is not one of the core disciplinary programs in the WHOI-MIT JP. They recognize the value of understanding societal challenges that drive research and innovation, the complex political, economic, and cultural context within which their research is embedded, and human behavioral factors that influence the efficacy of solutions. JP students would benefit from more structured, formalized educational opportunities in policy and social sciences so that they can be better prepared to address society's most challenging ocean and coastal issues, like climate change, marine pollution, overfishing, habitat change, ocean acidification, and more, through a variety of career paths (academia, government, NGOs, etc).

Recommendation: WHOI-MIT JP leadership should establish a working group to identify and implement opportunities for engaging JP students with policy and social science. There is momentum from the leadership at MIT, WHOI, the JP, and the WHOI Marine Policy Center (MPC) to better engage JP students with policy and social science so that they will be better prepared to solve global challenges and find careers in diverse spaces. Some educational opportunities include offering courses taught by WHOI MPC scientists, encouraging collaborations among WHOI and MIT faculty working on coastal and marine policy issues, exploring how social science and policy could be used to help frame the overall discussion around climate at both institutions, and more.

Jointness and Connectedness

Observation: The degree of “jointness” between MIT and WHOI has been a recurring theme in previous reviews of the JP. We acknowledge that students will have different experiences in the JP based on their research interests and advisor(s). However, JP-relevant research programs at MIT and WHOI are becoming increasingly interdisciplinary and this should be reflected in the next generation of JP leadership. A key recommendation of the committee is the need to advertise the benefits of and incentivize the involvement in the JP, especially for MIT faculty. Flexible first-year graduate research funding would be an important mechanism for bringing a new cohort of faculty into the JP.

We acknowledge that the JP has put in place new programs to aid in orienting new students, e.g. student cruises, social events and the “Navigating a Ph.D.” class, and developing a cohesive culture between the two institutions. Our committee feels that future efforts should ensure that these efforts to integrate multiple departments also include faculty.

Recommendation: Our committee recommends that an annual Joint Program symposium be established that highlights successful collaborations within the program and to showcase the program to potential new faculty mentors. The symposium should include speakers from both MIT and WHOI, and emphasize work by senior graduate students in the JP. Dedicated time for networking, and potentially facilitated interactions, should be scheduled to stimulate new collaborations. A goal of bringing 3-5 new faculty members into the JP, especially from departments outside of EAPS at MIT, over the next five years seems a reasonable goal.

Observation: The committee has noted that in certain disciplines, engagement with the JP has been sustained by a relatively small number of MIT faculty members. The committee feels it is essential to continue to seek new MIT faculty members that have an interest in mentoring students entering through the JP and potentially contributing to new courses or other academic programs in support of the JP mission. This expansion would benefit from incentives for new faculty to engage with the JP, especially in departments that have not traditionally had a large footprint in JP student mentoring.

Recommendation: Flexible first-year graduate student fellowships are essential for recruiting the most talented students to the JP and providing them with the flexibility to explore new interdisciplinary research directions through tight collaborations between MIT and WHOI research groups. We recommend fundraising efforts to support these graduate fellowships as one of the highest priorities for the JP. Future fellowships should be directed towards projects that involve joint advising between MIT and WHOI faculty. Fellowships should also be used to engage faculty from departments without a long history of involvement in the JP.

Recommendation: All incoming JP graduate students should be assigned advisors at both MIT and WHOI. Advisors need not have previous involvement in the JP, but should welcome students to their lab groups meetings and provide academic advice through the general exam.

Observation: It is a reality of the geographical constraints underlying the JP that travel between Boston and Woods Hole will be a challenge. Yet, addressing these issues is key to the success of a truly connected educational program. At the moment, a major concern of the students is a (perceived) asymmetry in the convenience of the shuttle between the two institutions. The timing of the shuttle (morning departure from MIT / evening return to MIT) favors one-day travel from Boston to Woods Hole, but not the other way around. Additionally, certain seminar series that might increase interactions between the two institutions are not optimally aligned with the shuttle schedule.

Recommendation: Our panel recommends a feasibility study on other modes of transportation that would provide increased commuting flexibility for the graduate students. A graduate student survey may reveal whether a travel allowance, which has a comparable total budget as the current shuttle, might provide more options for students.

Observation: Students participating in joint educational offerings outside of the JP program provide additional opportunities for developing new collaborations between MIT and WHOI faculty and may allow for more exploratory research projects. The Summer Student Fellowship program has proven to be a strong recruitment tool for the JP and the Navy Master's degree program has enhanced class size and interactions between the two institutions.

Recommendation: Extending the model of the Navy Master's program to other partners, potentially in industry or other government sectors, will bring additional students into the program and increase teaching opportunities for WHOI faculty. More Master's opportunities may also help with increasing diversity in the JP (see next section). This expansion should be explored as a potential avenue for growth of the educational program as well as a way of increasing participation by new departments at MIT. We also recommend exploring an expansion of MIT's Undergraduate Research Opportunity Program (UROP), which could also increase student engagement between MIT and WHOI.

Recommendation: The JP should continue to survey students on an annual basis to determine their satisfaction with the program and how it is meeting their career goals. The results of these surveys should be analyzed at the time of future JP reviews.

Observation: Minimum enrollment in classes taught at WHOI is set by the number of JP students enrolled, regardless of enrollment by MIT-only students. This can cause classes to be canceled at the last minute, even if total student enrollment exceeds the minimum.

Recommendation: Revisit the minimum enrollment rule with the appropriate administrators.

Diversity, Equity, and Inclusion

Observation: The geosciences, including oceanography, are the least diverse of all STEM fields, with little progress in the last 40 years (Bernard and Cooperdock 2018), so the JP is not alone in its struggles to improve diversity, equity, and inclusion (DEI) in its student body. The WHOI side of the JP faces even greater challenges for creating an inclusive and welcoming atmosphere to minoritized students given its location in a region of low racial diversity and without the resources of a major university. Indeed, students offered some insight into the challenges of recruitment and retention, which included the lack of a sense of community for students (as well as staff and faculty) from underrepresented groups as well as the need to navigate a challenging housing market. One JP student at MIT highlighted that they chose to live in Cambridge despite having a WHOI advisor because they find Cambridge to be more diverse and welcoming than Woods Hole. Our committee appreciated hearing from the WHOI's Chief Diversity Officer (CDO) and the ways in which she is supporting institutional leadership. However, there was limited information about how the WHOI DEI vision engages JP students in its planning. Some students noted that they did not feel they had a connection with the CDO.

Improving DEI has a recruiting component and a retention component. The committee commends and supports existing and planned recruiting efforts to minority-serving institutions at both the undergraduate and graduate levels, but suggests that priority be placed on strengthening efforts to improve retention so that recruited minoritized individuals can thrive. These include structural and individual actions that can improve the climate to create a more inclusive and welcoming environment. The “hidden curriculum” of graduate school refers to the unspoken cultural norms that govern interactions and expectations between advisors and their advisees (Cooke *et al.* 2021, Pensky *et al.* 2021). These can present particularly difficult hurdles for minoritized (including first gen) students, eroding their sense of belonging and leading to attrition.

We offer two categories of recommendations to create a more welcoming atmosphere for minoritized students: 1) simplifying and clarifying expectations of students as they navigate their PhD, 2) implementing effective and inclusive mentoring practices.

Recommendation 1: Simplifying and clarifying expectations of students as they navigate their PhD

- The recommendations presented in Section 3 to simplify the structure of the JC pathways and to codify them in a single JP handbook will clarify students' expectations for the program.
- The recommendations in Section 3 for simplifying and unifying the separate JC requirements will build a larger JP community of students who are able to mentor and support each other—this will be especially important for building a cohort of minoritized students when numbers are small.
- We commend the JP for offering a “Navigating a PhD” class in the summer to entering JP students. This type of course can not only communicate unstated norms and

provide resources and strategies to address potential challenges, but also build a supportive cohort and create a sense of belonging (Cooke *et al.* 2021). We recommend that all incoming students take such a course to promote equity and inclusion.

Recommendation 2: Implement effective and inclusive mentoring practices

- All advisors need to be trained in effective and inclusive mentoring practices. Many resources exist for developing this type of training. An example of a set of recommendations for developing and sustaining effective mentoring relationships from one of our universities (including references therein) is here: <https://tlc.ucsc.edu/resources/mentoring-in-research-teaching/research-mentorship/> One example from this document is:
 - Establishment of mentorship agreements and/or individual development plans (IDPs) at the beginning of the academic year. These provide a consistent framework for all advisors to have structured conversations with their advisees about mutual expectations and personal and shared goals, and create a sense of mutual investment and responsibility for the mentorship relationship and can help uncover the hidden curriculum. The most important part is the process of discussing the agreement and/or plan. We suggest that students and advisors revisit these yearly so that both can be responsive to the other.
- The new Dean of the Academic Programs Office should work with WHOI's new (as of 2022) Chief Diversity, Equity, and Inclusion Officer to create these trainings for the WHOI-based advisors. The JP might also be able to tap into MIT's Institute Community & Equity Office (<https://iceo.mit.edu/about-iceo/>) for help. We note that in our conversations with students and faculty at WHOI, there was low awareness about WHOI's new Chief DEI Officer plans to improve the climate for DEI. This may reflect insufficient resources to be effective. She and this office need to be given the resources and support from WHOI leadership to provide this kind of training.
- Recognizing that it may take more time and effort to be an effective mentor to someone from a different cultural background, and that prospective advisors have expressed concern about the high cost of JP students and are thus likely to be risk averse in their admissions decisions, the committee supports further exploration for offering a masters degree as a means for increasing diversity (see recommendation to expand the Navy Master's program in section 5). This may be an appealing and lower-risk opportunity for students to consider academia and for advisors to begin working with the student.

Finally, recognizing that the community at MIT and in Boston is more diverse than at WHOI and in Woods Hole, and that MIT has much greater resources for fostering DEI, any improvements to the connectedness between MIT and WHOI (Section 5) will help WHOI-based students access the greater networks and resources at MIT and in Boston.

Observation: There has been a dramatic rise in gender disparity in recent years skewed towards women entering the MIT-WHOI JP. This trend of increasing female enrollment is occurring across MIT—MIT graduate admissions were 33% women in 2015 and 41% in 2024—yet, at WHOI this trend is more extreme, with women representing a significant majority in many of the disciplinary programs.

Recommendation: Our committee encourages the JP to study this trend to understand what factors are contributing to the gender disparity and whether it is an issue that requires changes in JP advertising, application assessment, recruitment processes, or other program policies.

Observation: While strides have been made both within the JP and more broadly in the oceanographic community to address issues of sexual harassment, power differentials still exist that impact JP students. Issues of harassment have not completely gone away. Those JP students participating in sea-going field campaigns or other field work remain at particularly high risk for being in situations where sexual harassment can occur.

Recommendation: JP advisors and administrators should be aware of and share with JP students recent resources that suggest best practices for planning a research expedition or other field work. These provide science team leaders with guidance on how to create plans that ensure safety and inclusivity. The recent *Oceanography* article “Know Before You Go: A Community-Derived Approach to Planning for and Preventing Sexual Harassment at Oceanographic Field Sites” (Ackerman *et al.* 2023) is an excellent example. These resources could be collected on a page of the WHOI JP website. Mandatory training, such as bystander intervention courses, should be considered, especially for JP members (students and faculty) participating in field work.

References

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Marine Policy: Educational Opportunities and Recommendations

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The Interest and Need: From conversations during the External Review and responses to recent surveys conducted by the WHOI Marine Policy Center (MPC)¹ and WHOI-MIT Joint Program², JP students and alums have expressed interest in policy and social science to better understand the context of their science and engineering research and to better prepare them for careers outside of academia (e.g., government, NGOs). Faculty from individual programs (e.g., BO, MG&G) also noted in their presentations to the External Review committee that their students have expressed interest in policy and climate change. JP students have been engaging with policy in various ways, including having WHOI Marine Policy faculty on their committees, including policy-specific chapters in their dissertations (at least two in recent years), taking policy courses at MIT, and applying to the Knauss Program. While there are opportunities for JP students to engage with policy, they have to actively seek out opportunities on their own and usually complete them in an ad hoc fashion.

Current landscape

MIT Science-Policy Certificate

Currently, JP students can take individual policy-related courses at MIT through the Technology and Policy Program (TPP). Students particularly interested in policy can complete a MIT Graduate Certificate Program in Science, Technology and Policy, which includes one core course, a 3-week policy bootcamp, an elective, and a capstone project. The WHOI MPC survey of JP students indicated that students were interested in the MIT STP Certificate, but faced barriers to completing it, such as having policy classes offered only at MIT and emphasizing technology and innovation policy that do not cover environmental or marine policy. There seems to be mixed support among faculty advisors for their students to take policy or social science courses that are not considered central to their science or engineering degree.

Marine Policy Center

The WHOI Marine Policy Center (MPC) conducts social scientific research that integrates economics, policy analysis, and law with the Institution's basic research in ocean sciences.

¹ Results of a 2021 survey of current JP students (at the time) to gauge interest in a new marine policy certificate program and additional marine policy classes. There were 50 responses. Results are presented in *Proposal for a Joint Program Marine Policy Certificate Program*. Prepared by Rebecca Chmiel, Samantha Clevenger, Alia Hidayat, Sheron Luk, and Mike Neubert (former MPC Director).

² Results of a 2024 survey of the Joint Program alumni. The survey was sent to all alumni who had graduated in 2014 or later, and for whom they had email addresses. There were 67 responses.

During the review, the External Committee heard about plans to expand the MPC's current emphasis on economics and policy analysis to more diverse areas of research and training in political science, anthropology, sociology, law, and history. MPC researchers regularly engage in multidisciplinary and interdisciplinary work with other WHOI scientists as well as researchers, policy analysts, and practitioners throughout the world. During the review, MPC researchers expressed interest in opportunities to expand collaborations with WHOI and MIT faculty. MPC researchers want to engage more with JP students by serving on committees and teaching classes; in fact, several have indicated that they are teaching classes at nearby academic institutions because there is no existing structure for them to teach courses for JP students. WHOI MPC scientists also expressed concerns that it would be highly challenging to get social science or policy courses approved, however, the WHOI-MIT JP leadership suggested that it might not be as challenging as they think. This is an area of opportunity.

Additional opportunities

In addition to taking policy classes at MIT and interacting with the WHOI MPC, JP students have taken advantage of other opportunities to engage with policy. For instance, ten JP students attended the COP28 UN Climate Change Conference in Dubai in the fall of 2023. Many of these students had been taking a class in MG&G that focuses on climate change, the IPCC, and more. Each year, several JP students apply for the Knauss Fellowship generally with high success. Virtually every one of the successful Knauss applicants decided early on in their tenure that they were going to apply for Knauss and, in order to strengthen their CV, took the STP certificate.

Other opportunities for JP students to better engage with policy and social science might include expanding connections with the IDSS Institute (Institute for Data, Systems, and Society) at MIT which focuses on connecting statistics, data science, information and decision systems, and social sciences to address societal challenges and with the MIT and WHOI Sea Grant programs which support research, education, and outreach related to coasts and oceans.

Next steps

Recommendation 1: Communicate through the JP website, the handbook, and/or another written program document a compiled list of different options for JP students to engage with social science and policy during their degree program.

Opportunities for JP students to engage with policy and social science are dispersed throughout the institutions and not all students are aware of all the opportunities available to them. Currently, students have to figure out on their own how to build their policy capacity. In an increasingly global world with challenges that span all of the areas in which MIT and WHOI students work, JP students would benefit from some formalized training in policy and social science. The level of training would vary from student to student, based on their interest and the value of understanding the broader political, cultural, and economic context of their

research. Having an understanding of the available opportunities would reduce barriers for students to consider more engagement with policy.

Recommendation 2: Establish a working group to identify and implement opportunities for engaging JP students with policy and social science.

There is momentum from the leadership at MIT, WHOI, and the Joint Program, the JP students, and the WHOI MPC to better engage JP students with policy and social science so that they will be better prepared to solve global challenges and find careers in diverse spaces. To date, there have been few conversations among leadership, students, JP faculty, and WHOI MPC scientists about how to do this. Now is the time to take advantage of this momentum.

Specific opportunities that were identified during this External Review include:

- Faculty across the Joint Program (MIT and WHOI) would benefit from some interaction with MPC scientists to learn more about what goes on at the MPC and to discuss how their students' work could benefit from an introduction to policy.
- There is funding for MIT faculty to spend 2-3 weeks during the summer at WHOI. Policy researchers and social scientists from MIT could be invited to visit WHOI during the summer and engage with students during that time (e.g., give special guest lectures, teach short-term classes, host policy discussions).
- There has been a decades-long interest in better connecting the MPC to the educational mission of WHOI. In the near-term, Marine Policy Center scientists could teach courses (e.g., marine policy bootcamp during the IAP; semester-long marine policy seminar). In the longer-term, they could explore the proposed certificate program (see *Proposal for a Joint Program Marine Policy Certificate Program, 2021*).
- The MPC could reinstate its Congressional Fellows program where science-policy staff working in DC (and elsewhere) would visit WHOI for a semester or summer. This would provide valuable opportunities for JP students and faculty to interact with individuals working in the science-policy realm.
- There are clear connections between the climate priorities of both institutions. JP leadership could explore how social science and policy could be used to help frame the overall discussion around climate at both institutions. The new MIT Climate Policy Center at the Sloan School of Management, MIT IDSS, WHOI MPC, and WHOI and MIT Sea Grant programs could be valuable partners in these discussions.
- The MPC could engage with Knauss Fellows before they leave for their fellowships in DC; e.g., provide introductory information about the policy process and the political landscape in DC.
- MIT is developing a general MIT-wide requirement for professional development for doctoral students. This could be a valuable opportunity for JP students to get some real-world experience in a policy internship or other relevant activity without conflicting with their science or engineering degree requirements. Internships with affiliated programs at each institution (i.e. MIT Climate Policy Center, MIT IDSS, WHOI MPC, MIT and WHOI Sea Grant programs) as well as external organizations should be explored.

Joint Program in Applied Ocean Science and Engineering

Disciplinary Report

Lead authors: Peter Dahl and Diane Greene

Introduction

Students accepted into the Applied Ocean Science and Engineering (AOSE) discipline of the MIT-WHOI Joint Program are affiliated with the Department of Applied Ocean Physics and Engineering (AOPE) at WHOI, as well as one of four engineering departments at MIT: Civil and Environmental Engineering (CEE), Mechanical Engineering (ME), Electrical Engineering and Computer Science (EECS), and Aeronautics and Astronautics (AA). The oversight of AOSE Joint Program students is managed by the AOSE Joint Committee (JCAOSE), which includes representatives from both AOPE and all four engineering departments at MIT.

Current Status

The AOSE program remains robust, as evidenced by a 55% increase in number of applicants over the last decade (90 applicants in 2024). The median acceptance rate over this same period is 15%, for which approximately 75% annually accept offers of admission. At the time of this report there are 33 students enrolled within AOSE with 9 Ph.D. and 4 Navy Masters degree admissions in 2024. Since 2020, 6 Navy students are admitted every year into the Joint Program, who typically enter either the AOSE or Physical Oceanography disciplines.

Students admitted to the AOSE program must satisfy degree program requirements of the MIT department they are affiliated with. Currently, the number of students by MIT department are: 21 in ME, 7 in EECS, 3 in CEE and 2 in AA. The larger number in ME corresponds to historical trends, and is in part driven by Master Navy students.

Additional requirements within the AOSE program include an oceanography breadth class, a course on the fundamentals of oceanographic instrumentation (MIT course catalog 2.688), and a one-semester WHOI research requirement. Once students have successfully presented their thesis proposal, they must form a thesis committee with representation from both AOPE and their home MIT department.

Shared interests among a core group of MIT faculty and WHOI scientific staff facilitates collaboration in advising, thesis committees, and the PhD qualifying exams. In terms of primary advisor (thesis chair), over the last 5 years a majority of students are advised by WHOI faculty (57%), while 30% are advised by MIT faculty with the remainder jointly co-advised. Remote/hybrid participation remains indispensable to successfully run AOSE business, from admission meetings to teaching classes.

Challenges

The research conducted by JP graduate students in the AOPE department is by nature multi-disciplinary, with course load for necessary training weighted towards MIT. This situation differs somewhat from the other JP disciplines where course load is weighted towards WHOI, with subsequent greater teaching effort originating from the corresponding WHOI departments. The WHOI Academic Program Office thus funds graduate course teaching effort in these departments at a greater level relative to scientists in AOPE. There is no obvious solution to this disparity, other than a recognition that smaller class sizes are the norm in courses taught by AOPE faculty, with the possibility of the APO taking this into account in terms of course funding decisions. Furthermore, it may be necessary to adjust this balance depending on faculty changes at MIT to maintain certain areas of excellence, e.g., field robotics, acoustics.

Of the four MIT engineering departments involved in AOSE, the PhD qualifying exam within the ME department has in the past (e.g., see AOPD review in 2019 JP review report) precipitated the most discussion primarily owing to exam topics not mapping well onto JP research areas. (The other three MIT engineering departments (EECS, CEE and AA) tend to offer a more flexible qualifying exam topic.) Discussion of the PhD qualifying exam also remains ongoing amongst MIT ME faculty, and with the recent change to include acoustics and robotics as qualifying exam topics for JP students, we believe this issue is settled for the immediate time frame. However, acoustics is taught by only one MIT ME professor, and were that situation to change owing to retirement, sabbatical, etc., this core subject may no longer be available to the qualifying exam.

During the last 5 years there has been an increasing percentage of faculty graduate student advising originating from the WHOI side, with the number of participating MIT faculty lower than ideal. In short, newer Assistant Professors at MIT, likely preoccupied with the tenure process, have not been replaced by more senior faculty at MIT who have traditionally participated in the JP. This is understandable in view of the growth of new interest areas within MIT engineering departments e.g., nano- and health technology, which both influence new academic hiring lines at MIT but does not necessarily align well with research at WHOI. Taking as one example, underwater acoustics/acoustical oceanography, which is and ought to remain, a core competency area in AOPE, the challenge in this case is working closer with EECS in the area array processing, machine learning, with the instruction in underwater acoustics gravitating more towards WHOI. Indeed, the number of EECS students has increased since 2019, which probably reflects a general trend towards this outcome. However, none of those EECS students has a primary advisor in MIT-EECS, which may become a problem in the long run.

Funding of graduate students by faculty of AOPE can also on occasion be encumbered by timing, i.e., a AOPE faculty member may have the funding in hand but student with desired interest or background is not available. To the extent the APO can provide a kind of temporary funding buffer, this can mitigate such problems.

Opportunities

The new WHOI David Center for Ocean Innovation and the Autonomous Vehicles and Sensor Technologies (AVAST) provides a huge opportunity for greater participation and growth in the AOSE discipline of the MIT-WHOI Joint Program, in terms of enabling new ocean technology, science, education, and outreach.

The laboratory space and facilities afforded by the David Center, optimized towards underwater, hydrodynamic and environmental research, are unlikely to be matched at MIT, particularly given that laboratory space there is becoming increasingly splintered and modified to accommodate new interest areas.

Given the Applied Ocean Science and Engineering (AOSE) discipline of the MIT-WHOI Joint Program involves now four engineering departments at MIT, affords certain advantages in terms of not being wholly dependent on one department at MIT. Currently, only two departments, ME and CEE have faculty representation on the MIT JP Associate directorship, and it is worthwhile to expand this role, perhaps on a rotating basis to include EECS and AA. However the number of students in AA is small, and efforts are currently being made to build a better bridge between WHOI and MIT-based AA faculty.

Given that AOSE has an established record of multi-department involvement at MIT, there should be no impediment to including more departments at MIT. In particular, the MIT department of Material Science and Engineering (MSE) does not (to our knowledge) have a formal relationship within the MIT-WHOI JP. Yet, there are scientists in AOPE who have expressed interest to us in collaborating with MSE. We again point to the David Center as a vehicle that might also provide enabling facilities for such collaboration.

Joint Program in Biological Oceanography (JPBO)

Disciplinary Report

Lead Authors: Paula Bontempi and Tracey Dalton

The joint program in biological oceanography (JPBO) appears to be flourishing with student and faculty successes. Program requirements clearly allow students to build a foundation in biological oceanography by providing opportunities to integrate disciplinary and interdisciplinary research and classes. There is a novel aspect to blending experiential learning into field courses, time at sea, etc. as part of the curriculum. In addition, students are encouraged to tailor their academic program to their specific interests and needs. The faculty and students seem dedicated, lively, and engaged. Student applications to the JPBO following the novel coronavirus pandemic remain strong since the last report in 2014. There is a clear synergy and complementarity with the courses and faculty at MIT/Cambridge that provide novel expertise to the JP, as well as with novel assets on the WHOI campus, such as the marine policy center, SeaGrant, etc.

Student applications to the JPBO have grown steadily over the last ten years (nearly 150/yr. in 2024). The number of students admitted v. those who accept the JP offer seem to be above the 50% mark over the last decade. There is a notable dip in admits/accepts during the period of the novel coronavirus pandemic (this may be faculty based as much as student admits/applicants), with a low point of admits/applicants in 2022. While this level of competition for JPBO slots ensures that the quality of students is very high, according to the faculty, the program loses excellent applicants due to a “lack of funding”. Admission rate is about 7% annually, with overall JPBO enrollment around 30 students/yr., on average. The discussion with JPBO faculty indicated that funding from academic program, endowment, and low faculty proposal success led to the decline in student recruitment and enrollment in 2017. There is also a high faculty to student ratio in the JPBO, which is a small program. This may be partly responsible for the decline in admissions recently – a general (and understandable) conservatism on the part of the faculty in the face of an increasingly uncertain funding climate and the need to use research funding productively. It’s possible that the aforementioned lack of incentive at WHOI in serving as a student advisor is also a challenge to greater student admission.

Retention among students was 100% over the last 5 years. Built into this number is the assumption that those who have entered the program recently will complete a terminal Doctoral degree. One interesting fact was that, to the extent known, there is tremendous gender identity disparity among JPBO students, with a 5:1 ratio of female:male identity. This may be part of a nationwide trend in oceanography, but bears some examination. It’s worth noting that this shift in gender identity distribution may have taken decades. Since the 2015-2018 period, there has been a small improvement in the recruitment and enrollment of students from historically underrepresented groups. While diverse enrolled student numbers are low overall, this uptick may be the result of a concentrated effort by JP staff to focus on attracting a diverse pool of applicants. In this light, the JP needs to ensure they have a plan to

properly mentor students from underrepresented groups, as discussed in the DEIJA section above.

Students at both MIT and WHOI mentioned that they would welcome additional opportunities to gain experience in teaching, in some capacity. Students at WHOI noted that some of them do seek out teaching opportunities at nearby institutions, like Mass Maritime, Cape Cod Community College, and the Sea Education Association.

One major item of note in academics was the variability in program execution across the disciplinary curricula, such as approaches of general exams and programs of study. There are numerous student handbooks depending on the disciplinary track a student pursues in the JP. The JP is encouraged to integrate handbooks, perhaps look across the disciplines of the JP for synergies to synthesize program requirements, etc. as that may help to build community for the students and among the new faculty by providing a single, extensive support network in the JP.

Major revisions to the curriculum and course requirements were undertaken within the last round of JP review. During the overview of the course listing for JPBO, it was unclear what the course delivery cadence is relative to the courses listed, which could make it a challenge for students to plan their degree and acquire the desired expertise. In addition, it was noted that there are only four teachers from BO, which could limit the number of electives available to students, particularly given that faculty may have extensive field time. This infrequent cadence and (recovery from) low enrollment match with the decline in enrollment for specialized topic courses.

The discussion with the MIT and WHOI faculty and students noted details such as the association with EAPS is a challenge for securing student fellowships, finding an outside member of one's committee from MIT; and a need to increase BO faculty participation in the JP. There was also a comment that the early career faculty at MIT are not interested in the JP, which could stem from the different ways that MIT departments award credit for participation in the joint program particularly for pre-tenure faculty. Worth noting was that it was surprising how little the disciplinary program leads knew about the respective disciplinary approach, and that the respective programs are really not integrated in the sense of execution and structure.

As per the issue of jointness, the faculty point to the fact that this is a perennial issue, they feel the students make do and come away with some novel collaborations. Student – faculty interaction overall is highly collaborative, and the collaboration at MIT truly varies by discipline; while PO has more overlap, biology is starting to become more synergistic particularly with the new hires. The MIT students noted a big challenge collaborating with the Biology department faculty. BO faculty at MIT mentioned some opportunities for MIT faculty to visit WHOI in the summer (e.g., offer a short course on DEI, teaching, policy; housing is provided already if MIT faculty want to use it). One question is if the students could get compensated to participate in those courses to encourage more interactions with MIT faculty, as well as address some training needs/interests of students. The faculty did raise some workload issues - research staff do not have any incentive to become advisors, which is something in a full soft money institution that could be rectified by leadership. Non-advising scientists are not paid to interact

with JP, only advisors get paid, which limits the advising capacity of the faculty. Faculty also pointed to teaching space at WHOI being limited.

We close with some feedback from the students and faculty on a range of topics, particularly community, student support by faculty/advisors/mentors, and overall well-being. Regarding community building, the review committee applauds the MIT/WHOI effort to host lunches every few weeks with faculty at MIT. Perhaps this can be done for the students as well. This has helped to boost interest in the JP on the MIT side and connect physically distant institutions. There was a strong demand for hybrid classes by students at both institutions to save on transportation and facilitate attendance given class location variability. The JPBO link to MIT and Harvard was a plus. The new Chaplain has been given the highest remarks and is truly impactful in student wellness. The students are also glad to have medical and dental care but resources are all in Cambridge, which highlights another area where transportation becomes a challenge, particularly for international students who may not drive or are not native English speakers. Housing continually is highlighted as a challenge, given the seasonality of the area, the homogeneity of the population, and the unaffordability overall. The greatest perceived impact is to diverse and international faculty, students, and staff. Students identified bullying and sexism as an issue in the workforce, particularly in engineering. First year is required in Cambridge but it is not a welcoming environment. Perhaps given the synergy in the new Climate science initiative at MIT – could the faculty be more joint?

Joint Program in Chemical Oceanography (JPCO)

Disciplinary Report

Lead author: Phoebe Lam

Introduction

The MIT-WHOI Joint Program in Chemical Oceanography remains the premier program for training in Chemical Oceanography and related fields. With 34 faculty participating in the program from the two institutions, no other program in the world can match the depth and breadth of expertise in Chemical Oceanography and related fields.

With the recent explosion of interest in marine carbon dioxide removal (mCDR) strategies from entrepreneurs and policymakers, all of which requires an understanding of marine and global biogeochemical cycling, there is little worry about the continued relevance conferred by training in Chemical Oceanography. Indeed, applications and enrollment to the JPCO remains robust and strong. However, there are structural issues in the JPCO that are affecting student and faculty morale and may prevent it from remaining at the top.

Main issues

The two biggest issues for the JPCO are:

1. the structure of the general exam
2. sustaining an interest in the program from the MIT side (i.e. jointness) since the two greatest MIT supporters of the JP, Ed Boyle and Phil Gschwend, have retired or will soon retire, and are no longer taking new students.

As discussed below, addressing the first issue may help with the second issue.

The Chemical Oceanography program in the JP is the only one of the four science disciplines in the JP that still has a written exam to examine general knowledge in addition to a research paper component: JPMGG has never had one; JPBO dropped theirs about ten years ago; and JPPO dropped theirs last year. During my visit, I heard both students and faculty express frustration that the CO general exam forced an up to ~6 month pause in the research progress of students in the second half of their second year as they studied for the written portion of the general exam. Students also expressed dissatisfaction with the amount and quality of feedback they received after the written general knowledge component.

The most concerning negative opinion was one that I heard from an MIT faculty member who perceived a lower level of scientific maturity in students' second year research papers coming from the JPCO compared to those coming from MIT EAPS-only. Either MIT EAPS is attracting higher quality students, or JPCO students' progress and scientific development are hampered

by the months taken away from research to study for the written general knowledge portion of the JPCO general exam. This was only one person's opinion, but especially at a time in which the engagement of the MIT side to JPCO is decreasing due to retirements, such a reputation could be a toxic disincentive for recruiting new MIT faculty to the JPCO. And since CO is now the only program in the JP to have a written general knowledge component, it can also be a disincentive to interdisciplinary students shopping around for programs whose natural home could be in one of multiple disciplines.

Main recommendation

- Update the JPCO general exam to be more aligned with the MIT EAPS general exam and with the other JP science disciplines
 1. Eliminate the written general knowledge portion of the general exam
 2. Meet with the JPBO and JPPO chairs and education coordinators to discuss lessons learned from their recent experiences in dropping their written general knowledge portion

As outlined in the main report, the committee strongly believes that a more streamlined general exam process across the JP will provide many benefits. For JPCO, which currently has the most cumbersome general exam, these recommendations are most urgent to remove any disincentives for MIT faculty and prospective students to engage with this program. With these issues addressed, the future is bright for the JPCO.

Joint Program in Marine Geology & Geophysics (JPMGG)

Disciplinary Report

Lead author: Kris Karnauskas

This report summarizes the key findings and recommendations from the external review of the MIT-WHOI Joint Program, with a focus on Marine Geology and Geophysics (JPMGG). The review involved meetings with faculty, students, and administrators from both MIT and WHOI, highlighting several challenges and opportunities for the program.

Key Findings

One of the most significant concerns raised during the broader review was the declining involvement of MIT faculty in the program. Since 2019, MIT's share of graduate student advising has dropped from roughly 40% to 10%, while WHOI's has risen from 60% to 90%. This decline in MIT engagement may affect the program's reputation and the balance of student advising between the institutions. This broader JP issue seems to be highly relevant to JPMGG. Additionally, the departure of around 12 faculty members from the Marine Geology and Geophysics program in the last five years was identified as a critical issue, although some departures were due to retirement.

There is a consensus among both faculty and students that the program could benefit from increased collaboration between MIT and WHOI. A proposal to assign each student a faculty liaison from the institution they are not primarily based at was widely supported as a way to strengthen the "jointness" of the program.

Students voiced concerns about coursework, particularly the "Geological Oceanography" course, which was described as overly condensed, poorly coordinated, and unresponsive to student feedback. Additionally, students cited limited course offerings and cohort sizes as obstacles to their educational experience.

Key Recommendations

1. Increase Faculty Engagement
 - A. MIT should work to reinvigorate faculty participation in the Joint Program. Clear incentives for involvement, particularly for junior faculty, should be established. Addressing time burdens, such as committee work, may help encourage greater participation.
 - B. Consideration of streamlined general exam processes, if not harmonizing them completely with EAPS, would also help based on conversations with MIT faculty.
2. Strengthen MIT-WHOI Collaboration

- A. Implement the proposal to assign each student a secondary advisor or faculty liaison from the other institution. This could foster stronger cross-institutional collaboration and enhance the students' academic and research experiences.
- B. Establish seed grant opportunities to support student research that cuts across the research interests of faculty at both WHOI and MIT.

3. Revise and Expand Course Offerings

- A. Redesign the "Geological Oceanography" course by either splitting it into two separate courses or adopting a project-based format. The feedback and grading mechanisms should be improved to ensure alignment with student expectations and needs.
- B. Increase the frequency and diversity of course offerings, ensuring that required courses are available regularly. Allow greater flexibility in course substitutions to mitigate the issue of course cancellations due to low enrollment.
- C. Plan course offerings further in advance, and find a way to communicate our-year plans with students so they may better plan their degree path.

4. Enhance Cohort Experience

- A. Address the small cohort sizes by organizing regular annual meetings between students, faculty, and program leadership. This could foster a stronger sense of community among students, their sense of agency in the program, and provide additional support for students throughout the program.

Implementing these recommendations will help the MIT-WHOI Joint Program in Marine Geology and Geophysics maintain its strong reputation, continue to provide a high-quality educational experience for its students, and prepare them for the current job market (academic and otherwise).

Joint Program in Physical Oceanography (JPPO) Disciplinary Report

Lead author: Andy Thompson

Summary statement: The JP's Physical Oceanography (PO) program is in a healthy state. The number of graduate students entering the program has grown in recent years, which is complemented by multiple new hires at both MIT and WHOI who anticipate mentoring PO students. WHOI PO faculty feel that they could adequately support a larger PO cohort; efforts to implement this through modifications to funding requirements or via first-year fellowships should be discussed. EAPS-affiliated PO students that do not have an MIT faculty member as a primary thesis adviser no longer have office space in the Green Building next to their peers, which impacts their sense of community within the JP.

The JP's Physical Oceanography (PO) program remains one of the top graduate programs in the world addressing the physical dynamics of the ocean and its coupling with other components of the climate system. The program's health is reflected in three main ways. First, the PO program has experienced a sustained period of successful graduate student recruitment, especially in the past two years, which has led to a positive trend in enrollment over the past five years. Indeed, there is a consensus among at least the WHOI faculty that a larger cohort could be adequately supported and would further strengthen the program. Second, the past ten years has seen a broadening of the research focus areas within the PO-affiliated faculty at MIT and WHOI that are participating in the JP. These hires have expanded the program's ability to address coupled climate problems, especially related to air-sea interactions (Gonzalez, Ryan, Ummenhofer and others), ocean-ice coupling (LeBras, Kang), and data-driven climate modeling (Bodner and others). The PO program has also expanded interactions with MIT faculty in engineering departments, which will compensate for the reduction in PO colleagues in the EAPS department actively advising new students as well as the need to develop research programs that leverage fundamental PO theory to inform solutions related to climate mitigation and adaptation. This continued diversification of research interests, while sustaining a core educational experience in PO observational and modeling approaches that addresses both global and regional scales, should be a focus in upcoming years.

Based on the health of the PO program, there was general interest in moving towards more flexible mechanisms for admitting graduate students into the JP. There was an overall sense that resources are sufficient to support a larger graduate student cohort in the PO program, and that a larger cohort would benefit the program through increased opportunities for student interactions and peer-to-peer learning as well as improvements in the diversity of matriculating students. The allocation of admissions quotas or caps has been perceived as conservative, occasionally resulting in the inability of WHOI faculty to recruit a student, even when there is a need and available funding on a research project. Additionally, the requirement of having a full year of funding in hand at the time of student recruitment was deemed challenging. Students

often dedicate most of their time to coursework and general exam preparation during their first two years, which leaves little time for substantial progress on a dedicated research topic. Thus, three-years of external graduate support from NSF, for example, often has a limited impact on project results. The best way to address this issue would be to prioritize flexible, first-year graduate funding, either from existing resources or in future fundraising efforts. Fellowships would increase flexibility and allow both students and faculty adequate time to find a suitable student-mentor match. Graduate fellowships are a common feature of the top Earth Sciences graduate programs in the US and are a key tool for recruiting the strongest students. The implementation of a fellowship program could have positive feedback by aiding recruitment of strong graduate students, which leads to more productive research and increased research grant success. At the very least, we recommend increased communication between faculty and WHOI's APO regarding research needs and financial constraints.

Faculty also indicated that teaching through the JP remains a challenge. At least three JP graduate students must be enrolled for a course before it can officially be taught by a WHOI faculty member. Yet, enrollment information is often only provided immediately prior to the start of the term, which complicates planning for both educational and financial reasons. Cancellation of a class just days before it is about to start results in wasted time on class preparation and also the abrupt loss of three months of salary support related to teaching. Our committee does not immediately have suggestions for how to address this issue, but increased clarity on the course offerings is essential for a stable graduate program. Additionally, financial support for TA's only reflects the number of JP students enrolled in the course, not the total number of JP and MIT students. Thus, situations can arise in which a class that is predominantly attended by MIT can only offer TA services to JP students, which puts the graduate student TA in an awkward position. Alternatively, the TA must support extra students and provide a high level of unpaid work. In the main report, we suggest an extension of the MIT-WHOI Master's program to other external partners, which may provide additional teaching opportunities to faculty at WHOI and perhaps lead to more stable enrollment for JP classes.

Based on discussions with students in the PO program, the most important issue that should be addressed is the availability of office space at MIT for EAPS-affiliated JP students that do not have an MIT thesis adviser. The committee is aware that allocation of office space to new faculty impacted this situation. New space was introduced on the 8th floor of the Green Building, but some students still felt isolated from the EAPS department. We are glad to know that the Joint Program is continuing to seek new space, independent of department, which will provide stability and more flexibility.

Overall, though, the students were positive about the sense of community and the peer support that has been received within the PO cohort and the JP as a whole. Students have appreciated the shift to a 2-project general exam, which has provided more flexibility for exploring new research topics. There was a useful discussion about whether a shorter timeline to passing the general exam would allow students to engage in thesis research earlier in their graduate student career, which may address some of the funding issues around admitting students into the JP. This discussion should be re-visited in the future.

Submitted on December 16, 2024 to:

Mick Follows

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Appendix: List of Committee Recommendations

Report Section	Recommendation
Alignment of the JP with MIT and WHOI Missions	Encourage strong student engagement in the development of climate initiatives at MIT and WHOI
Alignment of the JP with MIT and WHOI Missions	Draft a JP mission statement that is re-visited on a regular (5-year) basis
Alignment of the JP with MIT and WHOI Missions	Consider the potential contributions to the JP in future hires at both MIT and WHOI
Structure of the Joint Program	Harmonize requirements of each JP discipline with those of their MIT-only counterparts
Structure of the Joint Program	Encourage JCs to work together towards defining a more common pathway for all JP students that is codified in a single handbook
Structure of the Joint Program	Consider the formation of a single Academic Committee with a Chair that rotates between the disciplines and has representation from all JCs
Resources	Establish a small committee to complete a WHOI-wide survey of current computational needs and AI training opportunities (for students and faculty)
Resources	Consider adding or requesting WHOI faculty representation on the Massachusetts Green High Performance Computing Center, Inc. Research, Education & Outreach Group and the Program Management Group
Resources	Identify courses offered at MIT that would benefit current JP students and provide a synopsis of how they would most effectively support various research backgrounds
Resources	Make financial resources available to improve computational resources and fluency within the JP
Resources	Consolidate ocean data and process it so that it can be easily leveraged across groups, read into data analysis software, etc.
Resources	Establish a working group to identify and implement opportunities for engaging JP students with policy and social science
Jointness and Connectedness	Establish an annual Joint Program symposium that serves to highlight successful collaborations within the program and showcase the program to potential future faculty mentors
Jointness and Connectedness	Fundraise to support graduate fellowships, particularly those directed towards projects that involve joint advising between MIT and WHOI faculty
Jointness and Connectedness	Assign all incoming JP graduate students with advisors at both MIT and WHOI
Jointness and Connectedness	Conduct a feasibility study for using different modes of transportation between Cambridge and Woods Hole
Jointness and Connectedness	Extend the model of the Navy Master's program to other partners, potentially in industry or other government sectors
Jointness and Connectedness	Survey students on an annual basis to determine their satisfaction with the program and how it is meeting their career goals

Report Section	Recommendation
Diversity, Equity and Inclusion	Simplify and clarify expectations of students as they navigate their degree programs (e.g., simplify structure of different JC pathways and codify them in a single JP handbook)
Diversity, Equity and Inclusion	Implement effective and inclusive mentoring practices for JP advisors
Diversity, Equity and Inclusion	Study factors contributing to gender disparity in enrollment (e.g., increasing proportion of women graduate students)
Diversity, Equity and Inclusion	Provide JP students and faculty with guidance for planning research expeditions or other field work to ensure safety and inclusivity
Disciplinary: Marine Policy	Communicate through the JP website, the handbook, and/or another written program document a compiled list of different options for JP students to engage with social science and policy during their degree program
Disciplinary: Marine Policy	Establish a working group to identify and implement opportunities for engaging JP students with policy and social science
Disciplinary: Chemical Oceanography	Update the JPCO general exam to be more aligned with the MIT EAPS general exam and with the other JP science disciplines
Disciplinary: Marine Geology and Geophysics	Increase faculty engagement, especially supporting MIT faculty participation in the JP
Disciplinary: Marine Geology and Geophysics	Strengthen MIT-WHOI collaboration (i.e. assign each student a secondary advisor/faculty liaison from the other institution; establish seed grant opportunities for student research)
Disciplinary: Marine Geology and Geophysics	Revise and expand course offerings (i.e. redesign Geological Oceanography; increase frequency and diversity of course offerings; plan course offerings further in advance)
Disciplinary: Marine Geology and Geophysics	Enhance cohort experience (i.e. organize regular annual meetings between students, faculty, and program leadership)
Disciplinary: Physical Oceanography	Prioritize flexible, first-year graduate funding, either from existing resources or in future fundraising efforts
Disciplinary: Physical Oceanography	Continue to seek flexible and stable solutions for office space at MIT for EAPS-affiliated JP students that do not have an MIT thesis advisor