April 18, 2008

The College of Marine Science—Who We Are, What We Want to Do, and Where We Want to Go

Marine Science Is Truly a *Graduate* Level, *Interdisciplinary* Science

The ocean is a natural system of enormous complexity that consists of seamless interactions of a near infinite number of subsystems. Over that past 50 years, students of the ocean have discovered that the separate application of the traditional scientific disciplines (physics, chemistry, biology, and geology) has not succeeded in addressing this complexity. New fields such as global systems science, ecosystems modeling, coupled ocean/atmosphere physics, biogeochemistry, and paleoceanography have emerged and have forged a new *interdisciplinary* approach to the oceanography and marine science*.

Through major research initiatives such as scientific ocean drilling and ocean observing, the best marine scientists are now cross-trained such that a physical oceanographer has sufficient understanding of biological oceanography (and vice versa) such that the two can effectively communicate at sufficiently high level to advance the science together. This is true throughout marine science. For sure, everyone cannot know everything. But, interdisciplinary maturation, starting with graduate school and continuing throughout a professional life, is a living organic tissue grows, strengthens through time. This tissue links physicists, chemists, biologists, geologists, mathematicians, computer scientists and engineers together so that they are fundamentally marine scientists first and foremost—not biologists, chemists, etc. They become truly interdisciplinary in that they can converse at a high level with others who might have initiated their scientific learning in another traditional discipline.

This merging of the traditional scientific disciplines begins at the *graduate* level. Seemingly counter-intuitive to statements above, budding scientists must learn the basics of the traditional fields in high school and as undergraduates. Then, at the graduate level, the sciences are merged and true marine science education begins by working along with experienced faculty. Graduate students' education comes primarily from their research—learning how peer into the unknown. Marine science undergraduate programs commonly lack the basics and consequently, do not adequately prepare students for interdisciplinary work.

So, the College of Marine Science is fundamentally an interdisciplinary graduate research program. This is essential to our success. That is our mission—interdisciplinary research in marine science at the graduate level. We need the stability and coherence of a single unit to meet this mission. This is our core belief. The creation of departments detracts from that coherence. And the attachment of units that have not participated in the interdisciplinary maturation changes the mission.

So, what is next?

But rather than maintaining the status quo, we are as anxious to define and realize a brighter future that will enhance USF's quest for AAU status. We want to enhance and expand our existing activity. We want to engage other elements of USF. We want to run a more efficient day-to-day administrative operation. We want to be good-faith members of the USF community.

We think that the College of Marine Science is positioned to become one of the premier graduate research programs in the marine and oceanographic sciences not only in the US but worldwide. Our performance over the past several decades, not only in the sciences but in ocean engineering and technology development, has placed us upon of verge of greatness. Our existing faculty members have national and international reputations for excellence. They are backed up by an outstanding research staff all of whom allow us to attract increasingly outstanding graduate students. These young people will provide tomorrow's solutions to today's global problems of climate change, food shortages, environmental degradation, and disease.

A critically important aspect of the College of Marine Science is that the faculty and graduate students work "hand in glove" together to solve problems. Essentially, the graduate students themselves work closer to the "abyss of the unknown" than the faculty thus providing these young people with invaluable real-world training.

More so than ever before, the scientific community realizes that the physical world and all life contained therein are intimately interlinked to land, the sea, and the atmosphere. No longer must marine scientists and oceanographers study just the brackish and saltwater. We understand that we are now global, earth systems scientists requiring new paths of inquiry into how the land, sea, and atmosphere all interact with each other and how all life responds to these interactions. Casting an even broader net, we need to engage our colleagues who examine the extraterrestrial world such as fluctuations in the Sun's output, variations of the Earth's orbit around the Sun, and even the long-term threat of meteorite impact.

So, with this vision of an unified global, natural system in mind, the College of Marine Science is poised to build new interdisciplinary research teams to provide answers to a myriad of societally-relevant issues such as overfishing, coastal erosion, red tides, dying coral reefs, hurricane prediction, sea level rise, floods, droughts, and to build better, more environmentally-sustainable and secure communities in the US.

Within the next 50-100 years the human population will expand from 6 billion to 11 billion people. Most of these additional people will live in emerging countries, most will live near the ocean, and all will require resources from the ocean. All will certainly impact the ocean. This human population growth will occur at the same time that scientific community is now convinced we will be entering a period of climate change

perhaps greater than any previously experienced by human civilization. Hence, the challenges are enormous.

The New Marine Science Frontiers

To position ourselves so that CMS can address the problems posed by these pressures, we present three major areas of emphasis:

1. The Global Climate—Oceans and Atmospheres

Understanding the interaction of the Earth's two major fluid bodies (the atmosphere and the ocean) is fundamental to predicting changes in our climate. With the atmosphere being everywhere and the ocean covering ~72% of the Earth's surface, understanding the coupling between these two huge systems is essential so that human civilization can prepare for whatever will come to pass in the next few decades, centuries and beyond. Including the atmospheric sciences is a centerpiece in our strategic thinking and is included in our mostly completed strategic plan.

Water, at least in large quantities, is unique to Earth. As best we can tell, without water life would never have evolved. Most of the Earth's hydrological cycle (the movement of water from the ocean to the air to the land and back to the sea) is based on ocean/atmosphere interactions—so that is why the College of Marine Science sees this as a primary area of emphasis.

In addition to this whole-Earth approach, we envision a strong presence in meso-scale ocean/atmosphere science. Scientists specializing in the meso-scale examine weather and regional aspects of climate. In this case, we would require specialists in understanding weather and climate affecting the western Atlantic, Gulf of Mexico, and Caribbean Basin, including tropical and extra-tropical storms impacting Florida.

2. Land/Ocean Interactions

Given the fact that so many of us live near the sea, it seems incomprehensible that we know so little about the water movement, containing sediments and dissolved material including pollutants and anthropogenic CO_2, from land through our estuaries, and into the coastal ocean. Additionally, it also seems incomprehensible that we are not sufficiently able to predict hurricane effects on coastlines in spite of the existing investments and high-profile news coverage. Any hurricane expert will freely admit that we simply do not understand hurricane intensification. For these reasons then, the College of Marine Science seeks to build interdisciplinary research teams armed with our best technology and including graduate students to quantify the effect of human development on the coastal ocean (depleted fish stocks, coral reef decay, nutrient loading, degrading benthic habitats) and the potential threats that the ocean poses to this development (red tides, hurricane storm surge, elevated sea level, beach erosion).

3. Living Marine Resources

Life in the ocean from viruses to whales is intimately and tightly interlinked with the hydrologic cycle and the atmosphere, ocean and land interactions. Marine life responds to the strong, ongoing changes in the global earth system, but we know little about how and under what conditions marine life responds to these changes. Global ocean genomic studies have revealed that life in the sea is far more diverse than ever before imagined. The pace of change in the modern ocean appears to be so rapid that predicting the response of marine productivity and the distribution of sea life is becoming increasingly complex, exciting, interesting even, but very difficult. Human life has become so dependent upon life in the ocean and so many marine species have become threatened, that developing the ability to predict the changes that will affect our management living ocean resources is now mandatory. Additionally the impacts that deteriorating water quality in the coastal ocean and harmful microbes have upon human health represent an ever increasing challenge for our ocean and earth system scientists. Engaging in ecologically based management necessitates a complete enough understanding of the multidisciplinary, atmosphere, ocean, land systems interactions along with the complex biological and chemical interactions that comprise the ecosystem.

Final Thought

With the appropriate strategic hires and the full participation of our USF colleagues in other programs, we think we can become a premier program in the marine sciences. Additionally, we can make significant contributions to advance the science and to elevate the human condition.

*Oceanography is a more traditional term that implies study of the large ocean basins (over one's head). Marine science is a more inclusive term that includes oceanography but the coastal ocean, bays, estuaries, up to the head of tides (not over one's head).

USF UNIVERSITY OF SOUTH FLORIDA
COLLEGE OF MARINE SCIENCE

College Summary
2005-2007

Type	Year 2005 2006	Year 2006 2007	Year 2007 2008	
Source of Grant Funds				
Federal	$ 14,575,910	$ 8,594,599	$ 3,140,968	
Private	$ 3,903,607	$ 1,624,612	$ 1,068,171	
State & Local Govt	$ 1,442,735	$ 10,608,663	$ 1,654,267	
USGS Pending			$ 1,058,889	
ONR Pending			$ 1,400,000	
Other Proposals Pending			$ 8,683,764	
Total	$ 19,922,252	$ 20,827,874	$ 17,006,059	
Estimated Earmarks		3,970,484	$1,540,000	
Graduates MS, PhD, Post Doctorals				
Masters Completed	12	14	3	Fall 07
Doctorates Completed	8	12	1	Fall 07
Enrolled Grad Students	122	123	111	
Post Doctoral Fellows	24	28	32	
Tenure Faculty Positions				
Distinguished Professor	3	3	4	
Professor	11	11	8	
Associate Professor	12	7	8	
Assistant Professor	2	4	2	
Dean	1	1	1	
Total	29	26	23	
REFEREED Publications & Articles by Ranked Faculty				
Appeared & Reviewed	77	70	103	
Pub data compiled by Annual Faculty Evaluation Reports				