

Spring 2015

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Center for Coastal Physical Oceanography, Old Dominion University

Ben Hamlington

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☆☆☆
Dr. Eileen Hofmann elected
PRESIDENT
 of Ocean Sciences
 section of AGU

See Pages 4-5
 for details

New Section!

Top 3 blog posts
 written by CCPO
 grad student,
 Stefanie Mack

CCPO CIRCULATION

Center for Coastal Physical Oceanography

SPRING 2015

VOL. 20, NO. 2

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Uncovering Anthropogenic Sea Level Rise

Dr. Ben Hamlington

Rising sea levels along the world's coastlines threaten to permanently impact infrastructure and ecosystems. One specific area of concern is the increased risk and impact of storms moving over higher sea levels. Regional sea level changes affect not only the potential for coastal flooding from such storms, but also the recurrence times of devastating extreme events. Addressing and mitigating these effects resulting from changes in sea level involves accurately determining the contributing factors and associated impacts to past, present and future sea level rise and variability. Providing such a regional assessment is a challenging task that requires expertise across a wide range of disciplines and a variety of data sources. Based on satellite altimetry measurements over the past two decades, regional sea level trends can be as much as four times the rate of global mean sea level. This severely limits the utility of any global sea level metric for planning and adaptation purposes at the regional level.

In some regions, natural (by natural, we refer to oscillatory and non-anthropogenic) climate variability on decadal timescales can lead to apparent trends that are significantly larger than the long-term trend. Removing trends associated with known climate variability can allow for a better understanding of the underlying

warming trend that could be associated with anthropogenic forcing. Separating the longer-term secular trends and accelerations from natural climate variability is a challenge, however, given the available observations of sea level. The modern satellite altimetry record, while offering nearly global coverage, spans only 20 years. The tide gauge record, on the other hand, provides a much longer record of sea level but has very poor coverage of the global ocean, particularly toward the first half of the 20th century. One possible solution to these sampling challenges is provided in the form of sea level reconstructions. Simply stated, a sea level reconstruction is a dataset with the spatial resolution of satellite altimetry and the record length of the tide gauges, constructed by combining these two datasets. By matching spatial patterns from the satellite record to the long tide gauge records in the past, a dataset is created that draws from the strengths of each of the input data sources (satellite altimetry and tide gauges).

While sea level reconstructions have been used to study global and regional sea level trends over the last century, we have instead focused on the longer time scale, natural climate variability, and how it affects sea level trends. One of the most significant climate signals in terms of

its effect on the Earth system is the Pacific Decadal Oscillation (PDO). The PDO is a decadal-scale pattern of predominantly North Pacific climate variability, with the associated variability commonly tracked by analyzing the North Pacific sea surface temperature (SST). Several studies have looked at the relationship between the PDO and sea level in the Pacific using both observational and model analyses. The high sea level rise in the western tropical Pacific (WTP) and lower than average sea level rise off the western coast of North America experienced in the past 20 years have been attributed in large part to the PDO, and the assumption has been made that when the PDO shifts phases, the sea level trends will similarly reverse course.

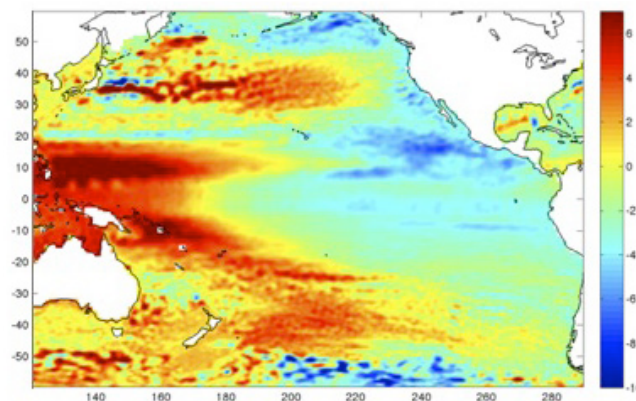


Figure 1. Sea level trends (mm/yr) from 1993 to 2010 as measured by satellite altimeters, from the Archiving, Validation and Interpretation of Satellite Oceanographic (AVISO) data. Note, global mean sea level trend has been removed.

Continued on pages 2-3



OLD DOMINION UNIVERSITY

Center for Coastal Physical Oceanography

IDEA FUSION



John Klinck
Professor of Oceanography
Director, CCPO

Dear Reader,

Science has traditionally been the pursuit of males, with a small fraction of scientists being female. Over the last century, more women have had careers in science. The fraction of women in physical oceanography has been growing over the last four decades.

At CCPO, we are proud to have Eileen Hofmann as a nationally and internationally visible ocean scientist. We are also proud to have women as graduate students and postdocs, both now and in the past. Stefanie Mack is a graduate student who is visible through her blog, giving details of life as a student as well as translating oceanography for a larger audience. Our campus features a new student organization with the charge to support women in STEM fields.

By these means, we hope to show the next generation the importance and excitement of STEM careers attracting the best and brightest of students to our oceanography programs here at Old Dominion University. We hope to inspire all of the current and aspiring women in science.

- John Klinck

Uncovering Anthropogenic Sea Level Rise (continued)

Dr. Ben Hamlington

This would mean significantly higher sea level trends off the western coast of the United States and much lower sea level trends around the low-lying islands in the WTP over the coming decades. As a result of the potential impact on these heavily populated coastal areas, understanding and quantifying the actual contribution of the PDO to sea level trends is of significant interest, both to the scientific community and society.

To estimate the contribution of the PDO to sea level in the past 20 years, we relied on our cyclostationary empirical orthogonal function (CSEOF) reconstructed sea level dataset covering the period from 1950 to 2010. The initial goal was to estimate the dominant 20-year sea level trend pattern over the past 60 years. In other words, we sought to determine if the regional trends observed by satellite altimeters during the past 20 years are unique or if they have been seen at other times in the past.

In Hamlington et al. (2013), we demonstrated that the regional trend pattern of the past two decades has been similarly observed in the past, and has gone through changes in sign roughly every 20 years. In other words, for the time period from 1968 to 1987, trends in the WTP were strongly negative, while trends off the west coast were positive. The shifts in this pattern are highly correlated with changes in the phase of the PDO. Having estimated this PDO contribution to regional sea level trends, we then subtracted this contribution from the total satellite altimetry trends to look at the remaining residual sea level trend pattern. Finally, in an attempt to attribute this residual pattern to anthropogenic forcing, we conducted a simple model experiment. Over the past half-century, warming in the Indian Ocean has been linked to increased greenhouse gases. This warming affects wind patterns, which then impact sea level in the WTP. By using the extra warming in the Indian Ocean to force a model, we were able to link the residual pattern of sea

level trends obtained after removing the PDO to the increase of greenhouse gases, and thus anthropogenic warming.

As shown in this study, using the longer record provided by sea level reconstructions, it is possible to separate and remove the natural variability and gain a better understanding of the underlying trends in the altimeter record that are attributable to anthropogenic forcing. The results presented here have important implications for mitigation, planning and adaptation to future sea level rise in these regions. The prevailing thought has been that once the PDO shifts and changes phases, the sea level rise in the WTP will ease and future decades will hold much more manageable levels of sea level change for the region. While this appears to be the case for areas near Indonesia, in the light of the results presented here, the high rate of sea level rise near the Philippines and northeastern Australia should not be similarly expected to abate over the next couple of decades.

Uncovering Anthropogenic Sea Level Rise (continued)

Dr. Ben Hamlington

With the recent devastation in these regions as part of Typhoon Haiyan, the ongoing sea level rise and potential for increased storm surge and coastal inundation should be a topic of continuing great concern. While we have made an important step with this study toward improving the understanding of regional sea level trends, further work is needed to quantify the effect of natural climate variability in other parts of the world. By understanding and quantifying this important contributor to sea level trends on decadal timescales, we can begin to answer important questions regarding how much of our changing climate is due to natural effects and how much is a result of anthropogenic warming.

Further Reading:

Hamlington, B.D., Strassburg, M.W., Leben, R.R., Han, W., Nerem, R.S., and Kim, K.-Y., 2014. Uncovering an anthropogenic sea-level rise signal in the Pacific Ocean, *Nat. Clim. Change*, 4, 782-785.

Hamlington, B.D., Leben, R.R., Strassburg, M.W., Nerem, R.S., Kim, K.-Y., 2013: Contribution of the Pacific Decadal Oscillation to Global Mean Sea Level Trends, *Geophys. Res. Lett.*, 40, 50950.

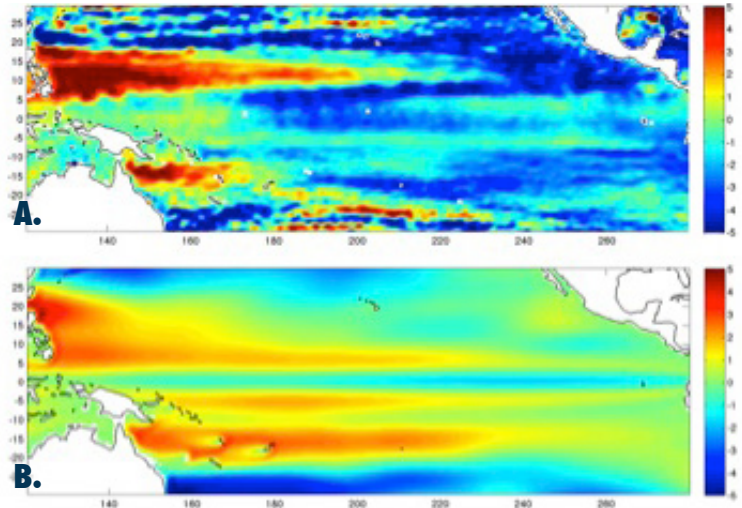


Figure 2. Sea level trends (mm/year) in WTP from (A.) satellite altimetry data minus PDO contribution, and (B.) model result obtained from anthropogenic forcing.

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Just Swimmingly

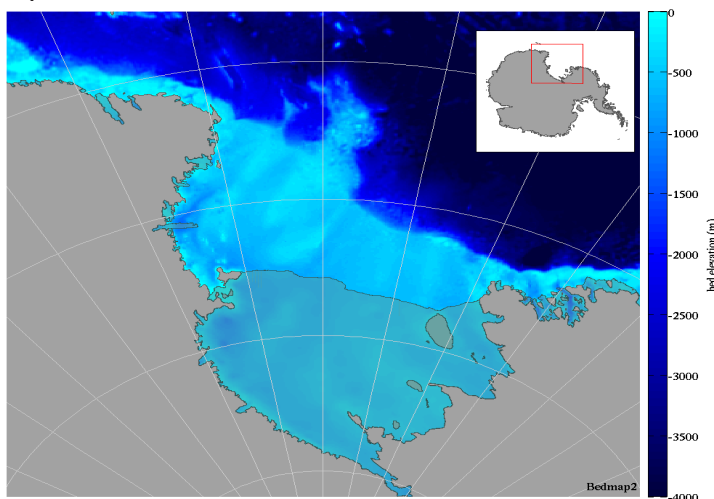
Tales of grad student life in oceanography.
A mixture of science and survival skills.

Stefanie Mack

Top 3 Blog Posts of Fall

1. Dive In: Iron from the seafloor to the surface

Iron is an important micronutrient for phytoplankton, and is very limited in parts of the Southern Ocean. I reviewed a recent paper on the subject and explained in general terms how scientists measure and quantify how iron gets from the seafloor to the surface ocean. This is the first entry in a series designed to translate recent scientific papers into descriptions anyone can understand.



The Ross Sea, Antarctica

2. Working on a collaborative project

Working on a large science project with researchers from other universities requires a lot of extra time and energy. Reflecting back on experiences with a collaborative project group, the benefits and life lessons outweigh the extra time spent doing work for other people.

3. Memberships

Graduate students have very limited budgets, and membership costs in professional societies can add up quite quickly. Here's a review of all the organizations I joined as a graduate student and whether the benefits for each are worth the cost of membership.

For Full Blog Posts:

<http://ohjustswimmingly.blogpost.com>

QR Code:





CCPO SPOTLIGHT: Dr. Ben Hamlington, Professor

Ben Hamlington joined the faculty of Old Dominion University's Department of Ocean, Earth and Atmospheric Sciences (OEAS) in August as an assistant professor. After completing his PhD in aerospace engineering sciences at the University of Colorado, he worked this past year as a research scientist at the Cooperative Institute for

Research in Environmental Sciences (CIRES) in Boulder, Colo. With a background in aerospace engineering, Ben has worked extensively with satellite remote sensing, pursuing applications ranging from early warning and detection of tsunamis to measuring and diagnosing the recent sea level rise observed around the globe. In the past few years, he has focused on sea level change in the tropical Pacific Ocean, attempting to improve projections of future sea level rise in the region. He also produces and continually updates a reconstructed sea level dataset that is hosted and made publicly available by

the NASA Jet Propulsion Laboratory Physical Oceanography Distributed Active Archive Center (PO.DAAC).

In joining Old Dominion University and the Center for Coastal Physical Oceanography, Ben hopes to extend his research to include more local studies and apply satellite measurements to improve the understanding of sea level rise along the East Coast of the United States. With the greatest sea level rise along the East Coast and the city of Norfolk particularly affected, ODU provides an ideal location for continued development of his work.



Dr. Eileen Hofmann

Dr. Hofmann elected President of Ocean Sciences, American Geophysical Union

John Klinck

Professor Eileen E. Hofmann has been elected president of the Ocean Sciences section of the American Geophysical Union. Section presidents serve three successive terms of two years duration in different capacities. Her two-year term as president-elect will begin Jan. 1, 2015. She will continue as section president on Jan. 1, 2017, and will serve as past president starting Jan. 1, 2019.

She is chair of the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) Project (2010-15) and a member of International Geosphere-Biosphere Programme (IGBP) science committee (2010-15). She is currently co-editor-in-chief of *Journal of Marine Systems*. She has served as a member of numerous National Research Council committees.

Dr. Hofmann is a professor in the Department of Ocean, Earth and Atmospheric Sciences of Old Dominion University. She has been a faculty member at ODU since 1989. She is recognized for her work on coupled physical-biological models with research interests in the areas of understanding physical-biological interactions in marine ecosystems, climate control of diseases of marine shellfish populations, descriptive physical oceanography, and mathematical modeling of marine ecosystems. She has worked in a variety of marine environments, most recently several continental shelf regions around Antarctica and Delaware Bay.

Dr. Hofmann has been a member of AGU since 1978. In the past, she served AGU as Ocean Sciences section secretary (1990-92), member of the AGU Meetings Committee (1994-98), chair of the Ewing Medal Committee (2006-08) and member of the *Geophysical Research Letters* editor search committee (2009-10). She was designated as Fellow of the AGU in 2013.

Dr. Hofmann has worked on various national and international committees including International (1996-2010), Southern Ocean (1999-2010), and U.S. (1989-97) Global Ocean Ecosystems Dynamics (GLOBEC) science committees.

Quick Fact:

The American Geophysical Union (AGU) serves as an international society for 62,000 members with interests in all of the earth sciences, as well as space and planetary sciences. The Ocean Sciences section of AGU serves many members with interests in various aspects of ocean science.

The faculty in the CCPO and OEAS department cover a wide range of disciplines, and through collaboration, Ben looks forward to addressing the multidisciplinary challenge of climate and sea level change. Ben has been a member of the NASA Ocean Surface Topography Science Team for the past several years, and is a member of the recently formed NASA Sea Level Rise Science Team. This team is tasked with developing and improving regional sea level projections across a range of timescales.

Ben, his wife and 18-month-old daughter are looking forward to living in Norfolk and exploring the surrounding area. While trading the mountains of Colorado for the beaches of Virginia has been a big change, he would like to thank the faculty and staff of CCPO and the OEAS department for being so welcoming and making the transition much more manageable.



CCPO SPOTLIGHT: Brett Buzzanga, Graduate Student

Brett Buzzanga is an example of the interdisciplinary approach CCPO and MARI are creating at ODU. Brett graduated from Rutgers University in 2011, with a Bachelor of Arts focused on political theory. Upon graduation he forayed into the private sector, where he helped the environmental startup ReVireo develop into a successful company. This experience with the environment had a big impact on his life and he returned to academia to develop his knowledge of science, completing an associate degree in fall 2013.

Brett decided to join CCPO/MARI this fall, working under Dr. Hans-Peter Plag. His diverse coursework reflects his background: as he wrestles with oceanography core courses, he also dwells on societal implications of climate change. His research will look at salt-water intrusion from storm surges and the resulting effects on groundwater. He hopes the findings of this research will help shape policies that protect society.

The Fellowship of Women in Science/AWIS Makes ODU Debut

Miasia Meniffee



Fellowship of Women in Science

The newly formed student organization the Fellowship of Women in Science (FWS) made its debut at the Women in STEM networking event sponsored by the Old Dominion University Women's Center. The event allowed science, technology, engineering and mathematics students to connect with faculty members, campus departments and student organizations.

The Women in STEM event was the perfect opportunity for ODU graduate student Carly Anne York, FWS president, to spread the word about the new organization that supports women in STEM fields at Old Dominion University. This organization is open to all genders and encourages all to join and attend FWS-sponsored events. The ODU Fellowship of Women in Science is affiliated with the nationally renowned Association for Women in Science (AWIS).

The Fellowship of Women in Science recently held an undergraduate Q&A session to give undergraduate students an opportunity to ask a panel of graduate students about graduate school and its rigorous processes. The panel of five graduate students addressed these common questions:

- When/how do I select a graduate program? Is it the right program?
- What's the difference between a PhD. candidate and a student?
- How do you juggle family life and academia?

The one-hour Q&A session was a success! CCPO's graduate student, Stefanie Mack, was asked to be on the panel and she discussed the importance of advising/ learning style compatibility. She provided tips on how to judge whether an environment is conducive to a student's success, because in graduate school, the advisor-student relationship is essential.



CONNECT WITH ODU FWS/AWIS:

<https://www.facebook.com/ODUwomeninscience>

ODU STUDENTS, FIND THEM ON MONARCH LINK:

<https://orgsync.com/86210/chapter>

Farewell Dr. Jennifer Graham!

CCPO Postdoctoral Research Associate



"Beginning in January, I will be a visiting fellow at the University of East Anglia, continuing the work I've been doing at ODU. I've developed a high resolution model of the West Antarctic Peninsula, investigating water mass transport and variability in this region. I've really enjoyed my time here and hope to stay in touch. I look forward to collaborating with CCPO in the future!"

- Jenny

Just the Facts Publications

Ezer, T. and **L.P. Atkinson**, Accelerated flooding along the U. S. East Coast: On the impact of sea level rise, tides, storms, the Gulf Stream and the North Atlantic Oscillations. *Earth's Future*, 2(8), 362-382, doi:10.1002/2014EF000252, 2014.

Marsay, C.M., P.N. Sedwick, **M.S. Dinniman**, P.M. Barrett, **S.L. Mack**, and D.J. McGillicuddy, Estimating the benthic efflux of dissolved iron on the Ross Sea continental shelf. *Geophysical Research Letters*, 41, doi:10.1002/2014GL061684, 2014.

Plag, H.-P., The credibility of science — Acknowledging what we do not know. Column 6 in “On The Edge.” *ApoGeo*, 29(3), Summer 2014, 12-14, 2014.

Plag, H.-P., The Year 2015: The start of a new decade of making it right? — Building a global resilient community. Column 7 in “On The Edge.” *ApoGeo*, 29(4), Fall 2014, 36-38, 2014.

Saramul, S. and **T. Ezer**, Spatial variations of sea level along the coast of Thailand: Impacts of extreme land subsidence, earthquakes and the seasonal monsoon, *Global and Planetary Change*, 122, 70-81, doi:10.1016/j.gloplacha.2014.08.012, 2014.

Walker, R., A.E. Tejada-Martinez, G. Martinat and **C.E. Grosch**, “Large-eddy simulation of open channel flow with surface cooling”, *International Journal of Heat & Fluid Flow*, In Press, <http://dx.doi.org/10.1016/j.ijheatfluidflow.2014.08.005>, 2014.

Presentations

Dinniman, M., **J. Klinck**, L.-S. Bai, D. Bromwich, K. Hines and D. Holland, “Sensitivity of modeled ice shelf basal melt around the Antarctic to the resolution of the atmospheric forcing and the ocean model”, Climate and Cryosphere’s West Antarctica Glacier-Ocean Modeling (CliC-WAGOM) Workshop, Abu Dhabi, United Arab Emirates, Oct. 27, 2014.

Ezer, T., “Accelerated coastal sea level and flooding along the U.S. East Coast and their relation to climate driven changes in the Atlantic Ocean circulation”, National Oceanography Centre, Southampton, UK, Nov. 7, 2014.

Ezer, T., “Climatic changes in Atlantic Ocean circulation and uneven sea level rise”, Euro-Mediterranean Center for Climate Change (CMCC), Bologna, Italy, Nov. 13, 2014.

Ezer, T., “Climate Change, Sea level rise and accelerated flooding along the U.S. east coast”, Dept. of Geography, Environment and Development Studies, Birkbeck College, University of London, London, UK, Oct. 9, 2014.

Ezer, T., “New statistical methods to detect acceleration in sea level: Examples from the US and UK coasts”, Coastal Seminar Series, University of Southampton, UK, Nov. 5, 2014.

Ezer, T., “Recent findings of the relation between coastal sea level rise, climate change and ocean dynamics”, GEOMAR, Helmholtz Centre for Ocean Research, Kiel, Germany, Oct. 29, 2014.

Jabs, E.P., “Arctic Opening: What does this mean for International Maritime Trade?” PORT 611 class: International Maritime Trade, Constant Hall, ODU, Oct. 21, 2014.

Jabs, E.P., “Hampton Roads Sea Level Rise Preparedness and Resilience Intergovernmental Planning Pilot Project,” Maritime Safety Transportation Panel, Virginia Port Authority, Norfolk, VA, Oct. 2, 2014.

Plag, H.-P., S. Brocklebank, D. Brosnan, P. Campus, S. Jules-Plag, S. Stein, “Extreme Geohazards: Reducing the disaster risk associated with low-probability, high-impact events”, Keynote at the GEORisk 2014 Conference, Madrid, Spain, Nov. 18-21, 2014.

Plag, H.-P., 2014. “Towards virtual research environments enabling knowledge creation in response to societal needs”, Invited presentation at the SURA workshop: Understanding and Modeling Risk and Resilience in Complex Coastal Systems, Washington, D.C., Oct. 29-30, 2014.

ODU Spotlight & 2015 REU Program Preview

Katherine C. Filippino

Research Assistant Professor & REU Director
Ocean, Earth, & Atmospheric Sciences

Dr. Katherine C. (KC) Filippino is a Research Assistant Professor in the OEAS department and she's also the program director for the OEAS Research Experience for Undergraduates (REU) program at ODU. The REU program is gearing up for another successful summer and we are now accepting applications for 2015. The program is focused on climate change and sea level rise in a coastal urban environment. When she's not guiding summer interns or assisting students in taking their senior

Now Accepting 2015 Applications!

<https://www.odu.edu/oeas/reu>

Field Studies course, Dr. Filippino's research interests are focused on understanding the nutrient dynamics, physical controls, and biological systems in the lower Chesapeake Bay, particularly the James River and our very own Elizabeth and Lafayette Rivers. This work has allowed her to continue to untangle the complicated triggers behind the annual bloom of the harmful dinoflagellate, *Cochlodinium polykrikoides*, and provide crucial information to modelers to build predictive models of the local bloom species.



You're Invited!

Join us to hear these renowned speakers address topics focused on adapting to our changing climate.

MARI & CCPO Presents the Spring 2015 Seminar Series

Reception begins at 3 PM

Seminar begins at 3:30 PM

Old Dominion University - Innovation Research Park Building II - Conference Center
4211 Monarch Way - Norfolk, Virginia 23508

January 26

Casey Dietrich

North Carolina State University

February 16

Malcolm Bowman

*State University of New York
Stony Brook*

March 16

William Hammond

University of Nevada, Reno

April 6

Yongcun Cheng

*Mitigation & Adaptation
Research Institute*

February 2

Isabella Velicogna

University of California, Irvine

February 23

Kent Carpenter

*Dept. of Biological Sciences,
Old Dominion University*

March 23

Kevin Weng

*Virginia Institute of
Marine Science*

April 13

Se-Hyeon Cheon

Seoul National University

February 9

Raghu Murtugudde

*Earth System Science
Interdisciplinary Center
University of Maryland*

March 2

Andrew Scheld

*Virginia Institute of
Marine Science*

March 30

Colleen Burge

*Institute of Marine & Environmental
Technology, University
System of Maryland*

For more information
contact Julie Morgan at
julie@ccpo.odu.edu

For abstracts and speaker bios, visit:

<http://www.ccpo.odu.edu/Seminars>

OLD DOMINION UNIVERSITY **7**



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