Less than five years ago, Old Dominion University started the Climate Change and Sea Level Rise Initiative (CCSLRI), which led to the recently established Mitigation and Adaptation Research Institute (MARI) and the Hampton Roads Sea Level Rise Preparedness & Resilience Intergovernmental Planning Pilot Project. This interdisciplinary area of research also has a long history in many European countries. Direct measurements of sea level started more than 200 years ago and flood mitigation measures have been in effect for a long time in London, the Netherlands and many other places. Today, reports on flooding in Norfolk, UK, by the BBC or reports on flooding in Norfolk, Va., USA, by the Washington Post, are eerily similar. Therefore, studies of sea level rise (SLR) and associated flooding must be a collaborative effort across oceanic boundaries.

As part of my research leave from ODU during the fall semester, 2014, I spent three months in Europe, visiting various research and academic institutions involved in climate change research. This article is a report on what I learned during those visits.

I had two main goals in mind: First, introducing the European audience to the new research done at CCSLRI and MARI; this was achieved by giving six invited seminars in the UK, Germany and Italy, and participating in various workshops and discussions. Second, learning about the latest research and data sources and developing collaborations with European scientists. Of particular interest to my research is the international project named RAPID that has monitored the Atlantic Meridional Overturning Circulation (AMOC) since 2004 (I attended a workshop in London that celebrated and summarized the first 10 years of continuous observations). Periods with weakening AMOC have shown to be related to increased sea level rise and flooding along the U.S. East Coast (Ezer et al., 2013; Ezer and Atkinson, 2014; Ezer, 2015; Goddard et al., 2015), so I have used the RAPID data in my research to connect climatic changes in ocean circulation with coastal sea level issues. Numerical modeling of the climate system is also an area of great interest to me, and in particular, learning more about the European climate model NEMO, and its distinction from other climate models that are more common in the U.S.

(Continued on page 2)
I am often struck by the international nature of ocean science. I take it for granted that I have friends and colleagues in many countries, while being surprised that my local friends and family do not have a similar global exposure. CCPO now has students from India and Korea, postdocs from Canada, UK and China, and faculty from Germany and Israel. CCPO is proud to have these international connections. Visits by CPPO faculty to other institutions keep these connections alive as do visits to CPPO by colleagues for collaboration and seminars.

Our outreach programs bring this international perspective to our local schools and organizations like the Boy Scouts and Girl Scouts of America. We talk to the students about ocean science and we share stories about our travel to various countries with different cultures, languages and attitudes. We hope to interest students of all ages in the global environment. The diversity of exposure gives us all a context to understand and appreciate our country and others.

Learning from the European experience with SLR was enhanced by visits to Amsterdam, the Netherlands, and Venice, Italy, two cities that have felt the impact of SLR in the past and must prepare for the impact of future SLR, as we will need to do here at Norfolk, VA. I also visited Steart Marshes in Somerset, southern England (Fig. 1)- this £20M project is one of UK’s largest man-made saltwater/freshwater wetland reserves. It was created from farmland as a mitigation action against sea level rise and flooding, whereas rising waters are tunneled into this marsh during high tide or storm surges to prevent flooding of surrounding villages and farms. It will also become a new nature reserve with habitats for birds and marine life. It is a large-scale engineering/environmental flood mitigation experiment (created not without controversy) that requires research on its environmental impact and final design.

While in Europe, I visited the following centers involved in climate change research:

1. The National Oceanography Centre (NOC) at the University of Southampton, UK. As a visiting professor there, I spent most of my time interacting with three research groups: (a) the coastal engineering and the environment group, (b) the RAPID observational group and (c) the climate modeling (NEMO) group. NOC in Southampton is the center for archiving the RAPID observations and the NOC branch in Liverpool is the center for archiving and maintaining the historical data of the Permanent Service for Mean Sea Level (PSMSL). These two data sets are vital for many climate studies.

2. Helmholtz Centre for Ocean Research (GEOMAR), which is affiliated with Kiel University, Germany. The institute leads research in oceanography and climate change. Their studies on numerical modeling of past and future climates are especially noted and relate to my own research.

3. Euro-Mediterranean Center for Climate Change (CMCC) is a research consortium consisting of several Italian research institutions, led by the “Istituto Nazionale di Geofisica e Vulcanologia” (INGV) and the University of Bologna, Italy. CMCC leads efforts to develop operational weather and climate models for the Mediterranean region as well as developing global ocean reanalysis system. Future collaboration with this center will connect my research on climate change in the Atlantic Ocean with climate variability in the Mediterranean region; data from the reanalysis system they developed have already been used in my research on AMOC reconstruction (Ezer, 2015).
In summary, there are numerous opportunities for more collaboration between researchers at ODU’s CCPO, CCSLRI and MARI and European research groups. For example, my research on the connection between ocean circulation and sea level rise along the U.S. coast (Ezer et al., 2013) has now been extended to the western European coasts (Ezer et al., 2015). The study shows that both sides of the Atlantic Ocean experience accelerated sea level, but with different dynamics. While variations of sea level on the U.S. East Coast are dominated by the Gulf Stream, sea level variations on European coasts are more complex and regional, affected by local coastal dynamics as well as large-scale influence from the North Atlantic Oscillations.

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ohjustswimmingly.com

Just Swimmingly: Top 3 Blog Posts of Spring
Stefanie Mack Presents: Tales of grad student life in oceanography. A mix of science and survival skills.

1. What can I do about climate change?
   Change the way you think
   Reduce, Reuse, Recycle
   Vote with your money
   Do the research
   Environmental Activism
   Take baby steps!

When it comes to climate change, many people feel helpless - like they aren’t making enough of a difference. Check out some suggestions on how to approach this problem, as an individual.

Read my full blogs at
ohjustswimmingly.com

2. Always back up data, always!
   Data storage is an issue for many graduate students. We often work with large sets of data, and even when we don’t, our entire graduate lives can be compressed into a handful of papers in progress. It is very important to properly back up your data as a graduate student. Any loss may set back your graduation by months, or even years. Use the tips I describe to make sure it doesn’t happen to you.

3. Starting the job search early
   As graduate students, we are often very focused on finishing our degrees, without much thought about what comes next. However, I’ve found that starting the job search early can make a grad student’s life much easier. By slowly signing up for job boards and email lists, you avoid the frantic search for a job. Along the way, you get an instinctive idea of how long the job process will take, when to actually start applying, and what options are available in your field.
Oceanography Merit Badge program at the NOAA Center for Operational Oceanographic Products and Services (CO-OPS) office in Chesapeake, Va. and continue to participate in each annual event they offer.

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Praveen Kumar, who joined CCPO in August 2014, is a graduate student pursuing his PhD in oceanography at ODU under the guidance of Dr. Eileen E. Hofmann and Dr. Hans-Peter Plag.

Praveen was born and raised in Goa, which is a coastal state on the west coast of India. In 2012, he earned his master’s degree in marine sciences from the Goa University. It was while pursuing his master’s degree that he became fascinated with the biogeochemical processes in the Arabian Sea (north-western Indian Ocean).

Subsequently, he joined the CSIR-National Institute of Oceanography (CSIR-NIO, Goa) as a Junior Research Fellow to help understand and study the Arabian Sea. However, due to his limited expertise in ocean/biogeochemical modeling, he realized that pursuing a PhD would help equip him with the necessary tools required for his research.

This led him to apply for the PhD program at ODU. Praveen’s research interest is focused on the impact of human-induced changes in the coastal water quality in the Chesapeake Bay and its effects on the marine life, namely oysters and surf clams. His research will involve simulations using oyster and surf clam models.

Setting-up a CTD/Rosette system for water sampling is one of the hands-on activities done by Boy Scouts as part of the Oceanography Merit Badge program.

Dr. Hans-Peter Plag.

Praveen Kumar, Graduate Student
CCPO SPOTLIGHT

Not a week goes by that someone interested in one of our programs does not contact me. Educational outreach is an exciting part of my job that allows me to inform others about the important research being done here at CCPO. We might introduce a curious student to a new area of interest through one of our events or even influence a future oceanographer. We hope to expand our outreach opportunities to reach as many students and Scouts as possible.

Praveen Kumar
Graduate Student
CCPO CIRCULATION SUMMER 2015
OLD DOMINION UNIVERSITY 5
A study co-authored by two of CCPO’s faculty members, a former Physical Oceanography undergraduate student, and a former CCPO researcher became the No. 1 most accessed and most cited paper among 1500+ papers published in the Journal of the American Geophysical Union. See recognized paper below:


Publications

West Antarctic Glacier-Ocean Model Project
Mike Dinniman, CCPO Research Scientist

Probably the most uncertain aspect of future sea level change over the next century or two has to do with the behavior of the marine-based (where the bottom of the ice sheet rests on bedrock that is below sea level) ice sheets, particularly the West Antarctic Ice Sheet (WAIS). Despite the importance of these ice sheets, the current generation of global climate models does not simulate sea level change resulting from glacier-ocean interaction. In order to help change this, a workshop was held at the New York University Abu Dhabi campus Oct. 27-29, 2014, bringing together an international group of more than 30 scientists to discuss the advancement of state-of-the-art regional-scale simulations of glacier-ocean interactions.

The goal of the workshop was to improve the physically based estimates of sea level change coming from the WAIS over the present century and beyond. The hope is that such regional-scale modeling research will lay the groundwork to include glacier-ocean interaction in global scale models.

The primary result of the workshop was a plan for a series of community activities, progressing from intercomparisons of separate ice sheet and ocean components toward comparing coupled models. A previously planned activity focused on stand-alone ice sheet models, the third Marine Ice Sheet Model Intercomparison Project (MISMIP+), was used as the basis for two new proposed projects. One project, the second Ice Shelf Ocean Model Intercomparison Project (ISOMIP+), will be focused on comparing stand-alone ocean models that include the floating portion of the ice sheets (ice shelves). The other project, the first Marine Ice Sheet-Ocean Model Intercomparison Project (MISOMIP), will essentially couple MISMIP+ and ISOMIP+. Design of these three projects has continued since the workshop with input from both workshop participants and the broader ice sheet-ocean modeling community. CCPO was a participant in the original ISOMIP project and intends to participate in ISOMIP+ and MISOMIP.

For more information on the West Antarctic Glacier-Ocean Model Project, visit: www.climate-cryosphere.org/activities/targeted/misomip.
REU Students to Research Climate Change & Sea Level Rise
Katherine Filippino
OEAS Research Assistant & REU Director

This summer, the Ocean, Earth and Atmospheric Sciences Department is once again hosting 10 undergraduate students as part of the Research Experience for Undergraduates (REU) program, funded by the National Science Foundation (NSF). Through a competitive grant process, NSF funds select sites throughout the country in a variety of scientific disciplines.

The REU site at OEAS, currently in its second year, is unique as students will focus their research around the timely and relevant topics of climate change and sea level rise in a coastal, urban environment. The 10 students, all with backgrounds in biology, meteorology, or environmental science, hail from U.S. colleges and universities: Penn State University, Bowling Green State University, Bloomsburg University, University of South Carolina, Wesleyan University, Harvard, Flagler College, University of New Hampshire, and the University of North Carolina at Wilmington.

Through a competitive application process, these students were selected to work one-on-one with experts in the field of oceanography, exposing them to in-depth research focused on climate change and sea level rise.

The primary element of the REU experience at ODU will allow undergraduates to experience research while being mentored by research-active faculty members. This will expose each participant to several sub-disciplines in ocean sciences, climate modeling and other fields related to the impact of localized climate change.

Students live on campus and receive room and board, and a stipend for the 10-week program. In addition to their research duties, students will attend weekly science seminars that will focus on climate change and sea level rise as well as our weekly workshops. In these workshops, they will learn skills in scientific writing and communication, discuss scientific ethics, attend a career panel, and learn about graduate school life in an informal panel with our graduate students. Additionally, students will be included in service events promoting environmental stewardship and attend field trips including a kayaking excursion to Goodwin Island, Clean the Bay Day activities for the Chesapeake Bay Program, a Bio Blitz at a local nature park, a tour of a certified laboratory at a Hampton Roads Sanitation District facility, and a tour of the NOAA facilities in Chesapeake. The students will benefit from ODU’s commitment in OEAS to climate-change research, outreach and education; from a faculty with high standing in numerous oceanography disciplines; and from ODU’s proximity to the ocean and bay.


Ezer, T., “Recent Findings of the Relation Between Coastal Sea Level Rise,” Climate Change and Ocean Dynamics, GEOMAR, Kiel, Germany, October 2014.

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