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Environmental Management in a Changing World: Coping with Sea Level Rise

Summer Program: 11 - 23 July 2016

The Nicholas School of the Environment (Duke University) and Venice International University offer a Summer Program that provides training in key topics about the impact of sea level rise on coastal areas and cities, and about adaptation and mitigation strategies.

Why now? Why at VIU?

The symptoms of Global Warming, and in particular an accelerating sea level rise, are already detectable in several regions of the globe. The discussion, at a governmental level, on the importance of reducing greenhouse gas emissions is ongoing, but strategic decisions have to be taken soon in particular in regard to low-lying coastal areas and cities, considering that coastal areas less than 5 meters above sea level are home to roughly 200 million people worldwide (World Ocean Review 2013). The Venice Lagoon will be used as a "laboratory", the ideal setup to study the intertwined dynamics of human and natural systems under a climate change. The Venice Lagoon is a diverse ecosystem providing invaluable services, which has been deeply transformed over the long history of the Venetian State and, in more recent years, by large scale engineering works. The area is also an exceptionally well-documented case of the coexistence of the natural and the built environments, of the tension between sustainable and unsustainable uses of natural resources, and of the potential for vigorous political controversy over possible adaptation strategies. VIU is uniquely positioned, both geographically and for the suite of multidisciplinary knowledge which it encompasses, to provide an educational program of unmatched quality on these topics.

Target (Level of students and suitable fields of study)

Graduate students and working professionals from any university, research institute, or other organization (private companies, government agencies, NGOs) with an interest in environmental issues and ability to read and write fluently in English. Advanced undergraduates will also be considered.

Program Description

There is a scientific consensus that the Earth's climate is warming at a geologically unprecedented rate and that this warming will lead to increasing rates of sea level rise (e.g. IPCC, 2013). What will be the impact of sea level rise on the world's coastal areas and coastal cities? What are the social and economic consequences? What are the expected impacts on human health? Should we plan for a "sustainable development" or for a "strategic retreat"? If a strategic retreat is chosen, what are the implications for our cultural heritage and legacy? What monitoring and management tools are currently available or should be developed in the near future? The impacts of accelerated sea level rise, and of more frequent and extreme storm surges, are not only destructive to the coastal ecosystems, but also to the regional socio-economic system, which includes fisheries, farming, forestry residential areas, and commercial and recreational activities. Coping with, adapting to and mitigating this critical impacts associated with climate change are severe challenges because the socio-economic consequences of sea level rise are difficult to forecast and, as history has shown (e.g. see the case of the lagoon of Venice – Italy - over several centuries), human societies can put in place very complex adaptive strategies, with possibly unforeseen long-term consequences. The course aims to give students a broad perspective on the impact of sea level rise upon coastal areas from the social, economic and environmental point of view. The courses will present the causes and consequences of global environmental change, focusing on global warming, changing oceans, and rising sea levels around the world. Data and models will be used to explore possible future scenarios, and the impact of the sea level rise on coastal morphology, ecosystems, water resources, population and health will be presented and discussed. Students will explore state-of-the-art monitoring technologies and available datasets. Adaptation and mitigation strategies will be analyzed and students will be involved in discussions on critical management issues in a fully multidisciplinary framework encompassing the environmental, social, economic, and health sciences.

Courses

Global environmental change, global warming, changing oceans and sea level rise, Georg Umgiesser *(ISMAR-CNR)*

Extreme events in coastal areas: data analysis and modelling, Marco Marani (*Duke University* and *Università of Padova*)

Coastal environmental change processes: modelling and prediction Andrea D'Alpaos (*Università di Padova*)

Climate change, sea level rise and global health in coastal areas, William Pan (*Duke University*)

Coastal wetlands ecology, restoration and management, Tjeerd Bouma (Royal Netherlands Institute of Sea Research)

Environmental monitoring of coastal morphology and water quality (lectures and labs), Sonia Silvestri (*Duke University*)

The impact of sea level rise and climate change on global water resources, Mario Putti (*Università di Padova*)

Planning for Natural Hazards and Climate Change Adaptation in Coastal Areas, Gavin Smith (*UNC Chapel Hill*)

Learning outcomes of the program

Students will explore and become familiar with the following topics: 1) causes and consequences of global environmental change; 2) modelling and prediction of environmental changes in coastal areas; 3) social, economic and political impacts of sea level rise; 4) environmental monitoring and management of coastal morphology and water quality; 5) the resilience of coastal human-natural systems; 6) sustainable development along the coast; 7) global health and climate change: future scenarios in coastal areas. At the end of the course students will be familiar with the physical processes that generate the global warming phenomenon, and will understand the consequences of changing oceans and rising sea levels. Satellites and other measurement tools will be an integral part of the training, and students will develop an extensive knowledge about models, predictions, and related uncertainties. Students will be required to participate in discussions on the impact of global environmental change on coastal areas, and will understand the importance of new policies for the management of coastal regions and cities and their economic implications.

Number of students

The minimum number of students for the activation of the program is 15. The maximum number of students is 25.

Schedule structure:

Lectures (in class) = 36 hrs
Labs (in the computer lab) = 16 hrs
Field Trips = 16 hrs
Seminars/study with tutors = 18 hrs
Final Presentations = 6 hrs
Total number of hrs in two weeks = **92 hrs**.

Mondays: 4 lectures or labs per day (1.5 hrs each) for a total of 6 hrs + 2 hrs for studying or attending guest speakers seminars.

Tuesdays to Friday: 2 lectures in the morning (1.5 hrs each) + 3 hrs of lab activities or field trips in the afternoons, for a total of 6 hrs + 2 hrs for studying or attending guest speakers seminars.

Saturdays: preparation of students' presentations on data analysis and activities developed during the week, for a total of 6 hrs per day.

Field Trips:
Four field trips of 4 hours are included, for a total of 16 hours. One of the field trips is to visit some natural and restored salt marshes, and it represents the perfect occasion to talk about the halophytic vegetation that grows in intertidal environments, the animals and about the ecology of waterlogged soils, with implications for carbon sequestration. During the second visit students explore a large peat soil area southern of the Venice lagoon, which is currently between 2 and 3.5 m below sea level. The high percentage of peat in the soil makes the area very productive, but the intensive agricultural activities have already contributed to the release of tons of CO_2 in the atmosphere, and as a consequence the area has undergone a strong subsidence process. The trip to the north lagoon inlet (Bocca di Lido) is important to discuss the adaptation strategies that have been developed by the Italian government to protect Venice, and in particular the difference of hard and soft protection projects. This trip is combined with a visit to the control center of the MOSE system (the three series of dams that will soon be completed at the three lagoon inlets to protect Venice from high tides and sea level rise). Finally, the fourth field trip is to collect mosquitoes in different locations (in the city and the lagoon) and gives the opportunity to discuss the link between sea level rise and the

increased risk of vector borne diseases.

Credits

Number of credits in ECTS system[1]: 3

This course has been included in the Master in Environmental Management list of courses at the Nicholas School of the Environment, Duke University. Students that will successfully complete the course will receive 2 MEM Credits from the Nicholas School.

Method of evaluation of students

The grading will include:

A) the work done in class, in the field and in the lab,

in terms of participation of the students in discussions

and debates; 20%

B) the final works/presentations on the lab activities; 30%

C) two tests (each test will be assigned at the end of

each week of the course, and will include a total of

12 questions, i.e. 3 questions prepared by each professor who taught during the week). 50%

Each professor will assign a final grade in x/100.

The grades will then be averaged to assign the final grade to the student (still in %). [For MEM students the conversion curve provided by Duke will be used].

[1] ECTS is the credit system for higher education used in the European Higher Education Area, involving is the Bologna Process. It is a learner-centred system for credit accumulation and transfer based on the transparency of learning outcomes and learning processes. ECTS credits are based on the workload of students in order to achieve expected learning outcomes. Workload indicates the time students typically need to complete all learning activities (such as lectures, seminars, projects, practical work, self-study and examinations) required to achieve the expected learning outcomes.

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