

# Multiple stressors in tropical marine environments

## Short Course for PhD, Masters (MPhil, MSc.) Students and Professionals

**25-30 March 2019**

**Centre for Coastal Management  
University of Cape Coast, Ghana**

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### OVERVIEW

Coastal marine ecosystems are threatened by multiple human-induced stressors, ranging from global stressors such as climate change, to local pollution, habitat loss and over-exploitation of resources. In general, cumulative effects of stressors on the marine eco-system are understudied and with respect to tropical ecosystems, knowledge is limited. In this course, we will discuss the sources, effects and potential solutions to climate change, pollution and unsustainable fisheries in tropical marine ecosystems, and introduce methods to experimentally study the effects of multiple stressors on organisms. The course will offer the students up-to-date knowledge of marine stressors and their inter-actions through lectures, group work and laboratory experiments illustrating the synergistic effects of the different stressors. Emphasis will be on experimental design and data analysis.

### TARGET GROUP

The course is designed for PhD and master students as well as young professionals, working on aquatic environments in general. The suitable disciplines are, for instance, biological oceanography, pollution and climate change, environmental science, chemistry, fisheries, coastal management, or management of freshwater or marine environments and their resources. The course is open for both West-African and Nordic students.

**Application deadline:** 15 February 2019

**Sponsorship:** The course is organized jointly by the Technical University of Denmark (DTU) and The University of Cape Coast (UCC). The course is supported by the Ministry of Foreign Affairs of Denmark through the DANIDA Project HOTSPOT. The Project will cover costs related to the training, training materials and meals for the West-African students. The support will not cover accommodation for this category of students. Nordic students will need to pay a registration fee of US\$ 700 which will cover the accommodation, meals (with the exception of dinner), excursion and the bench fee. Participants are encouraged to arrange for their own travel.

**ECTS credits:** The course is equivalent to 5 ECTS credits. The students will receive a Certificate after completion of the course.

**Total Number of Participants:** 20 (10 Nordic Students and 10 West African Students and Professionals will be enrolled to be selected on a competitive basis).



### COURSE STRUCTURE

The course consists of lectures and group work focusing on different aspects of multiple stressors, hands-on laboratory experiment, students are expected to present their PhD or master projects, where possible in the context of the course. At a final seminar, all participants will be expected to present their results of the field and laboratory experiments undertaken during the course. Each day will start with a lecture on the day's theme, presenting the stressor, its source(s), and its main known consequences in marine systems. The lecture will be followed by group work where the students will discuss possible solutions to the problem, and present their ideas for the rest of the class. In the afternoons the students will work on simple eco-toxicological experiments, investigating lethal or sub-lethal effects of pollutants on diverse plankton organisms at different temperatures. In groups of 3-5, the students will plan, design and conduct a laboratory experiment, paying attention in formulation of hypothesis and data analysis, and present their results in a seminar during the last day of the course.



## TOPICS BY DAY

### **Day 1: Multiple stressors in tropical marine environment and experimental design**

During the first day of the course, we will give an overview of the different stressors that influence marine ecosystems, their anthropogenic sources and geographic variation. We will also discuss why tropical environment is particularly vulnerable to stressors. In addition, we will put emphasis on the methods investigating the effects of stressors in marine environment, including topics such as hypothesis testing, experimental design and analysis.

### **Day 2: Climate change and invasive species**

On the second day of the course we will present the main ecosystem effects of climate change, and how temperature increase is expected to influence organisms, populations and ecosystems in the tropical areas. We will also discuss the sources and treats of invasive species, and how the increasing temperature might promote range extensions of these organisms.

### **Day 3: Pollution: Oil, heavy metals and plastic**

On the third day we will introduce the main sources and effects of oil, heavy metals and marine litter in the marine environment, and how these compounds interact to induce synergistic or antagonistic effects in the ecosystems.

### **Day 4: Fisheries management**

This topic will address important contributions of the fishing industry globally in terms of food and nutrition security, income, employment, tourism, and our cultural values. Special reference will be made to West Africa relative to sustainable fisheries management efforts, challenges and opportunities to the industry and society. A field excursion to a local fish market will be undertaken.

### **Day 5: Eutrophication and sewage**

On this day, the course will focus on the causes, processes and ecological impact of eutrophication in the marine environment. Allochthonous sources of nutrient to the marine environment with special emphasis on sewage will be discussed. Preventive and remediation approach to eutrophication would also be highlighted.

## LEARNING OUTCOMES

After completing the course the students will be able to:

- List the main anthropogenic stressors and their sources on the tropical marine environments, using the Gulf of Guinea as an example
- Describe the main (known) effects of multiple stressors in tropical areas, distinguishing the species, population and ecosystem level effects
- Set up testable hypothesis and design an experiment investigating an effect of a stressor on plankton organisms
- Conduct simple laboratory experiments on the effects of stressors on plankton
- Analyze, interpret and orally present results from an experiment
- Appreciate the complex interactions between anthropogenic stressors and ecosystem properties, as well as the difficulties to extrapolate laboratory results to the nature
- Propose technological or management solutions that could be considered to improve the state of the marine environment in the coast of Ghana

