University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

Estuarine Systems Ecology
3 credits

# MEES 611
Spring 2019

## Course Objectives / Overview

This is a 3-credit course designed to provide graduate students with an integrated understanding of estuarine ecosystem processes and facility with key methods for synthesis and modeling. The course is organized into three parts presented in parallel: 1) introduction to estuarine ecology; 2) introduction to numerical modeling; and 3) student ecosystem modeling projects. In the first of these components, we provide a background in estuarine ecology and illustrate and explain how the diversity of organisms and processes in estuarine ecosystems exhibit functional uniformity, which can be described using a small number of relatively simple algebraic expressions. Toward the second objective, students will be introduced to the methods for modeling and analysis of estuarine ecosystems. Basic techniques for computer simulation (conceptualization, programming, calibration, validation, sensitivity analysis) will be described and students will be introduced to a wide variety of model applications in estuarine ecosystems. Student modeling exercises and projects will be accomplished using spread-sheet operations, and a structured icon-driven software package designed for dynamic modeling (Stella—available for Mac/OS and Windows). Other quantitative analytical methods will also be reviewed, and these will be discussed in relation to estuarine ecosystems. Finally, the students will learn to collaborate in teams to develop a simple ecosystem simulation model designed to address an estuarine ecosystem research and management question of their choice.

## Expected Learning Outcomes

Students who take MEES 611 will acquire the following advances in their understanding of ecosystem processes and modeling.

*1) An integrated understanding of estuaries as ecological systems, with key linkages among physical, chemical, and biological process;*
*2) Ability to recognize, explain and analyze biogeochemical cycles and trophic networks in estuarine ecosystems;*
*3) Comprehension of how estuarine ecological processes respond to anthropogenic drivers, especially those associated with eutrophication and climate change;*
*4) Sufficient knowledge of modeling processes to build and implement simple ecosystem models to simulate dynamic interactions and to improve integrated understanding of estuaries and other ecosystems;*
*5) Enhanced quantitative tools to analyze and synthesize data toward an integrative understanding of how coastal ecosystems work and a breadth of knowledge that improves ability to collaborate effectively with colleagues in other related disciplines.*
*6) Improved skills for success in inter-disciplinary, multi-investigator collaborative research*

**INSTRUCTOR DETAILS:**
**Dr. Jeremy Testa**
jtesta@umces.edu
410-326-7266

**CLASS MEETING DETAILS:**
**Dates:**
**Times:**
**Originating Site:**
**IVN bridge number:**
(*******)
**Phone call in number:**
(***)
**Room phone number:**
(*****)

**CURRICULUM FULLFILMENT:**
MEES 611 fulfills an elective

**Prerequisites**
MEES607 (preferred)

**Teaching Assistant**
N/A

## Course Assessment / Grading

There will be a mid-term exam. Student projects will involve team-oriented development of an ecosystem simulation model. Each student will be expected to contribute to both oral and written reports explaining key aspects of their model, including introduction, methods, results and discussion. Periodic homework assignments will involve analyzing and developing solutions to simple modeling problems. Grades will be based on the mid-term exam (20% total), on home-works (30%), on the project reports (40%) and on class participation (10%). A rubric for grading the group-projects will be presented in the second half of the semester. The course is designed to be fun, with a relaxed atmosphere maintained. Whereas plagiarism will not be tolerated, students are encouraged to work together to learn from one another and solve problems in a collaborative and collegial way (aside from the exams).

## Tentative Weekly Course Schedule

| Lecture # | | | |
|---|---|---|---|
| | A) Introduction & Background | | |
| | Jan 26 | 1) No class – readings and survey | |
| 1 | Jan 31 | 2) Introduction to Estuarine Ecosystems and the course | |
| 2 | Feb 2 | 3) Introduction to Modeling | (HW #1) |
| | | | |
| | B) Estuarine Ecosystem Structure & Function | | |
| 3 | Feb 7 | 1) Plankton Ecosystems | |
| 4 | Feb 9 | 2) Benthic Subsystems | |
| 5 | Feb 14 | 3) Seagrass Ecosystems | |
| | | | |
| | C) Simulation Modeling Methods and Concepts | | |
| 6 | Feb 16 | 1) Ecological Modeling & the Scientific Process | |
| 7 | Feb 21 | 2) Modeling Concepts & Methods | (HW #2) |
| 8 | Feb 23 | 3) Introduction to STELLA | |
| 9 | Feb 28 | 4) Model Formulations & Calibration | |
| | | | |
| | D) Estuarine Physics, Geology, Chemistry | | |
| 10 | Mar 2 | 1) Chemical Inputs, Mixing, Concentrations | (HW #3) |
| 11 | Mar 7 | 2) Nutrient Cycling & Biogeochemistry | |
| 12 | Mar 9 | 3) Hydrodynamics and Physical Transport | |
| 13 | Mar 14 | 4) Mid-Term Exam Review | |
| | | | |
| | Mar 16 | MID-TERM EXAM | |
| | Mar 20-24 | SPRING BREAK | |
| | Mar 28 | MODEL WORKSHOP (UMCES Annapolis) 9am-1pm | |
| | | | |
| | D) Estuarine Physics, Geology, Chemistry Continued | | |
| 14 | Mar 30 | 1) Box Models | (HW #3) |
| 15 | Apr 4 | 2) Geology and Sedimentology | |
| | | | |
| | E) Ecological Processes: | | |
| 16 | Apr 6 | 1) Light and Photosynthesis | |
| 17 | Apr 11 | 2) Ecosystem Metabolism | |
| 18 | Apr 13 | 3) Bioenergetics and Respiration | |
| 19 | Apr 18 | 4) Modeling Project Development | |
| 20 | Apr 25 | 5) Predation and Food-selection (HW #4) | |
| 21 | Apr 27 | 6) Estuarine Food Webs (guest lecture) | |
| | | | |
| | G) Eutrophication Science & Management | | |
| 22 | May 2 | 1) Eutrophication, Hypoxia, and Ecosystem Management | |
| 23 | May 4 | 2) Experimental Ecosystems | |
| 24 | May 9 | 3) Synthesis in Ecosystem Ecology | |
| | May 11 | PRESENTATION OF MODEL PROJECTS (Location TBA) | |

## Required textbooks, reading and/or software or computer needs

***No Textbooks are required***

***Laptop computer for in-class exercises necessary***

## Course Communication

We will be using the distance learning tool, Moodle for storing and disseminating class information, including class notes and lectures, computer model files, assigned readings, and homework. Each student will be given a personal login and password to access the site. Materials for the next class will be posted no later than 12 hours before the beginning of the class. You are strongly encouraged to download and bring lecture material and modeling software to each class as these are critical components of the lectures and will aid in in-class exercises. Please bookmark the Moodle site (https://moodle.cbl.umces.edu/login/index.php) in your web browser so that you can rapidly get there.

## Resources

N/A

## Campus Policies

The University of Maryland Center for Environmental Science has drafted and approved of various academic and research-related policies by which all students and faculty must abide.

Please visit http://www.umces.edu/consolidated-usm-and-umces-policies-and-procedures for a full list of campus-wide academic policies.

## Course-Specific Policies and Expectations

N/A