MAR 650: Marine Ecosystem Dynamics

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This course is aimed principally at (1) description of the global to local scale interaction between physical, biological, and chemical processes in the ocean, (2) understanding of the basic theory of the ecosystem dynamics, and (3) synthesis of existing and new-developed ecosystem models and their applications to the ocean, lakes, and estuaries. Topics cover the broad area of observations, dynamics, and modeling, beginning with the description of basic principal of the dynamics, following with reviews of the recent discoveries in the field of marine ecosystem in the last decade and ecosystem model dynamics.

Lectures consist of 6 major topics: 1) Basic concepts of the bi-physical interaction; 2) Global to basin scale bio-physical processes; 3) Coastal and estuarine bio-physical processes; 4) dynamics of the marine ecosystem modeling; 5) Application of ecosystem models.

Homework will be assigned to students on a weekly base. Students will be evaluated mainly based on the performance in the class (20%), homework (50%), mid-term test (15%) and final examination (15%).

UMASS-D academic fall semester calendars: September 7 to December 15, 2009. No classes on October 8 (Columbus Day), November 11 (Veterans Day); November 23-27 (Thanksgiving recess).
Fall classes end: December 15
Mid-Exam: around October 26
Final Exam: December 16-23.

Class Time: 11:00 AM-1:00 PM, Monday.

Lecture calendars: Total lectures: 14. They are scheduled on September 12, 19, 26; October 3, 10, 17, 24, 31; November 7, 14, 21, 28; December 5, 12.

Lecture Outline:

Topic 1: **Basic Concepts of the Bi-Physical Interaction**

- Radiation spectrum, photosynthesis and primary production
- Earth rotation effects: Coriolis force

- Oceanic boundary layers
- Wind-induced mixed layer and thermocline and theirs relation to spring phytoplankton blooms

Topic 2: Global to Basin Scale Bio-Physical Processes

- Wind-induced global scale general circulation
- Mechanism of the formation of biological deserts
- Characteristics of the western boundary current ecosystem
- Characteristics of cold- and warm-core rings' ecosystem
- Characteristics of the equatorial ocean ecosystem
- Characteristics of the Southern Ocean ecosystem
- Characteristics of the Indian Ocean ecosystem

Topic 3: Coastal and Estuarine Bio-Physical Processes

- Coastal oceanic fronts
- Characteristics of frontal circulations
- Controls of frontal physical processes on biological production
- Physical mechanisms for cross-frontal water transports

Topic 4: Dynamics of the Marine Ecosystem Modeling

- Basic concepts of the ecosystem modeling
- Nutrient-phytoplankton (NP) model
- Autotroph-herbivore Interactions
- Nutrient-phytoplankton-zooplankton model
- Roles of detritus in nutrient cycling: NPD and NPZD models
- Roles of microbial processes
- Population dynamics
- Water quality model: Dissolved oxygen processes, eutrophication and harmful algal bloom

Topic 5: Applications of Ecosystem Models

- Tidal mixing frontal ecosystem dynamics model: studies of Georges Bank ecosystem processes
- Individual based model: studies of zooplankton growth on Georges Bank
- Low-salinity plume-driven ecosystem dynamics model: studies of Texas and Louisiana continental shelves
- Coastal bay and gulf ecosystem model: studies of Jiaozhou Bay, Bohai Sea, and Changjiang Estuary.
- Great Lake ecosystem model: studies of Lake Michigan ecosystem

- Estuarine water quality model: studies of Satilla River Estuary ecosystem