ERACOM
JOINT MASTER PROGRAM IN ENVIRONMENTAL RISK ASSESSMENT AND COASTAL MANAGEMENT

B5. ECOLOGICAL AND CLIMATE MODELLING IN GLOBAL AND REGIONAL SCALES

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Course outline-lectures

1. Modelling Approaches
- a. Types of modelling strategies: deterministic, process based, random, and statistical approaches to modelling
- b. Stochastic and fractal processes
- c. Models with multi-scale variability
- d. Lab: models of random and deterministic variability

2. Analysis of Data for Coastline Studies
- a. Types of coastal data: tides and waves, ecological and climatic data
- b. Cyclic and stochastic patterns of environmental variability
- c. Multi-resolution data analysis, scale dependence, extreme events.
- d. Lab: analysing and forecasting patterns with the Box-Jenkins approach

3. Population modelling
- a. Introduction to population models
- b. Modelling life history
- c. Stochastic simulation Individual based models
- d. Incorporating environmental and demographic stochasticity

4. Studying responses to environmental variation
- a. Global changes, spatial and temporal variation in life-history
- b. Phenological responses
- c. Sifts in geographical position
- d. Spatial explicit population models

5. Graph theory
- a. Introduction to network-based analysis
- b. Needs and applications of graph theory
- c. Dispersal and graph theory topology
- d. Connectivity relationships

6. The Climate System
- a. Factors that govern Earth's climate system
- b. Basic energy balance
- c. Feedback mechanisms and chemistry-climate interactions
- d. Climate sensitivity

7. Climate Models
- a. Basic components of a climate model
- b. Hierarchy of climate models
- c. Global Climate Models (GCMs) and Regional Climate Models (RCMs)

8. Climate simulations

a. Natural forcing and anthropogenic forcing
b. Initial and boundary conditions
c. Future scenarios
d. Analysis of the errors and uncertainties

9. Training course part A

a. Description and set-up of a simple climate model
b. Use of the climate model (MAGICC)
c. Use of the regional climate scenario generator (SCENGEN)
d. Assess greenhouse-gas induced climate change

10. Training course part B

a. Climate model application under different future emission scenarios
b. Class assignment presentations and discussion

Basic references:

1. Goosse H., P.Y. Barriat, W. Lefebvre, M.F. Loutre and V. Zunz, (date of view). Introduction to climate dynamics and climate modeling. Online textbook available at http://www.elic.ucl.ac.be/textbook.

2. IPCC, 2007. Climate change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, in: Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M., Miller, H.L. (Eds), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 996.

3. Neelin, J. David, Climate Change and Climate Modeling, Cambridge University Press, Cambridge, UK, 2011, ISBN:9780521602433

4. World Meteorological Organization, Climate into the 21st Century, edited by William Burroughs, Cambridge University Press, Cambridge, UK, 2003, ISBN:0521792029.