# 國立臺北大學自然資源與環境管理研究所
# 101 學年度第二學期『環境系統分析專題』

課程講義(二)：環境系統、模式與量化指標

Environmental Systems, Modeling, and Indicators

**S.**: Soubbotina T.P. and with K.A. Sheram, *Beyond Economic Growth: Meeting the Challenges of Global Development*, World Bank, Washington, D.C., 2000.

**O.**: Organisation for Economic Co-Operation and Development (OECD), *Handbook on Constructing Composite Indicators: Methodology and User Guide*, OECD, 2008.

**D.**: ENVIROMATICS11 - Decision support systems.ppt; ENVIROMATICS11 - ApendixA.pdf

**B.**: Dissolved Oxygen Sag Curve

- ENVIRONMENTAL SYSTEMS ANALYSIS: MODELING AND DECISION MAKING
  - Environmental Systems and Environmental Modeling
    - ⇨ A **system** is composed of interrelated components, connected together in order to facilitate information, matter and energy flows.
    - ⇨ **Modeling** can be defined as the process of application of fundamental knowledge or experience to simulate or describe the performance of a real system to achieve certain goals.
    - ⇨ Physical modeling, Empirical modeling, and Mathematical modeling
    - ⇨ **Environmental Systems**: Ecological/Biological, Chemical (Engineering) and Socio-Economical Phenomena/Processes
    - ⇨ **Environmental Modeling** => *e.g.*, Streeter-Phelps Equation of Oxygen Sag Curve (**B.**)

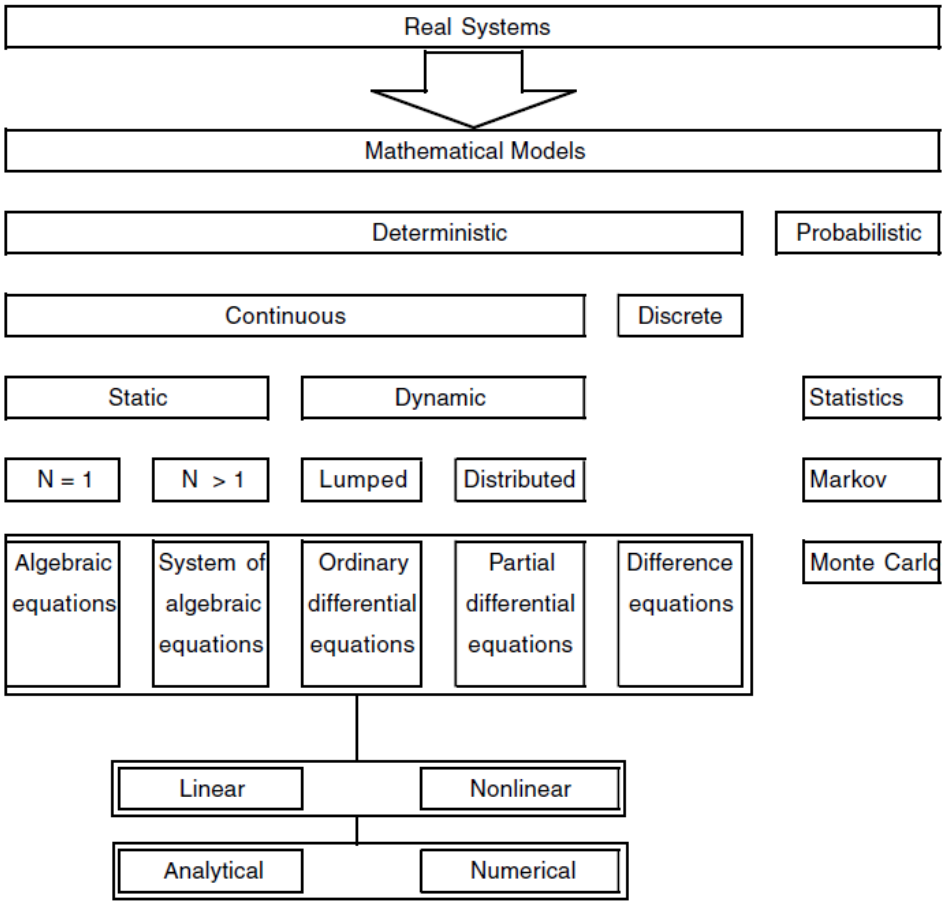


**Figure 1.1** Classification of mathematical models ($N$ = number of variables).

- Environmental Systems Analysis and Environmental Informatics (Environmatics)
  - ⇨ **Environmental Systems Analysis**: Applications of system approaches to dealing with problems/issues of environmental modeling and decision making
  - ⇨ **Environmental informatics** is a part of applied Informatics and supports methods and procedures of information technologies which contribute to environmental data analysis and environmental protection.
  - ⇨ Topics of environmental informatics:
    - Data capture and data storage
    - Methods of environmental sampling
    - Environmental data analysis
    - Environmental statistics
    - Environmental time series
    - Environmental simulation models
    - Decision support systems

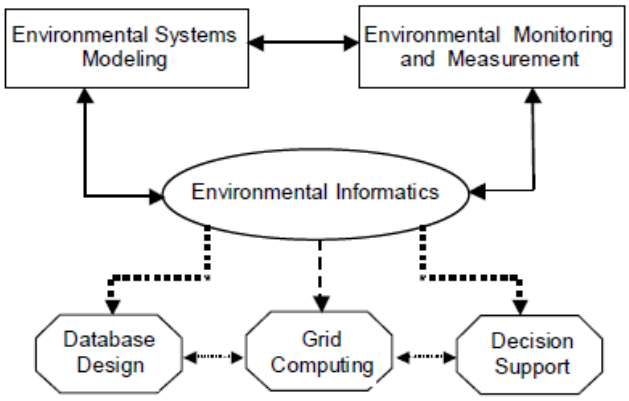


**Figure 1**. Components of environmental informatics and their interactions.

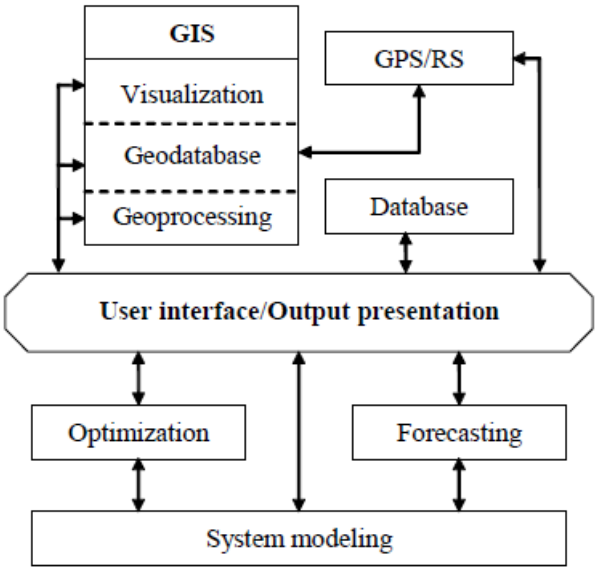


**Figure 2.** Outline of a computing system for environmental decision support.

  - ⇨ Examples: Identification of Statistical Distributions and Monte Carlo Simulation

- INDICATOR, INDEX AND METRIC SYSTEM
  - Metric System: Performance, Benchmarking, Indicator, and Index
    - ⇨ Environmental Indices: PSI vs. API; RPI vs. WQI
    - ⇨ Sub-indices vs. Indicators
  - OECD Handbook (**O.**): Composite indicators which compare country performance are increasingly recognised as a useful tool in policy analysis and public communication.
    - ⇨ The construction of composite indicators:
      - Theoretical framework
      - Data selection
      - Imputation of missing data
      - Multivariate analysis
      - Normalisation
      - Weighting and aggregation
      - Robustness and sensitivity
      - Back to the real data
      - Links to other variables
      - Presentation and Visualisation
    - ⇨ Example: Sustainability metrics and indices => Sustainability_metrics_and_indices wiki
    - ⇨ Legatum Prosperity Index => The 2012 Legatum Prosperity Index

- Homework Assignment #1 (Reading Assignments)

  Please read the accompanying handouts of **O.** and **S.** along with the "2011 永續發展指標系統評量結果".