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

課程講義(02)：環境系統、模式與量化指標
Environmental Systems, Modeling, and Indicators

● 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
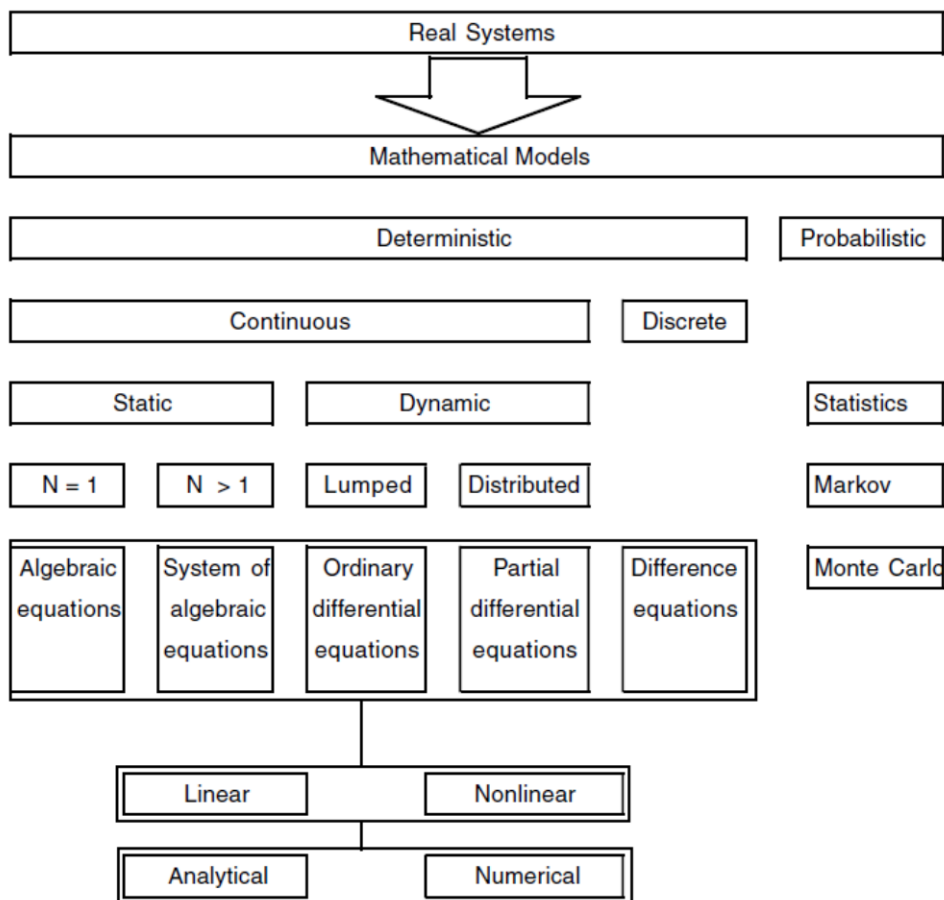    ⇨ **Environmental Modeling** => *e.g.*, Streeter-Phelps Equation of Oxygen Sag Curve (**B.**)



**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
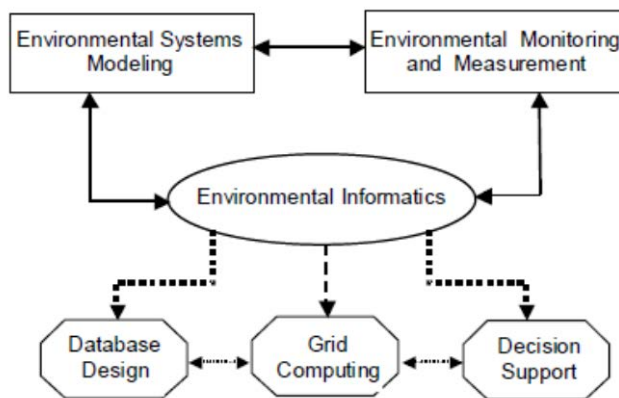- Environmental statistics
- Environmental time series

- Environmental simulation models
- Decision support systems



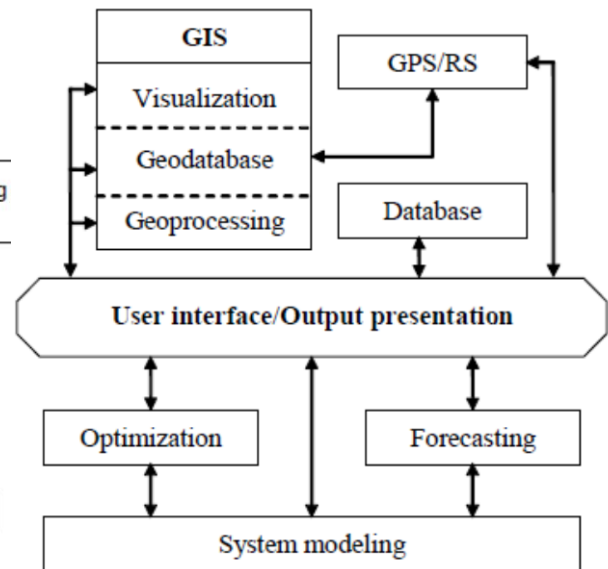Figure 1. Components of environmental informatics and their interactions.



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

⇨ Example 1: Identification of Statistical Distributions and Monte Carlo Simulation

⇨ Example 2: Dissolved Oxygen Sag Curve and System Dynamics

● 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

  ⇨ Examples: RPI, PSI, AQI, 細懸浮微粒(PM2.5)指標
  ⇨ Legatum Prosperity Index => The 2014 Legatum Prosperity Index

● Homework Assignment #1 (Reading Assignments)

請閱讀 OECD (2008) Handbook，並且嘗試分析探討"2013 永續發展指標系統評量結果"，其中各指標之特性及其應用之綜整（composite）方法。