

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

課程講義(03)：環境系統、模式與量化指標
Environmental Systems, Modeling, and Indicators

- 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](#); [Air Quality Index](#), [River Pollution Index](#), [CTSI](#), [Environmental Performance Index \(EPI\)](#); [Global Climate Risk Index 2017](#); [Global Risks Report 2017](#)

● 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.**)

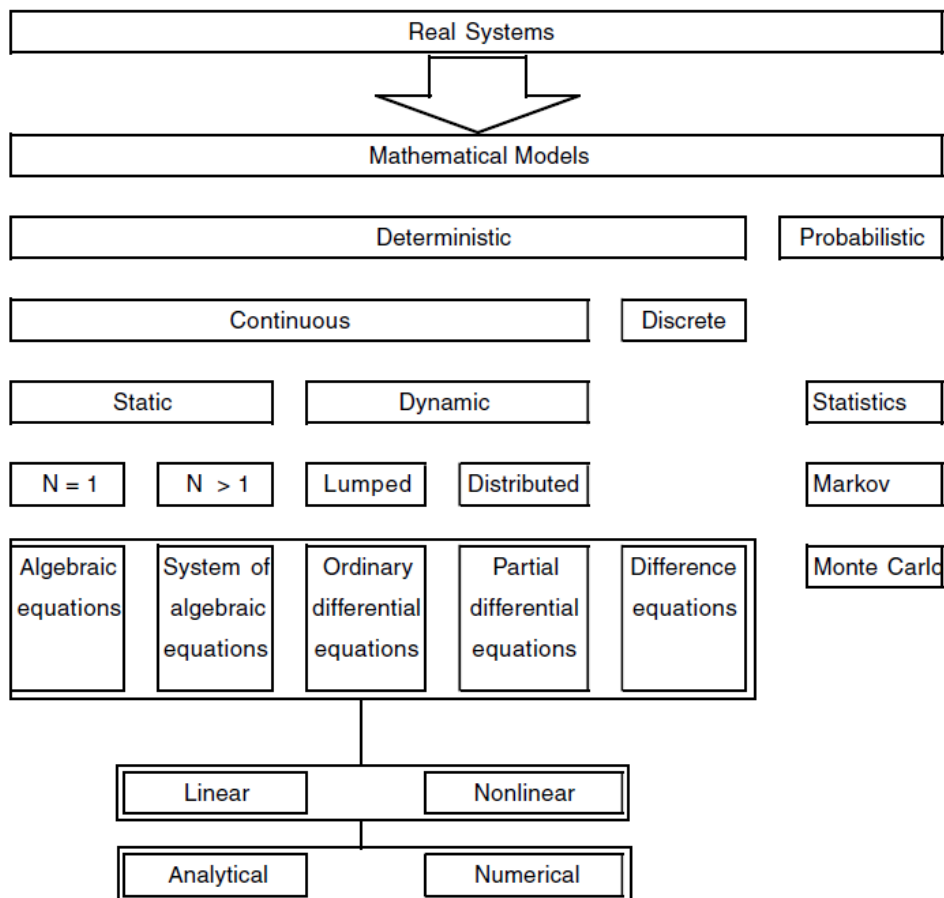


Figure 1.1 Classification of mathematical models (N = number of variables).

(Nirmalakhandan, N. *Modeling Tools for Environmental Engineers and Scientists*, CRC Press, London, 2002.)

- 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 that 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

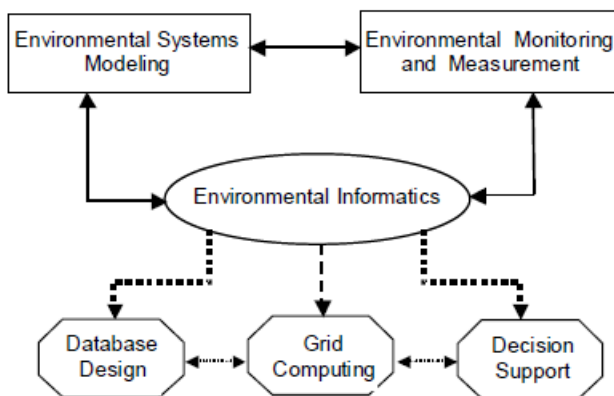


Figure 1. Components of environmental informatics and their interactions.

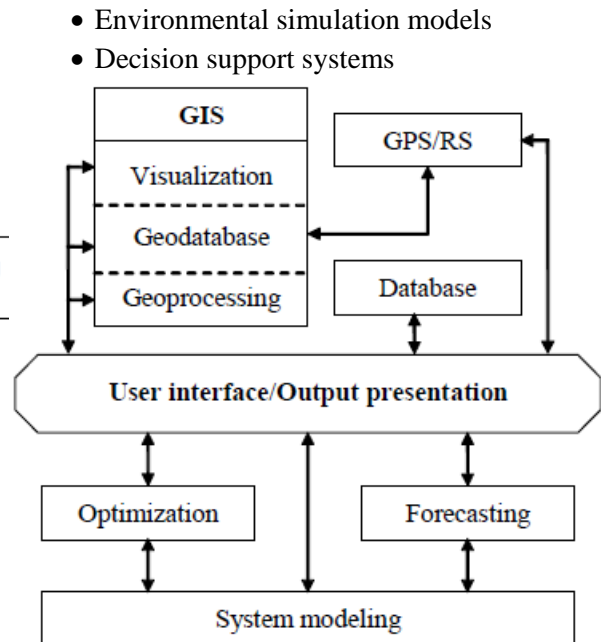


Figure 2. Outline of a computing system for environmental decision support.

- ⇒ 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 => CTSI
 - ⇒ Index, Sub-indices, and Indicators => Eclipse and Ambiguity => [許明華論文](#)
- 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
 - ⇒ Yale University 2016 [Environmental Performance Index](#)
 - ⇒ Germanwatch [Global Climate Risk Index 2017](#); WEF [Global Risks Report 2017](#)

● Homework Assignment #1 (Reading Assignments)

請閱讀 OECD (2008) Handbook，並嘗試操作 Normalization and Visualization。