816.343: Environmental Risk Analysis and Management

H.P. Nachtnebel

HyWa-BOKU

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Course Objectives

to develop a methodological framework for risk analysis and management and

to demonstrate the suitability of the various approaches by the help of case studies. The case studies refer to pollution problems of surface and groundwater systems, as well as to impacts of rare events like extreme floods on the society.

Expected background

- Some knowledge in numerical modelling
- Understanding physically based processes
- Background in environmental management

Risk Analysis

The expression of risk depends on the way how uncertainties in the elements of risk analysis are considered. According to widely agreed principles for risk analysis the main steps are in the identification of the hazard, relationship between load, resistance and consequence (or dose-response function), assessment of the exposure and finally in the characterisation of risk.

Starting with the classical probabilistic formulation which is based on the expectation value of risk other measures are introduced like fuzzy approaches which explicitly consider the imprecision in either load, resistance or consequence. Especially, the use of expectation values is critically reviewed and additional indicators are proposed which refer to quantiles of the probability distribution of the risk.

Risk Management

Risk management describes the process of evaluating and ranking of alternative regulatory actions and finally a selection of a preferred alternative. Obviously, the ultimate goal in risk management is the evaluation of trade-offs among risk, economic, political and social advantages.

The respective methods are described and their limitations in application are given. Again, the emphasis is the demonstration of the applicability of the methods by the help of case studies referring to pollution problems and other natural hazards like floods and droughts.

Course Content

- Elements of Risk Analysis
- Expression of Risk
- Time Series Analysis and Application
- Spatial Analysis and Application
- Groundwater Pollution
- Flood Risk Assessment
- Flood Risk and Climate Change
- Assessment of Erosion
- Earthquake Assessment
- Risk Management and MCDM
- Regional Risk Management
- Flood Risk Management

Environmental Risk

Block (1) Lectures.	**08.03., 09.03., 10.03., 15.03., 16.03., 17.03, 22.03., 23.03. , 24.03, (29.03.)**
Block (2) Pesentation by students	**05.05, 19.05.,**
Exams:	**25.05. at 14:00, 15.06. at 14:00**

Environmental Risk

Block (1) Lectures. 08.03., 09.03., 10.03., 15.03., 16.03., 22.03., 23.03. , 24.03, (29.03.)

Block (2) Pesentation by students 10.05, 11.05., 12.05.,
Exams: 25.05. at 14:00, 15.06. at 14:00

Version: tentative topics

Block (2) 10.05.2022: Modelling of Environmental Risks

- 2.1 Describing Environmental Systems: Systems Approach, Static and Dynamic
- 2.2 Modelling Environmental Systems: Hazard Assessment Models
- 2.3 Hazard Exposure (Transfer of Hazards in Space and Time)
- 2.4 Assessing Uncertainty and Sensitivity in Modelling
- 2.5 Simulation techniques

Block (3) 11.05.2022: Risk Assessment: Quantifying Environmental Risks

- 3.1 Flood Risk Assessment: Quantifying the Impacts of Floods
- 3.2 Drought Risk Assessment: Quantifying the Impacts of Droughts
- 3.3 Erosion Risk Assessment
- 3.4 Assessment of Climate Change Impacts
- 3.5 Health Risk Assessment
- 3.6 Risk Assessment of Earthquakes
- 3.7 Quantifying the Impacts of (Water) Pollution
- 3.8 Quantifying the Impacts of Groundwater Pollution

Block (4) 12.05.2022: Risk Management

- 4.1 Handling Uncertainty in Decision Making
- 4.2 Decision Making in Forest Management under Multiple Criteria
- 4.3 Perception of Risk (in different societies: individual and collective risk)
- 4.4 Managing Long Term Impacts of Hazardous Events (Tsunamis, earth quakes ,. Nuclear disasters,..)
- 4.5 Risk of Power systems
- 4.6 Mitigating Hazards at the Different Levels (local, regional, globally)

Organisation of each paper/presentation

- **Each group (2 students) prepare a presentation and a paper**
- **Presentation is about 15-20 ‘ max.**
- **For each topic a paper of 10-20 pages should be drafted including graphs and references.**
- **The papers should be organised in the following way:**
  - Definition of objective and tasks
  - Introduction and general description of the problem
  - Methodology and relevant literature
  - Application to an environmental case study (e.g. flood risk, pollution risk, environmental damage, erosion problems, drinking water supply, overexploitation of natural resources like deforestation, Aral Sea problem…..)
  - Discussion and Conclusions
  - Summary
  - References