University of Pavia

IUSS School of Advanced Studies

Civil Engineering for Mitigation of Risk from Natural Hazards

Course: Hydrological Risk
a.y.: 2021/2022
Lecturer: prof. Mario Martina
Date: 01/10/2021 - 26/10/2019
Classroom: 1 - IUSS Marelli, Piazza Ercole Marelli, 1

OBJECTIVES

The objective of the course is to introduce students to the main hydrological hazards (fluvial flood, flash flood, excess of rainfall and drought) and the consequent risks. The course aims at providing to the students an overview of the main approaches to assess the hydrological risk and of the main modelling techniques to quantify it.

DESCRIPTION

1. Introduction to hydrology and flood risk, 2. The main processes of the hydrological cycle, 3. Modelling approaches to compute the discharge in a river, 4. Definition of flood, 5. Statistical methods to describe the extreme events, 6. The Intense-Duration-Frequency curve, 7. The Flood Frequency Curve, 8. Anatomy of a Flood Risk Model, 9. Models for hazard estimation, 10. 1D and 2D hydraulic models, 11. Simplified geomorphological models, 12. The role of the hydraulic defenses, 13. Models for the vulnerability estimation, 14. Models for the exposure, 15. Generation of flood events, 16. Flood risk analysis, 17 Definition of drought, 18. Main modelling approach to assess the drought risk.
During the course there will be presentations on specific applications: the estimation of the defence failure effects, the downscaling of the exposure model, the computation of building damages due to flood, models for drought estimation over large areas, simple tools for the estimation of the extreme events distribution.

REQUIREMENTS

Basic knowledge of Hydrology and Probability and Statistics.

REFERENCES

Eslamian, Saeid. *Handbook of Engineering Hydrology*, Boca Raton, FL: CRC Press Taylor & Francis Group, 2014
Yacov Haimes, *Risk Modelling, Assessment and Management,* Wiley, 2016
Zakai Sen, D. Chase, D. Savic, W. Grayman, S. Beckwith, and E. Koelle (2003). *Apply Drought Modelling, Prediction and Mitigation*. Elsevier, 2015
Kirsten Mitchell-Wallace, Matthew Jones, John Hillier, Matthew Foote, Natural Catastrophe Risk Management and Modelling: A Practitioner's Guide, Wiley, 2017
J.C. Gaillard, Natural Hazards and Disasters, Wiley, 2017

ASSESSMENT

Assignments will be handed over and graded during the course. The final examination will consist of a presentation of a study case. Students will be admitted to the final exam based on a satisfactory performance in the assignment.

COURSE SCHEDULE

Tuesday-Wednesday-Thursday 09-12 and 15-17

Date	From	To	Type	Topic
05/10/2019	09:00	12:00	Lecture	Definition of risk
05/10/2019	15:00	17:00	Lecture	Definition of hydrological phenomena
06/10/2019	09:00	12:00	Lecture	Concepts of hydrology
06/10/2019	15:00	17:00	Lecture	Models to compute the discharge
07/10/2019	09:00	12:00	Lecture	Models to compute the flood
07/10/2019	15:00	17:00	Lecture	Statistical method to estimate the peak of the discharge
12/10/2019	09:00	12:00	Lecture	Physically-based models to compute the flood hydrograph
12/10/2019	15:00	17:00	Tutorial	Montecarlo simulations
13/10/2019	09:00	12:00	Lecture	Definition of drought
13/10/2019	15:00	17:00	Tutorial	Description of the drought indexes
14/10/2019	09:00	12:00	Lecture	Flood damage models
14/10/2019	15:00	17:00	Tutorial	Drought damage models
19/10/2019	09:00	12:00	Lecture	How to estimate the exposure values
19/10/2019	15:00	17:00	Tutorial	Combining together all the risk components
20/10/2019	09:00	12:00	Lecture	Anatomy of catastrophe models
21/10/2019	15:00	17:00	Tutorial	How to compute the cost benefit ratio
26/10/2019	09:00	12:00	Lecture	How to reduce the risk or transfer the risk
26/10/2019	15:00	17:00	Tutorial	Exercise on R