Laurea Magistrale
Atmospheric Science and Technology (LMAST)

SUBJECT TITLE	Hydroclimatology
TEACHER NAME(S)	Francesco Cioffi
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Teacher phone	0644585523
Teacher meeting	Appointment by email or phone
Teacher office address	DICEA_Hydraulics/Sanitary/Topography building 2nd floor
DISCIPLINE (SSD)	ICAR01
Semester (1-4)	1/2
Credits (CFU/ECTS)	6
Lecture hours (h)	60
Prerequisite and learning activity	Fundamentals of Algebra, Mathematics, Physics,fluidmechanics
Teaching language and method	English, room lessons
Assessment method	Final project, oral exame
SUBJECT WEBSITE	https://www.dicea.uniroma1.it/en/users/francescocioffi

OBJECTIVES

The course will provide fundamentals about theoretical, technical and practical issues in : a) Modeling the link between local precipitation regime, with a specific focus to extreme hydrological events as rainfall/flood and drought events, and large-scale atmospheric circulation features; b) impact assessment of hydrological changes at local scale; c) identifying technical solutions to cope such impact on social, economical and Environmental systems.

OUTCOMES (Dublin descriptors: knowledge, understanding, explain, skill, ability)

Analysis and solution capabilities relevant to the problems of design, implementation and operation of climate/hydrological/hydraulic models with particular regard to the analysis of the interaction between the different spatial and temporal scales of the involved phenomena, from the planetary scale of atmospheric circulation to the basin scale or to the typical hydraulic scales of water bodies. Gain a solid knowledge about the problems in data analysis and modelling, design and implementation of modelling systems for application at regional or basin scale.

PROGRAM CONTENT

Introduction to climate models. Non-linearity, chaoticness and feedbacks in the climate system. Global and Regional atmospheric circulation models. Performance and drawbacks in representing the hydrological cycle. Atmospheric rivers and humidity transport. Bias and bias correction. Global warming scenarios. Uncertainty in climate projections. Ensemble models.

Statistical and dynamical rainfall downscaling models. Hidden Markov Model and Non-homogeneous Hidden Markov Model for daily rainfall amount and occurrence downscaling. Selection of atmospheric predictors and data reduction methods. Criteria to assess the model performance and climate projections.

Extreme hydrological events: floods and droughts. Modelling the link between extreme hydrological events and large scale atmospheric circulation features. Complex Networks, Event Synchronization and Self-Organized Map.

Forecasting and projections. Criteria to perform early-warning and seasonal forecasts, as well as, climate projections of intensity and occurrence of hydrological extremes at local scale by using large scale atmospheric circulation simulations from reanalysis and future projections from climate change scenarios.

Assessment of the impact of hydrological extreme at basin and/or regional scale. Rainfall-runoff hydrological models. Hydraulic models. Criteria and methods for the assessment of hydraulic risk due to floods and droughts. Optimization models for decision support to plan risk reduction by flooding and water management.

Application to real-world engineering problems by using the chain of climate/hydrological/hydraulic models.

REFERENCES AND MATERIAL

Students attending classes are require to study lecture notes, scientific papers, codes provided by the instructor.