

PhD Course in Environmental Engineering

Proposed research subjects for 19th cycle

Area	N.	Title	Advisor(s)
A	1	Distributed surface hydrology	Riccardo Rigon (tutor)
	2	Innovative methodologies for aquifer's characterization	Alberto Bellin (tutor), Yoram Rubin (University of California at Berkeley)
	3	Climate change and hydrology: the impact on transport of nutrients and contaminants at the catchment scale	Alberto Bellin (tutor), Riccardo Rigon
	4	Mud and debris flows: rheological behaviours and global relationships	Aronne Armanini (tutor), Luigi Fraccarollo
	5	Bed morphology of steep gradient torrents	Aronne Armanini (tutor)
	6	High concentrated sediment transport in unsteady mobile bed channel flow	Luigi Fraccarollo, Aronne Armanini, Giorgio Rosatti
	7	Morphodynamics of braided rivers	Marco Tubino (tutor), Guido Zolezzi, Giorgio Rosatti
	8	Atmosphere and climate dynamics in mountain environment	Dino Zardi (tutor)
	9	Numerical modeling of the exchange between the Venice lagoon and the Adriatic sea	Marco Tubino (tutor)
B	10	The health risk analysis as a tool for the optimisation of the technological choices in waste management	Marco Ragazzi (tutor), Marco Tubino, Giuliano Ziglio
	11	Water distribution network reliability: quantitative and qualitative aspects	Paolo Bertola (tutor)
	12	Development of biomolecular techniques for the identification of bacterial species in environmental biotechnology applications	Gianni Andreottola (tutor)
	13	Geodesy and spatial data analysis for environmental monitoring	Battista Benciolini (tutor)
C	14	Methodological approaches for Strategic Environmental Assessment	Corrado Diamantini (tutor), Davide Geneletti
	15	Measuring and evaluating environmental sustainability: indicators selection for Alpine regions	Corrado Diamantini (tutor)
	16	Sustainable Architecture: Environmental Costs of Building Life Cycle	Antonio Frattari (tutor)
	17	Sustainable Architecture: Low Energy Timber Buildings	Antonio Frattari (tutor)
D	18	Numerical methods for partial differential equations associated with environmental flows	E.T. Toro (tutor)

Description of the proposed research subjects

1. Distributed surface hydrology

The research will be dedicated to the development and validation of the distributed hydrological model GEOTOP. In particular, some of the hypotheses will be analyzed in a critical way and tested by comparison with field data. With regard to this, it is expected the use and the analysis of high resolution digital terrain model and satellite data set. There are several aspects of interest for modelling as, for example soil erosion, slopes instability, flood waves formation, the coupling of land surface hydrology with local meteorological models, but the main goal for this doctoral research is to investigate the role of vegetation in the energy and water fluxes partitioning either for annual time scales and over climatological periods of time. Vegetation effects in extreme events will be also assessed. The spatial scale of interest is mainly that of small-medium mountain catchments.

2. Innovative methodologies for aquifer's characterization

Migration of contaminants in the earth's subsurface is controlled by hydraulic property variations, often leading to preferential pathways, and spatially variable geochemical properties which accurate identification is needed in order to minimize the probability of failure of the remediation activities. This research activity focuses on new methodologies for aquifer's characterization founded on the integrated use of concentration data and geophysical surveys data, both analyzed in a Bayesian framework in order to infer the spatial variability while reducing uncertainty.

3. Climate change and hydrology: the impact on transport of nutrients and contaminants at the catchment scale

The objective of this research program is to select and improve existing modeling approaches in order to assess the impact of global change land-use and management practices on soil-groundwater-river systems. Soil functioning, interaction between surface and subsurface water bodies, and impact of global change on the hydrological cycle are the sectors where the activity will be concentrated in collaboration with a large EU research group. An important objective is the quantification, through predictive models, of the impact of climate variations on the hydrological cycle and water resources.

4. Mud and debris flows: rheological behaviour and global relationships

The experimental and theoretical research is devoted to determinate the rheological property of water and mud or debris mixture. The experimental equipment is already available and permits the analysis of debris or mud flows on mobile bed in uniform flow conditions. The recent rheological theory must be pursued as, for instance, those which concerned the two-phase mudflows or to the kinetics theory of gas dense for the debris flows in collision regimes. The problem of particle size sorting and segregation will be investigated. Global analyses, looking at some problems of interest in torrent engineering (such as the shape of the bottom profile in the transversal sections or the relationships expressing the sediment transport and the bottom shear stress), will be pursued as well. The experimental phase of the research will be carried out in the Hydraulic Laboratory of CUDAM.

5. Bed morphology of steep gradient torrents

The research is mainly devoted to identify the bed forms forming in steep gradient torrents, like step-pools and chute-pool sequences. The bed forms will be reproduced in a high sloping channel in the Hydraulic Laboratory of CUDAM.

A new theoretical approach based on equations of water and sediment motion will be tried. Different analytic and numerical techniques will be used.

6. High concentrated sediment transport in unsteady mobile bed channel flow

The experimental and theory research is addressed to analysis of the unsteady currents of the water and sediments, like those generated by a dam break in mobile bed channels. Poorly sorted sediments will be first employed in the experiments, though the various runs will be characterized by a different grain size. This will allow to evaluate both the dynamic role of the particles and their ensemble behaviour as far as surface traction and seepage are concerned. Experimental, theoretical and numerical tools will be exploited. The research is part of the European project THARMIT.

7. Morphodynamics of braided rivers

The research activity will focus on experimental and field observations of the physical processes characterizing the evolution of braided rivers. Data acquisition and processing are planned in order to further understand the lag between physical modelling and natural phenomena. Typical features of braided networks, such as unsteadiness of water and sediment supply, together with sediment heterogeneity, will be investigated. The research activity is ultimately aimed at providing scientific support to predictive models of braiding dynamics that are presently being developed.

8. Atmosphere and climate dynamics in mountain environment

The research project is focused on atmospheric phenomena occurring in mountain regions, and in particular boundary layer processes associated with valley wind systems. The research activity may include either field measurements (with ground based and/or airborne instruments) and subsequent data analysis or numerical simulation with meteorological models. Another possible topic is the climatological analysis of long time series of instrumental data for detection of long term climate trends.

Further details at the website: <http://apg.ing.unin.it>.

9. Numerical modeling of the exchange between the Venice lagoon and the Adriatic sea

The research regards the numerical modelling of the exchange (water, salinity, pollutants, sediments) between the Venice lagoon and the Adriatic Sea and the comparison of the model results with available field data.

10. The health risk analysis as a tool for the optimisation of the technological choices in waste management

The aim of the research are: a) to enhance the present health risk analysis from waste combustion; b) to adopt the health risk analysis also in treatment plants different from combustion plants in order to obtain adequate guide lines for their implementation; c) to set up a method for the energetic-economic-environmental optimisation of waste management referring to the assessment of the environmental costs from pollutant emissions.

11. Water distribution network reliability: quantitative and qualitative aspects

The research deals with the study of hydraulic network simulation problems and with the study of design and managing of hydraulic network; the aim of the research is the reliability increasing of the whole system with a deep knowledge of some qualitative aspect involved by drinking water.

12. Development of biomolecular techniques for the identification of bacterial species in environmental biotechnology applications

The application of enhanced biomolecular techniques allows to identify bacterial cells and to measure their activity in the biodegradation of specific contaminants, improving significantly the enhanced design and monitoring of biological processes applied to different matrixes (wastewater, supply water, biosolids, contaminated soils and aquifers). The PhD student will study and apply to different matrixes (activated sludge, biofilm, compost, soil and ground water) innovative techniques as Fluorescent In Situ Hybridization, Cytometry, Immunoessays. Research results will contribute to the development of more effective design and monitoring procedures of various environmental biotechnologies.

13. Geodesy and spatial data analysis for environmental monitoring

The research will be dedicated to the development of techniques for the analysis of spatially referred environmental data. Both geometric and thematic data will be treated, and modern positioning methods will be considered as data sources.

14. Methodological approaches for Strategic Environmental Assessment

The research activity consists in the generation of an information system aimed at synthesising the environmental assets and values, and at the testing the effectiveness of the system within the Strategic Environmental Assessment of spatial/land use and sectoral plans. The research involves the use of tools such as GIS and Decision Support Systems, and of specific techniques to achieve consensual value judgments.

15. Measuring and evaluating environmental sustainability: indicators selection for Alpine regions

The research activity consists in an identification of relevant processes affecting, from an environmental point of view, Alpine areas, and in a selection of appropriate indicators to be utilized in decisions making. Selected indicators will be tested in different regions, to measure and evaluate sustainability.

16. Sustainable Architecture: Environmental costs of building life cycle

The life cycle of the buildings has an environmental costs related to the impoverishment of renewable resources, energy consumption and environmental pollution. The research aim is to assess the environmental costs of two storey buildings in timber and in reinforced concrete structure.

17. Sustainable Architecture: Low energy timber buildings

The research aim is to design new timber buildings in which the typological and constructive characteristics are compatible with the use of alternative heating and coolness systems based on the use of renewable and not polluted resources.

18. Numerical methods for partial differential equations associated with environmental flows

To develop new numerical methods for solving partial differential equations associated with environmental flows that contain advection, reaction, diffusion and dispersion terms. We shall aim for schemes that are: (a) non-oscillatory, (b) of high accuracy in space and time and (c) that are efficient in dealing with stiff terms.