

Three PhD positions available at Department of Civil, Environmental and Mechanical Engineering  
University of Trento

We encourage highly motivated students to apply for admission to the following PhD programs:

- PhD Program in Civil, Environmental and Mechanical Engineering  
(<https://www.unitn.it/en/ateneo/1954/announcement-of-selection>)

2 open scholarships (see recommended topics below)  
+ 1 scholarship on reserved topics

Deadline for application: August 29 at 4 pm (Central Europe Time, GMT +2)

PhD in Civil, Environmental and Mechanical Engineering  
Curriculum A: Civil and Environmental Engineering

<https://www.unitn.it/en/ateneo/1954/announcement-of-selection>

2 open scholarships: proposals on the following themes will be warmly welcomed.

1. Transport processes along riverine environments and their impact on climate change  
(P.I. Alessandra Marzadri, UniTrento)  
Recent studies underline the importance of riverine environments in greenhouse gases (GHGs) emissions drawing attention to the fact that nearly all fresh waters contain carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O) in concentrations that are supersaturated with respect to that of the atmosphere. In riverine environments, CO<sub>2</sub> and CH<sub>4</sub> emissions are controlled by the processes involving the metabolism of terrestrial organic carbon; while nitrification-denitrification processes are the major processes controlling N<sub>2</sub>O emissions. The proposed research will focus on modeling transport of nutrients and contaminants at the catchment and larger scales. New approaches will be developed in order to take into account the multifaceted interactions occurring in the riverine environment both in the stream and in the hyporheic zone.

2. Data-driven modelling of thermal dynamics in water bodies:  
Physical models vs. machine learning  
(P.I. Marco Toffolon, UniTrento)  
Water temperature is a key physical variable affecting the whole range of biological and chemical processes occurring in lakes and rivers. Traditionally, two approaches have been developed to simulate water temperature, namely using physically based models and statistical models. Now the increasing availability of information, the so-called big data, is paving the way to the use of machine learning in environmental studies, a research field that is exponentially growing. The aim of the proposed study is to test the performances of machine learning tools in the context of water temperature dynamics, and to analyse their strength and weakness in comparison with those of physically based deterministic models.

1 Reserved Topic scholarship (Departments of Excellence Grant A2)

3. Effects of climate change and human exploitation on groundwater resources in a meso-scale watershed

(P.I. Bruno Majone and Alberto Bellin, UniTrento)

Groundwater is a critical resource under threat by overexploitation due to the combined effect of population growth and climate change. Despite its importance our capability to model groundwater at catchment and regional scales is still limited. This research project focuses on modeling groundwater at the catchment and regional scales. In particular, we are seeking for a suitable parametrization of formation heterogeneity and exchanges with the surface water. The final objective is to combine groundwater modeling with artificial intelligence techniques to limit modeling errors and better assess the impact of water extractions by making the best use of all available data.

Attached is an extended description of the research activities. The PhD student will be included in an interdisciplinary research group.

Alberto Bellin ([alberto.bellin@unitn.it](mailto:alberto.bellin@unitn.it))

Bruno Majone ([bruno.majone@unitn.it](mailto:bruno.majone@unitn.it))

Alessandra Marzadri ([alessandra.marzadri@unitn.it](mailto:alessandra.marzadri@unitn.it))

Marco Toffolon ([marco.toffolon@unitn.it](mailto:marco.toffolon@unitn.it))