



PhD in INGEGNERIA AMBIENTALE E DELLE INFRASTRUTTURE / ENVIRONMENTAL AND INFRASTRUCTURE ENGINEERING - 38th cycle

Research Area n. 3 - Environmental and Hydraulic Engineering and Geomatics

PNRR_352 Research Field: INFRASTRUCTURES AND SUBSURFACE WATER BODIES*

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

The subsurface is markedly heterogeneous and complex and available information is generally limited. Accounting for these aspects is nowadays a top priority and a major challenge. This especially critical considering the potential competitive uses of subsurface water and energy resources in the context of energy transition under global changes. The research will analyze: (a) the key processes controlling surface-subsurface flow and mass exchanges in the context of their interaction with subsurface structures, addressing issues arising in a truly integrated water cycle analysis; (b) the effect of climate change, heterogeneity of the subsurface environment and ensuing uncertainty on the ability to predict dynamics of groundwater and its vulnerability to anthropogenic contamination. Surface water and groundwater models will be dynamically coupled in an optimal fashion. This will enable for prediction in real-time of system responses to extreme hydroclimatic events, including quantification of the associated uncertainty, in line with the objectives of the National PNRR (with particular relevance to M2C4- Protection of the territory and water resources).

Objectives of the research

Development of robust methodologies and tools that can be used to study the quantitative (changes in piezometric



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| | <p>levels and fluxes) and qualitative (i.e., deterioration of groundwater quality) impact of subsurface critical infrastructures on the surface-subsurface water continuum. The newly developed methodologies will allow including the joint impact of climate change and subsurface (infra) structures on the assessment of the temporal evolution of groundwater levels, fluxes, and quality. This will guide the planning of future actions for sustainable development and environmental protection. Development of probabilistic risk assessment strategies, to increase certainty through quantification of risk and to allow establishing decision-making tools able to include and quantify acceptable (or otherwise unacceptable) risk levels.</p> |
| <p>Methods and techniques that will be developed and used to carry out the research</p> | <p>The team involved in the project (see below) offers a variety of competences on surface-subsurface flow/transport modeling and uncertainty quantification to cope with modern energy transition schemes under competitive (ground)water demands in a changing environmental scenario.</p> <p>Overall, methodologies and tools developed during the research activity will enable one to (i) describe and reproduce spatial distribution of geomaterials and their attributes; (ii) model surface water - groundwater interaction using available data, including global datasets; (iii) accurately simulate transport of pollutants across various scales and forcing conditions, and (iv) provide model predictions in a probabilistic framework, accounting for uncertainties related to our knowledge of the surface/underground environment and climate conditions. It is requested to the PhD candidate: i) to have a basic knowledge of Italian language, in order to interact with industrial partner technicians; ii) to be able to write technical reports in Italian.</p> |
| <p>Educational objectives</p> | <p>Prepare highly qualified professionals to efficiently tackle engineering scenarios linked to groundwater/infrastructure management and protection in the context of multiple uses of (ground)water resources and climate changes. Close collaboration between PoliMI and the industrial partner yields a unique opportunity for the PhD to be</p> |



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| | trained in diverse aspects contributing to shape their future careers, including economic-management and goals oriented to sustainable use of subsurface water and energy resources. |
| Job opportunities | Industrial companies, professionals in groundwater management and protection of critical infrastructure sites. |
| Composition of the research group | 3 Full Professors 2 Associated Professors 1 Assistant Professors 7 PhD Students |
| Name of the research directors | Monica Riva, Monica Papini |

| Contacts | |
|-------------------------|--|
| monica.riva@polimi.it | |
| monica.papini@polimi.it | |

| Additional support - Financial aid per PhD student per year (gross amount) | |
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| Housing - Foreign Students | -- |
| Housing - Out-of-town residents (more than 80Km out of Milano) | -- |

| Scholarship Increase for a period abroad | |
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| Amount monthly | 700.0 € |
| By number of months | 6 |

| National Operational Program for Research and Innovation | |
|---|-------------------------------|
| Company where the candidate will attend the stage (name and brief description) | TECNE Autostrade per l'Italia |
| By number of months at the company | 6 |
| Institution or company where the candidate will spend the period abroad (name and brief description) | to be defined |
| By number of months abroad | 6 |

| Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information |
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| <p>Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research:</p> <ul style="list-style-type: none"> •Université de Strasbourg, France •Universitat Politècnica De Catalunya, Barcelona, Spain •University of Southern California, USC, USA |



- Berlin Institute of Technology, TUB, Germany
- Autostrade per l'Italia

Educational activities (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences): approximately 1902,38 euros per PhD candidate per year, on average.

Teaching assistantship (availability of funding in recognition of support to teaching activities by the PhD candidate): there are various forms of financial aid for activities of support to the teaching practice. The PhD candidate is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: PhDs have their own computer for individual use. They will also have access to CFDHub (www.cfdhub.polimi.it), an Interdepartmental laboratory of PoliMi, with a state-of-the-art infrastructure and scientific computing system.

Desk availability: individual assignment for the entire career.