CIVIL AND ENVIRONMENTAL ENGINEERING

DIATI – Integrated approaches for sustainable groundwater management

Funded By	Dipartimento DIATI
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Context of the research activity	Climate change leads to variations in the availability of water resources, both in quantitative and qualitative terms. This phenomenon has a significant impact on all productive sectors and civil life but is particularly critical for the agricultural sector. Changes in precipitation patterns, increased seasonal variability, and the heightened alternation between periods of water abundance and drought negatively affect agricultural production. Groundwater has historically been a high-quality water resource, less susceptible to seasonal variability compared to surface water resources. These characteristics are becoming increasingly important in the context of climate change. Controlled aquifer recharge techniques are becoming more widespread and can be an effective tool to counteract the overexploitation of groundwater resources. These approaches involve the injection or gravitational introduction of water from surface water bodies or treated wastewater to recharge a depleted aquifer.
Objectives	The proposed doctoral program aims to develop methodological and quantitative tools for a sustainable and planned use of groundwater resources within the context of climate change. In particular, the PhD candidate will focus on the development of an integrated methodology for assessing water availability, forecasting short-, medium-, and long-term challenges, and identifying and designing controlled aquifer recharge interventions. Specifically, the proposed doctoral program intends to pursue two complementary elements in parallel: (i) the development of a methodological approach and the operational tools necessary for a proper quantitative estimation of groundwater resources, analyzing medium- and long-term trends in a context of variations in precipitation, evapotranspiration, and consumption; (ii) the analysis of the impacts of controlled aquifer recharge systems (for example, through infiltration basins and injection wells) both in quantitative terms (evaluating the effectiveness of these systems in countering resource depletion) and in qualitative terms (examining issues associated with the use of treated wastewater, such as the accumulation of micropollutants in the soil, and the impact of surface waters with different

	chemistries on the chemistry of groundwater). For the second theme, the development of numerical models aimed at quantifying the phenomena analyzed is planned, in support of the design. The research topic will be addressed with particular reference to the regional context, through local case studies.

Skills and competencies for the development of the activity	The ideal candidate has knowledge of implications and applications of engineering processes; has a strong background in applied environmental engineering or in the environmental implications/applications of engineering processes and technologies, and in groundwater engineering or hydrogeology; is familiar with analytical and numerical tools for quantitative simulation of environmental processes; has good written and oral communication skills and a good knowledge of the English language; is motivated, independent, and shows the potential to develop an original research activity leading to exceptional scientific accomplishments.