

CIVIL AND ENVIRONMENTAL ENGINEERING

MUR DM 117/TELT - Link between water resource dynamics and climate change in the Alpine area

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Context of the research activity	<p>The research has the objective of evaluating the effect of climate change on water resources in the Alpine and pre-Alpine areas. The idea is to identify, through statistical analysis and rainfall runoff transformation, changes in the flow regime of mountain springs and streams and attribute them to potential human or natural forcings. The research results can improve forecasting strategies for droughts and water crises at different time scales, in current conditions and in future scenarios.</p> <p>Progetto finanziato nell'ambito del PNRR - DM 117/2023 - CUP E14D23001990004</p>
	<p>In recent years, the general concern that climate change may affect the amount of water resources seems to be confirmed by the observed phenomena. The recent drought that began in the winter of 2021-22 has shown the vulnerability of this resource, so much so that even in our region traditionally rich in water, drinking water rationing strategies had to be implemented and the irrigation sector was significantly reduced in difficulty. In periods of drought, the lack of water is initially evident in surface water bodies and subsequently in springs and aquifers, which initially can compensate for the water shortage in the surface water network, but are also a limited resource. Springs, for example, are an important source of water supply in Italy.</p> <p>Although in a strictly Alpine area the melting of glaciers, where they are present, still masks the water deficit, high temperatures and variations in the rainfall regime have led to critical situations in the Alpine area. The presence of many sources of drinking water at high altitudes requires timely and accurate analyzes to evaluate the effect of climate change on this resource. The risk of overexploitation of springs during periods of drought is high, with environmental damage that will probably take a long time to eliminate.</p>

Objectives

This research doctorate project aims to characterize the water resource in the Alpine and Pre-Alpine areas in space and time with reference to springs and surface water courses, with reference to the Italian reality of the North West. Particular attention will be paid to the Val di Susa, in which the co-financing company of the doctoral scholarship operates. It is expected that the beneficiary doctoral student will spend 6 months in the company and 6 months abroad in a university or research institute.

The main activities planned for the PhD student are listed below:

- Analysis of the scientific literature on the topic in question to understand the existing problems, learn about the approaches developed, examine the modeling choices, compare the results obtained in the literature in order to make the most appropriate modeling choices
- Retrieval of climatic and hydrological data made available by the company as well as data available in other hot-spots in the Piedmontese Alps
- Statistical analysis of flow data (watercourses and springs) available on various sites in Piedmont, with particular attention to the Val di Susa, in order to identify the dynamics of hydrological regimes
- Analysis of the link between flows and precipitation indices (liquid and snow) and temperature in order to understand which climatic and/or anthropic forcings most influence the flows of springs and watercourses and to identify and attribute any trends of the historical series
- Analysis of the link between flow rates/climate indices and chemical-physical parameters monitored in watercourses and springs in order to understand if and how flow variations are linked to these parameters
- Identification at single event scale of the precipitation-flow relationship of springs and streams through different conceptual modeling approaches for the characterization of the inflow-outflow transfer functions
- Analysis of the inflow-outflow transfer functions obtained on the individual events for their possible seasonal characterization and/or to identify the presence of a possible change over time due to climatic and/or anthropic factors
- Evaluation of the possible future impact of climate change on the flow regime (watercourses and springs) using reference climate scenarios.

The following results are expected to be obtained through the proposed research activity:

- Updating knowledge on the topic, examining the problems and approaches adopted for the solution as well as the results achieved in similar situations, if any
- Knowledge and development of procedures for time series processing with particular regard to monitoring network data management (possible data errors, missing data etc...)
- Overview of the spatio-temporal trends of the hydrological regimes in some hot-spots of the Alpine-Pre-Alpine arc of the North West, with particular reference to the Val di Susa
- Development of conceptual inflow-outflow models with different approaches useful for diagnosing anomalies due to hydrological and/or anthropic forcings on the hydrological regime of springs and streams
- Estimates of the hydrological regime of the flows of springs and streams for different future scenarios.

The topic addressed in this research is expected to significantly improve our understanding of the causes and extent of change in Alpine water resources, in line with one of the activities of Mission 2 of the Recovery and Resilience Plan (PNRR): Green Revolution and ecological transition.

Skills and competencies for the development of the activity

It is expected that the PhD student will spend part of their research time abroad. A good knowledge of the English language is therefore mandatory. Programming skills are required. Experience in issues related to hydrology, hydrogeology and climatology are desirable but not mandatory, as is experience in using hydrological rainfall-runoff models.