POLITECNICO DI MILANO

PhD in SCIENCE, TECHNOLOGY AND POLICY FOR SUSTAINABLE CHANGE - 41st cycle

THEMATIC Research Field: FROM RISK TO ACTION: OPERATIONALIZING CLIMATE TIPPING POINTS WITH AI FOR ADAPTATION PLANNING

Monthly net income of PhDscholarship (max 36 months)
1600.0 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	Climate tipping points represent critical thresholds in the Earth system whose crossing can trigger abrupt and potentially irreversible changes, with cascading impacts on societies and ecosystems. Traditional risk assessment methods struggle to capture such nonlinear dynamics, particularly under extremes like droughts and heatwaves.This PhD project leverages artificial intelligence (AI) and machine learning (ML) to advance understanding of climate risks under tipping scenarios. The objectives are to: •Analyze how extreme events evolve and propagate when global (e.g., ice sheets, monsoons) and regional (e.g., glacier retreat) tipping elements are crossed. •Develop data-driven and hybrid models to assess cascading impacts on water resources, natural hazards, and sectoral vulnerabilities (agriculture, ecosystems, hydropower, navigation). •Provide actionable insights to support adaptation strategies and robust decision-making under deep uncertainty By integrating AI/ML with climate and socio-environmental analysis, the project aims to deliver innovative tools for anticipating and managing risks in a changing climate.
Methods and techniques that will be	

developed and used to carry out the research	The project will integrate artificial intelligence and machine learning techniques, including hybrid and physics-informed models, to analyze climate risks and cascading impacts under tipping point scenarios. Climate and socio-economic datasets will be coupled with causal inference and network analysis methods to explore feedbacks and interdependencies across sectors. High-performance computing resources will support the processing of large-scale data and simulations. The PhD, funded by the **Euro-Mediterranean Center on Climate Change (CMCC)** within the **Technologies for Climate Transition (TCT)** Division, will involve close collaboration with the **Unit E.1 Disaster Risk Management** at the **European Joint Research Centre (JRC), Ispra** (Dr. Andrea Toreti), providing access to unique datasets and expertise on climate extremes.
Educational objectives	The doctoral program offers advanced training organized in three pillars: •Basic Research, which includes methodological courses related to key aspects of theoretical and applied research in science, policy, and technology of sustainable change; •Specific Research, designed to strengthen candidates' knowledge on specific topics aligned with their research interests and increase their presence in the international scientific community through participation in conferences and presentation of their scientific work in academic contexts. •Development of the Doctoral Thesis, which allows candidates to develop leading-edge research competencies and produce original scientific work on a topic that contributes to scientific debate and has societal impacts A period of study in worldwide most recognized research institutions is supported by the doctoral school and the supervisor

Job opportunities	The PhD graduates will be equipped with distinctive skills and advanced trans-disciplinary knowledge that open up career opportunities as analysts, researchers, or planners at universities, international research centers, public and international institutions, R&D departments, regulatory authorities, policy institutions, and other public bodies.
Composition of the research group	1 Full Professors 1 Associated Professors 4 Assistant Professors 10 PhD Students
Name of the research directors	Matteo Giuliani / Andrea Castelletti

Contacts

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Additional support - Financial aid per PhD student per year (gross amount)

Housing - Foreign Students

1st year	2nd year	3rd year
2500.0 € per student	2500.0 € per student	2500.0 € per student

max number of financial aid available: 1, given in order of merit ..

Housing - Out-of-town residents

1st year	2nd year	3rd year
2500.0 € per student	2500.0 € per student	2500.0 € per student

max number of financial aid available: 1, given in order of merit ..

Scholarship Increase for a period abroad	
Amount monthly	800.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

EDUCATIONAL ACTIVITY:
The PhD programme includes a structured training plan with advanced courses, seminars, and workshops covering core and transversal research skills. Each PhD candidate is provided with an individual budget to support participation in international conferences, summer schools, and research exchange programmes. Additional support for these activities can also be provided through the research group’s funds.

TEACHING ASSISTANTSHIP:
PhD candidates will have the opportunity to contribute to the teaching activities of the research group, with a maximum of 40 paid hours per year for teaching assistantship. Additional paid opportunities for tutoring and support to students enrolled in the courses offered by the group are also available.

COMPUTER AVAILABILITY:
A personal laptop will be provided for the entire duration of the PhD programme. High-performance computing (HPC) facilities are available both within the department and through external partners. Campus-wide software licenses for major applications are freely accessible.

DESK AVAILABILITY:
A dedicated desk equipped with a 27-inch monitor is provided in the laboratory for the entire duration of the programme.