Sustainable Water Management Doctoral Programme (Water4All)

Title of the PhD Project	Artificial Intelligence and remote sensing to support hydrological process understanding under climatic change
Acronym	HYDROCLIM-AI
Research Fields of the Project	Hydrology and Water Resources, Artificial Intelligence, Remote Sensing, Data Science, Hydrological Models, Climate Science
Keywords	Water Resources, hydrological modeling, Artificial Intelligence, Remote Sensing, climate change
Host Institution, Department and Campus Location	Middle East Technical University, Geological Engineering Department, Ankara
PhD Awarding Institution and Graduate Programme	Middle East Technical University, Engineering Faculty/Graduate School of Applied and Natural Sciences
Name and Affiliation of Main Supervisor	Assoc. Dr. Koray K. Yilmaz, Geological Engineering Department, Middle East Technical University
Name and Affiliation of Co-Supervisors	Prof. Dr. Alper Baba, Civil Engineering Department, İzmir Institute of Technology Prof. Dr. İsmail Yücel, Civil Engineering Department, Middle East Technical University
Research Environment and Infrastructure	PhD candidate will have access to the research infrastructure available at Middle East Technical University, including access to high performance computing systems (e.g. ULAKBIM).

Scientific Context of the Project	New research indicates that Artificial Intelligence (AI; e.g. deep learning) models surpass process-based models in hydrologic prediction and forecasting. However, there remains uncertainty regarding their capability to project hydrologic response under climate change, for which extrapolation beyond the historical climate range is necessary. This project will investigate alternative modeling setups involving AI-based hydrologic models, process-based hydrologic models and hybrid models to benchmark physical consistency and reliability of hydrologic projections obtained by alternative modeling techniques. Models will be trained to a large number of basins with diverse hydroclimatic conditions, supported by in-situ and remotely sensed datasets in an effort to increase information content and to make sure AI-models learn fundamental hydrological processes from the data. The project findings will ultimately help to better understand the utility and limitations of Artificial Intelligence models in hydrological applications under climate change.
Brief Workplan	The main aim of this thesis is to develop novel AI-based hydrologic models and benchmark their performance with process-based hydrological models under selected climate change scenario(s). The tentative yearly workplan is presented below: • Comprehensive literature review and training in Artificial Intelligence models and process-based hydrological models, performing simple case studies with literature data • In-situ and remotely-sensed data collection and management, Training alternative AI-based hydrologic models and calibrating process-based hydrologic models. • Developing novel AI-based and/or hybrid models and benchmarking predictions compared to process-based hydrologic models. • Utilize tools to facilitate interpretability and explainability of AI-based models. • Documentation and reporting to compile research findings into a comprehensive report. Prepare presentations for scientific conferences, workshops, and stakeholder meetings. Disseminate results through various channels, including academic publications, stakeholder meetings and public outreach.

Innovative Aspects of the Project	Through integrating Artificial Intelligence (data-based), Hydrological Modeling (process-based) and climate change science, this project will help to improve hydrologic projections for use in risk management and water management.
Training Opportunities of the Project	The selected candidate will be offered opportunities for training about hydrological modeling, Artificial Intelligence Models and/or climate modeling in important operational research centers. The supervisory team and student will discuss and form a training plan at the start of the PhD, considering both personal interests and scientific needs.
Interdisciplinary Aspects	The topic of the project is directly relevant with climate science, data science, hydrology and water resources, policy and governance, hydrologic risk and sustainability studies.
Intersectoral Mobility **☐ Short Visit** **☐ Secondment**	TBD
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International Academic Secondment	TBD

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Main Supervisor	
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Co-supervisors	
Brief CV	**Prof. Dr. Alper BABA** **E-mail:** alperbaba@iyte.edu.tr **Academic Degrees** Ph.D. Hydrogeology, Dokuz Eylül University, Türkiye 2000 M.Sc. Geological Engineering, Dokuz Eylül University, Türkiye 1995 B.Sc. Geological Engineering, Dokuz Eylül University, Türkiye 1992 **Professional Networks** Google Scholar: https://scholar.google.com.tr/citations?user=QVgCMkEAAAAJ&hl=en ResearchGate:

	https://www.researchgate.net/profile/Alper-Baba Scopus: https://www.scopus.com/authid/detail.uri?authorId=7201982375 ORCID: https://orcid.org/0000-0001-5307-3156
Brief CV	**Prof. Dr. İsmail YÜCEL** **E-mail:** iyucel@metu.edu.tr **Academic Degrees** Ph.D. Hydrology, The University of Arizona, USA 2001 M.Sc. Hydrology, The University of Arizona, USA 1996 B.Sc. Meteorological Engineering, İstanbul Technical University, Türkiye 1993 **Professional Networks** Google Scholar: https://scholar.google.com/citations?user=RGHnl3YAAAAJ ResearchGate: https://www.researchgate.net/profile/Ismail-Yucel-2 Scopus: https://www.scopus.com/authid/detail.uri?authorId=57204345432 ORCID: https://orcid.org/0000-0001-9073-9324