

**Sustainable Water Management  
Doctoral Programme (Water4All)**



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<b>Title of the PhD Project</b>	Improved hydrometeorological extreme prediction using remote sensing and artificial intelligence to better understand climate change
<b>Acronym</b>	HYDMETPRD
<b>Research Fields of the Project</b>	Atmospheric science, hydrometeorology, hydrology, computing science that focuses on machine learning and artificial intelligence
<b>Keywords</b>	WRF, WRF-Hydro, climate change, extreme weather and climate, AI
<b>Host Institution, Department and Campus Location</b>	Middle East Technical University, Civil Engineering Department, Ankara
<b>PhD Awarding Institution and Graduate Programme</b>	Middle East Technical University, Engineering Faculty/Graduate School of Applied and Natural Sciences
<b>Name and Affiliation of Main Supervisor</b>	Prof. Dr. İsmail Yücel, Civil Engineering Department, Middle East Technical University
<b>Name and Affiliation of Co-Supervisors</b>	Prof. Dr. Orhan Gündüz, Environmental Engineering, Izmir Institute of Technology Prof. Dr. M. Tuğrul Yılmaz, Civil Engineering Department, Middle East Technical University
<b>Research Environment and Infrastructure</b>	PhD candidate will have access to the research infrastructure available at Middle East Technical University and Water Resources Laboratory. When a specific high computing system is needed, other national high computing system (e.g. Ulakbim) will also be contacted.
<b>Scientific Context of the Project</b>	Climatic changes exacerbates the duration, intensity and frequency of extreme events which adversely impact different socio-economic sectors worldwide. As weather conditions change and intensify, they become even harder to forecast. There is a



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	<p>particular need for critical assessment in improving the prediction system for these hydrometeorological extremes.</p> <p>Artificial Intelligence (AI) together with remote sensing can help predict extreme weather in the era of climate change. Some of the most promising approaches come from blending AI with existing scientific knowledge based on physics-based forecasts from numerical weather prediction models. AI identifies the patterns in massive amounts of data provided from physics-based WRF simulations and plugging AI components into existing physics-based model (WRF) extreme forecast simulations for improved predictions. This study will also implement improved WRF extreme weather predictions into a WRF-Hydro model to forecast flood discharges in hydrological catchments at high spatial resolution.</p>
<p><b>Brief Workplan</b></p>	<p>Detailed and up to date literature review in the use of AI together with numerical weather prediction models (WRF).</p> <p>Investigate appropriate AI or machine learning (ML) methods for extreme weather cases</p> <p>Setup/configure and train the AI algorithm based on available WRF high resolution simulations and observations</p> <p>Identify extreme weather conditions and setup WRF model for these events.</p> <p>Apply trained AI algorithm for extreme WRF simulations to obtain improved forecasts.</p> <p>Setup coupled WRF with WRF-Hydro for flood discharge estimations.</p>
<p><b>Innovative Aspects of the Project</b></p>	<p>Blending AI and remote sensing data (e.g. sea surface temperature) with numerical weather prediction models can improve the prediction of extreme weather in the era of climate change.</p>
<p><b>Training Opportunities of the Project</b></p>	<p>The project can provide opportunities for training in the hybrid utilization of AI and physics-based numerical weather prediction models for short-term extreme weather forecasts in important operational research centers.</p>



<b>Interdisciplinary Aspects</b>	This research will gain benefit from interdisciplinary work of atmospheric science, computing science, and hydrology.
<b>Intersectoral Mobility</b> <input type="checkbox"/> Short Visit <input type="checkbox"/> Secondment	TBD
<b>Intersectoral Mobility</b> <input type="checkbox"/> Short Visit <input type="checkbox"/> Secondment	TBD
<b>International Academic Secondment</b>	TBD

Main Supervisor										
<b>Brief CV</b>	<p><b>Prof. Dr. İsmail YÜCEL</b></p> <p>E-mail: <a href="mailto:iyucel@metu.edu.tr">iyucel@metu.edu.tr</a></p> <p><b>Academic Degrees</b></p> <table><tr><td>Ph.D.</td><td>Hydrology, The University of Arizona, USA</td><td>2001</td></tr><tr><td>M.Sc.</td><td>Hydrology, The University of Arizona, USA</td><td>1996</td></tr><tr><td>B.Sc.</td><td>Meteorological Engineering, İstanbul Technical University, Türkiye</td><td>1993</td></tr></table> <p><b>Professional Networks</b></p> <p>Google Scholar:</p>	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
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	<p><a href="https://scholar.google.com/citations?user=RGHnI3YAAAAJ">https://scholar.google.com/citations?user=RGHnI3YAAAAJ</a></p> <p>ResearchGate:</p> <p><a href="https://www.researchgate.net/profile/Ismail-Yucel-2">https://www.researchgate.net/profile/Ismail-Yucel-2</a></p> <p>Scopus:</p> <p><a href="https://www.scopus.com/authid/detail.uri?authorId=57204345432">https://www.scopus.com/authid/detail.uri?authorId=57204345432</a></p> <p>ORCID:</p> <p><a href="https://orcid.org/0000-0001-9073-9324">https://orcid.org/0000-0001-9073-9324</a></p>												
<b>Co-supervisors</b>													
<b>Brief CV</b>	<p><b>Prof. Dr. Orhan GÜNDÜZ</b></p> <p>E-mail: <a href="mailto:orhangunduz@iyte.edu.tr">orhangunduz@iyte.edu.tr</a></p> <p><b>Academic Degrees</b></p> <table><tr><td>Ph.D.</td><td>Environmental Engineering, Georgia Institute of Technology, USA</td><td>2004</td></tr><tr><td>M.Sc.</td><td>Civil Engineering, Georgia Institute of Technology, USA</td><td>2000</td></tr><tr><td>M.Sc.</td><td>Environmental Engineering, Middle East Technical University, Türkiye</td><td>1997</td></tr><tr><td>B.Sc.</td><td>Environmental Engineering, Middle East Technical University, Türkiye</td><td>1994</td></tr></table> <p><b>Professional Networks</b></p> <p>Google Scholar:</p> <p><a href="https://scholar.google.com/citations?user=zmIGAlSAAAAJ&amp;hl=en">https://scholar.google.com/citations?user=zmIGAlSAAAAJ&amp;hl=en</a></p> <p>ResearchGate:</p> <p><a href="https://www.researchgate.net/profile/Orhan-Gunduz">https://www.researchgate.net/profile/Orhan-Gunduz</a></p> <p>Scopus:</p> <p><a href="https://www.scopus.com/authid/detail.uri?authorId=9743239900">https://www.scopus.com/authid/detail.uri?authorId=9743239900</a></p> <p>ORCID:</p> <p><a href="https://orcid.org/0000-0001-6302-0277">https://orcid.org/0000-0001-6302-0277</a></p>	Ph.D.	Environmental Engineering, Georgia Institute of Technology, USA	2004	M.Sc.	Civil Engineering, Georgia Institute of Technology, USA	2000	M.Sc.	Environmental Engineering, Middle East Technical University, Türkiye	1997	B.Sc.	Environmental Engineering, Middle East Technical University, Türkiye	1994
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<b>Brief CV</b>	<p><b>Prof. Dr. M. Tuğrul YILMAZ</b></p> <p>E-mail: <a href="mailto:tuyilmaz@metu.edu.tr">tuyilmaz@metu.edu.tr</a></p> <p><b>Academic Degrees</b></p>												



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<b>Professional Networks</b>		
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