Sustainable Water Management

Doctoral Programme (Water4All)

Title of the PhD Project	Integrating remotely sensed soil moisture measurements in quantifying large scale groundwater storage estimations
Acronym	SM2GW
Research Fields of the Project	Remote sensing, Soil moisture prediction, Groundwater storage, Environmental modeling
Keywords	Remotely-sensed data, Soil moisture, Groundwater, Recharge, Mathematical modeling
Host Institution, Department and Campus Location	Izmir Institute of Technology Department of Environmental Engineering Gülbahçe Campus, İzmir, Türkiye
PhD Awarding Institution and Graduate Programme	Izmir Institute of Technology Graduate School PhD in Environmental Engineering
Name and Affiliation of Main Supervisor	Prof. Dr. Orhan GÜNDÜZ Izmir Institute of Technology Department of Environmental Engineering and Department of International Water Resources
Name and Affiliation of Co-Supervisors	Prof. Dr. İsmail YÜCEL, Middle East Technical University Prof. Dr. Alper BABA, Izmir Institute of Technology
Research Environment and Infrastructure	The selected candidate will have access to the research infrastructure available at Izmir Institute of Technology.
Scientific Context of the Project	Soil moisture is a key parameter taking part in hydrologic processes. It acts as the link between overland flow and groundwater flow processes. In-situ measurement of soil moisture had challenges some of which are overcome by remote sensing techniques. Today, remotely sensed soil moisture can be accurately determined at high spatio-temporal resolutions. The movement of soil moisture along the unsaturated zone is governed by the Richards law, which is a highly nonlinear equation that necessitates significant inputs along the vertical soil domain. Modeling soil moisture movement in the root zone is critical for determining the infiltration amounts to the groundwater domain. Accurate simulation of vertical movement of soil moisture can be used to determine the spatial and temporal variations of groundwater recharge.

Sustainable Water Management

Doctoral Programme (Water4All)

Brief Workplan	The main aim of this research is to develop a physics-based model to estimate spatio-temporal variations of groundwater recharge by using soil moisture movement along the vertical domain. The calculated recharge values can then be used in accurate modeling of large scale groundwater flow. A tentative work plan is given as follows: 1. Collection of soil moisture data (in-situ and remotely-based techniques) 2. Formulation of a mathematical model to simulate soil moisture movement in the root zone 3. Calculation of groundwater recharge and assessment of groundwater storage
Innovative Aspects of the Project	Remote sensing of soil moisture and challenges in its data collection, solution of a highly non-linear system under extreme boundary conditions, numerical challenges of discontinuity, physics-based analysis of groundwater recharge over large spatio-temporal domains
Training Opportunities of the Project	The doctoral candidate will have a chance for training on subjects such as remote sensing, field applications and hydrological modeling in renown government and private organizations as well as academic institutions. The training program will be custom designed for the selected candidate according to his/her needs and interests.
Interdisciplinary Aspects	This research involves various distinct aspects of hydrology and climate science including but not limited to remote sensing, mathematical modeling and numerical analysis within the scope of civil, environmental, geological and meteorological engineering.
Intersectoral Mobility **☒ Short Visit** **☒ Secondment**	State Hydraulic Works
Intersectoral Mobility **☒ Short Visit** **☐Secondment**	Izmir Water and Sewerage Administration
International Academic Secondment	Villanova University

Sustainable Water Management

Doctoral Programme (Water4All)

Main Supervisor	
Brief CV	**Prof. Dr. Orhan GÜNDÜZ** **E-mail:** orhangunduz@iyte.edu.tr **Academic Degrees** 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 **Professional Networks** Google Scholar: https://scholar.google.com/citations?user=zmIGAlsAAAAJ&hl=en ResearchGate: https://www.researchgate.net/profile/Orhan-Gunduz Scopus: https://www.scopus.com/authid/detail.uri?authorId=9743239900 ORCID: https://orcid.org/0000-0001-6302-0277
Co-supervisors	
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
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