







# Data-Driven Hydrology: Interpolating Groundwater Data Using Machine Learning Techniques to Understand Groundwater Dynamics at Regional Scale

Workshop on Machine Learning for data-driven groundwater modeling

# Nov 19, 2024 at ZALF, House 45, Eberswalder Str. 84, 15374 Müncheberg

Time duration: One day (9:00 – 16:00)

Format: On-site

Chair: Prof. Dr. Claas Nendel, Leibniz Centre for Agricultural Landscape Research (ZALF)

**Presenter:** Dr. Ahsan Raza, Leibniz Centre for Agricultural Landscape Research (ZALF)

Keynote speaker: Prof. Dr. Andreas Güntner (Chair of Hydrogravimetry at Potsdam University)

## Background

Künstliche Intelligenz Kompetenz in der Landwirtschaft (KIKompAg) is a multi-disciplinary project that aims to coordinate and advance the concept for the integration of multisource data, artificial intelligence (AI) and various simulation methods for the cross-scale monitoring of agricultural systems. One of the primary foci is on how machine learning applications can be used to improve our understanding of groundwater dynamics at different scales.

Machine Learning (ML) techniques have widely been used recently in agroecosystem problems. Scientists use these techniques for weed detection, disease control, yield prediction, and climate change impact analysis. However, ML techniques have also great potential to unravel large-scale groundwater supply to crops. In this context, the use of ML involves leveraging advanced algorithms and data analytics to understand and predict the behavior of groundwater systems. By integrating diverse datasets, including satellite observations, in-situ ground observations, and climate data, machine learning helps in creating comprehensive models that provide insights into groundwater dynamics.

#### Scope

The workshop is designed for researchers in agro-hydrological studies and practitioners who are interested in gaining a **practical introduction** to Machine Learning and exploring its **potential applications** in groundwater modeling. In the workshop, **theoretical content** will be taught and then implemented using practical examples.

The specific aims are to advance the first two protocol-based studies of KIKompAg, which focus on **(1)** the downscaling of GRACE-derived GWSA to 1 km<sup>2</sup> using the ML approach and identifying the anomaly trends and **(2)** the reconstruction of high-resolution groundwater data at 1 km<sup>2</sup> spatial resolution using different ML methods and their inter-comparison.

We will examine the use of time series data and conduct several hands-on sessions where participants will have the opportunity to test the developed processing models.







## Our learning content:

- 1. Machine Learning overview with R
- 2. Preprocessing of data
- 3. Process monitoring and optimization
- 4. Performance evaluation of machine learning models
- 5. Practice-oriented & application-related hands-on

## Tentative Plan

Activity	Presenter	Time
Welcome and opening remarks (Introduction of KIKompAG project)	Prof. Dr. Claas Nendel	9:00 - 9:30
Presentation: Overview of progress of groundwater modeling with machine learning (Introduction of methods and data)	Dr. Ahsan Raza	9:30 - 10:15
Presentation: Groundwater storage variations from GRACE/GRACE-FO satellite data	Prof. Dr. Andreas Güntner	10:15 - 10:45
Coffee break		10:45 - 11:00
Hands-on: Downscaling of GRACE-derived GWSA	Dr. Ahsan Raza	11-00 - 12:15
Lunch		12:15- 13:15
Presentation: Filling the temporal and spatial gaps in groundwater level data	Dr. Ahsan Raza	13:15-13:45
Coffee break		13:45 - 14:00
Hands-on: Reconstructing high-resolution groundwater level data	Dr. Ahsan Raza	14:00 - 15:15
Final discussion	Dr. Gohar Ghazaryan, Dr. Ahsan Raza	15:15 - 15:45
End of the workshop (Group Photo)		15:45 - 16:00

Registration: https://forms.office.com/r/6865c8itR8

**Deadline:** October 15<sup>th</sup>, 2024

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