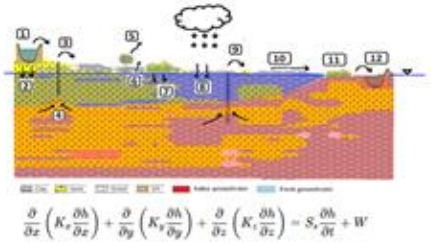
University of Stuttgart
Germany

Department for Stochastic Simulation
and Safety Research for Hydrosystems (LS³)

Deep Learning of Trend Function in Non-Stationary Groundwater Process.



$$\frac{\partial}{\partial x}\left(K_x\frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(K_y\frac{\partial h}{\partial y}\right)+\frac{\partial}{\partial z}\left(K_z\frac{\partial h}{\partial z}\right)=S_s\frac{\partial h}{\partial t}+W$$

M.Sc. Topic

Groundwater levels can be seen as a large-scale trend, superimposed with local variations around the trend. Knowing the large-scale trend may form a firm basis for refinement with geostatistical approaches. Geostatistical methods often assume so-called stationarity: that the statistics (like mean, variance, and spatial correlation) of groundwater levels are invariant under translation in the space-time domain. Currently, handling trends in geostatistics is only possible with linear, regression-like methods. However, for groundwater applications, the large-scale trend can be a complex, non-linear function due to spatially varying recharge or pumping management regimes, boundary conditions, geological trends, and the nonlinear dependence of heads on hydraulic conductivities.

In such non-linear settings, existing geostatistical methods fail to produce good maps of groundwater levels. Therefore, we want to extend geostatistical methods. The trend ansatz must become nonlinear and should exploit available satellite data or auxiliary information on land use, recharge, boundary conditions, and so forth. We propose this Master thesis topic to formulate an approach that combines different approaches from deep learning with geostatistical interpolation to estimate groundwater levels under nonstationary and non-linear conditions.

Prospective Tasks

- Literature review for exploring different approaches.
- Formulate a deep learning approach for the large-scale trend.
- Write a code (e.g. in Python).
- Design and simulate different scenarios for testing and validation.
- Visualization of results and discussion.

General Information

- Advisors: Waqas Ahmed (Stuttgart), Prof. Wolfgang Nowak (Stuttgart)

Desirable Skills

- Python (or comparable), MODFLOW, computer programming
- Hydro(geo)logy, Groundwater Modelling, (geo)Statistics, Machine learning

Apply now!

waqas.ahmed@iws.uni-stuttgart.de