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GROUNDWATER CONTAMINANT SOURCE CHARACTERIZATION THROUGH ARTIFICIAL NEURAL NETWORKS

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Abstract

Water plays a crucial role in human life and in all its activities. For this reason, all water resources and in particular groundwater should be managed in a sustainable way in order to satisfy current needs and without causing environmental consequences. Unfortunately, economies based on intensive agriculture and industrial production lead to unsustainable use of water, the effect of which also includes the contamination of aquifers. In this context, the identification of the location of the contaminant source with its release history has attracted great attention within the scientific community called upon to provide theoretical methods to limit the spread of the contaminant. To identify remediation strategies immediately is essential to have a tool that can provide accurate results in real time. With this aim, surrogate models can become the conceptual models of primary choice being able to study forward and inverse transport problem using a number of observations, which is not much greater than the unknown parameters to be calculated, reducing in this way the computational cost compared with other more complex models. Data-driven surrogate models lead to the field of Artificial Intelligence where neural networks, trained on a finite dataset, are able to estimate the desired output by means of a learning process emulating the behavior of the human brain.

In this work, a feedforward artificial neural network (FFWD-ANN) has been developed to analyze different cases as surrogate model. The investigated domain has been selected from a literature study (Ayvaz, 2010) and the training dataset has been randomly developed by means of the Latin Hypercube Sampling in order to reduce the number of forward simulations. Initially, the network has been trained to solve forward transport problem. In the proposed approach, the ANN well estimates the pollutant concentrations in 7 monitoring wells, at different times, by using as input data the release history at two contaminant sources with known locations. Then, the surrogate model has been trained to deal with inverse transport problem related to different application cases: 1. estimation of the release history at one contaminant source with known location; 2. simultaneous estimation of the release history and location of one contaminant source; 3. estimation of the release history at two contaminant sources with known location; 4. simultaneous estimation of the release history at two contaminant sources with known location and error on observations.

The results have been compared with literature data (Ayvaz, 2010; Jamshidi et al. 2020). Artificial Neural Network seems to be well suited to dealing with this type of forward and inverse problems, preserving the reliability of the results and reducing the computational burden of numerical models.

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This book contains the abstracts and extended abstracts submitted to the conference and focusing on geostatistics applied to different fields such as: ecology, natural resources, environmental pollution and risk assessment, forestry, agriculture, geostatistical theory and new methodologies, health, epidemiology, ecotoxicology, inverse modeling, multiple point geostatistics, remote sensing, soil applications, spatio-temporal processes and surface and subsurface hydrology.

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