**Cite this article**
Paleologos EK (2025)
Editorial: Collaborative research in a fast-changing global environment.
*Environmental Geotechnics* **12(1)**: 1–3,
https://doi.org/10.1680/jenge.2025.12.1.1

**Editorial**



**Environmental Geotechnics**

# Editorial: Collaborative research in a fast-changing global environment

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The present editorial of the journal *Environmental Geotechnics* inaugurates a new era in the journal's editorials, envisioned by the editor, *Dr. Devendra Narain Singh*, where apart from synthesising the research contained in a themed issue, editorials would converse with new researchers, who are embarking in their journey in science, and provide glimpses of the professional life and experiences of more mature researchers. As the author of the first editorial of this type I would like to extend my gratitude to *Dr. Singh* for entrusting me with this task.

The current issue of the journal illustrates succinctly modern trends in geotechnical research, where engineering applications are interwoven with environmental concerns and geotechnical studies are expanded to include knowledge from other disciplines, which in this case, include hydrology, contaminant transport in porous media and marine sediments, and chemical, as well as biological studies of sediment and municipal waste.

The first article entitled *"Mechanical damage of geotextiles induced by recycled construction and demolition waste"* explores circular economy's objective to reuse and recycle construction and demolition waste (CDW) in geotechnical applications. Such applications include, among others, new structures, earth walls and embankments, and transportation infrastructure. The need to recycle and reuse CDW is illustrated by the sheer quantity of CDW generated, which in the United States is double the amount of municipal solid waste (EPA, 2024), in Europe, constituting more than one-third of all the waste and half of its extracted material (European Commission, 2025), and in China, where CDW is disposed unsegregated in landfills and being recycled by only 5%–10%, expected to reach more than 2 billion tonnes (AECOM Asia Company, 2018). Thus, with cities' aging building stock and end-of-life infrastructure, reuse and recycling of CDW as means to save natural resources and free up landfill space has become a global priority.

Two of the papers, *"Analytical solutions for transport of organic solutes in multi-layered porous media,"* and *"The role of hydraulic and thermal properties of soil in evaporation: a numerical insight"* have their foundation on research literature from the discipline of hydrology with investigations related to geotechnical applications. Thus, the interest in the first article lies in the transport of organic contaminants contained in landfill leachate, which can migrate through a landfill's clay liner and pollute the soil. The other article investigates the effect of soil–atmosphere's interaction and of evaporation on slope stability, pollution containment and remediation, and soil heave/shrinkage. These two articles with the bibliography on their subject matter illustrate both the intersection of multiple scientific fields, which in this case include soil science, saturated and unsaturated hydrogeology, engineering geology, atmospheric science, and geomechanics, as well as the wealth of accumulated knowledge that can be found in neighboring scientific fields, which can be utilized in geotechnical studies.

Thus, what stands out is that in the presence of complex problems new researchers in the area of environmental geotechnics need, foremost, to equip themselves with solid analytical, numerical, and laboratory and field experimental skills. These tools would allow them to transcend narrow, early-career research directions and expand their investigations to more complex problems, which require knowledge from related scientific areas. Especially nowadays, with the fast global transition taking place, issues of climate change, sustainability, and clean energy sources have been placed at the forefront, transforming the type of problems we are called upon to address, relative to more traditional issues that had dominated civil engineering until very recently. There is a significant role that the civil engineering profession can play in all of the above, which is not widely understood, on topics such as, the mechanical and geochemical properties of geologic formations where carbon dioxide or hydrogen can be stored, hydrologic and

environmental assessments of new mining sites, needed for the extraction of the critical minerals that are required for the global transition towards cleaner forms of energy, the design of more secure ponds and dams for mining tailings waste, to mention a few of the emerging and pressing world problems.

Such transition of research interests over the years is illustrative of the career of many researchers. In the case of this associate editor, doctoral studies (1986–1992) focused on groundwater hydrology, with minor in mathematics, at the department of Hydrology and Water Resources (now renamed as department of Hydrology & Atmospheric Sciences) at the University of Arizona, Tucson, Az. The department is a global leader in water science research with many faculty being then and now members of the U.S. National Academy of Engineering. Prominent among them was my advisor, *Dr. Shlomo P. Neuman*, one of the leading groundwater hydrologists of the 20th century, member of the U.S. National Academy of Engineering, who has received all major awards for his seminal work in the field (The International Association of Hydrogeologists, 2025; Neuman, 2007). He was the one that all of us aspired to become and instilled in us the standards of excellence to pursue in our work. My doctoral work developed the first theoretical solution in the literature for the effective hydraulic conductivity in bounded domains using the stochastic framework in the flow of water in heterogenous porous media (Paleologos *et al*., 1996; Neuman *et al*., 1993).

There has been an extremely rich body of work developed in stochastic groundwater hydrology to address saturated and unsaturated flow problems and contaminant transport in heterogenous media, not well known or utilized by several engineering disciplines (including geotechnical engineering) to deal with related problems. I would like to highlight the extensive body of work by *Dr. T.-C. Jim Yeh* (e.g. Yeh and Liu, 2000), a professor of mine at the University of Arizona, whose research can inform aspects, such as those by the paper in this journal's issue on the transport of contaminants in porous media.

While my focus in groundwater hydrology continued over more than 20 years with several students of mine having produced interesting work in saturated and unsaturated flow problems (for example Sarris and Paleologos, 2004; Avanidou and Paleologos, 2002; Papapetridis and Paleologos, 2011), I started exploring also other research directions. These included Bayesian probabilistic theory (Lerche and Paleologos, 2001), while being a faculty at the University of South Carolina, U.S.A (1995–2007), and later on geoenvironmental problems, while in the United Arab Emirates (Mohamed and Paleologos, 2017; Paleologos and Mohamed, 2024). A special tribute goes to the late *Dr. Lucien Duckstein*, professor of mine at the University of Arizona, who has been a major contributor to multi-objective analysis, Bayesian decision theory, and fuzzy logick with applications to hydrology and water resources. A book on his life, "*Lucien's Story: A Memoir*," was published in 1996 by Marlboro Press. The power of Bayesian theory as an extremely rich framework to analyse a large class of problems can be seen in *E.T. Jayes* writings and book "*Probability Theory: The Logick of Science*". Jaynes' work can be illuminating and capable of opening new research paths to scientists.

The path to expand to research directions, not traditionally considered as part of civil engineering, and to interact with researchers from allied scientific fields is evident also in the last three papers of this issue. The articles *"Real-time monitoring of pH and dissolved oxygen during disturbances in polluted sediments"* and *"Characterisation, remediation and valorisation of contaminated sediments: a critical review"* exemplify the illumination of issues related to polluted marine sediments through the scientific input from environmental geology, geochemistry, sedimentology, soil science, and geography. The former discusses tools for assessing the risk of polluted sediments migrating in the water column during dredging operations, whereas the latter provides a comprehensive review of solutions for the remediation and reuse of contaminated sediment that include innovative techniques of chemo-mechanical treatment. Finally, the article *"Environmental impacts of landfills: perspectives on bio-monitoring,"* presents part of the extensive research work at the Warsaw University Life Sciences, SGGW, Warsaw, Poland, where plant biology illuminates, the much-needed understanding of the broader impact of landfills, not limited to pollution of air, soil, and water, but extending to the modification of an area's vegetated landscape.

In conclusion, the complex nature of current environmental and geotechnical problems, where physical, chemical, and biological processes interact and provide feedback to each other requires input from a broad range of scientific disciplines in order to reach an understanding and to develop solutions. Although expanding to knowledge from other sciences can appear daunting, it can prove to be extremely rewarding at a personal level, and also lead to international recognition, as was the case in the collaboration of many of the researchers of the above articles in the publication that received the *2023 Environmental Geotechnics Award* by ICE (Roque *et al*., 2022).

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