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Porous media as a canvas for hydro-bio-geo-chemical processes: Facing the challenges

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The more we study flow and transport processes in porous media, the larger the number of questions that arise. Heterogeneity, uncertainty, multidisciplinarity, and interdisciplinarity are key words that make our live as researchers miserable... and interesting. There are many ways of facing complexity; this is equivalent as deciding what colors and textures to consider when being placed in front of a fresh canvas, or what are the sounds to include and combine in a music production. You can try to get as much as you can from one discipline, using very sophisticated state-of-the-art models. On the other hand, you can choose to bring to any given problem a number of disciplines, maybe having to sacrifice deepness in exchange of the better good of yet still sophisticated multifaceted solutions. There are quite a number of examples of the latter approach. In this talk, I will present a few of those, eventually concentrating in managed aquifer recharge (MAR) practices. This technology involves water resources from a myriad of perspectives, covering from climate change to legislation, from social awareness to reactive transport, from toxicological issues to biofilm formation, from circular economy to emerging compounds, from research to pure technological developments, and more. All of these elements deserve our attention as researchers, and we cannot pretend to master all of them. Integration, development of large research groups, open science are words that will appear in this talk. So does mathematics, and physics, and geochemistry, and organic chemistry, and biology. In any given hydrogeological problem you might need to combine equations, statistics, experiments, field work, and modeling; expect all of them in this talk. As groundwater complexity keeps amazing and mesmerizing me, do not expect solutions being provided, just anticipate more and more challenging research questions being asked.