Model-Based Management of Groundwater Resources Under Uncertainty

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We often use numerical models for groundwater management purposes. Model-based management of groundwater resources relates scientific knowledge and societal preferences. Decisions in groundwater resources management are difficult not only because societal preferences are difficult to elicit and may be conflicting, but also because groundwater resource systems are complex. Characterizing groundwater resources is not a trivial task and is data intensive. Due to limited insight into the subsurface, we cannot generally afford a precise description of the complex spatial subsurface geological variations, which makes it difficult to reliably describe groundwater flow and solute transport processes. Accordingly, we are inevitably dealing with conceptual and parametric uncertainties.

To deal with the problem of subsurface characterization, the talk will emphasize the importance of using lithological and geophysical data along with geostatistical methods to develop hydrofacies models that reconstruct the subsurface geological architecture. To accommodate for different sources of uncertainty, the talk will introduce multi-model analysis techniques such as model selection or model combination, which are gaining attention in groundwater hydrology. Two case studies will be used for illustration. The first one is about saltwater intrusion management in a fluvial aquifer-fault system in Baton Rouge, Louisiana. The second case study is about designing a groundwater remediation system for multiple contaminate plumes of volatile organic compounds and chlorinated hydrocarbons in an ecological sensitive area near the Mediterranean Sea in Italy. These two examples will illustrate how hydrofacies modeling serves as viable prerequisites for groundwater flow and solute transport modeling, and how multi-model analysis serves as a learning and decision support tool. Drawing on these concepts, in the second part of the talk, I will highlight my prospective contributions to both the immediate tasks and the long-term objectives of the 'Ike Wai project. I will present some ideas related to integrating the multifaceted data that are involved in the 'Ike Wai project with recent advancements in groundwater modeling. This is to develop high fidelity groundwater models, which are essential for conducting hydrological and socioeconomic analyses and for supporting decisions related to groundwater resources management. All are welcome to attend!