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A New Mixing Cells Model for the Assessment of Transmissivity and Storage Coefficients in Unsteady Groundwater Flow System Based on Hydrochemistry and Environmental Isotopes.

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A Mixing Cells Modeling (MCM) approach has been developed to assess unsteady groundwater fluxes in complex aquifers with vague hydrological data. In such systems, the boundaries and hydrological conditions along the boundaries are not well defined or distinct, following the lack of hydrological and hydrogeological information. Thus, it is challenging to construct, calibrate, and solve a flow or transport hydrological model based on the continuity approach. In the more simplistic yet practical MCM approach, the groundwater basin is divided into pseudo-homogeneous cells of varying sizes according to the distribution of wells and springs available for sampling and analyses for hydrochemistry and isotopes (e.g., 1–3). The flow equations are replaced by mass balance equations of water and solutes written for each cell separately over the modeled aquifer. With this, we assume that the stable isotopes are conservative tracers, as are most ions, metals, and other dissolved compounds in pseudo-hydro-chemical equilibrium with the aquifer's minerals. The groundwater fluxes (volume/time) between the cells are the unknown parameters common to every set of balance equations we are trying to estimate. If, in addition to sampling groundwater for hydro-chemical and isotopic analyses, we also measure the hydraulic (piezometric) head, one can replace the flux term with a Darcy-like expression of the product of the hydraulic gradient by the conductance, the equivalent of transmissivity in a continuum modeling approach. The mass balance equations are greater than the unknowns by analyzing the groundwater for many dissolved tracers. Thus, the MCM modeling scheme is solved by a linear programming optimization scheme based on the mass balance of water, isotopes, and dissolved minerals as linear constraints.

This presentation demonstrates how the modified MCM allows the user to assess the groundwater fluxes, transmissivities, and storage coefficients in a complex unsteady groundwater flow system where the spatial distribution of isotopes and dissolved minerals varies with time.

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