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System hydrology models for managing the salinity of Lake Kinneret, Israel

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Abstract The salinity of Lake Kinneret (LK), Israel, fluctuating between 190 to 280 ppm Cl^-, is significantly higher than the salinity of the Jordan River (~30 ppm Cl^-) and other surface streams that flow to the lake. By pumping ~330 million cubic metres annually of the lake water through the National Water Carrier (NWC) to the coastal area of Israel, the lake water is used for drinking, irrigation and re-use in the populated areas above the coastal aquifer. Its extensive usage as agricultural irrigation, both as original LK water and re-used water, poses a threat to the future sustainability of the groundwater and agricultural soils near the coastal areas. The hydrology of LK has been studied for the explicit purpose of establishing operational tools that can be used for managerial decisions regarding maintaining and reducing LK salinity. By application of the system modeling approach to three different hydrological problems associated with Lake Kinneret salinity, the major physical laws that govern its operation have been established. The three studies focused on: (1) detection of three unknown components, namely, evaporation, saline springs discharge and salinity, of the monthly water–solute–heat balances of the lake; (2) identification of the karst hydrological system of the saline springs that recharge the lake; and (3) long-term predictions of LK salinity, in response to operational changes. Each system will be presented from the description of the problem, through the conceptual model approach, to the results and the attributed conclusions. Finally, the usage of each system separately is discussed, together with the integration of knowledge from the three studies, in order to reach practical managerial decisions.

Key words system hydrology; direct and inverse problems; karst hydrology; mass balances; lake salinity