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Coupled Mixing-Cell and Mass Balance Flow Path Models of the White River Flow System, Nevada, USA

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In a continuing effort to characterize the White River Flow System (WRFS), in east-southeast Nevada, mass balance (MB), Discrete-State Compartment (DSC) and Discrete-State Compartment-Shuffled Complex Evolution (DSC-SCE) models were compared using δD and δ^{18}O to evaluate recharge-discharge estimates and likely flow paths of regional ground water flow in the WRFS. DSC models use a simple mixing-cell network symbolizing ground water systems that can be used for a variety of analyses and are particularly useful for regional scale problems with limited data (Campana et al., 2001). DSC-SCE models combine the DSC and a global optimization algorithm that utilizes probabilistic and deterministic approaches, clustering and systematic and competitive evolution to obtain optimal solutions (Duan et al.,1993). MB models using historical reconnaissance recharge-discharge (RD) estimates produced poor results in the WRFS, with model predicted δD and δ^{18}O values for regional springs at the terminus of the flow system being 12.6‰ and 1.73‰ permil different than measured values, respectively. In contrast, MB models using the new RD values have predicted δD and δ^{18}O values within $\pm$ 2‰ and $\pm$ 0.2‰ of measured values for all regional springs in the WRFS except for Pahranagat Valley. MB model results of observed versus modeled δD and δ^{18}O values at regional springs indicate that new RD estimates and resulting inter basin flow volumes and proposed flow paths are reasonable for the WRFS. DSC models, which mimicked MB parameters, most closely approximated cell outflow values compared to new RD estimates. Statistical analysis of DSC-SCE realizations assessed the viability of hypothesized flow paths and estimated RD values with the sum of square errors. DSC-SCE models found agreement with flow paths in scenarios that removed evapotranspiration (ET) before mixing with local and regional waters. Cell outflow, ET and recharge values varied significantly from the new RD

estimates. Both DSC and DSC-SCE models suggest that discharge, primarily ET, may be underestimated in the MB models. DSC-SCE models that allow for all possible down flow paths of inter basin flow infer that additional flow paths other than those modeled in the MB and DSC models are possible.