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Blended near-optimal tools for flexible water resources decision making

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State-of-the-art systems analysis techniques focus on efficiently finding optimal solutions. Yet an optimal solution is optimal only for the static modelled issues and managers often seek near-optimal alternatives that address un-modelled or changing objectives, preferences, limits, uncertainties, and other issues. Early on, Modelling to Generate Alternatives (MGA) formalized near-optimal as performance within a tolerable deviation from the optimal objective function value and identified a few maximally-different alternatives that addressed select un-modelled issues. This paper presents new stratified, Monte Carlo Markov Chain sampling and parallel coordinate plotting tools that generate and communicate the structure and full extent of the near-optimal region to an optimization problem. Plot controls allow users to interactively explore region features of most interest. Controls also streamline the process to elicit un-modelled issues and update the model formulation in response to elicited issues. Use for a single-objective water quality management problem at Echo Reservoir, Utah identifies numerous and flexible practices to reduce the phosphorus load to the reservoir and maintain close-to-optimal performance. Compared to MGA, the new blended tools generate more numerous alternatives faster, more fully show the near-optimal region, help elicit a larger set of un-modelled issues, and offer managers greater flexibility to cope in a changing world.