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Robust optimization of a water resources operation problem that contains model structural uncertainty

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As seen in recent literature, the uncertainty present in water resources system models can result in operations that do not perform at the level anticipated in their design. For an individual case study, we have shown that the potential regret associated with ignoring model structural uncertainty alone can outweigh the benefits of using sophisticated optimization algorithms to design operations. Under such uncertainty it can become difficult to recommend any specific operations for practitioners. Where irreducible uncertainty exists (irreducible for intents and purposes), previous work has typically re-evaluated optimized operations under a range of uncertain values to create a measure of robustness for given operations; this can be thought of in plain language as answering the question 'how much regret will arise if the model used for optimization turns out to not be the model that best represents reality?'. Once this question has been answered, it is then possible to make recommendations on operations. We believe that this approach wastes time and effort on optimization of a deterministic model that we later admit to be uncertain. In this work we move the consideration of uncertainty from the re-evaluation phase into the optimization phase. A function evaluation in the optimization process instead evaluates operational performance across a range of plausible model structures with uncertain values. We present the two workflows next to each other to compare the recommendations that each would provide.