The importance of realism in reservoir operation optimization

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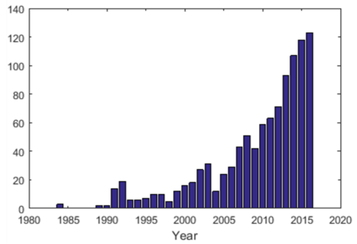
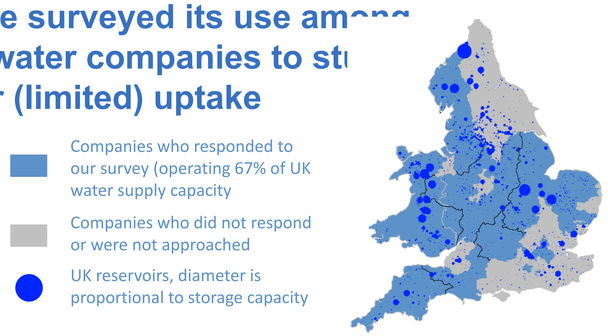
1. Reservoir operation optimization is an increasingly active field of research

Web of Science records per year for 'reservoir operation optimization'

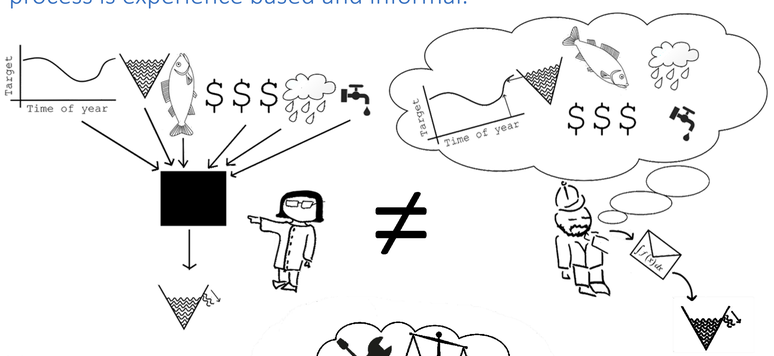


2. We surveyed its use among UK water companies to study their (limited) uptake



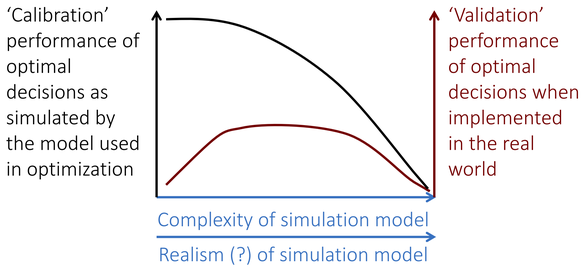
3. Key results include:

a) Research studies most commonly use a prescriptive, formal decision making process while in practice the decision making process is experience based and informal.



b) Practitioners hesitate to follow model recommendations due to concerns about model realism.

4. How 'realistic' should simulation models used for optimization be?



6. Discussion and future work

We see large discrepancies between models within the aspects of realism: 'inputs, forcing and physics' and 'selection of objectives'. We can explore these further by introducing uncertainty.

'Physical modelling choices' had less impact, we will use sensitivity analysis to rigorously quantify the impact of such simplifications on real world performance.

5. We optimize operation policies using increasingly complex (/realistic?) simulation models. We then evaluate optimized policies on the most complex simulation model.

Aspect of realism

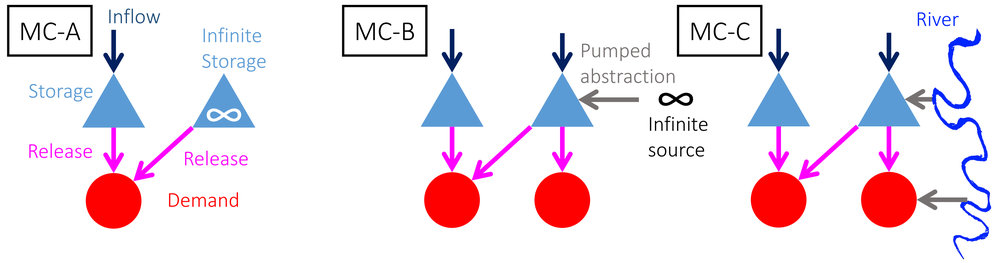
Simulation models of increasing complexity

'Calibration' optimizes a set of operation policies for a hypervolume (a multi-objective performance measure). Calibration performance evaluates the policies on A/B/C models but the same objective. 'Validation' evaluates the policies on only the most complex model.

Results

Black boxes are calibration performance and red, validation (higher is better). Objectives are also indicated

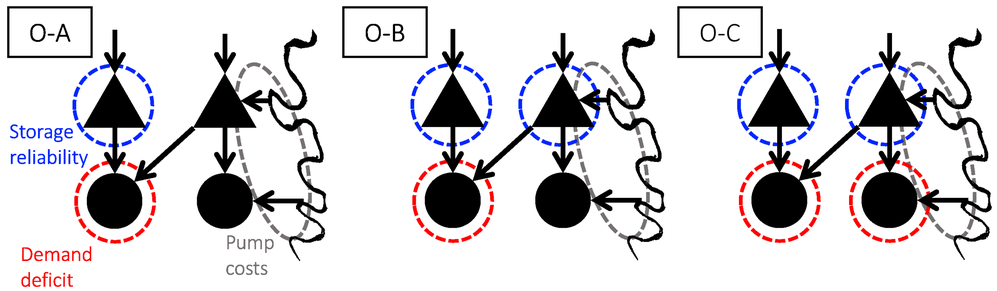
Physical modelling choices



	MC-A	MC-B	MC-C
	0.738		
		0.723	0.723
	0.712		
		0.706	0.706

3 objective hypervolume using all available objectives in MC-A

Selection of objectives

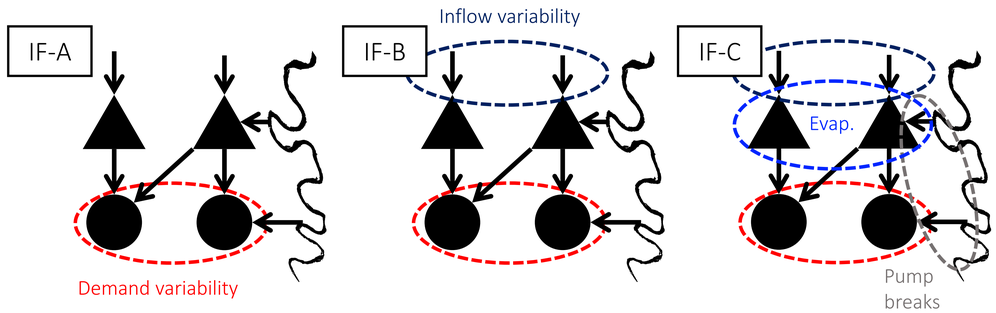


	O-A	O-B	O-C
	0.958	0.956	0.949
			0.783
		0.577	
	0.420		

3 objective hypervolume using O-A objectives

5 objective hypervolume using O-C objectives

Inputs, forcing and physics



	IF-A	IF-B	IF-C
	0.857		
		0.253	0.162
		0.753	0.752
	0.587		

5 objective hypervolume using O-C objectives

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