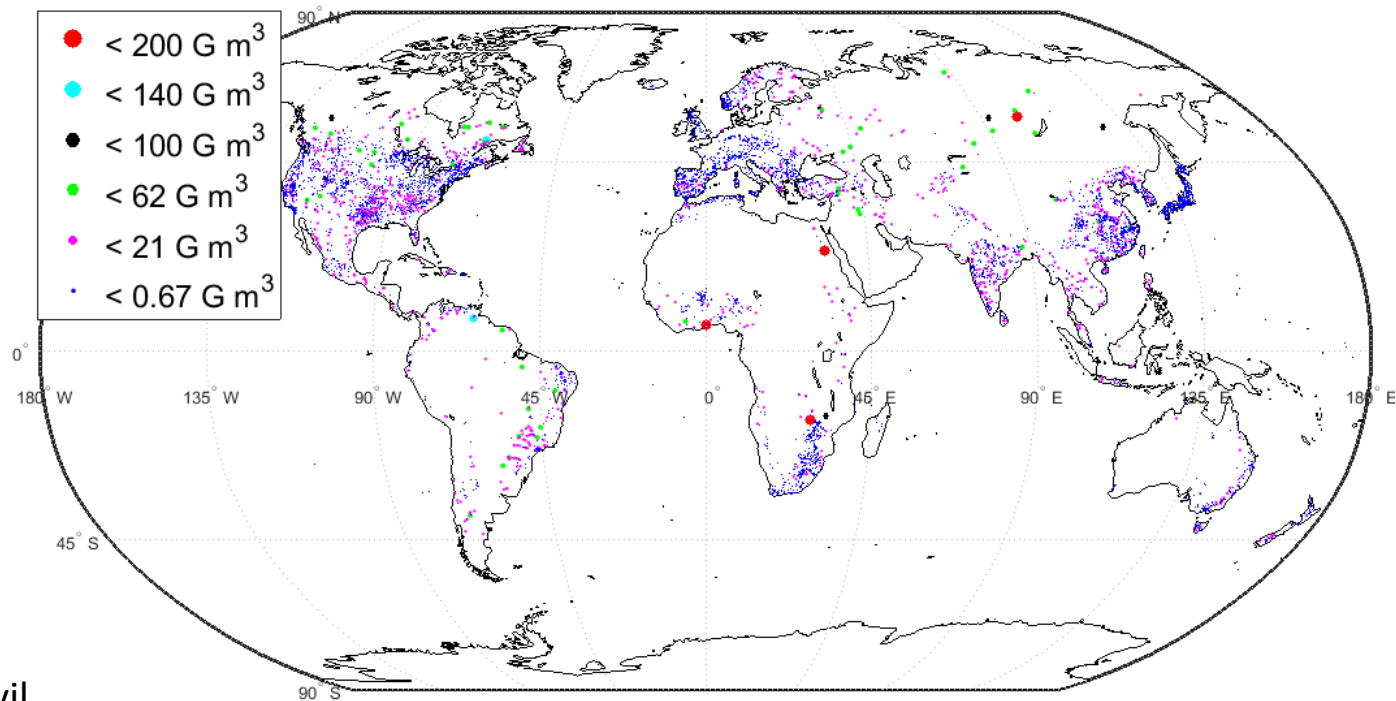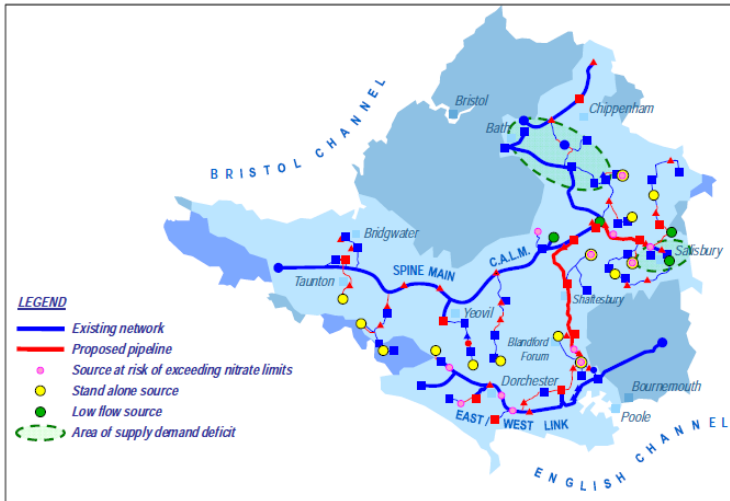# Optimisation of water resources operation and how to bring this into practice

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Operation is becoming more constrained

wfd Water Framework Directive UK TAG

..but we have sophisticated reservoir infrastructure and increasingly active research towards its efficient operation

(Right) the records by publication year from a web of science search for topic 'reservoir operation optimisation'

2
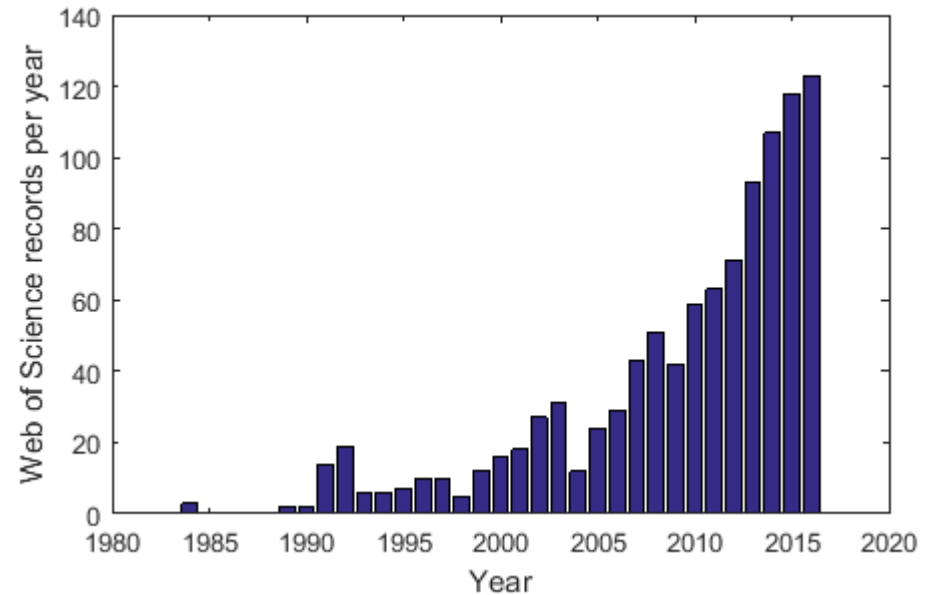
There is a poorly understood gap between research and practice

1) Review literature from a practical rather than mathematical perspective
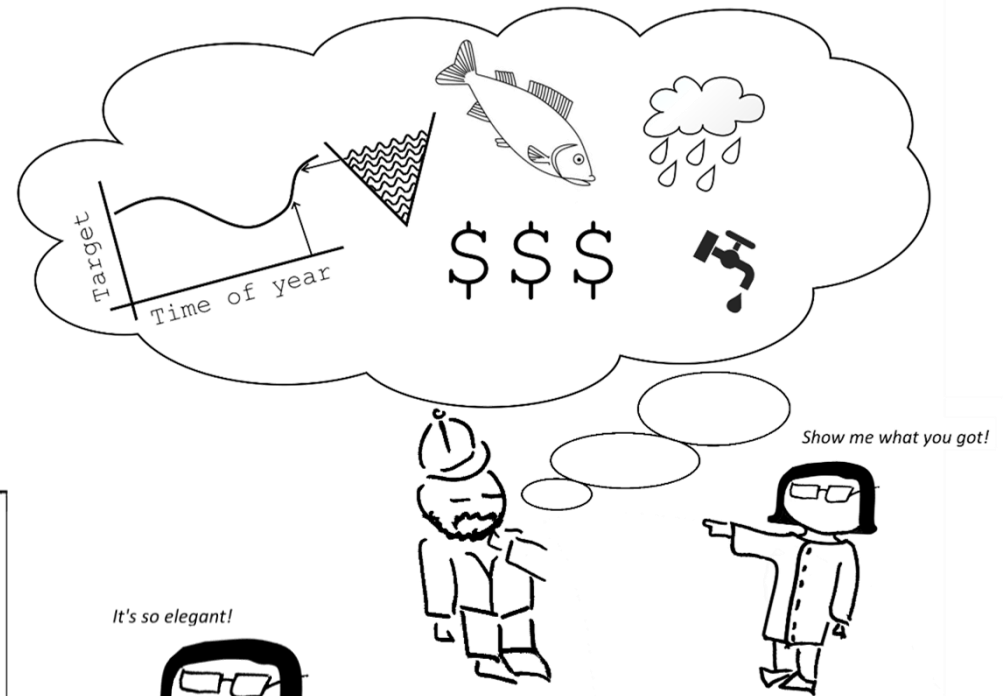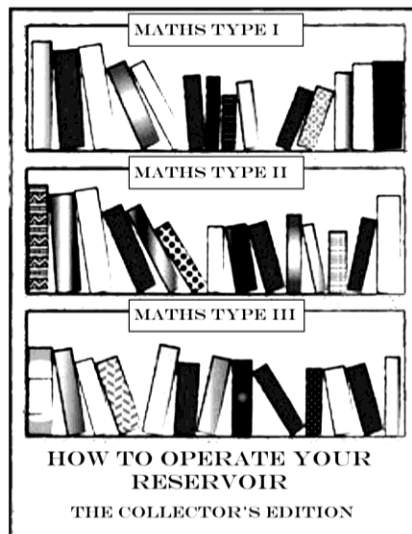
2) Survey water companies to understand their current decision making process and awareness of operation optimization

We have surveyed, by questionnaire, companies representing 40% of total UK storage capacity

- Pilot study detailed interviews with 2 hydropower and 2 water supply companies.

- 7 of 10 approached companies responded, typically water resources managers (and their team).

Legend

Surveyed companies

Not surveyed companies

Reservoirs (size proportional to capacity)
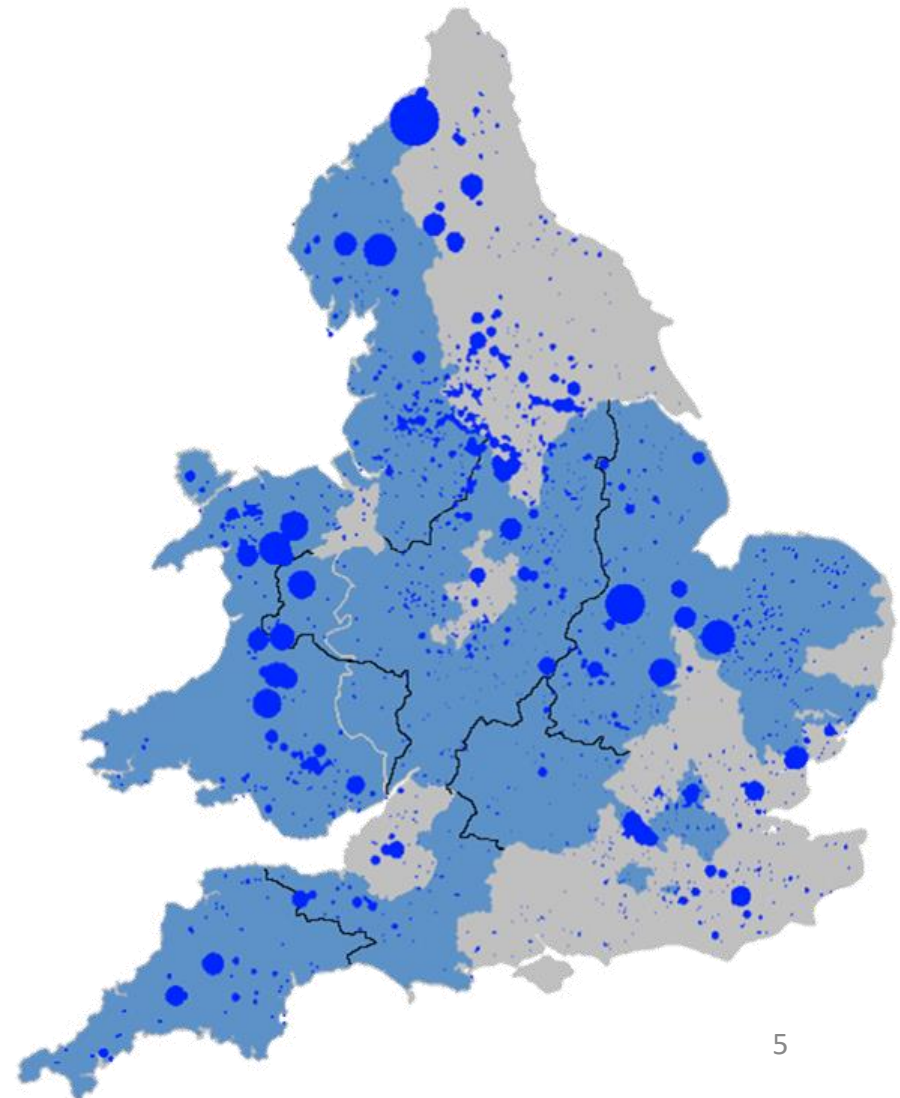
UK water systems are highly suitable for implementation of operation optimization

Each person is a company's response to a question designed to assess water system suitability to operation optimization

Q: % of reservoirs with constant releases

0-20%

61-80%

Q: % of rivers with constant abstractions

0-20%

21-40%   >81%

Q: % of boreholes with constant abstractions

0-20%

21-40%

41-60%   >81%

Q: % of sources connected into some kind of grid

0-20%

61-80%

>81%

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Research assumes an automated, optimization-focused decision making process
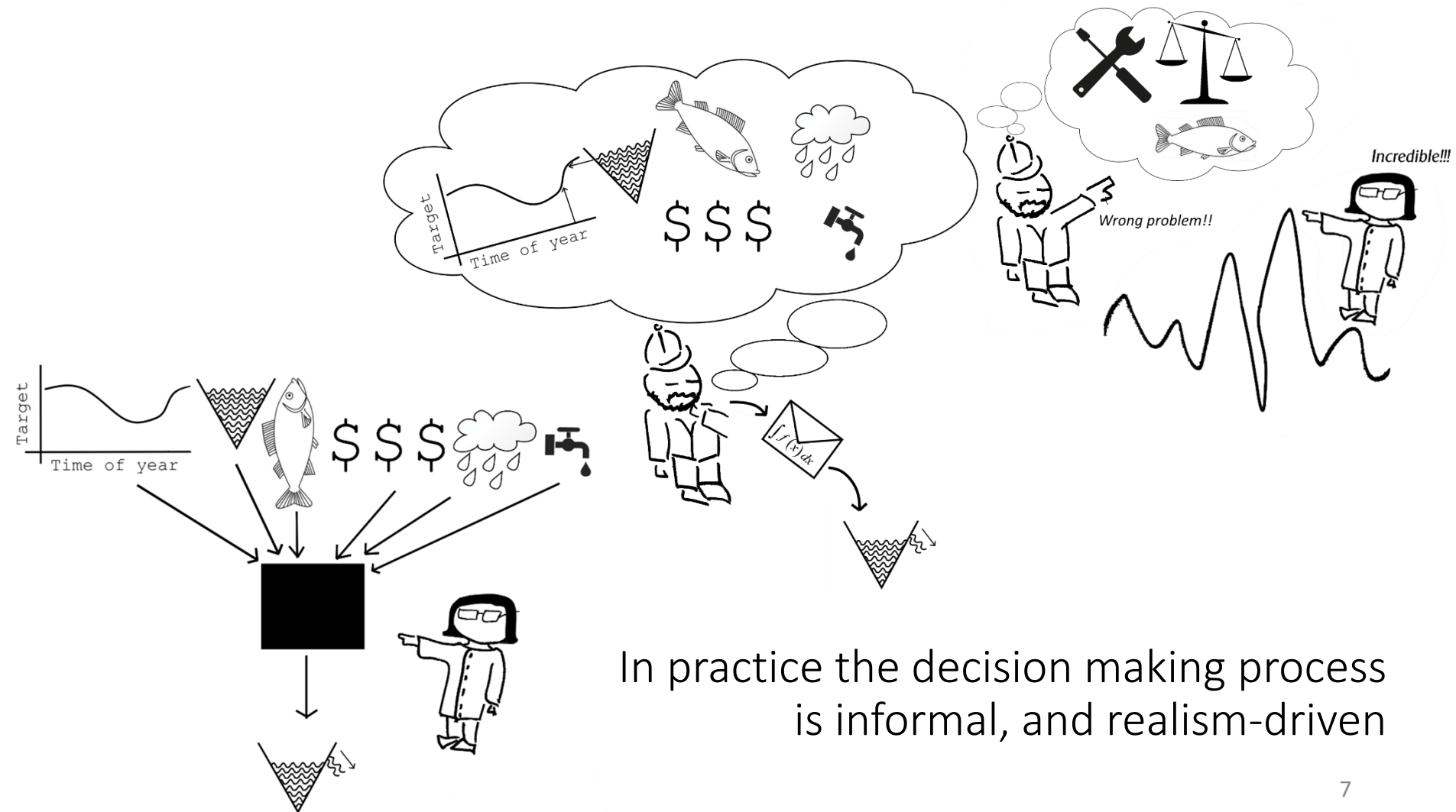
In practice the decision making process is informal, and realism-driven

There is a distinct difference in the 'paradigm' of operation between research and practice

Importance of bridging gap

(high)

Expected ease of bridging gap:

Hard | Med | Easy

(low)

Research

Optimization focused

Automated decision making

Multi-objective optimization

Operation policies

Release sequences

Algorithm efficiency

Global optimality

Practice

Problem focused

Informal decision making

Operating within the law

Rule curves

Allocation problems

Quick enough

Good enough

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We are collaborating with Wessex water to investigate the optimization/problem focus gap

A trade off between optimization and problem focus will exist (red line), but no one has studied how to find this

We hope to characterise this uncertainty around 'real performance' for the Wessex water case study

Performance of 'optimal' decisions as simulated by the model

A ?   ?
  ?   ?
    ?
  ?   ?   ?

Performance of 'optimal' decisions when implemented in the real world
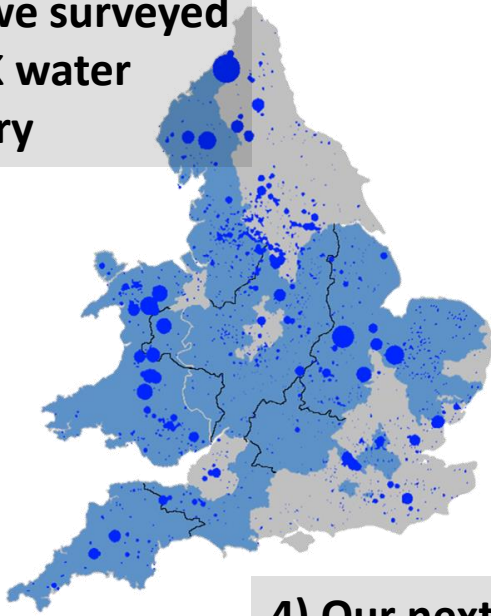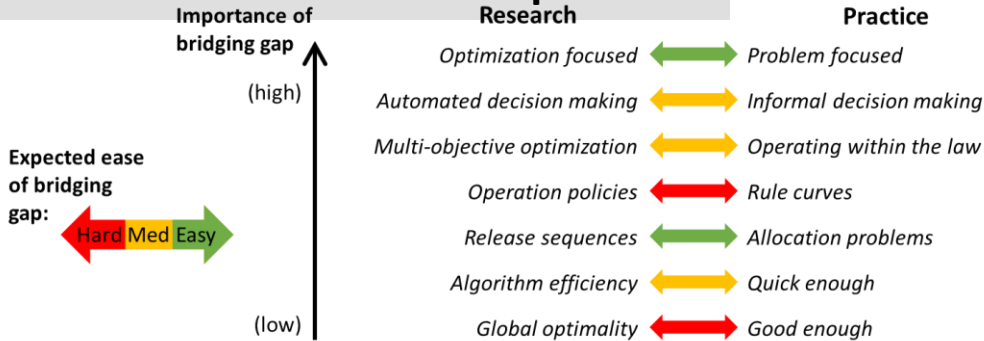
B

Realism of simulation model

Complexity of simulation model???

9
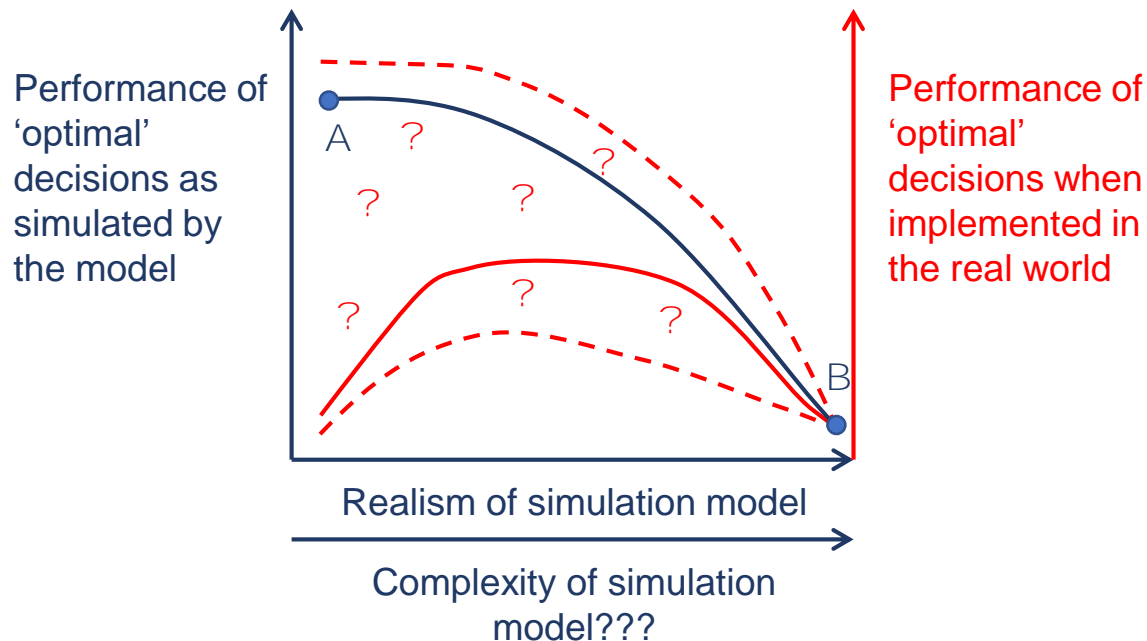
We have identified gaps between practice and research and aim to bridge them

1) There's a lot of cool tools that aren't used in practice
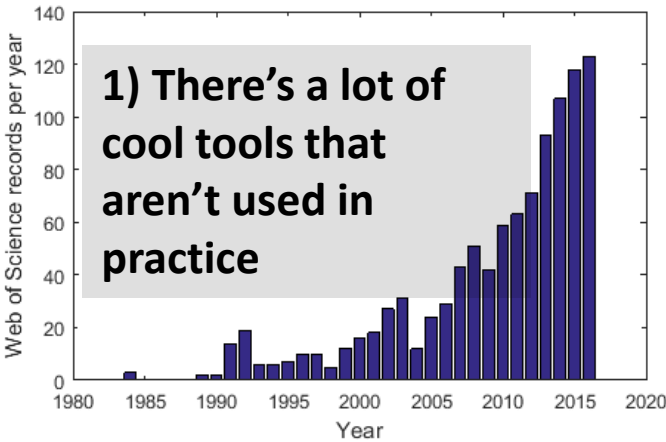
2) So we surveyed the UK water industry

3) There's a range of gaps that need to be bridged to bring the full potential of these tools into practice

Research		Practice
Optimization focused	⟷	Problem focused
Automated decision making	⟷	Informal decision making
Multi-objective optimization	⟷	Operating within the law
Operation policies	⟷	Rule curves
Release sequences	⟷	Allocation problems
Algorithm efficiency	⟷	Quick enough
Global optimality	⟷	Good enough

Importance of bridging gap (high) ... (low)

Expected ease of bridging gap: Hard / Med / Easy

4) Our next step is to identify the balance between optimization and problem focus for a case study

Performance on model that is being optimized

Performance when 'optimal' solution is implemented in real life

Realism of model that is being optimized

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