CIWEM Conference on Integrated Water Management, 21st October 2010

Integration: Philosophy or Fantasy?

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Outline

- Introduction to the urban wastewater system
- Integration, modelling and control
- Application to an urban catchment
- Water quality
- Energy
- Flooding
- Conclusions

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Introduction

- Current practice: separate design & operation of sewer system, wastewater treatment plant and receiving water
- Degree and sophistication of control of most urban wastewater systems is low
- To understand and improve system performance need to consider system as a whole by modelling of integrated urban wastewater system
- Demonstrate potential efficiency gains

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Integrated modelling tools

- Work began in late 1990s, up to present….
- SYNOPSIS - Software package for synchronous optimization and simulation of the urban wastewater system (Schütze, Butler & Beck)
- Allows simulation of long-term water quantity and quality processes in the integrated system, as well as the analysis and optimization of real-time control strategies
- SIMBA (simba.ifak.eu/simba) v6

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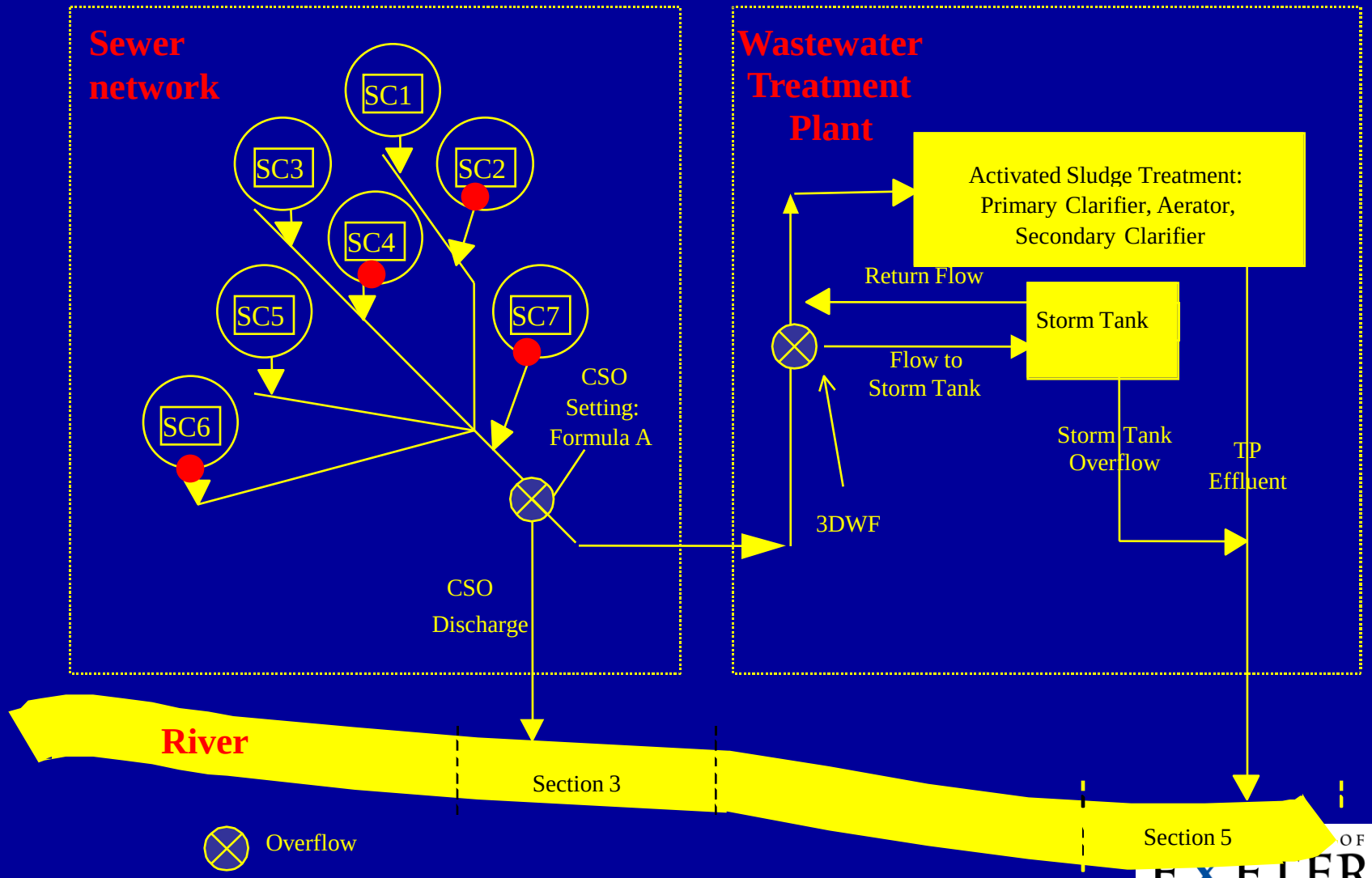
Schematic of test catchment



Control strategies

- The first question we addressed was: can integrated control provide an improvement to river water quality compared with current practice?
- Three strategies have been chosen:
  - Local control (base case)
  - Global control
  - integrated control

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Performance criteria

- River water quality:
  - the duration (% of time) of the dissolved oxygen concentration below a 4 mg/l threshold value at any location in the river
  - the minimum DO concentration in the river during the simulated time period
- Optimization of single objective – dissolved oxygen

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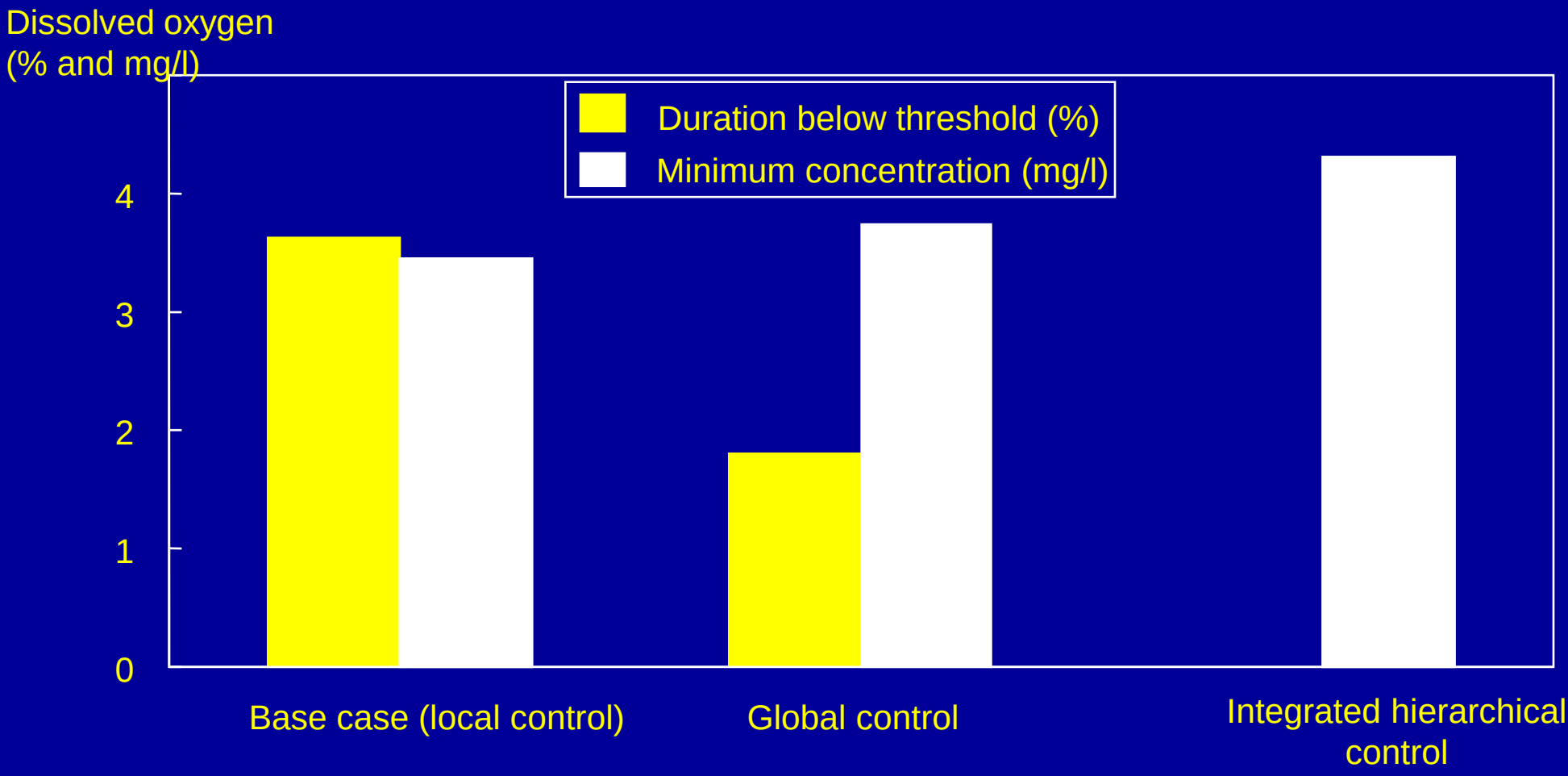
Performance of control strategies



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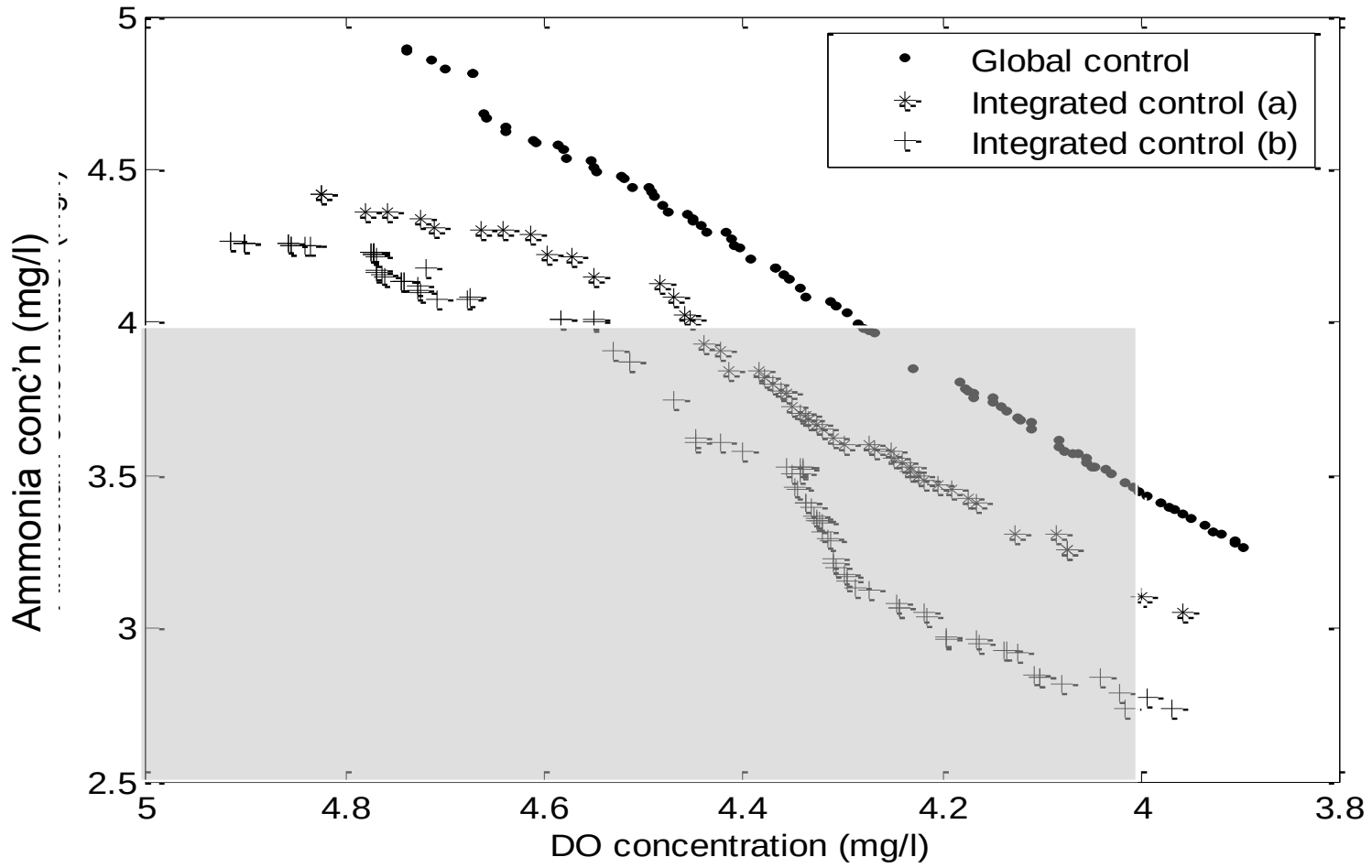
Two-objective optimisation



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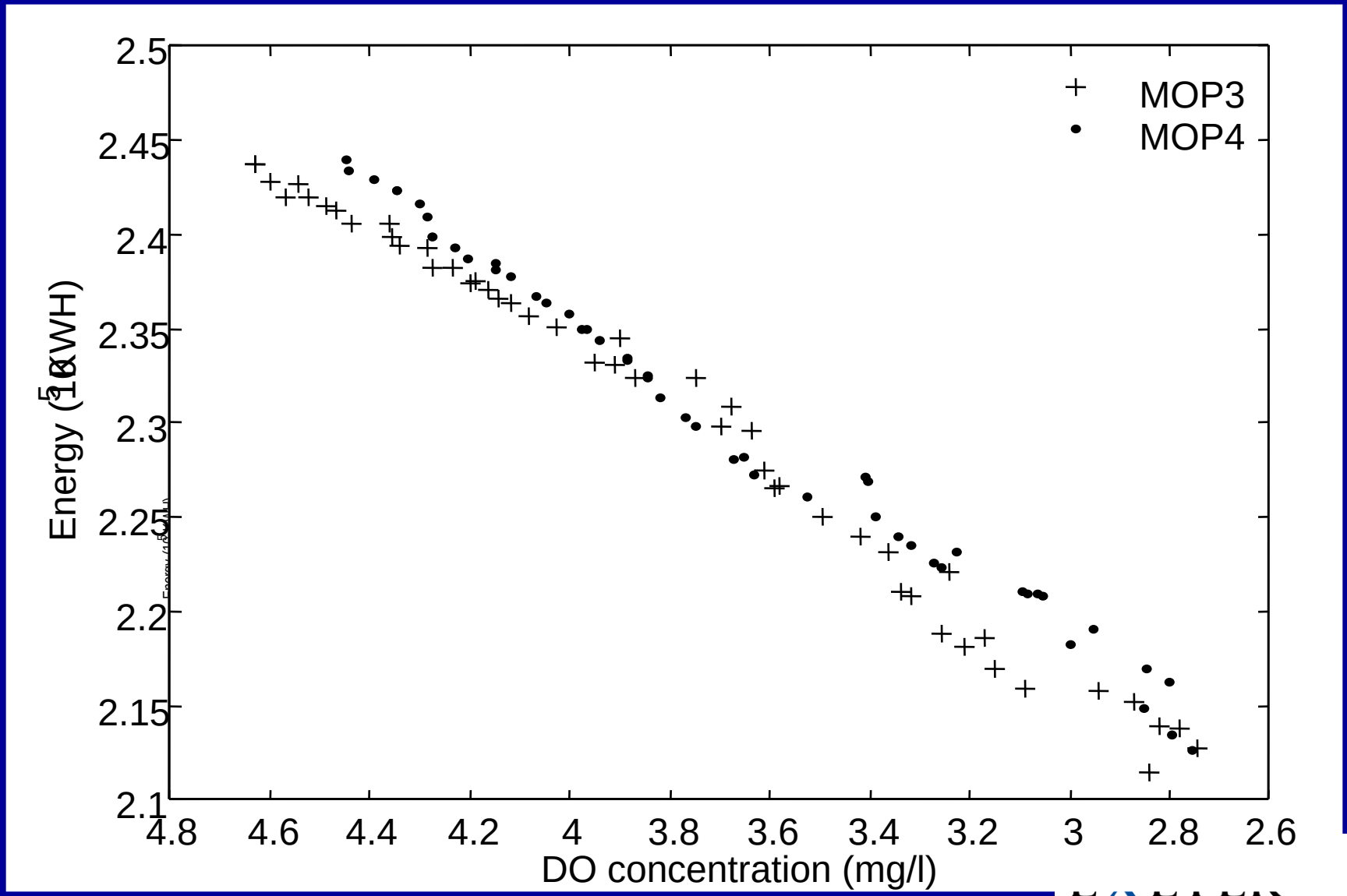
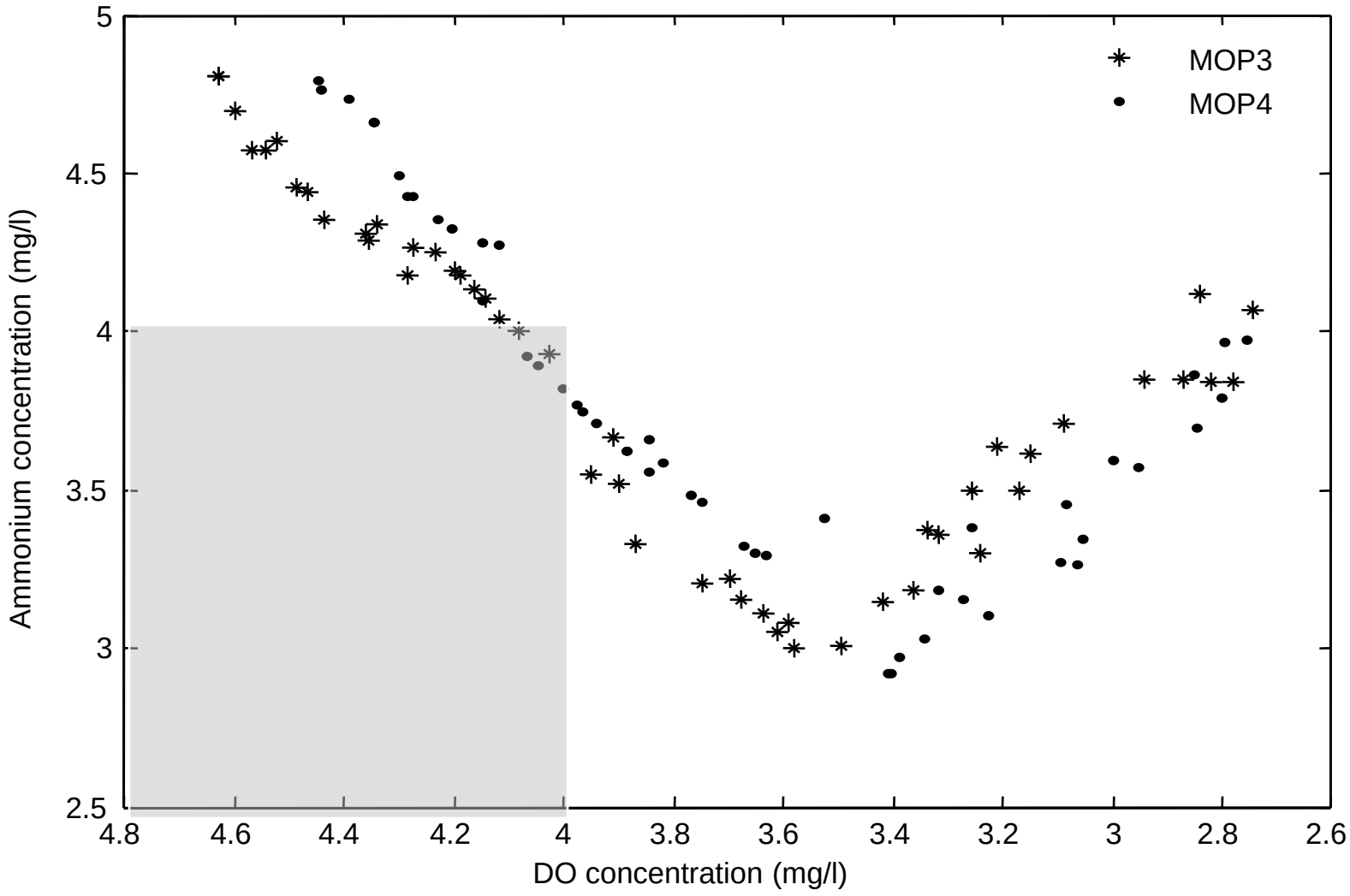
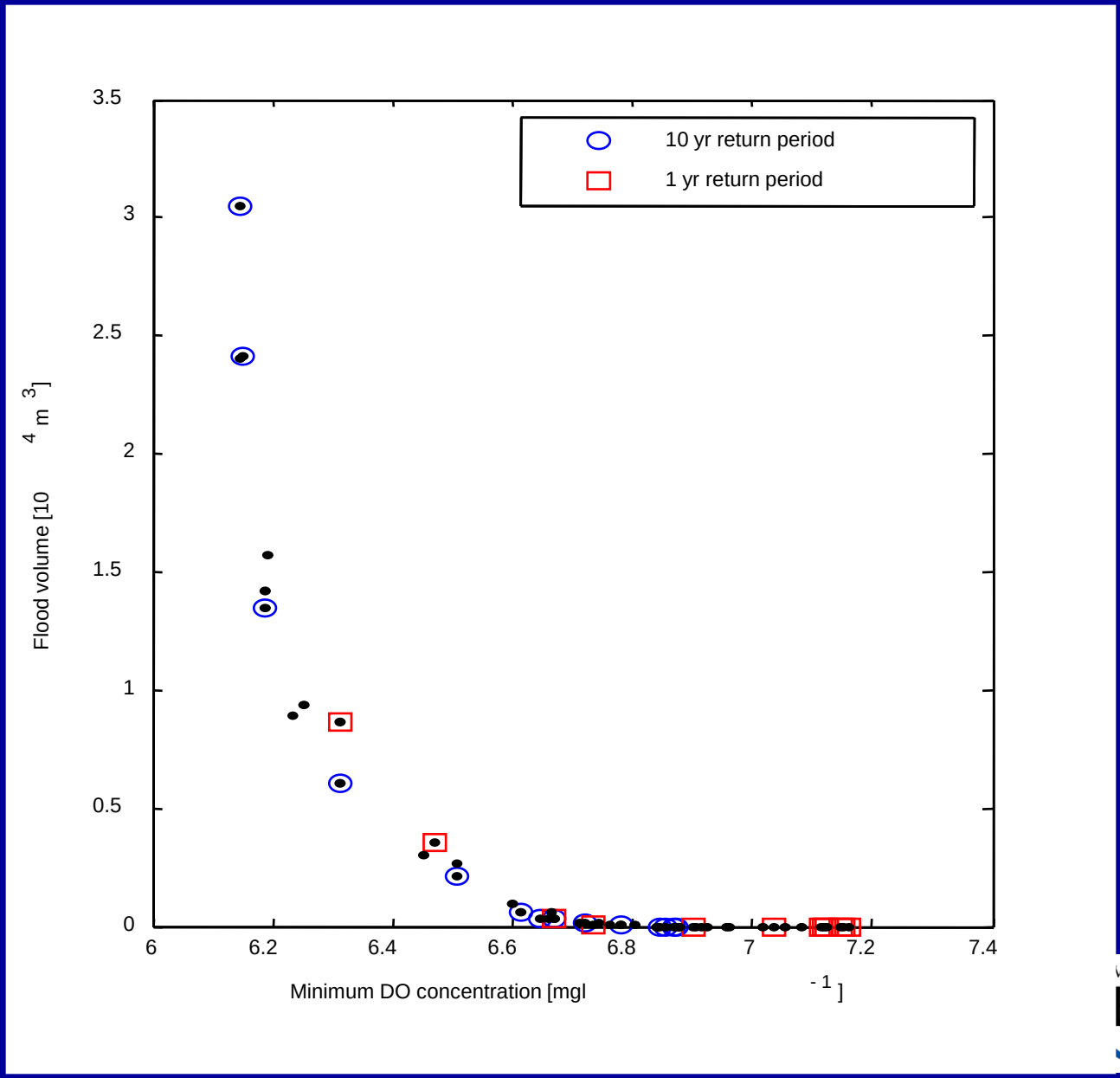
Three-objective optimisation



Three-objective optimisation



Flood volume vs minimum DO



Conclusions

- Improved performance: river water quality
- Greater understanding: difficulty of improving several WQ variables simultaneously
- Unintended benefits: low energy options
- Reduces unintended consequences: flood frequency link to water quality
- Integration – not a fantasy, but a philosophy with immense promise

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