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Resilience scenarios for integrated water systems (RIWS)

Ana Mijic, Leyang Liu, Jeni Giambona and Barnaby Dobson

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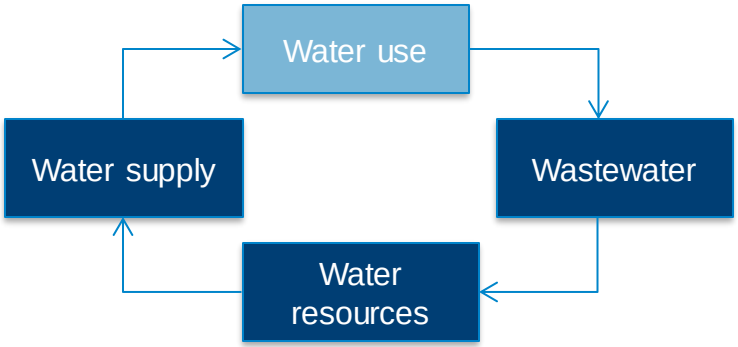
Challenges of integrated water systems



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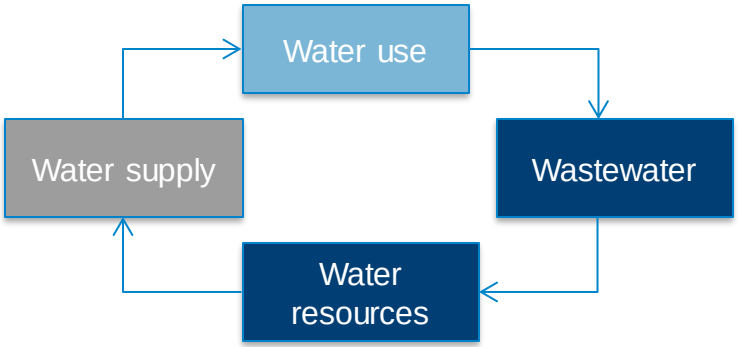
Challenges of integrated water systems

With high temperatures above 40°C in summer 2022 and critically low rainfall, decreased river flows triggered a hosepipe ban, impacting millions of people's water supply



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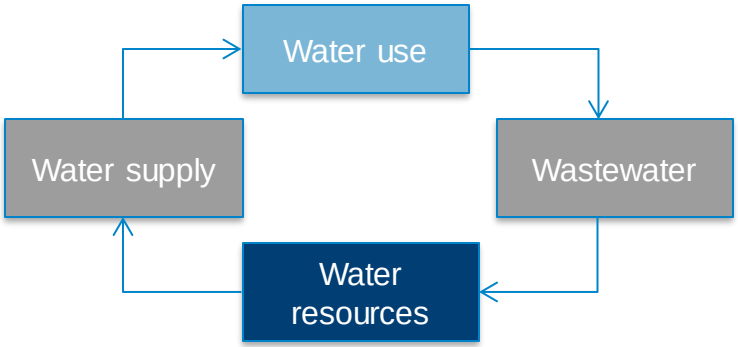
Challenges of integrated water systems



Water companies had to issue a public apology for uncontrolled sewage spills and promise £10bn investment in upgrading their wastewater systems

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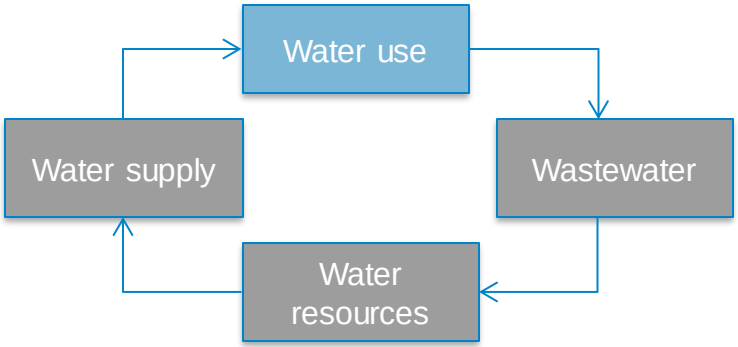
Challenges of integrated water systems



The Government's 2022 report on the river water quality revealed that 'only 14% of English rivers met good ecological status and no river met good chemical status'

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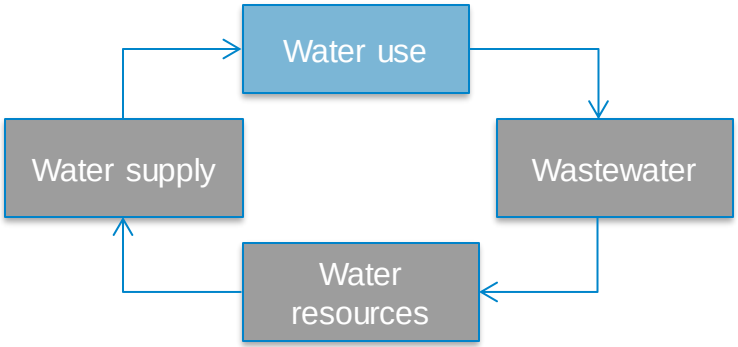
Challenges of integrated water systems



There is a need to develop resilience assessments to address interlinked challenges of water systems and the environment.

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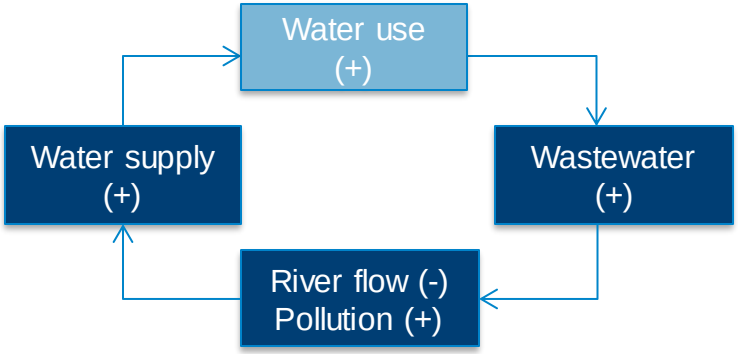
Resilience assessment challenges



[1] Water system interdependences

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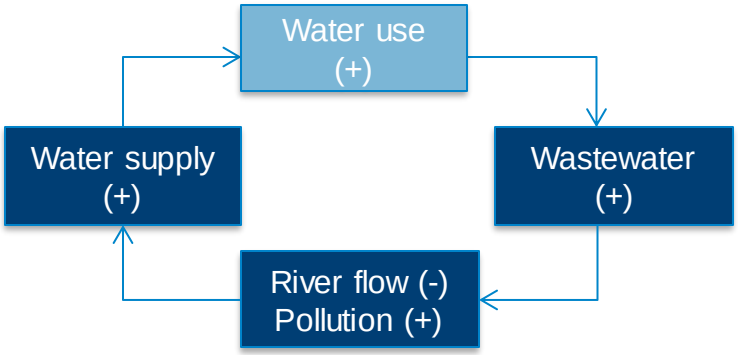
Resilience assessment challenges



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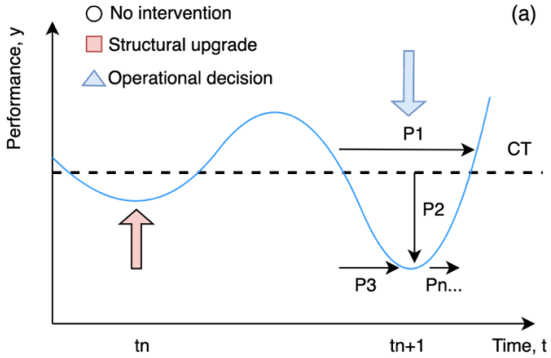

[2] Resilience metrics implementation

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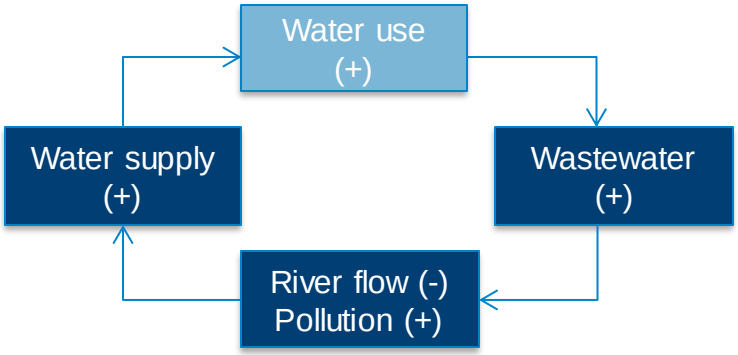
Resilience assessment challenges



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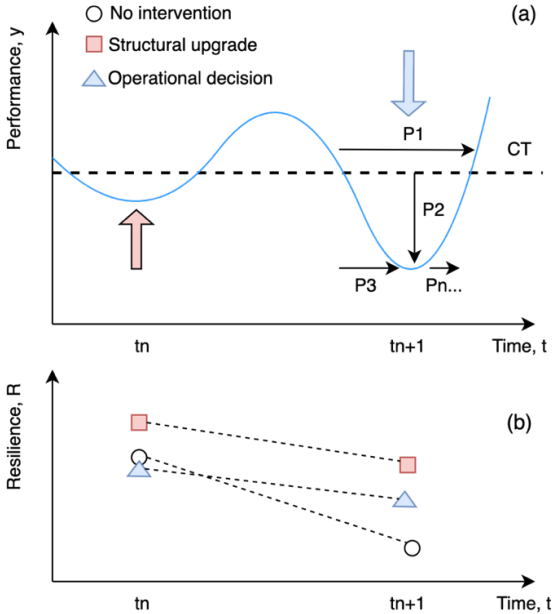

[2] Resilience metrics implementation

[3] Resilience for adaptive planning

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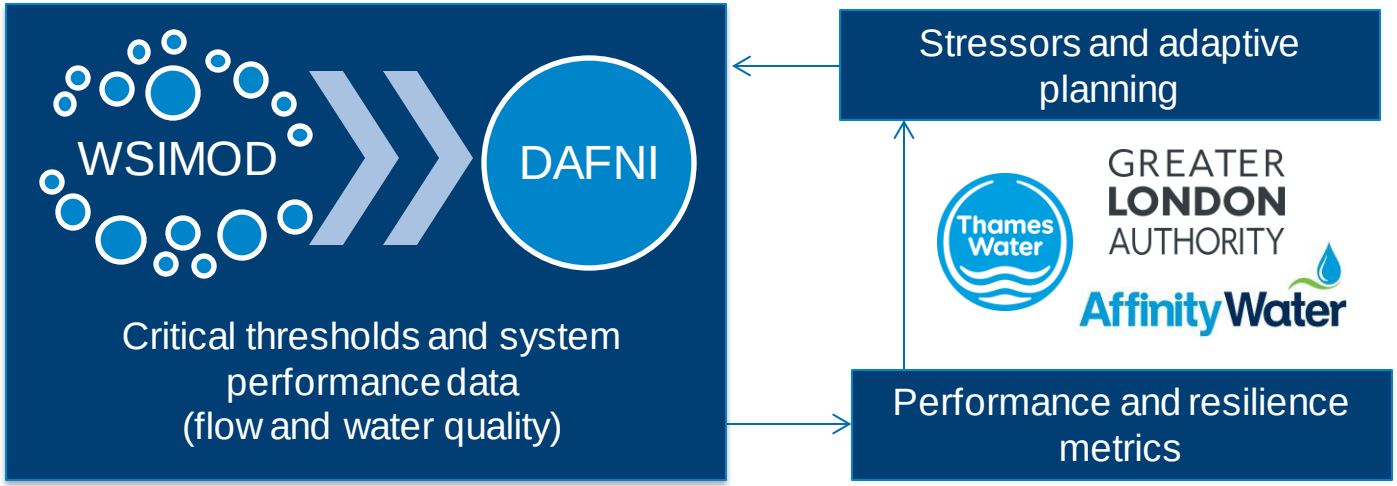
Resilience for integrated water systems project



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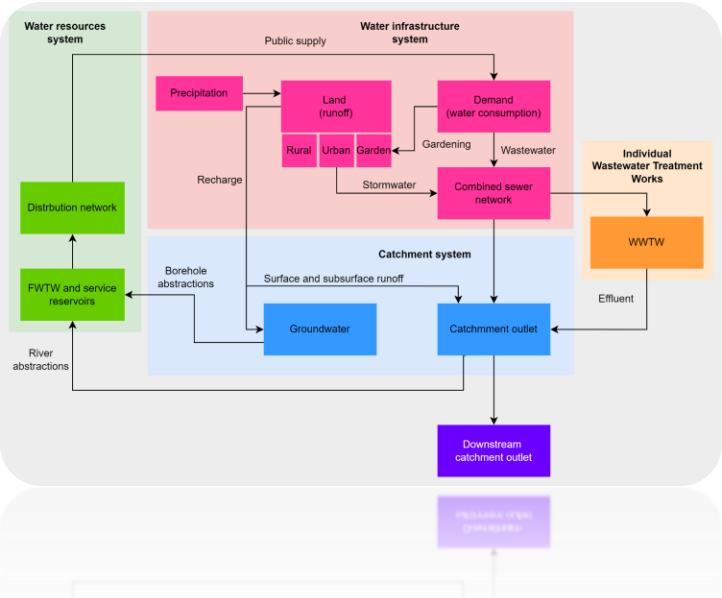
WSIMOD: Model for simulating human impacted water quality and quantity

WSIMOD generic configuration



*list of references is included at the end of the presentation

Highly flexible whole-water system modelling Python package using well-documented, open-source software

Enables analysis of water management and long-term planning from a physically based, systems-level perspective

A range of urban and catchment scale applications described in 9 peer reviewed articles*

Used in 5 projects for regional water strategies in England with planning authorities and environmental regulators

WSIMOD

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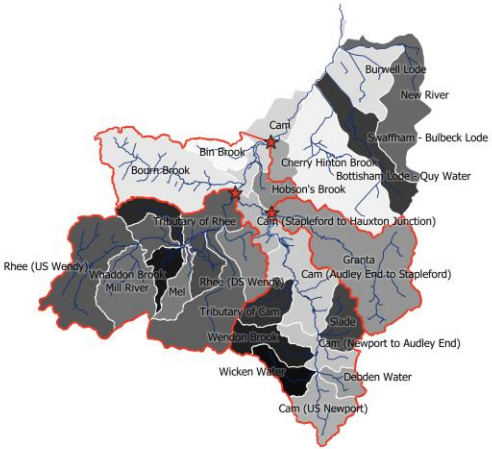
Integrated water planning

- **Purpose**: to coordinate water management options (WMO) implementations within a specified region, defined through multiple water plans
- **Evaluation**: to use in-river flow and water quality indicators and derived metric to evaluate impacts under future scenarios and effectiveness of WMO



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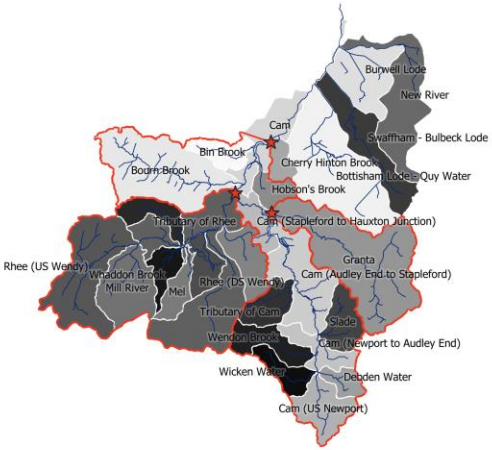

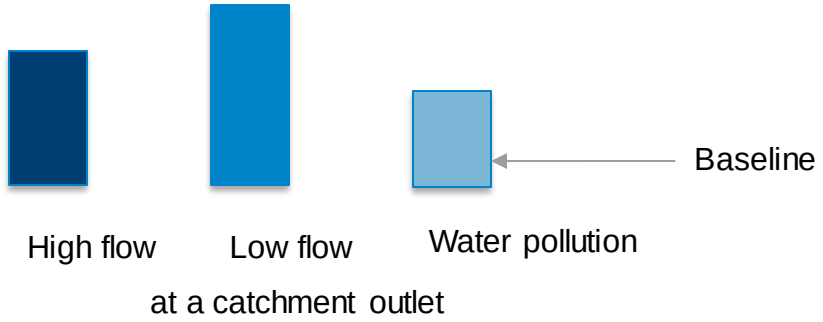

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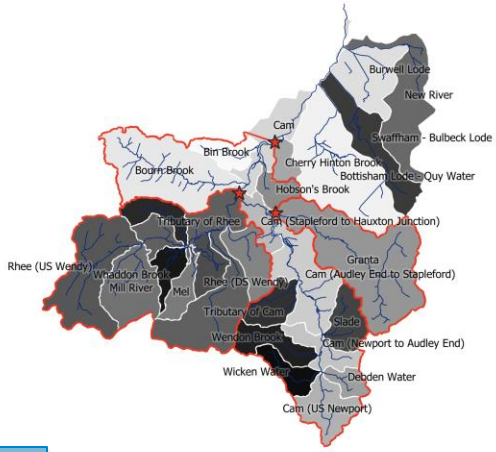

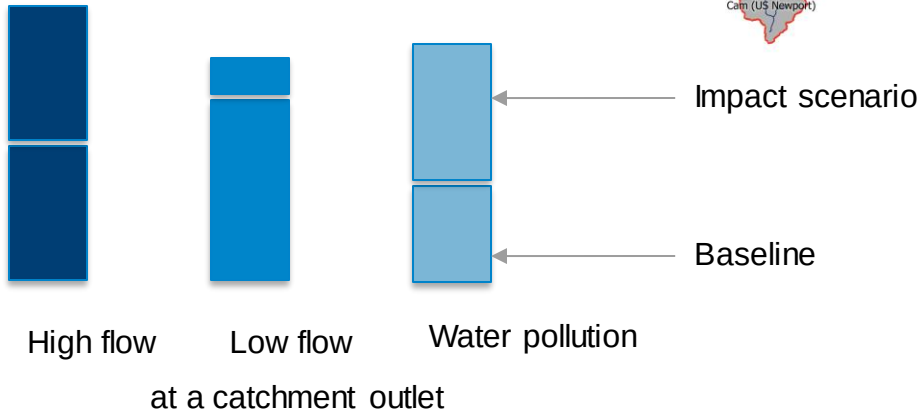

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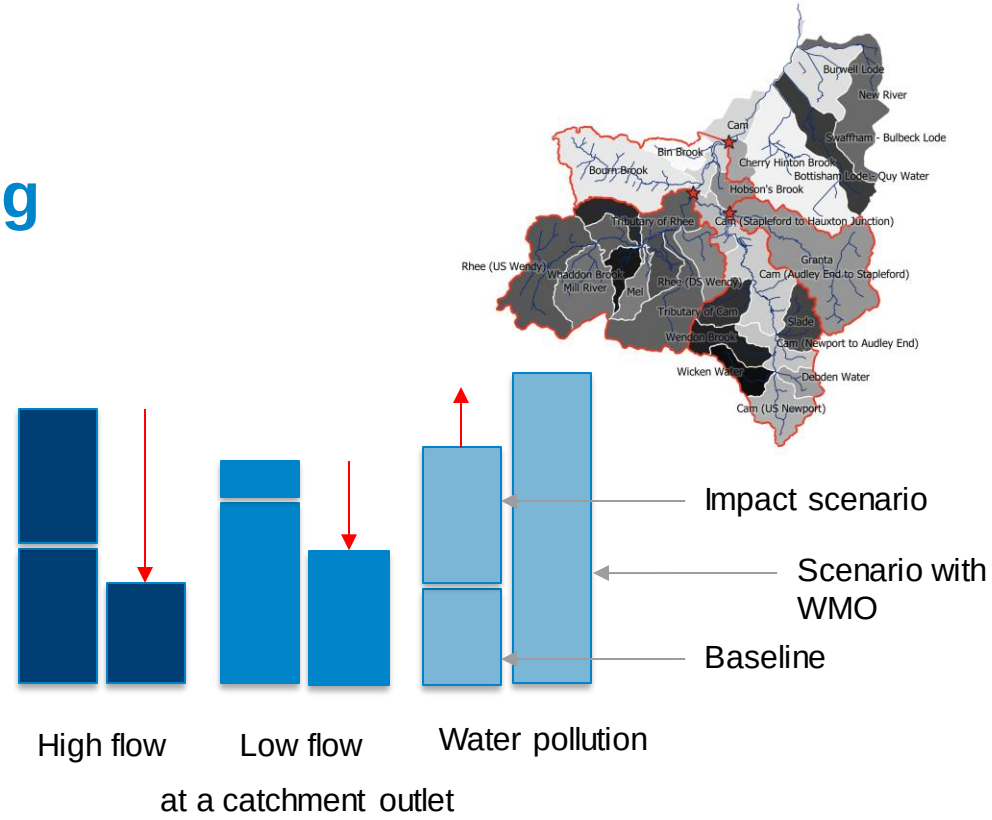

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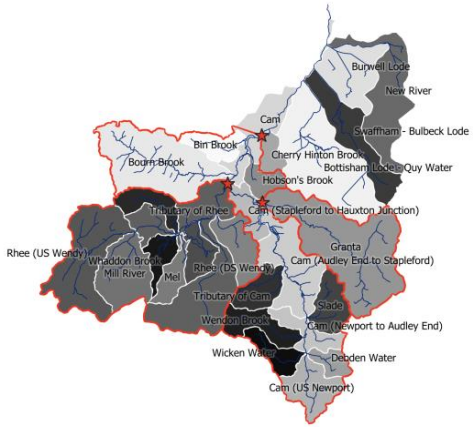
WSIMOD for future planning

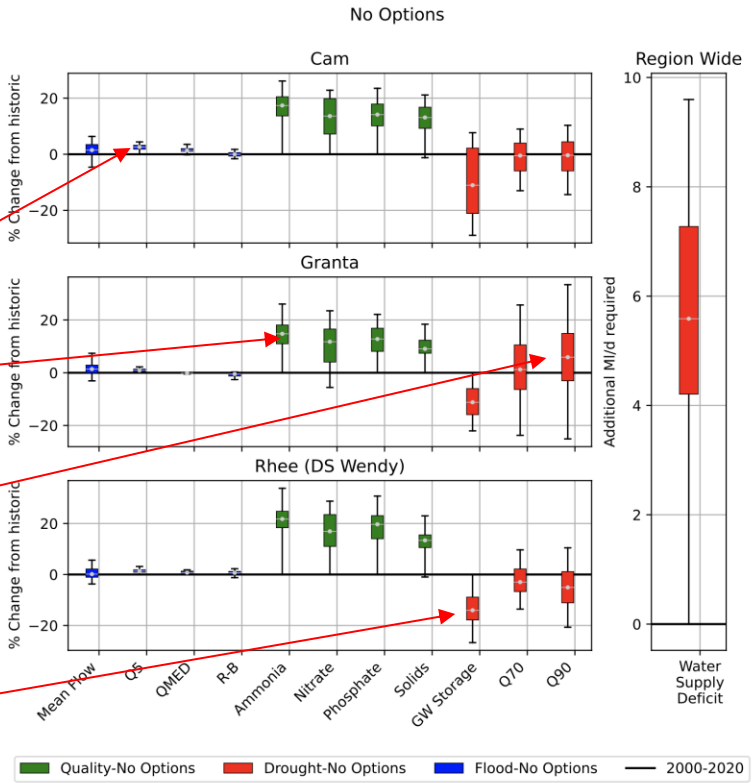


Minor impacts on flood risk

Significant worsening in river water quality

Increase in flow (Q70, Q90) in dry periods due to additional WWTP discharge

General trend of decrease in water availability



Oxford-Cambridge regional planning:
- 5 development and 2 climate scenarios
- 12 indicators

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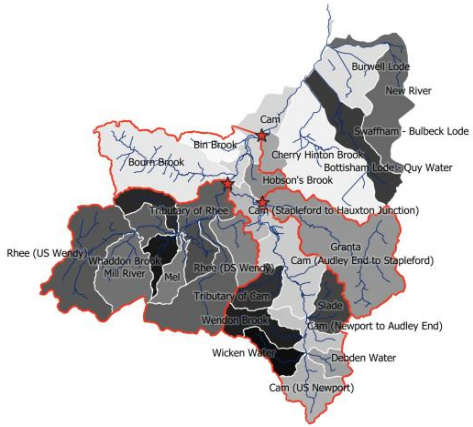
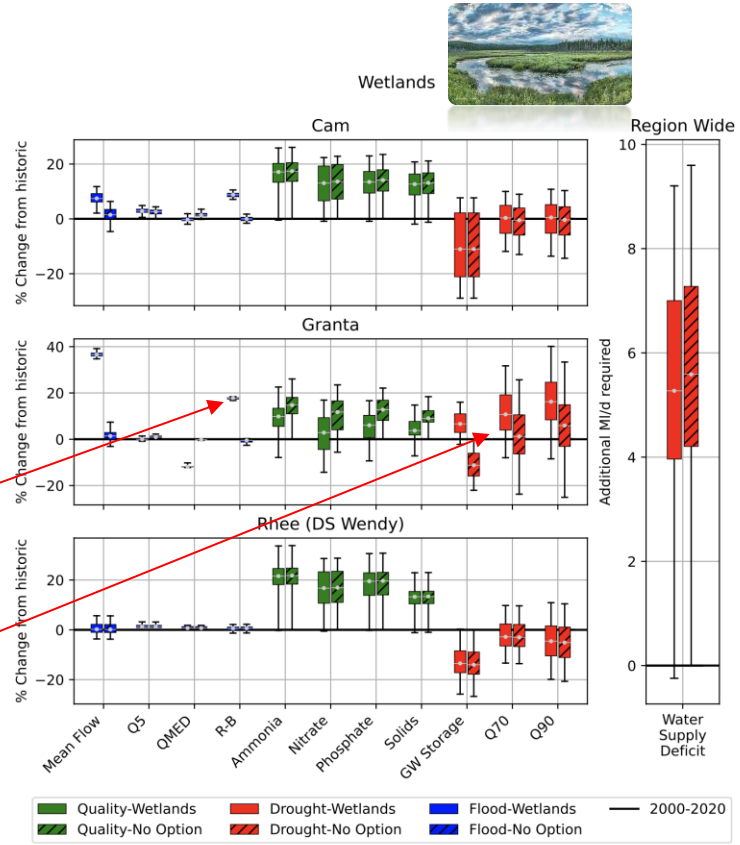
WSIMOD for future planning



Reduction of flooding and pollution

Increase in GW storage and baseflow



WSIMOD can assess effectiveness of planning options across a range of scenarios evaluated through flood, drought and water quality indicators

Dashed – no options
Solid – with wetlands

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List of references

[1] Dobson, B., & Mijic, A. (2020). Protecting rivers by integrating supply-wastewater infrastructure planning and coordinating operational decisions. *Environmental Research Letters*, *15*(11), 114025.

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[7] Liu, L., Dobson, B., & Mijic, A. (2023). Optimisation of urban-rural nature-based solutions for integrated catchment water management. *Journal of Environmental Management*, *329*, 117045.

[8] Dobson, B., Liu, L., & Mijic, A. (2023). Water Systems Integrated Modelling framework, WSIMOD: A Python package for integrated modelling of water quality and quantity across the water cycle. *Journal of Open Source Software*, *8*(83), 4996.

[9] Liu, L., Dobson, B., & Mijic, A. (2023). Water quality management at a critical checkpoint by coordinated multi-catchment urban-rural load allocation. *Journal of Environmental Management*, *340*, 117979.