Project fact sheet

Shifting water availability and demand – the implications of climate change

Key points

- Climate change poses increasing uncertainty for water availability in the Murray–Darling Basin, threatening agricultural productivity and ecosystem health.
- Stress testing and machine learning approaches are transforming water resource management, enabling adaptation to diverse climate futures.
- The project builds resilience by identifying thresholds of vulnerability and developing strategies to sustain critical water systems.

The challenge

The Murray–Darling Basin is a cornerstone of Australia's agriculture, supporting diverse communities and ecosystems. However, climate change threatens this vital resource with reductions in river flows (up to 20%) and significant variability in rainfall patterns. These changes undermine water allocation reliability, with differing impacts across regions and sectors. Traditional water management methods, which assume predictable conditions, are inadequate for addressing these complex, evolving challenges.

The opportunity

This project provides a unique opportunity to reframe water management through innovative techniques. Stress testing evaluates the resilience of water systems against diverse plausible futures, moving away from reactive strategies to proactive, robust planning. Machine learning accelerates insights by modelling system behaviour under various scenarios, offering flexible tools for managing uncertainty.

Our research

- **Stress testing for resilience**: By flipping traditional methods, stress testing evaluates system performance under extreme conditions. This approach begins with critical objectives, such as sustaining irrigation or ecological flows, and examines the pressures that compromise them. For instance, New South Wales and Victoria exhibit differing allocation resilience, highlighting opportunities for tailored interventions.
- **Stochastic modelling**: Large-scale stochastic climate flow modelling generates monthly data across the Basin, offering granular insights into system dynamics. These models identify 'vulnerability surfaces' to detect

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thresholds where performance deteriorates rapidly.

- **Machine learning applications**: Machine learning simplifies and enhances complex resource models, significantly reducing time and computational demands. These emulators replicate outcomes from detailed models, enabling rapid scenario testing and adaptation analysis. Insights reveal that the northern basin is twice as sensitive to precipitation changes compared to the southern basin.

> “By simulating adaptation responses quickly, we support resilient strategies that protect the system from failure under varied conditions
>
> - Dr Andrew John

Outcomes

The project delivers actionable insights, including:

- Identification of critical thresholds for hydrological metrics, revealing where adaptive strategies are most needed.
- Enhanced understanding of allocation disparities and climate sensitivities between regions.
- Development of tools like vulnerability maps and machine learning emulators to support planning.
- Strategies for managing low and high flow conditions, balancing ecological and agricultural demands.

Next steps

Moving forward, researchers aim to integrate these methods into broader basin-wide planning frameworks.

Workshops will refine the tools with stakeholder feedback, ensuring they meet practical needs.

The team will also explore additional climate scenarios and management responses to build a comprehensive adaptation toolkit.

One Basin CRC

Since our inception in mid-2022, the **One Basin Cooperative Research Centre** has brought together 85 partners across the Murray–Darling Basin.

Our purpose is to work together to grow value from water in a changing world.

From Queensland to South Australia, we are finding practical solutions to complex challenges, training the next generation of scientists, and nurturing regional communities.

Our collective goal is a productive, resilient and sustainable Murray–Darling Basin.

Key personnel

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