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Water Systems Research Group

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Water Research at the University of Adelaide

Environment Institute

- Energy
- Water
- Climate
- ...

- WaterSYSTEMS
- Water Quality and Treatment
- Hydropedology
- Water Ecology
Water Research Centre

About:
- Part of the Environment Institute. Brings together hydrologists, ecologists, biochemists, engineers, mathematical modellers and social scientists to undertake transdisciplinary water research.

WaterSYSTEMS Research Group

About:
- To provide high-quality research in support of sustainable planning, design, operation and management of water systems.
Academic staff

Martin Lambert  
Angus Simpson  
Holger Maier  
Dmitri Kavetski  
Mark Thyer  
Seth Westra  
Aaron Zecchin
What we do

Average extreme rainfall, accounting for climate variability and change

Rainfall-runoff modelling (various types).

Flood risk (including estuarine floods)

Environmental water

Water infrastructure planning (supply & demand, robust vs optimal decision making)

Water infrastructure climate “stress testing”

Household water use

Pipeline condition assessment; corrosion & water quality in pipes

Also: remote sensing, big data analysis, uncertainty & environmental decision making...

Water quality (potable, reuse,...)
Flood risk estimation methods

- **Continuous simulation** (for systems with significant storage)
- **Joint probability problems** (estuarine regions, confluence of two rivers)
- **Climate change**

Key contact: Seth Westra
Climate variability & change, and water supply

- **Water security assessments** (e.g. Adelaide’s reservoir inflows under climate change)
- **Seasonal forecasting** (reservoir inflows and water supply systems)
- **Stochastic generation & climate stress testing** (exploring system behaviour and examining conditions under which systems ‘fail’ – case study in Lake Como, Italy)

Key contact: Seth Westra
Optimal planning for an uncertain future

- Optimal long-term planning plays an important role in may water infrastructure problems.
- This is complicated by uncertainty about future conditions (e.g. population dynamics, climate change).
- Advanced approaches to optimal planning under uncertainty can identify infrastructure portfolios that:
  - Are robust to short- to medium-term uncertainties
  - Are flexible to adapt to changing longer-term conditions

Key contact: Holger Maier
Getting the most out of existing data

- Increasing amounts of data collected by water authorities and Government agencies.
- We don’t make the most of this substantial investment by not interrogating and analysing these data.
- Advanced analysis of existing data can:
  - Increase our understanding of the dynamics of complex systems
  - Identify errors in the collected data
  - Identify inputs and outputs for predictive models

Key contact: Holger Maier
Hydrological model development, calibration and uncertainty analysis

- Hydrological and, more generally, environmental models often require calibration to achieve meaningful predictions
- Currently used calibration methods are often *ad hoc*, producing unreliable parameter and uncertainty estimates
- Benefits of improved modelling techniques:
  - Calibrate models more robustly and efficiently
  - Produce reliable parameter estimates
  - Quantify uncertainty in model predictions
  - Identify and where possible remedy model weaknesses

Key contact: Dmitri Kavetski
Wall condition assessment for transmission pipelines

Cement mortar lining lost and metal wall corroded

Cement mortar lining intact and wall not corroded

Spalled cement mortar lining and corroded metal wall

Cross-sections through pipeline

Longitudinal section along pipeline

Pressure transducer

Pressure wave

Graph showing transient pressure response when wall is damaged

$H_0$

$\Delta H$

$H$

$\Delta H =$ pressure rise following generated transient

Transient plateau would be flat for an undamaged pipeline

Key contact: Aaron Zecchin
Wall condition assessment for transmission pipelines

- **On-going research**
  - Lead by Prof Martin Lambert, Prof Angus Simpson and Dr Aaron Zecchin
  - ARC Discovery Project: “Cost Effective Pipeline Condition Assessment Using Paired Pressure Sensor Arrays”
  - ARC Linkage project: “Combining Transient Micro-Reflections and Multi-Sensor Arrays for Condition Assessment of Buried Pipes”

- **Solving real problems in the field**
  - Patented in AU, NZ, UK, US, HK
  - 6 field trials funded by the University and water utilities in 2012 and 2013
  - Commercialisation starts from July 2013 with business partner Detection Services Co. Ltd.

“Hydraulic Transient Analysis has, so far, been the most cost-effective and comprehensive of the noninvasive methods trialled by the Planned Maintenance Delivery and Tactical Asset Maintenance teams.” — September 2012, Issue 33, QUU (Queensland Urban Utility) Newsletter

Key contact: Aaron Zecchin
Fire mains water systems results

- Microbial corrosion of the assets
  - Reduction of assets life
  - Reduction of hydraulic performance
- Fire water systems are known for high levels of discolouration
- Used in emergency situation
- Study observed the following
  - Three different fire stands
  - Duration of the discolouration period (NTU, Flow rate)
  - Bacterial community (High throughput sequencing)
  - Water chemistry

Key contact: Martin Lambert
Fire mains water systems results

- **Microbial community:**
  - Microbial corrosion bacteria identified
  - Bacteria associated with negative dermatological effects

- ~ 1 minute of highly discoloured material

- Chemical composition indicates discolouration was associated to iron

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Key contact: Martin Lambert
Thank you