EXPECT Science explainer

Developing resilient engineering applications using EXPECT regional climate data.

ENGINEERING | WATER | CLIMATE | RESILIENCE

FULL NAME

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INSTITUTION & DEPARTMENT

University of Toronto, Civil engineering department

EXPERTISE

Engineering applications related to climate processes

SUMMARY

Human progress depends on how our technologies manage water challenges. Activities such as urbanisation and deforestation can shift the balance of how engineering applications, like infrastructure, respond to climate stresses.

Using EXPECT data to explore the interactions between climate and environmental impact, helps us develop resilient technologies that adapt to change. These advances support sustainable solutions that rely on local engagement and ownership.

Can you explain why/how your expertise is related to climate change?

Hamed Ibrahim: I have a background in mathematics and groundwater hydrology, which I applied to research waterborne diseases. In particular, River Blindness, a vector-borne disease that affects farmers in remote tropical regions.

Later, I started working on numerical modelling of large-scale ocean and atmosphere processes for engineering purposes. In one project in the Persian Gulf, we used a coupled model to develop strategies for seawater desalinisation. *(Figure 1)*

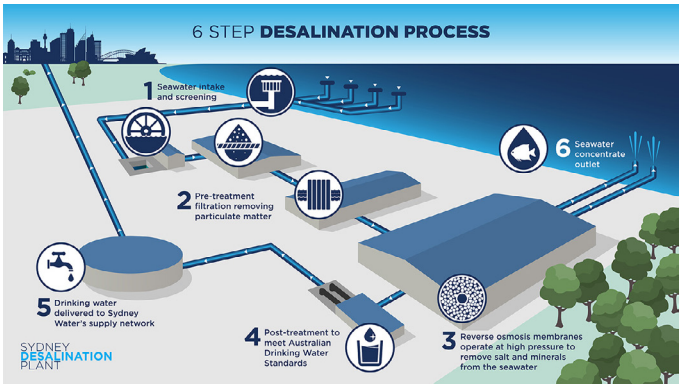


Figure 1. How desalination works. @Sydney Desalination Plant.

Through this work, I became more aware of how climate processes affect and drive many water-related issues that are directly related to pressing societal challenges.

Understanding how technologies like agriculture, cities, and energy systems interact with these processes is key to building a sustainable future.

Within EXPECT, what's the focus of your research?

H.I.: I study how rainfall is divided into infiltration (water soaking into the soil), runoff (water flowing on the surface), and evapotranspiration (water returning to the atmosphere through evaporation and plant transpiration). Human activities interfere with these land-surface processes, for example through urban activities or deforestation, consequently affecting the partitioning of rainfall and heat energy, and impacting the environment.

The EXPECT project provides advanced regional climate data that I use to improve local and regional-scale models to increase our understanding of the interactions between urban surfaces, water flows and the regional climate. My goal is to identify critical design parameters for infrastructure that are resilient to future climatic changes, thereby achieving more sustainable built-natural environments.

Besides having the technologies to deal with complex water problems, I aim to contribute to climate challenges in Global South regions, which lack the resources to navigate the consequences of extreme weather events.

What is a common misbelief about the topic we are covering?

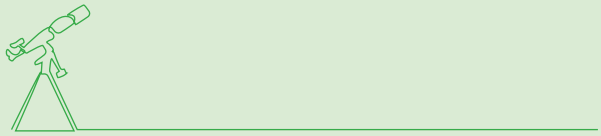
H.I.: A common misconception about climate change is that infrastructure designed for the upcoming 10 to 20 years will withstand changes expected over several decades.

Bridging theory and practice is crucial. When we explain how climate and infrastructure challenges overlap, people outside science - such as policymakers and citizens - can see that they are part of the same issue. Creating that shared understanding motivates collaboration and collective action, which is essential for real and sustainable solutions to the climate problem.

LOOKING FORWARD

We are combining traditional science with engineering practice because solving climate challenges requires both. EXPECT data helps us understand the interactions between urban areas and future water problems, so that we can develop adaptative engineering solutions.

Ultimately, sustainable progress means developing new technologies and encouraging behavioural change, while ensuring that communities feel involved and empowered to act.



WHY A SCIENCE EXPLAINER

Through short, focused questions, project researchers share what they study, why it matters, and how their investigations lead to real-world findings.

By opening up the day-to-day challenges and thinking behind climate research, these explainers make science more accessible, transparent, and trustworthy for other researchers and decision-makers alike.

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Funding

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