TRANSCRIPT

Sydney Ideas podcast

Running out of water?

Thursday 6 August 2020

PETR MATOUS
Hello, everyone. Thank you all for zooming in today for our webinar titled, *Running out of water*. We chose a deliberately provocative title as you will appreciate while listening to today's thoughts, water is strictly speaking, not something that disappears after use.

And so in this sense, it cannot really run out. But we will need to do things differently. This webinar is coming to you from the Gadigal land, land blessed by saltwater in the east; Parramatta River in the north and Cooks River in the south.

We acknowledge that water has always had a great spiritual significance for the traditional custodians, the Gadigal, who've cared for it for tens of thousands of years.

From this land, you will hear about cutting edge research and water from an absolutely brilliant lineup of speakers.

Professor Dianne Wiley, the Head of School of Chemical and Biomolecular Engineering will set the scene and introduce the state-of-the-art research in water treatment.

Professor Ben Eggleton, a co-director of the New South Wales Smart Sensor Network, will explain how remote sensing of the underground can save us precious resources.

Professor Sally Cripps who leads the data resource analytics for resources and environments. We'll explain how better understanding of uncertainty can help us drought proof Australia.

I, Petr Matous from the School of Project Management in Faculty of Engineering, will talk about how applications of network science can help us better understand complex socio-environmental systems.

Most importantly, we have the great privilege of being joined today by the NSW Minister for Water, Property and Housing, the Honorable Linda Jane Pavey.

LINDA PAVEY MP

Thank you very much for your kind introduction. It's wonderful to be in such with such esteemed company, one doctor and three professors.

I'm just a Member for Oxley on the mid north coast of New South Wales and whilst we are on Gadigal land; I wish I was on Gumbaynggir land, which would mean I'd be at home and the Macleay River would be right out in front of me.

But water is certainly a topic that has been front and centre of the community's mind, whether In the city or in the country in recent times, and I've very much enjoyed being Water Minister for the past 17 months.

It's been a tumultuous time, whilst we still are in in severe drought, in great parts of western New South Wales, and our storage is at levels that are not high enough, we've still got many challenges with communities like Bathurst, Tamworth and Orange with some of the worst droughts that they've ever experienced.

It is a great time to be talking about climate change, and the challenges it does bring. And in those challenges also accepting that at times we get falls that that are out of the ordinary.

It was the most delightful news because we were in a very stressful situation in Sydney with our catchment with Warragamba down to 40%. And in the space of a week, it went up to 82% the Sydney catchment. But we had experienced the hardest and fastest drop ever recorded in the catchment.

So it has been focusing our government's mind very much on into the future and the options that we have to ensure that that we cater for growth and the challenges that climate is bringing, and has brought.

So as I said, we're managing our way through drought. But I've got to say some of our country communities are really leading the way; I think Sydney is using currently around 180 litres per person a day.

In the in the city of Orange, they've really embraced change and conversations and they're down to I think probably the lowest in Australia, of a major regional centre or city; at about 120 litres per day with their storm water harvesting and showing themselves as a role model.

Recycling is very much at the heart of what happens particularly in regional & rural communities; and we want it to be more so in Sydney and it needs to be with the growth expectations for the new Western Sydney and quite rightly we've got a plan to plant 7 million trees.

Those trees are going to need to be watered and proper thinking about how our water systems and how recycling will work is very much at the heart of what we're doing.

You know, I was delighted only two months ago to announce a new contract with the steelworks down on the Illawarra; increasing our recycled water use in Sydney; up to 47 billion litres is recycled across 23 schemes and Illawarra steel is our biggest client of recycled water.

And our state water is driving towards doubling its recycling capability over the next 25 years. And local government and private sector recycling programmes will also continue to rise as a capability is added added to the system.

As I said regional New South Wales some 12% of the total water supply is derived from recycled water and I think there's a there's a greater understanding and respect of water within our regional communities whether it's from our farming practices, and you know the fact that a lot of people still you know get their water from their own personal tanks, has given us an opportunity to take some of those learnings and have those conversations within the city.

Technology is very much going to be at the heart of it, I've just done an interview with ABC Country Hour, talking about we are going to have the first floodplain harvesting licencing regime in Australia in the northern northwest part of New South Wales.

Ihat has been developed over six years of really hard work from people within my agency. But at the heart of it is smart sensing and technology that will ensure the greatest of transparency, and faith back into our farmers and our irrigators where we've seen some instances in recent times with some of that, faith has been lost and we need to restore that.

Because, you know, I want to be able to eat Australian rice and wear Australian cotton and drink Australian wine and having a very proper, transparent system of managing water within our regions is at the heart of that.

So delighted with some of the reforms that we've been able to achieve in New South Wales and also returning enormous amounts of water back to the environment.

And so that, you know, this terrible drought that we've been in, you know, the water that we've given back to the environment has ensured that Adelaide hasn't run out of water; that we've had strong flows of all of our rivers, our regulated river systems, we have been able to manage through this climate change period, and a severe drought and supporting our communities.

So you know, we should be proud of what we've done and learn from that and keep up that challenge. And I'll give you an example to also Hunter Water has installed data loggers for large non-residential customers who make up 70% of non-residential consumption.

This is enabling businesses to reduce leakage and increase our outstanding to increase our understanding of water use.

Hunter Water has led that under the former CEO Jim Bentley, who is now the Deputy Secretary for Water across New South Wales and there's a focus on leakage in Sydney Water we've been able to reduce those leakage rates and it's an all systems attempt.

It's not just one solution to increasing supply. It's not just a doubling de-sal, it's also looking at leaks and a more conservative water consumption by the by the greater population.

It is important we work with the community to ensure the best possible use of scarce resource. The solution to ensuring the sustainability of our water supplies cannot be provided by government alone.

It's a partnership with our local councils, we have 92 local water authorities across New South Wales. Victoria, I envy, have 16 but we've been working very well with our councils to ensure that we might take a more district like approach and improve that capacity.

That has been one of the benefits of the drought and supporting our communities ensure that they have the infrastructure to get through the drought; water conservation, recycling, desalination, storm water harvesting and other mechanism for extending our water supply are in operation.

And that is also in addition to construction of the three dams that we have announced to the government and you know, 650 Giga litres for Wyangala Dam, Dungowan Dam near Tamworth to improve the town's water supply as well as farming activity.

And also we're working on our final business case on a new dam on the Mole River on the Queensland border. It's a big job.

But as I said, we know the challenges that climate change bring; we know that there will be years of dry and there'll be moments of huge East Coast Lows that we saw in February where we were able to move within one week, 40% at Warragamba Dam, up to 82% within a week's period.

And I've got to say I'm very encouraged by the radar. At the moment over the next 10 days we could be seeing some very good news in terms of some of our communities out west that that are facing strong drought still.

We take our role as a custodian of water, of our precious water resources, very seriously. It's only by consulting and working with the community at all levels from the commercial irrigators, our productive industries to our regional communities; our metropolitan population and research organisations.

And I reiterate too that our new Deputy Secretary Jim Bentley is very much focused on reaching out to the research section.

I'm sad that I won't be able to be on this call because some of the speakers, I want to hear about the groundwater technologies, the sensing, I was in Nabiac, which is need Taree Only last week and the Nabiac Warfield apparently has something like 4000 Giga litres of water underneath them.

It was a warning the chief scientist gave me my first weeks as Minister; we need to better understand the ground our ground borders across New South Wales. And I'm happy to be working with my agency, to better understand that.

There's a whole suite of solutions. There's a whole suite of work and it's not just for government to do it, its to do it with our communities, local government; researchers like yourself, and I commend you for the work that you're doing.

Water is at the heart and soul of everything and a better aspect of it; a better appreciation, and a better use of it will serve us all for generations to come. Thank you very much.

DIANNE WILEY
Thank you Minister Pavey for that really great introduction. My name is Dianne Wiley. I'm coming to you today from the lands under the traditional custodianship of the Gweagal, Bidjigal and Gadigal clans.

As the Minister just said, water is a very valuable resource, and I wanted to share with you about some great ideas we're working on in the School of Chemical and Biomolecular Engineering at the University of Sydney to both produce new resources and treat our water resources better so that we can make better use of our water.

Many of you've probably heard about the use of dialysis to help people with kidney disease, remove waste products from their blood. Now in order for that technique to work, it needs water.

So usually what happens in hospitals, the town water is treated and put through a process of reverse osmosis and the permeate water from that process goes to the dialysis unit. In the meantime, the reject water from that process, which is actually quite clean goes off to sewerage.

So our team led by Dr. David Wang and Dr. Gustavo Fimbres Weihs are working with the some of the hospitals from the Western New South Wales local health districts, on a clever way of making better use of that reject water.

And here one of the techniques they're looking at is a membrane process called nanofiltration. Which is able to recycle a lot of that arrow, reject water; and then use the other water that's left over for things like irrigation, toilet flushing, gardens.

Now that team has estimated that up to 25% of the water that's currently needed for dialysis could be recycled in that way.

And down the bottom on the right-hand side, you can see a little membrane system that we've got in the laboratory on another technique called forward osmosis; for also looking at how we could better recycle the water from the hospitals.

We also have Professor PJ Cullen working on how to decontaminate water that's contaminated by PFAS.

PFAS you might have heard about. It's a firefighting foam, which unfortunately has ended up in a number of our water resources.

On the right-hand side in purple there you can see a bubble column which is used in conjunction with plasma to completely decompose the PFAS that’s in the water and on the left-hand side you can see the plasma discharging into the air bubbles.

And when it does that it creates a whole range of ions and radicals that can completely destroy the PFAS. The plasma can also be used for other types of wastes, including dyes, pesticides, antibiotics, microbes; and some other members of his team are also looking currently at how this technology might be used to destroy COVID.

In a project that I'm working on, that's led by Associate Professor Chiara Neto from Chemistry and Professor Martijn de Sterke from Physics, we are looking at a really clever way to try to condense water from the air. And on the right-hand side there, you can see the very smart surface that we have working in the laboratory to condense water.

Now as many of you realise, condensing water needs some sort of cold source to do that condensation, and on the left-hand side there you can see our clever little devices sitting up on the top of Sydney Nanohub at the University.

And this device uses as its coldness. the coldness from deep space. And that's really clever because it means that we can condense the water in the air without the use of electrical energy.

And we can do it 24 hours a day, even in really bright sunlight. And this sort of water could be used to support wildlife in droughts, or perhaps to grow grapes, or grow other crops or look after animals.

And in fact, we've also been looking at whether it could be used in a city like Sydney to help support our water resources and provide us with a new source of water.

We also have another project which is just starting up with the Smart Grid Cooperative Research Centre, led by Professor Marjorie Valix where we are looking to use waste products such as glass and mine wastes to put into new types of concrete and cement.

Because believe it or not, we're actually running out of some of the raw resources like sand and gravel that needs to go into that cement. And so by using these waste materials, we hope that we can produce in conjunction with our industry partners from mining companies, waste recyclers, cement manufacturers, and water utilities such as Sydney water and Hunter Water; to produce new concrete products that will be more environmentally friendly, more sustainable, more durable, and hopefully also cheaper.

And that it can be used for water networks such as pipes, culverts, gutters, and also pavements. And that's a good point for me to hand over to Ben to talk to you about some of the sensing work.

BEN EGGLETON
Thanks, Dianne. Great to be with you today. So picking up on the theme, I'm going to talk really about sensing the underground where all - where is all the water going? I'm speaking with two hats. I'm director of Sydney Nano.

But I'm also co-director of the New South Wales Smart Sensing Network. So, this is an image of the water cycle.

And of course, if we just click through, there are a number of issues that we're going to pick up on in this session. We already heard about the plane harvesting.

We know about the fish kills, we know about groundwater monitoring, I'm going to focus on advanced pipe sensing, which the minister alluded to.

And of course, with all these issues, there's a massive amount of data which the sensors provide and the data analytics that you'll hear about from my colleague, Sally. And the statistics will inform us of what's going on and where we can invest.

So with that perspective, let me just make sure what we all understand what we mean by a Smart Sensor. So we all have one sitting in front of us right now, in our smartphone. It is indeed loaded with fantastic sensors that are connected onto the cloud.

And we often use machine learning or AI to provide that control of our environment. So our houses, our cars are loaded with sensors; the New South Wales smart sensing network was set up to provide that thought leadership across New South Wales.

So our vision is to transform the ecosystem. advance prosperity across the state through solutions and opportunities that we create by bringing together academia, industry and government to position New South Wales as a recognised global leader.

Um, so we represent many of the New South Wales universities, plus our friends in the ACT in ANU and University of Canberra.

So of course, smart sensors are really paramount to many of the issues we face today. I was just on a panel discussion right before this session hosted by ASTI on the topic of COVID-19.

And I presented work we're doing at Sydney Nano and through the smart sensing network on using sensor fusion to detect signatures of infectious disease, possibly based on wearables. But of course, we also work in agriculture using sensors to detect and enhance smart ag, smart cities.

Okay, so let me just sort of frame the conversation by two key issues already mentioned by the Minister.

Massive amounts of water are being lost simply through leaks and breaks in pipes. In fact, it's about 10% of the water is lost through leaking pipes; that's equivalent to the amount of water generated by desalination plant.

This is a global issue. This is not unique to Sydney. Sydney probably is better than many places around the world; during the drought, this was a pretty big issue.

Even with the dams a full, it's basic, the catastrophic failure the damage that is done when these pipes break; to a residence, to infrastructure, to transport, to industry is severe.

So this is really one of the grand challenges. So the New South Wales Smart City network really brings together those three pillars of innovation, the knowledge demand, which is the water utilities in this case.

We bring the universities together across New South Wales, ACT and we work closely with industry. So the water utilities that have been involved in this work are across Australia but also we connect with global water utilities, in the UK in particular.

So what's interesting about our work here is that we've taken quite a whole of sense, whole of pipe perspective if you like, and we're utilising sensor fusion, which basically means that we're not just using one sensor to map the underground; we're going to use a suite of different sensors that will look for different features or attributes of the underground.

So on the one hand, we're working with the University of ANU and Canberra on quantum sensing, that measures the gravity field above the ground on the surface that reveals the density of the soil, which is the signature of a leaking pipe.

We're working with the University of Newcastle on drones that measure from above, using LIDAR and hyperspectral imaging of water concentration at the surface and that reveals whether the pipe is leaking, whether the pipe corroding.

We're working with the University of New South Wales on distributed acoustic sensors or hydrophones that are embedded in an optical fibre.

So these are sensors that are actually placed in the pipe. They're dragged along the pipe and we listen literally, to the sound of the signature of a leaking pipe. And then we work with UTS on utilising acoustic sensors that are attached to the infrastructure above the ground.

And here again, we listen to a leaking pipe and of course, we use a massive amount of data analytics; sensor fusion, data fusion; to look for the signatures of those cracking pipes.

So there are a number of really key areas where smart sensors are going to enable smart decisions. The Minister already alluded to the floodplain harvesting and how can sensors better inform hydrological modelling.

I think we're going to hear a little bit from Sally. I alluded to the fish kills. How do we measure water quality in a scalable and durable meta, groundwater monitoring? How do we completely understand the surface ground water interaction?

What can advanced sensors offer? And of course, this overarching data analytics agenda, how do we share data, it's a big issue, more effectively and efficiently across different agencies. How do we use real time data and data analytics to improve the response times.

So right now, there are a couple of key issues and conversations that we're involved in with key stakeholders where we are bringing together universities across Australia with water utilities and other government agencies.

The Murray Darling water issue is a big one and there right now is open for tender through the Australian Government; an opportunity to bring smart sensors and data analytics to address this really key national issue.

And of course the Australian water and pipe network test facility, which is an initiative of the New South Wales smart sensing network is leading to establish a test facility in Western Sydney that would really allow Australia to be a world leader in water research and innovation to be integrated with the Western Sydney city build and to allow a consortium approach across the universities, the water utilities and the government agencies to address some of the really key issues around portables water, sewer, storm water, and water cycling and treatment.

I think with that I thank you and I look forward to the conversation. Over to Sally.

SALLY CRIPPS
Yeah. I it's a joy to be here today and talking in such illustrious company, and I'm going to be talking today about what we're doing in mathematics and statistics in order to try and understand how data analytics can help us in the management of our natural resources.

So DARE, which stands for Data Analytics, Resources and Environment. We are a data analytics centre with the difference; which is where we are focused on uncertainty.

So how can we use data to really understand uncertainty because the million-dollar question facing people like Minister Pavey, is how do you make decisions for the future in the face of such uncertainty?

How do you make the best possible evidence-based decisions that are robust to the amount of uncertainty that we see in our climate and you don't have to look far in our climate to just realise that back in the past how uncertain things are we hit in October of last year, we were in the middle of one of our worst droughts.

That was followed by bushfires. That were some of the worst we've seen, which had a devastating impact not only on the vegetation, but also on our foreigner and shortly after that, we had one of the well, a welcome flood.

But it was a flood of some substance. And you heard Minister Pavey say that we went from 40% to 82% in the Warragamba Dam.

So, in that context, we don't really have to think too hard just to appreciate what a difficult decision it is to model the uncertainty around our water supply, and how key that is for managing how we go forward into the future.

So, in doing this at the data analytics centre, what we've done is we've got a whole bunch of data scientists together there are people who are mathematicians, computer scientists, statisticians, and I've listed them on the left side there, together with a whole bunch of people who are really great scientists in their particular domain.

Lucy Willem and Fiona, for example, working in water, Glenda Aaron and Jody Webster in biodiversity, and the Mark Lindsay, Mark Jessel and Kristen in the in the more landscapes or the minerals. Now, key in all of this is we do use a lot of data, we use the data that's provided by Ben's group.

We also inform Ben's group about where we are most uncertain about what's actually happening, so that they can strategically place their senses.

I suppose what I do want to say though, is that the conventional or superficial use of big data is often really dangerously misleading.

So, because it underestimates uncertainty, you get predictions and predictions are all well and good and they're certainly important. But without understanding the uncertainty around those predictions, you will not get optimal decisions made.

So the centre is a $12 million enterprise. And we look at a whole bunch of things together because we argue that you can't just look at water without looking at other aspects like biodiversity or minerals, and so we look at all three together.

And we have three themes as well for data science, which is, you know, exploring data ,building models and making decisions and to do this well we've got some New South Wales government partners, Department of Planning and Industry, the Natural Resources Commission, the data analytics centre of New South Wales.

We have other New South Wales government entities such as Water New South Wales, and you've heard Ben alking about the NSSM, which is the New South Wales Smart Sensing Network.

We've got other state and federal government agencies Geoscience Australia, Bureau of Meteorology, the Biodiversity Institute of Western Australia. And we're very grateful for our funders who are both from the philanthropic world The Minderoo Foundation has made a very generous donation to us, but also companies; New Crest, IAG, McKinsey.

These are companies who are really interested in the long-term future of Australia's environment, and who have very generously sponsored us and are keen to carry out their business but in a way that ensures the future for Australia.

Just to give you an idea of some of the work that we've been looking at, I've got here you'll see something moving across your screen, that's water vapour going on a daily basis.

This was a project where we had about 300 million data points, we had daily measurements of rainfall across the entire Australian continent and we wanted to see, you know, what was the impact of various indicators, climate indicators on that rainfall?

We all know. we've all heard about ENSO which is the El Nino Southern Oscillation index on the east coast. We know that that's a contributor to what happens to rainfall in Australia.

We know the Indian Ocean Dipole is something on our west coast, the Southern Annular Mode Indiex is from the Southern Ocean, and we what we really wanted to understand was what parts, under what conditions do those things give us indications about what's going to happen to daily rainfall in Australia.

And the real focus is, of course on daily rainfall, because it's very different to have 100 mls in one day rather than 100 mils over 30 days. So, we really wanted to understand this. And that was a very, that was a good project, and that papers appeared in the Annals of Applied Statistics.

We do a lot of other projects. And these are just some of them that I've listed up here. A lot of them are around understanding the uncertainty now natural system, and you can see there that one of them at least under the water, where's the water gone? That's what Ben was talking about.

That's probabilistic models for the water balance dynamics there. We're trying to really understand where the groundwater has gone and working very closely with our colleagues in sensing to say well, we actually need a sensor placed here because we're really unsure of what lies underneath.

And so it's together using mathematics with the sensors that can actually give us big insights. And just finish off to say that it is in this understanding of uncertainty that we have the best hope in planning for a future.

The Murray Darling Basin has got a tender out, and you heard about that from Ben as well. And we're trying to do what we can in that regard, in order to understand what's happening to the water storage in the Murray Darling Basin.

We've done some work on that in the past. You'll see a graph on the bottom left, the red line is the actual water storage going from 1970 up to the present. The blue is what we're sort of predicting; what you can see from that is it's highly variable.

But when we built a probabilistic model, we can actually get predictions and probability distributions over those predictions.

And in using things like the Southern Oscillation Index as an indicator of what rainfall is going to be, we can, you know, six months in advance explain 75% of the variability in the storage in the Murray down basin.

So, I'm very hopeful that together, mathematics and science can work hand in hand to actually lead to better insights and outcomes for the Murray Darling Basin, and for the water in general across New South Wales. Thanks very much.

PETR MATOUS
Now, I have the privilege of giving the last presentation today before we turn to discussion. We'll make the case for socio-environmental modelling, starting with my personal experience or working experience

The kind of light on the screen is how I started my work with water 20 years ago, and it was building water supply network models on the computer.

Such Digital Network models simplify the reality and allow us to simulate water flows, water pressure distribution and contaminant contagion across the network.

Similar digital models only a bit better looking are still used in practice to design. restructure and maintain actual physical water supply networks.

After this experience, Ive later become involved in the assessment of water systems in several countries of Southeast Asia. Water systems in these cities have always often failed to provide water to a large proportion of its citizens.

The main problem was in hydraulics are necessarily a lot like water resources, but something more complex for example, in Manila, where these pictures are from, local water providers could not build direct water connections to their customers in vast informal settlements around the city.

Because these settlements were technically illegal. The inhabitants of these communities obtained water through free so-called community-based water systems. The community received water from the provider in bulk and took care of the distribution by themselves. Little pipes like these in the photos. It seems like a great and empowering solution.

But a closer examination found that how much water, what quality and for how much money each community member could get; depended on their social position in their community.

Something like social position in a community sounds too vague to rigorously consider for water supply, management or policy purposes, but it can actually be measured using the network paradigm again, only this time we are not speaking about water networks but social networks.

The diagrams on the screen show examples of two actual measured social networks in two different communities in Indonesia. The links in the diagram represent relationships between the community members, who are depicted by the small circles.

Depending on how water systems are designed, where you are in these types of community social networks, in the centre or on the edge can determine how much water you can get. With this knowledge specific practical recommendations for more equitable and sustainable water provision could be made.

In general, we can run infrastructure projects better if we understand better the structure of the affected communities and the stakeholder networks that surround them.

Subsequent studies have shown that social networks matter for other things too, because people influence each other and learn from each other and networks.

For example, our current research suggests that communities that are highly centralised around the single individual, like the star diagram on the right, are less likely to adopt progressive technologies and be more likely to stay stuck with old ways of doing things.

Networks matter at larger scales too. For example, in our recent joint research led by our colleague in Sweden, we explained the need for understanding networks of ecological and social interdependencies jointly for more sustainable environmental governance.

Such network conceptualizations can help us make visible and quantify; what would normally be put into a 'too complex to do something about' category. This approach can help us also to uncover any governance gaps that need to be breached.

For example, if on the green ecological layer, there is an ecological interdependency between a river in one jurisdiction, and a water body in another jurisdiction; and if on the red social layer, the corresponding agencies that look after these respective resources are not linked by communication and collaboration relationships are probably going to have a problem.

I would argue that this sociology ecological misalignment is a cause of many troubles that we are dealing with now. Because water in our ecosystems are not compartmentalised in the way that our agencies and our disciplines that look after them often are.

I hope these examples illustrate the importance of considering ecological and social systems jointly for better management of important resources, such as water; and how network analysis can help make sense of such complex interdependencies.

I'll finish my presentation here and move to the discussion. I will I will go straight into the participants questions.

And one of them is actually quite close to what I wanted to ask anyway. It's about the future. So we've heard about what technologies are being developed now, what is being used now, but thinking about 2030, which is the day that we put into the description of the event in our advertisement?

What do you think? What will be the technologies? What will be the strategies that will we will need to in 2030, to deal with the situation that we're heading towards, with climate change mentioned by the Minister.

We have changing demographics, changing cities, regional areas, and we know that we're running out of water and all of that, but what can we do? What will we need to do 10 years from now? Any takers for this question?

DIANNE WILEY
So I'll start on that one. I think that we need to start to see water as our whole resource, because it's not just the water.

You know, if we desalinate things, there's a lot of other components in that saltwater that we could actually be using in our communities.

And certainly, we need to be looking at not just recycling the water one or two times, but also taking other products out. So, for example, we already know that if we treated sewage water, we could recover a lot of agricultural fertiliser products and things like that.

So really starting to think of water as that much more holistic resource and reusing it over and over again and using not just the water itself, which of course is really vital, but also using all the other components that are in it as well.

SALLY CRIPPS
So water is part of our much larger ecosystem and what we do to ensure that we have enough water whether it's to have a desal plant, which has knock on effects, for other things, whether it's to use groundwater in order to ensure supply also has other effects, like raising the salt table.

So all of these things have to be considered as part of a whole and added over to that complexity is the complexity that I believe; that we simply do not really yet understand just how extreme our climate can be. We've only started taking reliable measurements on this for, you know, 200 years.

My concern is that it could well be going into the future much more extreme than what we're seeing now. And how do you plan for those increasing extreme events is nontrivial.

And something that we, you know, we need to understand and I think the first way to best understand that is, is by working with scientists who do know these things but also by getting data from sensors and various bits and pieces in order for us to get an actual handle on how variable these things really are.

BEN EGGLETON
Just to pick up on Sally's point, it's all about the data and data need sensors. I've been to the command centre at Sydney Water in Parramatta; it's a fascinating room where they manage the Sydney water network.

And they have a big dashboard, where you kind of expect to see the Sydney map of all the pipes and it's a bit like a Google Maps you kind of expected to be interactive and that there were sensors everywhere and they can use AI and I asked the guys, I said, How do you find out if there's a pipe leak? He said, we get a phone call.

I said, Do you use social media? He said, yeah, we monitor the Twitter channels, you know, and every once in a while, someone tags us, we call them. And this is best practice.

They're kind of actually one of the leading water utility, the companies in the world, so they really haven't brought the leading edge innovation; the AI, the smart sensors to bear on that problem. And I think, you know, there's so much progress. I mean, we can bring that 10% loss down to 4%. That's only the beginning.

PETR MATOUS
Thank you, Ben. If I can just follow up with a question to Sally. Sally, you mentioned that there's a lot of superficial use of big data that can cause more and more damage than good, that quite intrigued me. Could you elaborate on that?

SALLY CRIPPS
Yeah. So I suppose that there's as I said, most people here have heard all about big data, but if we're just using that data without understanding, feeding them into algorithms that we don't understand, that don't actually measure uncertainty, then we're not getting the big picture.

So the big question, there is no amount of data that is going to reduce the variability in our climate. So it's not really a question of using data to, you know, be able to predict exactly what's going to happen, we're never going to do that, what we what we have to do is use data in a smart way to understand uncertainty and to model uncertainty, because it's about risk management going forward.

And so we need to collect the right data. It's not just a question of having lots of data. So we need to be in conversation with our people to say, we need if we're, I want to make this decision about whether to build this desal plant or whether to increase the dam at Warragamba.

Or any other decision that we may have about water in the future. That has got to be taken into the context of what sort of risks does that pose, how variable is it going forward, and that often cannot be answered with data we currently have.

So it's not just a question of lots of data, but we need the right data and that's where you need to work with people like, Ben in sensing and say, well actually, this is what, this is the data we need, how can you put a device there that will actually sense that. So in order for it to feed back, we have a lot of data, but most of it is pretty useless.

PETR MATOUS
And so we have only a few minutes left. I would like to give an opportunity to every panel member if they have some final closing message. What they think is the key point in their from their own disciplinary viewpoint or from their own expertise in terms of water, going forward.

BEN EGGLETON
I can give my take home message is sensors and data. I think that there are off the shelf sensors that already add value. And there's a lot of innovation happening in sensors. Thinking about quantum sensors, think about some of the nanotechnology that's going to transform that whole space.

SALLY CRIPPS
Yeah, okay. Well I might take home would be that, you know that every Australian is a stakeholder in the water business. And that we need actually people coming together from different backgrounds, different disciplines to work collectively on doing this.

So scientists, the community, trying to understand better what our needs are for the future and figuring out, trying to drought proof Australia basically, by trying to understand just how variable it is and how we can take measures to mitigate against being in a position where we, as we almost did last year, ran out of water.

DIANNE WILEY
I'd add to that and saying let's stop treating water as a once off use resource. And let's start getting together and getting and working on all our great ideas to try and think how we can better treat and reuse; and produce new water sources like that technology that I showed you about getting water direct from the air without having to wait for it to rain.

PETR MATOUS
I think it's a wonderful concluding concluding message. It sounds to me, like a sci fi with it from the air and being cooled by coldness from the space. It's amazing.

And I was hoping that on this panel, we will not just complain about how the environment is all going to hell and how many problems and challenges we have, but that we can actually illustrate what are some potential pieces of the puzzles that can work as practical solutions.

And while we're very aware that our expertise is skewed towards just one side, we just want one part of the overall solution. I think that there is a lot of knowledge here that could be practically applied and provide evidence for any future solution.

So with that, I would like to thank all of the participants.

ANNA BURNS
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Finally, we want to acknowledge that this podcast was made in Sydney which sits on the land of the Gadigal people of the Eora nation. It is upon their ancestral lands that the University of Sydney is built.