# Managing Bushfire risk in a changing climate transcript

[Victoria government logo]

[Text on screen] Managing Bushfire risk in a changing climate

[Beth Roberts] Welcome to Managing Bushfire risk in a changing climate.

I'm Beth Roberts, Director of Victoria's newly established Office of Bushfire Risk Management and I'll be your host for this evening.

But before we begin and in the spirit of reconciliation, I'd like to acknowledge the Traditional Custodians of Country throughout Australia and their connections over thousands of years to land, sea and community.

While I welcomed you in the language of the people of the Kulin Nation where our livestream is coming to you from, tonight, I have the privilege of sitting on Gunaikurnai Country in east Gippsland and I pay my respects to their Elders past and present and emerging and extend that respect to all Aboriginal and Torres Strait Islander people who are with us.

You have all dialled in from around Australia and, possibly also the world so please do let us know where you're from by utilising the chat function to the right-hand side of your Zoom platform.

I also invite you throughout this evening to use that chat box to post any questions that come to your mind as you're listening to our guests, and our moderator Megan is on hand just to make sure we get to as many of those questions as we can in the final 15 minutes this evening.

But, with limited time with you all let's dive straight in.

We know we live in one of the most bushfire prone regions in the world and while bushfires have always been part of Victoria and living in Victoria, we also know that climate change is making things worse.

If we take a look at some of the recently published research in the *International Journal of Wildland Fire* the combination of an increase in bushfires, along with a decrease in spring rain is said to triple in some parts of Victoria by the end of the century. From that research alone it's fair to say that we do have a fight on our hands.

Every year, we have about a thousand bush fires in Victoria and 90% of those start in forests which really underlines the crucial role of agencies like Forest Fire Management Victoria, the Country Fire Authority and Fire Rescue Victoria to work together to find new ways to manage bushfire risk alongside those communities that simply know their landscape best. So, we have four panellists joining us tonight from all of those sectors that I just spoke to you about and they'll be sharing their knowledge skills and expertise with you.

Firstly, I'd like to welcome Dr Sarah Harris, Manager of Research and Development from the County Fire Authority.

For over 20 years Sarah has conducted fire and climate science research at universities, through government departments and also as a Caltech postdoc research scholar based at NASA’s jet propulsion lab in the US.

Sarah's research focuses on the variability and change in fire weather climate wildfire links, and prediction of seasonal wildfire activity.

She and her team at the CFA work on developing products and solutions to improve our operational response to bushfire management.

Welcome Sarah. Thanks for joining us and over to you.

[Dr Sarah Harris] Thanks Beth.

So today I'm going to explore some of the science of climate change and fire. What we do know and even what we don't know.

Today when I'm talking about climate change or global warming, I'm referring to human-induced warming of the earth system.

This is now unequivocal. The evidence suggests there is no doubt that our activities have led to an increase in global temperatures.

These changes in the earth's temperature have many flow-on effects including, resulting in more frequent and intense storms heat waves and droughts.

This has implications for us in many ways, including to our health, livelihoods, the economy and much more.

And it's also likely that we will continue to see a rise in temperature until at least the mid-century under all scenarios. After that it depends on the actions of all of us.

What does this mean?

So that's what is going on with global change but what does this mean for us here in Victoria and/ also for bushfires?

Firstly, in Victoria we've seen an increase in temperatures of over one degree in the last century and a reduction in cool season rainfall in winter and spring.

Unfortunately, these factors are expected to worsen with further increases in temperature and more hot days, rising sea levels and, also a reduction in snowfall.

You can explore these changes further on the DELWP website in terms of what this means for bushfires it is much more complex. You need to consider the fire weather, whether there is vegetation available to burn, and whether the vegetation is dry enough to burn, and also whether there is an ignition source to start the fire.

So, let's explore some of these factors. So, what we do know is that in terms of fire weather, so hot dry and windy conditions, these have increased in the south and eastern parts of Australia over the last 50 years and this is expected to worsen over the rest of the century.

Recent research that Beth mentioned at the beginning has found that we could see a doubling and up to tripling of days categorised as very high.

In addition to the fire season being more extreme, we have seen and will continue to see the fire season lengthening. What we've found for Victoria is that the fire season is

starting earlier, sometimes up to three months earlier.

This has serious implications for bushfire management in terms of increasing the demand on firefighters and resources and making it difficult for us to share resources nationally and internationally as seasons overlap.

This may also have implications for planned burn windows most likely shifting optimal burning periods for certain vegetation types.

We're also looking likely to experience more dangerous fire conditions and more lightning ignited fires.

Many of you may have heard of pyrocumulus nimbus or piracy b events in the news either during the 2019-2020 Black Summer season or overseas recently in the US.

These are essentially clouds generated by the heat of the bushfire and they can generate, they can create their own thunderstorms leading to erratic winds and lightning that can start new fires.

These are incredibly dangerous for firefighters and the communities they are trying to protect.

Unfortunately, scientists have found that the conditions that are favourable for these events to occur and also other phenomena like dry lightning are going to increase.

I've already talked about Victoria experiencing higher temperatures and reduced cool season rainfall. These changes lead to dry landscapes and dry landscapes mean the vegetation is more flammable, so the vegetation is more likely ignite and carry fire.

This is what we've experienced for some of our most significant fire seasons including Ash Wednesday, Black Saturday, and Black Summer.

All of these fire seasons were preceded by hot and dry spring conditions.

Unfortunately, under climate change many of the factors that contribute to dry landscapes are expected to worsen with more frequent and hotter hot days and heat waves and these variables may even exacerbate drought conditions.

So, what about the vegetation or biomass or fuels as we like to call it?

Essentially when we're talking about fuels, we're talking about all the elements that you can see in this picture. What is on the ground, the shrubs, the dry leaves caught in the shrubs, the trees, the bark on the trees, and also how close these things are together.

All of these are important for fires. We often hear people talk about fuel load in relation to fire risk.

There are so many more factors that need to be considered to understand fire risk and how fire will behave in relation to fuel.

Trying to predict how this is changing due to climate change is incredibly complex. We need to consider how vegetation will respond to higher temperatures and reduce cool season rainfall; how vegetation will respond to increasing atmospheric carbon dioxide; how vegetation will respond to higher fire frequency and severity; will any of this led to shifts in vegetation communities.

Where we once had forests will it be replaced with grass. And all of this varies for different vegetation types.

This is one of the drivers we have the most uncertainty about in terms of climate change, and of course this is an area where we are focusing our research attention on now as this is important to work out how our fire regime will change.

So, what does all this mean for bushfire management. We have some good evidence already you know what this means; we've already experienced an increase in number of fires.

In the last two decades we've had five fire seasons over 400,000 hectares burned. This is in comparison to only two seasons in the preceding three decades. Longer and more extreme and dangerous fire conditions could lead to firefighter fatigue and hot day's heat waves leading to heat stroke for those firefighters and greater risk overall for injury or worse. It could lead to an increased demand for resources in terms of personnel aircraft trucks, a reduced capacity to share resources nationally and internationally as fire seasons overlap, reduced or shifting opportunities for fuel reduction burns in some regions and overall, more expensive to respond to these fire events.

And while it seems I've provided a lot of negative news there is still a lot we can do to adapt to climate change.

We can better prepare before a fire season can occur, ensure we're engaging with the community to build resilience and focus on shared responsibility of fire risk. Where possible increased vegetation management through a variety of approaches. We can improve how we respond to fires explore, new technologies to quickly detect and suppress fires, explore increasing capacity and capability and, of course invest in research and development to ensure we're making evidence-based decisions on the latest science.

And I'll leave it there with some summary points.

Thanks for your time this evening and I'll pass back to Beth.

[Beth Roberts] Thanks so much Sarah. I appreciate all of the information that you've just given us, and I can see that you've sparked some questions already from the audience. And there's particular interest in understanding more about how research is helping fire agencies balance other values like biodiversity and health.

We'll come back to those at the end of the presentations this evening but for now let me introduce you to our second panellist Chris Hardman, Chief Fire Officer of Forest, Fire Management Victoria.

Chris's career in Australia has spanned four decades across Parks Vic and also DELWP; from responding to arson as the chief ranger in the Dandenong Ranges early in his career to being qualified as an incident controller in 2002.

Chris has been responsible for high-pressure decision-making during several of our fire emergencies including the devastating 2009 Black Saturday fires and of course most recently during the 19/20 Black Summer.

Chris now holds the most senior fire role in Victoria. Chris Hardman thanks for joining us and over to you.

[Chris Hardman] Thanks a lot Beth and just amazing statistics from Sarah which paints that really grim picture that we all have to come to terms with.

So, I've been in this job for three years and in our first year we had lots of fires and then we were facing the 19-20 season, so climate change is very much in my frame of reference every day.

I've seen the effects of climate change. We've had more fires, more storms, I'm not sure earthquakes are linked to climate change, but who knows but tragic events like

Black Saturday, the Black Summer fires and the extreme fire behaviour the pyrocumulus nimbus type fire behaviour, which is very, very, very dangerous for our firefighters in the field.

In my role I lead a team of more than 3000 incredible human beings that deliver forest and fire management on 8 million hectares of public land that, this equates to about a total of one-third of our state.

Our work involves bushfire hazard reduction, the delivery of conservation programs, the delivery of recreation services and of course we're one of the biggest road managers in the state with more than 50,000 kilometres of roads and tracks on the public land estate.

Our collective number one priority is to reduce the risk of bushfires to our communities, to the environment, and to the state's critical infrastructure which we all rely on.

We do have amazing and fantastic sophisticated tools and modelling to analyse the work that we do that tell us how much the work we are doing, how much that actually reduces bushfire risk to all of those values that we care so much about.

When you see our folks in green in the bush burning off mulching, slashing vegetation we're actively working toward a goal of reducing bushfire risk in a very planned and a very deliberate way. We do not leave its chance. It is based on local knowledge and the best science.

The work that we do leads to forests which are less flammable. And that means fires can be contained faster. When we talk about risk reduction it's not all about fuel management: it's super important but having firefighters to go out there and put the fire out, keeping it small reduces the risk to all of the values that we care about.

Firefighting now in today's world is all about partnerships. We work with scientists (sorry) we work with scientists, bureau of meteorology and that's really increasing our understanding of fire behaviour. People like Sarah and others you'll hear tonight.

The more we know knowledge is power and it makes a difference to how we go about our work.

Our number one priority is to keep everybody safe, protecting our beautiful environment, wonderful ecology, and reducing risk to homes and the livelihoods and the economy of Victoria.

We also partner with communities on bushfire prevention and recovery. We do know that many communities have been in these dreadful bushfires lead to years of recovery and we're very much involved in that process.

And without repeating too much but we know that living in Victoria means we are living with fire. It's not something we can choose. Victoria and Australia have evolved with fire. We live in that part of the world and living with fire, building our understanding and knowledge will build our resilience and our capability to live with this thing which is going to be more present with us as time goes by as the climate science is showing us.

You know 170% increase in bushfire ignitions in the last 50 years - that's a big number. A 20% decrease in spring rainfall that makes a massive difference every year to the flammability of our forests and particularly how early those forests are available to burn.

And the scary one that Sarah spoke about was a 40% increase in very high and severe fire risk days. And that's just in the last 50 years. And again, you know that will more than triple in some parts of our state so, living with fire means it's going to be a part of our lives and what do we do to live alongside it, we have to keep ourselves safe we have to try and protect our ecology in our environment, and we do that by understanding the challenge that climate change is delivering to us.

We are definitely going to have fewer ideal days, we traditionally do us burning in spring and then autumn but fewer ideal days in those seasons, the prevention activities that include plan burning on the public land estate in a hotter and dry climate will become more high risk. This means that we need to innovate, we're going to need to develop the best tools and programs to reduce the risk that climate change poses to all of us.

We will be burning in areas that we've traditionally burned in autumn in winter. This is stuff that Sarah was talking about, that we have to adapt to make sure that we will burn when the conditions are right. Ignore the calendar, ignore the date, and just do what we can when we can.

We are lucky to have some of the best bushfire management professionals and tools anywhere in the world. I work very closely with our friends in Canada and the US and in Victoria. I'm very proud to say that we have people with deep understanding of how to deal with this challenge. And we are called upon to support international agencies when in their times of need. We've been to the America and the US and Canada on many occasions, and I think I'm just extraordinarily proud of the work we do supporting our colleagues around Australia and globally.

We have for many years we've been developing, have developed a leading bushfire risk management approach in Victoria, but we need to keep working together, and we need to meet the challenges of climate change. Things are changing rapidly.

I have seen fire behaviour 20, 20 hours after 15 millimetres of rain I've seen fire crowning up the slopes of our beautiful forests and I've never seen that in 30 odd years.

Thankfully in the last state budget we received record amounts of funding with more than a half a billion dollars committed to forest and fire management and that money will be invested wisely to do everything we can to continue to reduce that ongoing and growing risk.

We've already begun investing these funds we've put on additional seasonal firefighters; we've put on additional forest and fire operations officers, these are our year-round firefighters, and we're updating our equipment, our technology and we're investing more in science and research to ensure that we are applying the best knowledge possible.

You know people think big airplanes put out bushfires but let me tell you it's human beings with bulldozers and trucks and with a torch in the hand, a drip torch in their hand; these are the people that put out bushfires and it takes many years of training, skill and experience to be able to do that on behalf of the community.

We know that this is just one step in our journey on the climate change adaptation. We know that we're going to have to do more. Every year we're learning more. Every year we reflect on how we did. And every year we plan to get better at doing what we're doing and i think it's incumbent upon all of us never to be satisfied with where we are because the climate is changing rapidly, and we have to change with it otherwise we will be running behind it and that's not good for any of us.

Our focus on containing fires at first attack means we keep fires small we reduce the damage they do to our environment, to our homes, to the economy and most importantly, human life.

Your forest firefighters last year contained 95% of all of the fires under five hectares.

As Beth said, we know we're going to get more than a thousand bushfires every year and that number is growing. We get more lightning, more dry lightning, we're trying to understand you know more about lightning and how it causes fires we're trying to understand more about fuel and how it ignites, and we'll talk more about that today.

One of the greatest threats to our beautiful parks, our beautiful forests is intense bushfires caused by climate change. The work we do to mitigate risk, the work we do to keep those fires small, may have an impact but I can tell you through first-hand experience the dryness in our soils, our wet forest burning we're seeing that the impact of these bushfires can be devastating to our ecology. And at the end of all of this of all of this conversation Victoria is our shared home. We're all in this fight against climate change together, bushfire risk management is a shared responsibility.

None of us, not one of us could do this alone. We have to do it together.

Look thanks a lot for listening to me and really look forward to your questions and I will pass back to Beth thanks a lot.

[Beth Roberts] Thanks so much Chris for your really candid conversation started just now. There was a lot in there and it's clear that you care not just about your 3000 staff but looking after a third of the state you put it and the vast array of jobs that you do in welcoming Victorians into the estate to enjoy their beautiful landscape, but also obviously an incredible amount of care for our communities and keeping us all safe.

You spoke a lot about partnerships throughout that thread and specifically there ended with the idea that we're all in this together, which of course is inclusive of communities and that's a really nice segue to our next panellist.

Lyn Harwood who is a resident of Mallacoota in Victoria's far east. Lyn weaves a really rich thread through life, she's a teacher, a dancer, an editor, a publisher, and an artist. She's spent the last 15 years editing Australian short stories with Bruce Pascoe and spends much of her time roaming the bush orchid hunting as she puts it. She also works with Black Duck Foods redeveloping indigenous food agriculture. She's a member of the local CFA in Mallacoota, and a driving force of the community-based bushfire management group there.

Lyn, I believe you've going to share with us a short video of this work, and of your work before speaking so I'll hand over to you and our tech team now. Thanks so much for joining us Lyn.

[Music]

[Text on screen] Building resilience through recovery

Community Based Bushfire Management

[Lyn Harwood] I reckon I see them because I'm terrified of snakes, so I'm always looking carefully at the ground.

[Music]

[Lyn Harwood] Lots of people walk past them. I don't and my mates don't and so that gives us a special joy.

One of the most amazing things about this area is the number of orchids that you find here and I'm a bit of an orchid tragic.

[Laughter]

[Lyn Harwood] There's over a hundred orchids that are here and there's something flowering every month of the year.

[Text on screen] Lyn Harwood

[Lyn Harwood] They are so beautiful. They're tiny, they're delicate, you have to go right up close to really appreciate them.

[Music]

[Lyn Harwood] I think that countries actually recovered a lot more quickly than community.

I don't think you even understand the trauma that you're going through until months afterwards and suddenly you'll be in tears.

It's a really slow process.

[Music]

[Lyn Harwood] A number of years ago we were concerned about the fuel accumulation around Mallacoota, and the drying weather. I put out a call generally to the Mallacoota community, anyone who's interested in talking about fuel management to come along to a meeting.

I've got half a dozen people, and we continued to work with the agency people to try and come to a greater understanding, a shared understanding, about fuel management around Mallacoota.

We came up with a number of plans for edge areas on the town and we were about to put it into practice when the fire beat us to it.

[Music]

[Lyn Harwood] We continued with our fuel management work after the bushfires but because of covert that wasn't going to work with a whole group of people. So, instead of having meetings, we've been able to provide people with information online in their own lounge room, where they can sit, they can watch it live, or they can watch it when they've got time and it's been a huge way of engaging people that we wouldn't normally have been able to do.

After such a traumatic event as a big bush fire, people's attitudes towards fuel management have become really divergent, so I think the aim of the webinars has been to inform people so that we can get a more, more subtle and more learned approach to fuel management.

[Music]

[Lyn Harwood] The Safer together team has been incredibly supportive. I really believe that we're on the right track and involving community with the agencies on a process of making our town more resilient and giving us greater protection from fire but at the same time allowing ourselves to enjoy the bush and what it gives to us.

Community actually knows how they how they live in the space and what is important to them so it's a long conversation and it's built on knowledge, it's built on knowing why things burn, and how to protect them and how to stop them burning, but it's also built on that is my favourite bush walk I love to do that and I do that every day you can't just chop down the trees to cut down the risk of fire.

There's actually a special orchid that comes out after a fire and you only see it after a fire. Its common name is Red Beak. We've never seen it in Mallacoota before, but we were waiting. We knew it would come. It's really like a burn, it comes up with a flame and then dies back to charcoal.

[Music]

[Text on screen] Safer Together

Our approach to reducing bushfire risk in Victoria

[CFA logo]

[Lyn Harwood] To um speak to you okay so there we go.

Thank you very much, thanks for the opportunity to speak to you about the involvement of community. Before we even went through the horror of the Black Saturday bushfire, the community in Mallacoota was very nervous about what was a whole number of years that had been dry and a lack of burns that had been able to, cool burns that had been able to take place as we've been talking about climate change in the last few minutes. We just hadn't had the opportunity to really provide a protection around our town so we were all very nervous and I felt that there was a better way of going forward than actually bulldozing a ring around the town.

A, that wasn't going to work but B, it's the repercussions from the community would have been horrific.

People would have been outraged. So, they needed, there really does need to be a discussion that is respectful, a real listening discussion between community and those members of the agencies that are involved in managing fuel.

So, the organisation that was convened had equal numbers of community and agency people and we had many, many, long hours of discussion about how to go about best protecting our town.

And that required us understanding what fuel agencies could do, what they couldn't do, what they were resourced to do, what they were legally required to do, but also as I said in that video, the community has to take responsibility for saying not just generally you can't do this or you can't do that but based on information and knowledge that they had to say, well how about we do it like this, how about we respect the biodiversity, you know the habitat of the glossy cockatoos, you know that's really important to us. We have to find a way of managing this so that we are respectful of the knowledge of the community, the desires of the community, as well as what agencies are actually able to do.

So, as you can imagine they were very long, they were very long conversations, and we had to share a lot of scientific information as well as that kind of more personal information. So that's been an ongoing job.

We've come up with plans, with maps that have we've put in front of the joint fuel management program which have been ticked off, but it doesn't stop there.

You know, every year is a new year of fuel management. Every year is a year where we have more knowledge, scientific knowledge, about you know why do some places burn hotter than another place. How are we going to mitigate against that? How does mulching, as a pretty impressive non-burn fuel treatment, how does that then going to affect the country. Can we do it year after year? And what are the implications of that for our country?

There is just, it's an ongoing battle; it's an ongoing challenge really, to understand more about the how the increased risk of fire can be mitigated and how we need to understand new ways of managing that.

We're going to have to really manage deep into the forest because we're not going to be able to burn, five years down the track there's just not going to be those windows of opportunity to do the big, large scale burns that we've been doing for years. We're going to have to look at smaller scale burns, we're going to have to look at opening up the forest and removing those middle layers.

Now these are ongoing conversations that the community has to be involved in. We tried to keep three things in our mind when we were working on our plans. That was understanding risk, respecting biodiversity of the country, and respecting the amenity of the people who live here. And they were our aims constantly. To find a way forward.

So, thanks for listening and thank you to my community and to the agencies that for two and a half years have worked so hard at getting these ideas together.

Over to you Beth.

[Beth Roberts] Thank you so much Lyn. It was a really powerful message both in the video and the narrative that you spoke too just now.

There's certainly a lot of love coming through for you from the chat line and someone even commenting that every community needs a Lyn.

And I couldn't agree more so thank you so much for your honest contribution tonight.

We'll certainly come back and address some of those questions, particularly also around balancing biodiversity and amenity and the ways in which we go about managing risk.

Firstly, though let me introduce to you all to our final panellist for this evening.

Associate Professor Gary Sheridan, who is the principal research fellow at Faculty of Science in The University of Melbourne.

Gary has 20 years of research experience that focuses on interaction of climate, bushfire hydrology and geomorphology in Australian forests. He works extensively with government, including DELWP and Melbourne Water, to ensure really strong uptake of his research and application of it in their formulation of policy which is so important in creating change.

He's an associate editor for the International Journal of Wildland Fire and he's also a member of Victorian government's scientific reference panel for DELWP.

Gary, I'll pass over to you to wrap us up with the presentations for the evening.

[Associate Professor Gary Sheridan] Thanks very much Beth for that introduction.

[The University of Melbourne logo]

[Text on screen] Forecasting forest fuel moisture using machine learning

Ass Prof Gary Sheridan, School of Ecosystem and Forest Sciences, Faculty of Science

[Associate Professor Gary Sheridan] So, my presentation today is titled Forecasting forest fuel moisture using machine learning and the research I want to talk to you about tackles a problem that is a significant one for fire managers and burn planners which is when a condition is going to be right to put a burn into the bush. So, it's a very delicate operation.

And the approach that we've taken I think is quite an exciting one, and quite

innovative and novel and I hope to outline it in the next few slides but firstly I'd just like to acknowledge the research team behind this project.

[Text on Screen] The University of Melbourne logo

The research project team

School of Ecosystem and Forest Sciences

Gary Sheridan Chris Lyell Assaf Inbar Rakesh Joshi

Melbourne Data Analytics Platform (MDAP)

Usha Nattala Jonathan Garber Simon Mutch Zaher Joukhadar

Forest Fire and Regions (DELWP) & CFA

Alicw Gower Tim Gazzard Thomas Duff (CFA)

Also..

* Sam Hillman
* Tegan Brown
* Stephen Deutsch
* ...others!

[Associate Professor Gary Sheridan] So this is the team was drawn from across the university and also with collaborators from Forest, Fire and Regions in DELWP and CFA. And work wouldn't have been possible without this great team behind the project.

And then before I go on also just want to clarify what I mean by fuel.

[Text on screen] What do we mean by fuel?

[Associate Professor Gary Sheridan] So when I talk about fuel in the forest, I mean that dead plant material on the forest floor, and both the amount of this material and its dryness is really critical for both the speed at which fire can spread but also whether ignitions will start in the forest.

[Text on screen] Why is forest fuel moisture so important for fire?

[Associate Professor Gary Sheridan] And just to kind of highlight for you just how important that moisture content or dryness is I've just put some data up here that shows the fuel moisture content on the horizontal axis and then the ignition probability of that fuel on the vertical axis.

And what you can see here is you only need a very small change in the fuel moisture content to go from a 100% chance of that fuel igniting down to no chance at all.

And this high sensitivity to fuel moisture is why this property is embedded within fire management documents such as policies and checklists and guidelines.

[Text on screen] What is fuel moisture forecasting so important for fire management?

Incorrect forecasts result in:

1. Missed burning opportunities (targets, bushfire risk0
2. Cancelled burns (Costly)
3. Underestimating or over estimating Bushfire risk (dangerous)
4. Poor understanding of how climate change will change fires

[Associate Professor Gary Sheridan] But most importantly it's really critical to be able to forecast fuel moisture into the future so that you can make decisions and help with planning of burning.

And if you get those forecasts wrong there's some really significant negative consequences.

So, one of them is missed burning opportunities. So, if your forecast says the fuels are going to be okay but in fact, they're either too wet and the burn won't start or too dry and the burn would be unpredictable then you've missed an opportunity. And there's a limited number of windows where burns can be put in by agencies.

The second consequence of incorrect forecasts is cancelled burns. So, if the burn if the forecast says the fuels are going to be okay and then they're not and the burn has to be cancelled, this is costly because there's a lot of equipment and personnel and helicopters and planes.

And it's very expensive running burns so we don't want burns being cancelled because we've got poor forecasts.

Forecasting is always also really important for bushfire risk because it's a key consideration in how dangerous a bushfire might be. So, knowing as far as that advanced as possible what the fuel moisture state might be is really critical for preparing for bushfires and preparing to fight bushfires.

And finally, at much longer time scales understanding the relationship between weather or climate and that fuel availability or fuel dryness and ultimately how that feeds into the frequency of fires. These are the kind of questions that Sarah was mentioning that where this kind of information is really valuable.

[Text on screen] Forest fuel moisture estimation

Manual field measurement

New automated field sensors “fuelsticks”

[Associate Professor Gary Sheridan] So the way we measured fuel moisture in the past is shown on the left there, manual measurements out in the forest but what we're trying to move to in this project is using these new sensors called fuelsticks and these are set up in the forest underneath the forest canopy and they continuously measure the moisture content of the fuel so like a wooden dowel and this is connected up to the internet so we get this real-time measure of fuel moisture under real field conditions.

[Text on screen] Network Station (AFMMN)

* 32 stations statewide
* Established 2014-2019
* Located in forests
* Real-time 30min readings
* Networked
* 1.5 M OBSERVATION!
* (...and 11,000 more everyweek!)

[Associate Professor Gary Sheridan] And there's about 32 of these stations have been set up across Victoria in a whole range of different forest types. And these are generating readings every 30 minutes, real-time readings.

And over the past five years or so we've managed to accumulate about one and a half million observations now of fuel moisture and we're generating another 11,000 observations every week.

So, this is just a complete game changer in this space. We've got all this new information on or measurements of fuel moisture, and what this allows us to do is use these new generation of models so you might remember 2001 of space odyssey where Hal 9000 was taking over the world. That was a precursor to the artificial intelligence models of today. So, these kind of models and machine learning models are common now across a whole range of disciplines so anything everything from text recognition to self-driving cars to social media algorithms use these artificial intelligence models.

[Text on screen] How are we using artificial intelligence (AI) to help us with forecasting forest fuel moisture?

MACHINE LEARNING MODEL “TRAINING”

[Associate Professor Gary Sheridan] And what we hope to do here is embed this new modelling technology within our problem of predicting fuel moisture.

So at the core we have this machine learning model that sits between inputs and these are inputs that come from a regular source like Bureau of Meteorology sort of seven day ahead, three-hour forecasts of weather, and we train that model to link those inputs which are our forecasts with the outputs which are our measurement of the fuel moisture and every new measurement that comes in the model just gets better and better and better at forecasting fuel moisture and ultimately we can forecast the fuel moisture without the stations at all once the model is fully trained.

[Text on screen] Why now?

Unprecedented supply of training data + Accessible machine learning models + Accessible, low cost cloud computing resources

[Associate Professor Gary Sheridan] So as I said this is a real game changer.

Why hasn't it been done before? There's a couple of reasons; the new stations that have been installed across the state giving us this unprecedented supply of fuel moisture observations to train the model.

These kinds of machine learning and artificial intelligence models have also become a lot more accessible for people like me and the models are quite demanding in terms of computer resources and computing costs and availability have changed a lot in recent years so we're now much more able to run these models.

So as far as I know this approach hasn't been tried anywhere else in the world. I think Victoria is the first in this space.

So just to remind you why we're doing all this modelling and how well is the modelling working.

[Text on screen] Preliminary results example: Model performance over 1 year for one site

[Associate Professor Gary Sheridan] So there's a lot of detail here I’ll draw your attention to a few things.

So, what this graph shows is the fuel moisture over an entire year at one site, one of those 32 sites.

The red line in that graph is the predicted fuel moisture content and the blue is the observed.

So, if those two lines sit on top of each other that means we've got the absolute perfect model and what we're looking at here is how fuels move in and out of that very small narrow yellow band.

That's the band of fuel moisture around between 9 and 16% where burns are successful. So, they're not too wet that the burn will go out, not too dry that the burn will be unpredictable.

And so, what we're what the model is trying to do is work out its forecast when we go into that band and the top panel is the one-day forecast, the middle one is a three day forecast, and the bottom one is seven day forecast.

So, what I want to just draw your attention to there in particular is this little statistic down in the far right here which is the PODs. That's the probability of detection, and this statistic is saying that our model is when we are predicting whether the fuels will be okay to burn in seven days’ time the model is right 80% of the time. And so, this is a pretty exciting and encouraging result for us and we've got a long way to go still improving the model so we're pretty happy about where this is so far.

[Text on screen] Statewide, high resolution, 7 day in advance

[Associate Professor Gary Sheridan] Of course building a model is just part of the problem. Getting that model implemented and operational is a whole separate problem altogether.

So, we've produced a proof of concept model which is being implemented this summer in DELWP and we'll get feedback on how that works and ultimately we'd like to incorporate this model within DELWP's fire information module, the foresight package, so that burn planners can have easy access to this information across the state whenever they need it for burn planning and bushfire management.

So that's where we're hoping to go to, and I hope the last few slides have given you a bit of an insight into how we're going about this project and lastly just again thank the research team and also thank DELWP for their financial support of this project. Thanks Beth.

[Beth Roberts] Fantastic thanks Gary and thanks to all of our presenters for bringing us to the point in time tonight where we are going to address some of the moderated questions.

Gary you've just left my screen but I’m going to ask you to pop back in while we've got you and let's talk a little bit more about the role of research.

There are some themes coming out in many of the questions in the fact that fire agencies do need to work in a contested space and balance bushfire risk right alongside other values like biodiversity and amenity that Lyn also spoke to. What is the role of research in assisting fire agencies in that space?

[Associate Professor Gary Sheridan] Yeah, it's a good question Beth.

So, fire management in forested areas is challenging because different members of the community of course are very different values and place a very different emphasis on values that the forest can provide and I guess you could think of the members of that range as being you know we're not burning enough to keep our communities safe at one end and we shouldn't be burning at all because of the potential negative impacts at the other end of that spectrum. And this is what we what we mean when we refer to the idea of a contested space, and most people align themselves somewhere along this spectrum of views so there's no right or wrong answer, it just depends on your particular values.

So, research can help people navigate this contested space by providing evidence on the effect of different management choices. So, research aims to answer questions like you know if I burn more how much how much will that reduce the risk of house loss during a bushfire; or if I burn more what are the costs to the other things I value, so risks to individual species or ecosystems or water etcetera.

Now in an ideal world this kind of research evidence provides a solid base in which all the parties can understand the trade-offs involved in any particular management scenario and then discussions can focus on how to accommodate the different community values rather than debating the actual physical impacts of burning.

But of course, in reality it's never this simple and I'm sure everyone's experienced that feeling that it seems like everyone has research evidence to support their particular point of view and this can be opposite points of view. And I know this can be very frustrating for community and for policymakers, but natural systems are so complex in a vast array of permutations of conditions and variables means that we can get opposite answers to the same question in different locations or at different times.

So as scientists we don't sort of put too much emphasis in any sort of one particular study and we look at the weight of evidence from multiple sources and many studies to sort of help direct us get more closer to the truth.

[Beth Roberts] Thanks so much Gary.

So, Sarah if research can help us as Gary said, you know understand the trade-offs and help fire agencies to actually approach bushfire risk management, from your point of view and the research that you do around innovation and perhaps even new technologies, how can those kinds of things help us in increasing the role that fire agencies play in managing bushfire risk.

[Dr Sarah Harris] Thanks Beth.

Yeah, I think oh I echo everything Gary said, and working closely with external scientists so important for fire agencies.

We place so very, so much value for research in fire management. Scientific research creates new information and that improves our decision making both as individuals and as an organisation and that leads to improved outcomes for people in the environment.

All the research that we're doing within agencies and commissioning externally is applied so meaning it has those practical real-world outcomes.

And although it often doesn't, it's not apparent to the communities or even individuals working within the agencies the value of research. It's usually behind everything we do. It's in the new technology we adopt or develop. It's in those great approaches to measuring and reducing risk. We're using by optimising practices and, even the way we engage with the community to result in outcomes and actions.

So, an example of how, an area i work in in research is trying to understand fire behaviour. And that outcome is that, by better understanding five behaviour we can better predict extreme conditions, in turn our firefighters and communities can be, are safe by earlier detection, earlier I guess warning so there's so much value for research for fire agencies.

[Beth Roberts] Thanks Sarah. So clearly research plays a really important role.

Just keeping on the theme of research Chris I'll come to you for this question which is what are we doing to ensure that community health is protected given the increasing research showing the damage that smoke from plant burning can cause.

[Chris Hardman] Thanks for that question Beth.

It’s a vex question of course. If you've got a family members that have respiratory illnesses we know that COVID itself, that there was a big focus on the impacts of plan burning and the risks that it posed to people that were at risk of COVID so, plan burn smoke you know it does exist, it is an issue and we do provide advice to residents about when we are burning and what the likely impacts of smoke are, but we've done lots of research on the smoke modelling and the impacts and effects of smoke on human health, on industry and a range of other areas.

So we also meet with the Victorian Asthma Foundation and other groups, but one of the things that we and I remember all of the time is that when we see long protracted bushfires we do see huge smoke volumes in the air for sometimes many months at a time and of course planned burning is done at much lower levels of intensity in much smaller areas and I’m not saying it doesn't have an impact but the research is there to support the work that we're doing on the effects that plan burn smoke has on communities and of course we use our warnings and our advice and provide as much information as we can to communities so they can make good decisions such as staying indoors if people have a particularly acute issue in a particular area.

So, it is it is a real issue, but I think there is an incredible amount of work going on to try and minimise those impacts but as I said of course the smoke from plan burning is much less impactful than the smoke from bushfires.

[Beth Roberts] Thanks very much Chris and obviously it's really about working right alongside communities through all of these complex and tricky issues.

On that theme of working with communities Lyn let me come to you for this question and you did go some way to talking about it in your presentation, but the question is how do we build community understanding of the changing climate and promote community involvement in building resilience.

[Lyn Harwood] I guess that's not an easy question to answer especially in a community that has been traumatised by the fires that we had in the in the Black Summer. People's or even traumatic response is continually triggered and despite what we are doing to share knowledge in every way we can so, through newsletters through webinars through answering emails through general talk and through the community, various community organisations, trauma keeps raising its head.

We're experiencing it again now as we come into the fire season where people who have been talking calmly about fuel management become distressed again and go to you know the trees are my enemy kind of response. So, it's really just reinforcing over and over again the knowledge that we have and the plans that we have and it's just it's just a loop it's just a cycle that we just have to continue with.

I think it's not done you know, the job of sharing knowledge and communication is not done, it's an ongoing work and it just has to be reinforced and people have to be invited to air their opinion, invited to challenge and be challenged and continually sharing knowledge.

I don't think it will ever end.

[Beth Roberts] Thanks so much Lyn I really like what you were saying there and that the conversations you know need to be respectful you spoke earlier about them being long conversations you know building value building each other's value and building and creating new knowledge.

Chris, on that theme of new knowledge there's a number of questions that have been posed to you to address the incorporation of traditional owner knowledge so i just wonder if you might be able to talk to what Forest Fire Management Victoria is doing to ensure that Traditional Owner knowledge of burning is reflected in land management approaches.

[Chris Hardman] It's a really fantastic question and there's a broad range of views and thoughts out there in the community about what Traditional Owner knowledge and how that can be brought to bear in this space and of course we work with all of the Traditional Owner corporations around Victoria and TOs - Victoria’s Traditional Owners - have established a Cultural Fire Strategy.

They've also recently completed a Landscape, a Cultural Landscape Strategy and those two bodies of work that have been developed by Traditional Owners are really helping shape the relationship that we have with Traditional Owners on Country.

On public land you know there is more than 100 cultural burns proposed to be on the joint fuel management plan this year and each mob around the state is at a different place with their rediscovery of knowledge of how fire should be applied in the landscape for cultural purposes.

What's really important to for the broader community to understand of course is that cultural fire is very different to the work that we do with hazard reduction, with community protection, and all of that type of work should not be confused with that with cultural fire.

Cultural fire is a practice that Traditional Owners have for their own reasons. It can be you know that the knowledge that they have shared with us it could be about cleansing Country; it can be about healing Country, but it's never about hazard reduction burning.

So we are working incredibly closely to remove as many of the barriers as possible to enable and empower Traditional Owners to practice cultural fire in the landscape and of course we're deeply grateful for the knowledge that they share with us and we're open to knowledge from any quarter to enable, to better shape the way we go about our work, but they shouldn't be confused and Traditional Owners are on their journey and we will do everything we can where they can we can remove the barriers to enable them to achieve the outcomes that they're seeking to on public land.

[Beth Roberts] Thanks Chris. You speak really strongly about the partnership to build not only with Traditional Owners, but also with community in the way in which we go about managing you know the entire state of Victoria and on that community approach Lyn i just want to come back to you with an additional question.

Someone that's really interested in your approach to fire agencies and the question is how do you actually start that productive and respectful discussion with fire agencies rather than simply being informed by those agencies or told what's going to happen.

[Lyn Harwood] I look, I guess I’m actually I was really lucky that early on when I started to talk about this idea. I had a lot of support from my regional officer in the CFA and I had a lot of support from the manager of the Orbost DELWP organisation. Plus, the one of the most important people in this region for Forest Fire Management lived in Mallacoota so I started off with three people who were prepared to listen and prepared to give it a go.

And I think right from the very first meeting when we sat down with community members who’d volunteered, we could we sensed that there was a really strong hope of moving forward together and that, look it happened and it happened because there were good people with good ideas and good intentions behind it.

Now I don't know how you replicate that, was I just lucky. I just happen to have lots of good people around me or maybe there is a general movement towards this notion that there has to be real communication and real conversations and look it's just I’m really grateful for it.

[Beth Roberts] Thanks Lyn. What a really natural place to bring the discussion tonight, real discussions and real communication that's exactly what we're trying to do with webinars like this.

Unfortunately, that brings us to the end of tonight's discussion there are so many questions that have come up and you know some really interesting and insightful questions.

This webinar is being recorded and after today's webinar you'll receive an email with a link to that and also an email address that you can provide us some feedback on whether it's about what you heard, what you'd like to hear in the future and help shape up this series of webinars as we move forward.

I'd really like to thank all of the panellists that have joined us tonight: Lyn Harwood, Gary Sheridan, Sarah Harris and Chris Hardman.

And thank you all for joining us for an incredibly productive conversation.

Good night.

[Text on screen] Managing Bushfire risk in a changing climate - a conversation with experts

[The University of Melbourne logo, CFA logo, Forest Fire Management Victoria logo]