The expert view: wildfire management in Australia

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Interviewee: Ruth Ryan – Principal Consultant, Waroo

February 2024

Figure 1 Nikki Armstrong, Andy Newell and Ruth Ryan discuss fire suppression strategy. Shelley Plantation, Upper Murray - Walwa Fire, North East Victoria, New Years Day 2020.

Ruth,

Thank you very much for making the time to discuss fire management with us. Can we start by summarising your background, and the work you are involved in?

Ruth: *Thank you for setting up this discussion. I studied forestry science for my undergraduate degree at the University of Melbourne, after which I began my work for the government of the Australian State of Victoria.*

I have been involved in forestry and fire management in Australia for some 40 years. Most of my career has been in the practical side of forestry and fire management.

For the last thirty years until very recently, I have worked for a private forestry company in the State of Victoria for whom I held various roles, the last ten years of which has been as their corporate fire manager. Most of my practical experience has been in the State of Victoria and other parts of South-eastern Australia, whilst always being interested, and having some involvement in fire management across Australia and elsewhere around the world.

I recently left my role for the forestry company, at which point I set up a private consultancy business working on fire projects and forestry and agricultural projects. I advise private forestry companies and I also undertake some activities for Forest and Wood Products Australia (a research organisation that supports the forestry industry), including reviewing future research investment needs for fire management in forestry.

I am also part of the Fire Res Advisory Board, which is an international board that has people from South Africa, the US, Canada, Italy, and Colombia plus myself from Australia, to look at overall guidance on fire management for an EU funded fire research project.

Gareth: Thanks for this overview, Ruth. One of the disaster risk areas of focus that I have been monitoring since January 2023, as part of the Disasters Avoided initiative, is the ongoing activities and efforts by many groups and organisations in Australia to proactively tackle the threat of wildfires (bushfires and grassfires).

I was living in Sydney, Australia, at the time of the 2019-20 Black Summer bushfires, and I have talked with people since this time about ongoing fire risk levels and how to best manage the risk. We are very interested to hear your views on how the efforts across Australia are helping to avoid fire-related disasters, and how we are learning from the past.

***Ruth:** It's interesting to talk about the work of people around the world to avoid disaster events and situations from happening. One of the fundamental aspects of risk management, as we all know, is that it needs to be focused on taking appropriate and reasonable action to avoid negative events, as well as recognising "upside risk" (opportunities). As part of this effort, we want to assess and measure the value of our actions and efforts – and this continues to be a challenge. Measuring the value of risk management is not always easy, because it can be complex to define and measure.*

Australia is a country that has lived and indeed thrived with fire for thousands of years. You mention the 2019-20 Black Summer fires in Australia, which were catastrophic. To me, each fire season has important and often unique aspects to it. We know that some fire seasons are worse than others. The ethos for me (we could say, "the mindset", per your Disasters Avoided model) is that it is about living with fire and having the right preparations in place for this. Linking back to my point earlier on assessing and measuring how well we achieve this, we need to agree metrics that show tangible value and benefits to people of the actions and the preparation we take to prevent fire disasters.

To look at fire management from recent history, I will start with the 2009 fires in Victoria that led to 174 deaths. A major Royal Commission was held after this tragic event; many changes that followed have been incremental rather than dramatic, and they have added up to collectively be significant when you look back to 2009 from the standpoint of 2024, fifteen years later.

Part of the reason why there were so few deaths in the huge 2019-20 Black Summer fires was because of lessons learned from 2009, including changes in people's attitudes (their mindset) towards fire risk. Since 2009 we have seen better management of fuels in forests, and a willingness of people who live in fire-prone areas to evacuate early. Prior to the fires of 2009 the general approach was for people to shelter at home in a fire situation. The 2009 event made it clear that this only works for people who know what they are doing and have the right preparations and protection in place. Today, the messaging for the public has largely changed to know the fire danger, know the risk and get out early. A number of fire episodes in Australia since 2009 have shown us the value of people getting out of the line of fire early.

Gareth: These insights are appreciated, Ruth. I have seen that the fire rating system in Australia has changed (which I have discussed with some people recently), and whilst I understand that there have been a few "false alarms" reported by the press from the new approach, the simplified new rating system seems to be helping.
I appreciate as well that models, systems, tools and communications guidance to people about the risks of fires have been worked on and improved in recent years.

Ruth: *Yes. An example of looking at risk and preparation is to consider the way that the Victorian State government undertakes their risk assessments nowadays. Forest fire management and the Victoria Country Fire Authority (CFA) have developed a system that is based on input from people who work in forest fire management.*

Perhaps I should first provide some overall context to Australia and its management of fire. The country is set up as a federation of States and each State manages their activities in coordination with the others. Fire management and control, land management and emergency management are handled by State governments. The Australian federal government provides background support; it does not generally get involved with on the ground fire management.

Each State has a slightly different approach to fire management. Each has a rural fire department that largely focuses on private land management, and they also have one or more public land departments that manage fire on public lands. There is often a coordinating agency to bring these agencies / teams together: they often respond as one team.

I can give a specific example of the State I know best, Victoria. Forest Fire Management Victoria is the government agency that has responsibility for fire management on State government land, which is most of the forested land in the State and where most of the fuel management work is carried out.

They have a number of regional plans covering both State and private land, through which they assess the risk of bushfires using modelling which is currently performed with a tool called Phoenix Rapid Fire (developed by the University of Melbourne). You can read about a successful example of its early use on their website. Forest Fire Management Victoria uses this tool to assess the potential for the number of houses to burn within an area, and they look at how their fuel management and fire management programme influences this.
They look at options which leads them to what is called a residual risk after actions are inputted. This residual risk is the space they watch carefully – it is the risk they can practically accept. The methodology of the tool helps them work through how much work is required to reduce the residual risk to an acceptable level. A key metric used for this is a combination of potential lives lost and houses lost.

Some key links which may provide further information for people interested in this topic are as follows:

- *Safer Together approach*
- *Safer Together Research modelling and knowledge application.*
- *Safer Together Strategic Bush Fire Management Planning*
    - *Download the Regional strategies from this site.*
- *Bushfire management strategies Interactive map*
- *Simulation of the effect of fuel reduction on bushfire spread.*
- *https://www.flarewildfire.com/software/phoenix-rapidfire/*
- *CFA* Am I at risk

Gareth: Is the Phoenix tool used by other States in Australia? I know that the Spark Operational tool is also being developed by CSIRO.

Ruth: *Yes, Phoenix Rapid Fire is currently being used in New South Wales, South Australia, and partially in Queensland too. Phoenix is a model that can run fire projections across the landscape. It is a model that can give a good prediction for landscape fires. It is continuously refined based on case studies of past fires, to continuously improve it, including after the 2009 fires in Victoria (after which a new revision of Phoenix was released).*

You mentioned Spark, which is the next generation of fire modelling, with modularisation of the approach. An evaluation of Spark is taking place at the moment however it has yet to be fully developed for operational purposes.

Ana: Is the fire risk in Australia adjusted for different seasons? I'm wondering about the timescales that are applied to using the Phoenix tool.

Ruth: *Teams look at the long-term risk in their plans and this shapes how they use Phoenix. They produce a graph that shows a timeline, with past risk and the current position, and projections that show the projected risk trend line if certain activities are undertaken, and the risk trend line if no activities are undertaken. This helps people to assess the extent of action they undertake.*

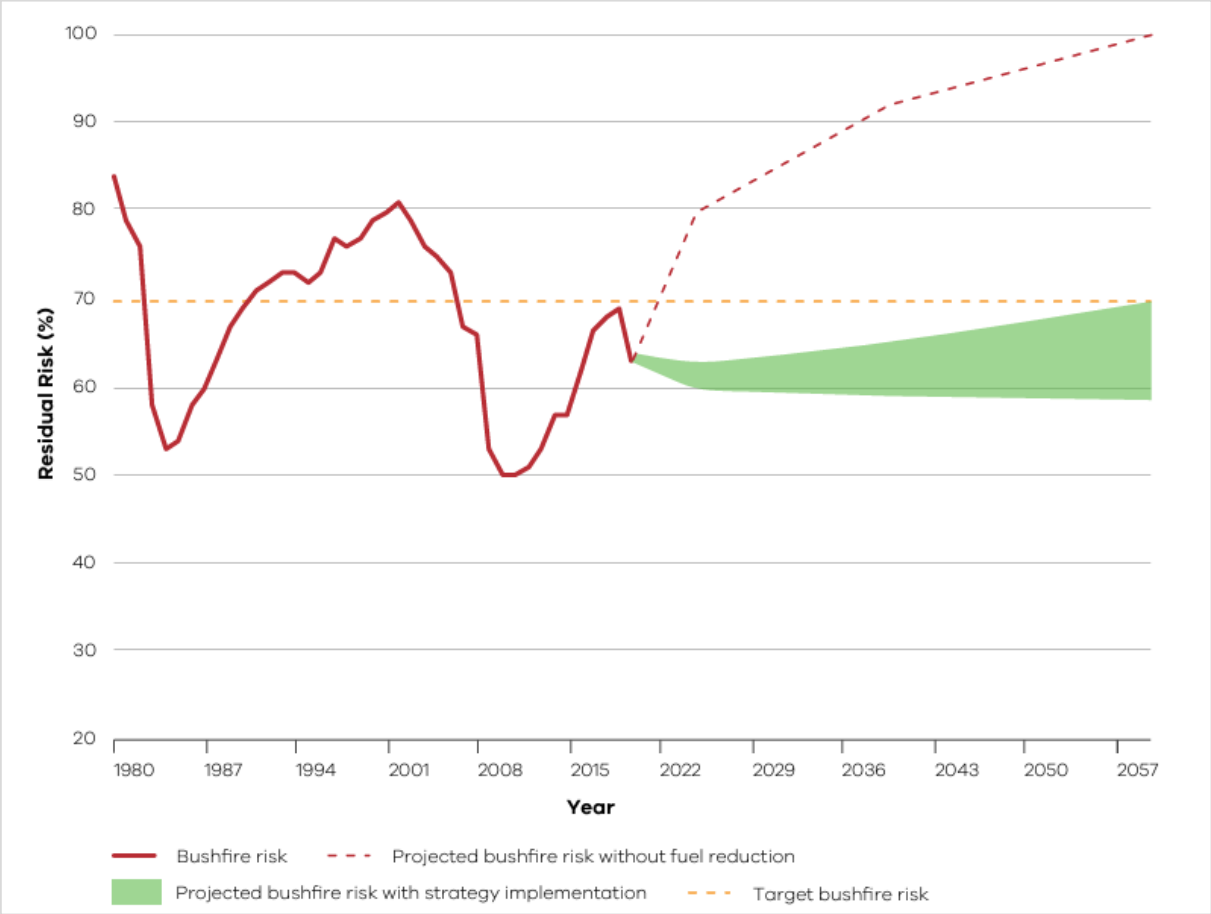

Figure 2 Statewide Residual Risk projected to 2060. (Graph taken from The State of Victoria Department of Environment, Land, Water and Planning 2020 Grampians Bushfire Management Strategy 2020.

There are also stochastic fire regime simulators, such as FLARE Wildfire FROST that are being developed to quantify long term risks and potential impacts of climate change.

Gareth: We appreciate your feedback on the range of tools and technology that is being used, and trialled, in Australia. Another aspect that we are looking at in our Disasters Avoided initiative is the value of indigenous knowledge around the world, for fire management and for tackling other types of hazards, including how to manage land and respect nature. We appreciate there are commercial pressures in to use and build on land whilst knowing that there are fire hazards.

Ruth: *Indigenous knowledge does inform our approach to managing and living with fire. It's a question of understanding how much indigenous knowledge remains within indigenous communities, and how to incorporate indigenous knowledge into fire planning. In Southern Australia, a lot of the indigenous knowledge has been diluted as indigenous populations have changed, whereas in Northern Australia more indigenous knowledge has been retained, with more indigenous people remaining on country. There are some concerted efforts in Southern Australia to ensure this knowledge is known and thought about. For example, Forest Fire Management Victoria has a programme to develop and use indigenous fire skills.*

A savannah burning initiative exists in Northern Australia which works with carbon credits. They are developing a system where carbon credits are paid to indigenous communities, for people to burn in shoulder seasons rather than have wildfires burning in the dry seasons, to reduce fire scale and impact and hence reduce the amount of carbon that is released (mostly in savannah grasslands).

Gareth: It's interesting to hear about the way that indigenous knowledge is being appreciated and used, Ruth. Just returning to some of the things you mentioned earlier, about the learnings from 2009 and other major fire events since, I'd like to ask you about some economics principles and the attitudes of people towards fire risk where they live. Australia is already heavily urbanised, of course, and as cities and towns expand further they continue to push into habitat that has obvious fire risks. What do you think about the views of the public when it comes to increasing urbanisation, their understanding of fire risk, and how all of us as citizens can play our part to help manage the risk.
From an economics perspective (something I look at often), the value of people's homes continues, mostly, to rise in Australia, so can and should people be personally investing some of their wealth in good fire management where they live?

Ruth: *It's an interesting point. There are ongoing challenges to ensure that urban populations really understand and think about their fire risk. Many people live close to bushland – even a small wooded area can represent a big risk. As you rightly say, Australia is urbanised to a great extent, much of which hugs the country's coastline. I think that over 85 per cent of Australians live within about 50km of the coast. We have a lot of people living on the urban and suburban fringes of wildlands, including bushland that is prone to fire. In what is called the Wildland Urban interface in the US, people who live in these areas do not always truly understand the degree of fire risk that exists on their doorstep, and hence do not undertake measures to develop their resilience.*

However, legal measures can drive and enforce a certain amount of change. From the 2009 fires a change in building regulations took place. If you live in an area that is classified as a bushfire management area, a rating system determines how and where it is permitted to build a new property. The higher the fire risk to a property, the more stringent the fire protection measures and the higher the expense to build the property. Measures such as sealing gaps, having simple roof lines, not storing flammable materials all count. However, the code is not retrospective, so unless a major renovation takes place, existing houses do not need to be updated.

Gareth: Your point about legal measures makes me think of the governance factor in our Disasters Avoided model. Good governance is essential to taking good action to prevent disasters from happening. I wonder how parts of the private sector can also help. For example, can insurers play a role in encouraging action by citizens to implement fire resilience for their homes?

Ruth: *One of the difficulties with introducing insurance incentives for better fire prevention is that people might rail against it and forego insurance all together, which could increase the onus on the government to pay for damages if something does happen. It is about getting the right balance.*

For instance, I live in a house that is in the middle of a forested area. I don't know if my insurance premiums are much different to people in a more urban area. However, I certainly accept the risk that one day my home may burn in a bushfire. The house construction is good, I manage the fuels around the property, I have pumps and sprinklers set up and I have the knowledge of what the fire conditions are likely to be and appropriate firefighting training. My home is well insured, and I take measures to protect valuables and store documents and data off-site.

Ana: Perhaps we can talk about metrics now (going back to a point made at the start of our conversation). What kind of work is undertaken to look back and assess what is working? I get the impression that in Australia (at all levels of government and society) there is a good approach to evaluating what is working, and what needs to change.

Ruth: *It's true that there is a lot of research carried out in Australia into events that happened and why they happened, but it can be hard to tease out the effects of preventative measures that avoided or reduced bad outcomes in terms of quantified benefits. We don't have a standard evaluation practice after every event to my knowledge, but people do analyse major events. Australia has a lot of good research devoted to hazards and hazard management. Natural Hazards Research Australia is a federal-funded organisation (an example of federal government background support) that coordinates a lot of research. There are also State-funded research organisations that perform similar work.*

Gareth: If I understand correctly, academic organisations also perform a lot of research, as do CSIRO (Commonwealth Scientific and Industrial Research Organisation).

Ruth: *Absolutely. CSIRO used to have a dedicated fire research role – with the development over the last twenty years or so of what is now Natural Hazards Research Australia, CSIRO has become a research provider to them. CSIRO researchers first developed the MacArthur Fire Danger Index, which was developed particularly for Eucalypt fires.*

There is AFAC, the Australian Fire Authorities Council, as well. They consist of the Chief Fire Officers from all States plus from government agencies that are involved in fire management. They have a fire predictive modelling group that do a lot of evaluation of new models with an Australia-wide view.

A lot of our universities also have bushfire research teams as well.

Ana: How does the private sector integrate with the analysis and work to continue to improve fire management?

Gareth: Does this start to link into how fire management is coordinated in Australia, as well?

Ruth: *The private sector is certainly key. There are often interlinkages between private sector land management and what the States do with land management. There are quite a number of forestry companies managing commercial timber plantations in Australia. Many of these plantations adjoin public land as well as private land. As we know, fire doesn't respect land management boundaries, hence almost any firefighting needs to integrate resources from a variety of organisations. This is why the Australasian Inter-service Incident Management System (AIIMS) was developed, over 20 years ago. It was initially based on the US system and has been adapted to the Australian environment. AIIMS is now used to manage most natural disaster incidents such as floods and storm damage as well as fire.*

In Victoria in 1996, legislation was introduced to set up Forest Industry Brigades, which are managed by private forestry companies. There are some similar models in other States as well. They provide a fire response which is integrated within the overall State Incident Command Centre. It's important to work as one organisation rather than different people looking at different interests.

Each State has a Rural Fire Service, which are mostly volunteer-based organisations. Victoria, for example, has about 50,000 volunteers of which about 30,000 are fully trained, and about 800 are registered under the forestry brigade model. These forest industry brigade people are generally paid for their services by private companies that manage the land. When a fire outbreak occurs, all parties to deal with it come under the Incident Command System (ICS). The ICS Management team takes into account that forestry brigades are particularly focusing on protecting their forest assets.

Ana: Team coordination to combat fires is always key, isn't it (national / federal, states, local and the type of ownership of land). I have seen how different countries approach it in different ways. In Spain, where much of the land is private and smallholder, it can be tricky. In the US land tends to be split between public and private.

Ruth: *I think one of the advantages of the Australian system is that we are continually getting better at working under one Incident Command and we are working to one objective and understanding where we all fit within this. I have noticed the differences in other countries when I have liaised with people in other countries. In Australia Incident Management coordination is well developed.*

Gareth: What you mention, Ruth, about working to one objective is a good example of having the right mindset and to applying good governance. What are your thoughts about the criticality of the many volunteers in Australia who fight fires? It seems to work very well from what I see. The model has been around for a while.

Ruth: *I think it does work well. The volunteers' networks are critical for our fire management. There is a good understanding of the focus that volunteers' networks have, typically to manage fires in agricultural areas. Many of the volunteers are local farmers or people who know their local district well. The training of volunteers has improved over time, and the bringing together of professional Incident Management that come from forestry management with the volunteer services has led to stronger fire management.*

I am not sure of the exact numbers, but a large majority of rural fires in the States are tackled by volunteers. Forestry management continue to have staff for fire management, and volunteers are crucial to managing fires, especially in agricultural areas.

Gareth: Perhaps we can talk about the mindset of chronic unease now, and the focus on continued preparation for possible serious fire situations and events. For the 2023-24 summer season in Australia, there have understandably been concerns about the risk of major fires occurring (including with the onset of El Nino). We know there has also been widespread flooding especially on the east coast of Australia. It seems to me, having been an observer of actions in Australia for the whole of 2023, that continued vigilance to guard against fire risks has been in place.

Ruth: *I think this is true. Heightened vigilance remains and there are systems in place to continue to monitor fire risks. These systems include organisations such as the Bureau of Meteorology (BOM). Their long-term forecasts are used. BOM was later in confirming E Nino than other country meteorological offices. BOM set a higher bar for confirming El Nino conditions, because the effect of El Nino on Australia is seen most when the ocean currents link with the atmosphere.*

With El Nino conditions, Australia typically sees a larger effect when it occurs earlier in the annual season, in springtime, because the drying out effect is larger than if El Nino occurs in the summer and the corresponding drying out period. As such, the effect of El Nino this summer season has not been as severe as it could have been. Australia has also seen the southern annular mode which has brought in a lot of moisture from the south.

Constant vigilance is always required, of course. Some parts of Australia are drying out – moisture content is key. Earlier in the season, northern NSW and QLD did experience quite a lot of fires, and there have been ongoing outbreaks which have been responded to by coordinated teams (who are crucial to ensuring fires do not get out of control). The system is set up with good forecasting, with AFAC and Natural Hazards Australia involved with the States. Each year there is preparatory work undertaken, which will surely continue.

One of the issues that concerns me at the moment is the trend for all hazards and all emergencies management. When I first started in forestry, we knew we had the fire season and then the burning season and over winter we would get a break from being on standby and dealing with emergencies. Today many Government land management agency staff and fire response agencies are involved in a succession of multiple emergencies, so staff are dealing with fire and then moving straight into flood / storm management with little reprieve in between. We must be careful of not creating burn-out of our staff.

Ana: With regard to your points about vigilance and forecasting of events, one of the things that I understand about Australia is that a large number of fires are ignited by lightning, that is to say, naturally occurring fires. It seems like a significant challenge to tackle, especially in remote areas and considering the vast land area of bushland forests.

Ruth: *Lightning strikes are indeed very much part of the Australian environment and landscape; they are a natural phenomenon, and they are part of nature's lifecycle. The extent and number of lightning strikes is specific to different locations – in some locations there are very few of them, and a much greater number of fires are unfortunately started by people.*

For example, in my work with the private sector I was involved with two districts in which the majority of fires were human-caused, and one district where more fires were caused by lightning. Our areas that have more lightning strikes are typically those that are mountainous with a lot of forestry. A lightning storm in one of these areas can easily cause 20 or 30 fires in short succession. The same can be true even on agricultural land. Teams try to predict what could be a dry lightning storm and to be prepared to respond.

There are lots of small volunteer brigades that are crucial to responding to fires started by lightning (and human-ignited fires too). Tuning in to dispatch radios demonstrates the value of volunteers doing this job. For example, there can be a tin shed in the middle of nowhere that houses a fire truck, with which farmers fight the fires. The system works well, and kudos to them for having this service available.

Some big challenges for us to deal with are fires that occur in deep remote forestry territory – we need to suppress them as soon as possible, using a combination of ground and aerial resources. If we can keep these fires small then our risk is reduced. Prescribed burning in remote forests greatly assists the ability of our firefighters to tackle these fires.

Gareth: Just picking up on your point about using aerial resources, one of the areas we have been looking into is how unmanned aerial vehicles (UAVs), including drones, might be able to support the awareness and tackling of fires that start deep in bushland and forests. I'd be interested in your views on the value of UAVs, today and in future.

Ruth: *It's interesting to think about UAVs. It can be difficult to find lightning strikes deep in forests. The way we do it at the moment is to start with a general awareness of when they take place, and to use a network of manned fire towers for spotting smoke. Fire towers work in the daytime only. We also send up manned aircraft with a spotter to try to find lightning strikes. Remote sensing with infrared in the night-time can help. However, the best practice at the moment still involves people on the ground, in fire towers and in the air. With the technology constantly changing however, I will be interested to see how UAVs might be used in future.*

Ana: Is satellite data useful for fighting fires?

Ruth: *Satellite coverage in Australia is either not frequent enough in covering the land, or the coverage that is more frequent is limited in how much land is seen and tracked. Often, by the time we see information from satellites such as Modus and others we already know about it. In many cases as well, the accuracy of the information from satellites is not precise enough.*

That said, a paper by the University of South Australia to review the potential for satellites and drones is interesting to review. The technology continues to evolve, which is good to see.

Cameras that are mounted on towers can play a useful role for spotting fires – camera quality is continually improving. The limitation with cameras at present is that the viewing distance is generally 15-20km, maybe 30km on a very clear day.
I have heard of one case of a person spotting a fire from something like 90km away – the human eye is a powerful tool for fire spotting still.

Ana: I wonder if in remote places satellite data can be helpful.

Ruth: *Yes, in central Australia (in the Northern Territory) for example this can be key. In the more populated States, the fires are typically reported by people who see them. I know of a German company that is looking into using Cubesats for fire detection. It will be interesting to see the future development of satellite information and timely data transmission.*

Gareth: What about the utilities sector, particularly the energy and power companies – can they play an important role in helping to spot fires and also helping to reduce the risk of fires starting through maintaining their infrastructure such as high voltage lines?

Ruth: *One of the issues with power grids is that transmission towers inevitably have interference with communications which means that adding cameras to them may not be feasible. However, there are some interesting examples to consider.*

In South Gippsland a wind farm project is aiming to be developed in a forest area (the Delburn Wind Farm project), and one of the ideas they are looking at is to put some cameras on wind turbines to assist with fire surveillance. So, there are options to explore.

Gareth: Can AI play a useful role in predicting where fires may start?

Ruth: *Again a developing science. I am sure that AI can be used to pick up data trends, however the data out is only as good as the data in hence we need to be careful to ensure data integrity and constantly test information against our real-life experiences. Fire science is a difficult research topic because it is difficult to recreate under controlled conditions, actual wildfire conditions. I am a firm believer that we need to take very opportunity to immediately set up case-studies and data gathering after major fire events so that we can learn from our experiences.*

Gareth and Ana: Thank you very much for your time, Ruth. We really appreciate your insights into how fire management in Australia functions, and the vital work taking place by many people across Australia to avoid wildfire disasters.

Ruth: *One of the things I also want to mention is that the NASA Earth Observatory Image of the Day daily emails are most useful. As well as for the fire side of things, it shows us what information can be gathered through remote sensing. I often forward these images to others. They are a good way of simplifying things for people and describing compelling stories through pictures.*