Spark
Operational

Spark – The bushfire simulation tool of Australia

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PRESENTER

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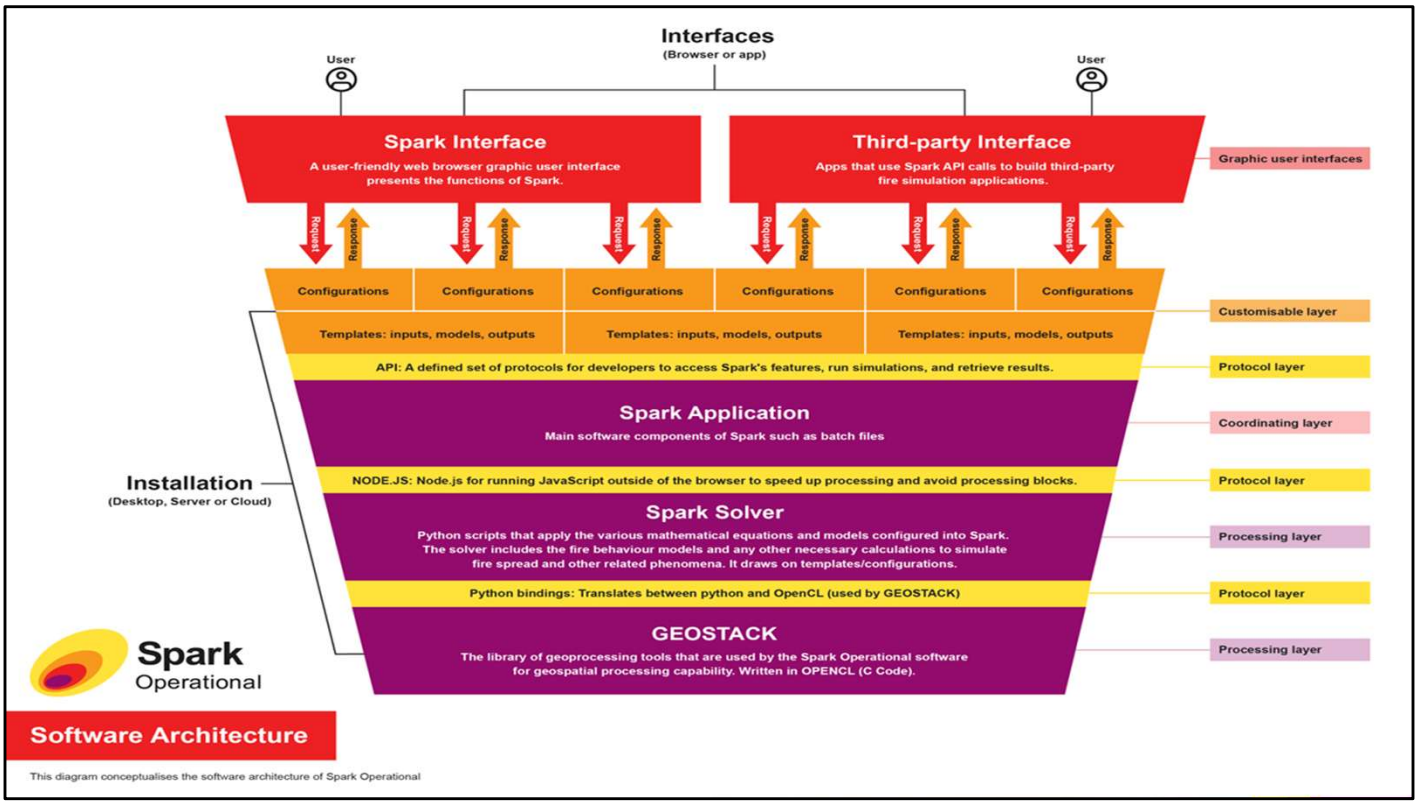
I would like to acknowledge the Kaurna people as the traditional custodians of the lands I am on today. I would also like to acknowledge to Maori as the Tangata Whenua and Treaty of Waitangi partners in Aotearoa New Zealand as AFAC partners. I pay my respects to their ancestors and elders, both past and present.

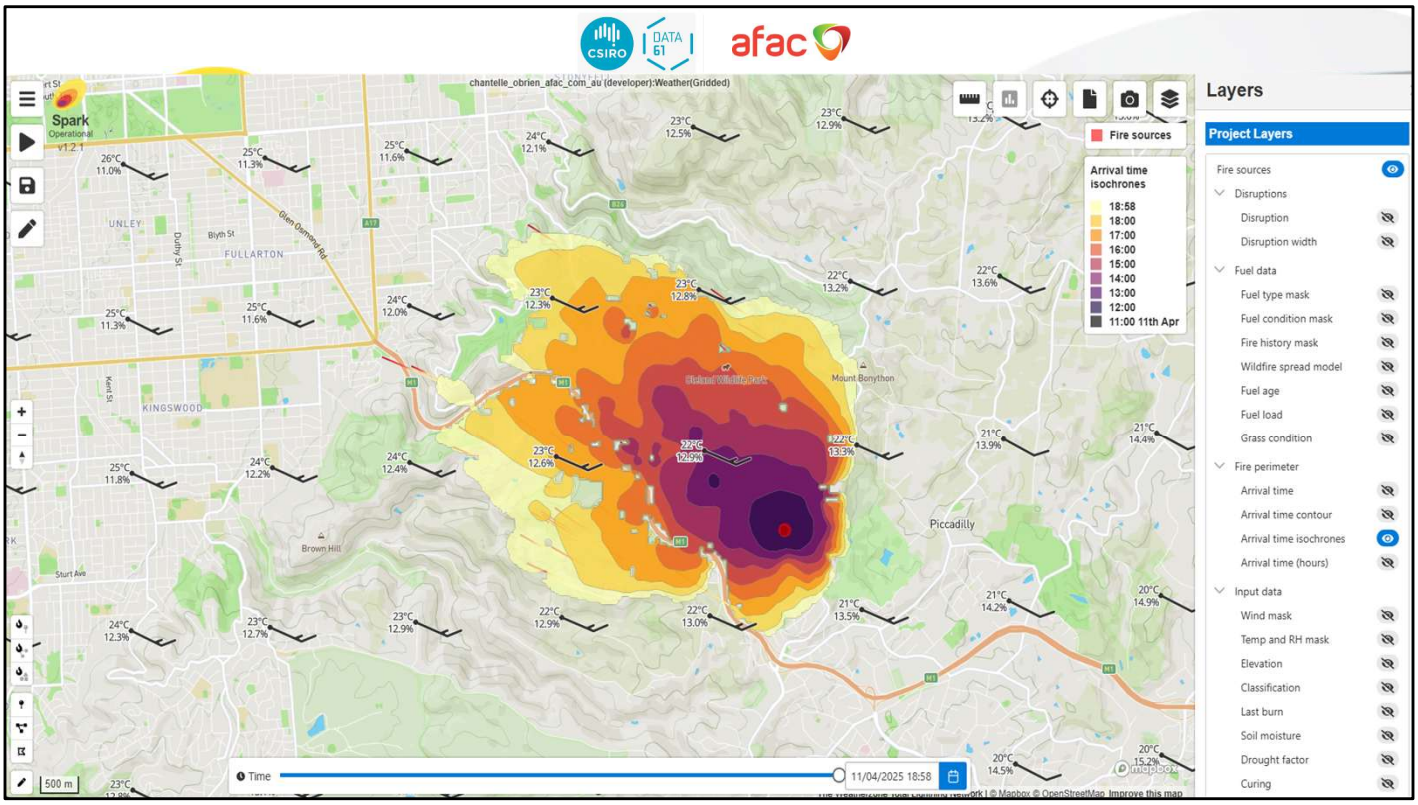
My name is Chantelle and I work for AFAC. This session, I will be sharing the customisability of Spark and show the different ways the agencies who have adopted Spark have been able to integrate Spark into their operational environments.



Spark has been about 10 years in the making. Over that time, it has evolved and matured. Spark is built as a framework, the various components can be separately improved or customised, so that the system is scalable, tailorable and updatable.
Spark design principles are that:
Codebase is Modern, Modular, Maintainable
UI is clean, simple and Optional – there is the ability to run predictions through the API.
All inputs visible (ignitions, weather, fuel, land attributes)
Interactively edit ignitions, fuels, disruptions, weather
Runs wide range of fire behaviour models and sub-models including the same models used for the AFDRS.
Easily connect to external data sources (eg hotspots, lightning, curing etc etc)
Flexible output generation, including file types, data inspection and report generation
Ensemble capable with a framework built to further develop new ensembles.
All this has allowed the agencies who have adopted Spark to customise the way it works in their environment. The following slides are just a few of the ways agencies have begun to customise Spark to fit their COP.

This is a graphic representation of Spark architecture and how all the elements link together and are able to be customised.
Orange layer is the simplest layer to customise, and is designed to be customised to suit local conditions, information, etc
The purple layers are also customisable and have been by a few agencies. This level of

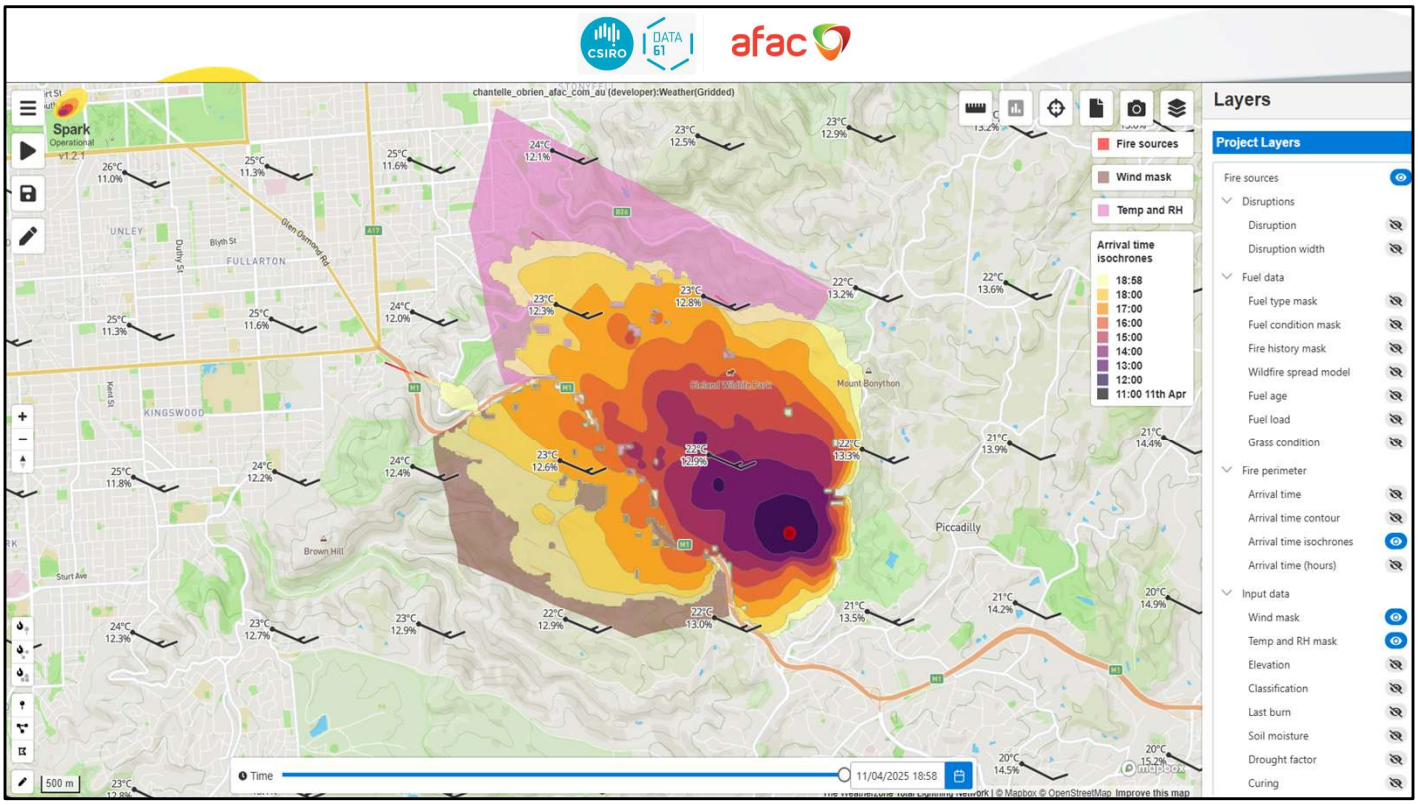
customisation is of a higher level and not needed to produce quality simulations.
It can also be seen here that the GUI designed for Spark isn't the only way users can view Spark outputs.



To create bushfire simulations, Spark uses forecast weather, raster fuel data, and terrain data to assist in the simulation of bushfire paths using rate of spread models. Currently the fire spread models are based on Australian fuels and conditions, but work is being done to incorporate overseas models, such a the Rothermel fire spread model.

Spark currently uses 9 different rate of spread models, that align with the fuel type they are being simulated in. Each model uses different inputs to determine rate of spread. The architecture of Spark allows users with knowledge of coding to change the fire spread models if needed.

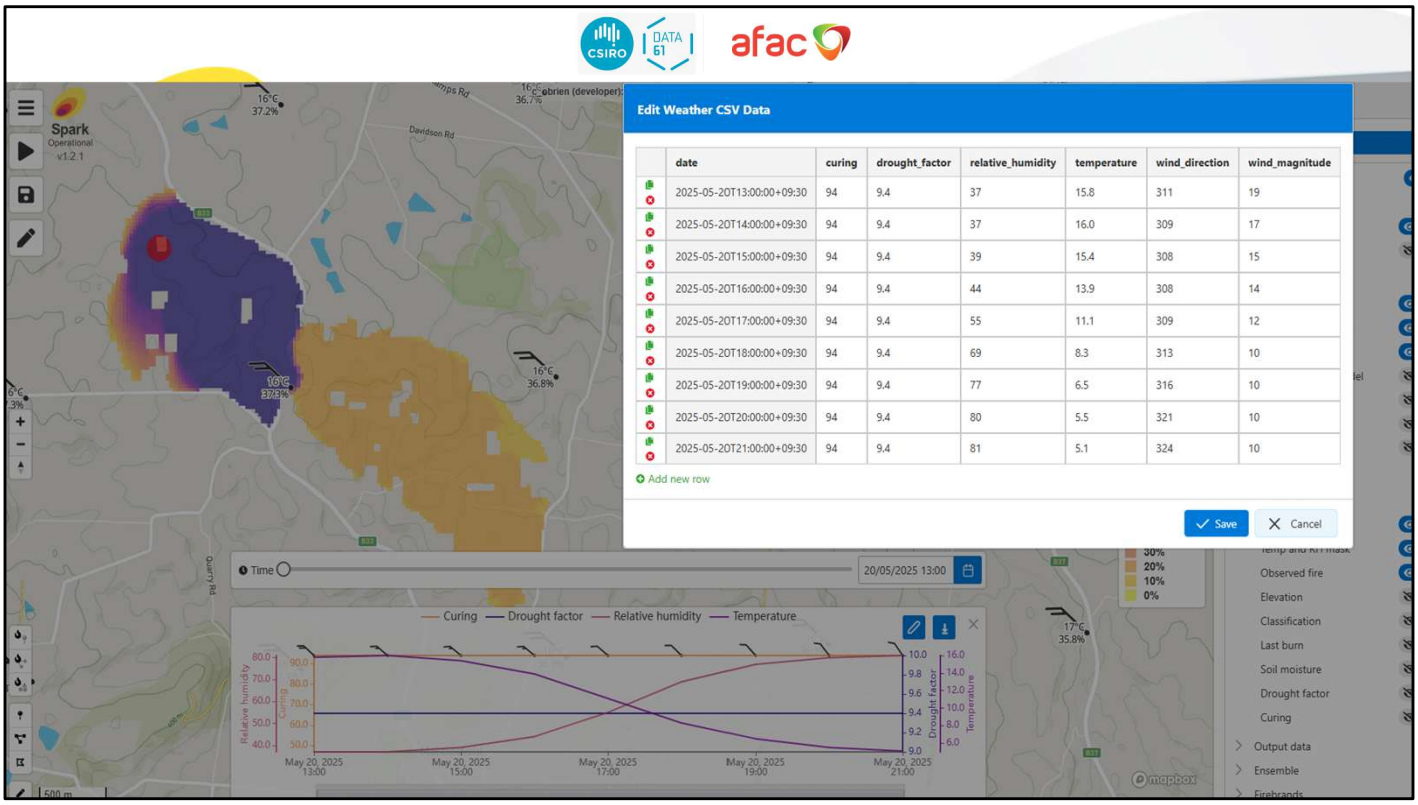
Spark simulations are run within a 6km grid. The resolution of the different inputs is different, and sometimes there is a need to change small areas in information.



In this example here, 2 different masks have been applied to the Spark simulation. This allows small scale customisation of different inputs, including fuel and weather.

These masks change the inputs the models read on a small scale. This is helpful if the forecast weather is different to observed weather, or if raster fuel data is different to observed conditions.

The whole principle of Spark Operational is to assist Incident Management Teams with the best way to respond to bushfire threat. The visual outputs that it provides are used to produce warnings that are shared with the public to assist with evacuations and other emergency orders. This has been shown to reduce the impact to human lives.

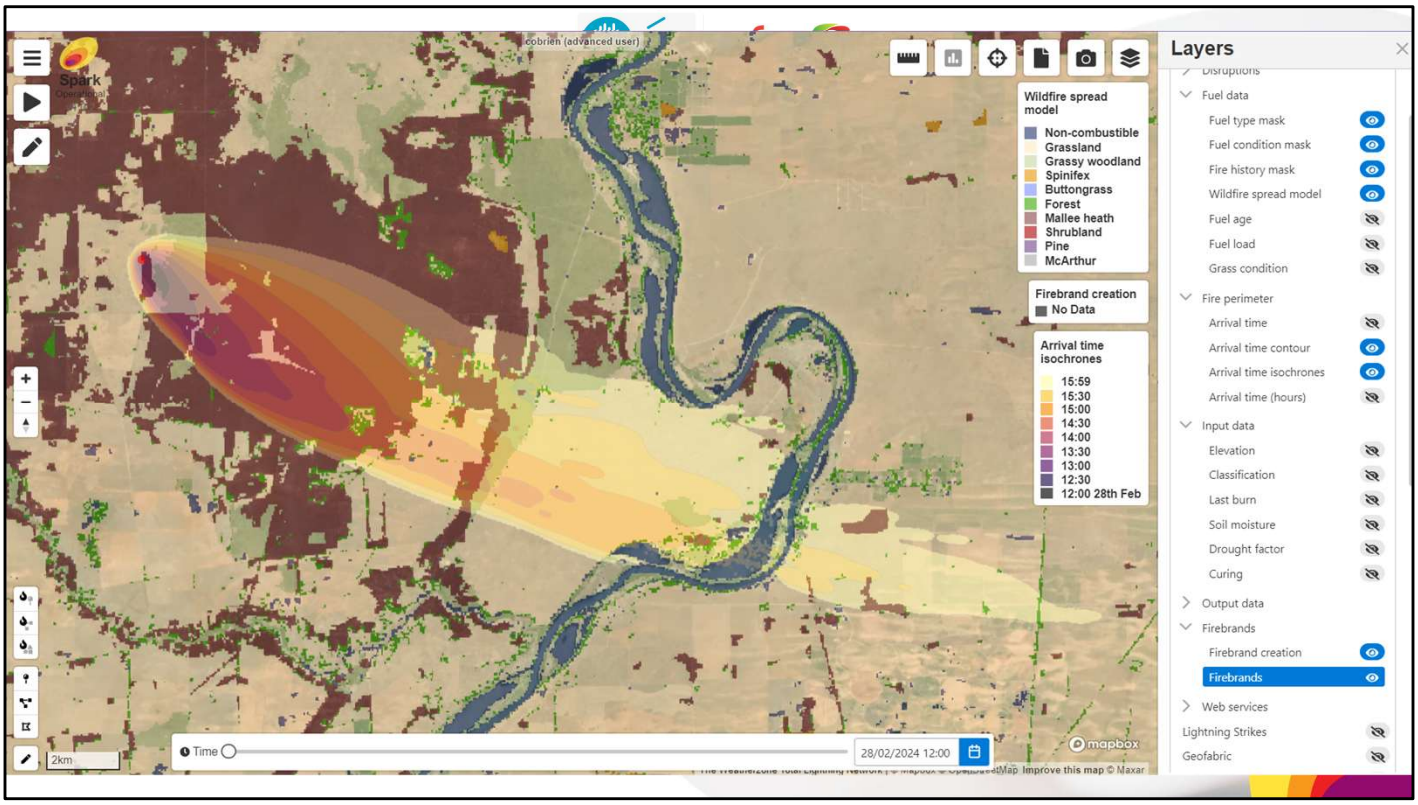


Weather ensembles

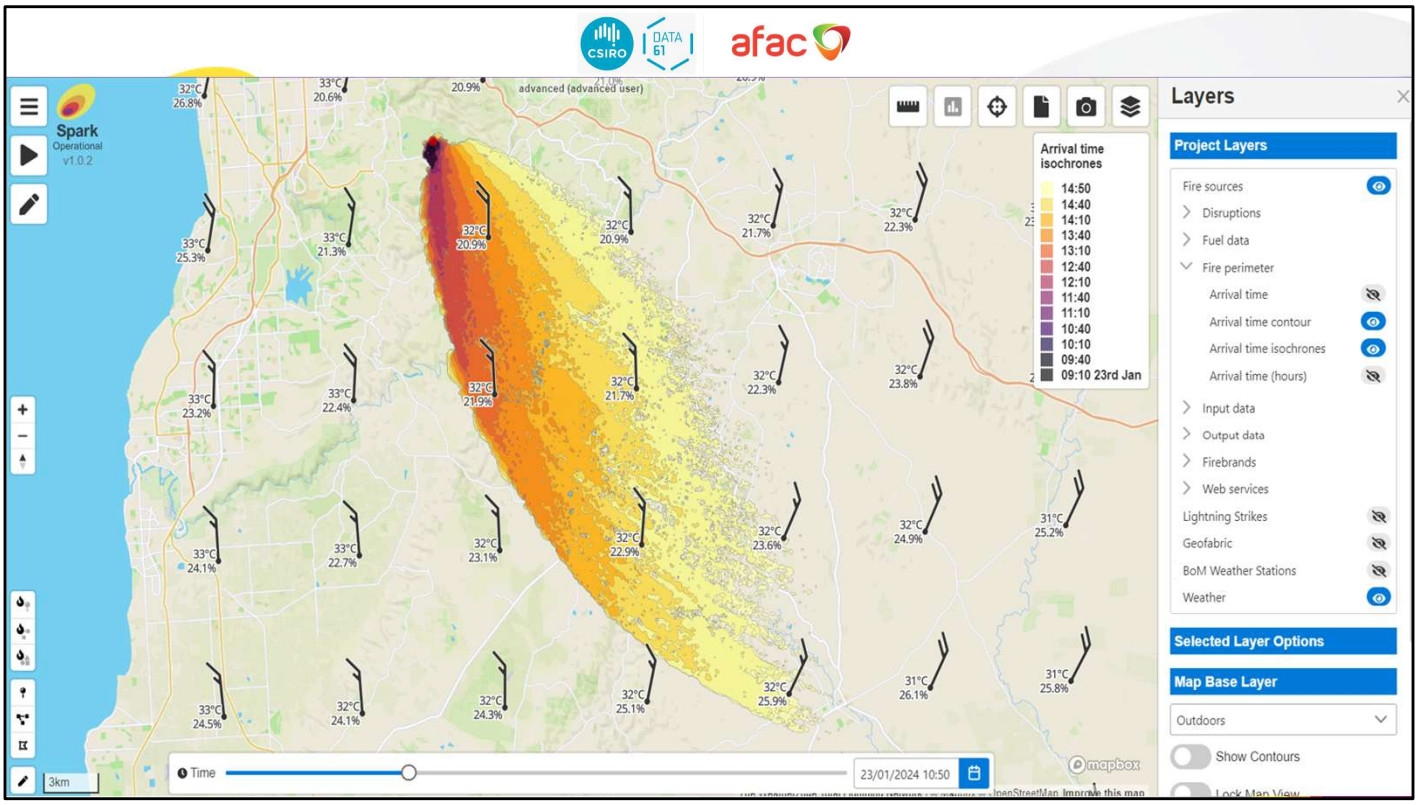
The current deployed version of Spark has a wind direction and wind magnitude ensemble that gives probability of an area being impacted.

Phase 4 of Spark development has added ensembles for 3 different forest models (McArthur, Vesta and Vesta mk2), fuel age and a full weather parameters ensemble.

These ensembles allow a quick comparison on small changes of each input, which can assist IMT to make decisions based on potential changes.



Spark is also in development to provide risk profiling across the landscape. This involves creating a grid of ignition points across a given landscape and running a simulation that ignites all points and shows areas that are at high risk of impact from wildfire. This will assist in identifying vulnerable areas and enable changes to building standards, preseason preparation and creating evacuation plans.



There is a vision to utilise contemporary bushfire behaviour models (Phoenix or Spark), to undertake gridded ensembles of fire behaviour predictions, across a given landscape to determine bushfire risk and trends in bushfire behaviour. Once bushfire risk is known, fuel hazard reduction strategies would be identified and assessed within the gridded ensemble methodology as a means to determine effectiveness and suitability. The capability to do this in SA is someway off and at this stage it is a best-practice model they would like to utilise in the future.

NSW RFS are building a framework that uses 3000 ignition points and 18 weather streams - asset locations, vulnerability curves, cultural heritage risks
Use the cloud to do processes faster (than a single computer/server)- Local Gov BMC level
Athena proj using Phoenix in the cloud with basic settings - 100,000s of ignition points - limitation is cost of using cloud based computing
Whole local gov area can be done in around 12 hours
Would like to move towards spark with the knowledge of limitations of Phoenix
Hope is to plug in Spark in place of Phoenix and use side by side to compare
What resolution is running - 180m and analysis, 540m to 1080m resolution for outputs
Limit to weather streams because of cost - old FDRs, 6 levels with changes in temp, wind, RH for each - aim for 54 weather streams
Statewide run expected to take days to a week of over 1m runs (100000s of points with 54 weather streams)
Moving towards net CDF data - in consultation with BoM

Only do 12 hours sims - 11am ignition with weather manipulated to start at 11am
Ignition risk vs impact risk
Run as clusters of LGAs - buffer of 20km - fires in, fires out of LGAs
Ignition points chosen as most likely locations
Model used to select locations - lightning on top of ridgetops

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Conclusions

The different ways that Spark has been customised to date is a testament to the developers in creating a program that allows changes to be made to suit the situation that it sits in. This covers customising the GUI, adding and changing model code, inserting local data/layers.

The future of Spark is bright, with many minds coming together to create and adapt Spark to a program that is easy to use, keeps up to date with the science, and can suit the agency it is used in.

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Thank you

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