Operationalising Research

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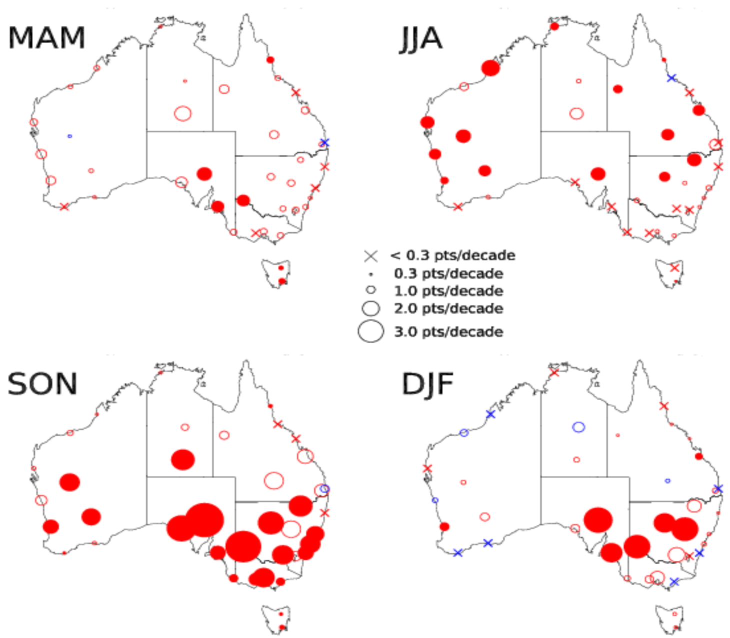
WHY:

- To improve our decision making in order to provide for safety of communities and emergency management volunteers and staff

Climate Change - Observed Changes

- Fire weather is becoming more extreme across most of Australia for most seasons.
- The greatest increase in trend is found in spring in the south east
- In Victoria
  - The number of very high days (FFDI >25) on average for parts Victoria has increased from 66 to 94 over the last 45 years.
  - There has been a ~170% increase in **fire occurrence** in Victoria 1972-2014 (DELWP data) with ~25% of this attributed to changes in climate

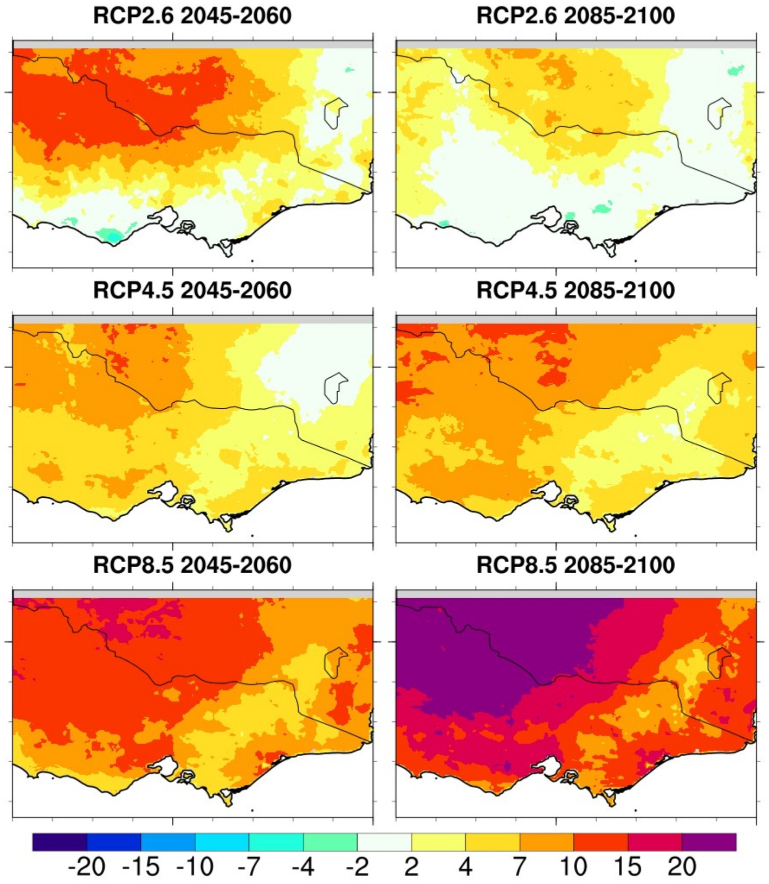


Observed seasonal change in fire weather at 39 stations across Australia (Harris and Lucas 2019)

Climate Change - Projected Changes

- Fire weather is projected to increase over the next century across Victoria

- Projected weather data can be used by fire and land managers in risk and adaptive management planning.



Change in the mean of the highest yearly FFDI values in future climate scenarios, averaged across the models used for each scenario, for 2045-2060 (left) and 2085-2100 (right) relative to 1973-2016. The top row is RCP2.6, middle row RCP4.5, bottom row RCP8.5.

Lengthening fire season and implications for Planned Burning

- The fire season is lengthening
- The occurrences of earlier starts to the season has doubled in the last 45 years (from 5 occurrences through to 2002 with FFDI>25 before September to 10 occurrences).
- An earlier start to the fire season indicates a reduced window of opportunity to burn during spring.
- This results in a shift to when planned burning activities can safely occur.

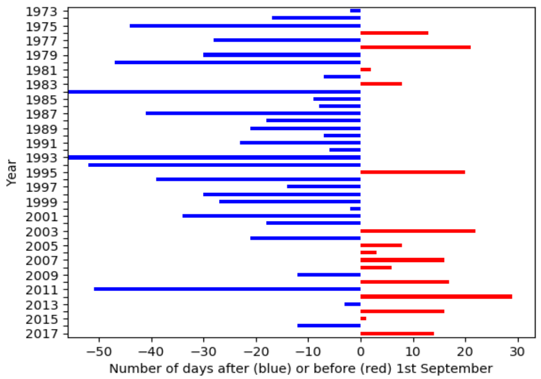
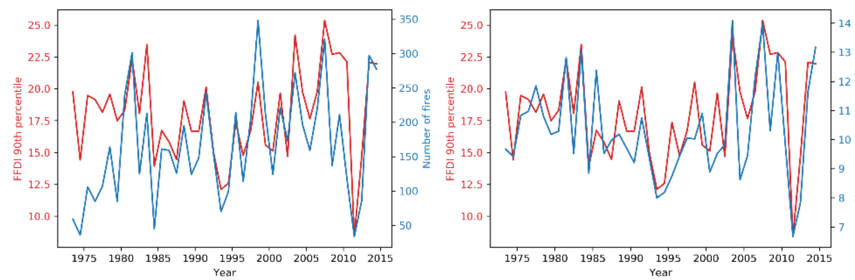


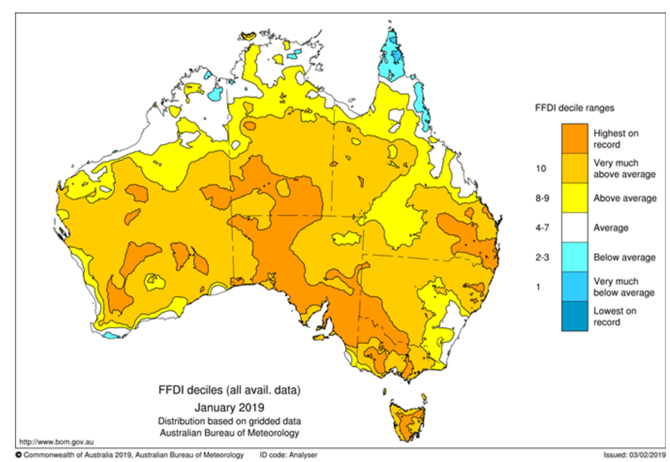
Figure 5.The number of days the first day of the year (Jul-Jun) to reach FFDI> 25 (for 10% of the area) deviates from the fire season start date (1st Sep) (Harris et al 2019)

Development of seasonal fire prediction tools

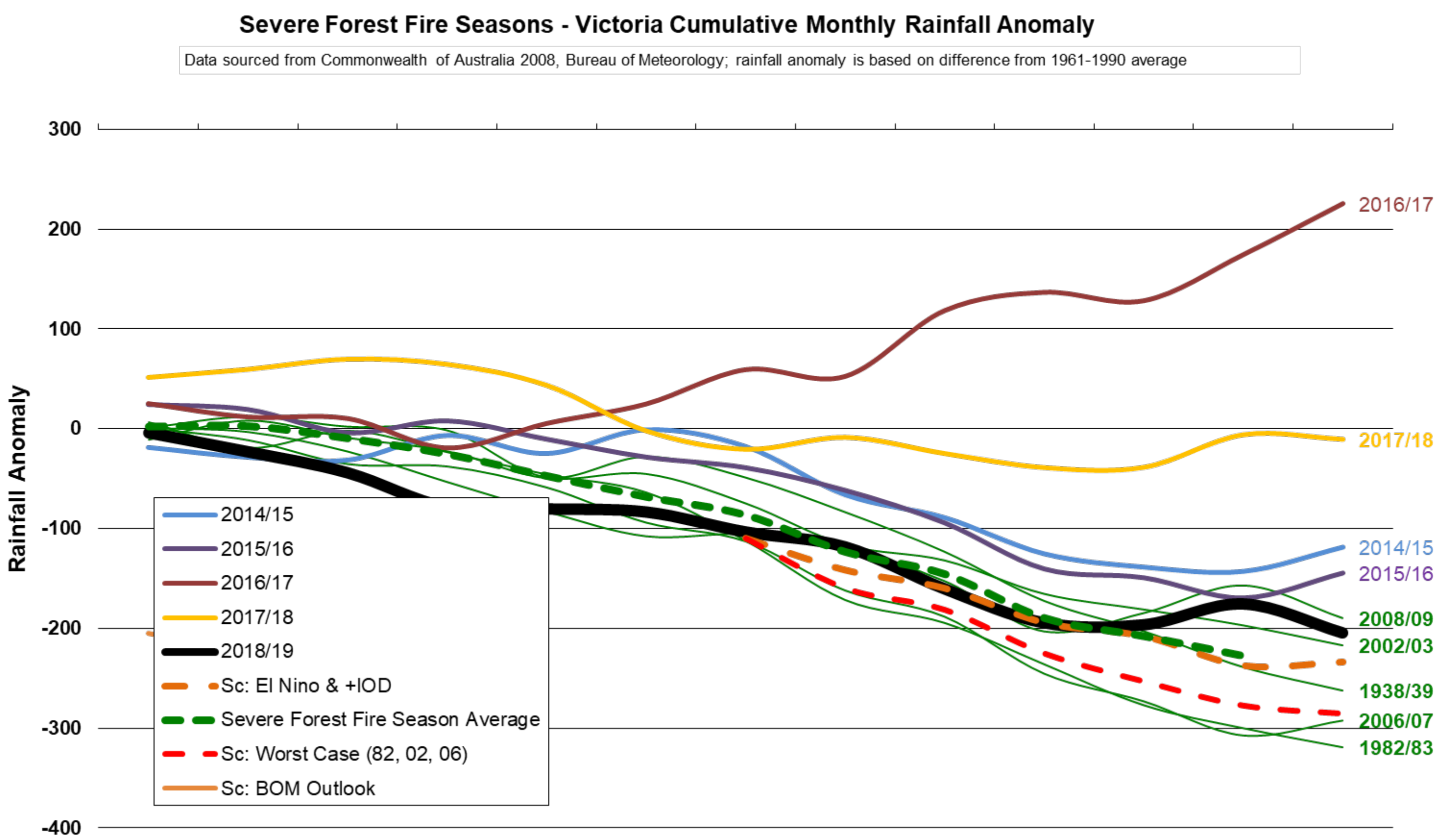
- Climate drivers (ENSO, IOD and SAM) influence fire weather in Australia
- Fire activity in Victoria is correlated with fire weather.
- Using climate drivers to produce seasonal outlook of fire weather we can better forecast fire potential



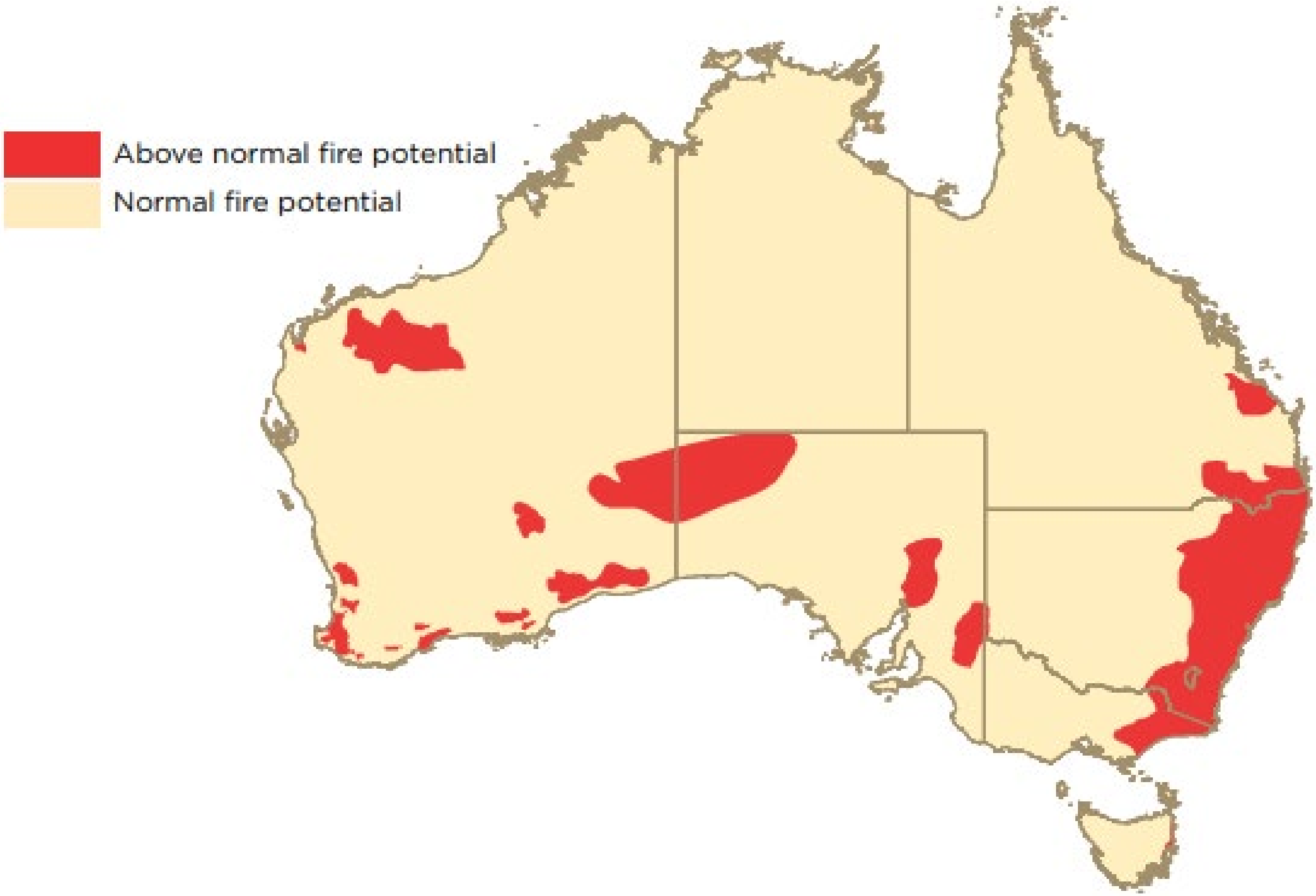
Annual (Jul-Jun) total number of fires and area burned (natural log) and 90th percentile FFDI (1972-2017) (Harris et al 2019)



Fire Season Predictions



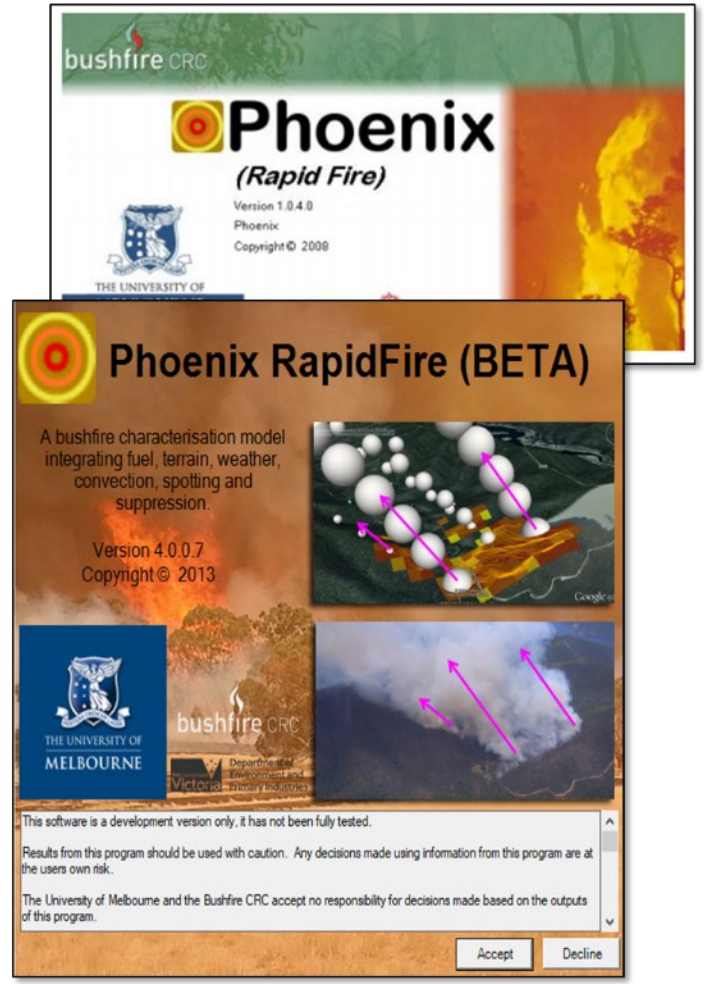
AFAC/BNHCRC seasonal outlook



- PHOENIX RapidFire (typically referred to as Phoenix) is a fire characterisation model used to capture the nature of a fire as it spreads across the landscape

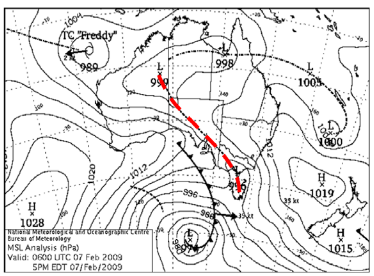
- As it spreads, the following fire characteristics are analysed:
  - Flame height
  - Fireline intensity
  - Fire size
  - Ember density
  - Property impacts

- Phoenix is used for Operational, Planning, Engagement and Education requirements

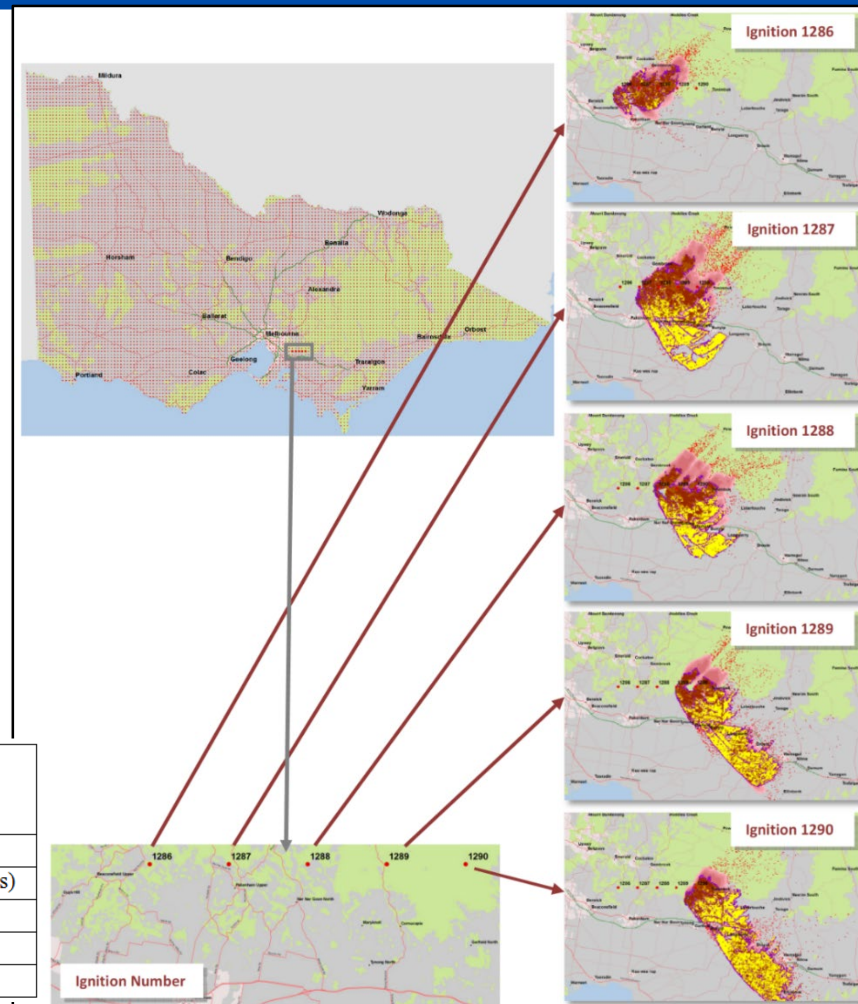


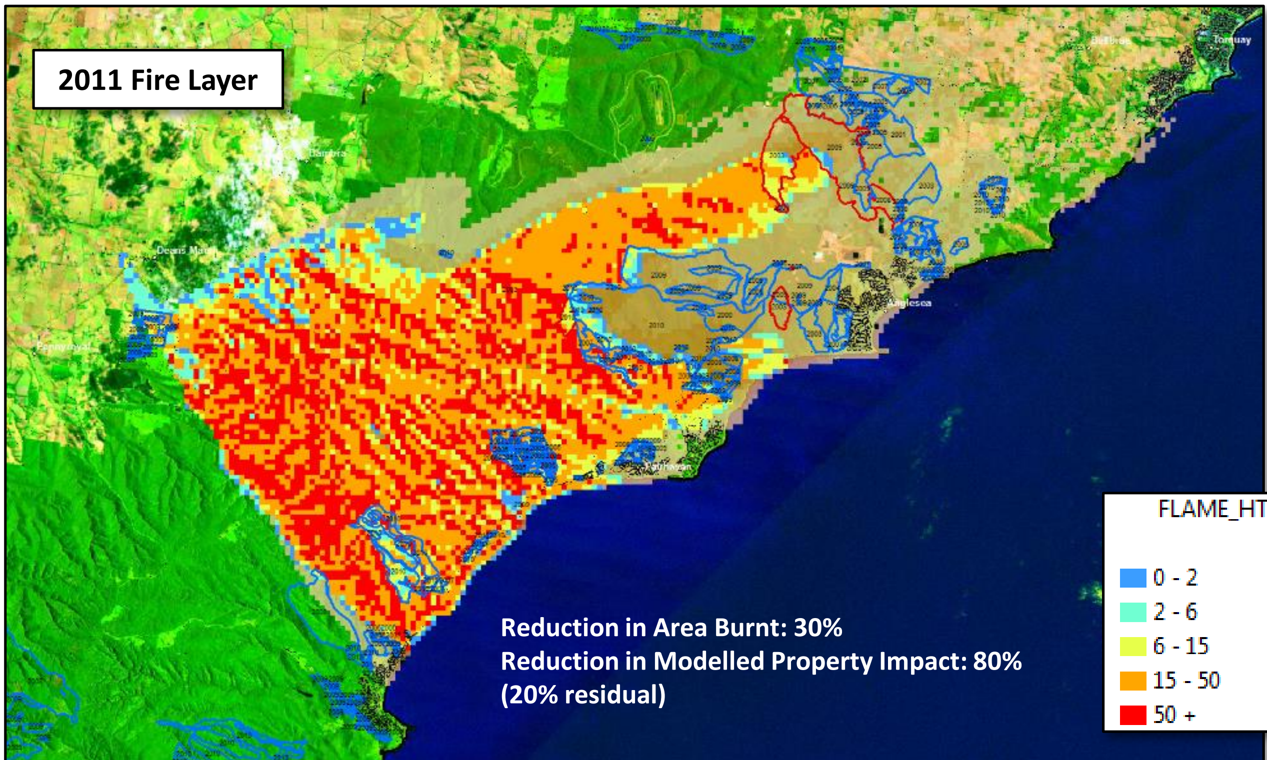
Simulation ignition grids can

- **Weather scenarios include:**
  - **Worst Case (FFDI 130)**
  - Code Red (FFDI 100+)
  - Extreme (FFDI 75-99)
  - Severe (FFDI 50-74)
  - Very High (FFDI 25-49)



Level	Descriptor	Description In any one year, the likelihood of the event occurring is:
A	Almost Certain	Close to 100% - Annually.
B	Likely	33% (ie., once in every three years)
C	Some chance	10% (ie., once every 10 years)
D	Unlikely	3% (once every 30 years)
E	Rare	1% (once every 100 years)




2011 Fire Layer
FLAME_HT
0 - 2
2 - 6
6 - 15
15 - 50
50 +
Reduction in Area Burnt: 30%
Reduction in Modelled Property Impact: 80%
(20% residual)

Application of self evacuation archetypes

Common self evacuation behavior in Australian bushfires have been identified.

Use these to educate, evaluate, model

Archetype	Key characteristics	Evacuate or Remain
Responsibility Denier	Believe they are not responsible for their personal safety or for their property	Highly committed evacuators but expect others to direct and assist
Dependent Evacuator	Expect the emergency services to protect them and their property because they are incapable of taking responsibility for themselves	
Considered Evacuator	Having carefully considered evacuation, are committed to it as soon as they are aware of a bushfire threat	Committed to self-directed evacuation
Community Guided	Seek guidance from neighbours, media and members of the community who they see as knowledgeable, well informed and providing reliable advice	Committed to evacuation on community advice
Worried Waverer	Prepare and equip their property and train to defend it but worry they lack practical experience to fight bushfire putting their personal safety at risk	Wavering between evacuating and remaining
Threat Denier	Do not believe that their personal safety or property is threatened by bushfire	Committed to remain as perceived lack of threat makes evacuation unnecessary
Experienced Independent	Are highly knowledge, competent and experienced and are responsible and self-reliant fighting bushfire	Highly committed to remaining because they are highly experienced and well prepared

Basic characteristics of archetypes (Strahan et al)

The CBBM Approach

Build networks to create capacity & opportunity and support on-going network development and relationships

Collective input enables clarification of values and priorities, identifies issues, and defines agreed issues & problems

Collective input generates proposed solutions gathers evidence and applies filters to identify priority actions

Develop plausible explanations for agreed actions identifies evidence-based agreed actions

Delivery of agreed actions achieves local outcomes including enhanced community-agency relations

Outcomes of local actions contribute to higher-level State outcomes

Suppression effectiveness and smart/IoT tanker

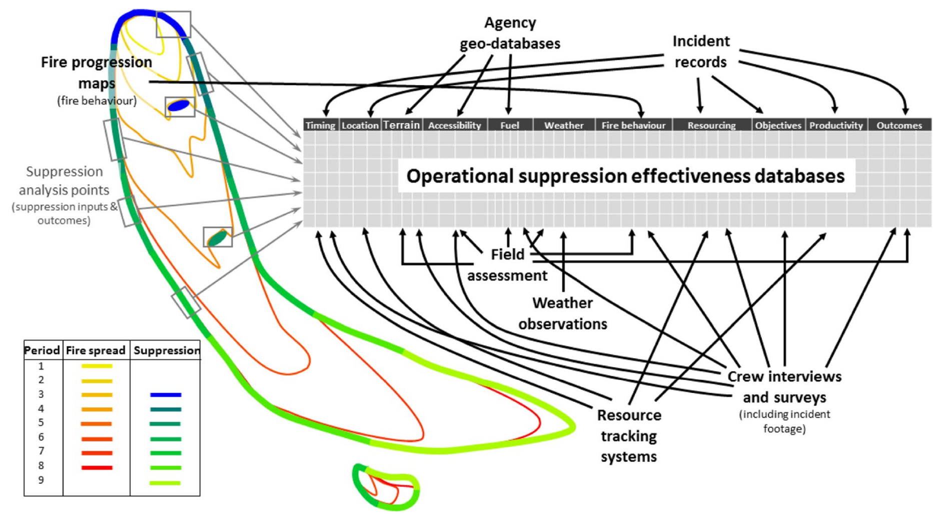
Objective:

Determine ground and air resource effectiveness

Approach:

- Design data requirement
- Collate existing data
- Collect new data

Smart/IoT tanker(s) – GPS tracking, video cameras, flow meters, automated processes

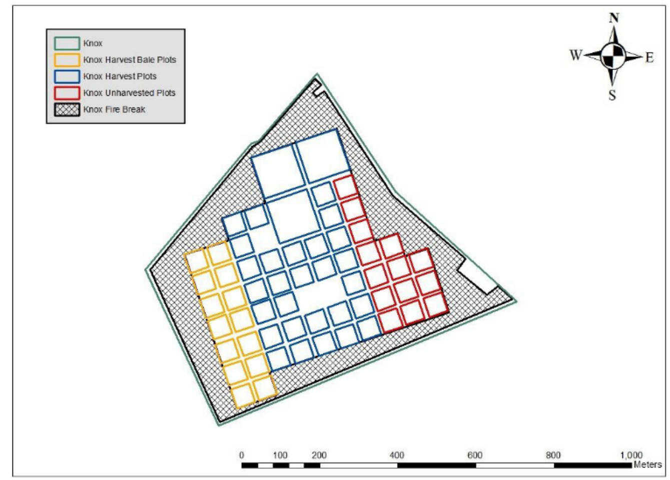


Conceptual path for developing operational suppression effectiveness databases using case study data (Plucinski et al 2019)

“You’ve got to burn to learn”
https://www.youtube.com/watch?v=QJ5SFjN1iOc&t=2s

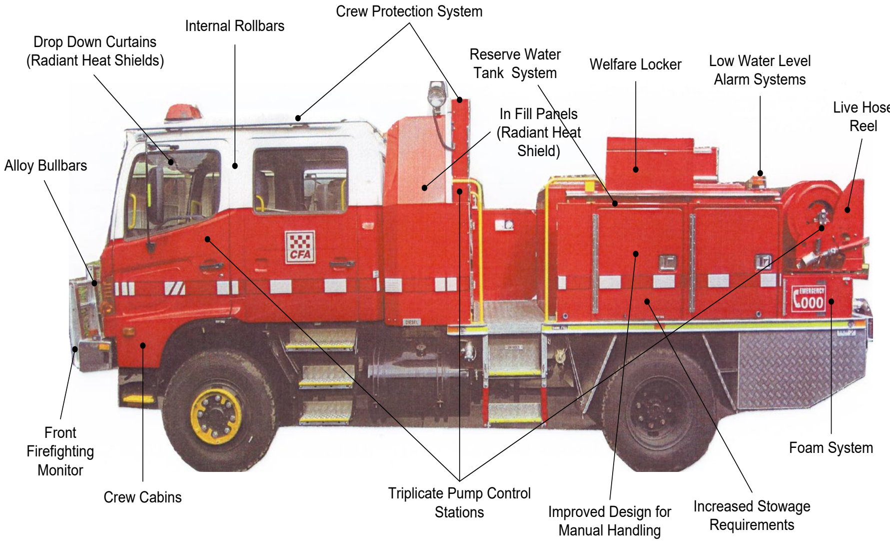
Cropland Fire Behaviour

Quantify fire propagation through different crop types (wheat, barley and canola) and the status of crops (unharvested, harvested and bailed) to test how applicable grass fire spread models are for crops
Approach: Experimental burns and statistical analysis



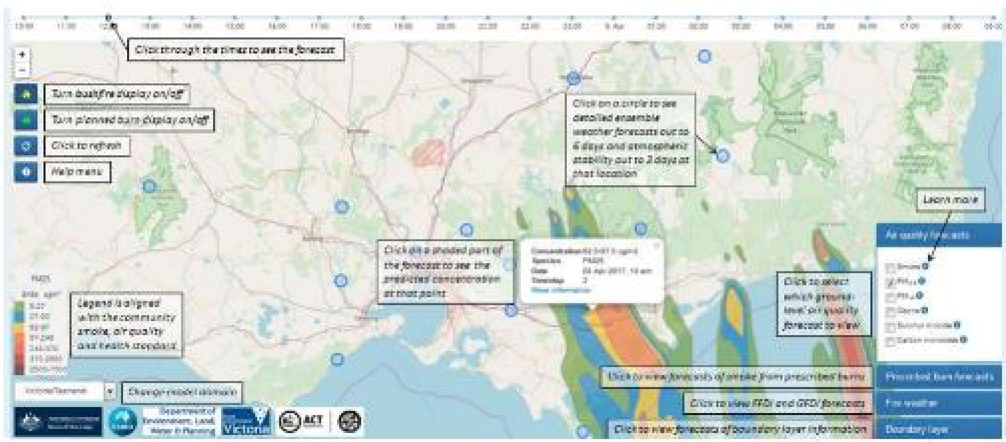
Crew protection

- Radiant heat curtains reduce cabin temperatures and can reduce flame intrusion
- Protected tanker at high fire intensities (up to 25,000 kW/m)
- Reduced internal cabin temperature (to 56^{o}C) vs external temperatures (500 to 950^{o}C)
- ROPS temperatures at 56^{o}C at lower levels
- The need for multiple layers of protection between firefighters and the fire to minimise:
  - Radiant heat loads inside cabin above pain threshold, burns to skin likely in fire intensity >5,000 kW/m
  - Mean body temperature increases exceed 1.5^{o}C when unprotected in fire intensities >5,000 kW/m
  - Toxic gas survivability acceptable with spray and heat curtains up to 10,000 kW/m



Smoke

- AQFx: a new quantitative smoke and air quality forecasting system.
- Used by fire and emergencies services:
  - To warn communities if wildfire smoke will be at unsafe levels
  - To determine if prescribed burns can be conducted




International Association of Wildland Fire
Facilitating communication and providing leadership for the wildland fire commun
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