bushfire&natural HAZARDSCRC

DETERMINING THRESHOLD CONDITIONS FOR EXTREME FIRE BEHAVIOUR

Standardising Data Obtained from Wildfires

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EXTREME FIRE BEHAVIOURS

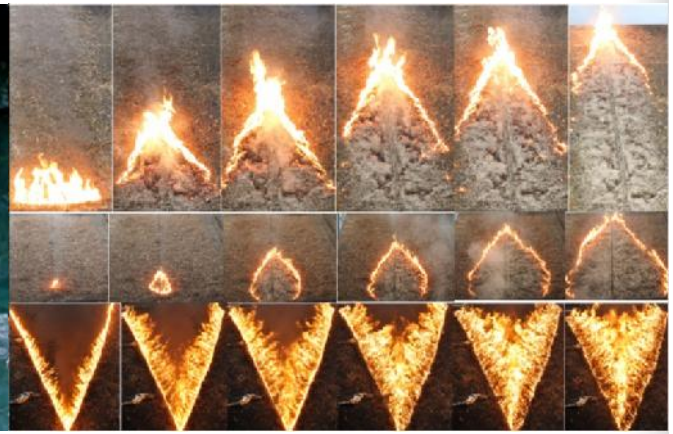
Spotting/fire storm

Fire tornado/whirls

Pyro-convective events

Crown fires

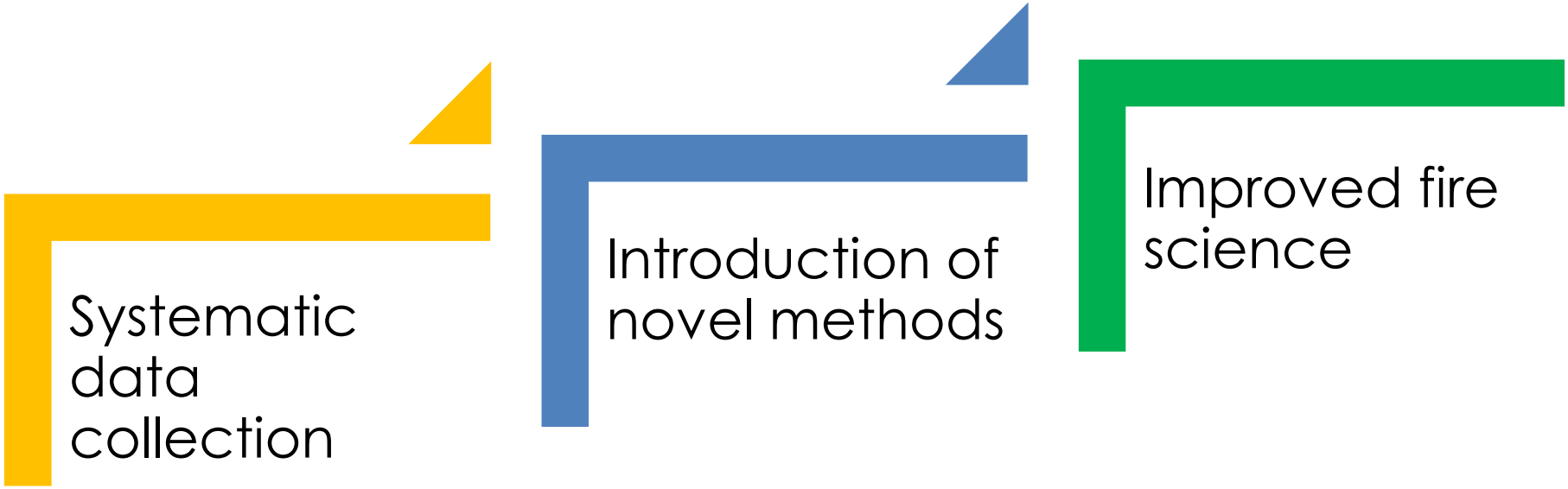
Conflagrations



Junction zones/Eruptive fires

What information needs to be collected during fires?

When collected, what data standards are appropriate?



List of fire management agencies that were approached in relation to the collection of data during fires

State or Territory	Agency
ACT	Parks and Conservation Service
	Rural Fire Service
NSW	National Parks and Wildlife Service
	Rural Fire Service
NT	Darwin Centre for Bushfire Research
	Bushfires NT
QLD	Queensland Parks and Wildlife Service
	Queensland Fire and Emergency Services
SA	Department of Environment, Water and Natural Resources
	Country Fire Service
TAS	Forestry Tasmania
	Tasmania Fire Service
VIC	Country Fire Authority
	Department of Environment, Land, Water and Planning
WA	Department of Parks and Wildlife

Data collection survey example

Data types		
1. Incident type	2. Aircraft GPS tracks	3. Suppression strategies
4. Contained/ escaped	5. Vehicle GPS tracks	6. Final perimeters
7. Ignition point/points	8. Response structures	9. Post fire impacts
10. Fencing / house losses	11. Weather Forecasts	12. Local weather observations
13. Urban infrastructure	14. Situation reports	15. Fuel /fire history
16. Weather radar	17. Progression isochrones	18. Fire behaviour type observations
19. Satellite images	20. FLIR video	21. Line scans

What kind of data are you collecting during an accident?

Name	Collect routinely	Collect occasionally	Should be collected routinely	Data storage (logbook/PC/ Web)
Small fire				
Medium fire				
Large fire				

Responses were received from

- Australian Capital Territory
- New South Wales
- Victoria
- Queensland
- South Australia
- Western Australia

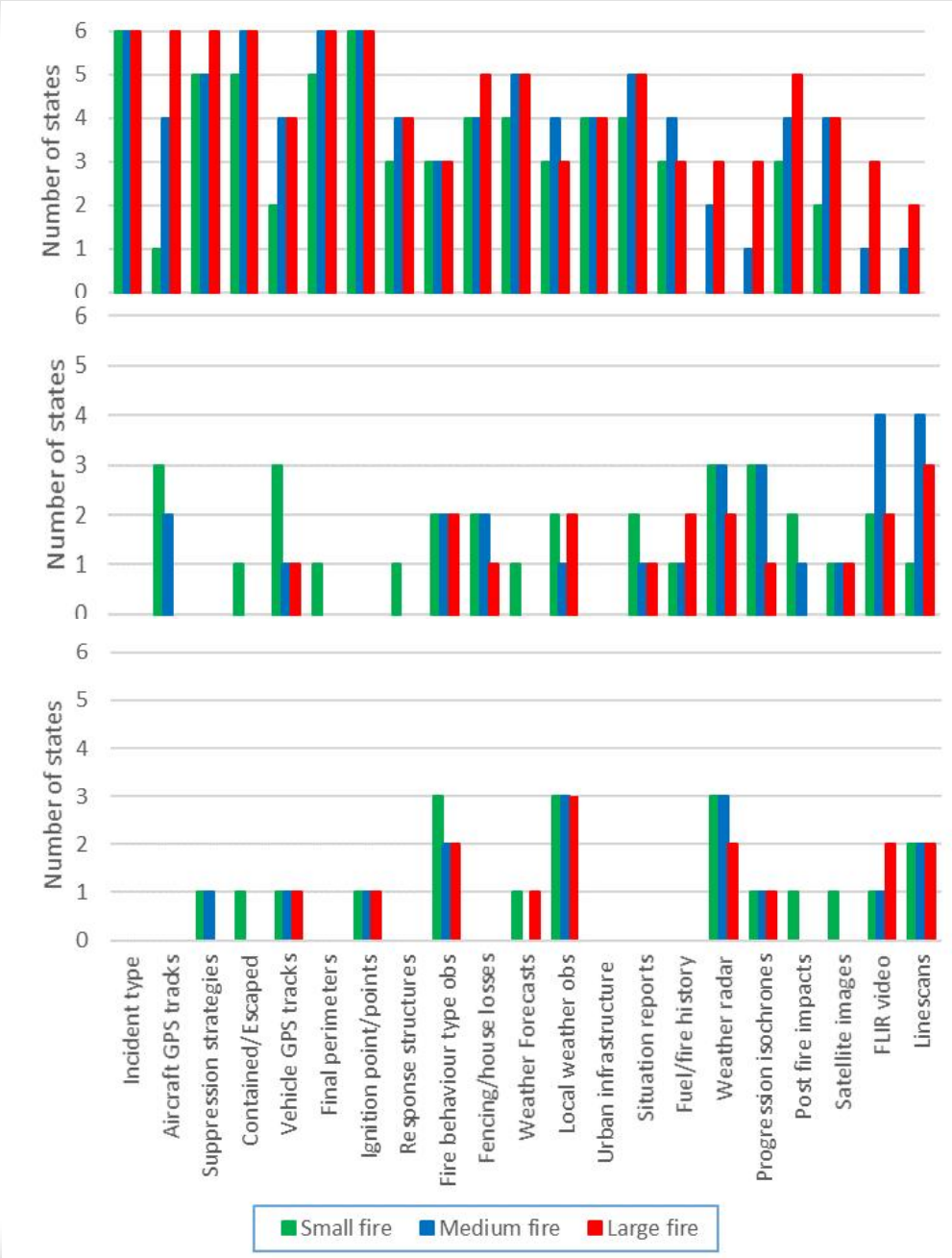
No responses were received from

- Tasmania
- Northern Territory

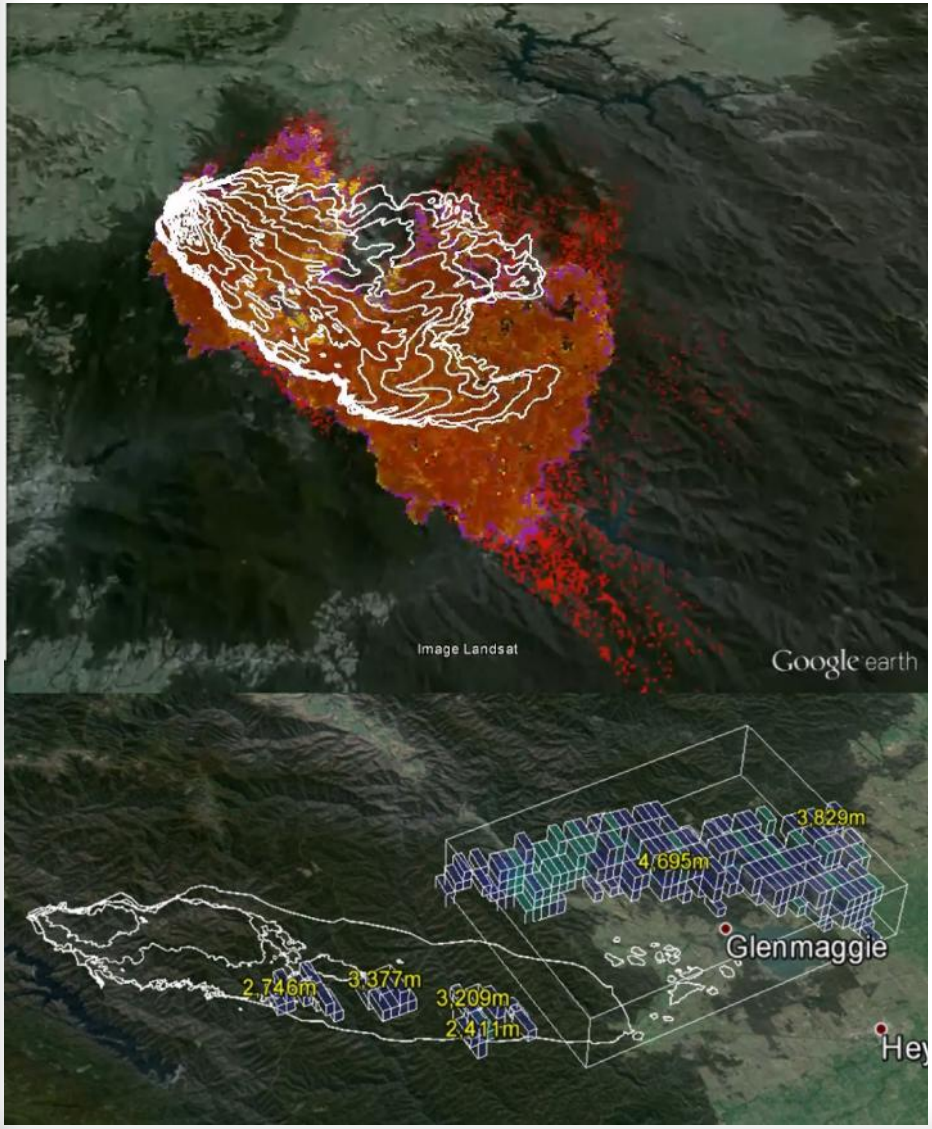
Fig. Responses from fire and land management agencies in Australia.

Clustered columns show the number of states, which collect specific data type routinely (a), occasionally (b) or should collect routinely (c).

The responses are given for small, medium and large fires.



INNOVATION IN DATA COLLECTION



There are a wide range of sources of information in relation to fires, however, as a starting point we recommend a focus on particular categories:

- Ground observations and operational information;
- Linescans;
- Forward Looking IR;
- Aerial observers;
- Satellites;
- Remote weather observations
- UAV observations;
- Vehicle/aircraft GPS tracks; and
- Suppression strategies.

List of recommended data and protocols for routinely collection using current technologies. It proposes which data should be collected routinely, how and what research output would be.

Data category	Data types	Protocol	Research outputs
Ground observations and operational information	▪ Building column ▪ Extreme fire behaviour ▪ Plume colour ▪ Wind entrainment ▪ Blocking plume ▪ Channelling ▪ Asset impact/losses ▪ Ignition point/points ▪ Fuel/fire history ▪ Ground weather observations	▪ Having an online system for noting significant events ▪ Periodic on-ground observations of weather ▪ Standardised data collection procedures for every data type to reduce dependence on the observer. E.g. for convective column: colour, height, sudden size/colour changes, tilt, PyroCb, downdraft, wind direction change.	▪ Understanding fire behaviour and fire-atmosphere interactions under regular/extreme conditions

Data category	Data types	Protocol	Research outputs
Linescans	▪ Linescan images	▪ Clear metadata on linescan flights ▪ Repeated linescans of fires every 30-60 minutes minimum ▪ A focus on active parts of fires and expected fire behaviour changes ▪ Using simultaneously multispectral sensors in both MWIR and TIR(LWIR) bands	▪ Fire intensity ▪ Flame depth ▪ Rate of spread ▪ Fire perimeter ▪ Flaming/smouldering combustion ▪ Hot spots

Data category	Data types	Protocol	Research outputs
Forward Looking IR	▪ IR/visual video and images ▪ Progression isochrones	▪ An online/digital documented process ▪ Every video and footage must have time and location ▪ Using simultaneously three sensors in MWIR, TIR(LWIR) and visual ranges ▪ Post processing of this data using specific algorithms ▪ Flight plan ▪ Targeting of spot fires ahead of moving fire fronts ▪ Opportunistic IR measurements/Guidelines on what to look for ▪ Recording of operator observations	▪ Real time fire dynamics ▪ Ember transport and ignition ▪ Suppression methodologies ▪ Actively burning areas ▪ Spot fires ▪ Energy radiated from the fire ▪ Fire intensity ▪ Flame depth ▪ Rate of spread ▪ Surface temperature ▪ Models validation

Data category	Data types	Protocol	Research outputs
Aerial observers	▪ Atmospheric profile ▪ Plume characteristics ▪ Changes in fireground conditions	▪ Standardised data collection procedures to reduce dependence on the observer ▪ Geolocation and time stamping imagery and digitally recording times and places of noteworthy fire behaviour ▪ Weather observation	▪ Understanding fire behaviour and fire-atmosphere interactions under regular/extreme conditions
Remote weather observations	▪ Meteorological parameters ▪ Radar data	▪ Having an online system to store data	▪ Visualization of active fires ▪ Detection of dynamic effects
Vehicle/aircraft GPS tracks and suppression strategies	▪ Aerial and ground GPS tracks ▪ Time of the water drop/suppression ▪ Vehicle type and fire size class	▪ Having an online system for data recording	▪ Optimisation suppression activities and strategy

Data category	Data types	Protocol	Research outputs
Satellites	▪ Satellite images ▪ Fire severity maps	▪ Procedure to adopt active sensors during fires ▪ System to identify and store data from satellites recording over fire areas as fires occur	▪ Fire intensity ▪ Flame depth ▪ Rate of spread ▪ Surface temperature ▪ Fire radiative power ▪ Char and ash cover ▪ Area burned ▪ Fire perimeter ▪ Flaming/smouldering combustion ▪ Smoke plume ▪ Plume injection heights ▪ Hot spots ▪ Atmospheric chemistry changes

Data category	Data types	Protocol	Research outputs
Unmanned Aerial Vehicle	▪ Local weather characteristics ▪ IR/visual video and images ▪ Lidar data	▪ Development and implementation of regulations to use UAVs during fires.	▪ Mapping canopy gaps and height ▪ Tracking fires ▪ Supporting intensive forest management ▪ Fire intensity ▪ Flame depth ▪ Rate of spread ▪ Hot spots/Spotting ▪ Real time fire dynamics ▪ Ember transport and ignition ▪ Suppression methodologies

CONCLUSION

The limited availability of high quality data on wildfire behaviour restricts the rate at which research can advance particularly on the most damaging fires that occur.

Improvement of data collection will facilitate providing leverage on data collected and allow robust conclusions to be reached sooner and with less expense. This would include improving systems and processes in use today, as well as considering new technologies than can help information to be collected more efficiently.

To be successful, this must be in a form of partnership between researchers and fire agencies, and ideally with a coordinated approach that standardises methods, technologies and approaches Australia wide.

FUTURE RESEARCH

- Analyse the frequency and importance of extreme fire behaviours (Dec 2017)
- Examine environmental contribution to landscape scale fire behaviour (2018 +)
- Evaluate influence of dynamic radiant heat on fire front propagation and structure ignition (2018 +)

THANK YOU!