



# AMICUS: National Fire Behaviour Knowledge Base

*Bringing together the best information for best decision*

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ECOSYSTEM SCIENCES/DIGITAL PRODUCTIVITY AND SERVICES FLAGSHIP

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# Amicus: *(an independent adviser)*

## National Fire Behaviour Knowledge Base (NFBKB)

### Outline

- National Fire Behaviour Knowledge Base
  - Relevance
  - Science
- Software architecture
- Benefits and applications
- Future development

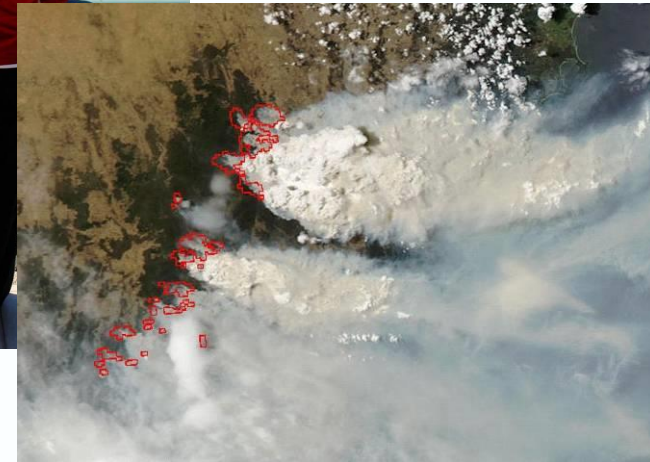
### Amicus- Fire behaviour DSS

- **NOT** another bushfire simulator
- Will **NOT** replace PHEONIX RapidFire- but will be **COMPLIMENTARY**

# Relevance

## National Fire Behaviour Knowledge Base (NFBKB)

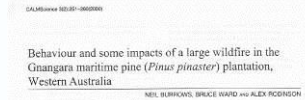
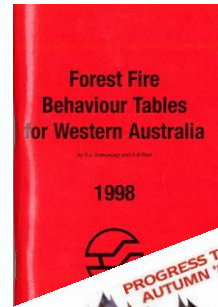
- Significant increase in frequency of severe disastrous bushfire causing unprecedented land lasting socio-economic and ecological impacts
- Current fire behaviour tools for prediction fail to incorporate the latest knowledge in fire science
- Limiting forecast quality and impairing critical decision making regarding community protection and safe and effective fire-fighting.





# Relevance

## National Fire Behaviour Knowledge Base (NFBKB)

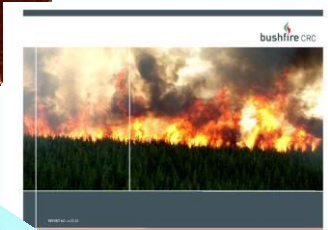
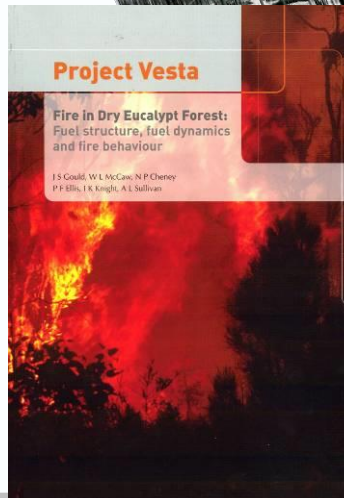


### Softwood Plantation Fire Synopsis



Fire Management Group (FMG)

Submitted by: The Softwood Plantation Fire Synopsis Group (SPFSG)

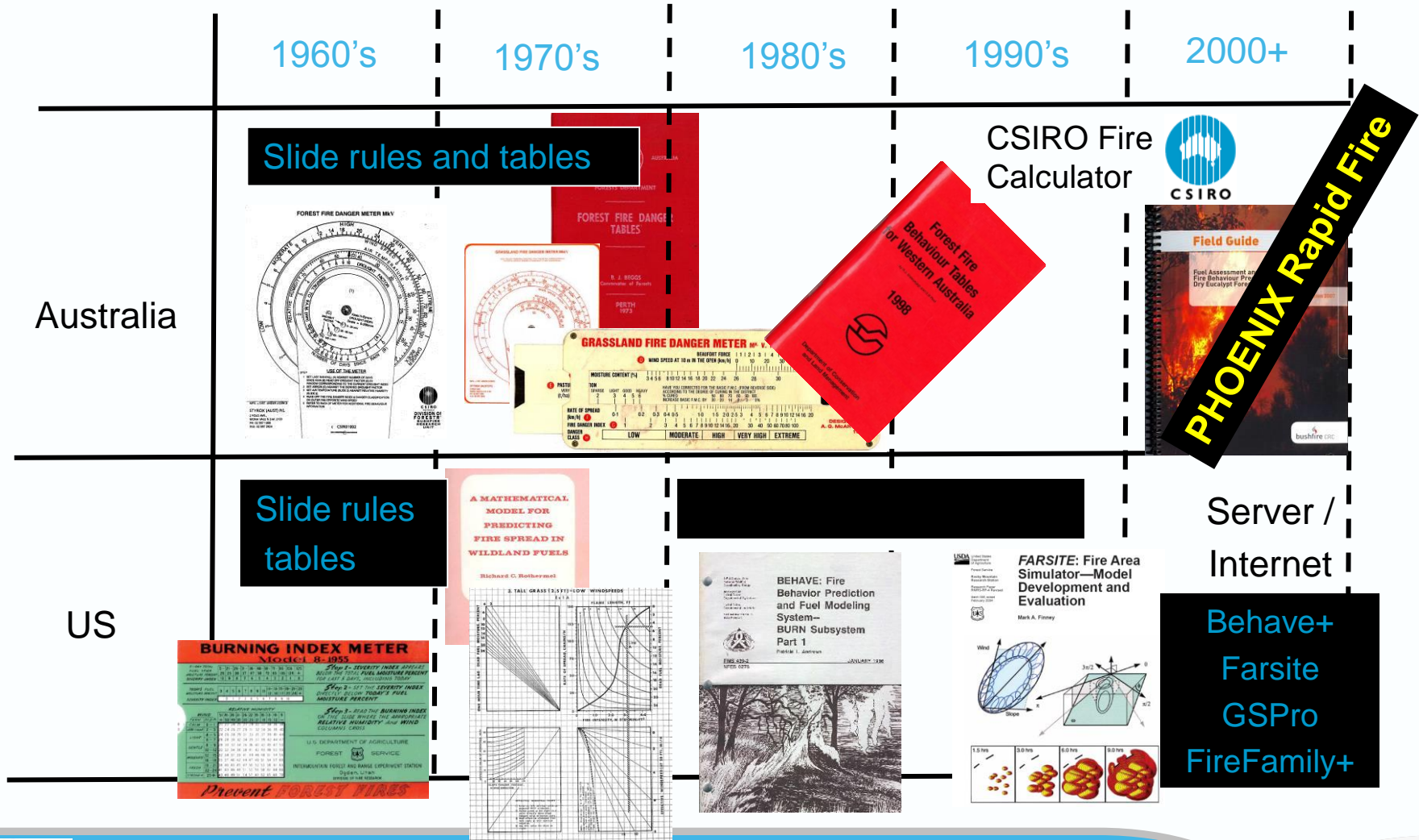


CSIRO – AMICUS: National Fire Behaviour Prediction System



# Evolution of decision making tools (1960's+)

Australia vs. United States





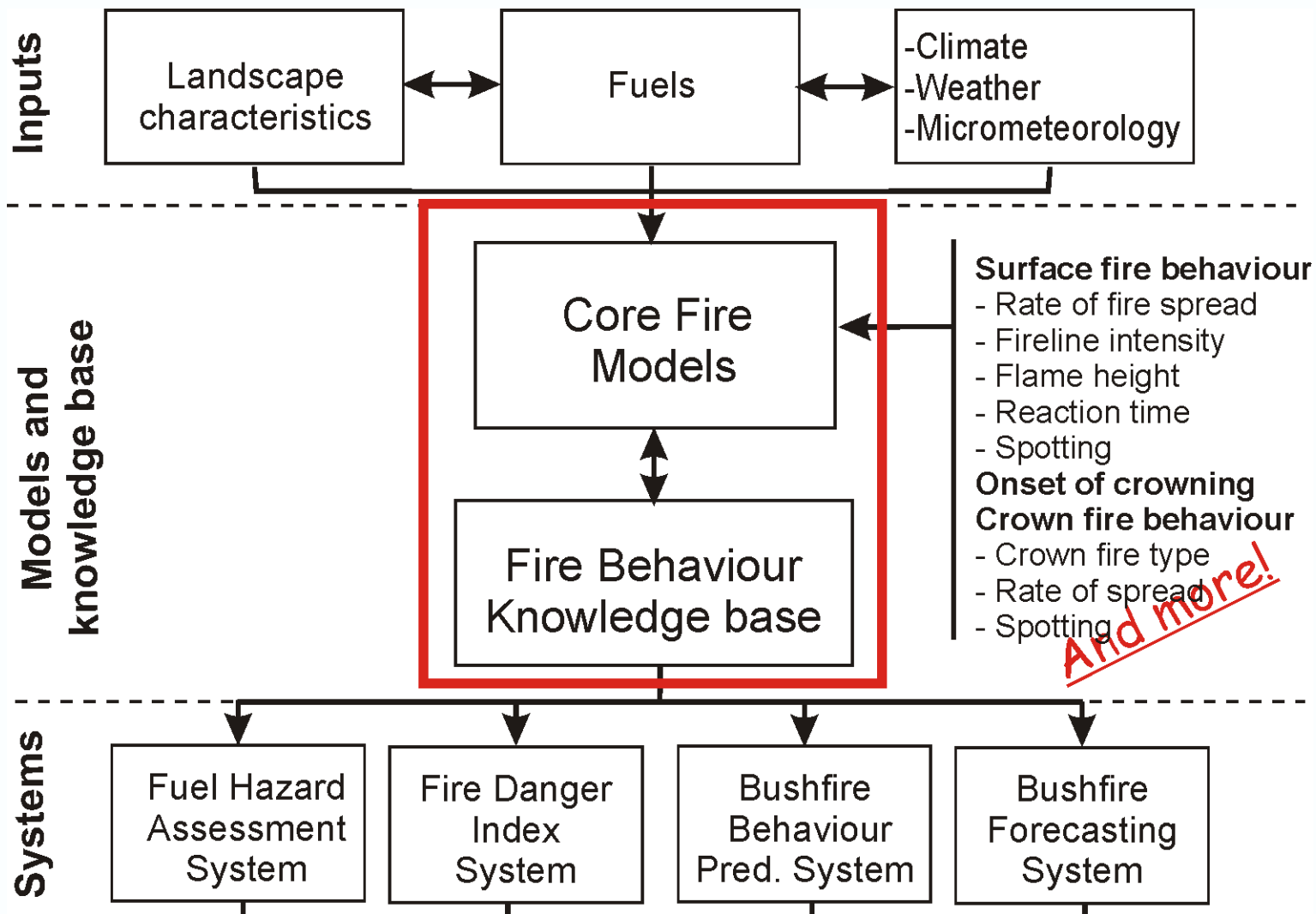
# Fire behaviour models and applications

## Models

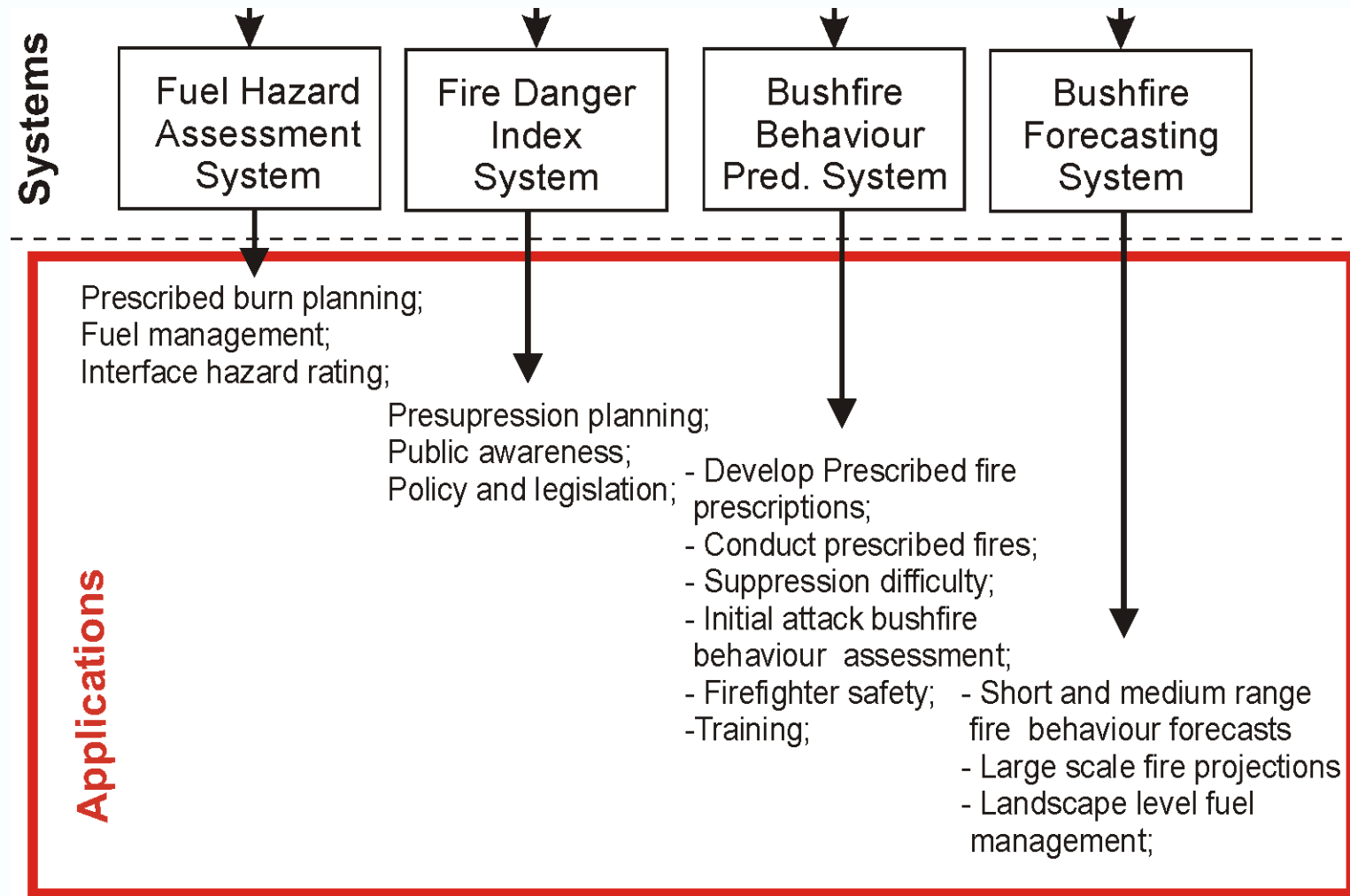
Fire spread sustainability  
Rate of fire spread  
Onset of crowning  
Fire intensity  
Flame height  
Scorch height  
Residence time  
Burnout time  
Spotting  
Fuel consumption  
Smoke production

## Applications

Fuel management  
Prescribed burn planning  
Interface hazard rating  
Pre-suppression planning  
Initial attack dispatching  
Firefighter safety  
Fire behaviour forecasting  
Bushfire suppression planning  
Large scale fire projections



## Sub-systems and applications

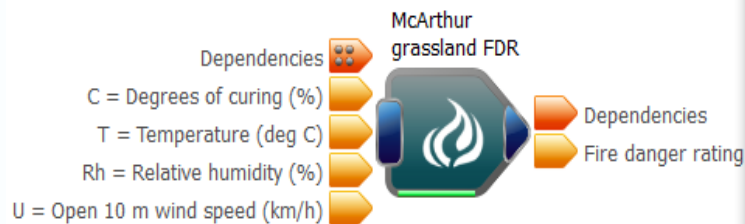




# Amicus- phase I *Fire behaviour calculations*

## Software development

- Amicus- NFBKB will be built using Workspace workflow environment (CSIRO Computational Informatics- Computational Modelling)
- Workspace workflow input and output operations



Operation editor - McArthur grassland FDR

No custom display

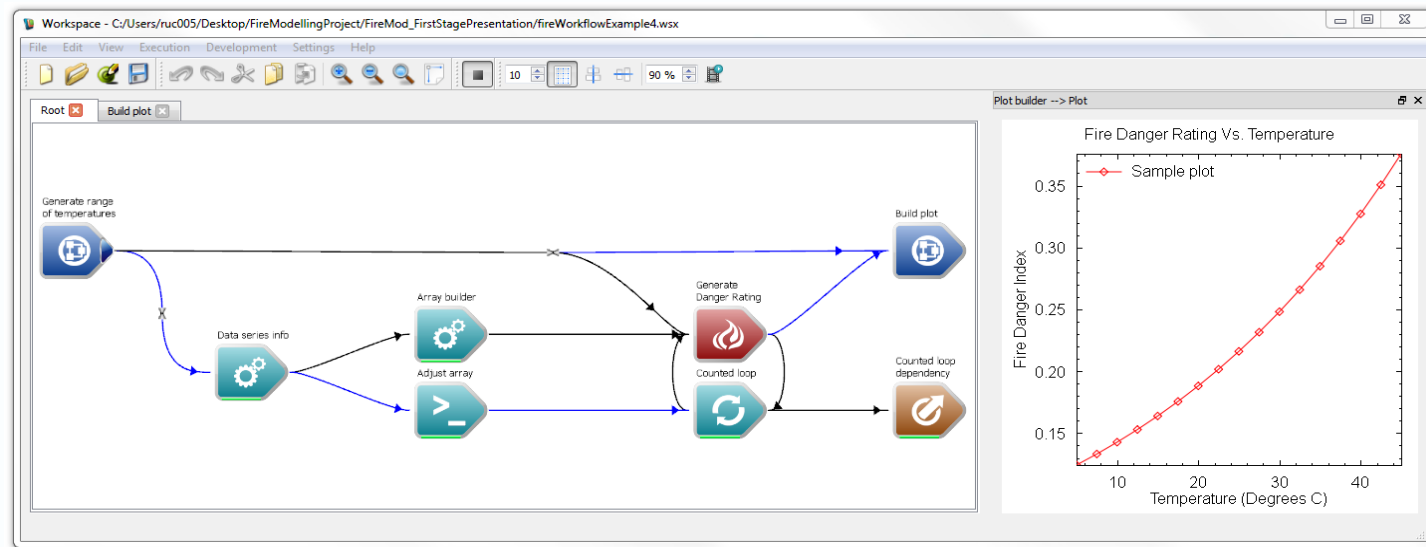
Name	Value
Inputs	
C = Degrees of curing (%)	75
T = Temperature (deg C)	33
Rh = Relative humidity (%)	9
U = Open 10 m wind speed (km/h)	45
Outputs	
Fire danger rating	25.9584318605712

Example of workspace operation that calculates fire danger rating for grasslands.

# Amicus- *phase I* Fire behaviour calculations

## Software development

- Workspace users may construct, modify and execute workflows using an intuitive graphical editor which inspects any input and output on workflow by using custom build widgets



A workflow that plots temperatures against fire danger indices using newly developed fire model operations.

# Amicus: Phase I Fire behaviour calculations

## Beta GUI layout

The image displays three overlapping screenshots of the Amicus - Fire Knowledge Base GUI. The top-most window shows the 'Inputs' tab with fields for Observation conditions (Measurement elevation: 268.0, Cloud cover (octs): 5, Date: 25/12/2013, Time: 14:50), Weather (Air temperature (C): 35.0, Relative humidity (%): 18.0, 10 m wind speed (km/h): 35.0, 10 m wind direction (degrees): 335.0, 2 m wind speed (km/h): 35.0, 2 m wind direction (degrees): 335.0, 2 m wind reduction factor: 2.5), and Rainfall/drought (Last rainfall (mm): 18.0, Days since last rain: 7, Soil dryness (KBDI or SDI) (mm): 98.0, Drought factor: 7). The 'Results' tab shows Fire Danger (Grasslands: Fire Danger Index 120, Rating Extreme; Forests: Fire Danger Index 38, Rating Very High) and Fire behaviour on flat ground (Rate of Spread (m/h): 2000, Flame height (m): 2.4, Spotting Distance (m): 2400, Fireline intensity (kW/m): 2.4). The bottom-most window shows the 'Inputs' tab with fields for Aspect (240.0), Slope (degrees) (18.0), Elevation (m) (960.00), and Select slope units (degrees selected). The bottom-left corner features a logo for 'Years COMMONWEALTH BUSH-FIRE RESEARCH'.

Amicus - Fire Knowledge Base

File Edit View Help

Inputs

Instructions Meteorology Fuels Terrain

Amicus - Fire Knowledge Base

File Edit View Help

Inputs

Instructions Meteorology Fuels Terrain

Amicus - Fire Knowledge Base

File Edit View Help

Inputs

Instructions Meteorology Fuels Terrain

Aspect 240.0

Slope (degrees) 18.0

Elevation (m) 960.00

Select slope units:

☒ degrees

☐ percent

☐ rise/run

Amicus - Fire Knowledge Base

File Edit View Help

Inputs

Instructions Meteorology Fuels Terrain

Observation conditions

Measurement elevation 268.0

Cloud cover (octs) 5

Date 25/12/2013

Time 14:50

Weather

Air temperature (C) 35.0

Relative humidity (%) 18.0

10 m wind speed (km/h) 35.0

10 m wind direction (degrees) 335.0

2 m wind speed (km/h) 35.0

2 m wind direction (degrees) 335.0

2 m wind reduction factor 2.5

Rainfall/drought

Last rainfall (mm) 18.0

Days since last rain 7

Soil dryness (KBDI or SDI) (mm) 98.0

Drought factor 7

Amicus - Fire Knowledge Base

File Edit View Help

Results

Southern Grass Northern Grass Dry Eucalypt McArthur Forest Summary

Fire Danger

Grasslands Forests

Fire Danger Index 120 38

Rating Extreme Very High

Fire behaviour on flat ground

Southern Grass Northern Grass Dry Eucalypt McArthur Forest

Grazed/Mown Woodland Very High 12.5 t/ha

Rate of Spread (m/h) 2000 2400 2400 2400

Flame height (m) 2.4 2.4 2.4 2.4

Spotting Distance (m) 2400 2400

Fireline intensity (kW/m) 2.4 2.4 2.4 2.4



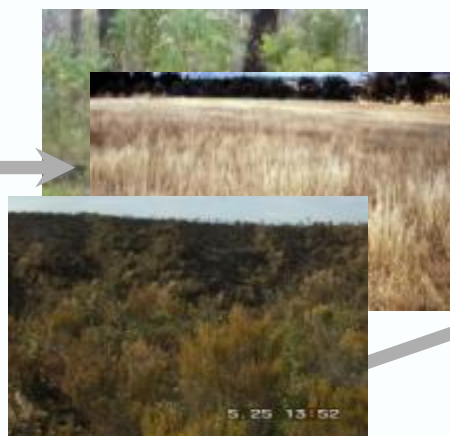
# Amicus: Phase II NFBKB

## Concept Overview

Vegetation description  
Fire history maps



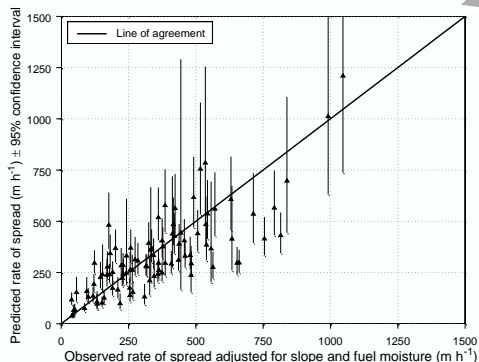
Bushfire fuel  
classifications



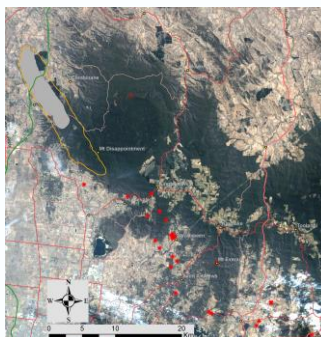
Weather/behaviour  
data

Time	Rainfall (mm)	Air Temp. (°C)	Dew Point (°C)	RH (%)	Vapour Pressure	Mean Wind Speed (km/h)	Wind Dir (°)	10-min Wind Gust (km/h)	Mean Sea Level Press. (hPa)	Station Level Press. (hPa)
0000	0	25.6	8.1	33	10.8	16.7	70	20.4	1006.3	947.9
0030	0	25.9	9.3	35	11.7	22.2	30	25.9	1006	947.7
0100	0	24.9	10	39	12.3	25.9	20	29.6	1005.8	947.3
0130	0	24.9	11.1	42	13.2	29.6	10	35.2	1005.5	947
0200	0	25.6	11.4	41	13.5	29.6	20	37.0	1005	946.8
0230	0	26	11	39	13.1	29.8	20	35.2	1004.5	946.4
0300	0	25.9	10.9	39	13	27.8	30	31.5	1004.5	946.4
0330	0	26.1	10.7	38	12.9	27.8	20	33.3	1004.4	946.3
0400	0	26.1	10.3	37	12.5	29.6	20	33.3	1004.2	946.1
0430	0	25.6	10.2	38	12.4	31.5	20	37.0	1004.1	945.9
0500	0	25.7	10.3	38	12.5	31.5	20	37.0	1004	945.8
0530	0	24.9	10.4	40	12.6	31.5	20	35.2	1004	945.6
0600	0	25.2	10.3	39	12.5	29.6	30	37.0	1003.9	945.6
0630	0	25.1	10.2	39	12.4	29.6	20	35.2	1003.9	945.6
0700	0	25.2	10.3	39	12.5	29.6	10	33.3	1004.1	945.8
0730	0	25.7	9.5	36	11.9	33.3	10	40.7	1004.2	946
0800	0	26.3	9.6	35	12	38.9	10	46.3	1004.3	946.2
0830	0	27.7	9.5	32	11.9	42.6	10	53.7	1004.1	946.3
0849	0	28.5	9.7	31	12	42.6	10	53.7	1003.8	946.1
0900	0	28.7	9.4	30	11.8	42.6	10	61.1	1003.4	945.8
0930	0	29.2	9.8	30	12.1	46.3	10	57.4	1003.4	945.9

Model comparison



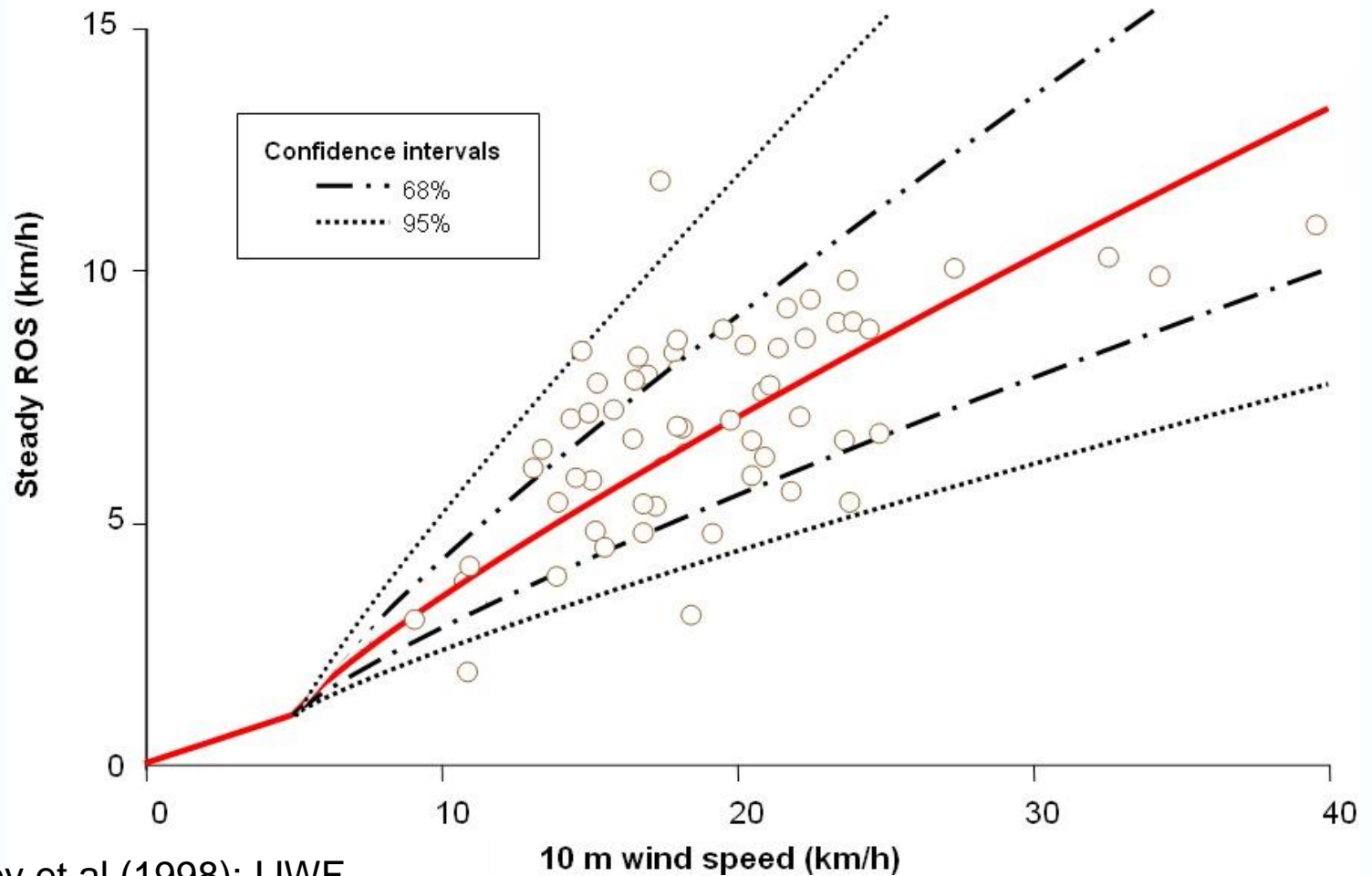
Photo/Video/PDF  
documentation



Fire behaviour  
details

# Amicus- *phase II* NFBKB

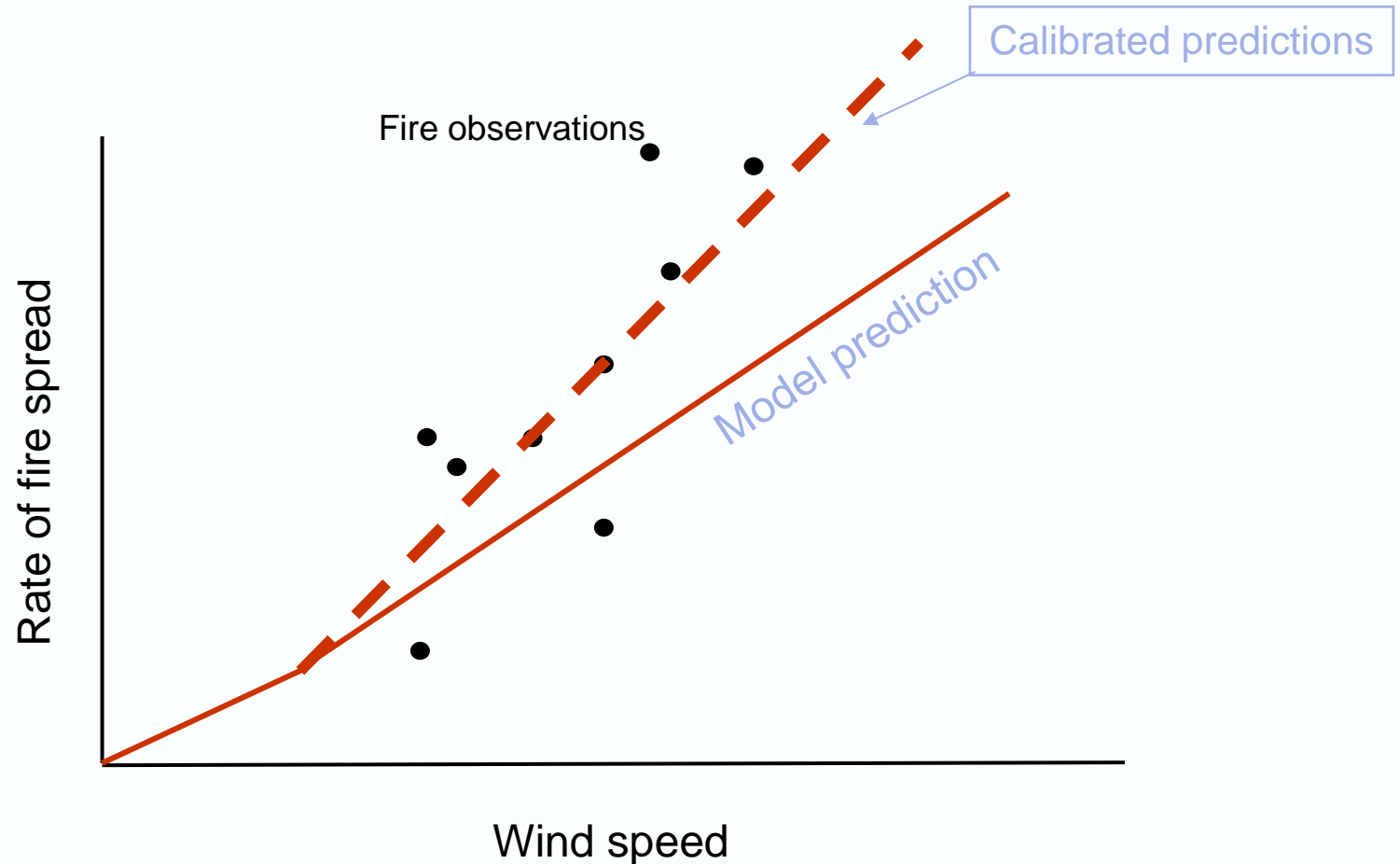
## Understanding natural variability in fire spread



Source Cheney et al (1998); IJWF

# Amicus- *phase II* NFBKB

## Fire behaviour prediction data assimilation



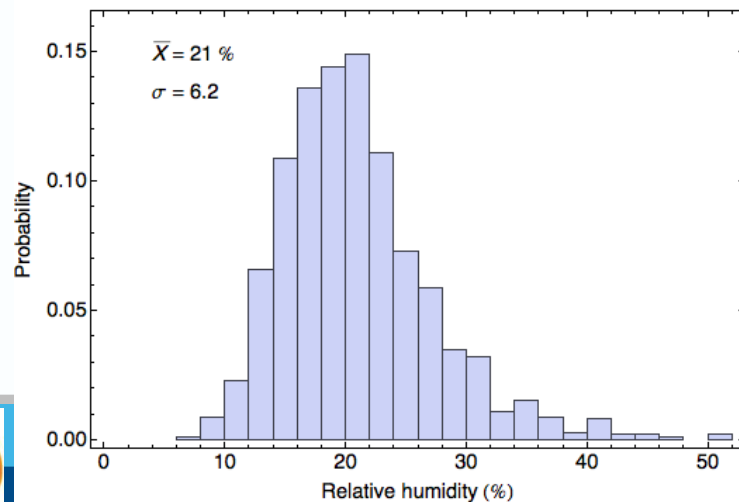
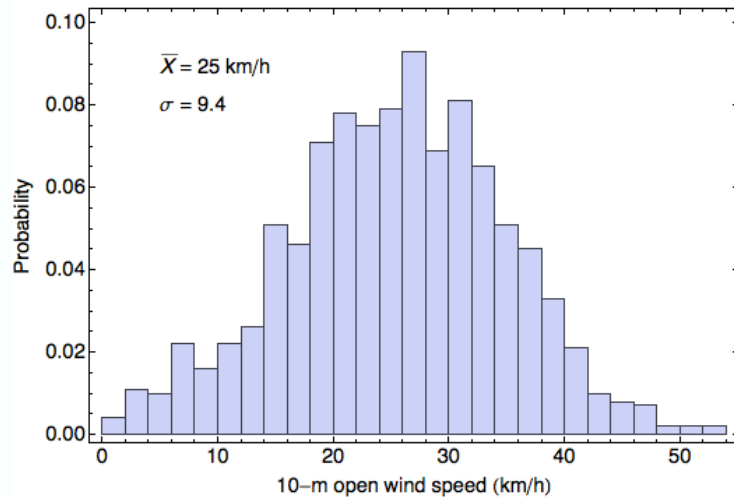
Ref: Cruz & Alexander (2013); EM&S



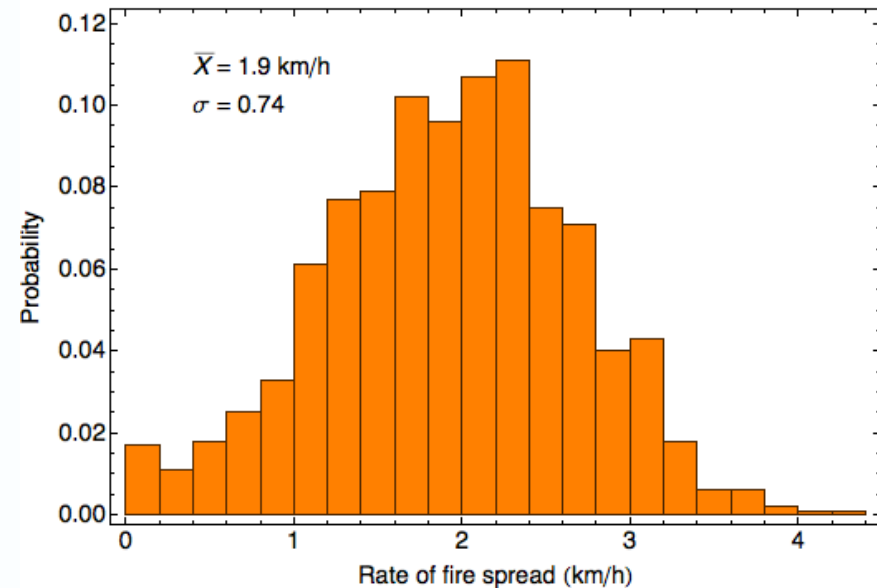
# Amicus- *phase II* NFBKB

Fire behaviour prediction- ensemble methods

## Input distribution



## Output distribution



# Australian bushfire fuel classification

- Fire behaviour
- Fire danger
- Prescribed burn planning
- Fuel hazard assessment
- Fire effects
- etc

- Fuel hazard rating
- Load
- Height
- Curing
- Particle size
- etc

Figure 1 consists of six line graphs arranged in a 2x3 grid, showing fuel load dynamics in a forest landscape. The y-axis for all graphs is 'Fuel load (t ha⁻¹)' ranging from 0 to 40. The x-axis for all graphs is 'Time since last fire (years)' ranging from 0 to 30. The top row shows 'Fuel load dynamics in a forest landscape' with three graphs: 'Forest regrowth forest', 'Fire-prone forest', and 'Highly fire-prone forest'. The bottom row shows 'Fuel load dynamics in a forest landscape' with three graphs: 'Fire-prone forest', 'Forest regrowth forest', and 'Highly fire-prone forest'. Each graph shows a curve representing fuel load over time, with different colors and line styles for each forest type. The curves generally show an increase in fuel load over time, with some forest types reaching higher loads than others.

# Amicus- NFBKB

## Application and benefits

- Operational tool for different platforms- PC, Tablets, Smartphone, Web base including the latest fire science
- NFBKB will be a powerful tool for fire behaviour analysis and prediction for FBAN(Fire Behaviour Analysts) , fire managers, etc
- Centralised repository of national fire behaviour data
- NFBKB will have the capacity to include photographs, videos, documents of pre-during and post-burn operation development DSS on prescribed burning
- Will integrate the Australian Bushfire Fuel Classification which will improve our overall understanding and prediction of fires



**Amicus- *Beta release***

# **CSIRO SYMPOSIUM**

## **Fire Behaviour**

The State of the Science for Practitioners

When: 14-16 October 2013

Where: CSIRO Discovery Centre, Canberra, ACT

To register your attendance at the symposium please go to:  
<http://tinyurl.com/CSIRO-Bushfire-Registration>

IN PARTNERSHIP WITH THE BUSHFIRE CRC, ACT PARKS AND  
CONSERVATION, ACT RURAL FIRE SERVICE AND NSW RURAL FIRE SERVICE.



CSIRO – AMICUS: National Fire Behaviour Prediction System



# Thank you

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## Acknowledgement:

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ECOSYSTEM SCIENCES/DIGITAL PRODUCTIVITY AND SERVICES FLAGSHIP

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