Fire Impact & Risk Evaluation – Decision Support Tool (FireDST)

Research Advisory Forum – Perth

14/5/2013
Ian French
Australian Government, Geoscience Australia
FireDST
Developing Knowledge

Paper 1: Quantitative bushfire risk assessment framework for severe and extreme fires,

Paper 2A: Spatial Interpolation of Bushfire Hazard: Observational Study
Sanabria A., Qin X., Li J., Cechet B., Lucas (submitted to Environmental Modelling and Software 4/1/2013)

Paper 2B: Estimating Fire Weather Danger in SE Australia using Climate Simulated Data

Paper 3: BFIM: Building Fire Impact Model, Sanabria A., French I., Cechet B.,
(accepted for special session at MODSIM 2013; Paper due July 2013)

Paper 4: FireDST: Fire Impact and Risk Evaluation Decision Support Tool,
French I., Cechet B., Yang T., Sanabria A., (accepted for special session at MODSIM 2013; Paper due July 2013)

Paper 5: Using wind multipliers to determine local wind speed from modelled regional
data for fire spread applications, Yang T., French I., Cechet B.
(accepted for special session at MODSIM 2013; Paper due July 2013)

Report 1: Quantitative bushfire risk assessment framework for severe and extreme fires,
Jones T., Woolf M., Cechet B., French I., Geoscience Australia Professional Opinion No 2012/01, August 2012

Report 2: GA 1.1.5 Neighbourhood scale parameters for the Interface between Vulnerability and Impact
Ian French, Geoscience Australia, Report to Bushfire CRC 9 December 2011

Report 3: GA 2.4.7A Case Study One – Analysis Process & Scenarios,
Ian French, Geoscience Australia, Kevin Tolhurst, University of Melbourne, Report to Bushfire CRC 12 April 2012

Report 4: GA 3.1.3 – Case Study One Beta Test Results
Ian French, Geoscience Australia, Report to Bushfire CRC 30 September 2012

Report 5: GA 3.2.3 Case Studies Sensitivity Analysis Specification
Ian French, Geoscience Australia, Kevin Tolhurst, University of Melbourne, Report to Bushfire CRC 21 March 2013

Report 6: GA 3.4.5– Results of the Geoscience Australia Sensitivity Analysis of FIRE-DST for Case study
1 (Kilmore 2009),
Ian French, Geoscience Australia, Report to Bushfire CRC 1 May 2013 (in final internal review)

Report 7: GA 3.4.5B– Results of the Geoscience Australia Analysis of using ACCESS Upper Atmospheric
Winds in Case Study 1 (Kilmore 2009) Ian French, Geoscience Australia, Report to Bushfire CRC 1 May 2013 (in final internal review)
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Research Extension

- Fire Weather & Risk Workshop (Bowral Sept. 2011)
- Fire Australia article: “Toolbox tipped to tackle fires faster and better”, McLoughlin D, Fire Australia, Summer 2011-12, pp14-16
- BCRC website & AFAC/BCRC conference 2011- Posters
- Fire Note: National EXposure Information System (NEXIS) – A capability to inform evidence based vulnerability and risk assessment as well as disaster management, Nadimpalli K., Cechet B., Dunford M.,(unpublished submitted to Bushfire CRC 30 June 2012)
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Research Extension

- Booth & Posters at AFAC/BCRC 2012 conference (raise awareness of project)
- AsiaPacificFire (article): “Toolbox Talk” 23/8/2012
- AFAC RLMG 6 May - Mark Chladil & David Youssef presented
- Aus/NZ Disaster and Emergency Management Conference, May 2013 Poster, FireDST: Building community resilience by simulating the uncertainty in bushfires. French I., Cechet B.,
- Presented early look at FireDST to staff in NSW RFS, CFA, DSE, MFB
- Booth at AFAC/BCRC 2013 conference (Final presentation of Project Results)
FireDST “proof of concept” system: What is it?

FireDST is a set of python code that integrates all of the research in the F.I.R.E – D.S.T. project to produce a probabilistic ensemble of bushfire spread predictions.

The FireDST user is able to include (or exclude) simulations in the probabilistic ensemble that model the uncertainty in all the inputs (eg Ignition location, Fuel load, Temperature, Humidity, Wind Speed, Wind Direction etc).

FireDST is able to display the aggregated impacts of the probabilistic ensemble on

• People impacted by the simulation (statistical approach using ABS statistics on population, those aged over 65 or under 5 or in need of assistance etc)
• Buildings (houses using the Geoscience Australia NEXIS database and Census information, and
• People impacted by the smoke
FireDST “proof of concept” system: How have we verified it?

We have examined 3 case studies of large fires in various conditions:

1) Victoria - Kilmore fire 7/2/2009 (complete & in write up) – started in open hilly region, progressed through pine forest and into National Park (mainly hardwood)

2) SA - Wangary Fire 2005 (research still underway) – mainly open farmland (pockets of scrubland)

3) NSW - Warragamba Fire (part of Mt Hall fire) 25/12/2001 (research still underway) – Fire started in National Park and spread through deep gullies, crossed Lake Burragorang, impacted Warragamba, Silverdale, Wallacia, Cecil Park.
FireDST Data Model

Components by participant

- **BoM** – new numerical interpolated weather model – 3 horizontal & vertical dimension

- **MESO Scale Weather**
  - GA – Weather time steps, Bias correction (wind strength) and weather scenarios

- **Phoenix Fire simulator**
  - GA – conversion of landscape fire spread to local fire spread information

- **Pre-process Building Properties & spatial relationships**
  - 1

- **Remote sensing input**
  - NEXIS Building database

- **Building Impact Probability layer**
  - 5

- **Building info (Type, location, age, 2006 ABS metrics (at Collection District))**
  - 6

- **Demographics**
  - People impacted
  - $ estimates
  - Replacement value
  - Contents
  - Economic impacts
  - 6

- **UniT Melbourne – improved Phoenix**

- **CSIRO(ES) – generic set of vulnerability curves for houses**

- **CSIRO(AR) – smoke dispersion modelling**

- **CSIRO** – Probabilistic fire spread model (BFIM)

- **GA – Visualisation and statistical metrics**

- **Uni Melbourne – Probabilistic fire spread model (BFIM)**

- **Remote sensing input**

- **Bureau of Meteorology ACCESS weather**

- **BoM – new numerical interpolated weather model – 3 horizontal & vertical dimension**

- **Wind Multipliers**

- **UniT Melbourne – improved Phoenix**

- **CSIRO(ES) – generic set of vulnerability curves for houses**

- **CSIRO(AR) – smoke dispersion modelling**

- **CSIRO** – Probabilistic fire spread model (BFIM)

- **GA – Visualisation and statistical metrics**
FireDST

Probabilistic view of a Kilmore ensemble for 60 minutes from ignition

The image displayed is for ensemble: Kilmore_200909207_FireDST_Ensemble

Other details:
- Temperature: Minus 2 Degrees To Plus 5 Degrees
- Humidity: Minus 2 Percent To Plus 5 Percent
- Wind speed: Minus 5 kph To Plus 5 kph
- Wind dir: Minus 10 Degrees To Plus 10 Degrees
- Time: Minus 60 min To Plus 60 min
- Ignitions: Kilmore ignition and 4 ignitions 2000m N,E,S,W of the actual Kilmore ignition
- Vegetation: Standard

Cases:
- Kilmore_200909207: Kilmore 200909207 - Ensemble

Summary of the variable combinations available in this ensemble:
- Selected a button to view the variable details and combinations

Table of Contents:
- Supplied weather
  - Supplied landscape: 0 Used, 1 Available
  - Single landscape change: 0 Used, 0 Available
  - Multi landscape change: 0 Used, 0 Available
- Supplied weather - Single landscape change
  - 0 Used, 0 Available
- Supplied weather - Multi landscape change
  - 0 Used, 0 Available

Number of active Phoenix simulations:
1 2 3 4 5 6 7 8 9 10

Update
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Probabilistic view of the Kilmore ensemble for 120 minutes from ignition
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Probabilistic view of the Kilmore ensemble for 240 minutes from ignition
Comparison of ensemble at 240 minutes with reconstruction fire isochrones
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**Impact Estimate:** people, people over 65, under 5 and in need of assistance
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Impact Estimate: Potential House Impact
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Impact Estimate: Smoke plume modelling – PM2.5 at 18:00
Purple: 3600m T15 Min, Bias corrected 10m, No vertical to 16:45

Red: 3600m T15 min Bias corrected 10m With Level4 (410m) Transport wind to 16:45

Yellow: fire Reconstruction to 16:45
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Other: GA Wind Multipliers - 100m @13:45
**FireDST**

**Other: Bushfire Attack Level (AS3959 – Method 1) – IIR2 - Kinglake**

- White BAL-Low
- Light green BAL 12.5
- Dark green BAL 19
- Light blue BAL 29
- Dark blue BAL 40
- Brown BAL-FZ

25m cells

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Figure 1.4C

Variation in Simulation Percent destroyed for Distance = 10m by varying the ember and radiation threshold values
FireDST

Other: Building Fire Impact Model overview (underway)

BFIM Model overview
- Pass 1 - FireDST at the landscape level (180m cells)
- Pass 2 - BFIM – effectiveness of occupant, neighbour & Emergency Services (modelling for before front passes and after front)
- Pass 3 – BFIM – building to building spread

Code is currently being unit tested.

BFIM Sensitivity analysis to be conducted.
- Initial 12 variables
- 7 story lines (plus user defined) – for number of occupants, neighbours and Emergency Services.

Compare results at Pine Ridge and Kinglake IIRs with BAL.
End of Presentation - Thankyou
FireDST Data Model
Components by participant

- BoM – new numerical interpolated weather model – 3 horizontal res & vertical dimension
- GA – Weather time steps, Bias correction (wind strength) and weather scenarios
- GA - M3 wind modification for local wind speed based on high-res terrain and veg.
- GA – conversion of landscape fire spread to local fire spread information
- GA – Building info (Type, location, age, 2006 ABS metrics (at Collection District))
- Demographics
  - People impacted
  - $ estimates
  - Replacement value
  - Contents
  - Economic impacts
- Uni Melbourne – improved Phoenix
- GA – Probabilistic fire spread model (BFIM)
- GA – Visualisation and statistical metrics
- CSIRO(AR) – smoke dispersion modelling
- CSIRO(ES) – generic set of vulnerability curves for houses

Pre-process
Building Properties & spatial relationships
Remotely sensing input
NEXIS Building database

Bureau of Meteorology
ACCESS weather
MESO Scale Weather
Wind Multipliers
Phoenix Fire simulator

Build Impact Probability layer
Building Impact

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