ACCESS-Fire

AFAC 2019

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Mount Solitary prescribed burn

Fire-atmosphere interactions

- The three-dimensional atmosphere
- Energy released by a fire changes the surrounding atmosphere
- Fire-atmosphere interactions influence fire behavior
- Surface-based approaches to fire prediction with linear assumptions have limitations

Project Objective

- Develop and test an Australian Coupled-Fire-Atmosphere modelling system, linked to the Australian Numerical Weather Prediction (NWP) operational framework and embedded in Bureau forecasting capability

ACCESS-Fire Australian **C**ommunity **C**limate and **E**arth **S**ystem **S**imulator

Australian NWP operational and research system for weather and climate prediction

Unified Model (UM) is the UK Met Office NWP system
(collaborators include Korea, South Africa, New Zealand, Philippines)

Empirical fire models linked to the atmospheric model include:
CSIRO Forest, Grass, McArthur, Rothermel

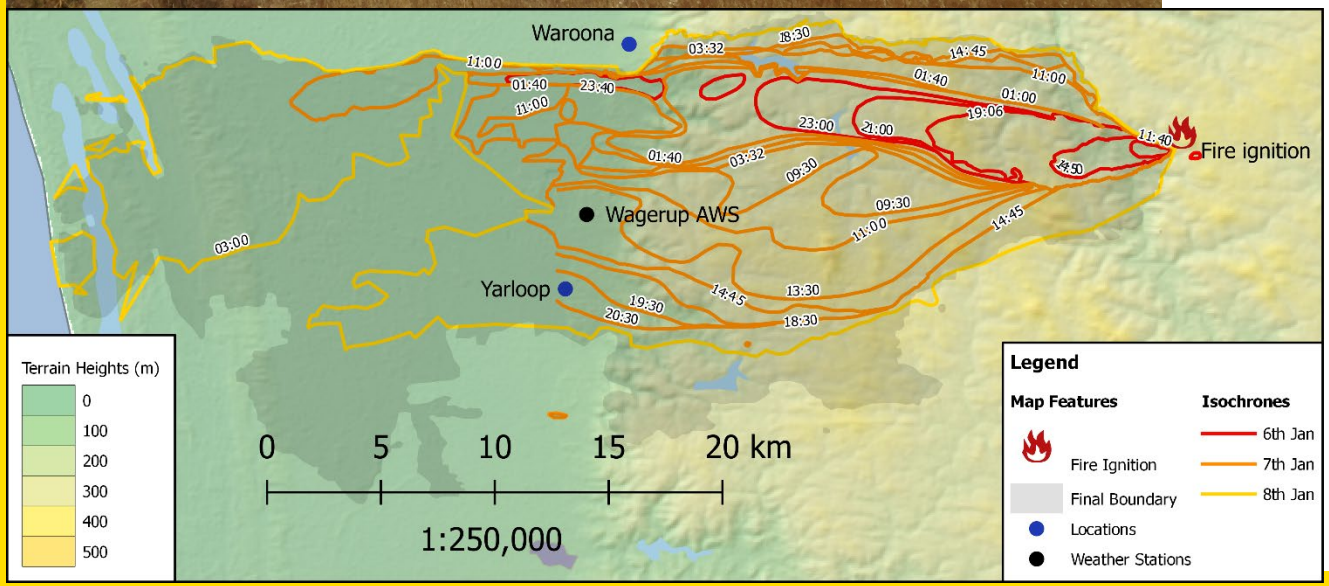
ACCESS-Fire

- Understand dynamical processes (limited observations)

= Improved capability and accuracy for fire prediction

- Fire model runs at each time-step. Energy fluxes to the atmospheric model, changes the structure of atmosphere (winds) around the fire.
- See how the fire changes the surrounding atmosphere (ellipse shape, convergence, plume processes, topographic interactions)

- Succession of IT problems overcome
- Nests 300m →100m resolution



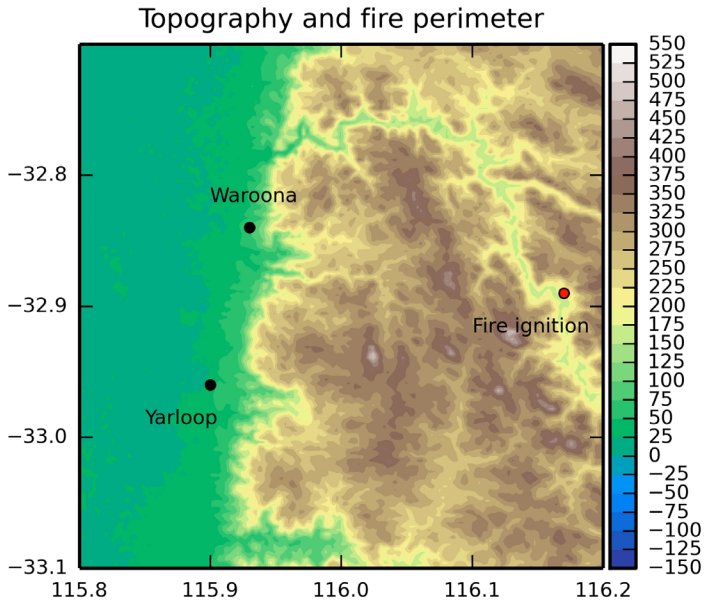
Waroona fire

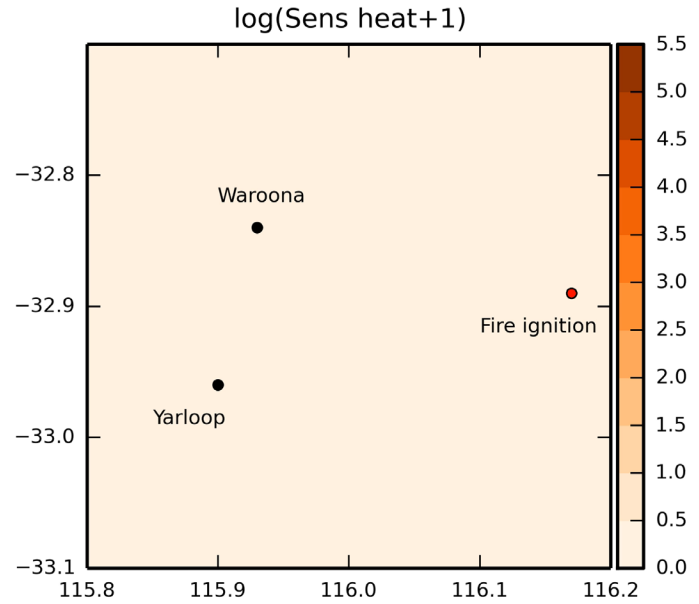
- 6-7 January 2016. 166 homes destroyed, 69,000 ha burnt.
- Four periods of extreme fire behavior
  - 2 pyrocumulonimbus events
  - 2 evening ember showers.
  - Did not reconcile with FDI's.
- Examine the ember showers at Waroona and Yarloop
- Downslope winds a key factor in many significant fire events (Margaret River, State Mine, Waroona, Greece, California, Canberra)

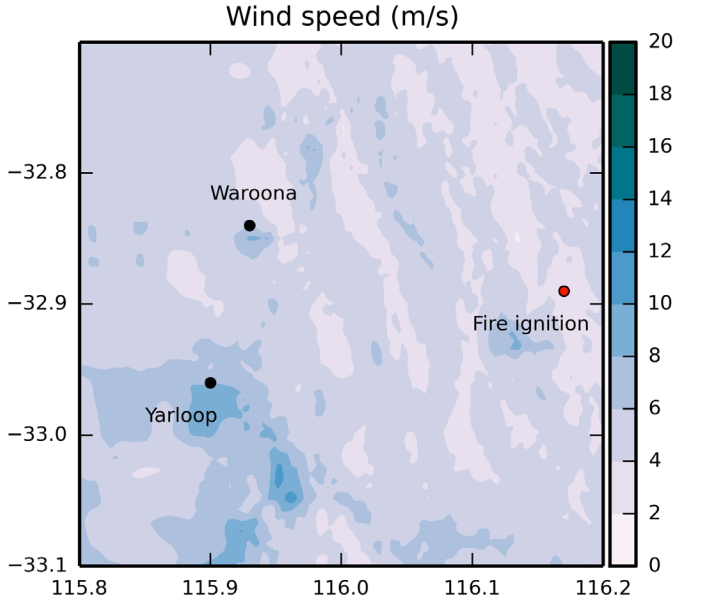
Waroona fire

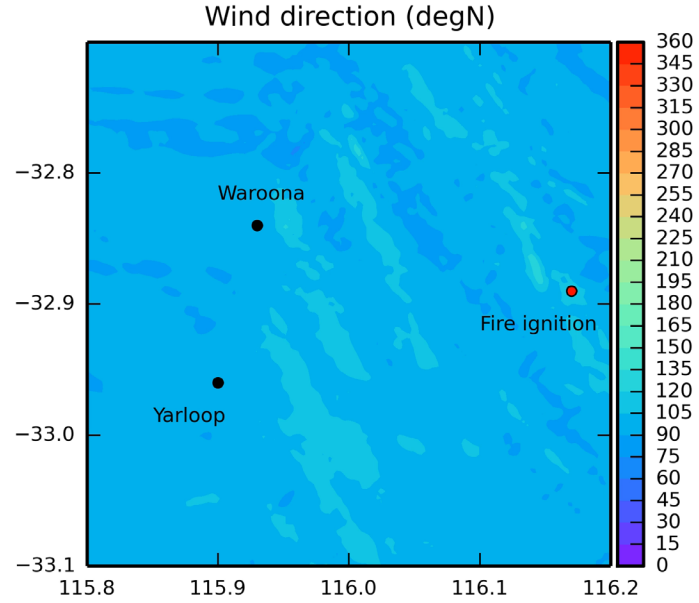
Day 1

2016-01-06 00:01:00









Waroona fire

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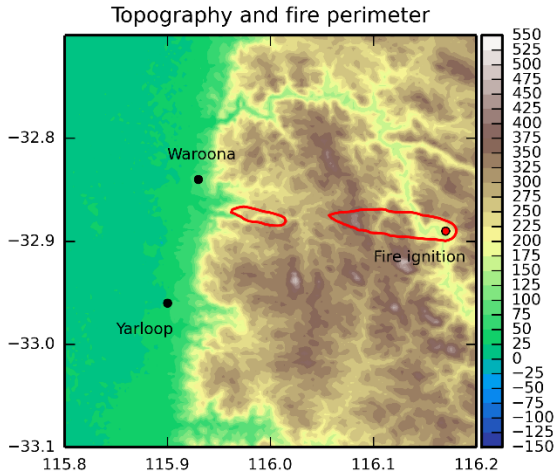
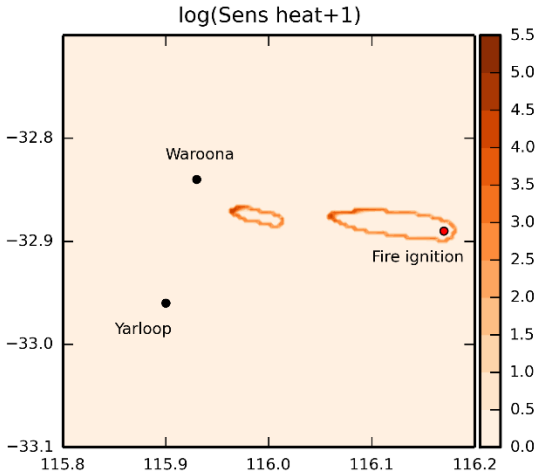
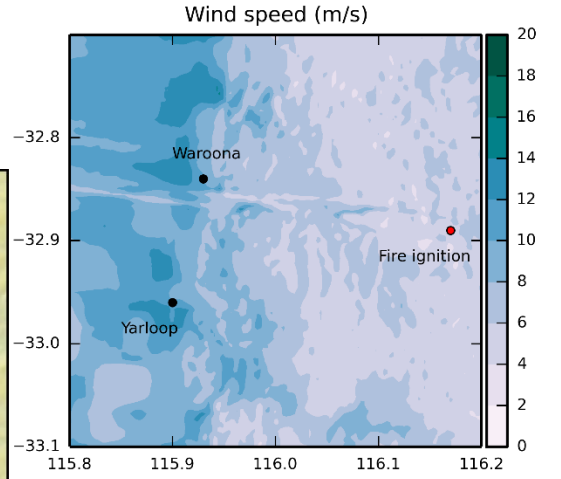
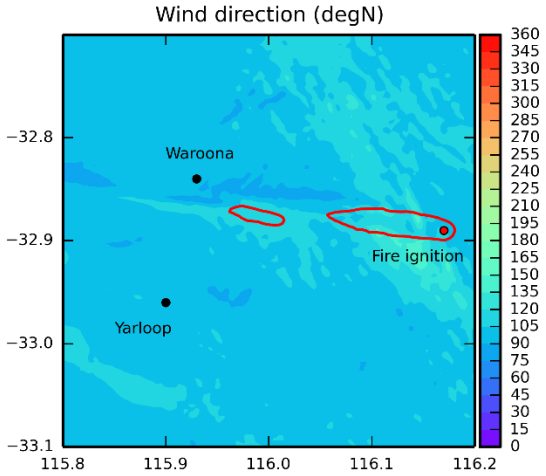
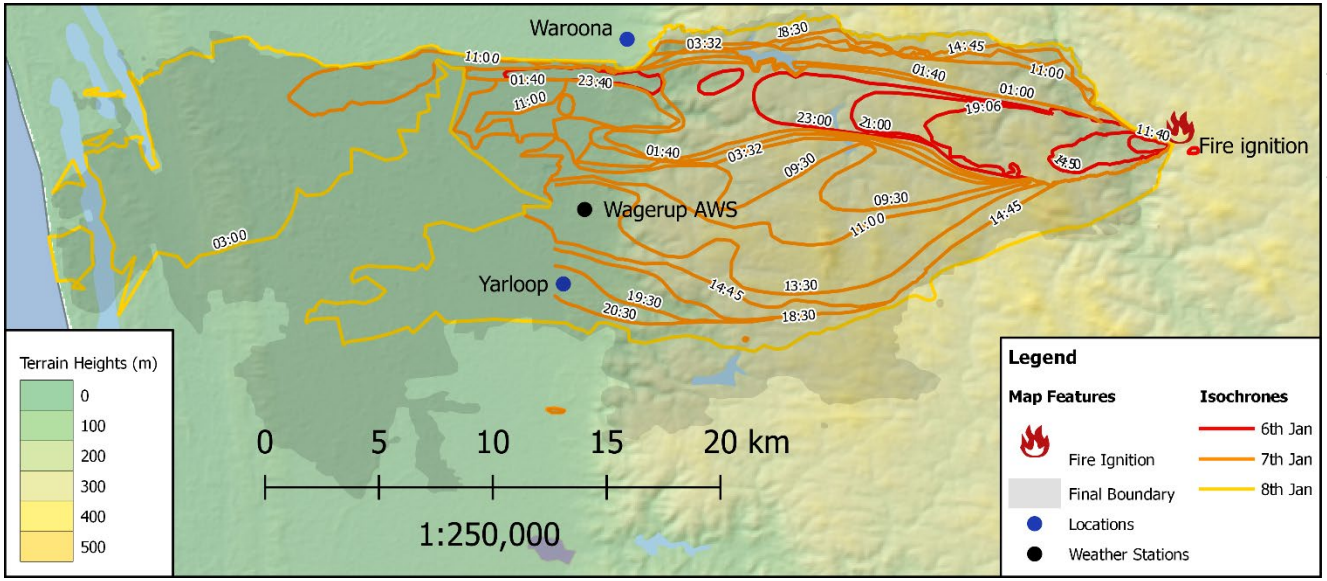




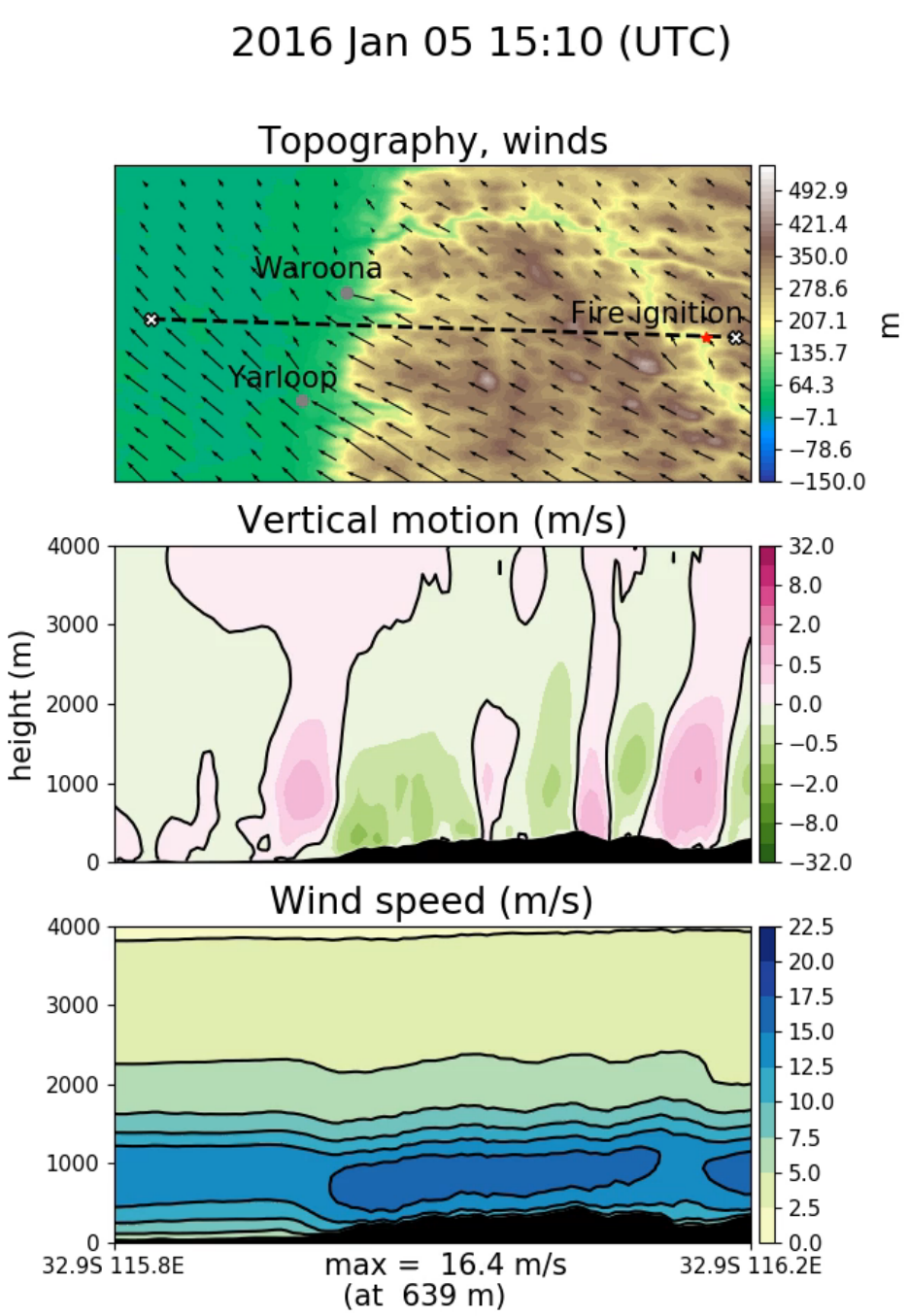






Waroona

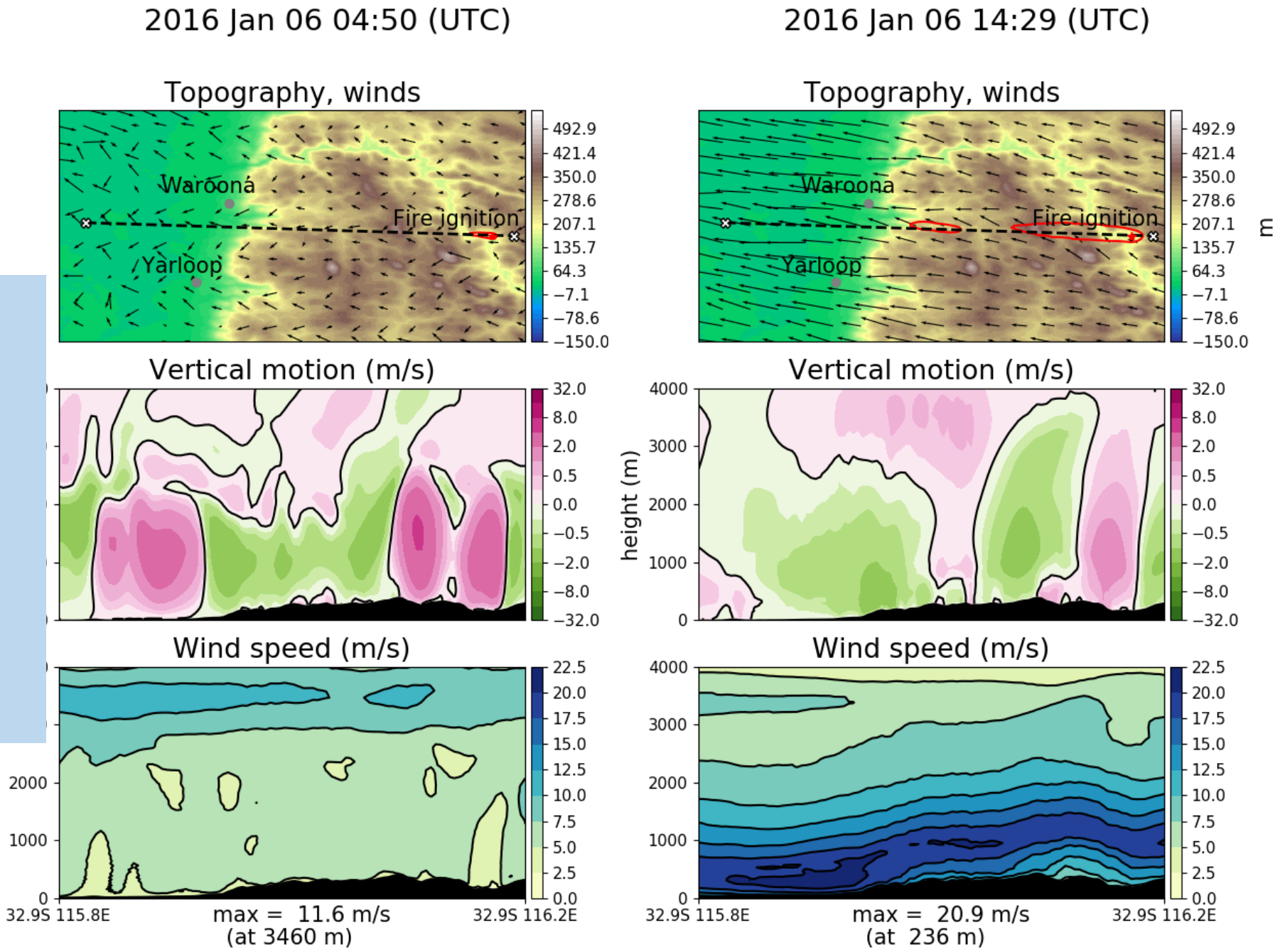
Wind <1000m ~80km/h + ~20km/h ambient wind



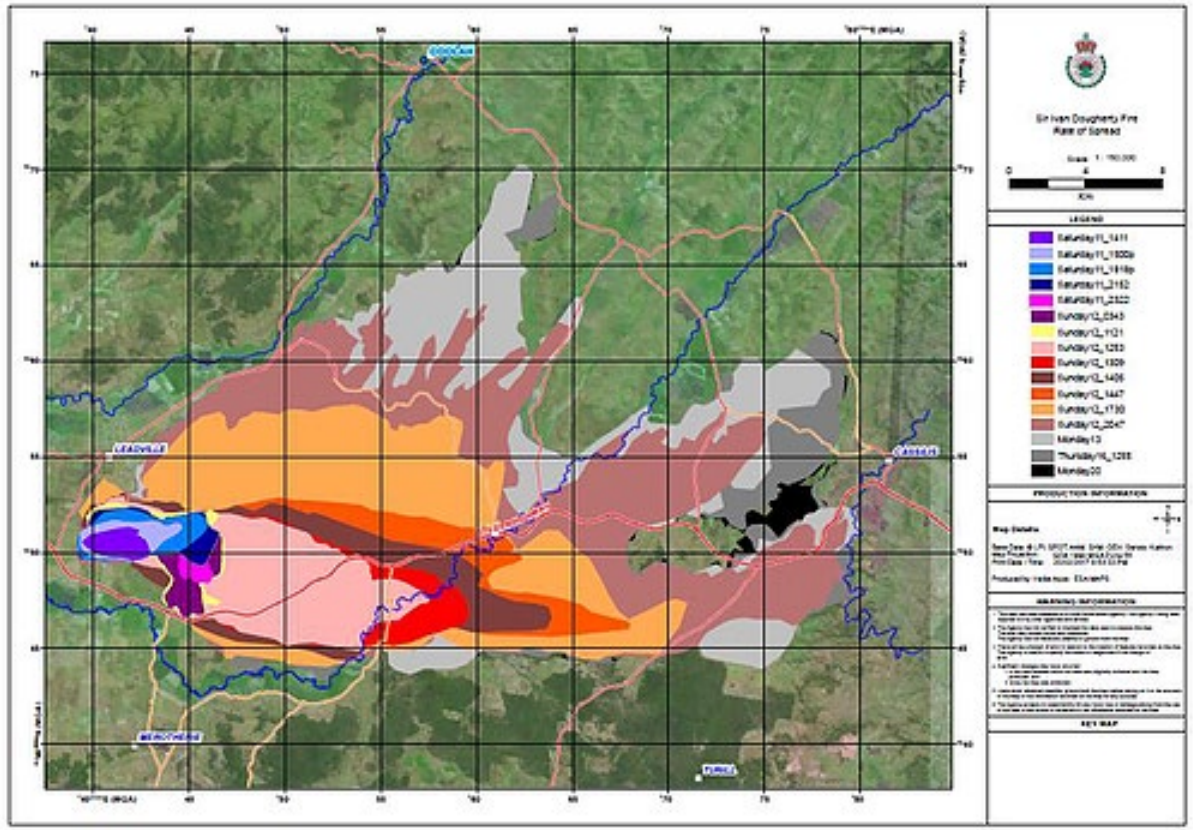
Waroona

Next steps:

- Examine Day 2 (evening)
- Refine the fire spread
- Explore the vertical circulation around the time of the two ember storms
- Analysis and narrative



Sir Ivan fire



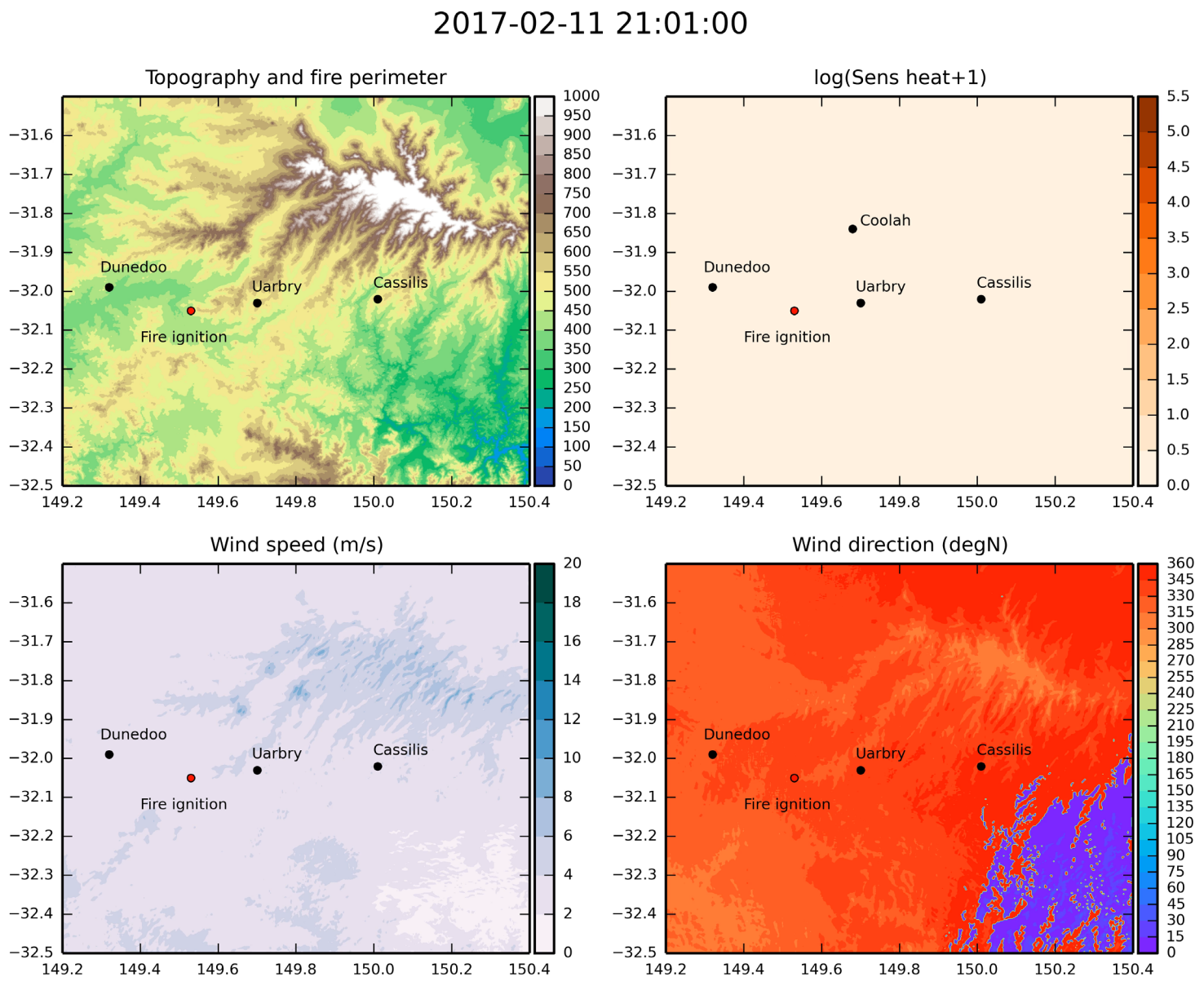
- 12 February 2017
- Burnt 55,000ha, 55 homes lost
- Very dry fuels due to severe drought
- NSW worst fire conditions ever
- 'Catastrophic' conditions identified several days in advance
- PyroCb developed over the fire near the northwest to southwest wind shift in the afternoon

Sir Ivan fire

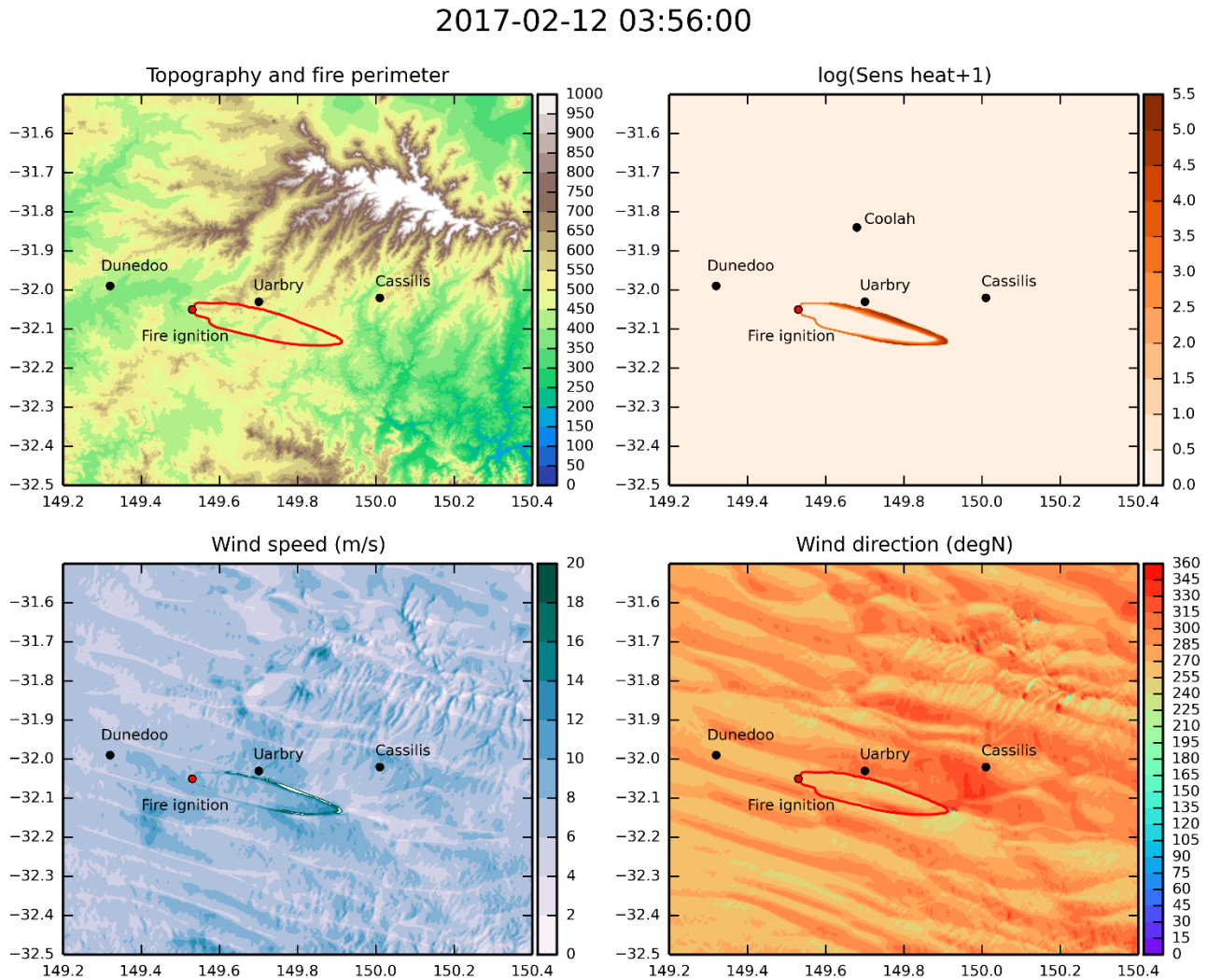
Initial runs use same fuel as Waroona
Very reasonable match for reconstruction (without any modification)

Next steps:

- Include fuels provided by RFS
- Comparison against observations
- Analysis and narrative



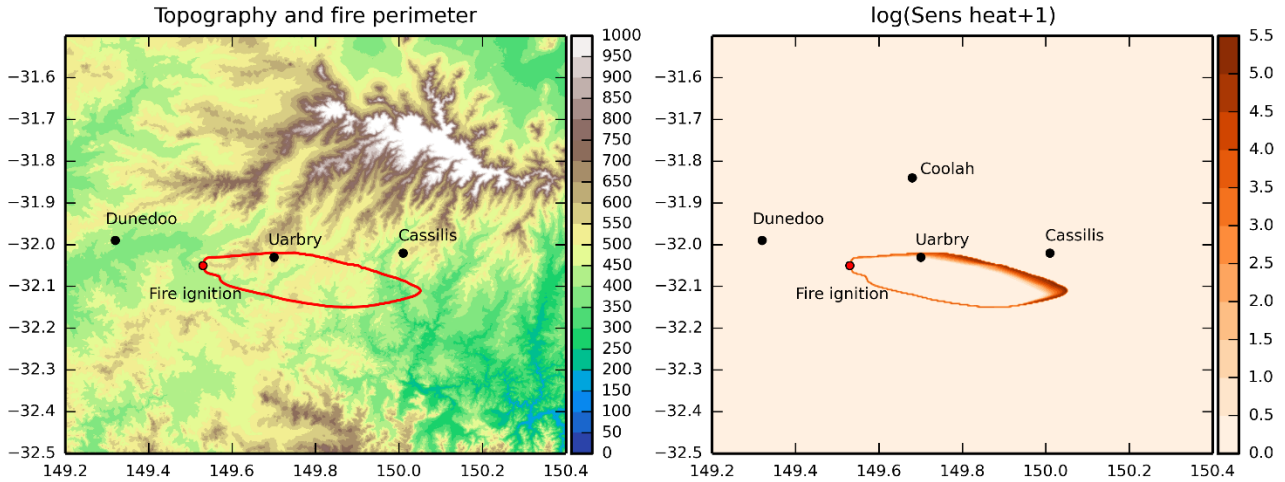
Sir Ivan fire

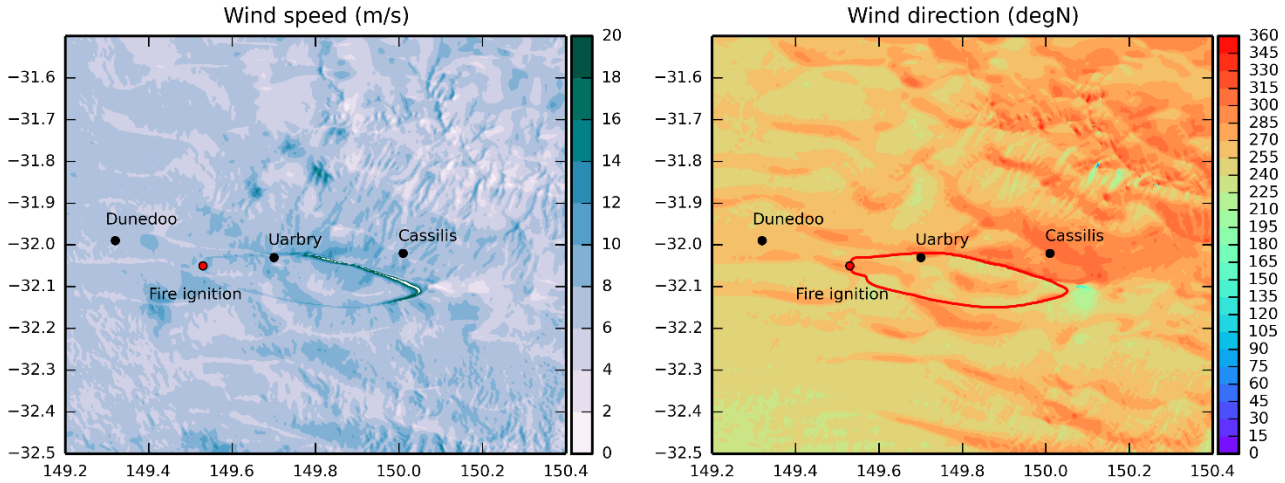


Sir Ivan fire

When was the wind change?
Pyrocb formed around 0530UTC

2017-02-12 05:31:00





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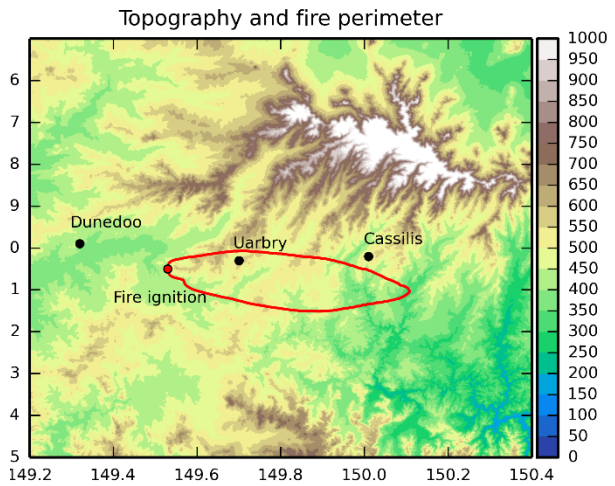

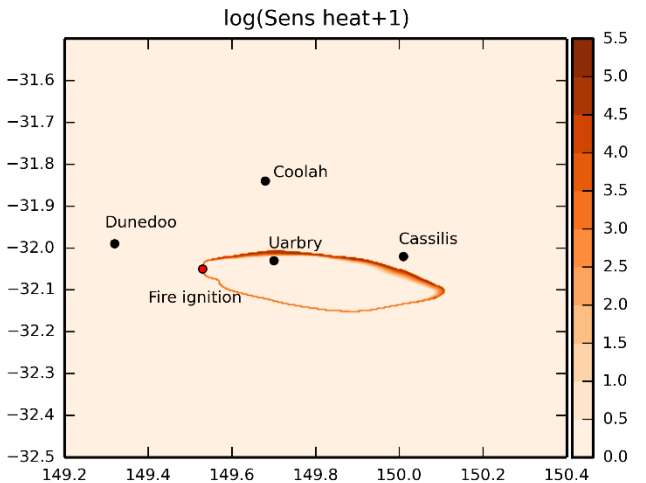

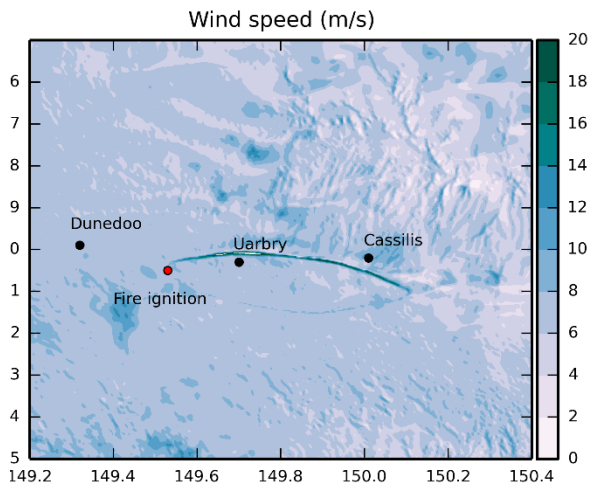

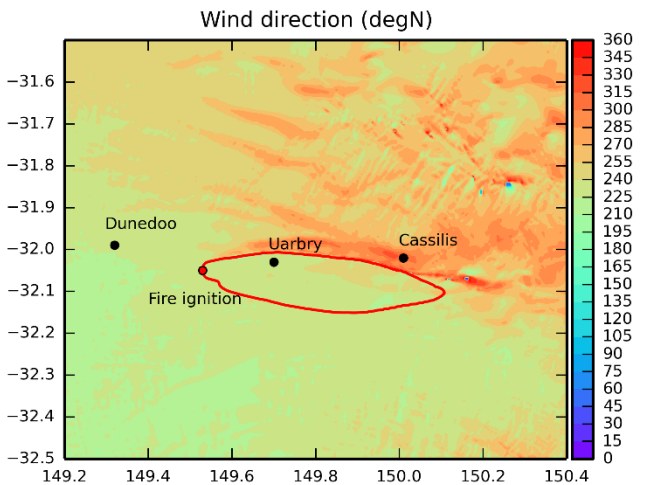

Manuscript in draft…

- **'Lessons learned from coupled fire-atmosphere research and implications for operational fire modelling'**

- Coauthors: Mika Peace, John Bally (Fire Prediction Services), Jay Charney (US Forest Service)

"Throughout this paper, we preserve the position that empirical uncoupled fire prediction approaches are inadequate under certain circumstances. The issue is identifying the circumstances under which the deficiencies in the current models may manifest as dangerously deficient guidance and what alternative information can be provided so that remedial and mitigation action can be taken."

- In review soon.. comments and input welcome (contact Mika)

- The paper contributes to developing the vision and business case informing future development of fire prediction models

Mount Solitary prescribed burn

ACCESS-Fire: a fire model coupled to a numerical weather prediction model

Two case studies in progress: Waroona and Sir Ivan

Current project to mid-2020 … where to next?
See our poster on coupled fire-atmosphere models

Thank you