# The Eyre Peninsula Fire of 11 January 2005: an ACCESS case study

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Robert Fawcett

AFAC 2013

Melbourne, 2 September 2013

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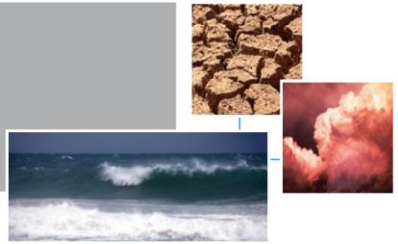
# Acknowledgements



- Co-authors
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    High Impact Weather Research
    Weather and Environmental Prediction
    The Centre for Australian Weather and Climate Research
    Docklands, Victoria
- Thanks to
  - The Earth System Modelling group in CAWCR
  - Bushfire CRC for partial funding of this work

ACCESS
The Australian Community Climate and Earth-System Simulator

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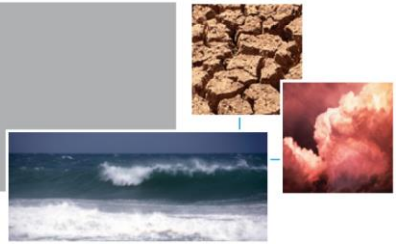
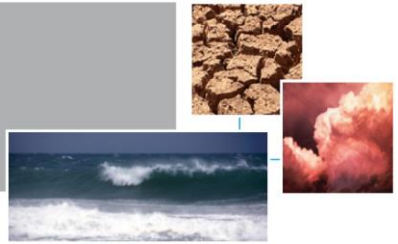
# What are we trying to do?



- Investigate the capability of ACCESS to model severe weather situations at high resolution (Grid Spacing ~ 1 km) and very high resolution (Gr Sp < 1 km)
  - looking well beyond what is currently operationally achievable (Gr Sp ~ 4 km)
    - computer run times, data volumes
  - dry weather – fires (✓), dust storms (✓); wet weather (?)
  - how good is the model at these resolutions?
    - verification issues, observational data availability
  - does the high-resolution modelling lead to an increased understanding of what happened on the day?
- Explore the possibility of having a 'rapid turn-around' post-event research capability
  - to look at severe weather events soon after they occur
  - to help us understand what happened and why
    - … at least some of the time

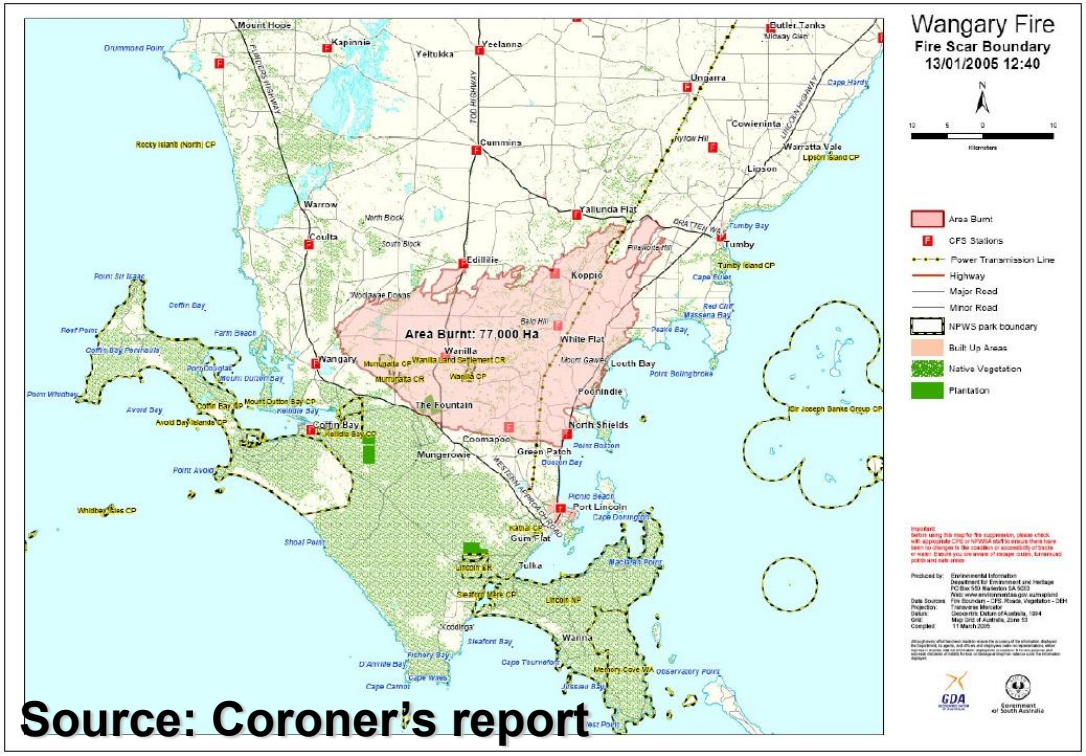
# How do we validate the simulations?

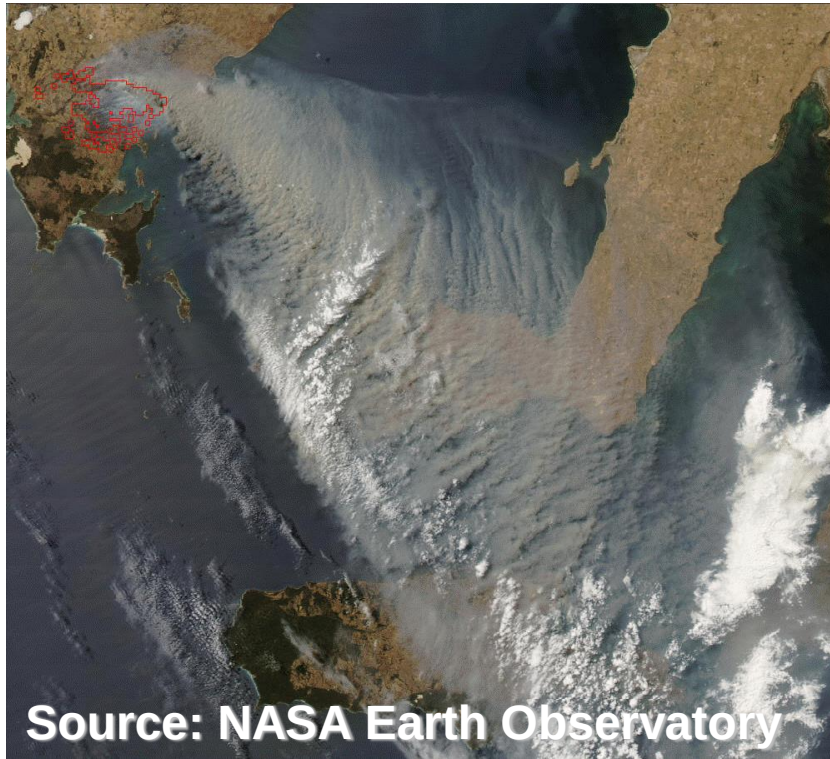


- By comparing the simulations against
  - surface observations
    - one-minute and thirty-minute automatic weather station (AWS) observations as available in the computational domains
  - upper-air observations
    - radiosonde and wind-profile balloon-flight observations as available in the computational domains
  - radar data
    - where available (minimal for EP – too far away from existing radars)
  - satellite observations
    - visual, infra-red imagery
- None of these observational data are assimilated into the model simulations, so the simulation can be validated against completely independent data.

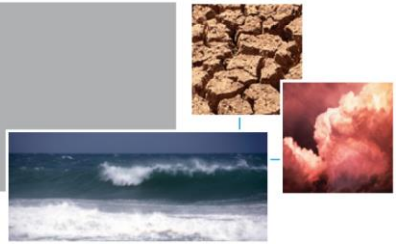
# What aspects of the modelling can we verify?

- timing of the main wind change on 11 January 2005
- forecast maximum temperature
- forecast maximum wind speeds
- upper-level temperature and moisture
- features observed in the radar and satellite imagery if available

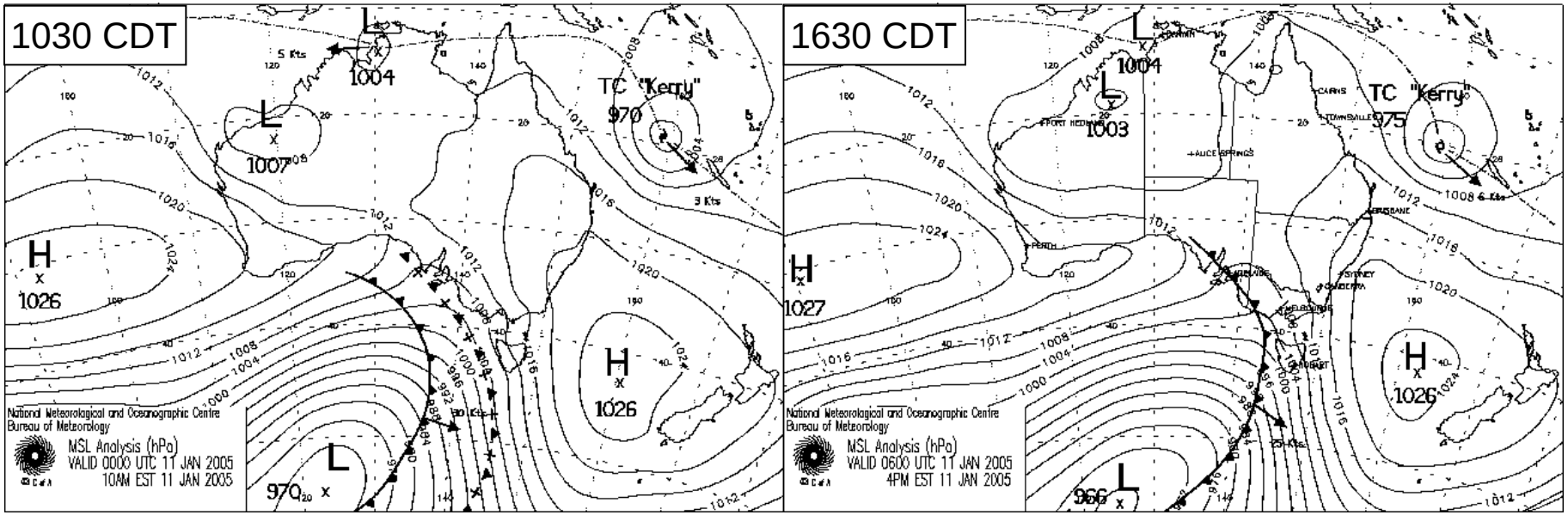


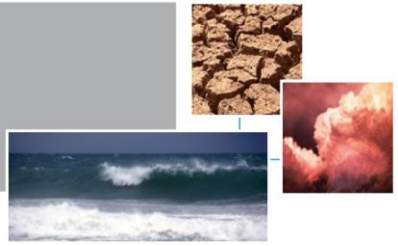
# Eyre Peninsula: what happened



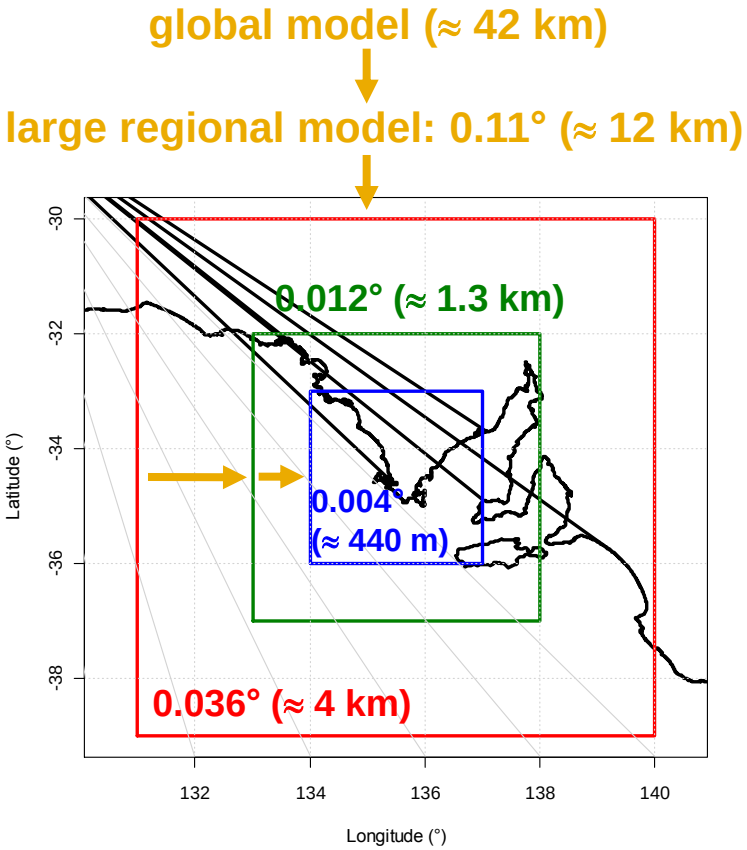
- familiar set of summer-time meteorological ingredients
  - high-pressure system in Tasman Sea
  - approaching cold front with prefrontal trough
  - fire started mid-afternoon on 10 January 2005
  - a significant wind change crossed the fire ground late morning / early afternoon on 11 January
  - warm N to NW winds replaced with cool S to SW winds
- dry slot seen in satellite imagery – Mills (2008) AMM 57 299-309
- 9 dead, > 100 injured, > 40,000 stock loss



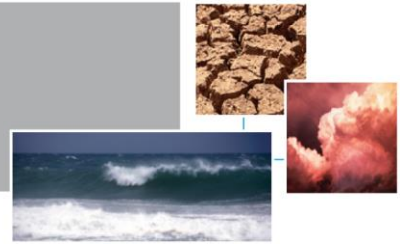
# Model configuration

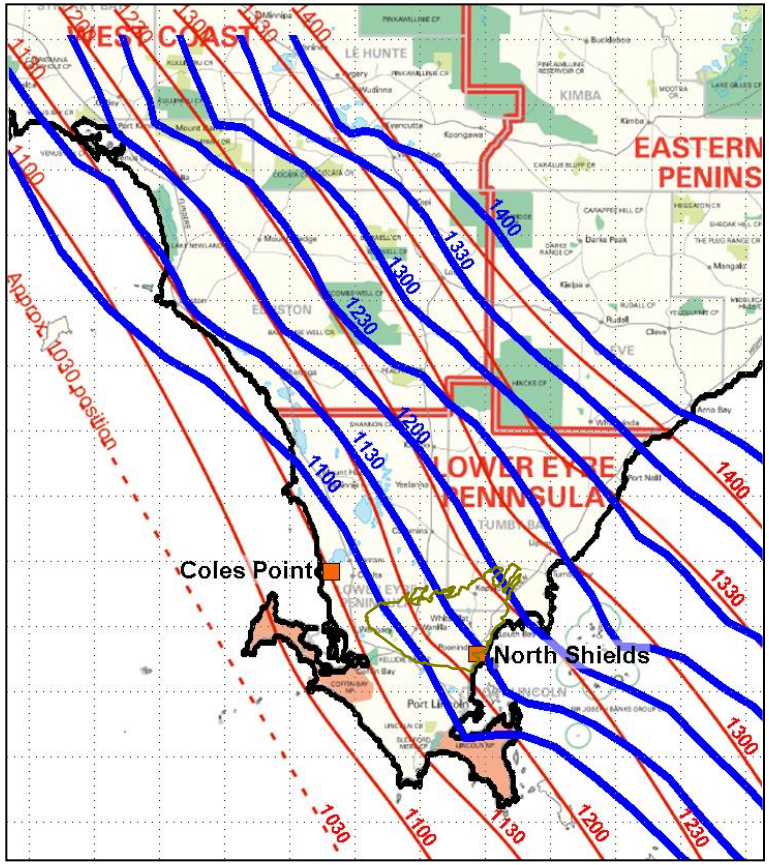


- multiple initialisations
  - 2005-01-09 0000 UTC (1030 CDT)
  - 2005-01-10 0000 UTC (1030 CDT)
  - 2005-01-10 0600 UTC (1630 CDT)
  - 2005-01-10 1200 UTC (2230 CDT)
- ERA-Interim global initial condition
- 50 vertical levels (up to about 60 km)
- Five levels of nesting
  - global, large regional (0.11°), 0.036°, 0.012°, 0.004°
  - one-way nesting from coarser resolution to finer resolution
- Fire not modelled
  - no feedbacks from fire to meteorology



# Primary wind change on 11 January 2005

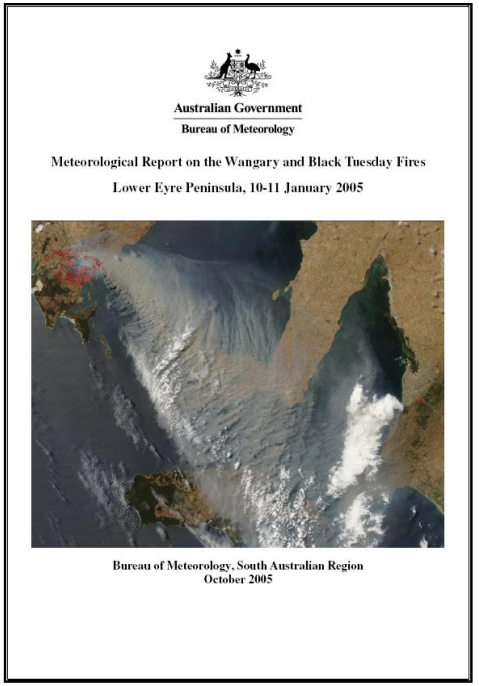





■ = automatic weather station (AWS)

Wind-change isochrones every half-hour as analysed (BoM 2005) and simulated (0.012° grid spacing) from 11:00 to 14:00 EDT on 11 January 2005. Timing errors are less than 1 hour.

Bureau of Meteorology 2005: Meteorological report on the Wangary and Black Tuesday Fires: Lower Eyre Peninsula, 10-11 January 2005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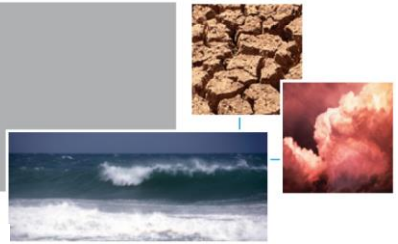
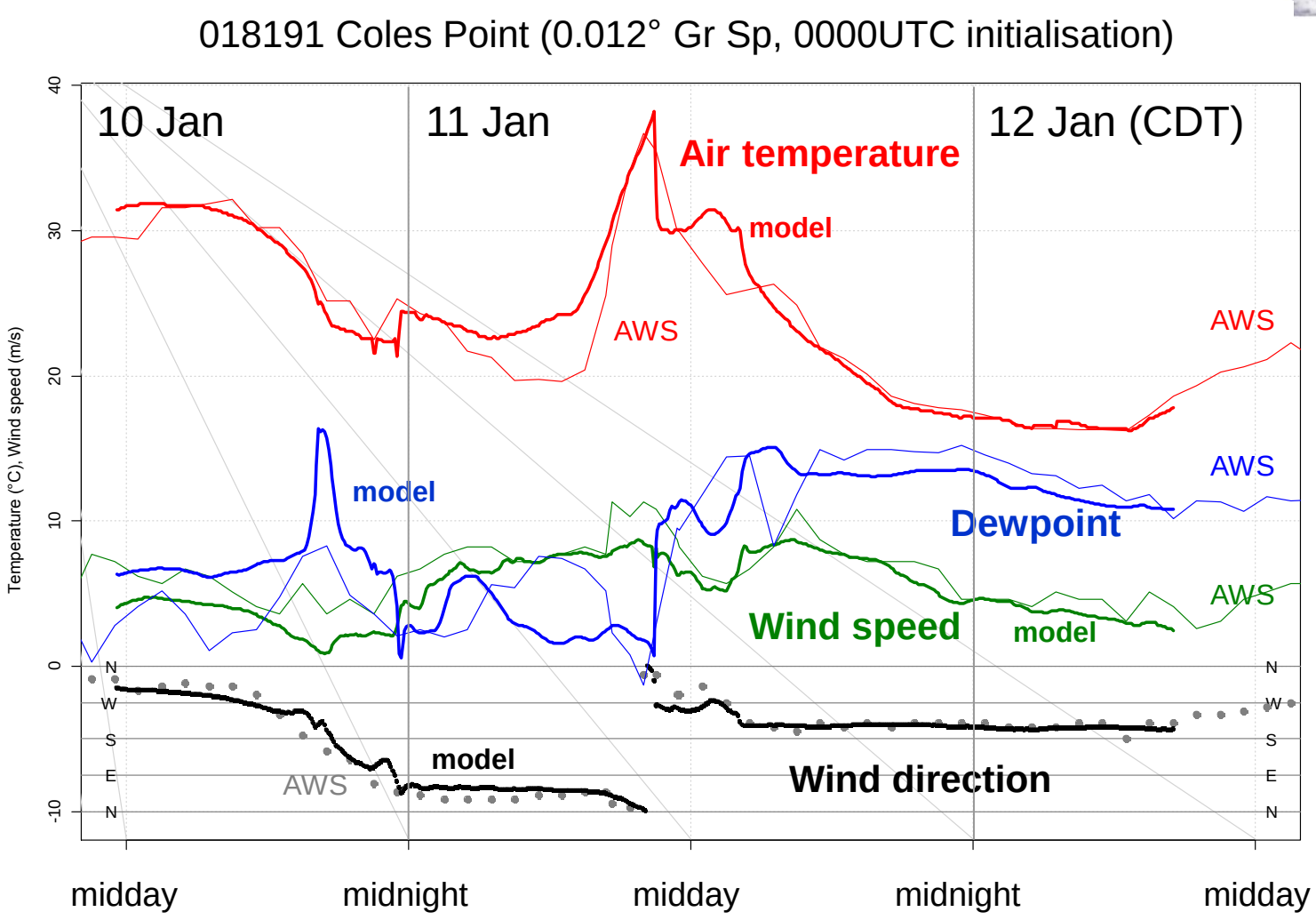
Meteorological Report on the Wangary and Black Tuesday Fires
Lower Eyre Peninsula, 10-11 January 2005

Bureau of Meteorology, South Australian Region
October 2005

# AWS verifications






- good timing of maximum temperature
- good wind directions
- peak 10-metre wind speeds a little under-forecast

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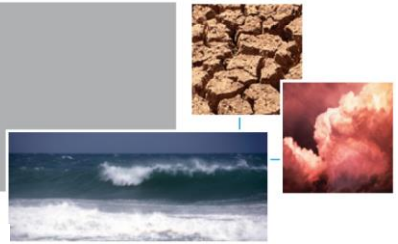
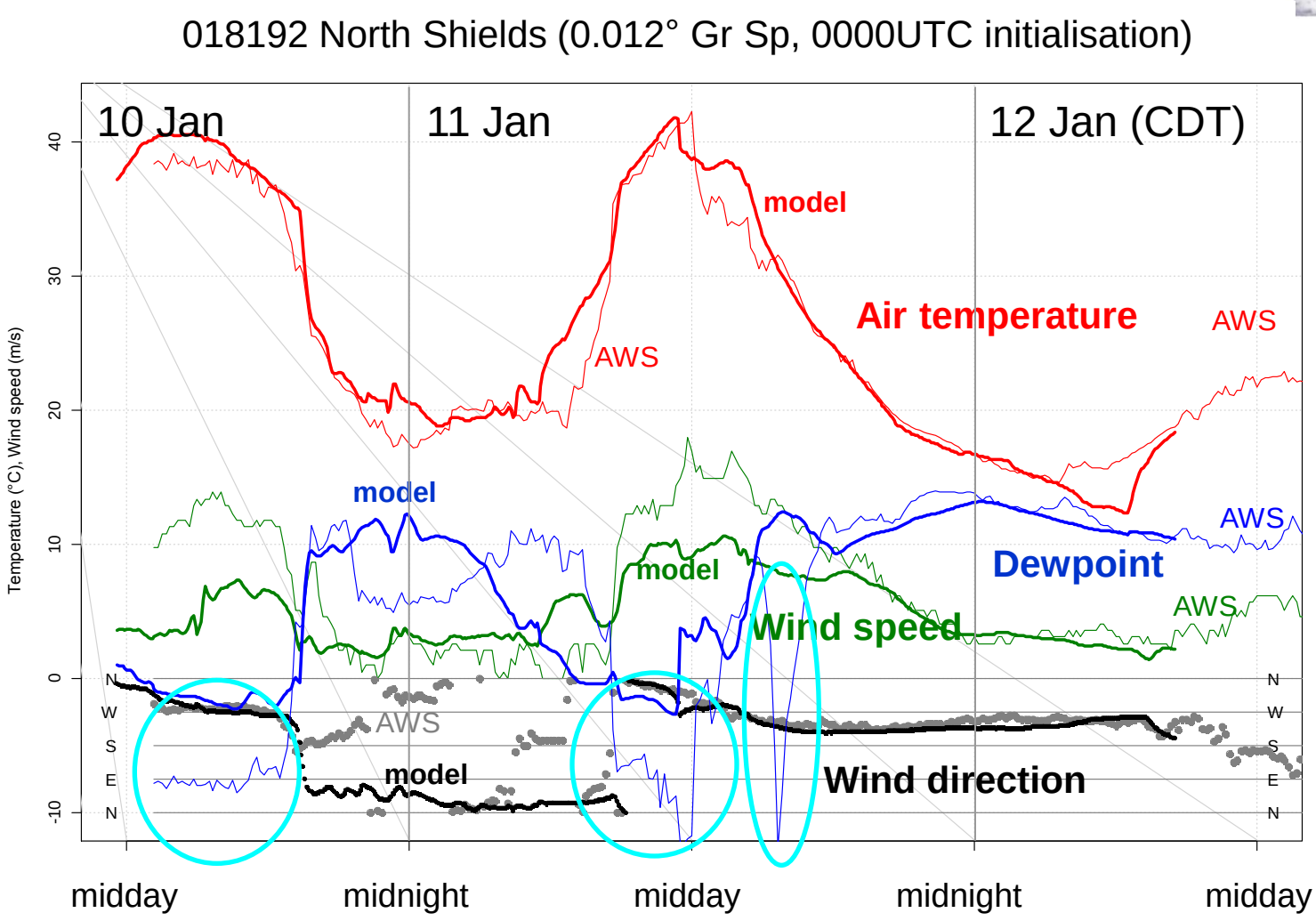
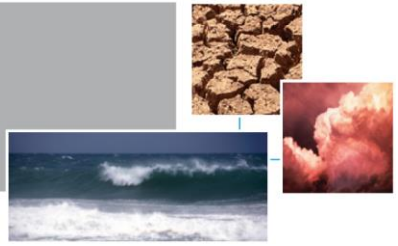


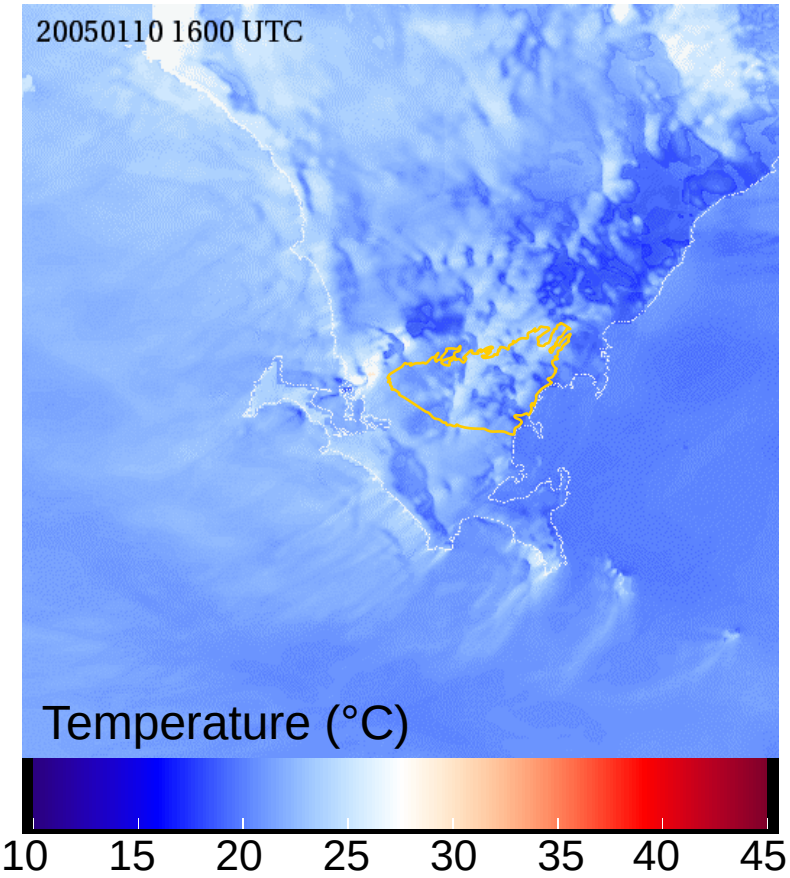


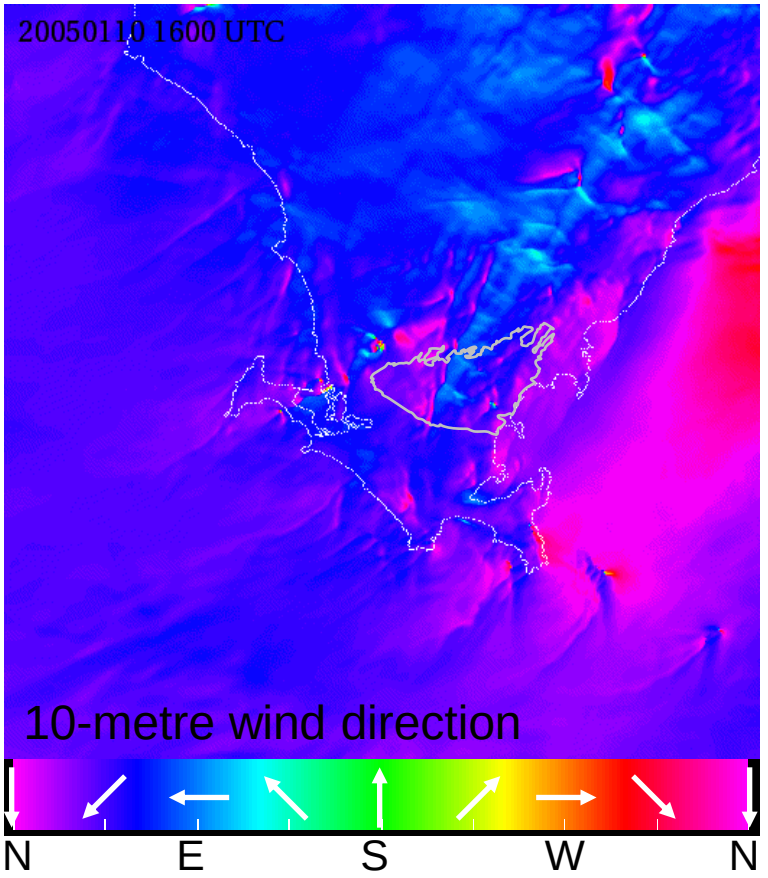

- forecast wind change about 40 minutes early
- peak wind speeds underdone
- evening temperatures on the 11th very well done
- two significant dry slots in observations on the 11th not adequately forecast

# Animations

1600 UTC 10 Jan to 0900 UTC 11 Jan
0230 CDT 10 Jan to 1930 CDT 11 Jan






0.004°-grid-spacing

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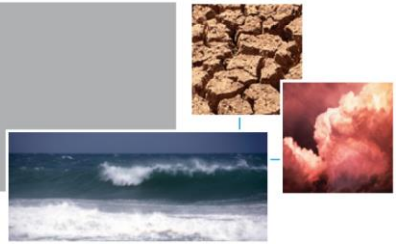

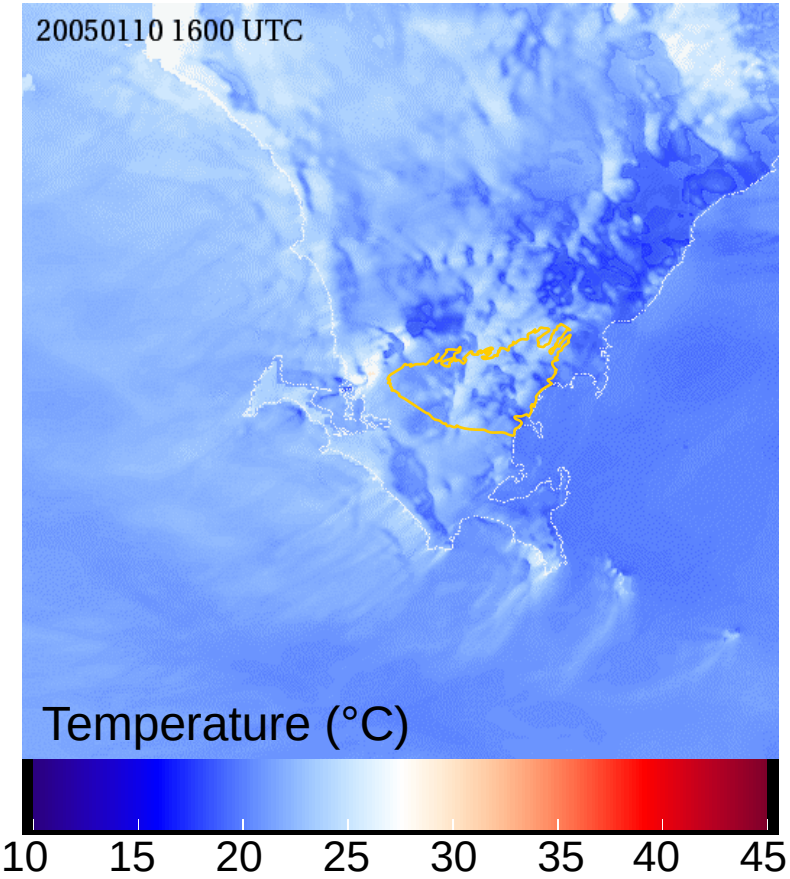


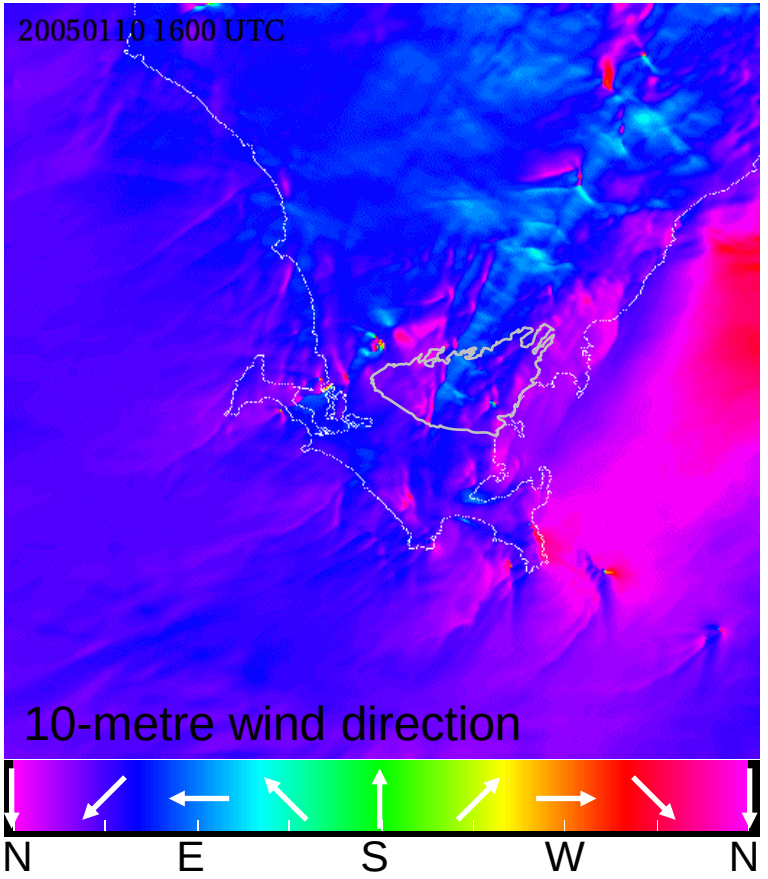


0.004°-grid-spacing

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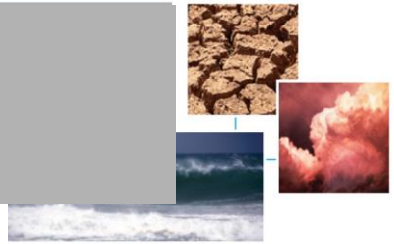
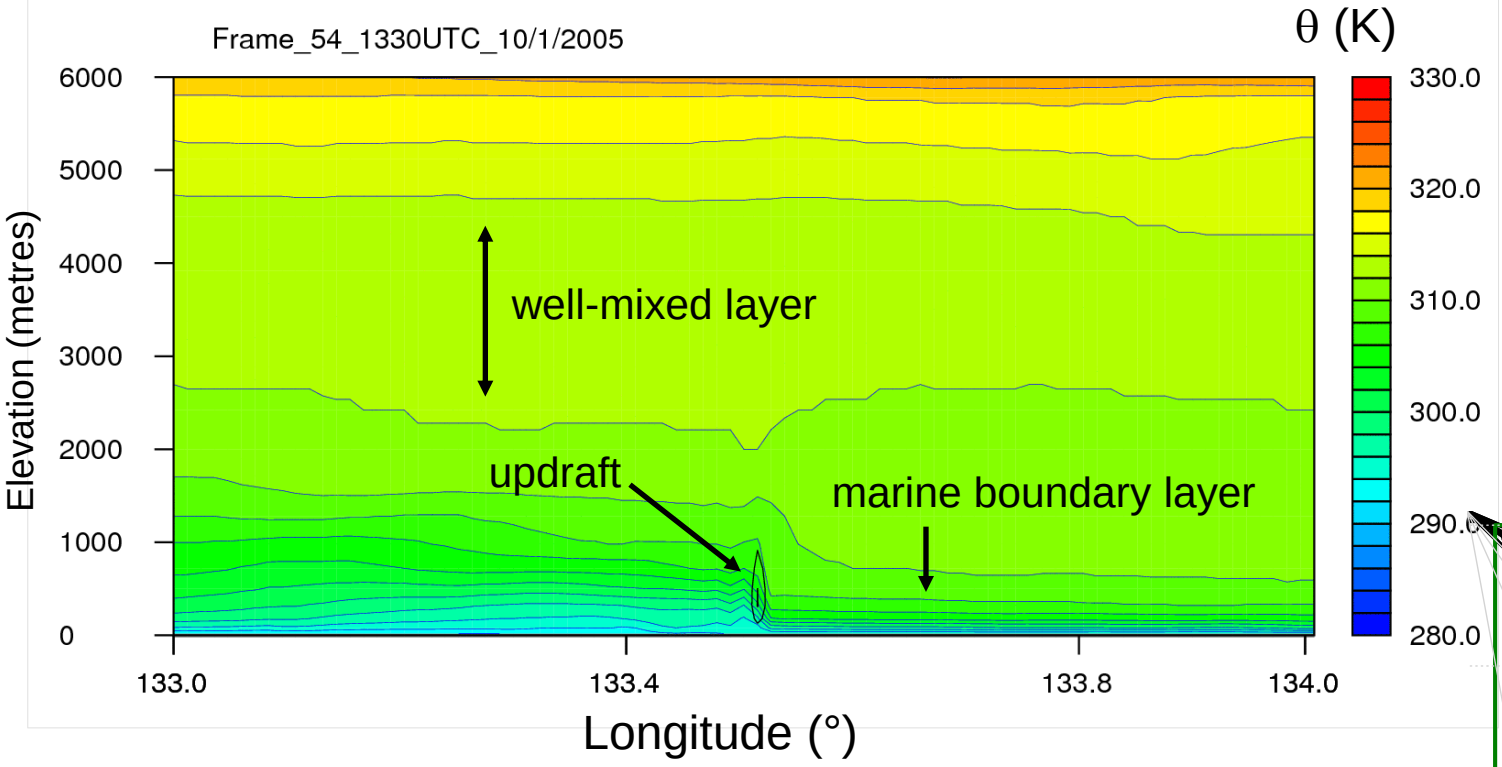
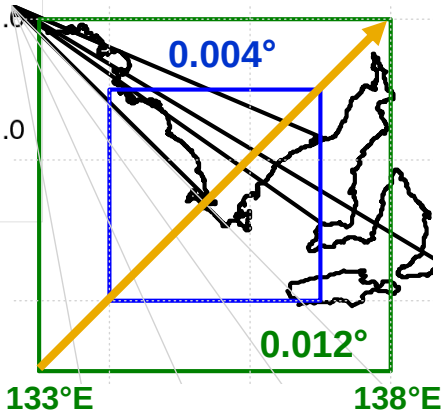
# Vertical cross-section of the wind change



- undular bore changes into density current




Cross-section moving along the orange arrow. Sea-level to 6,000 metres. Colours show potential temperature in Kelvin. Black (*grey*) contours show positive (*negative*) vertical velocity in 1.5 m/s intervals. From the 0.012°-grid-spacing simulation.




potential temperature = pressure-adjusted temperature

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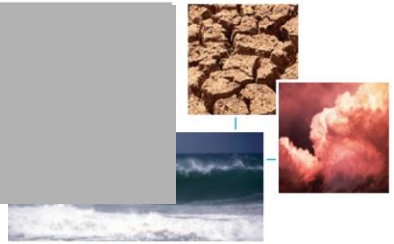

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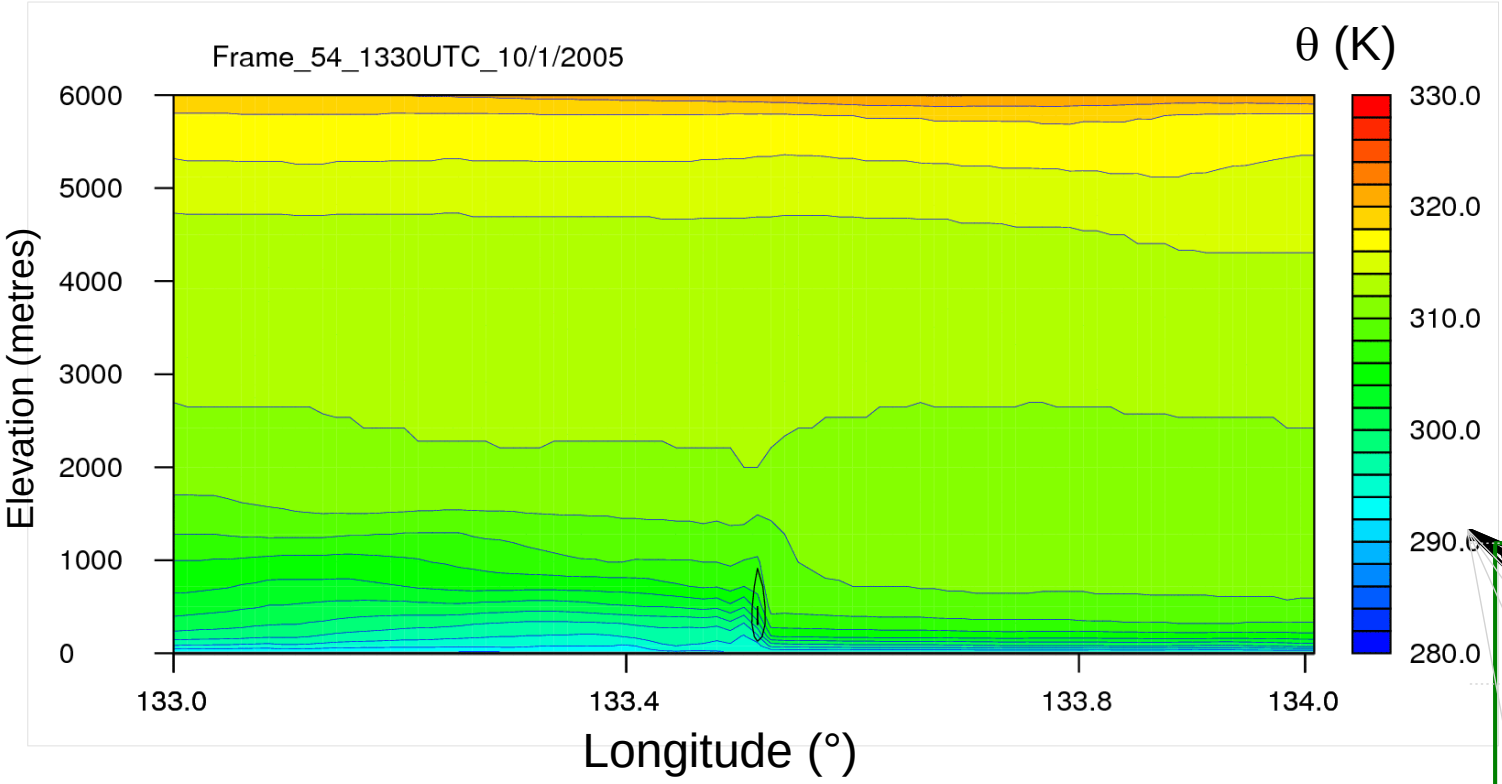


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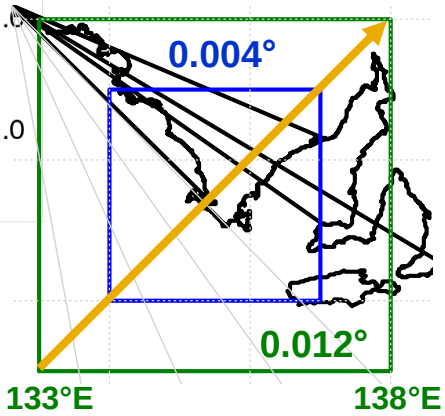


potential temperature = pressure-adjusted temperature

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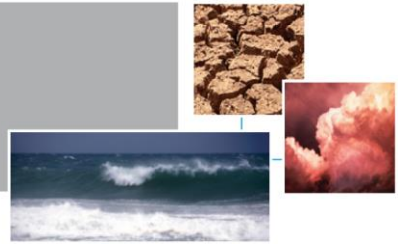
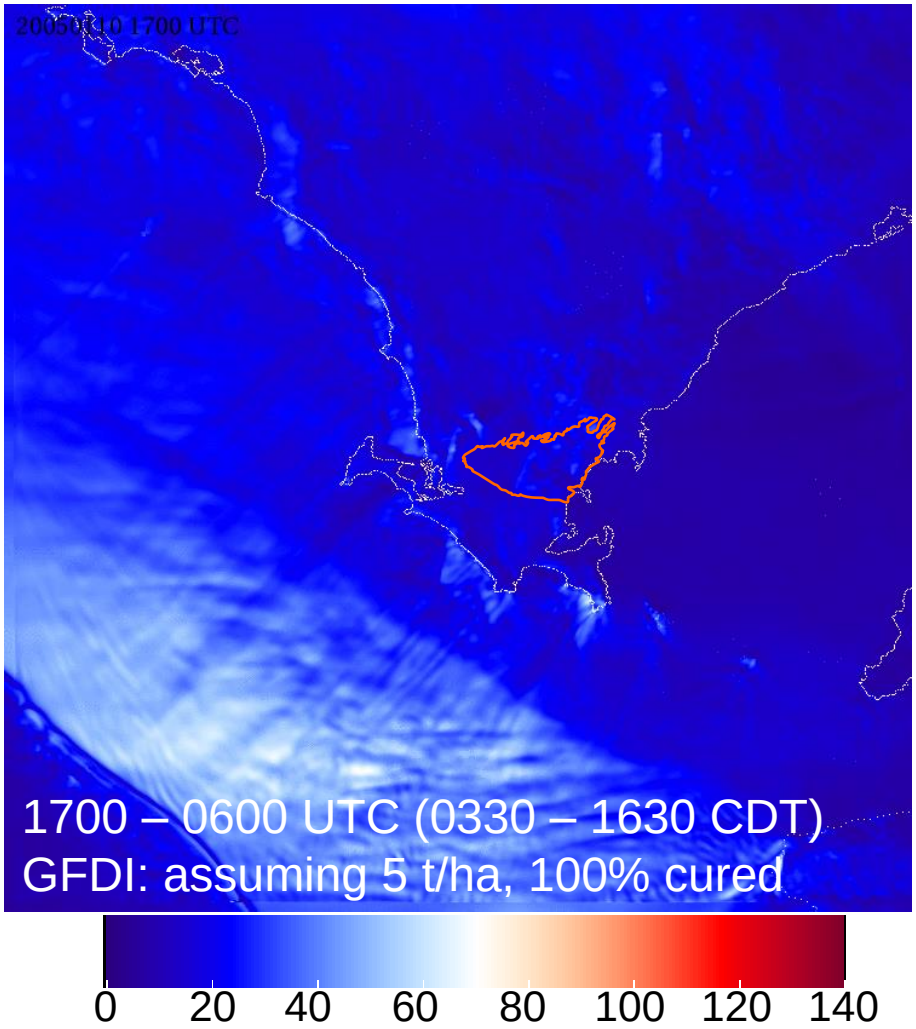
# Grass Fire Danger Index (Mark 5)



- FDI > 40 over fire ground
- areas of elevated FDI behind the change
- wakes from the coastal topography in post-change flow
- features reminiscent of Black Saturday further up the EP
  - small-scale vortices on the wind change
  - pre-frontal boundary-layer rolls (visible in sat. imagery over western Victoria)
  - very high FDI associated with these features

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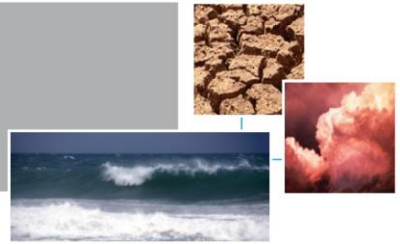
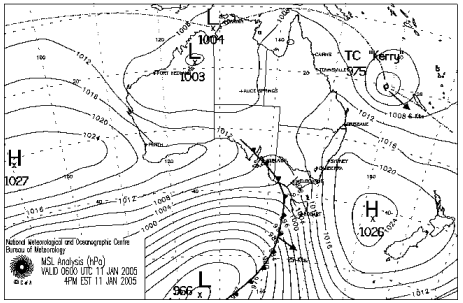
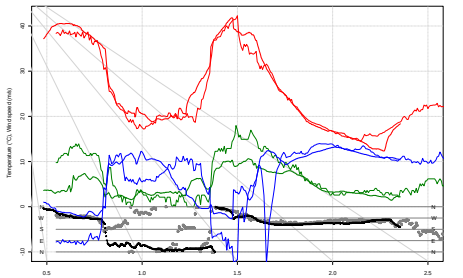
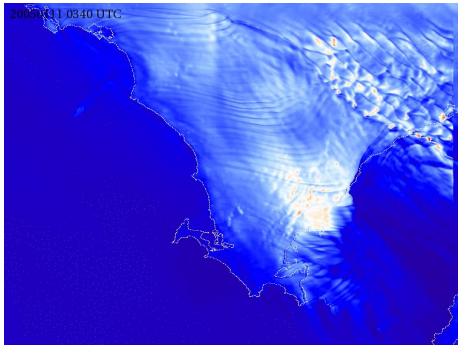
# Summary



- Meteorology of LEP fire (10-11 Jan 2005) modelled at very high resolution with ACCESS
- Familiar summer-time synoptic situation
- Validation against independent data yields good results, although dry slot missed
- Elevated FDI values behind the change
- Interesting similarities to Black Saturday further up the Eyre Peninsula
  - although bore transition is “opposite”



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Robert Fawcett
High Impact Weather Research

Phone: 03 9669 4296
Email: r.fawcett@bom.gov.au
Web: www.cawcr.gov.au

# Thank you

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Wangary Fire
Fire Scar Boundary
13/01/2005 12:40
N
10 5 0 10
Kilometers
Area Burnt
CFS Stations
Power Transmission Line
Highway
Major Road
Minor Road
NPWS park boundary
Built Up Areas
Native Vegetation
Plantation
Area Burnt: 77,000 Ha
Mount Hope
Kapinnie
Yeltukka
Yeelanna
Butler Tanks
Midway Glen
Ungarra
Cape Hardy
Cowieninta
Nyllow Hill
Warratta Vale
Lipson Island CP
Lipson
Cummins
Rocky Islands (North) CP
Warrow
North Block
South Block
Yallunda Flat
Coulta
Edillilie
Koppio
Pillaworta Hill
Tumby Bay
Tumby
Tumby Island CP
Cape Elliot
Point Sir Isaac
Coffin Bay
Woolawae Downs
Bald Hill
White Flat
Red Cliff
Massena Bay
Peake Bay
Reef Point
Farm Beach
Coffin Bay Peninsula
Wangary
Wanilla
Wanilla Land Settlement CR
Murrunatta CP
Murrunatta CR
Wanna CP
Mount Gawler
Louth Bay
Point Bolingbroke
Port Douglas
Mount Dutton Bay
Point Whidbey
Mount Dutton Bay CP
Kellidie Bay
Avoid Bay
Coffin Bay NP
Avoid Bay Islands CP
The Fountain
Poonindie
Sir Joseph Banks Group CP
Coffin Bay
Kellidie Bay CP
North Shields
Coomapoo
Point Boston
Mungerowie
Green Patch
Boston Bay
Point Avoid
Whidbey Isles CP
Picnic Beach
Port Lincoln
Cape Donington
Kathai CP
Gum Flat
Shoal Point
Tulka
Lincoln CR
Macaroni Point
Sleaford Mere CP
Lincoln NP
Koddinga
Wanna
Sleaford Bay
Fishery Bay
D'Anville Bay
Cape Tournefort
Memory Cove WA
Observatory Point
Cape Wiles
Cape Carnot
Jussieu Bay
West Point
FLINDERS HIGHWAY
TOD HIGHWAY
LINCOLN HIGHWAY
BRATTEN WAY
WESTERN APPROACH ROAD
Important:
Before using this map for fire suppression, please check with appropriate CFS or NPWSA staff to ensure there have been no changes to the condition or accessibility of tracks or water. Ensure you are aware of escape routes, turnaround points and safe areas.
Produced by: Environmental Information
Department for Environment and Heritage
PO Box 550 Marleston SA 5033
Web: www.environment.sa.gov.au/mapland
Data Sources: Fire Boundary - CFS, Roads, Vegetation - DEH
Projection: Transverse Mercator
Datum: Geocentric Datum of Australia, 1994
Grid: Map Grid of Australia, Zone 53
Compiled: 11 March 2005
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