Modelling the fire weather of the Coonabarabran fire of 13 January 2013

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Claire Yeo
(Co-authors: R J B Fawcett, W Thurston, J D Kepert and K J Tory)

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Australian Government
Bureau of Meteorology

The Centre for Australian Weather and Climate Research
A partnership between CSIRO and the Bureau of Meteorology

CSIRO

What are we trying to do?

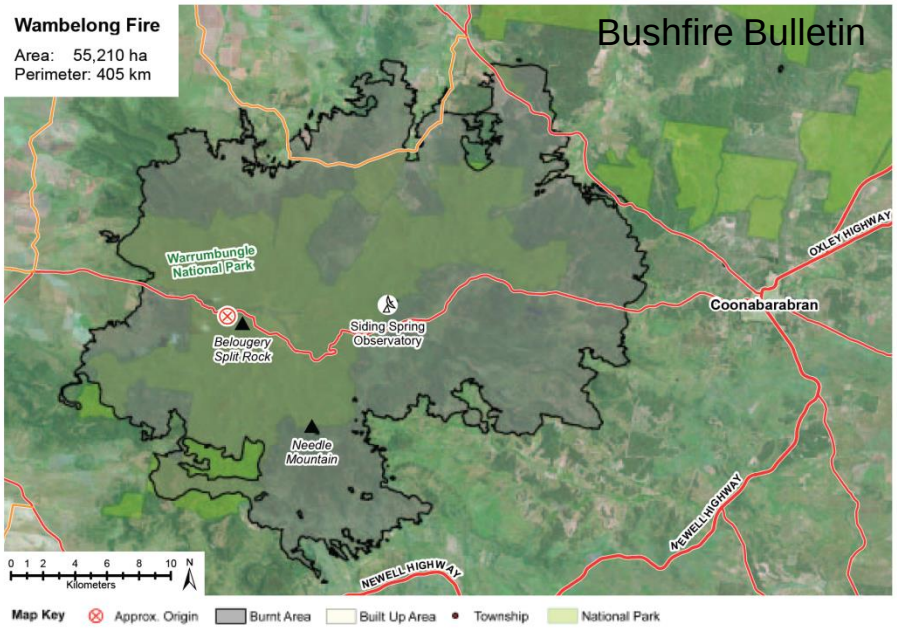
- Investigate the capability of ACCESS to model severe weather situations at high resolution (Grid Spacing ~ 1 km) and very high resolution (Grid Spacing < 1 km)
  - Looking well beyond what is currently operationally achievable (Grid Spacing ~ 4 km)
    - Computer run times, data volumes
  - How good is the model at these resolutions?
  - Does the high-resolution modelling lead to an increased understanding of what happened on the day?

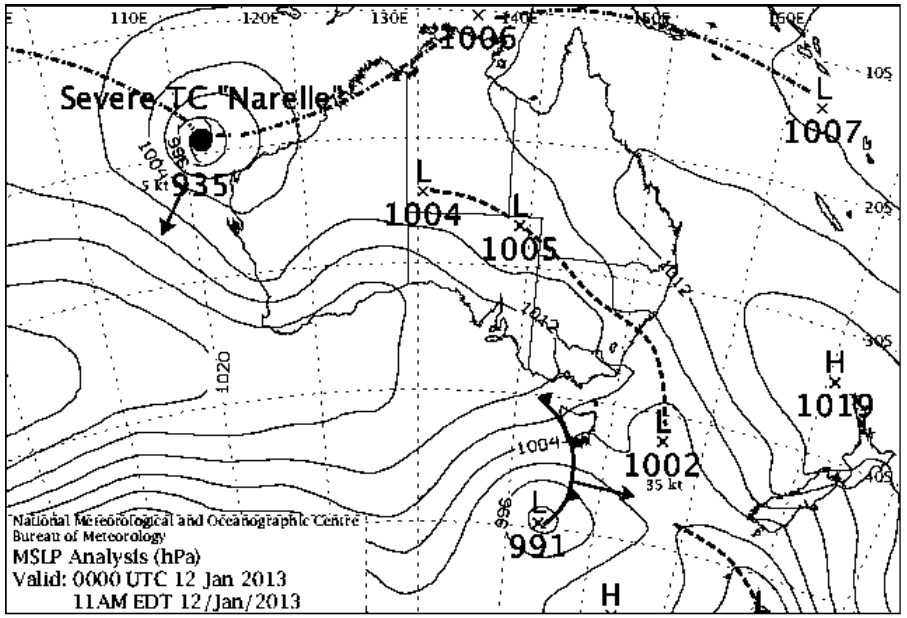
ACCESS

The Australian Community Climate and Earth-System Simulator

Coonabarabran Jan 2013: what happened

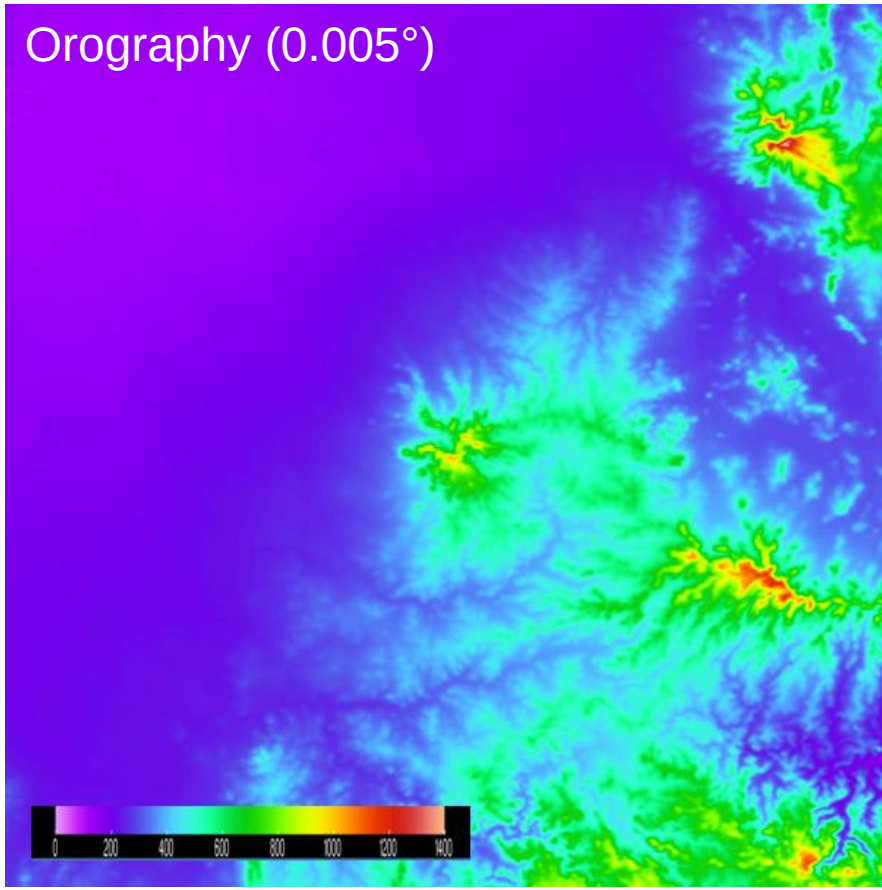
- Fire started around 1600 EDT on Saturday 12 January
- Sunday 13 January was a very bad fire weather day
- MSLP trough across NSW
  - Moved across fire ground late afternoon on Sunday
  - Characteristics of a cool change or cold front





ACCESS Model configuration

- UK Met Office atmospheric model
- Initialisation time
  - 2013-01-12 0300 UTC (1400 EDT)
- Bureau of Meteorology global initial condition
- 50 vertical levels (up to about 60 km)
- Five levels of nesting
  - Global
  - Large regional (0.11°)
  - 0.036° (~ 4 km)
  - 0.012° (~ 1.3 km)
  - 0.005° / 0.075° (~ 550 m / 825 m)
- Fire not modelled
  - No feedbacks from fire to meteorology

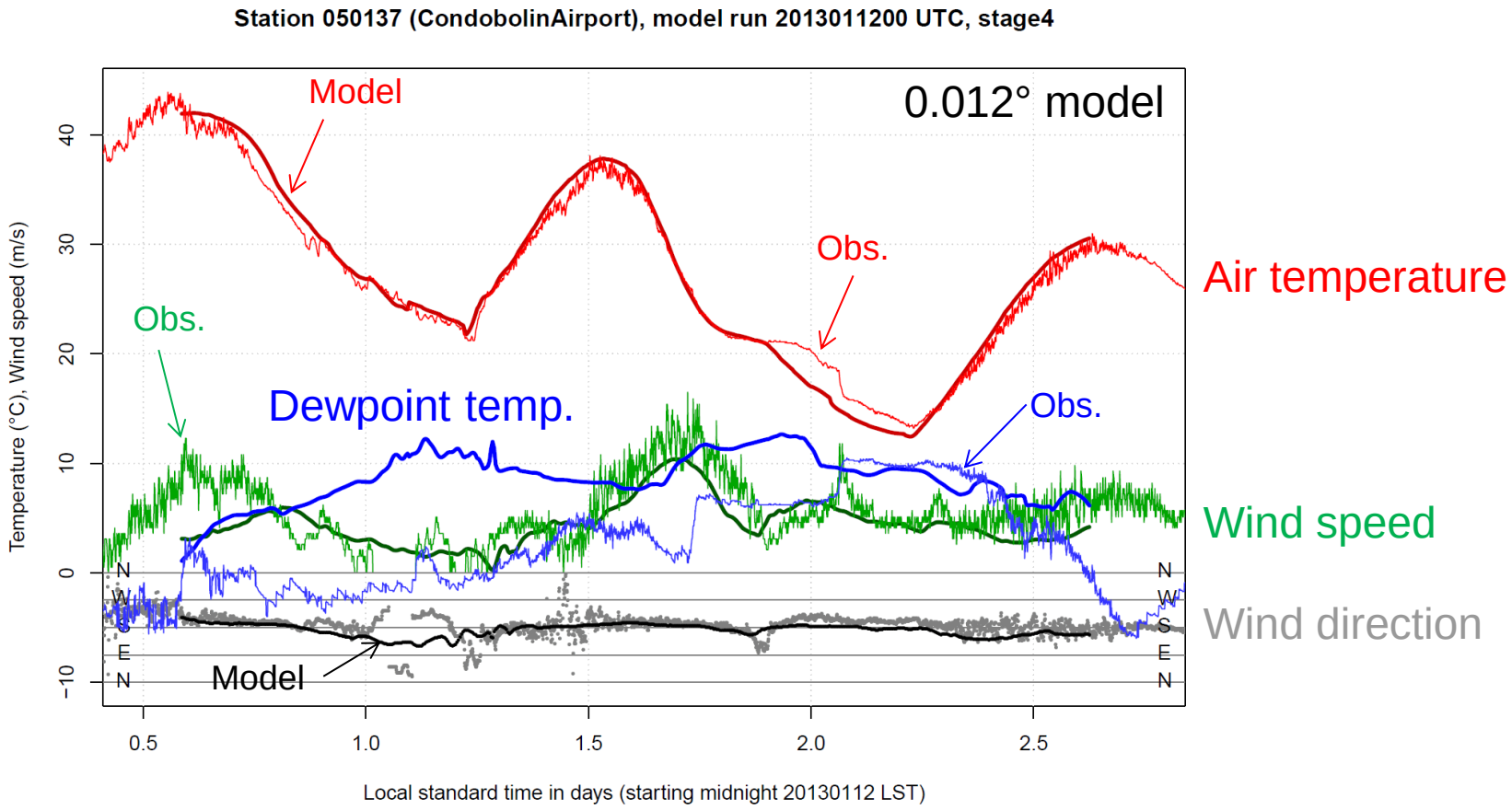


Model validation

- Compare model outputs with AWS data
  - Not precisely comparing "like with like" but still useful
  - Model will likely not put convection in the same places as the observations
- Compare model outputs with radar data
  - Two lines of convection in the model
  - SW line is clearly seen on the radar, although model is a little behind
  - NE line not so obvious in the radar

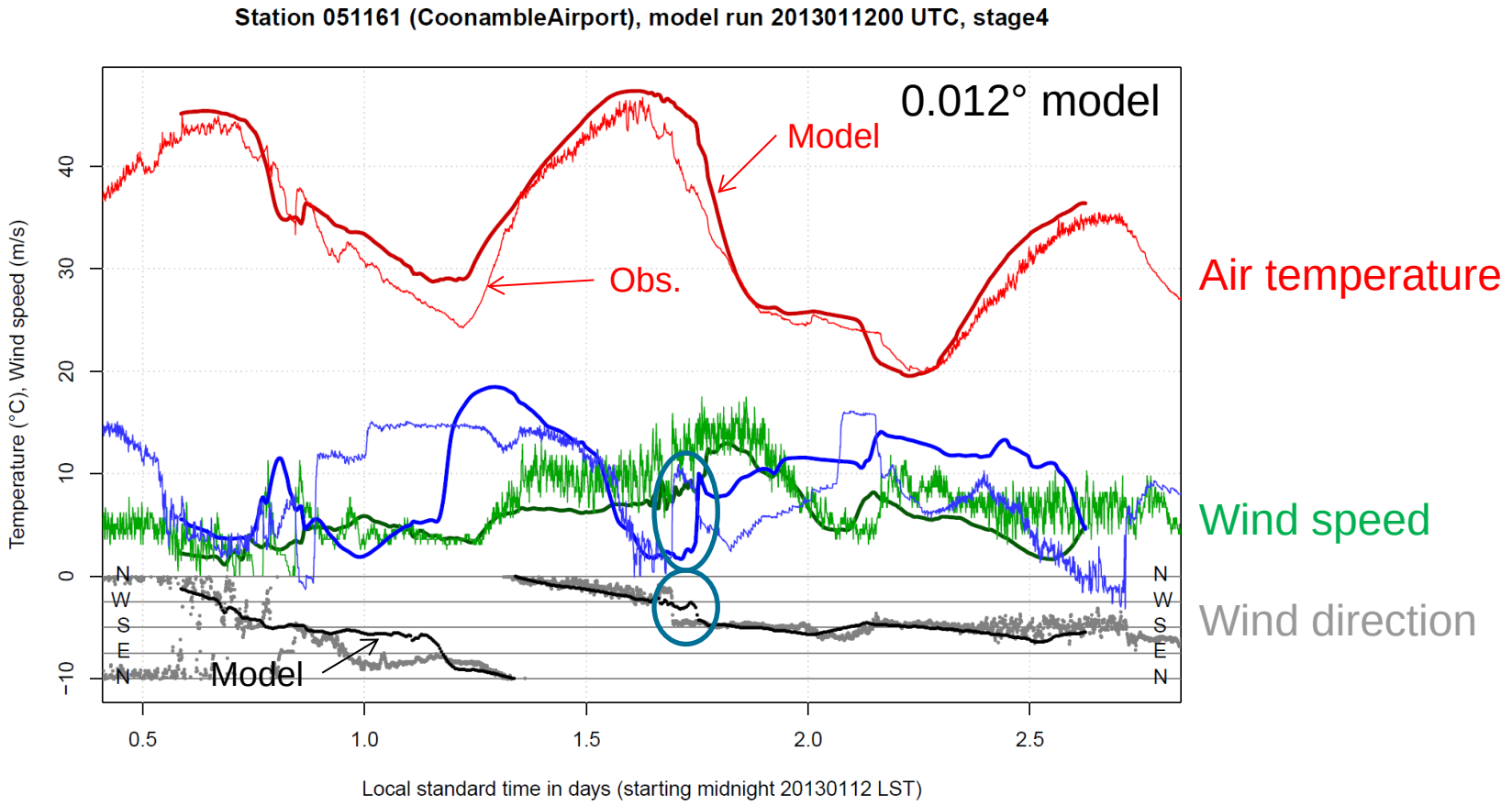
Model validation

- In areas of relatively flat ground, the model can give very good results



Model validation

- Timing of the main change isn't perfect – model change is late (~ 80 min)



Model validation

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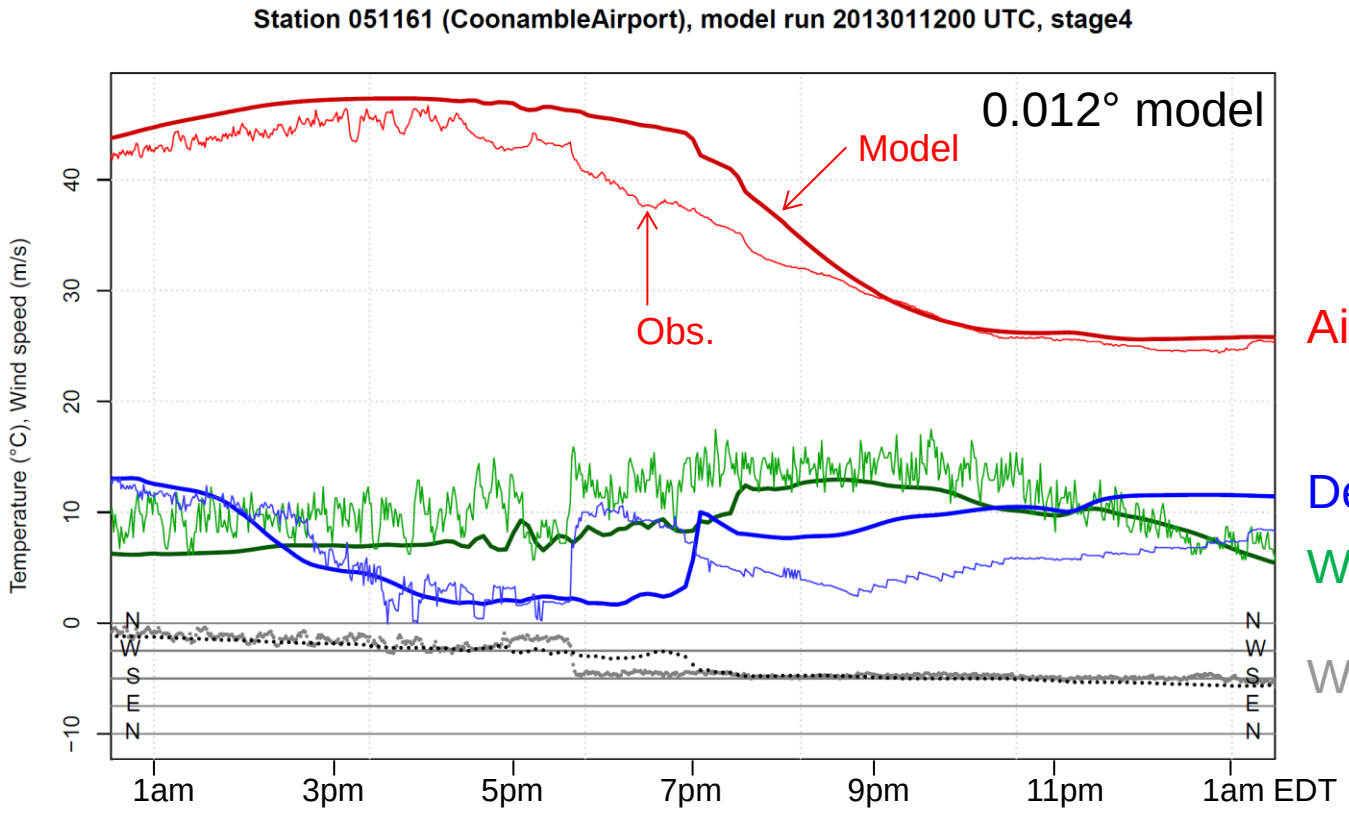
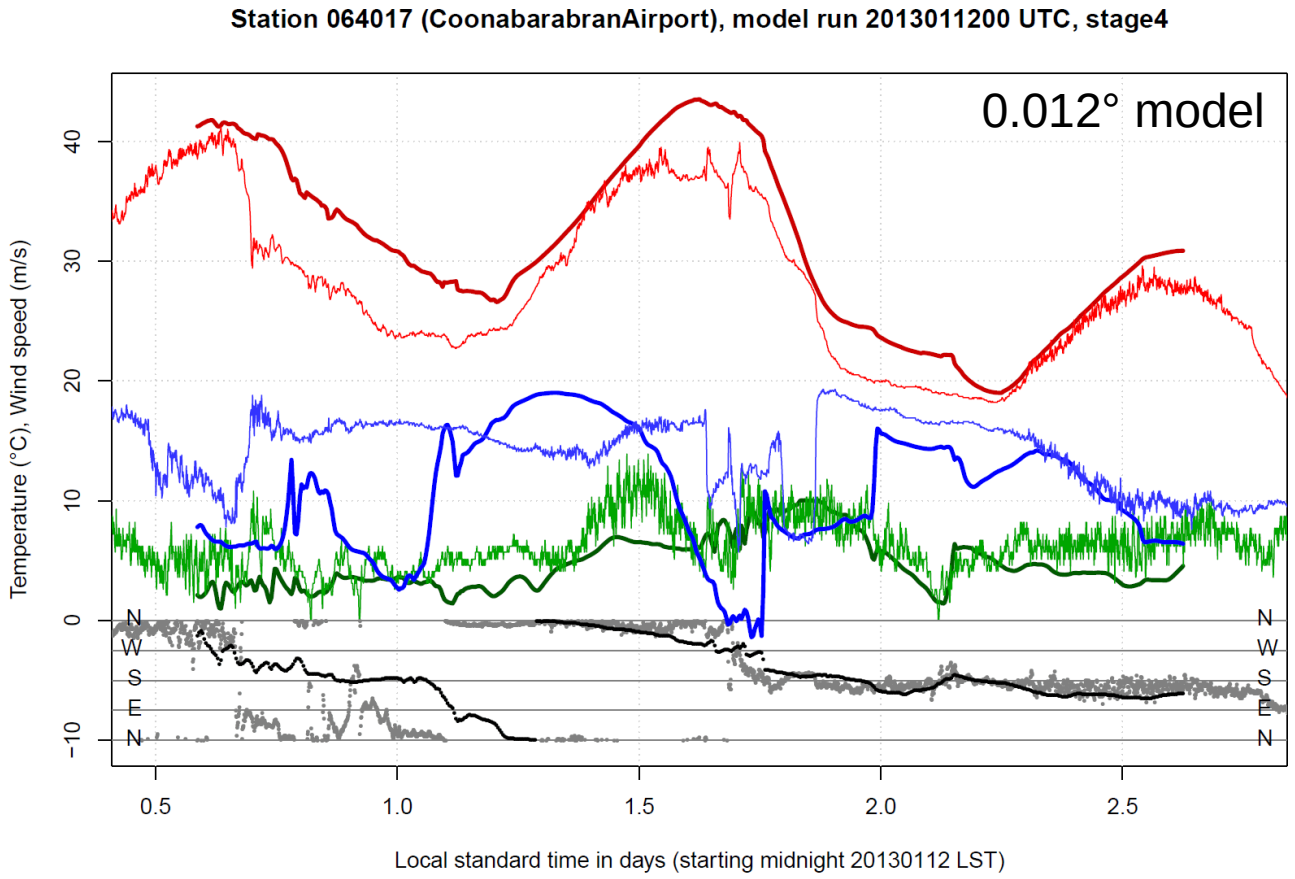


Model validation

- In areas of complicated orography, orographical simplification can lead to T biases due to elevation differences



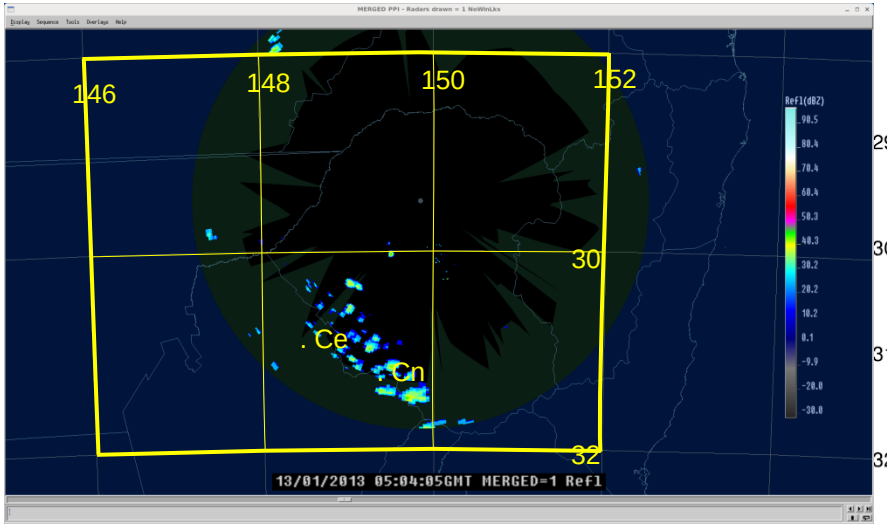
Air temperature

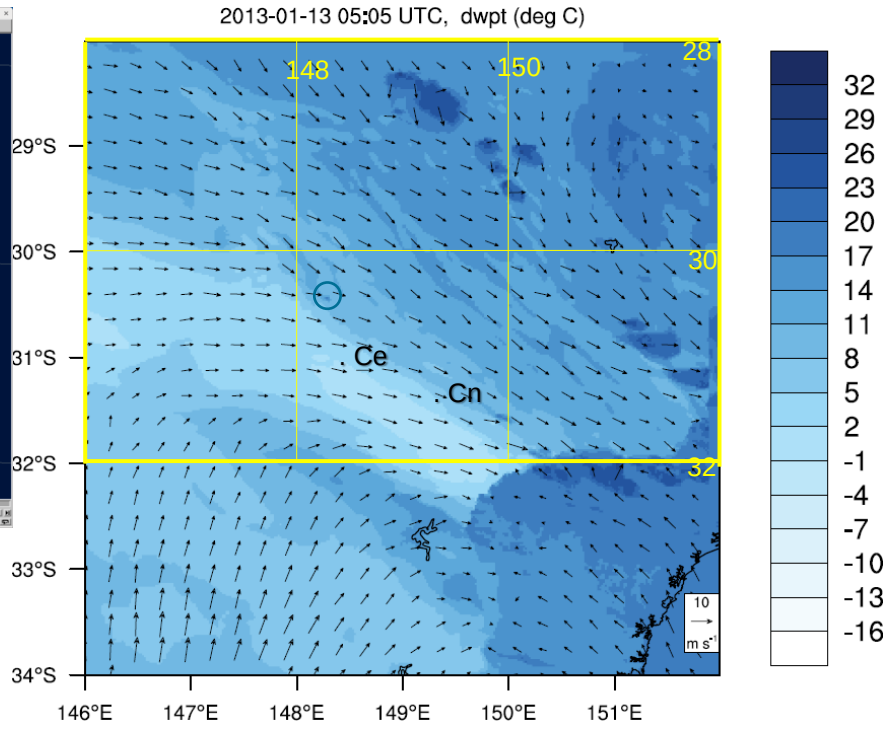
Dewpoint temp.

Wind speed

Wind direction

Radar comparison: 1604 EDT



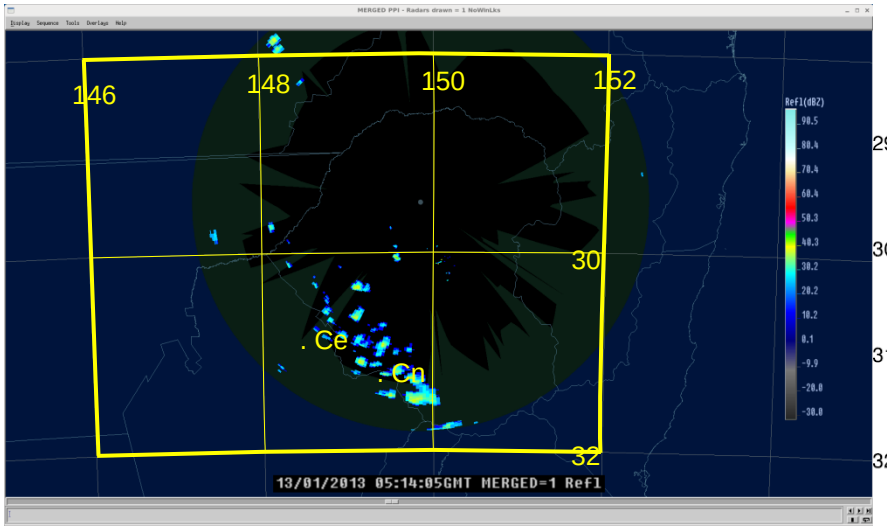


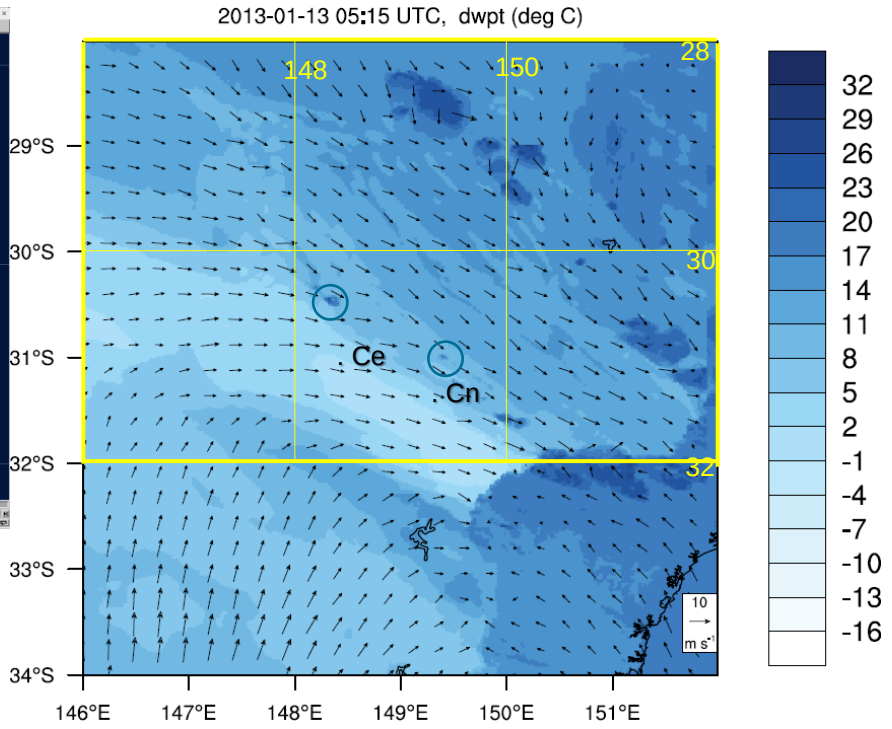
Radar reflectivity in dBZ (10-minute intervals) and modelled screen-level dewpoint / 10-metre wind arrows (from the 0.012° model).

20130113 0504 UTC

20130113 0505 UTC

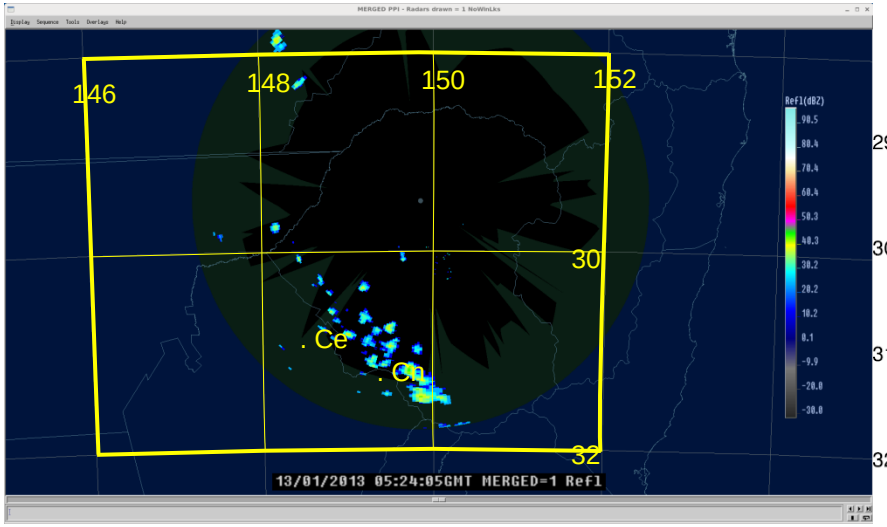
Radar comparison: 1614 EDT

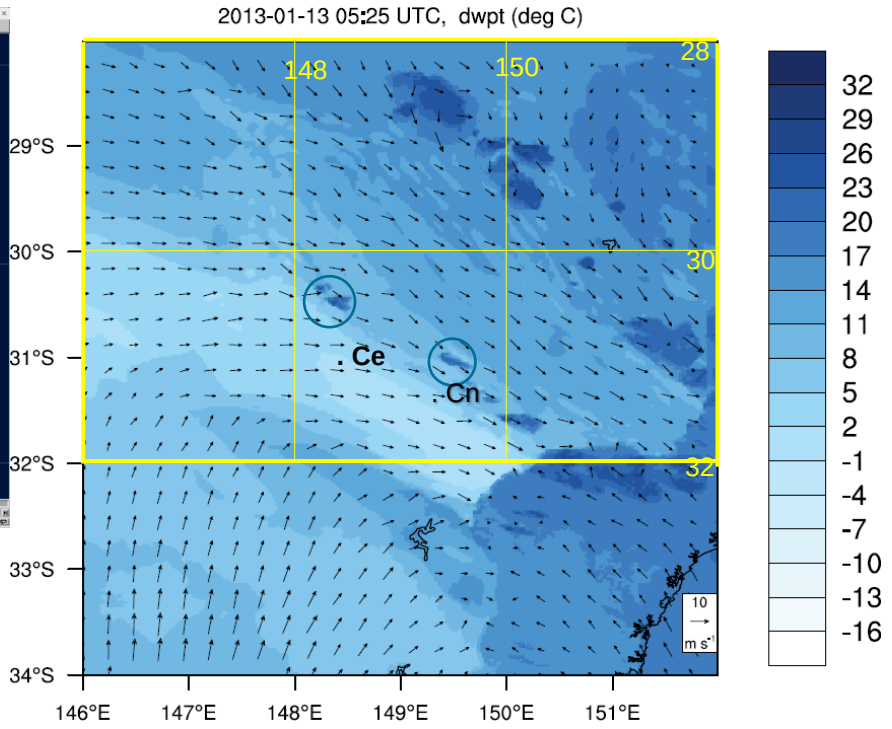




20130113 0514 UTC

Radar comparison: 1624 EDT





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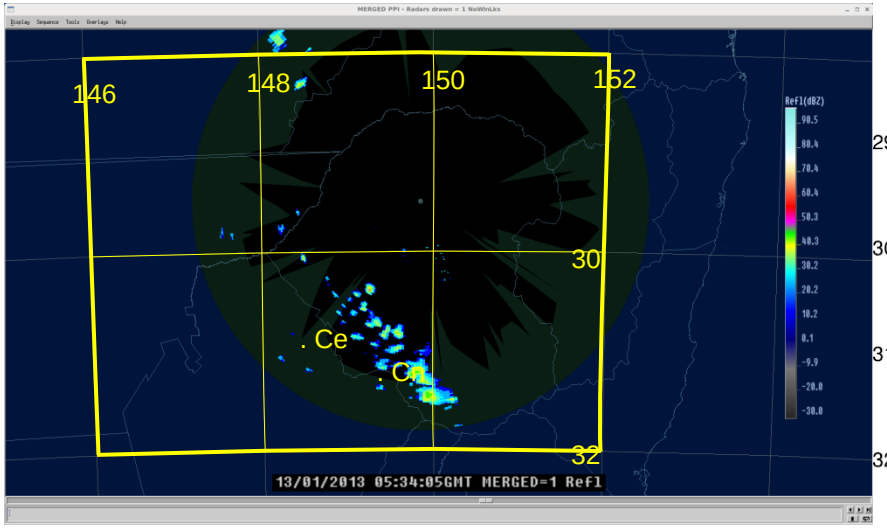

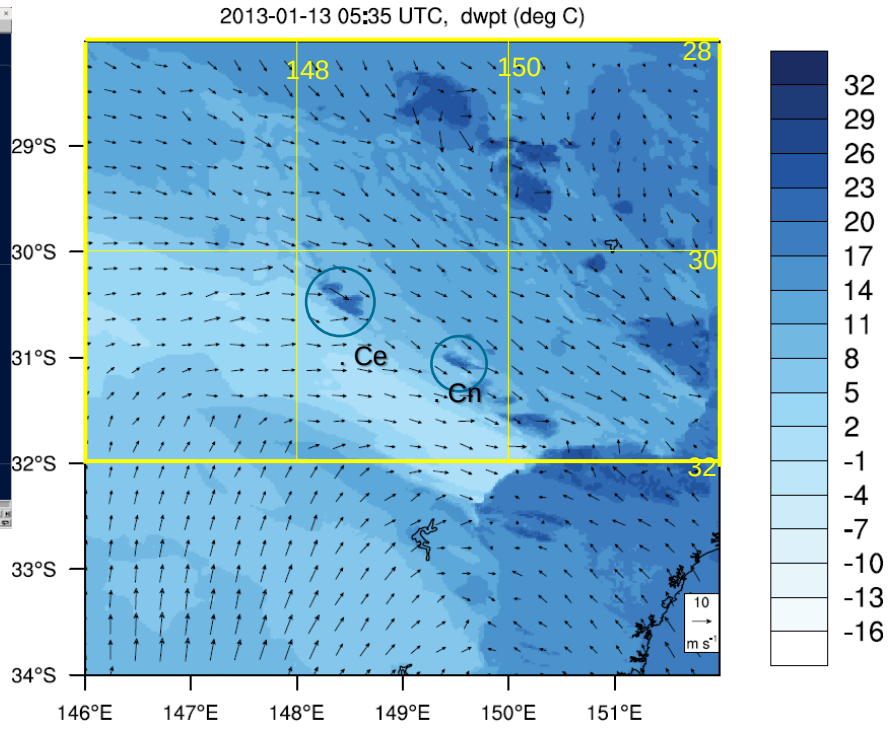

20130113 0534 UTC

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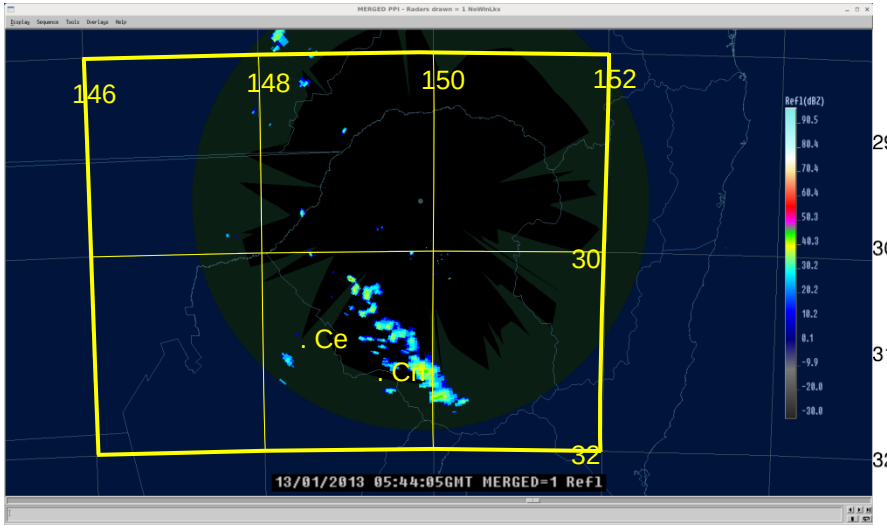
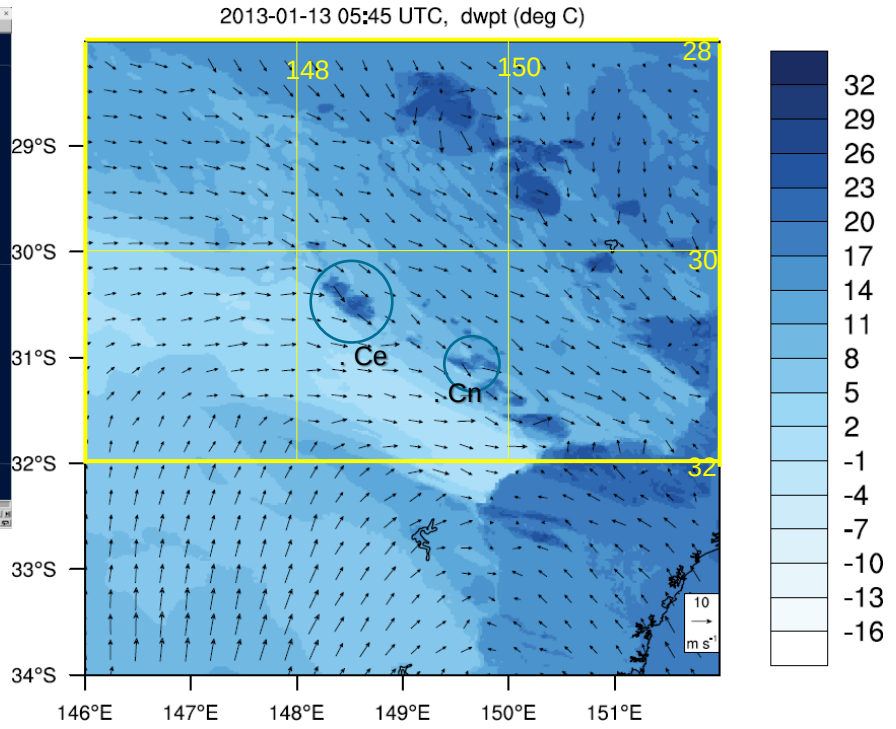
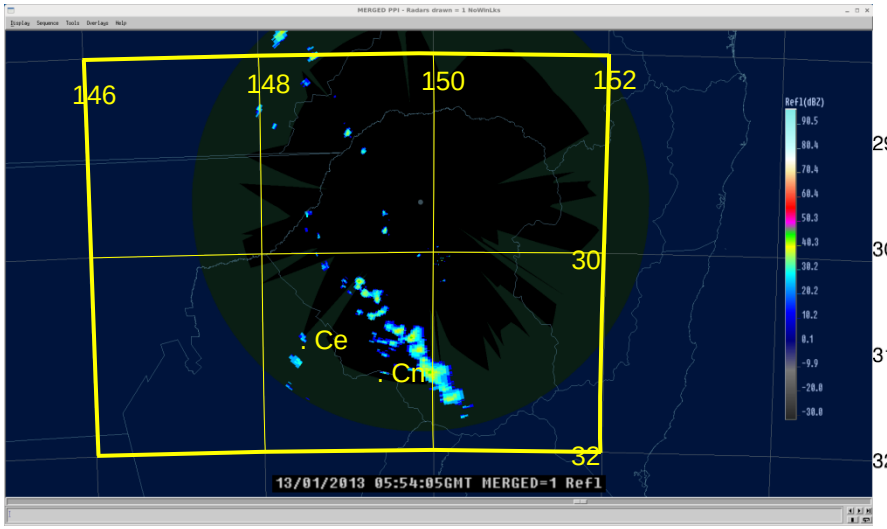
Radar comparison: 1644 EDT

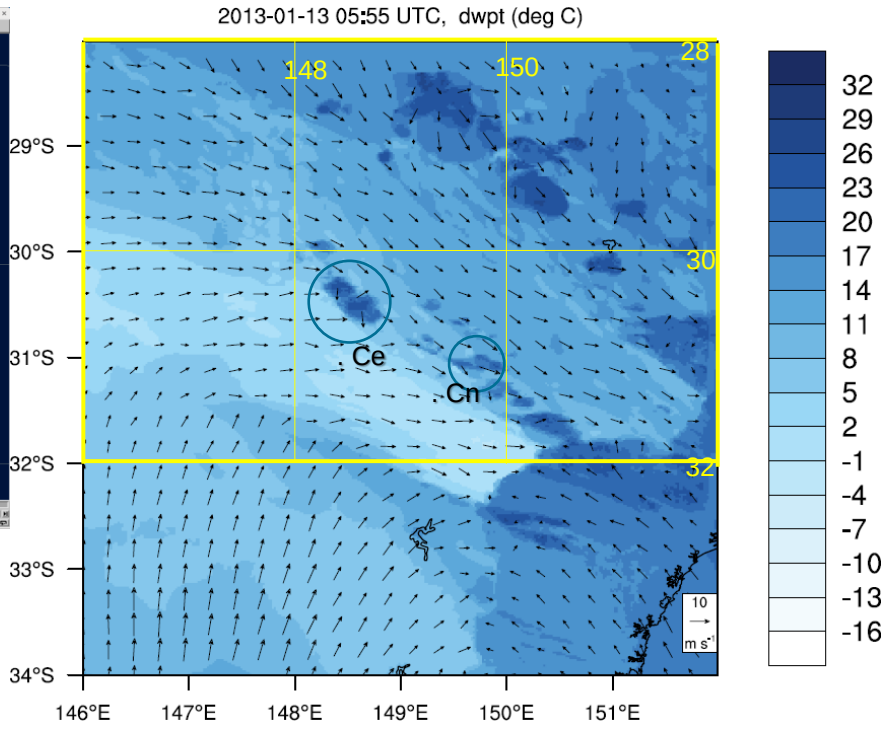




20130113 0544 UTC

Radar comparison: 1654 EDT





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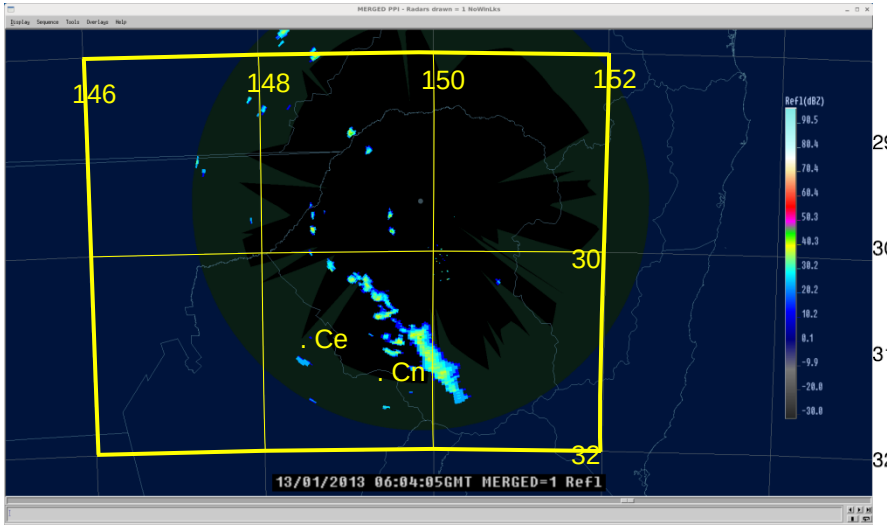
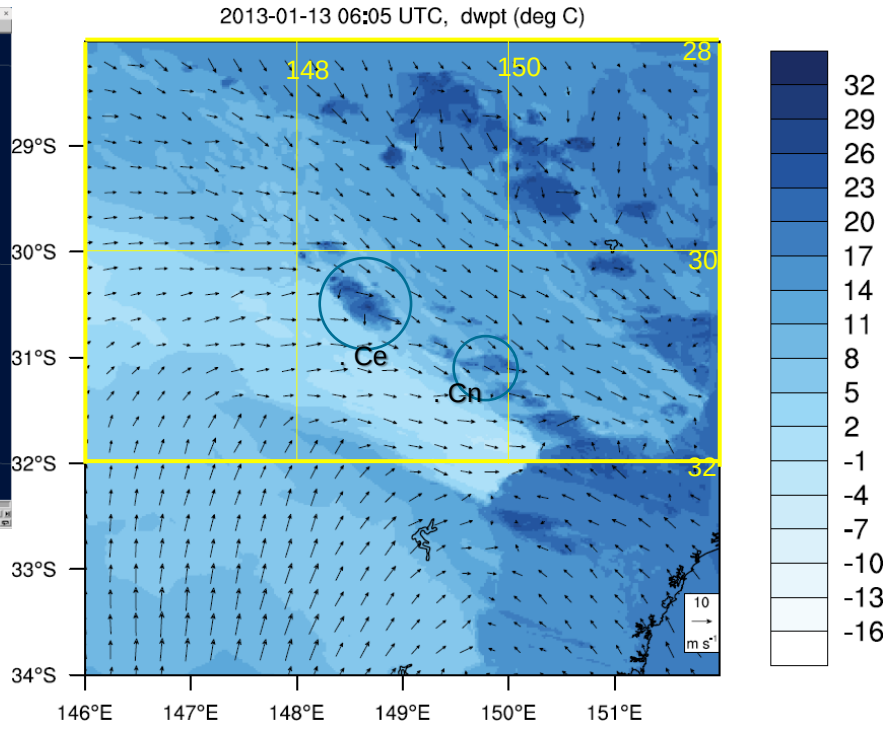
Radar comparison: 1704 EDT





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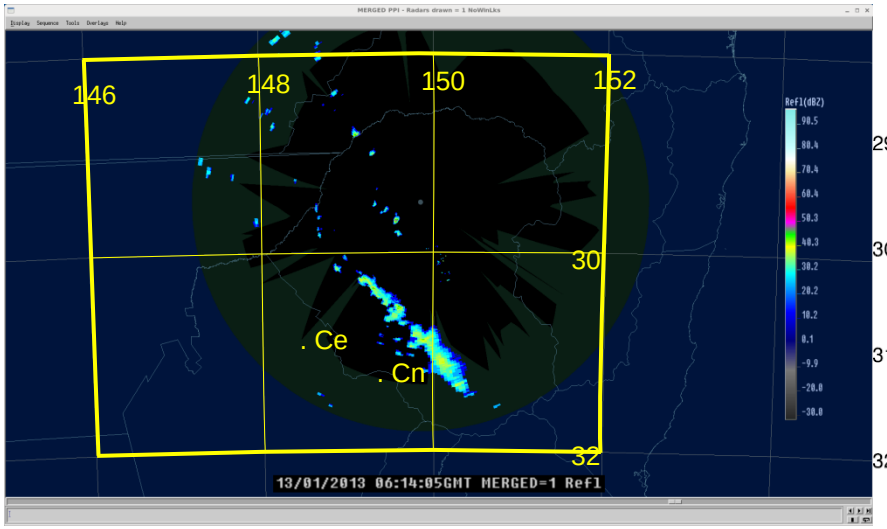

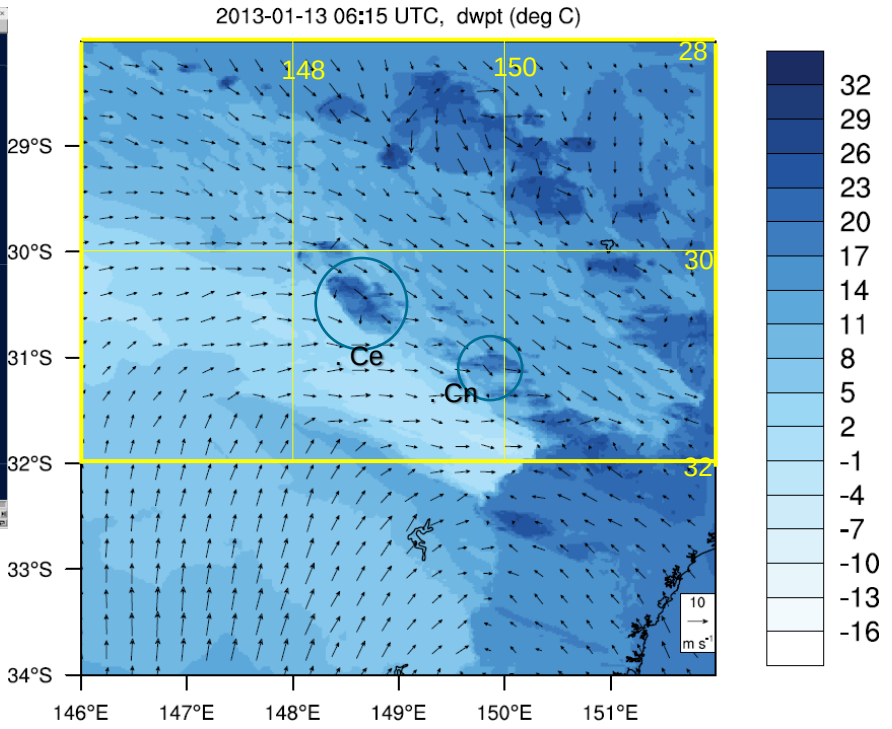

20130113 0614 UTC

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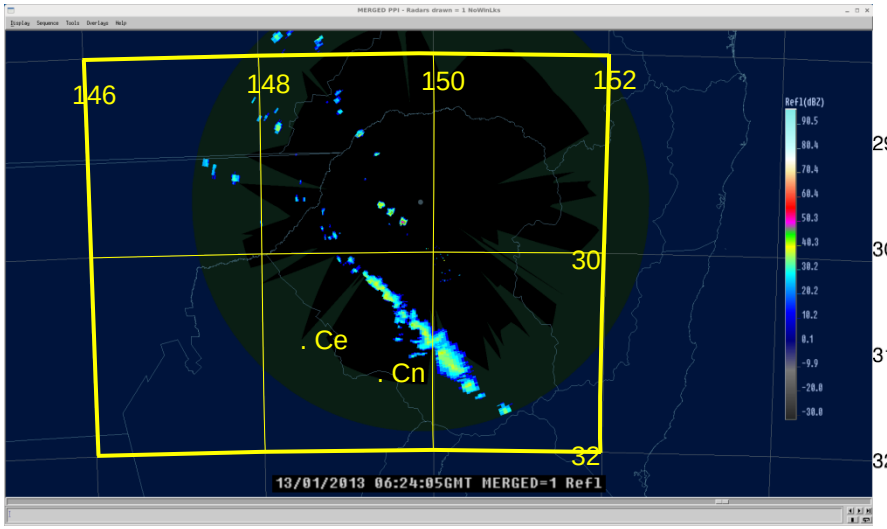

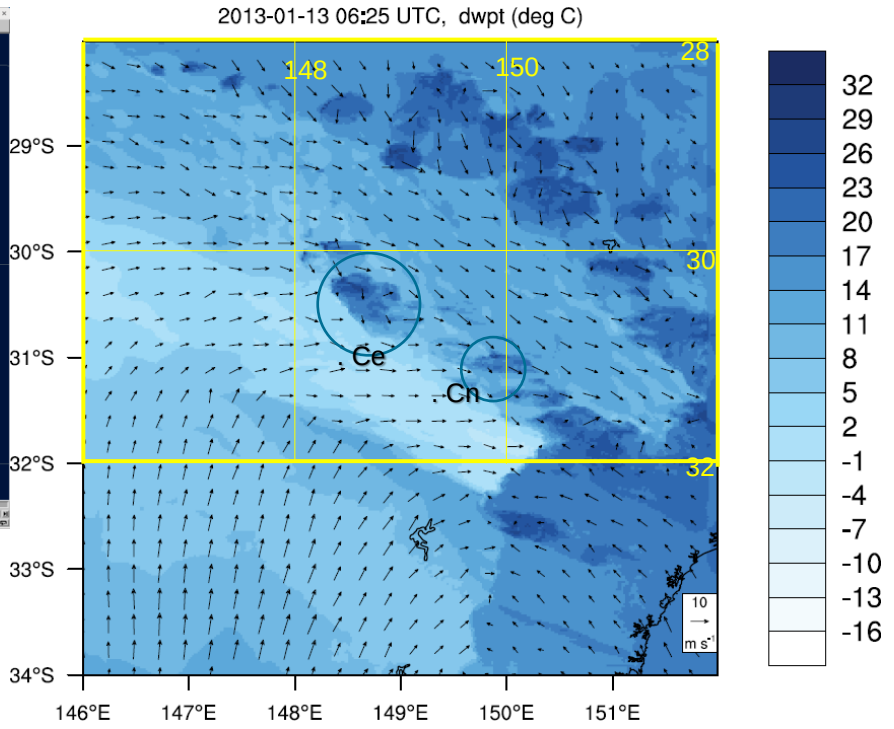

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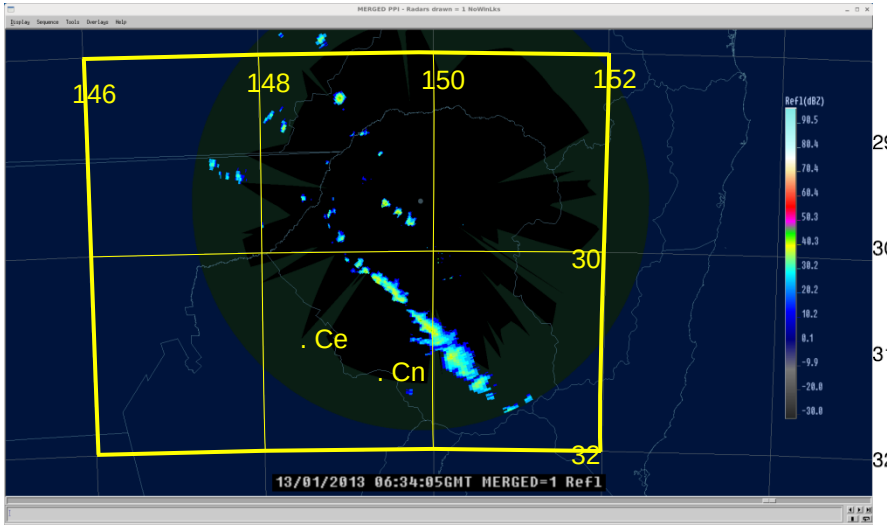

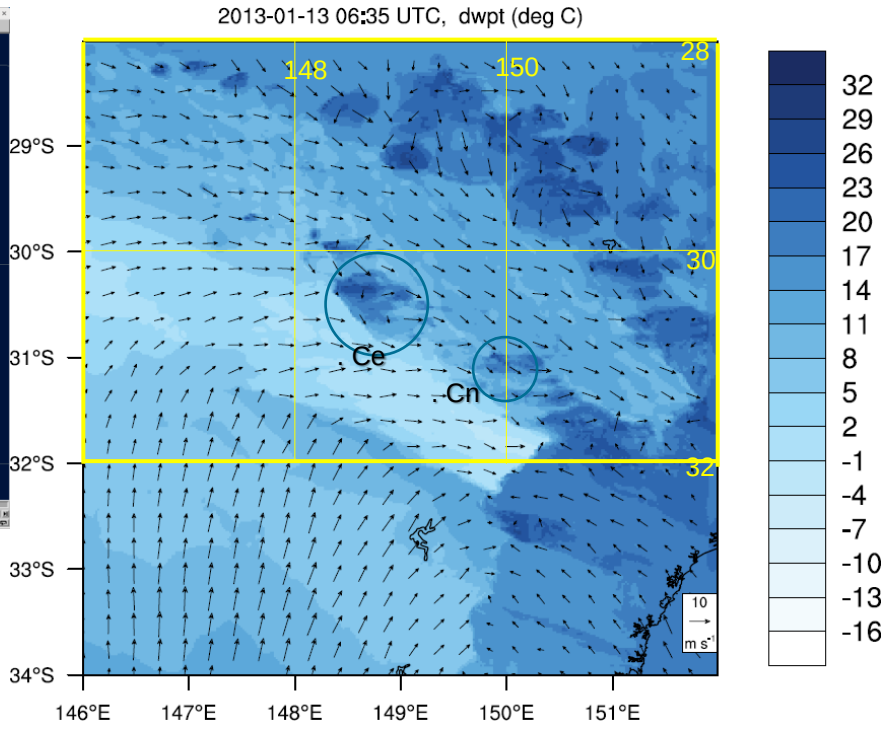

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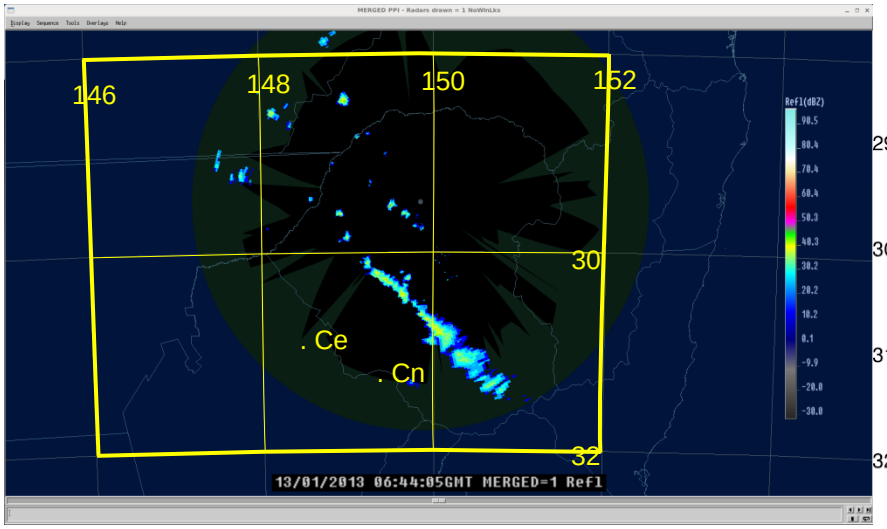

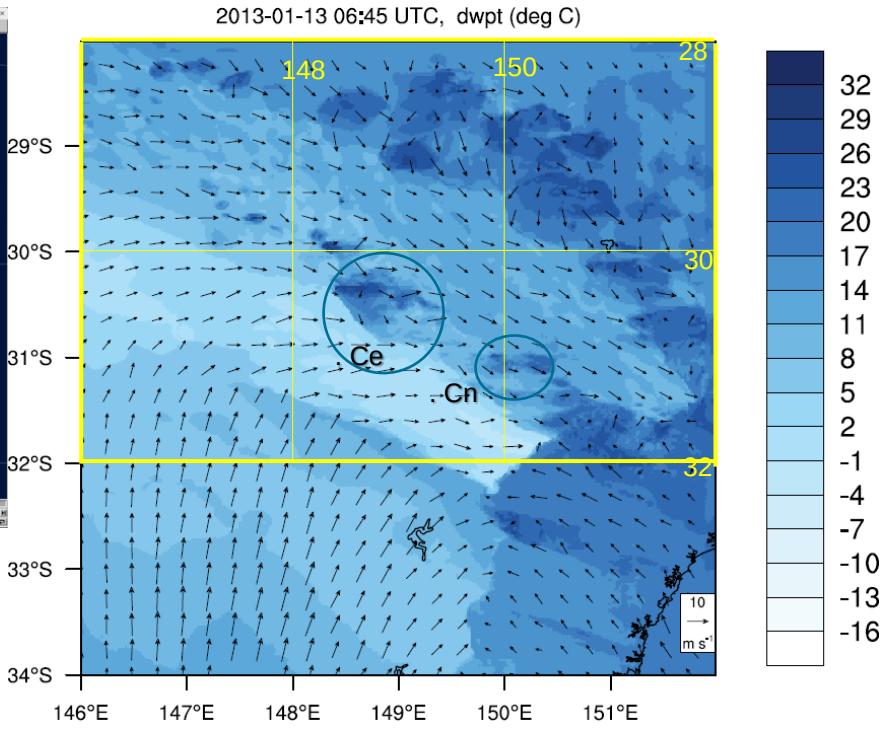

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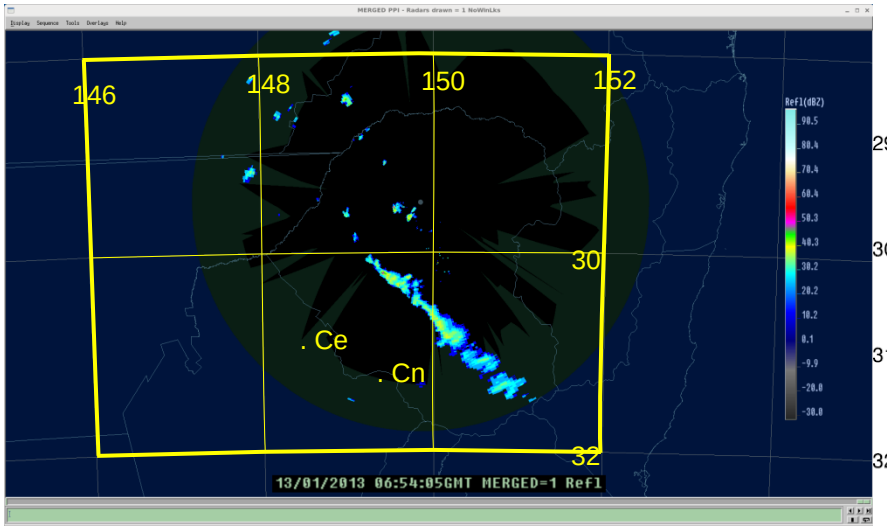
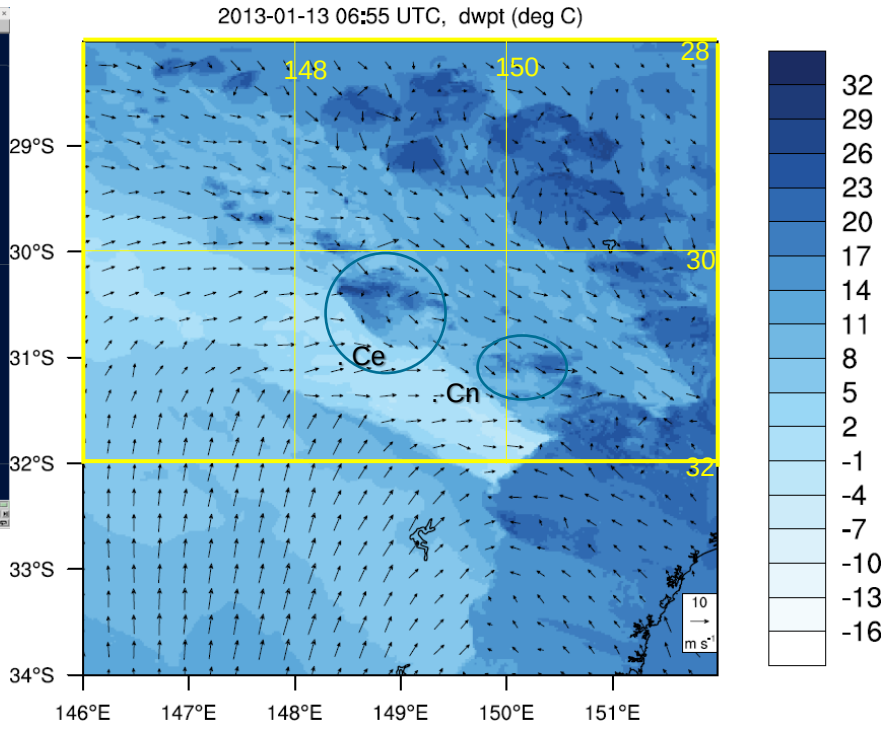
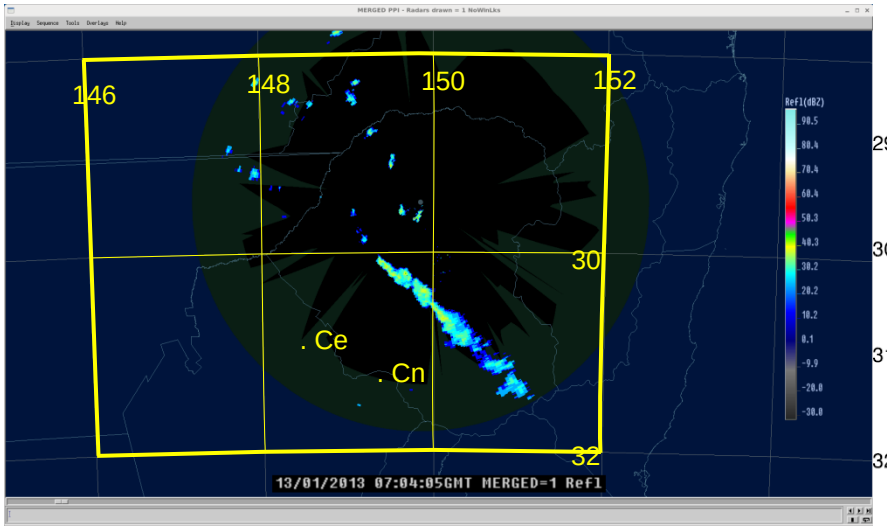
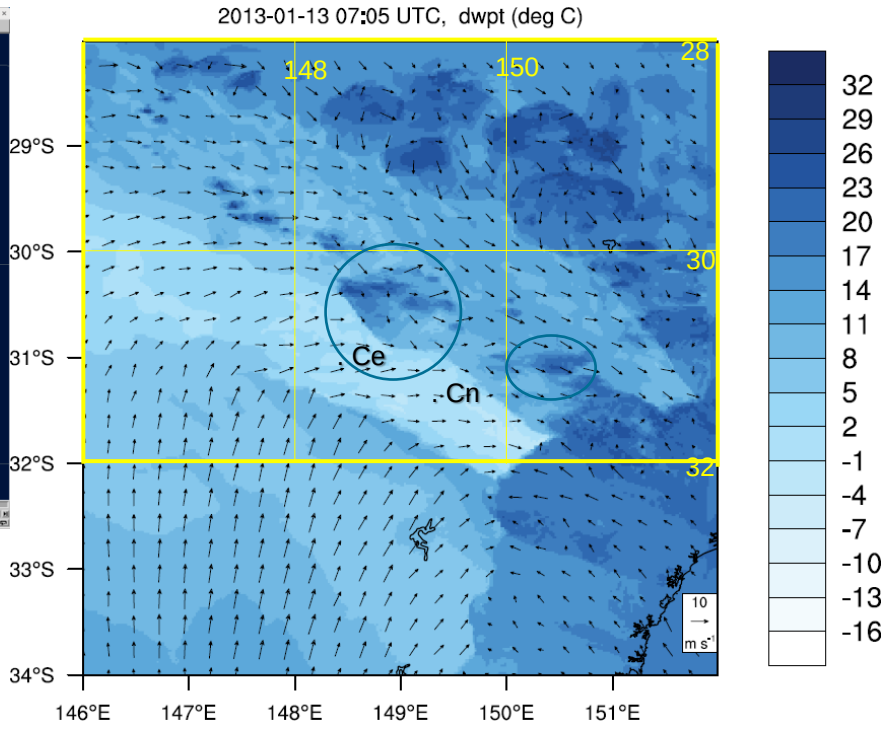




20130113 0654 UTC

Radar comparison: 1804 EDT





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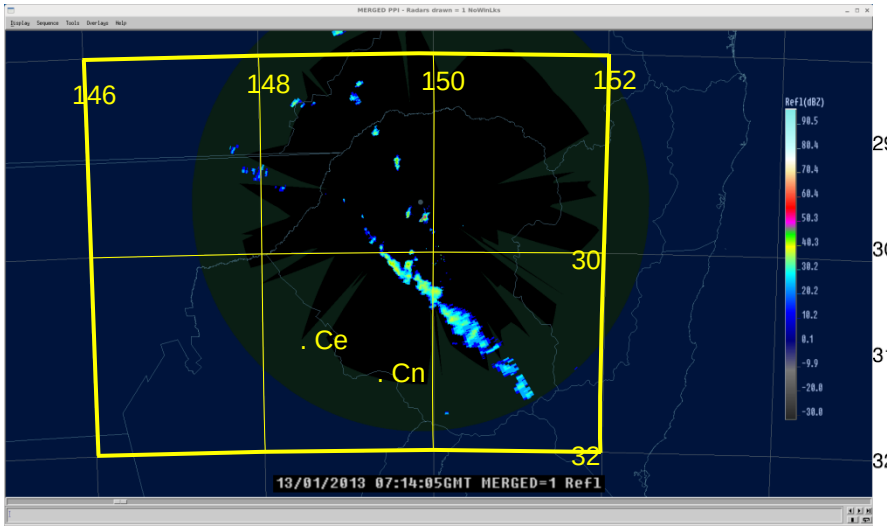

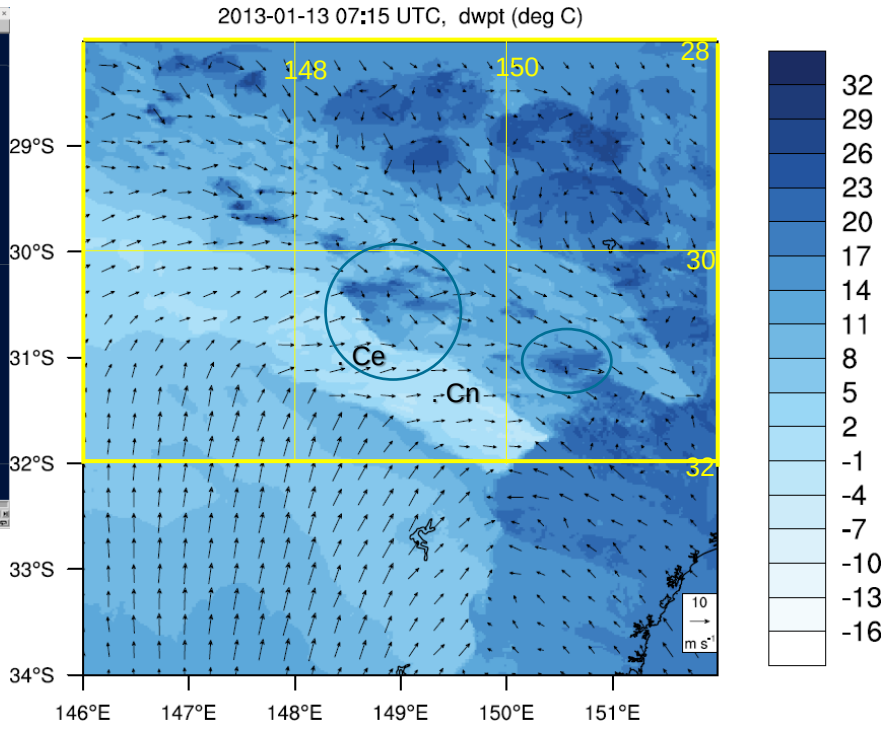

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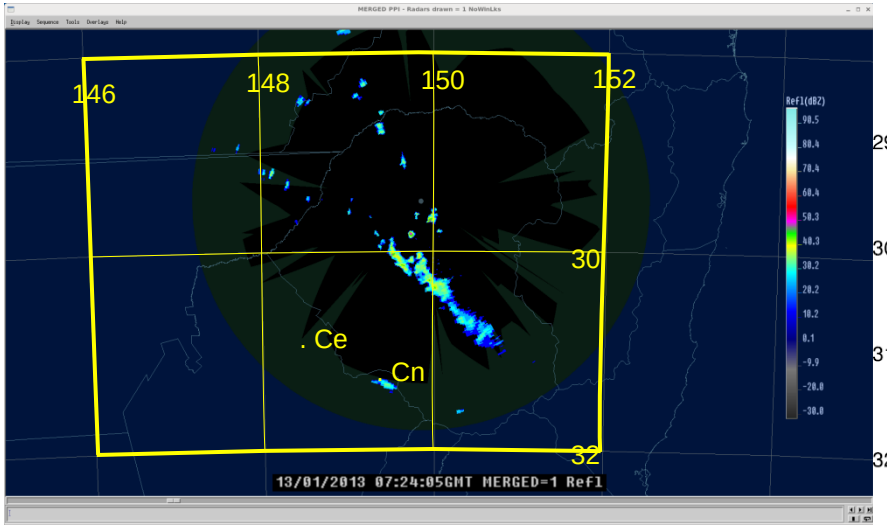

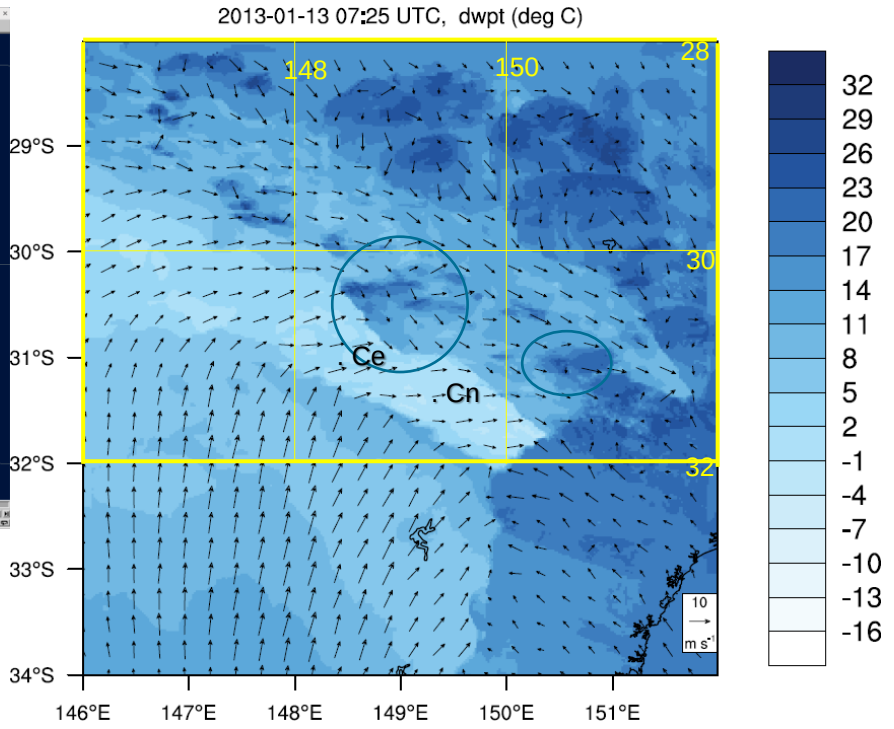

20130113 0724 UTC

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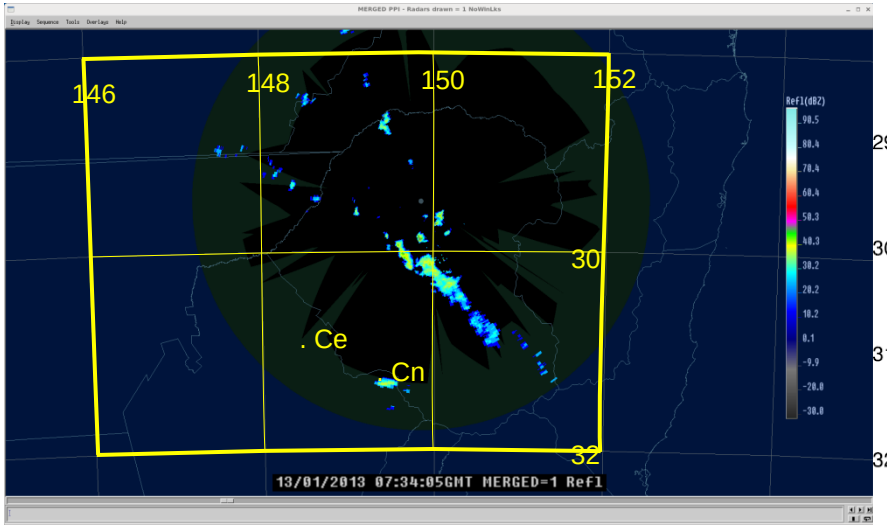
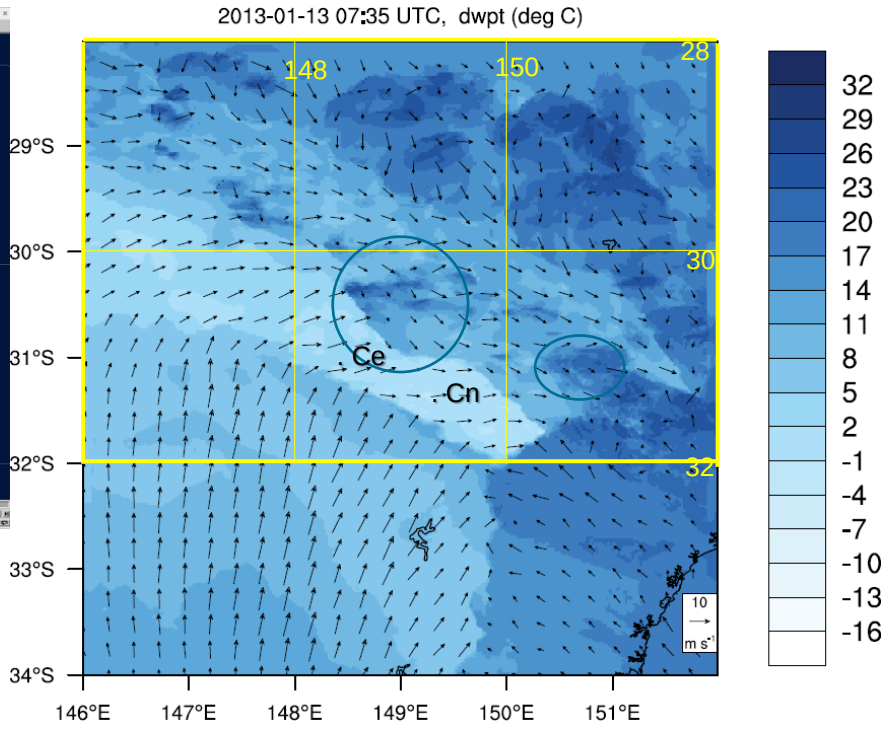
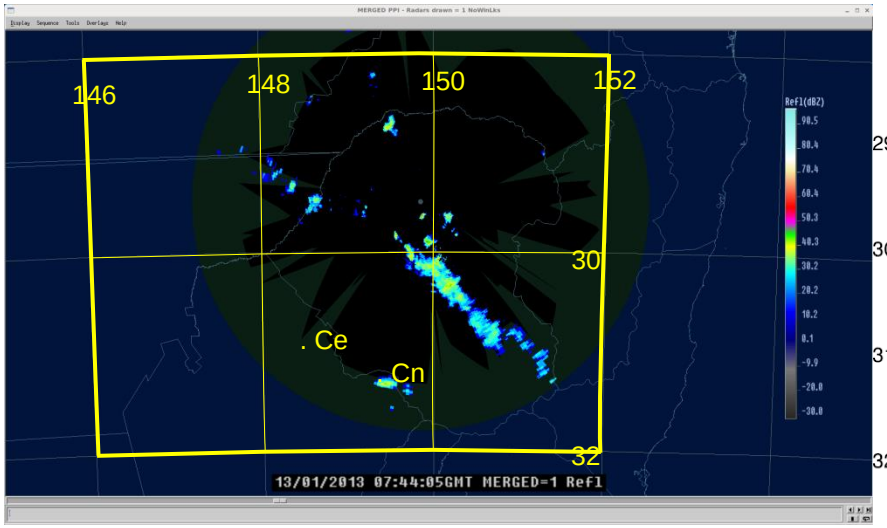
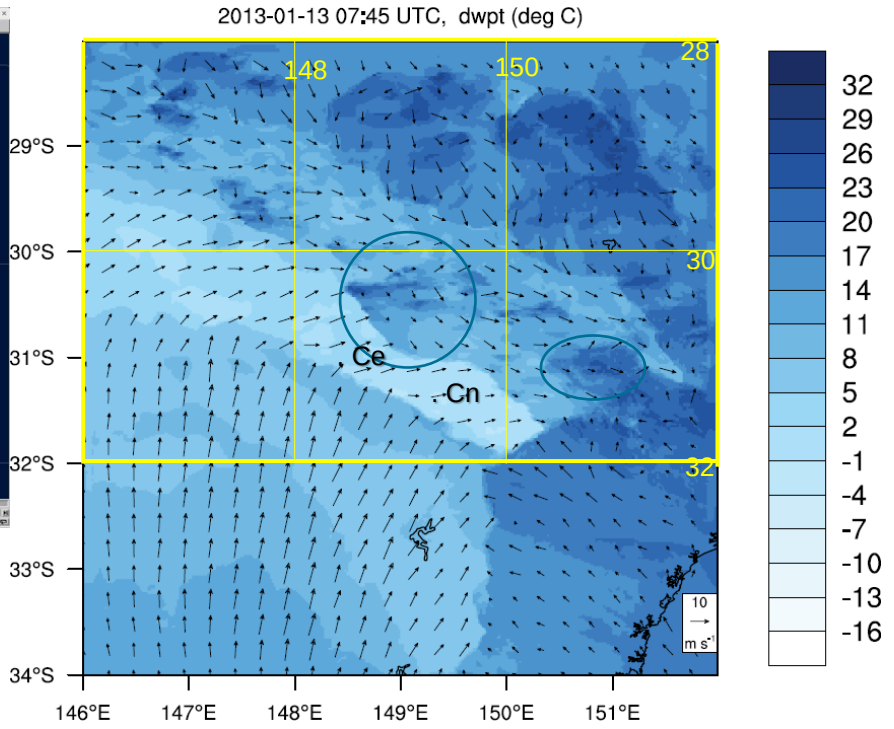




20130113 0734 UTC

Radar comparison: 1844 EDT





20130113 0744 UTC

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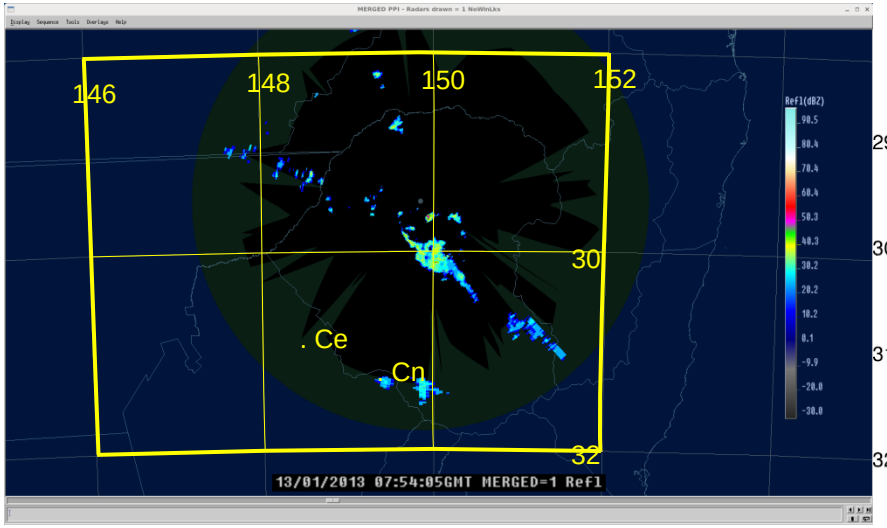
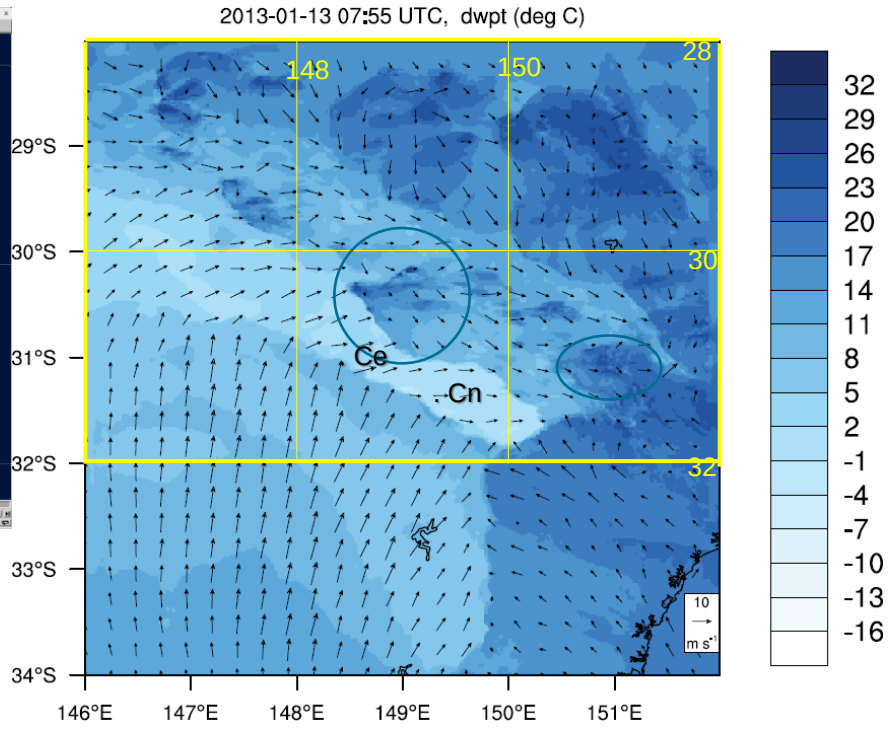
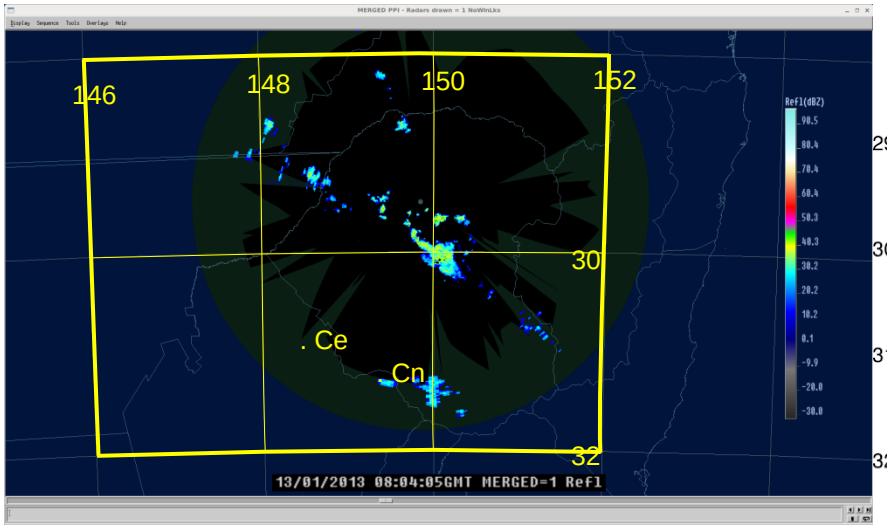
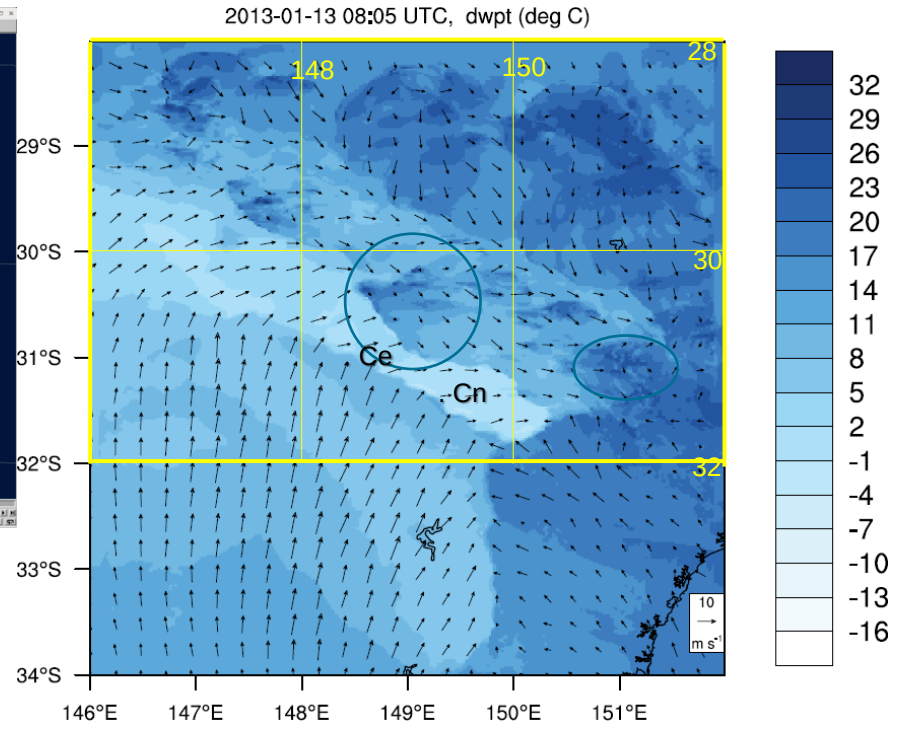




20130113 0754 UTC

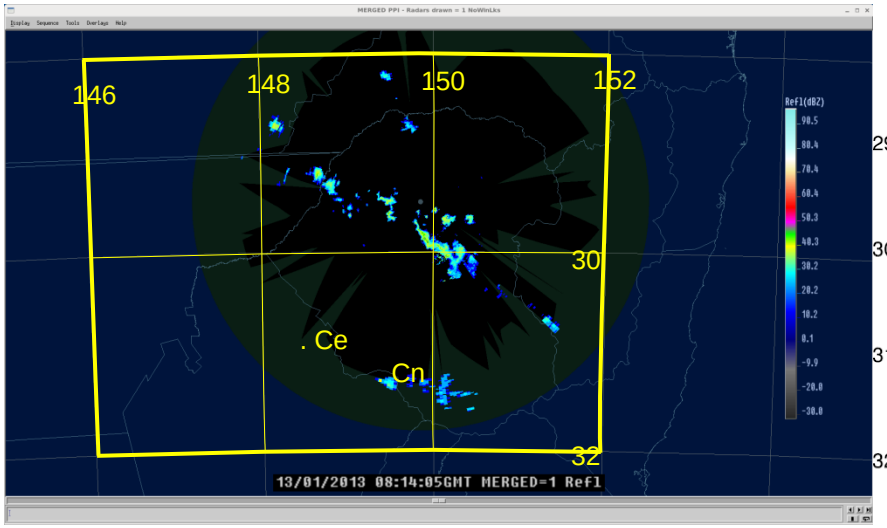
Radar comparison: 1904 EDT

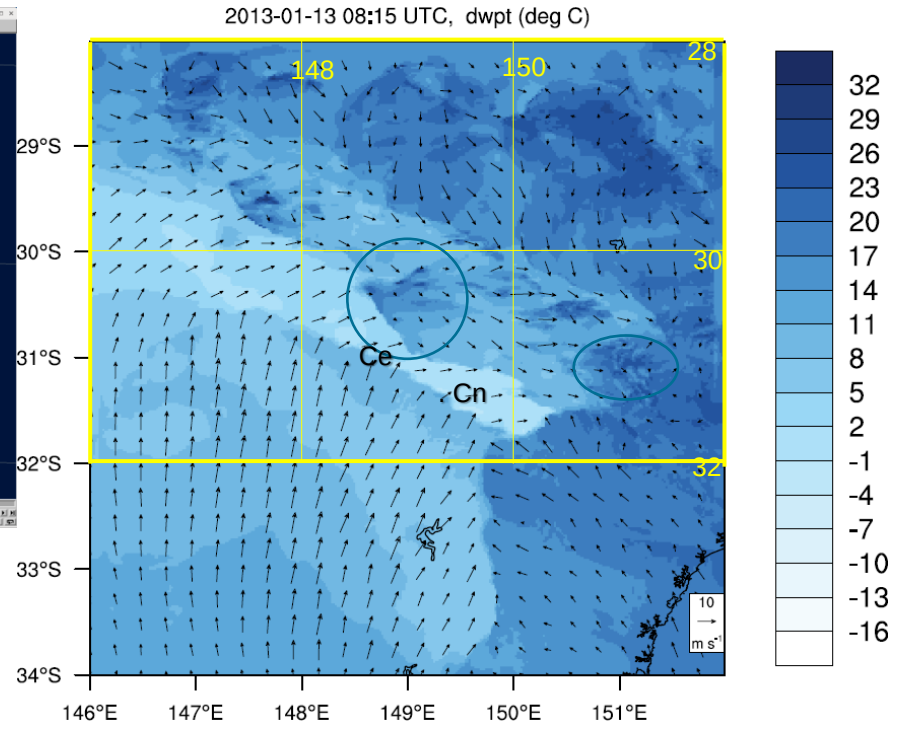




20130113 0804 UTC

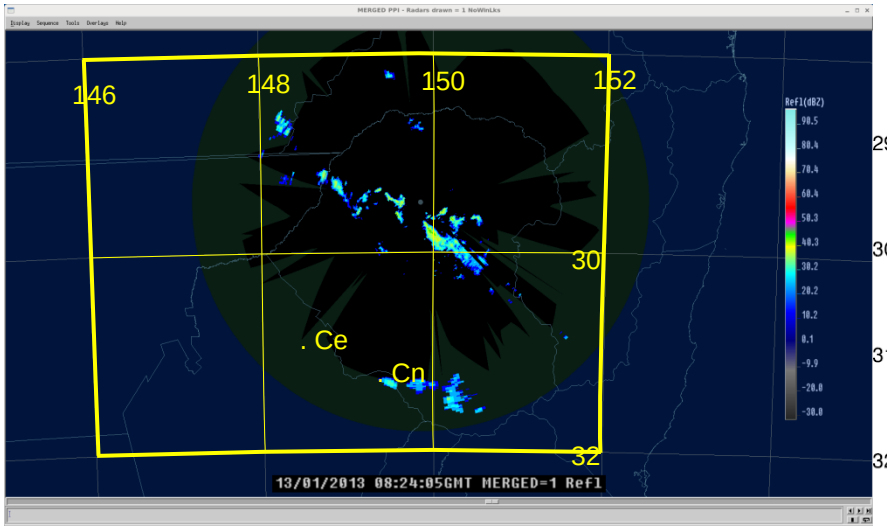
Radar comparison: 1914 EDT

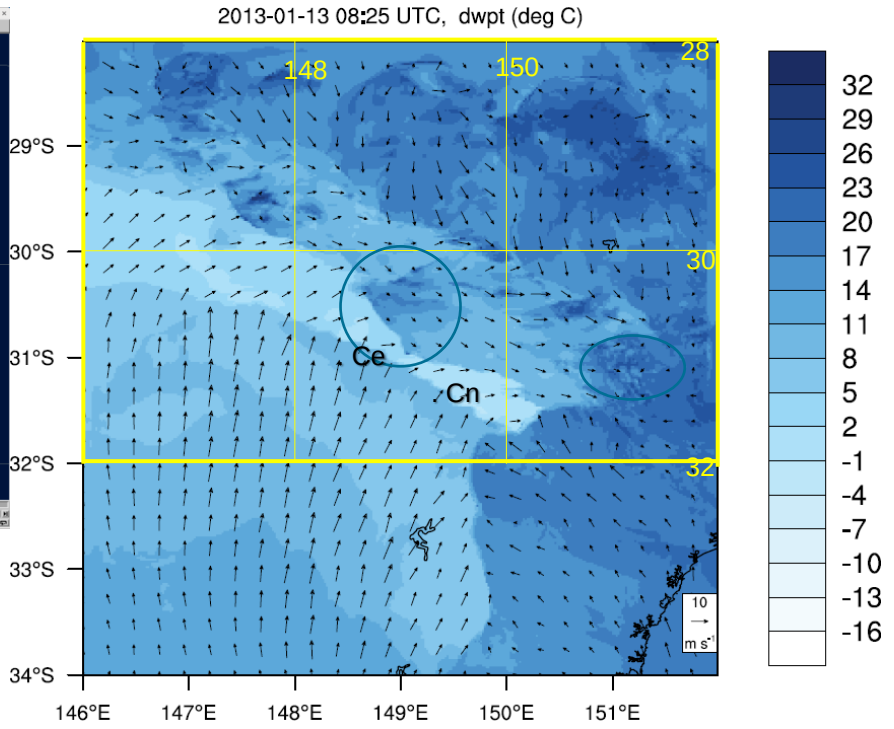




20130113 0814 UTC

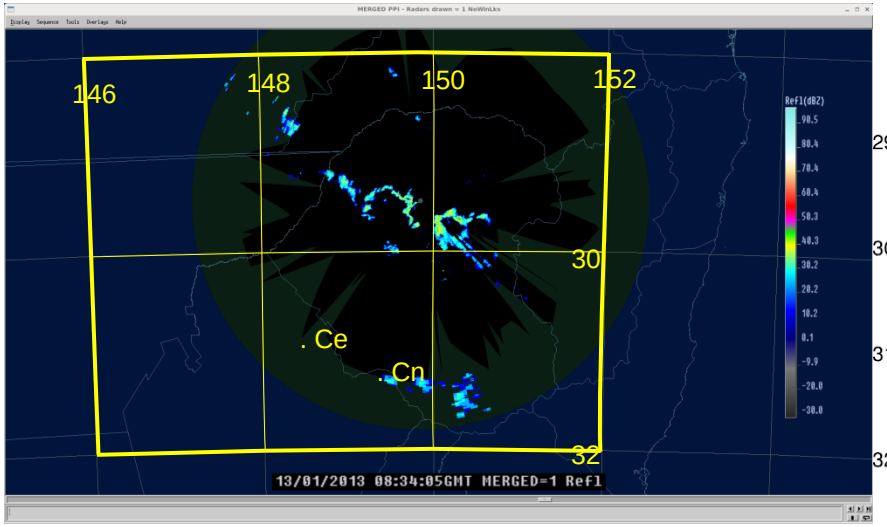
Radar comparison: 1924 EDT

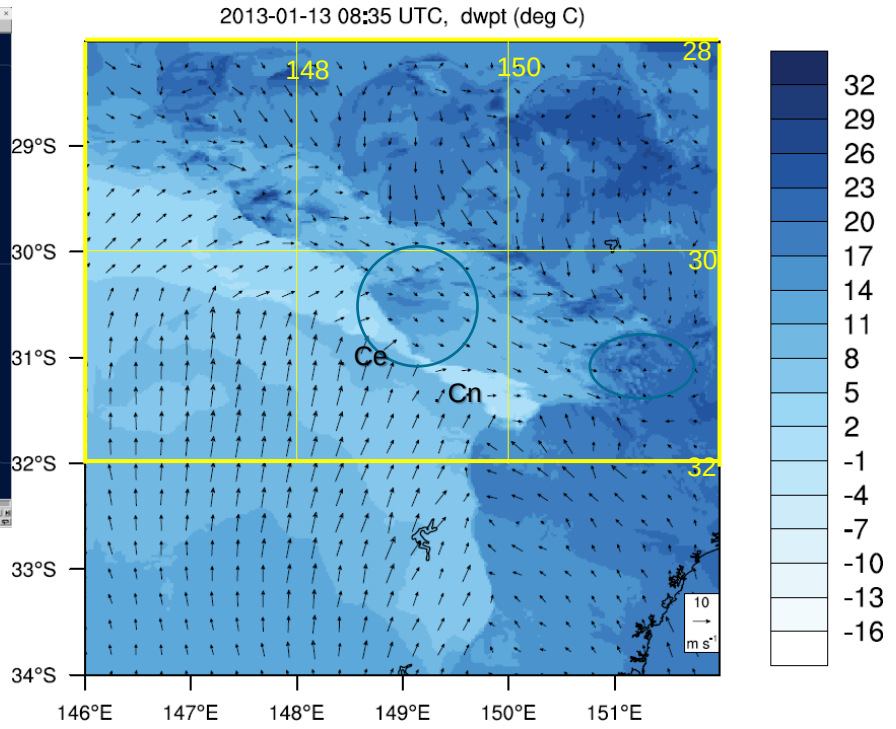




20130113 0824 UTC

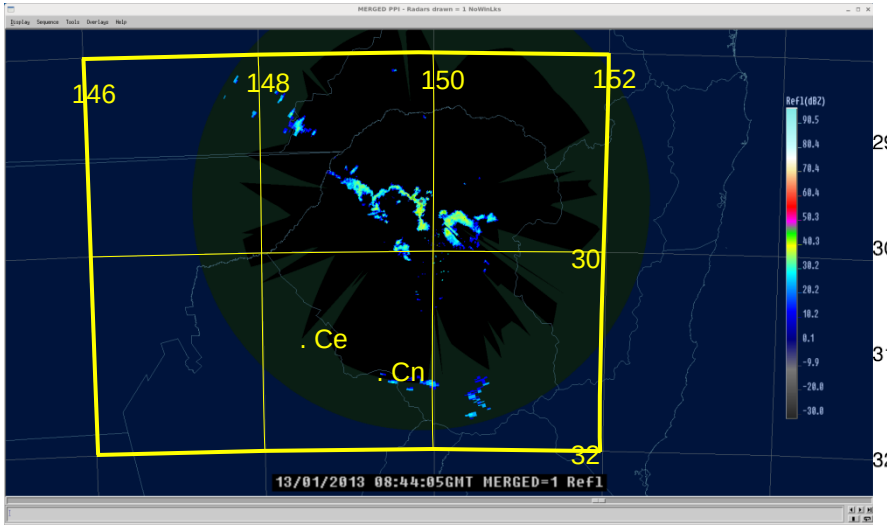
Radar comparison: 1934 EDT

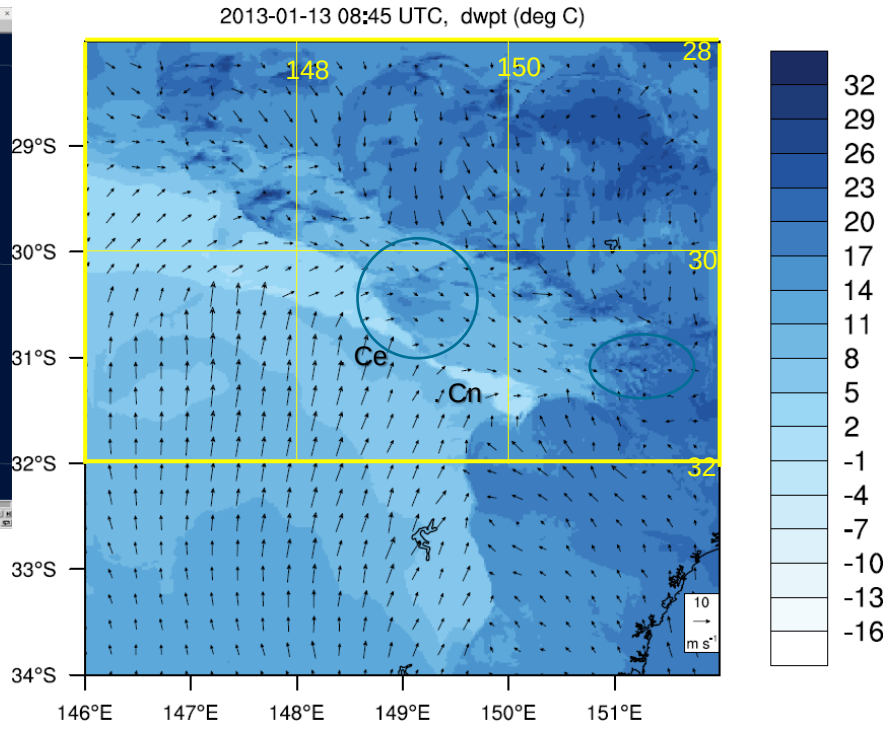




20130113 0834 UTC

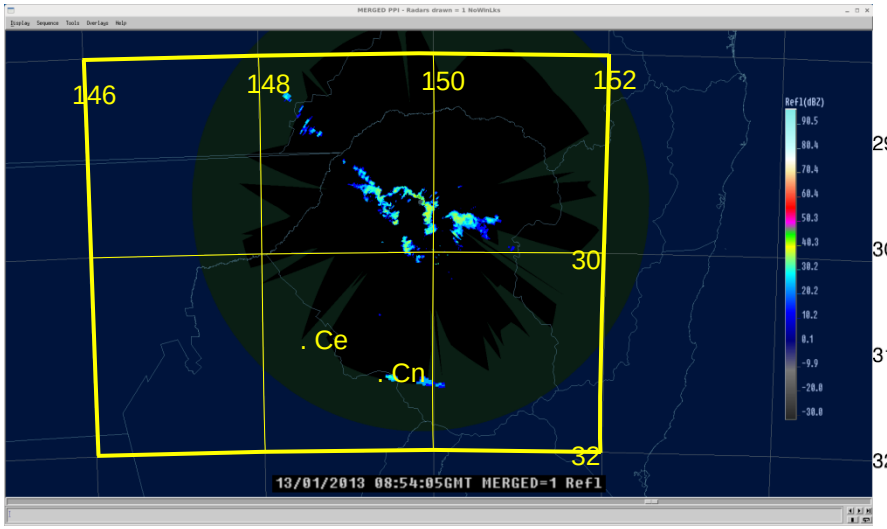
Radar comparison: 1944 EDT

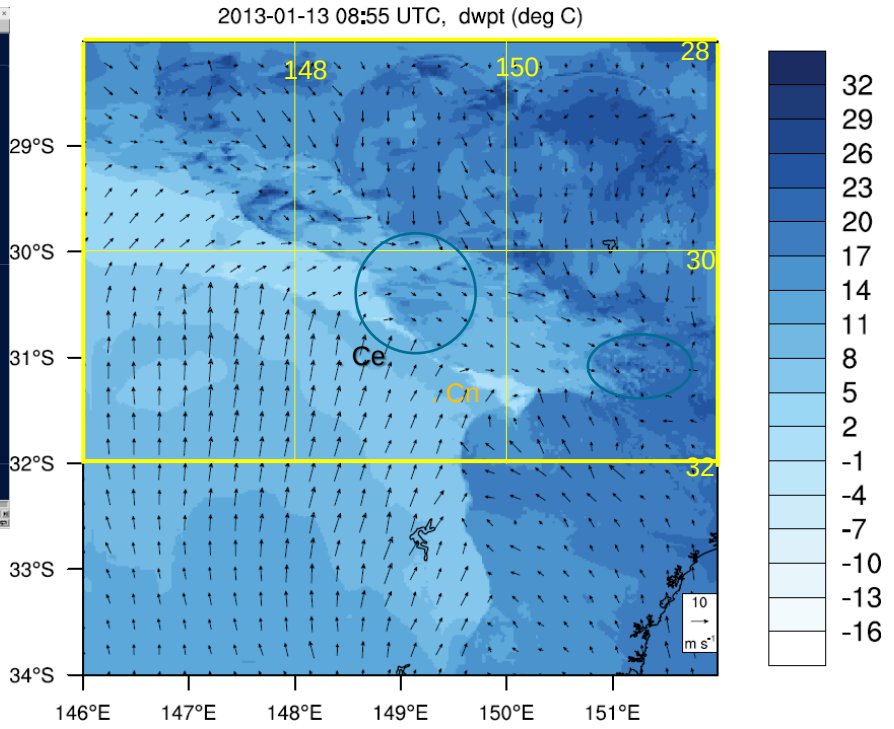




20130113 0844 UTC

Radar comparison: 1954 EDT

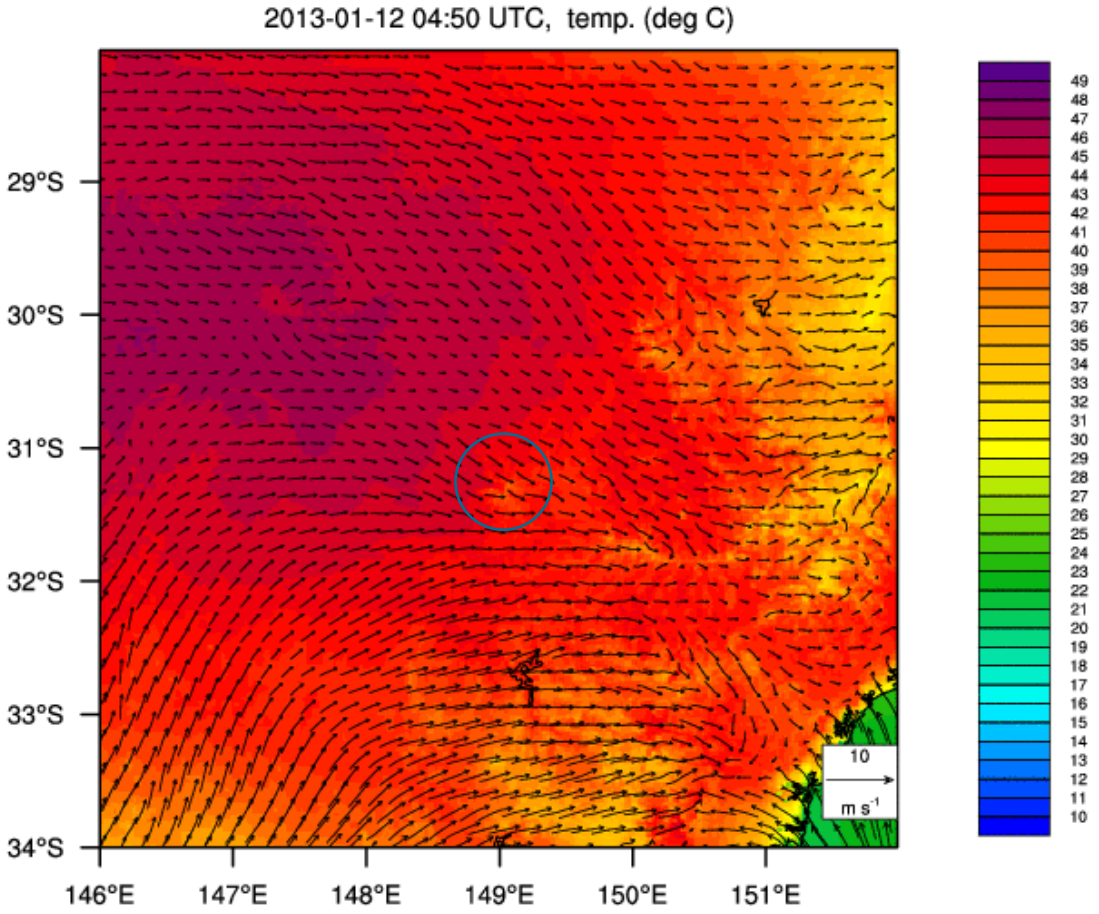




20130113 0854 UTC

What does the model show?

- Screen temperature + wind lines animation
- 0.012° model
- Circle → Warrumbungle NP
- Notable features
  - Wind curvature around trough line
  - Convective outflows
  - Incursions of maritime air
  - Colliding change lines
  - Main change with cold-front characteristics
  - Pooling of cold air in valleys



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CSIRO

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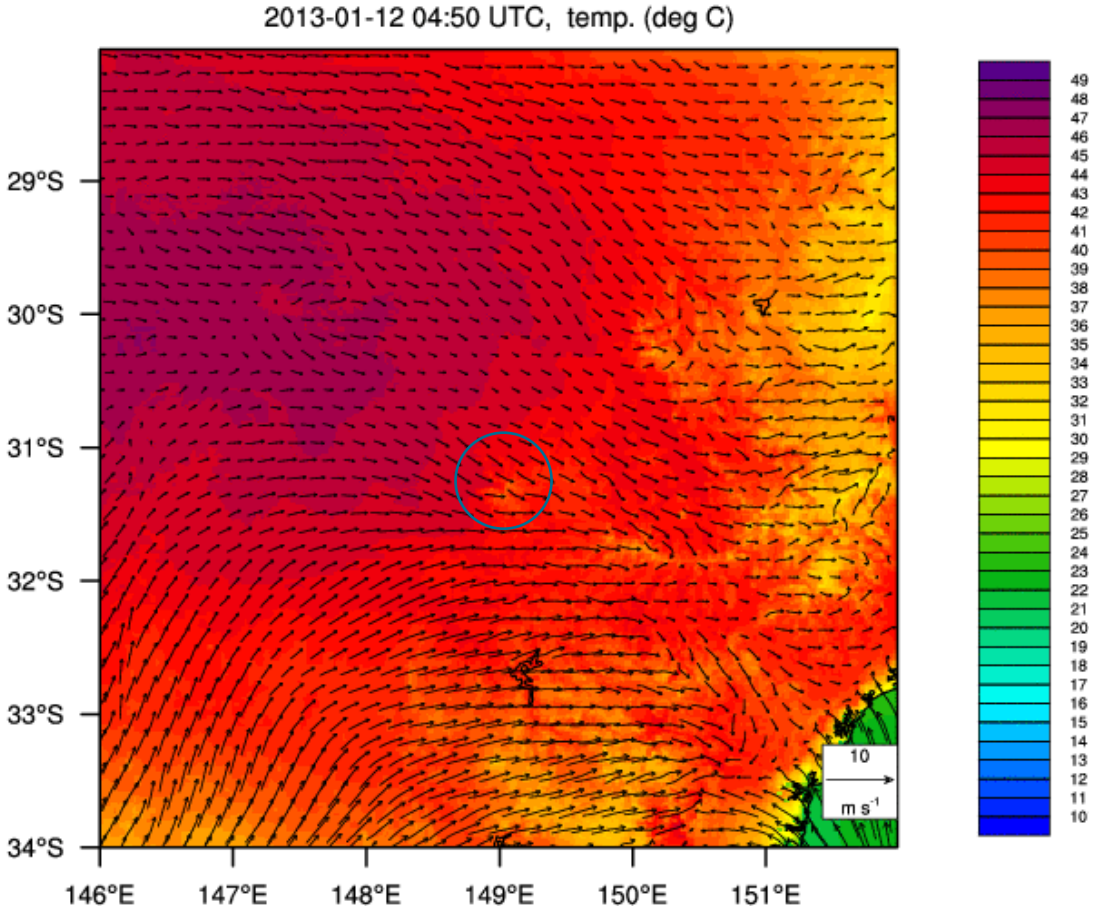

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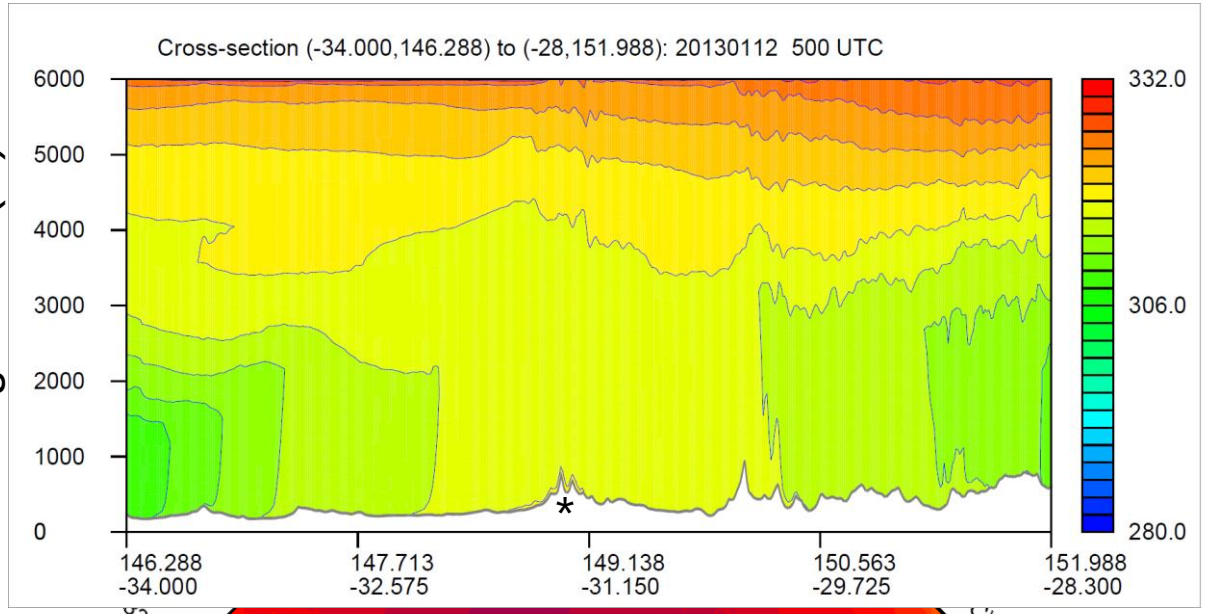
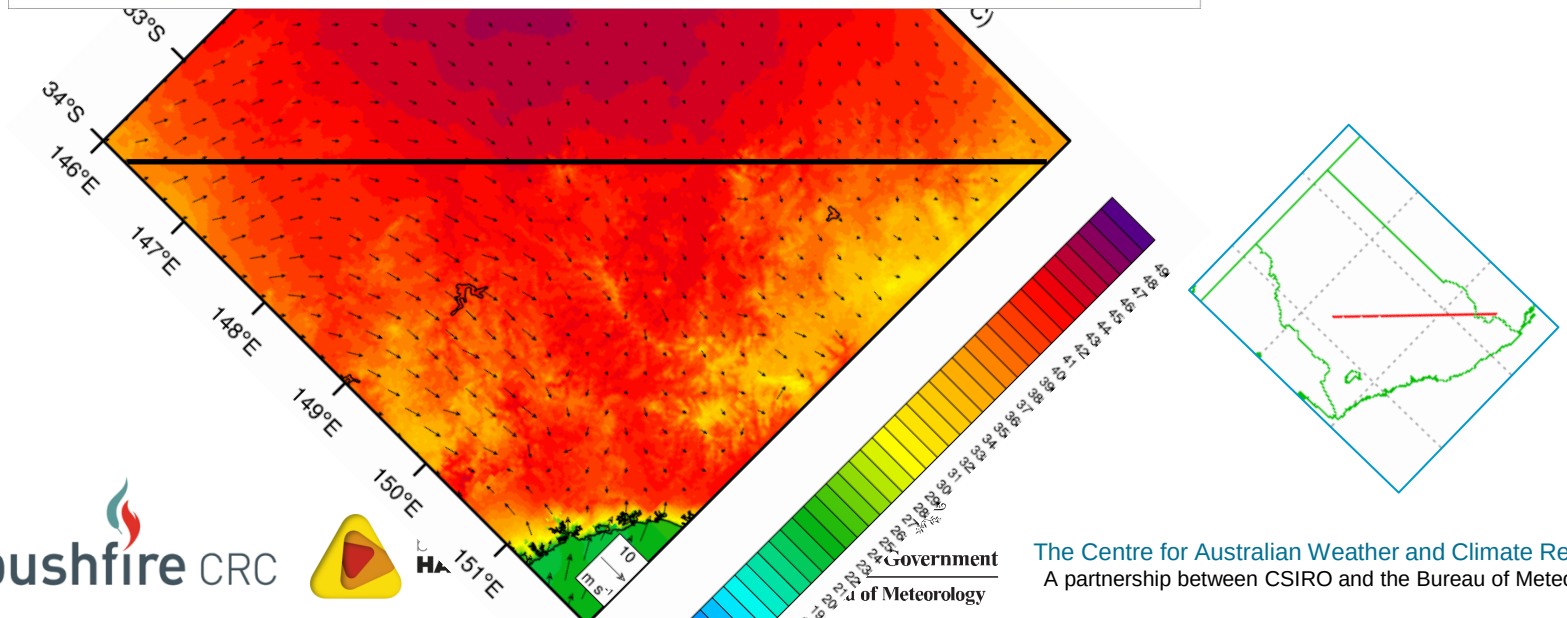
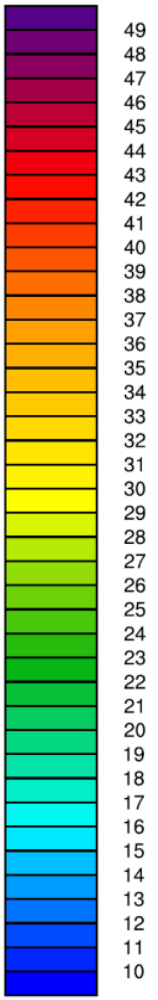
What does the model show?



1600 EDT 12 January

- Fire starts
- Well-mixed boundary layer to about 4000 m
- Hot conditions
- Cooler air masses to SW and NE





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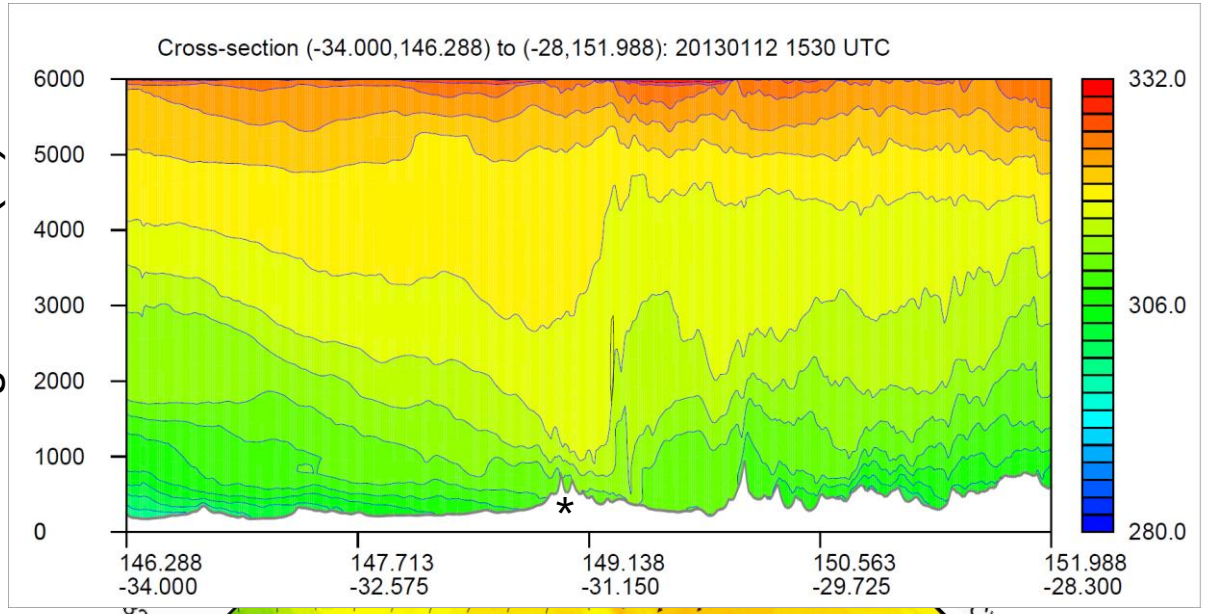
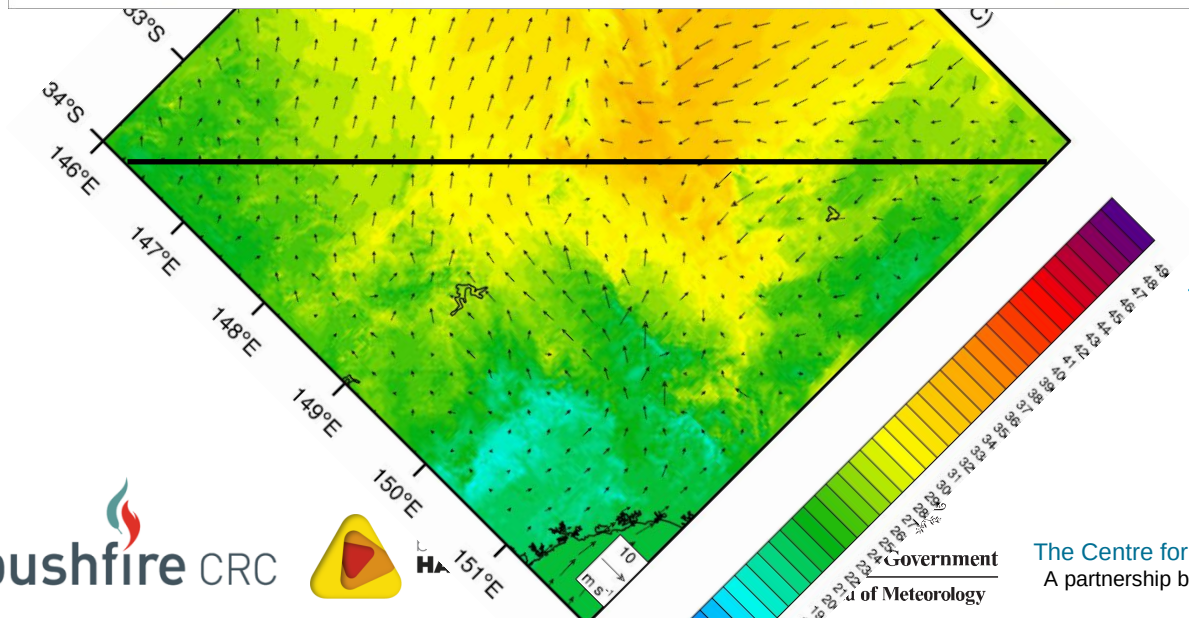
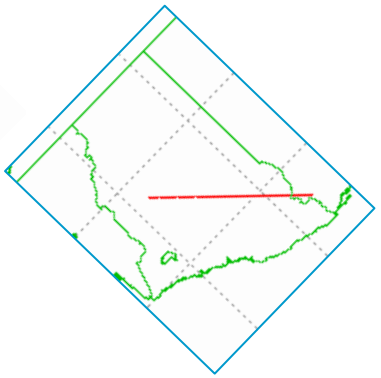
What does the model show?

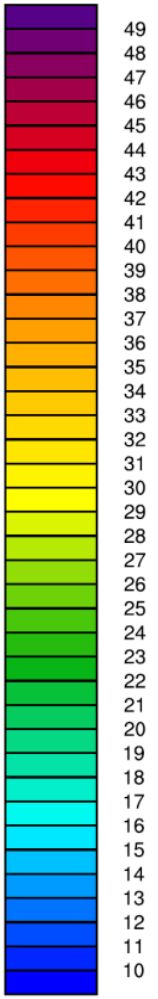


0230 EDT 13 January

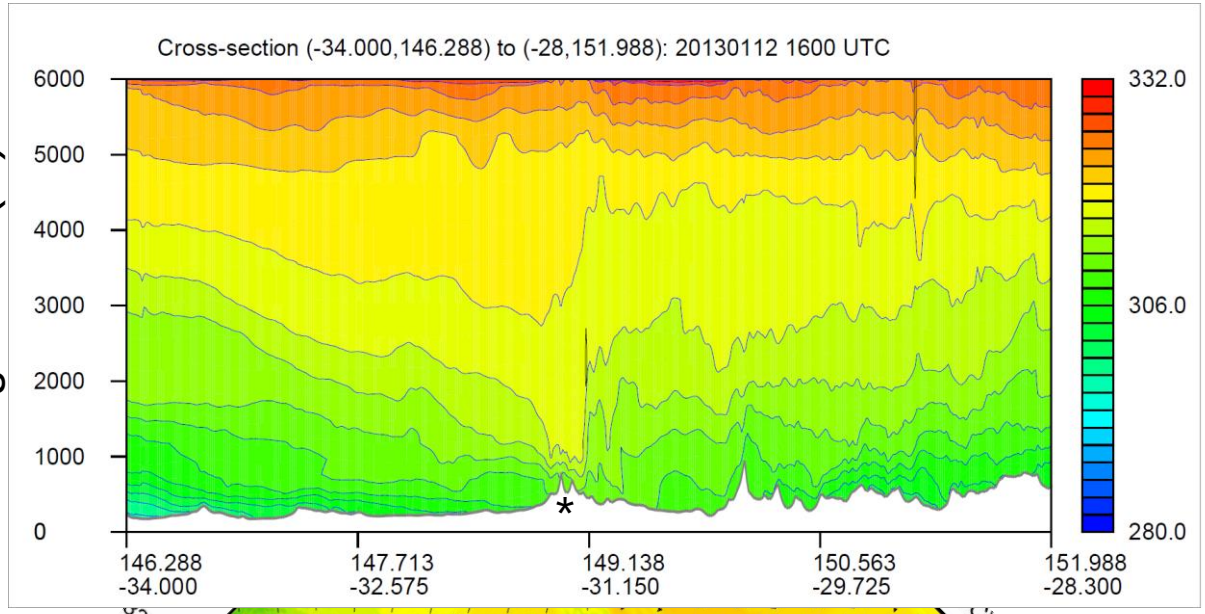
- Weak mountain waves over WNP
- Bore from NE





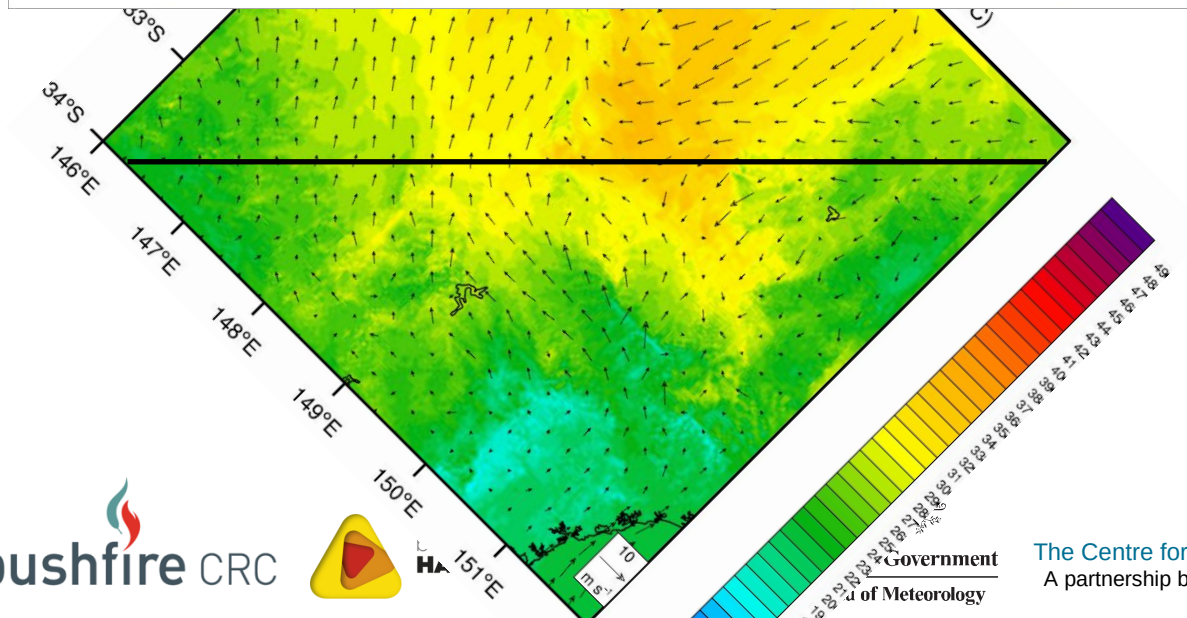


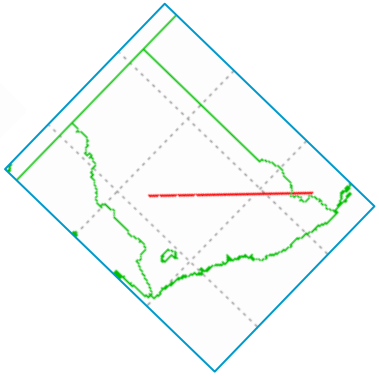
What does the model show?

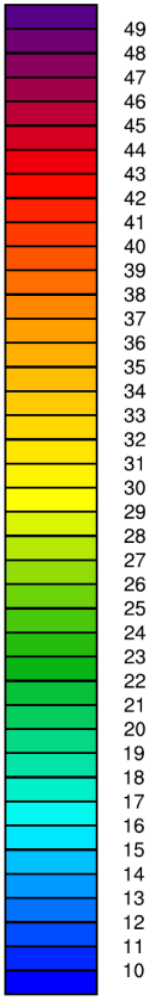


0300 EDT 13 January

- Weak mountain waves over WNP
- Bore from NE







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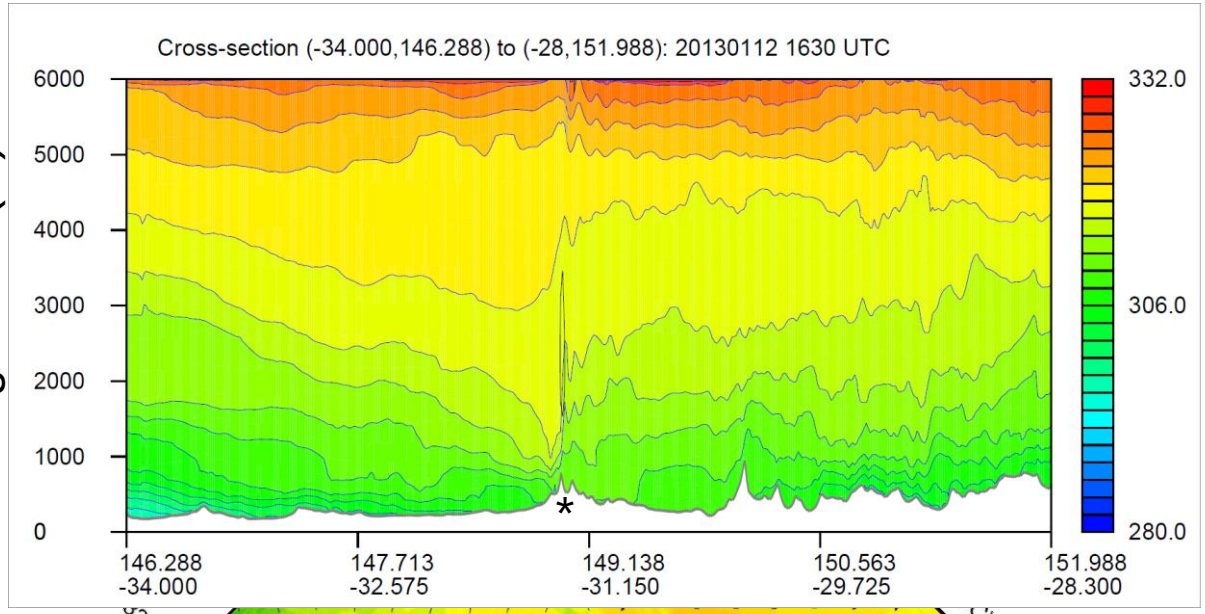

0330 EDT 13 January

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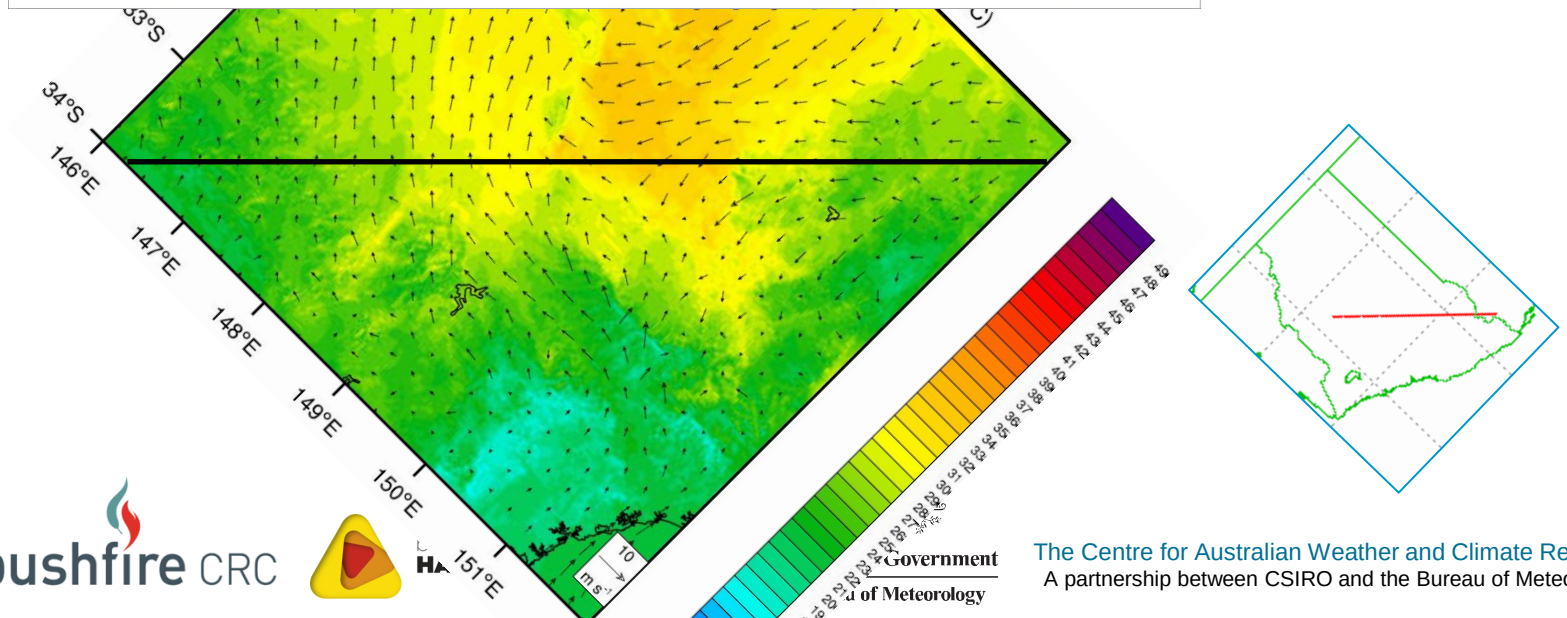

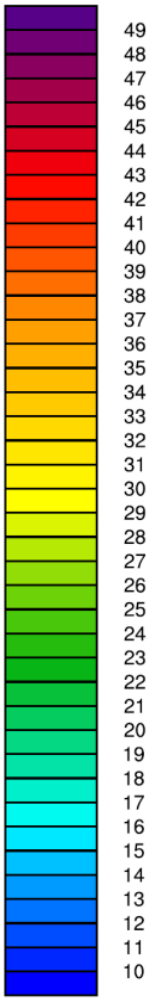

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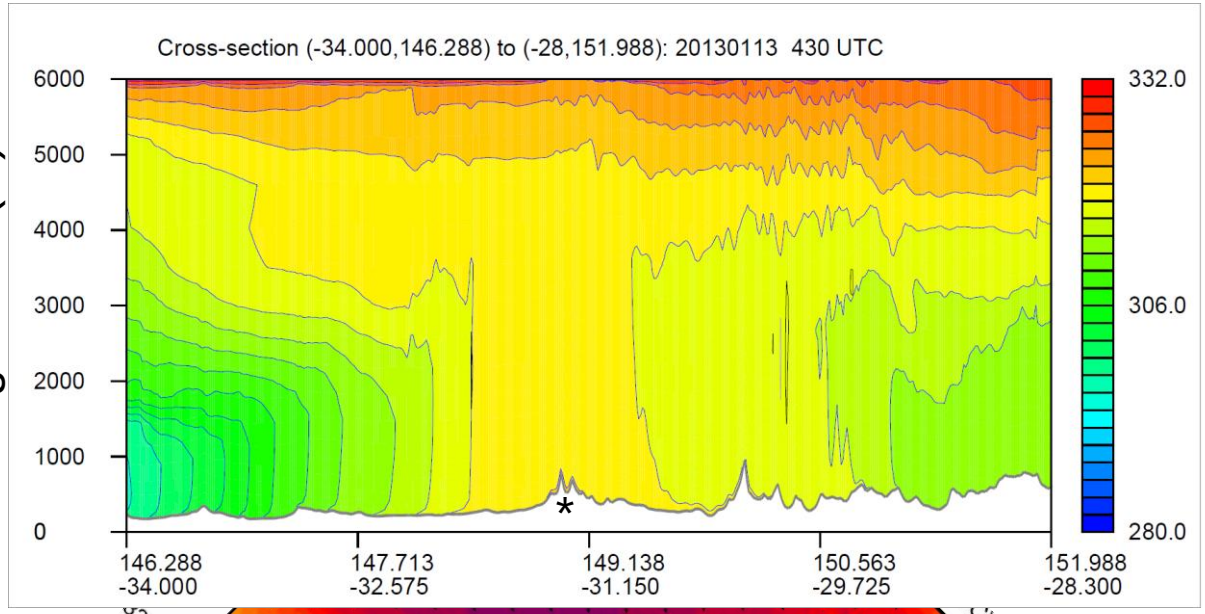
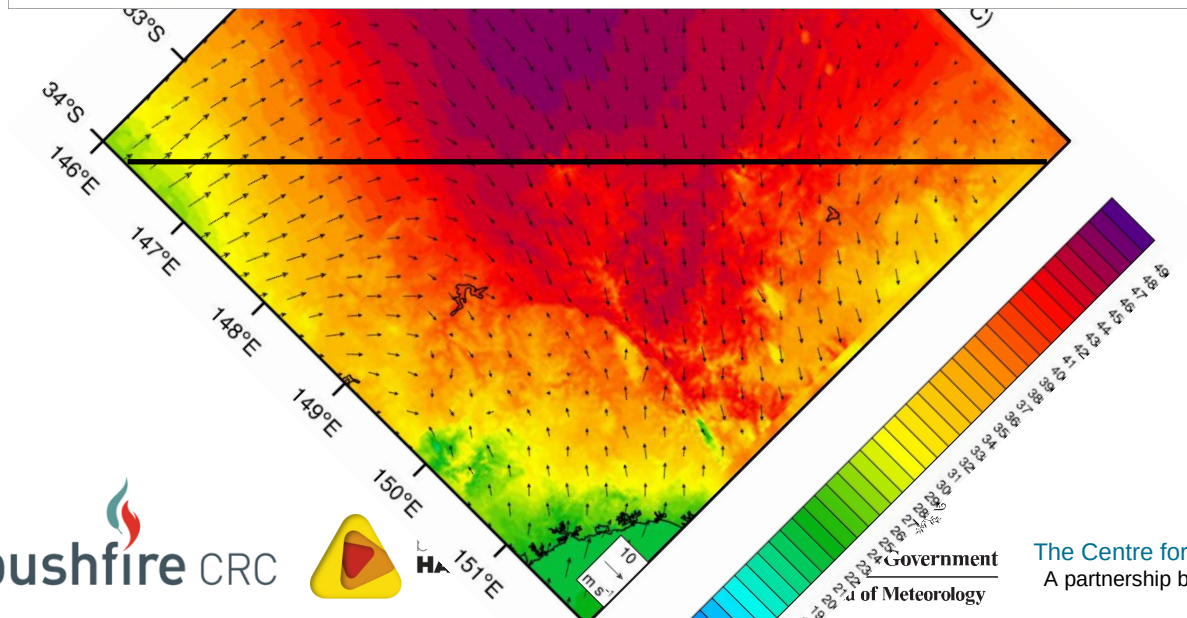
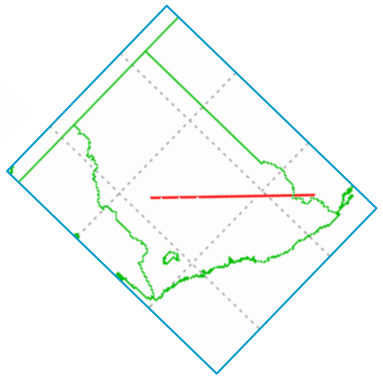
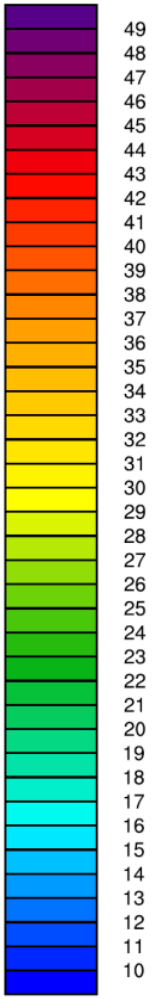


1530 EDT 13 January

- Well-mixed boundary layer to 5000 metres
- Hot W to NW winds
- Cooler air to SW and NE







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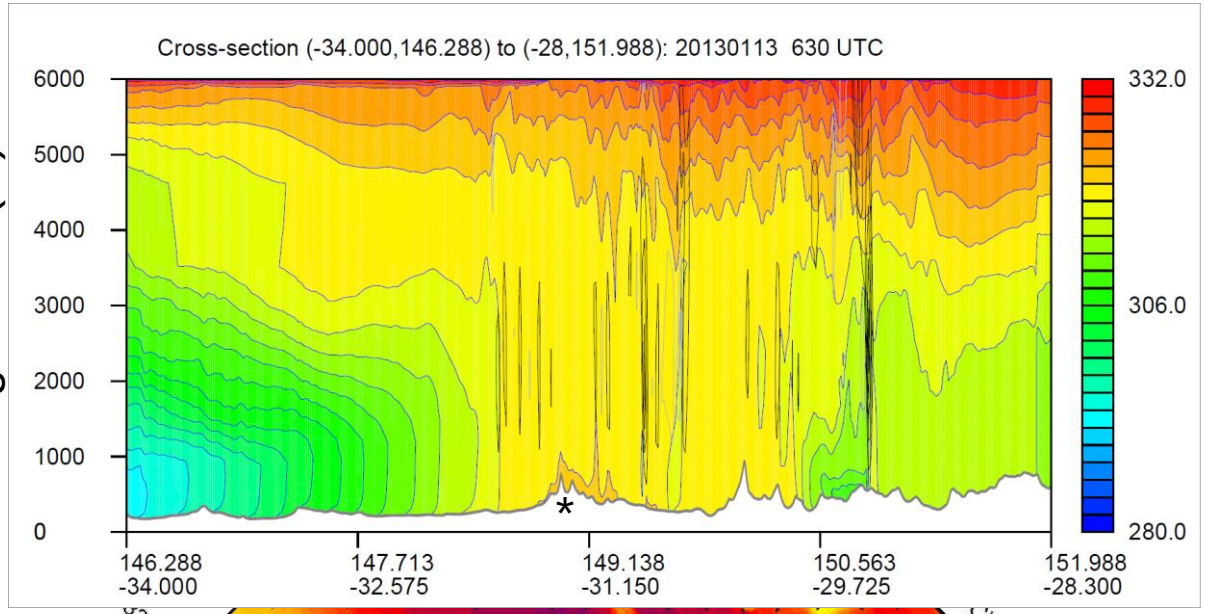
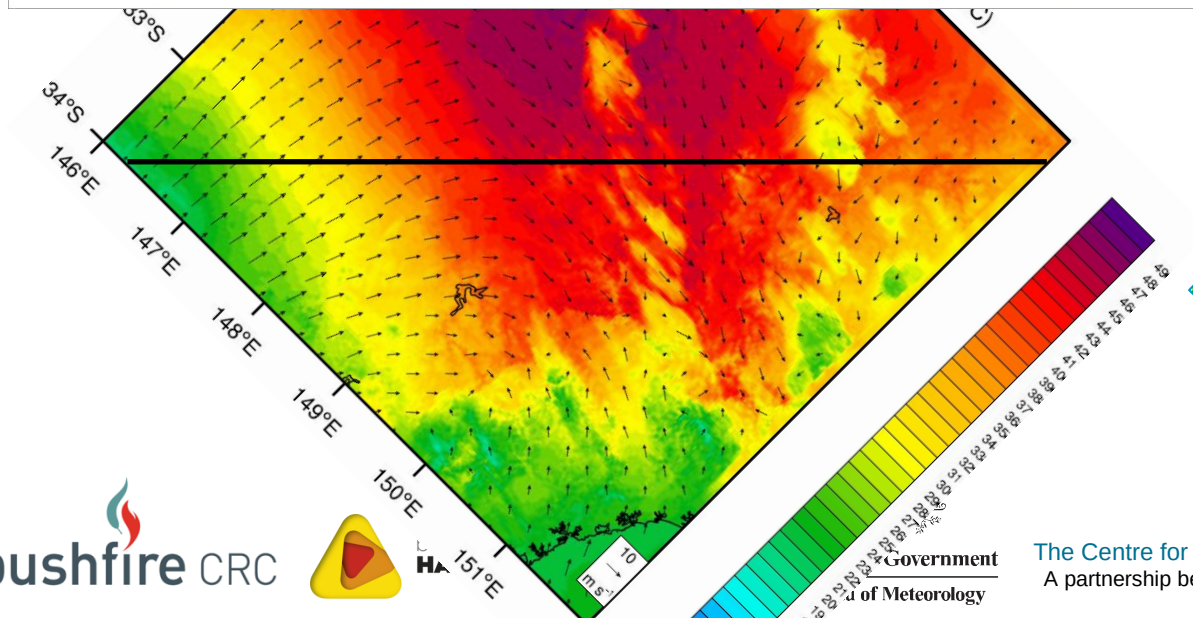
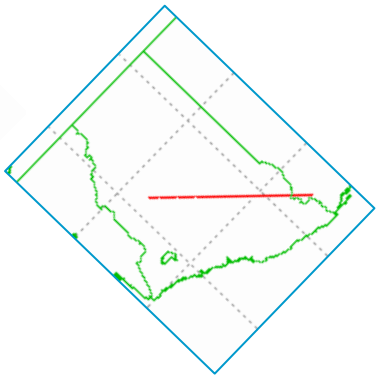
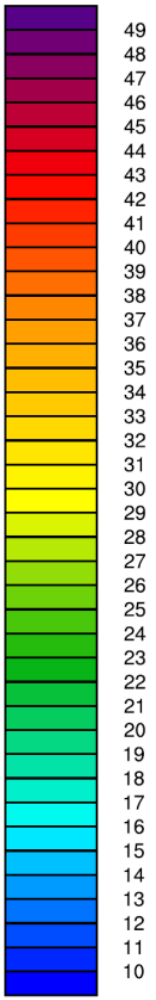




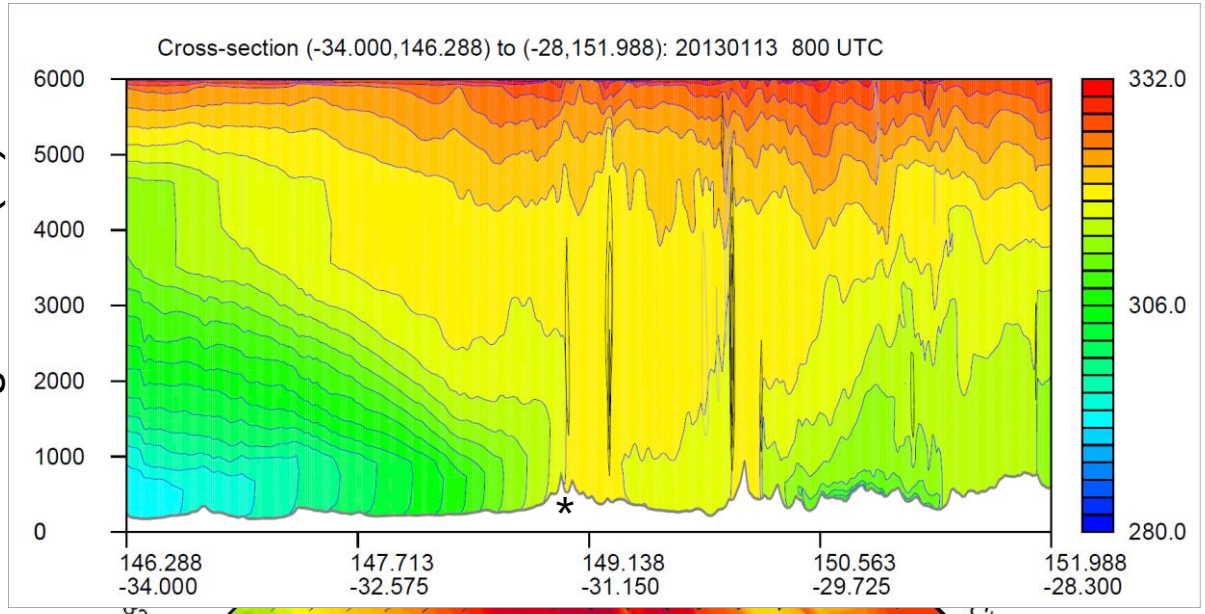


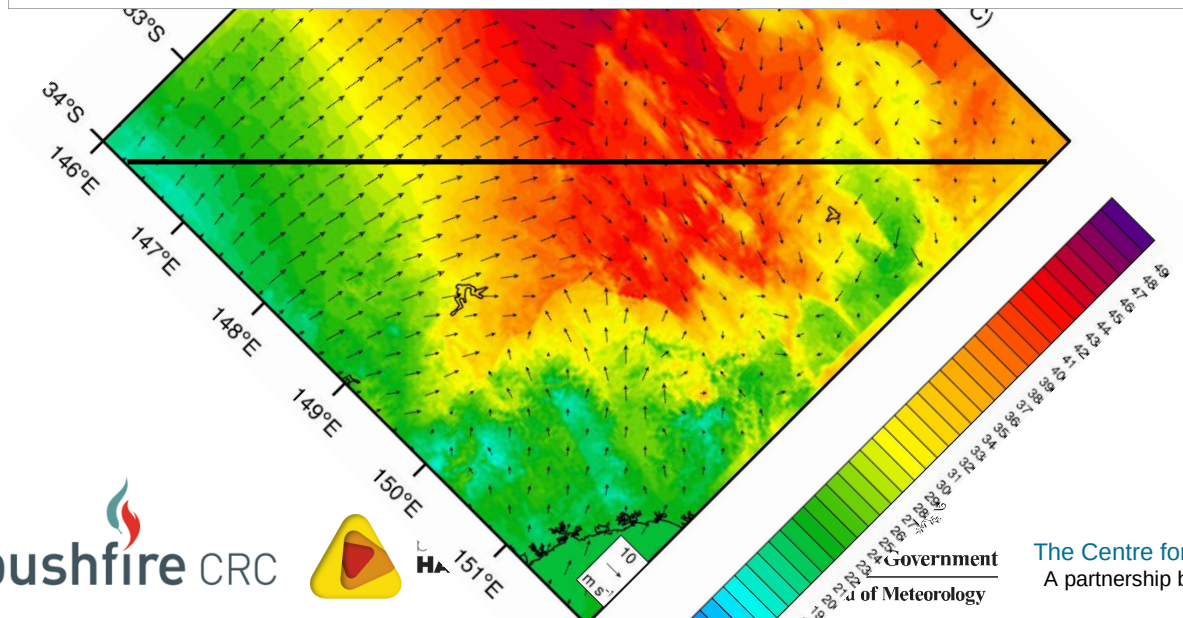
1730 EDT 13 January

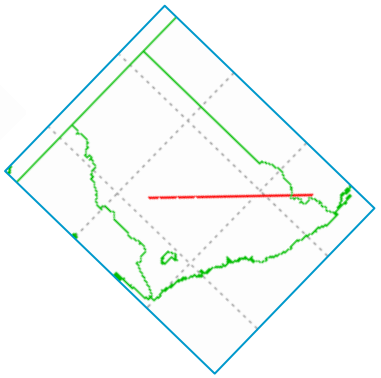
- Suggestions of boundary-layer rolls ahead of main change
- Increased wind-direction variability at the surface

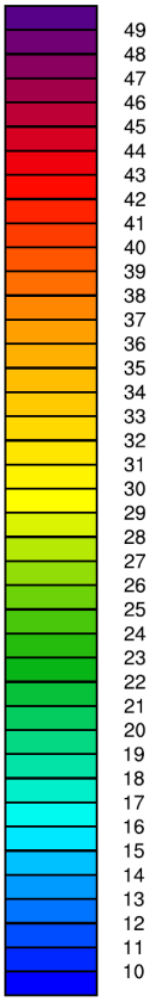


What does the model show?









1900 EDT 13 January

- The main change arrives at the WNP
- Incursion of cooler maritime air to the SE of the WNP

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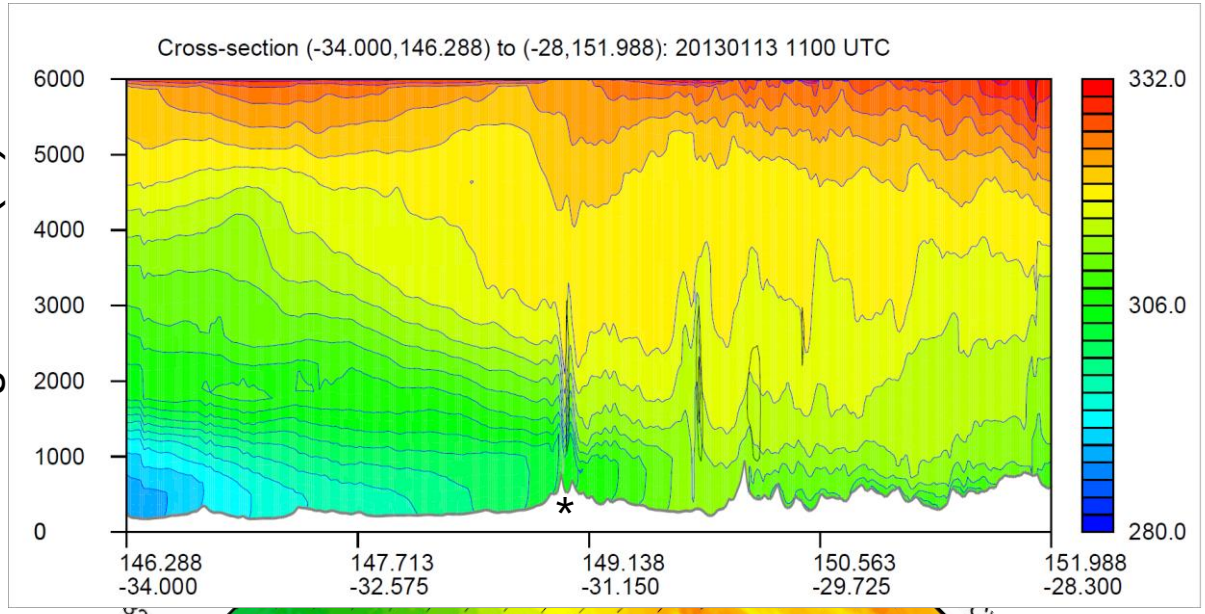
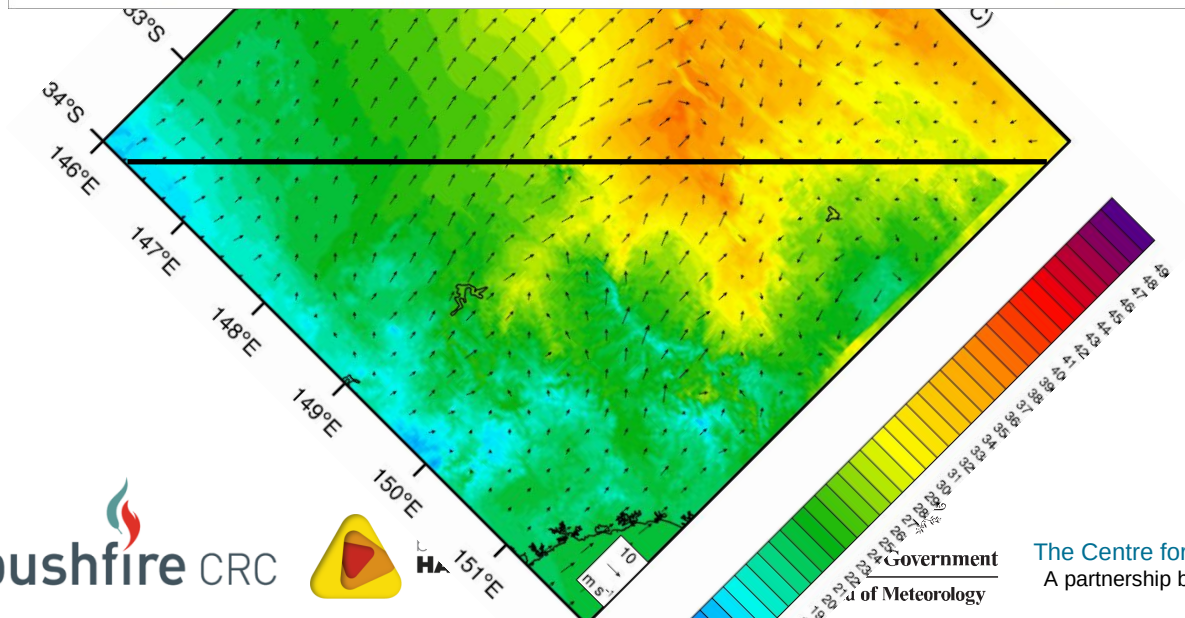
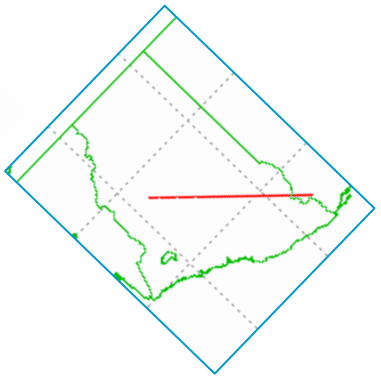
What does the model show?

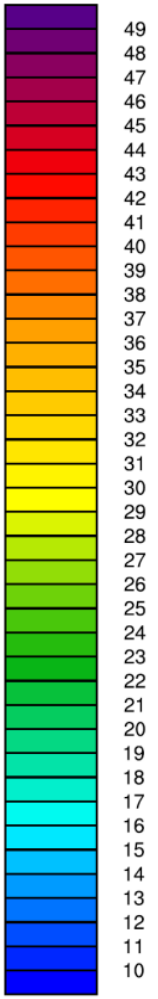


2200 EDT 13 January

- Strong mountain-wave activity over WNP
- Could result in strong winds and increased gustiness at surface

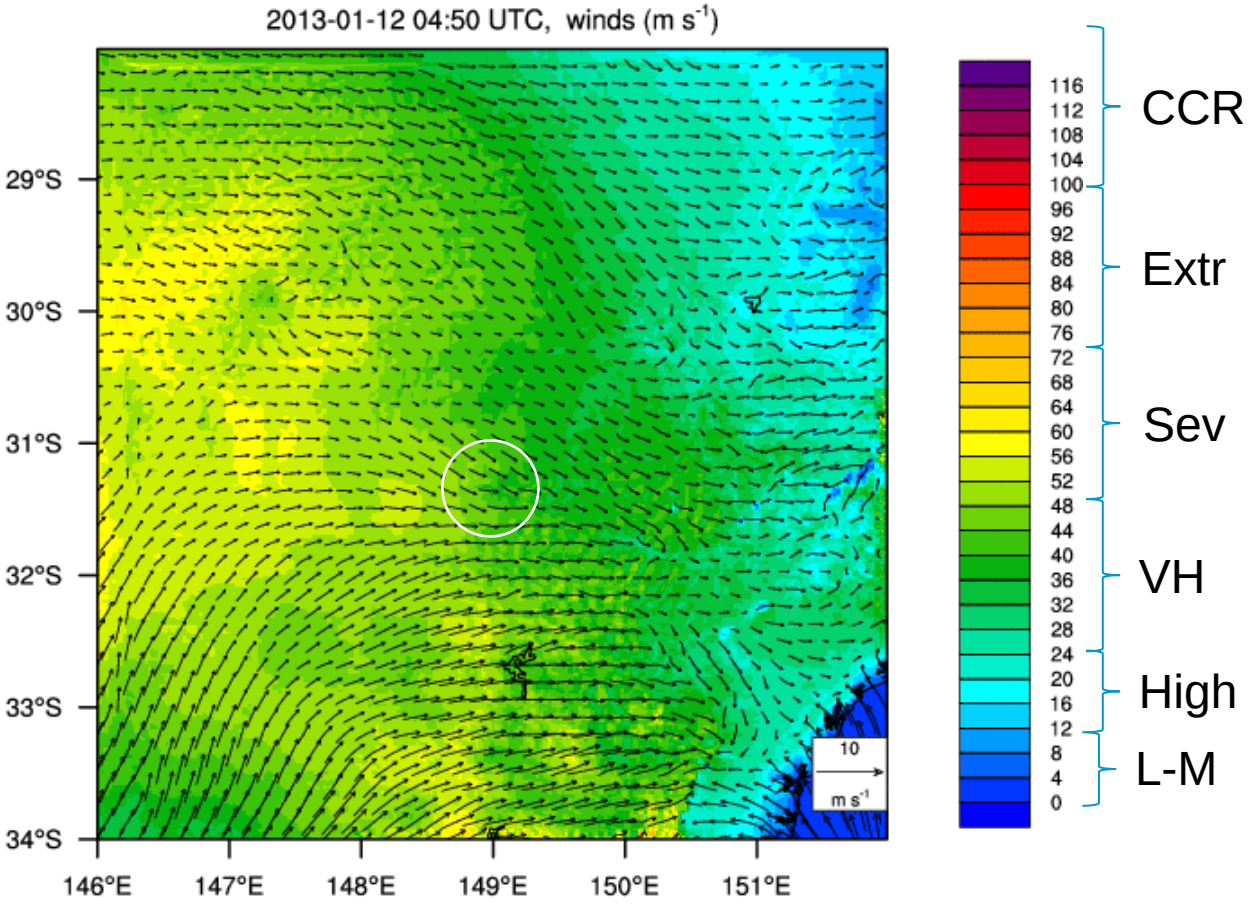






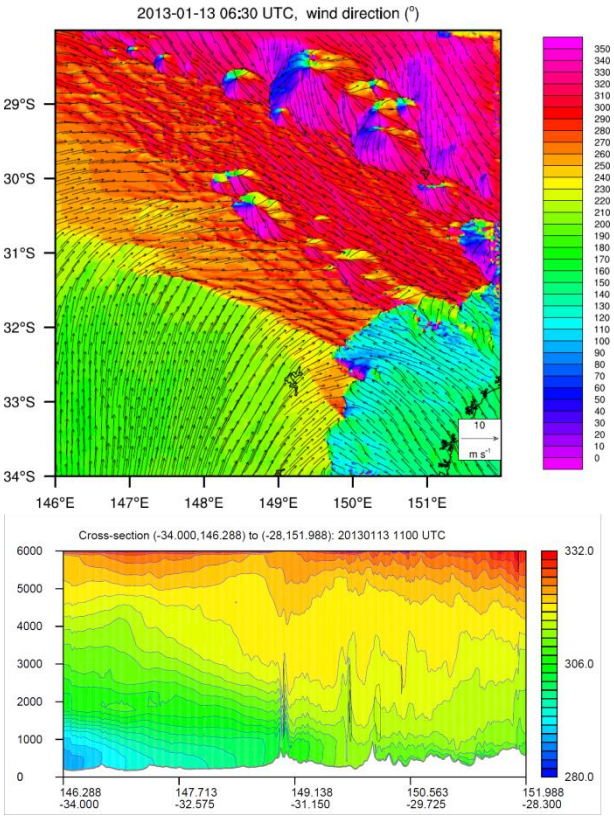
What does the model show

- Notional instantaneous FFDI Mark V calculation assuming DF = 10
- 0.012° model
- *Severe* to *Extreme* values widespread
- *Catastrophic* values on the main change
- *Extreme* values around Warrumbungle NP



Summary

- Meteorology of the Coonabarabran fire 13 Jan 2013 modelled
- Meteorological situation across NSW is very complicated
- Many air-mass boundaries and wind changes
- Mountain wave activity overnight could have impacted the fire



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