

## *Impact of Diurnal Variation of Plume Height on Smoke Dispersion Forecasts*

Photo P. Venz, ODPI Forestry, Beerburrum

**Alan Wain**

Bureau of Meteorology Research Centre,  
Melbourne

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## Introduction

Work forms part of CRC Program B2.1

-Smoke Management

- Diurnal variation of plume height
  - background - why change?
  - case studies – effects of change
- Other developments in progress

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## Background:

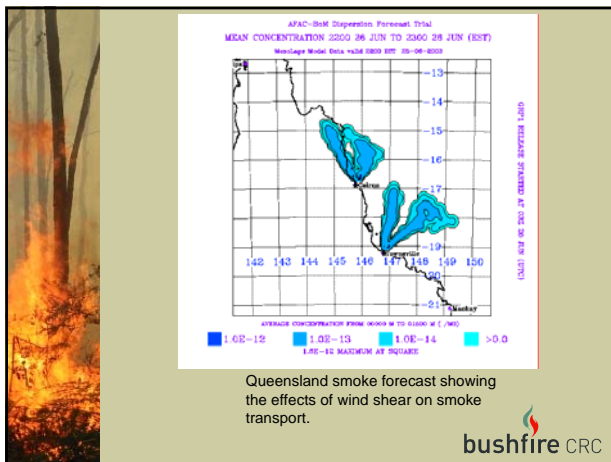
- Current Smoke Dispersion Forecasts use a fixed height smoke column for the duration of the forecast.
- Fires and the atmosphere are both dynamic systems
- Specifying the right plume height over the life of the smoke forecast will ensure that smoke transport is calculated using the correct winds.
- Use a dynamic method of plume height specification

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## Dynamics affecting Smoke Plumes

- Wind speed and direction change with increasing height as surface effects lessen.
- This is called wind shear.

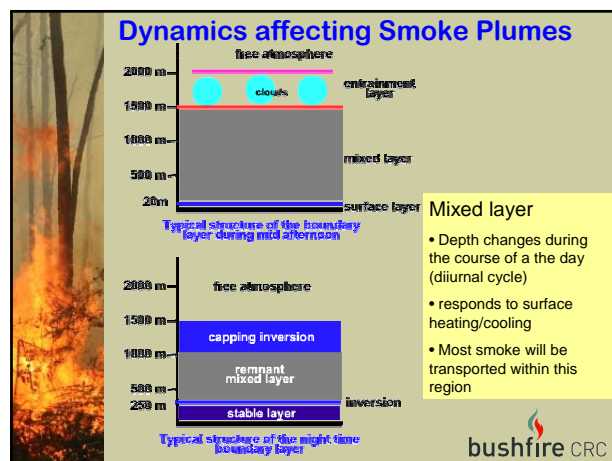
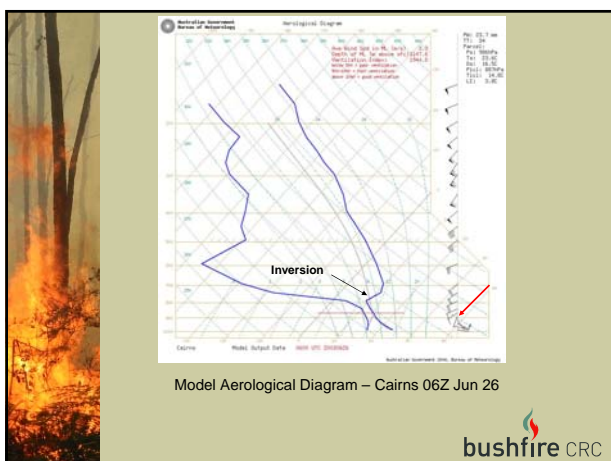
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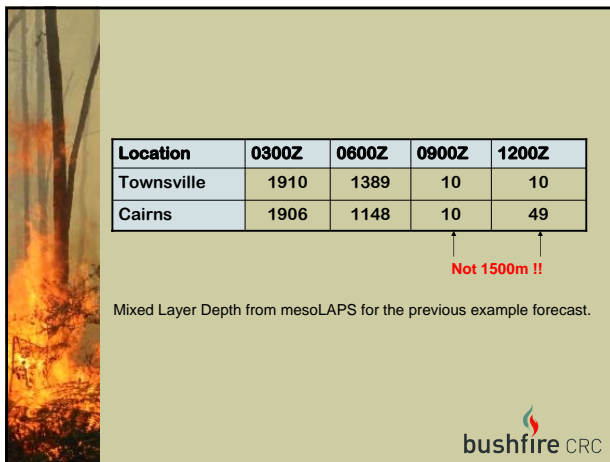


	0300Z	0600Z	0900Z	1200Z
Surface	191.7	194.1	190.0	205.7
900 hPa (~900m)	199.0	201.0	192.8	189.2
850 hPa (~1400m)	209.9	207.1	193.8	184.9
800 hPa (~1900m)	229.4	220.0	208.0	198.0
Shear (800-surf)	37.7	25.9	18.0	7.7

Profile of Wind Direction from mesoLAPS model - Townsville

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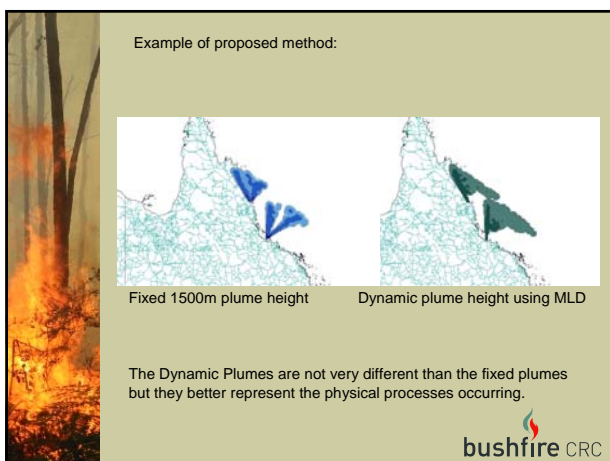


- Smoke does not often rise above the mixed layer so the varying MLD could be used a surrogate for varying plume height.

**Method:**

- Calculate MLD at beginning of forecast
- Run forecast for short period (3 hrs)
- Dump smoke concentration field to file for use in next forecast.
- Recalculate MLD, ingest saved concentrations
- repeat as required.

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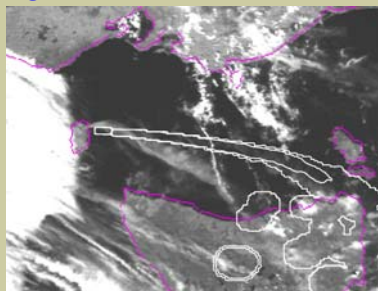


**Verification:**

Fixed height forecast  
vs  
Dynamic MLD method

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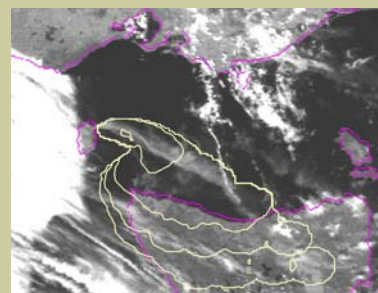
## Case 1. King Island-0330Z



Outline of normal smoke forecast superimposed on GMS satellite image – 0330Z.  
Forecast begins >15 hours earlier (1200Z Jan 10)

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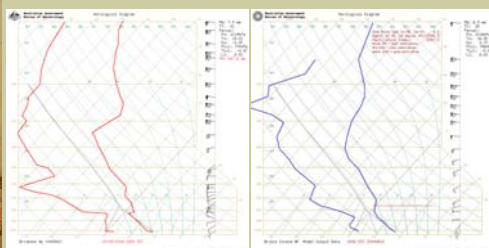
The new Improved Version!



Same satellite image (0330Z) but forecast has dynamic plume height (updated every 3 hours).  
Plume has spread over greater area but forecasts eastern edge of observed plume quite well.

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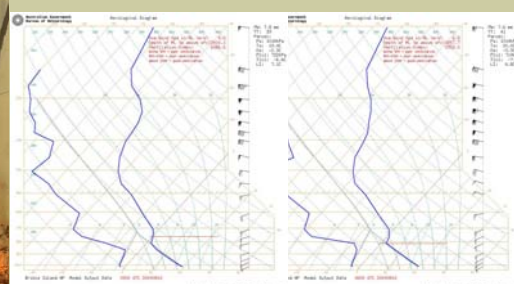
## Case 2. Bribe Island



Brisbane Airport  
balloon sounding

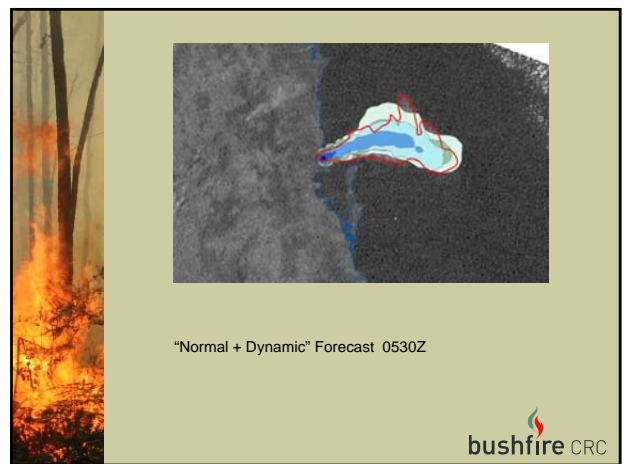
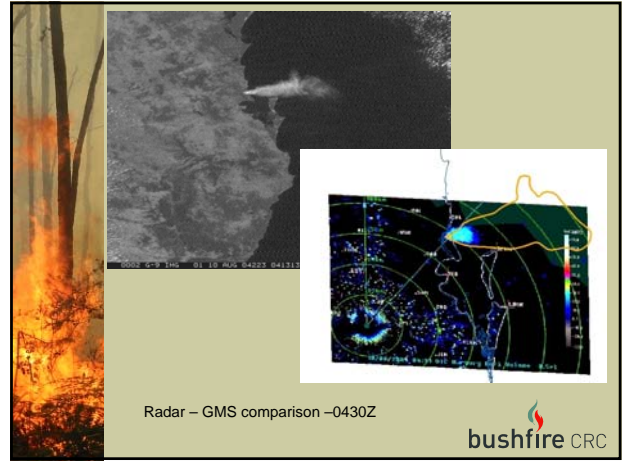
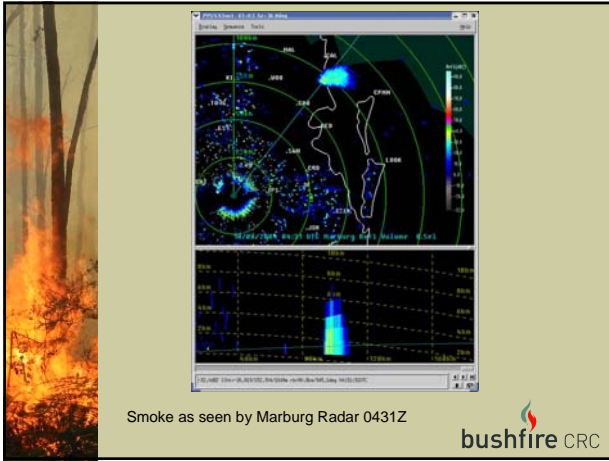
Bribe Island  
model sounding

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Model soundings 0300Z and 0600Z

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### Dynamic Plume Height forecasts


- *Still a work in progress (more verification needed)*
- *Encouraging results so far*
- *Can extend for multiple days incorporating new mesoLAPS runs*
- *Interim solution pending development of plume rise model.*





### Future Developments:


- **Pre-existing smoke**




Satellite Image showing widespread smoke

Hysplit forecast made for the same time


Allowing particles a 24 hour lifetime gives a more realistic smoke distribution




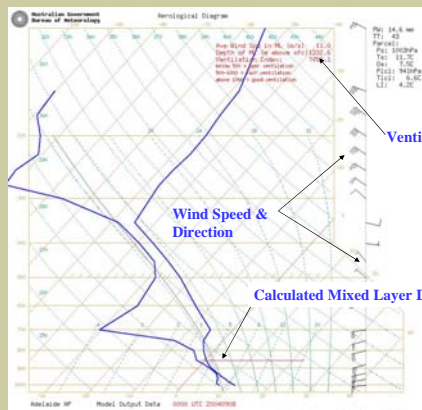


### •Model Aerological diagrams (f160)

- Show vertical structure as seen by mesoLAPS
- Show changes over time (3hrly)
- Calculate Ventilation Index
- Available for all Smoke Fx locations







Ventilation Index

Wind Speed & Direction

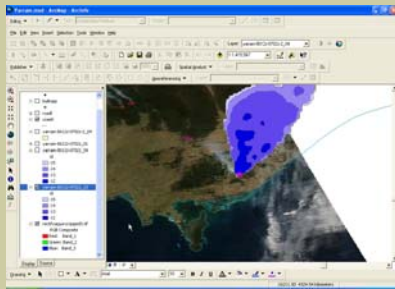
Calculated Mixed Layer Depth

Model Profile for Adelaide AP



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## Ongoing Verification



A not so good forecast!

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## Improvements to Displays

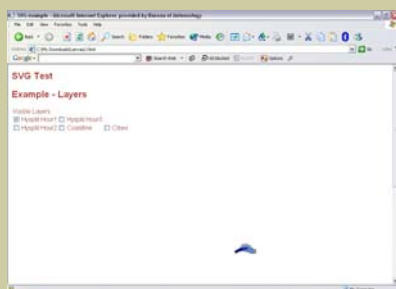


ArcGIS

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## Scaleable Vector Graphics (SVG)

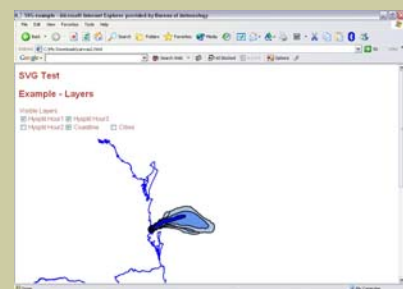
- Zoom & Pan in web browser
- Click layers on/off




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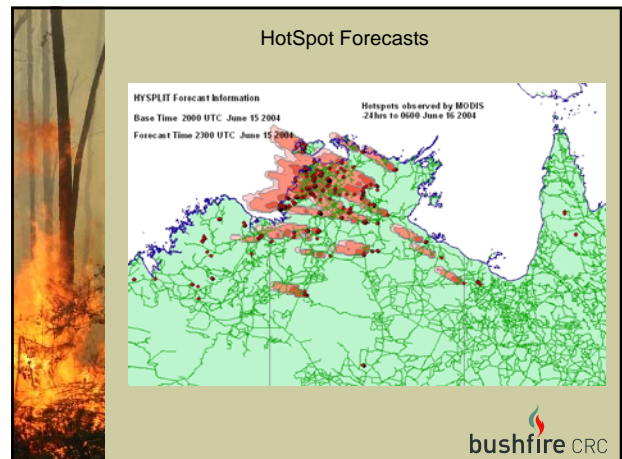

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**Multi level output**

- Concentrations currently averaged
- Most interest in lower levels
- Display each layer in concentration grid separately?

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**•Finer grid meteorological data**

- Currently mesoLAPS
  - ~12.5km Australia wide with 29 vertical levels
- New model
  - 10 km grid with 50 vertical levels
  - 5 km subgrid over major population areas
- Better resolution of small scale features
- Implementation 2005-06

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**THE END**

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