



The Bushfire Convective Plume Experiment

Mobile Radar Observation of Pyro-convection
from the Mt Bolton Bushfire, Victoria 2016

Nicholas McCarthy

The Problem of Vertical Velocity

Vertical velocity makes wildland fire a complex 3D problem

1. Updrafts
2. Downdrafts
3. Spotting



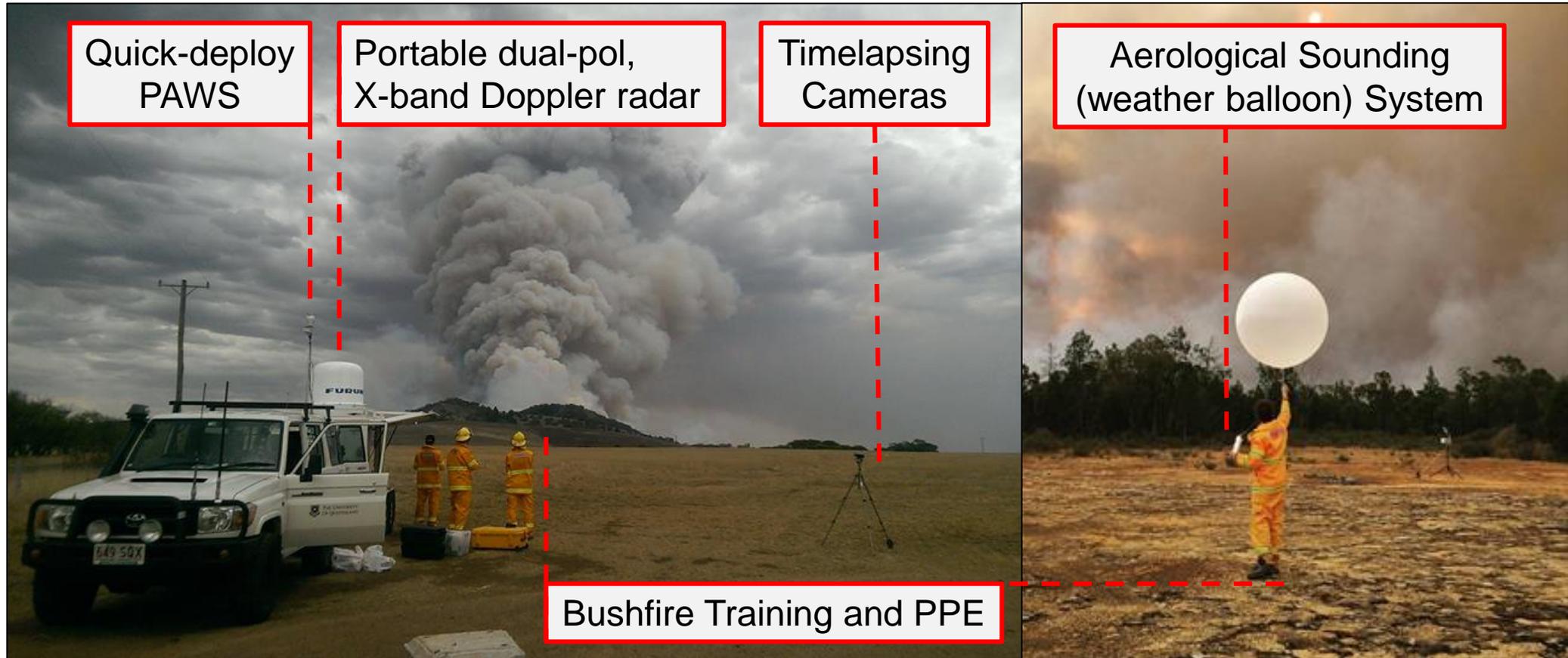
The diagnostic ability of dual-polarised Doppler X-band radar in a bushfire context: The Mt Bolton Bushfire

Convection and Bushfires



Source: Newsflare

The toolkit



Deployment Strategy

- **Domain:**
 - Central and Southern QLD
 - NSW (excluding western districts)
 - Victoria
- **Drought conditions** predicate districts of focus

Wildfire Strategy:

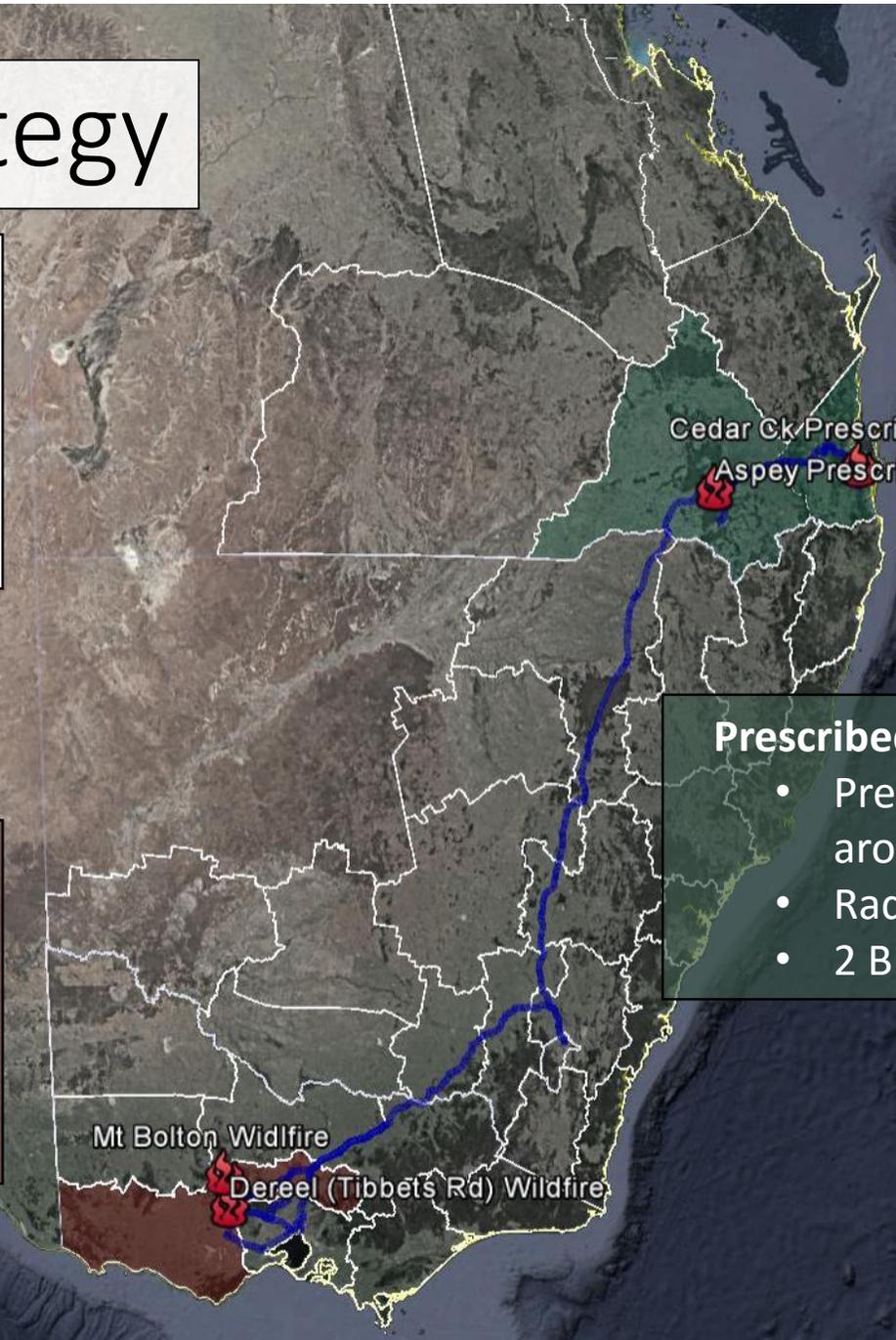
- Pre-deployment to Fire Weather District when FFDI exceeds 50
- Safe deployment to ~ 7km upwind of fire heel
- 2 Fires to date (Vic)

Prescribed Burning Strategy:

- Pre-deployment of equipment around perimeter
- Radar at vantage point
- 2 Burns to date (QLD)

Legend

- Incident Deployments
- Travel with Radar



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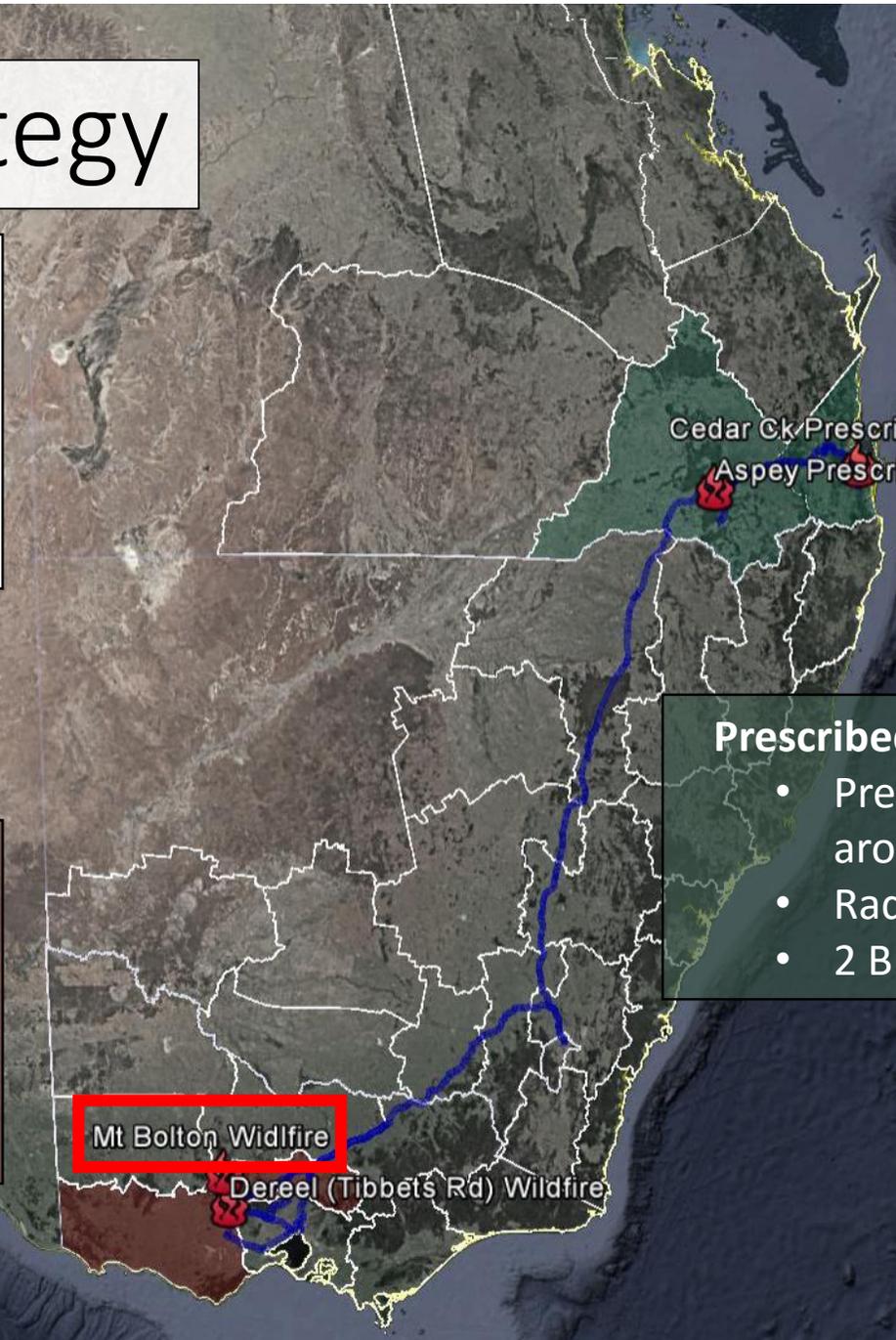
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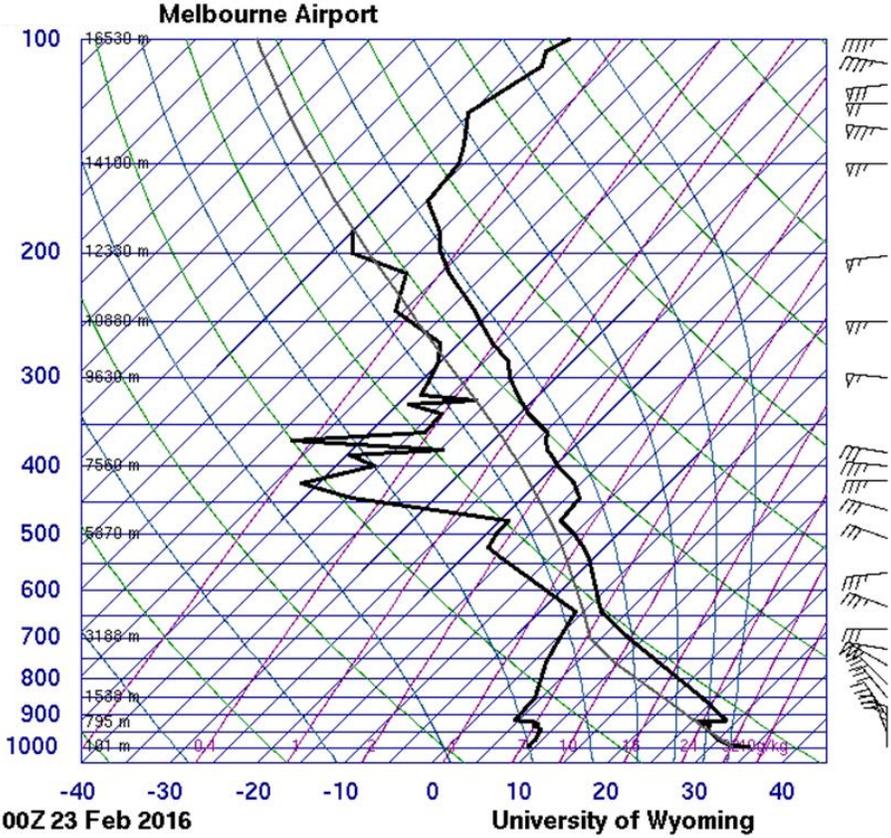
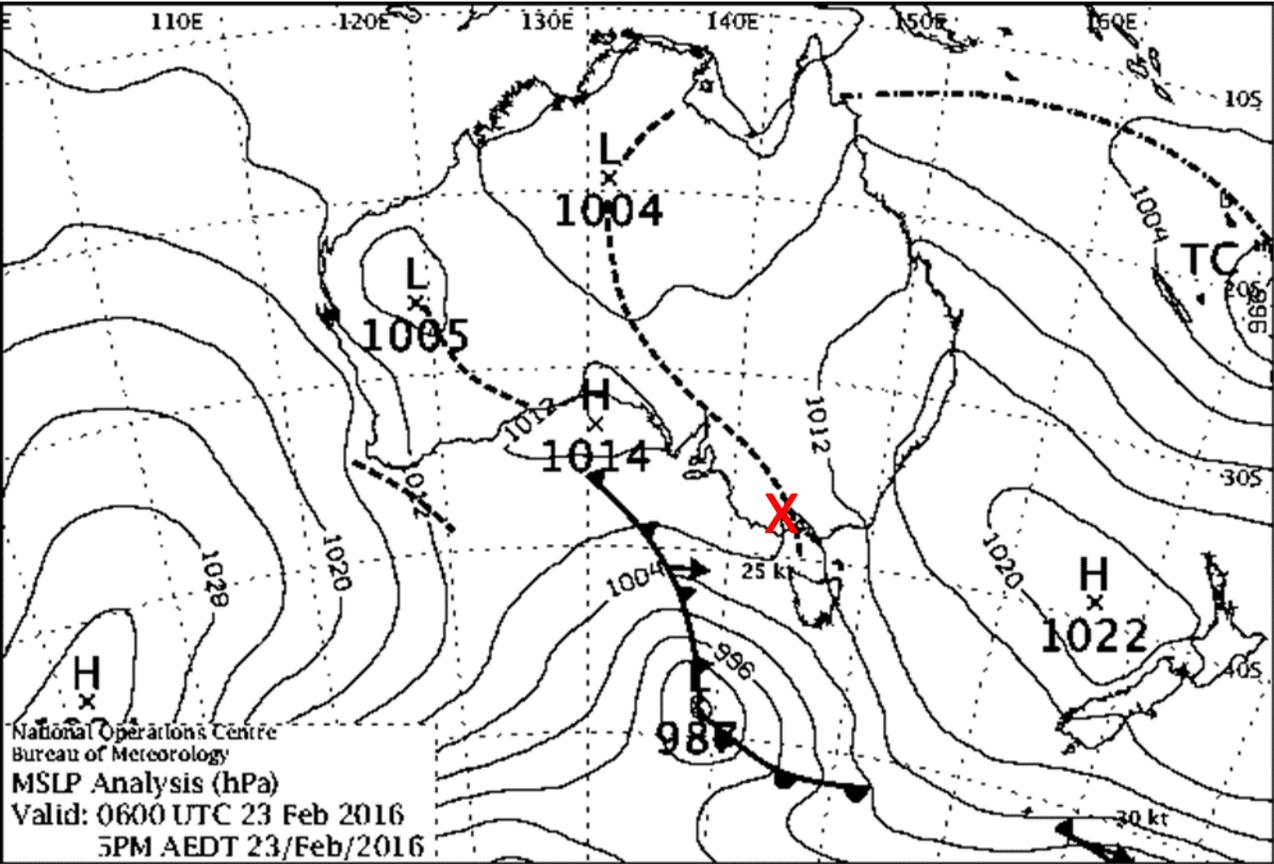
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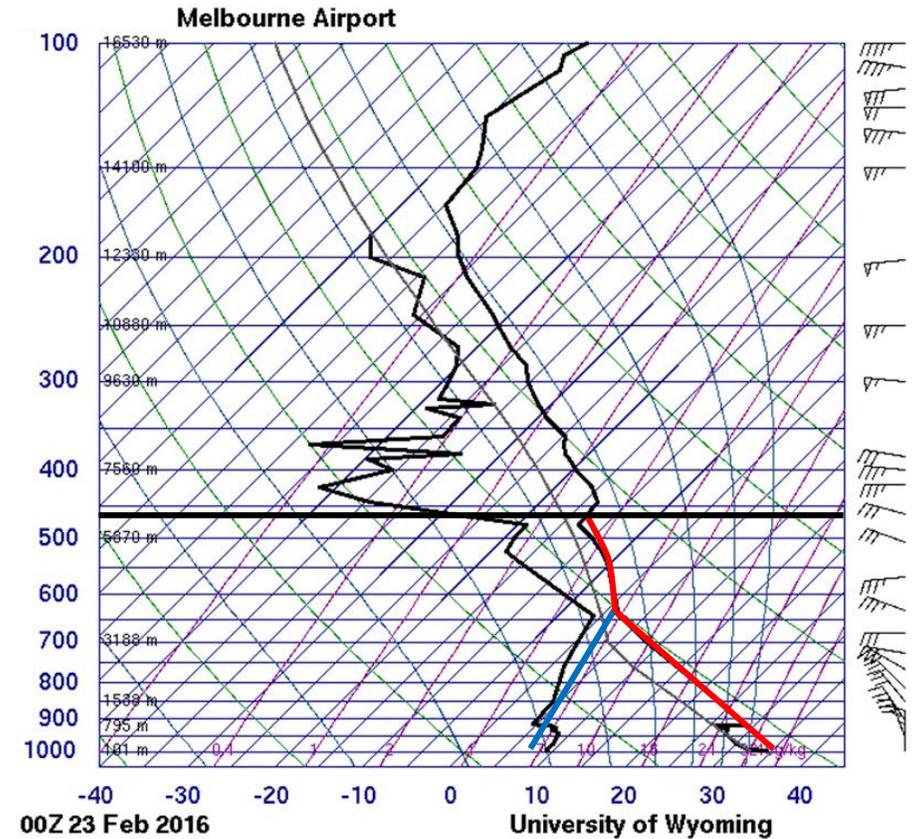
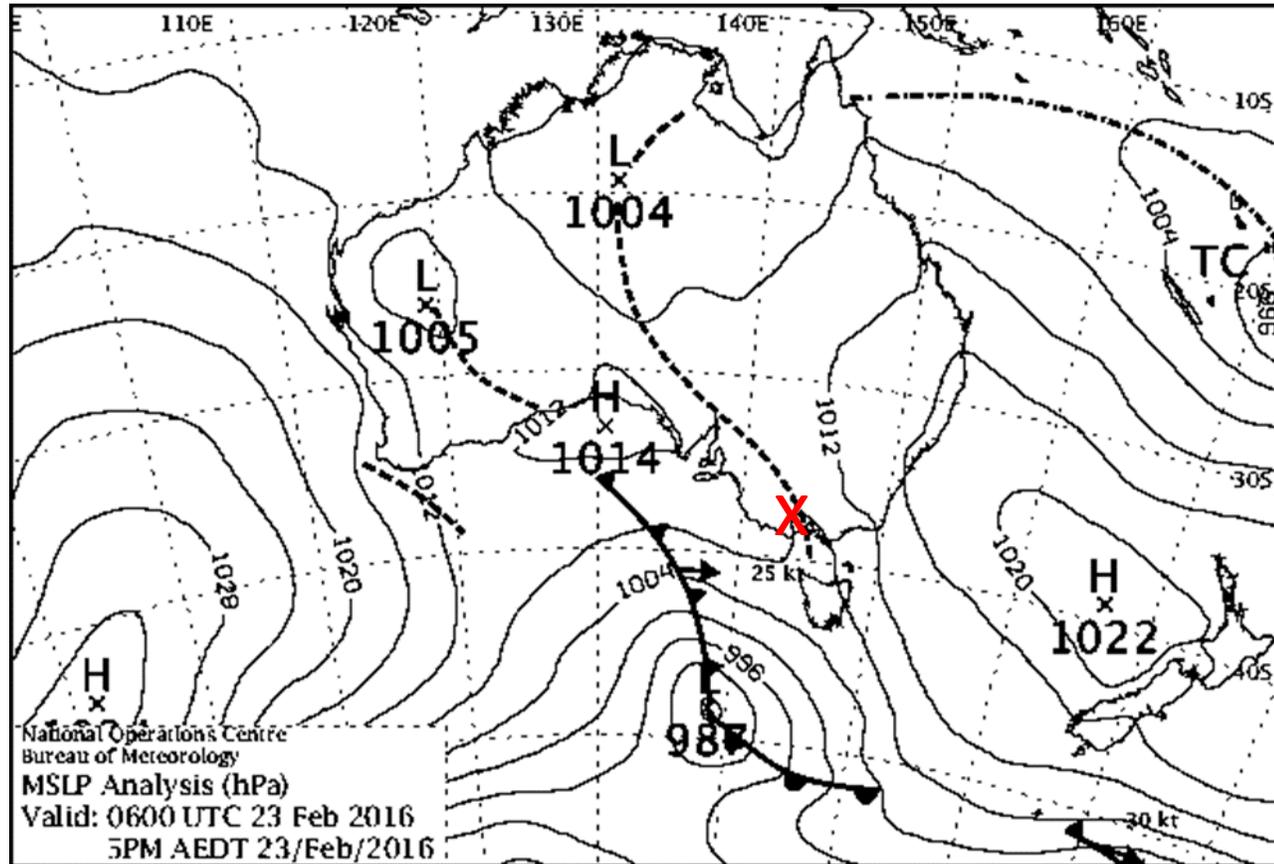
Legend
• Incident Deployments
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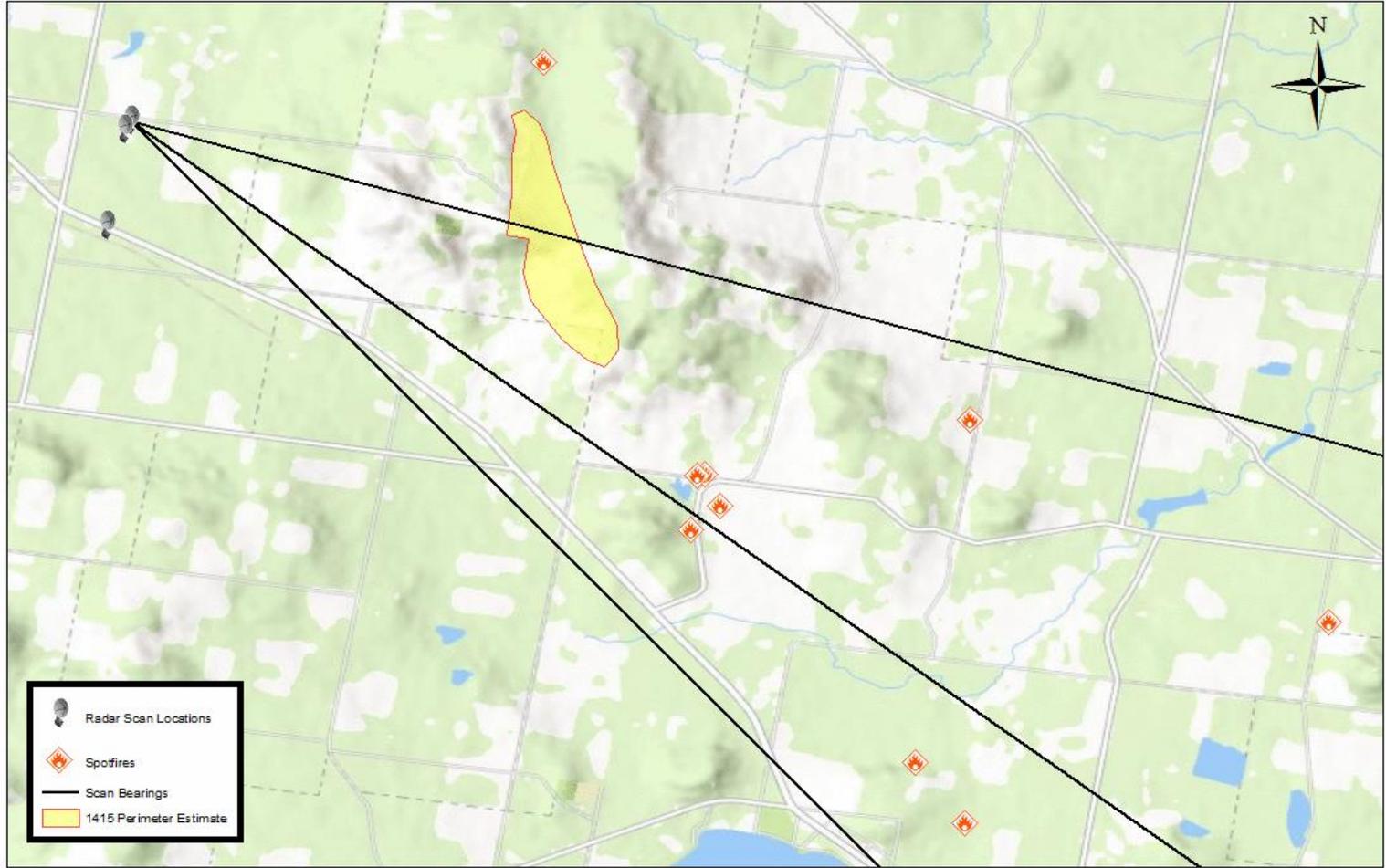
Mt Bolton Bushfire: Overview



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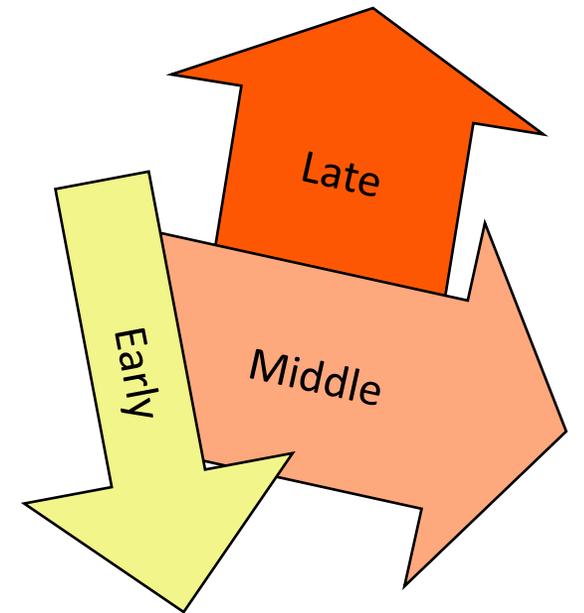
Mt Bolton Bushfire: Overview



1:55,000

Service Layer Credits: Sources: Esri, HERE, DeLorme, increment P Corp., NPS, NRCAN, Ordnance Survey, © OpenStreetMap contributors, USGS, NGA, NASA,

Directions of Spread

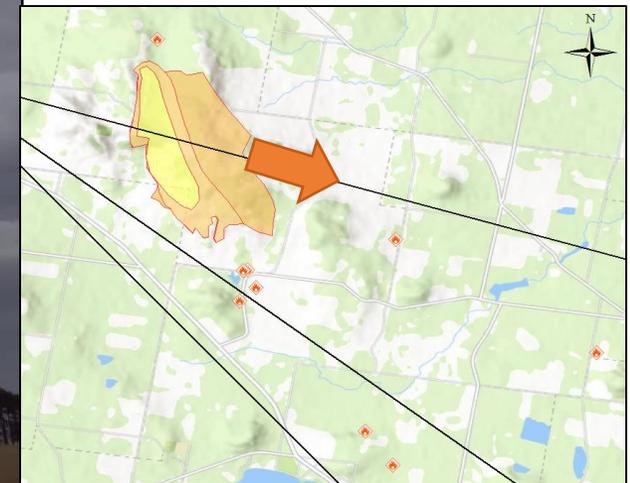


Mt Bolton Bushfire: Overview



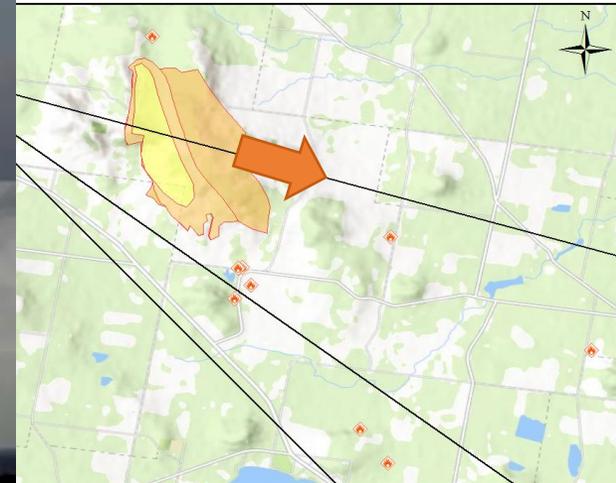
Footage: CFA Air Observer Wayne Riggs

Mt Bolton Convective Plume: Upwind Perspective

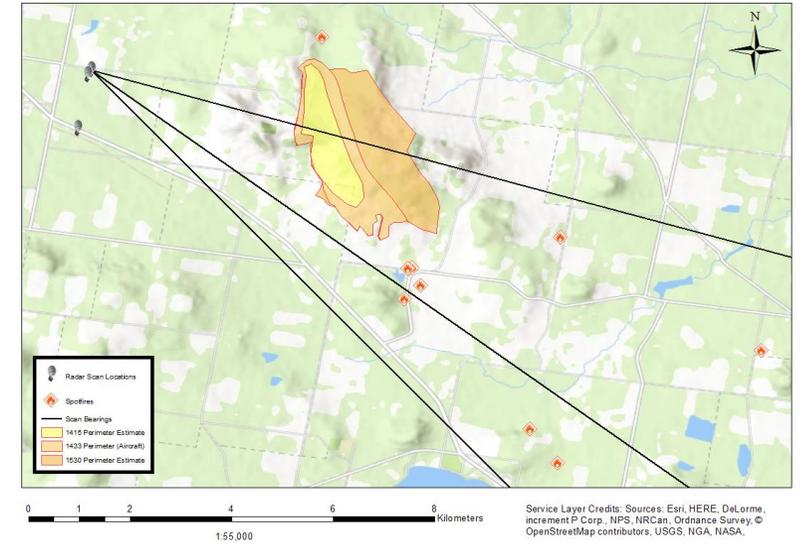
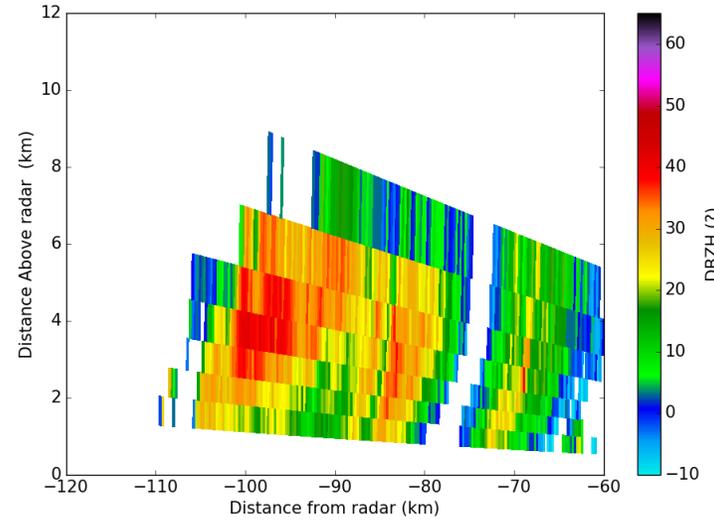
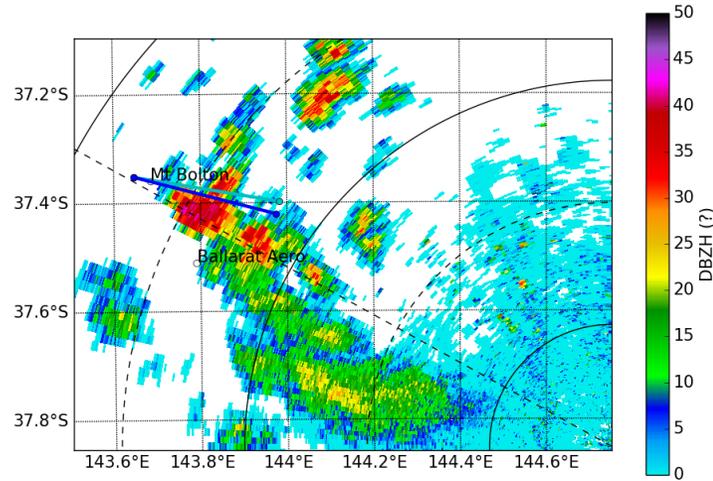


Mt Bolton Convective Plume: Crosswind Perspective

15:24:01



Mt Bolton Bushfire Findings



The Problem of Vertical Velocity

Vertical velocity makes wildland fire a complex 3D problem

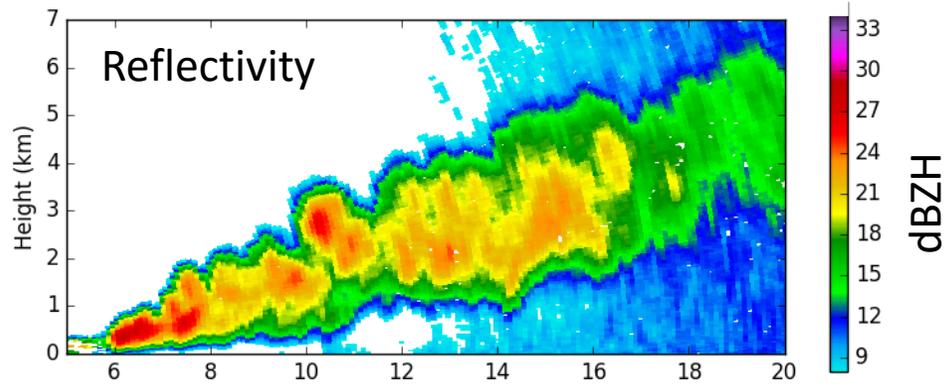
1. **Updrafts**
2. **Downdrafts**
3. **Spotting**



The diagnostic ability of dual-polarised Doppler X-band radar in a bushfire context: The Mt Bolton Bushfire

Updrafts: Mt Bolton Bushfire Findings

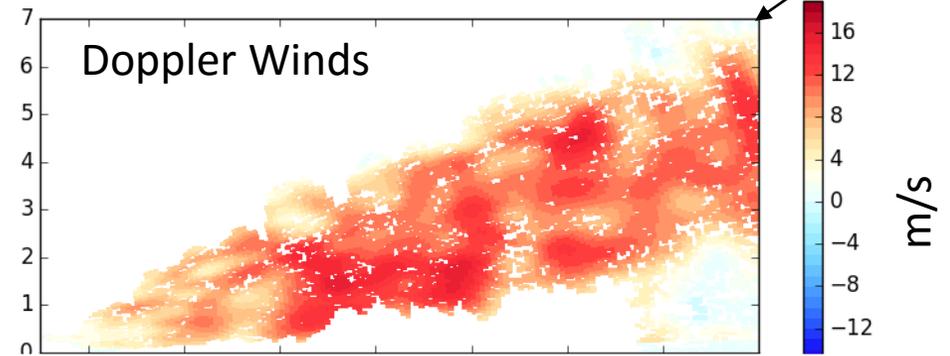
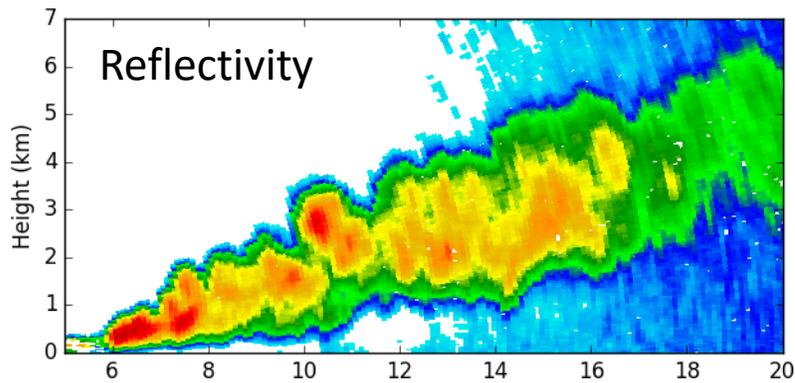
RHI Scan over Mt Bolton Fire at 15:23 Local on 2016-02-23



Updrafts: Mt Bolton Bushfire Findings

RHI Scan over Mt Bolton Fire at 15:23 Local on 2016-02-23

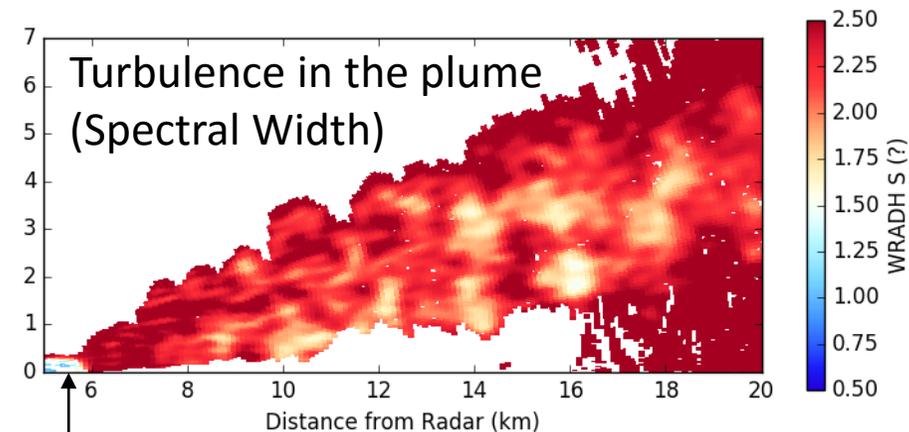
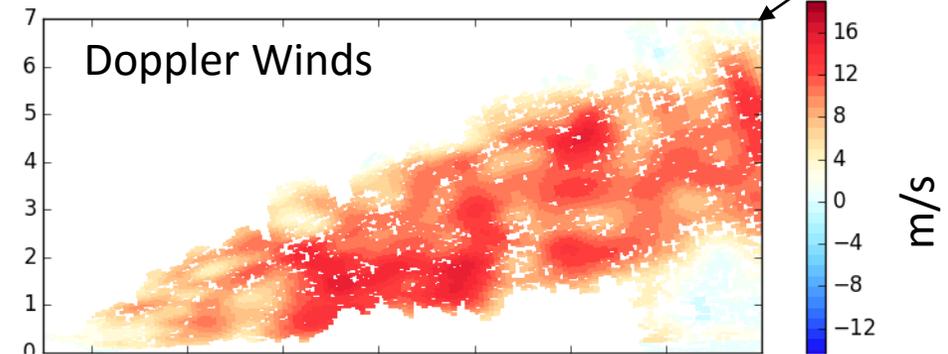
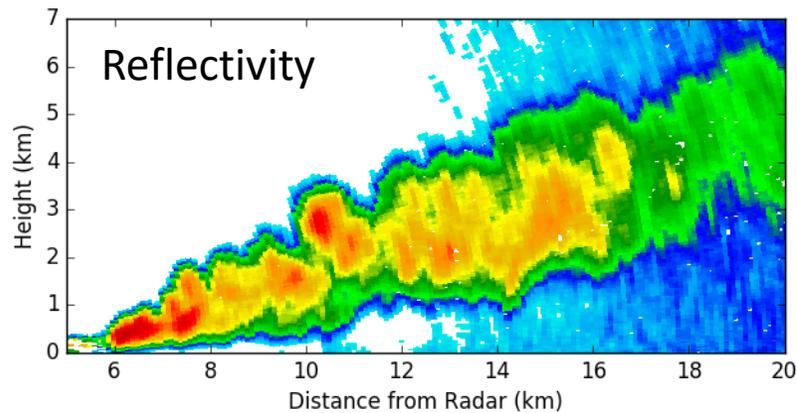
Towards/Away
from Radar



Updrafts: Mt Bolton Bushfire Findings

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RHI Scan over Mt Bolton Fire at 15:23 Local on 2016-02-23

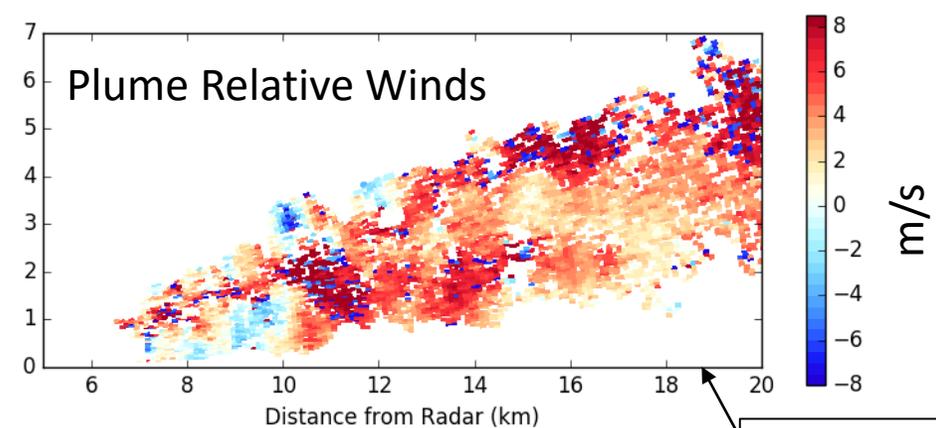
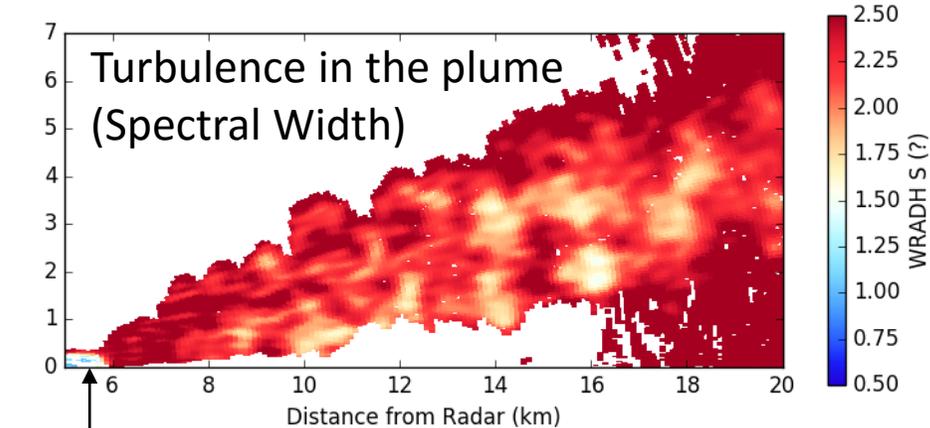
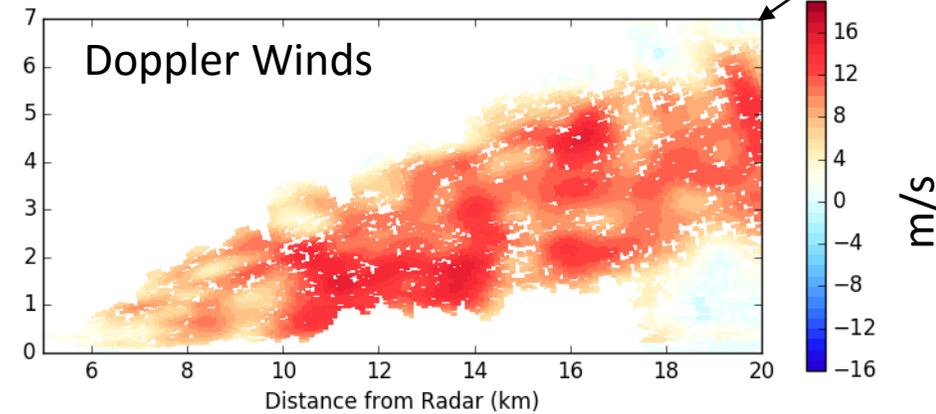
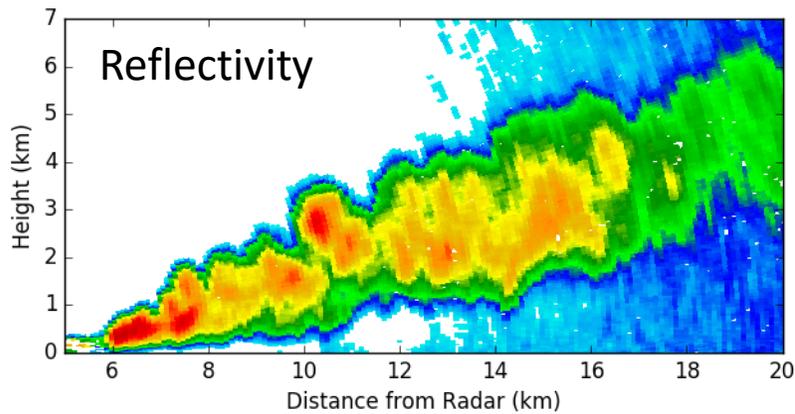


More red = more turbulent

Updrafts: Mt Bolton Bushfire Findings

RHI Scan over Mt Bolton Fire at 15:23 Local on 2016-02-23

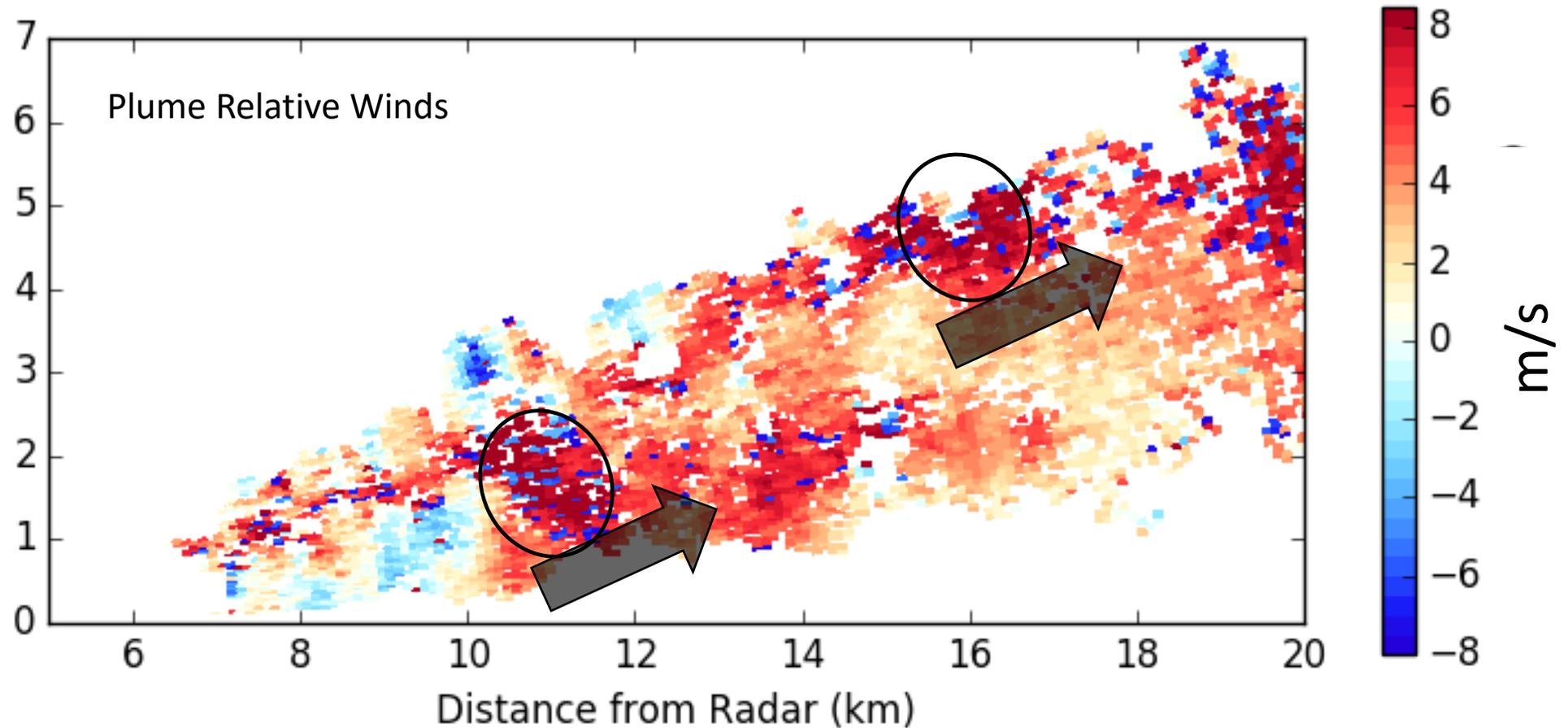
Towards/Away
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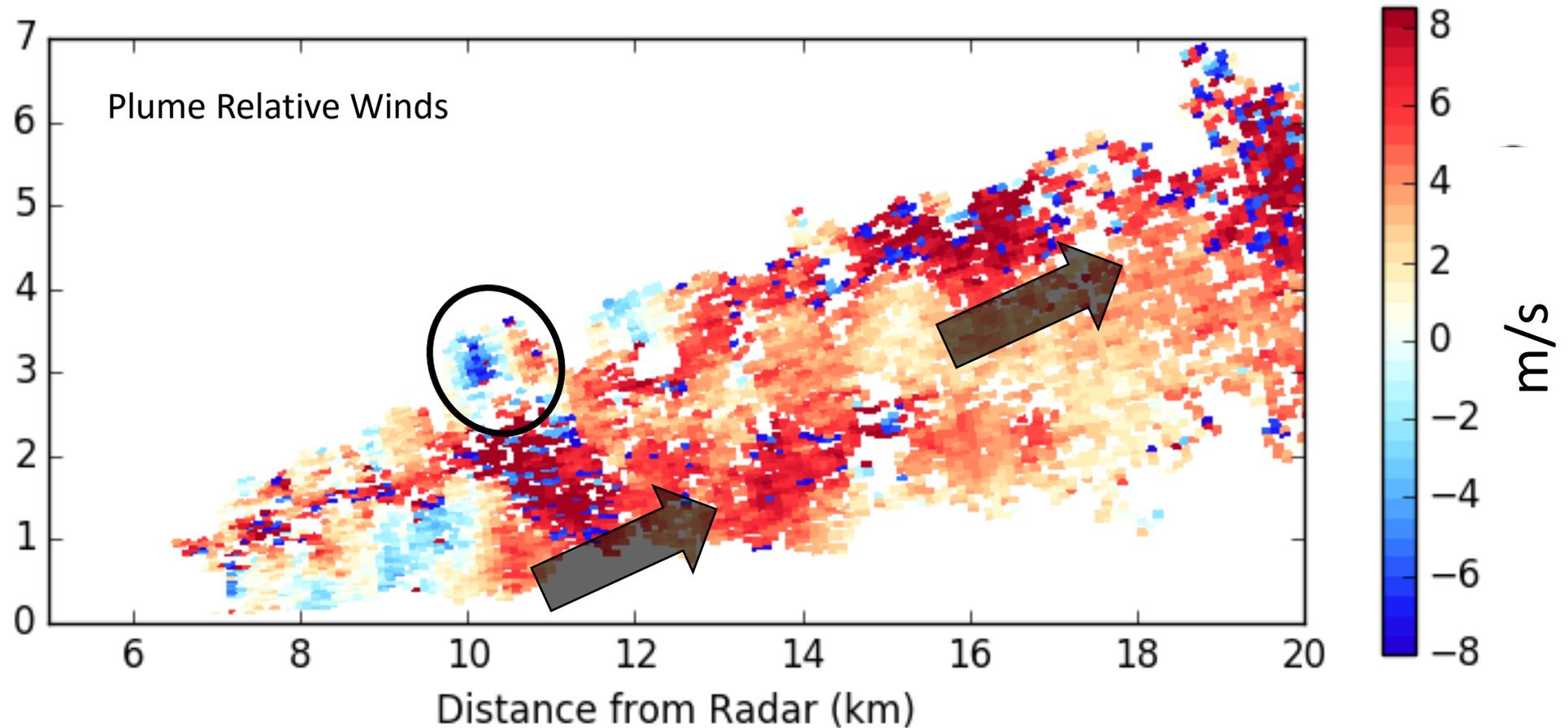
Circulations within
the plume

Updrafts: Mt Bolton Bushfire Findings



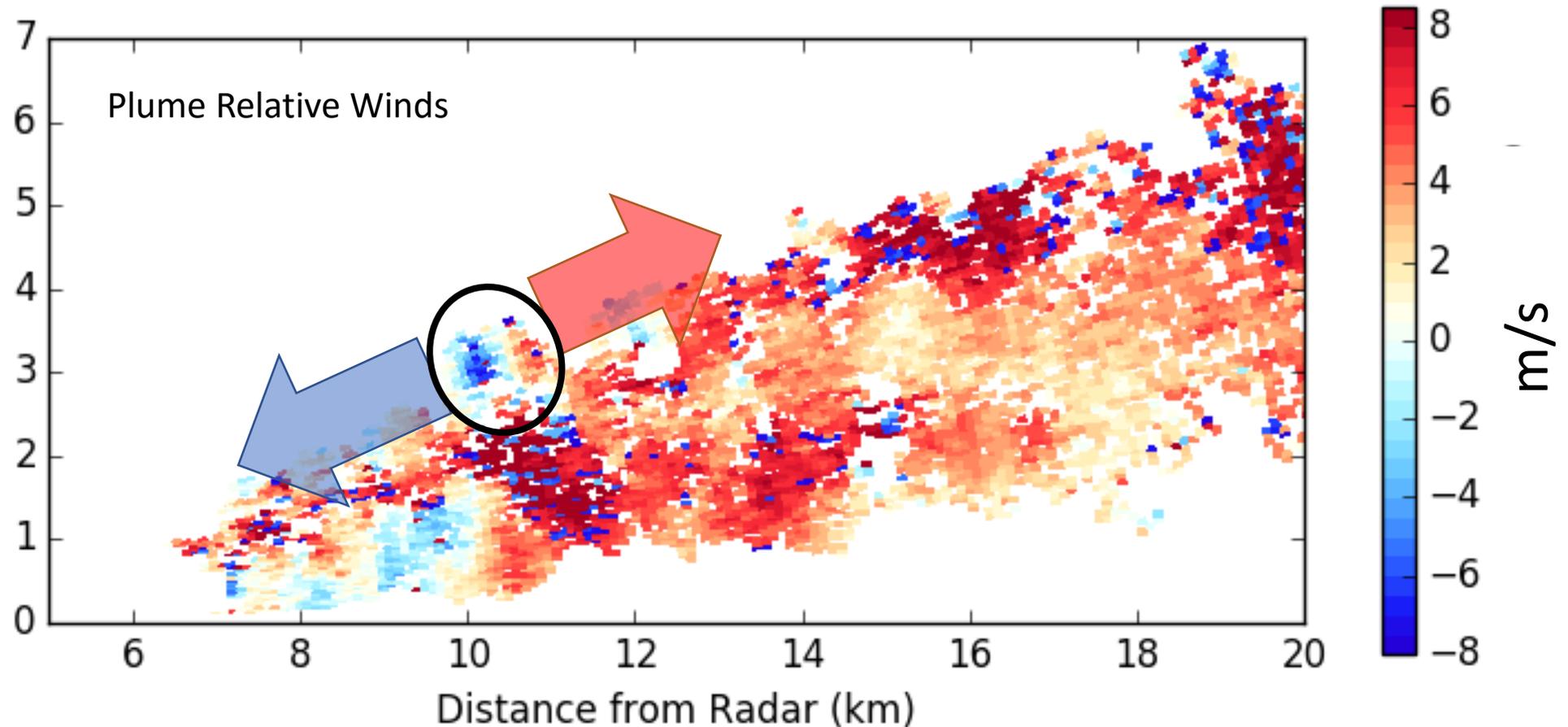
Circulations within the plume calculating by subtracting an estimate of the advection term

Updrafts: Mt Bolton Bushfire Findings



Circulations within the plume calculating by subtracting an estimate of the advection term

Updrafts: Mt Bolton Bushfire Findings



Circulations within the plume calculating by subtracting an estimate of the advection term

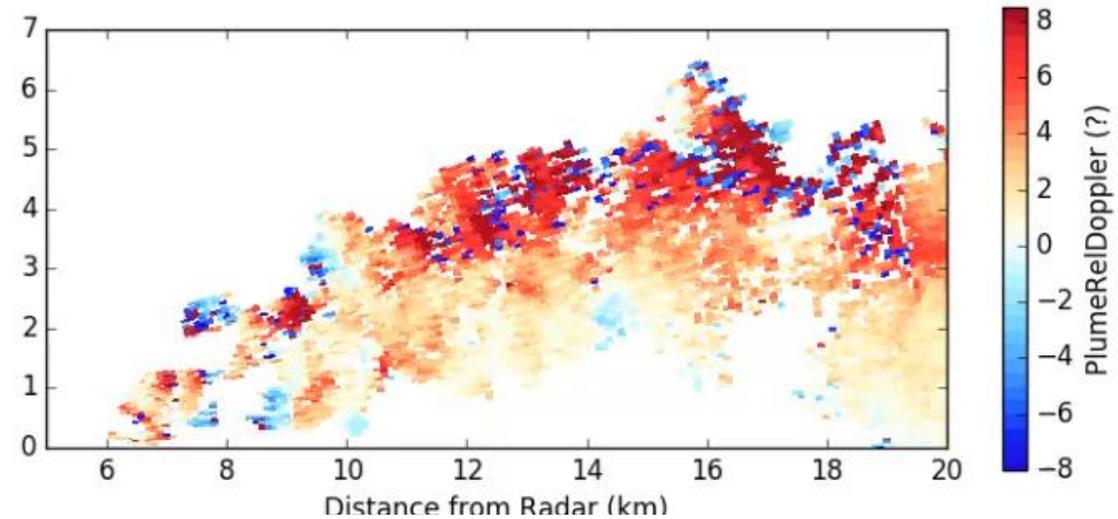
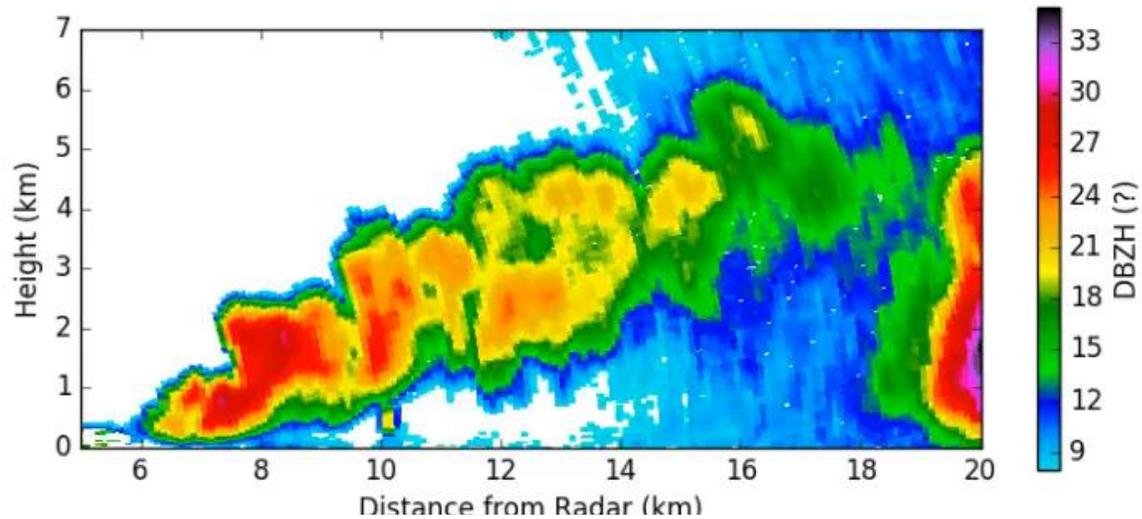
Updrafts: Mt Bolton Bushfire Findings

15:32:30



Updrafts: Mt Bolton Bushfire Findings

RHI Scan over Mt Bolton Fire at 15:20 Local on 2016-02-23



The Problem of Vertical Velocity

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The diagnostic ability of dual-polarised Doppler X-band radar in a bushfire context: The Mt Bolton Bushfire

Downdrafts

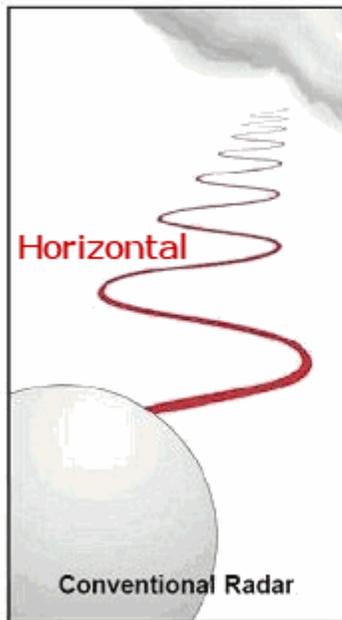
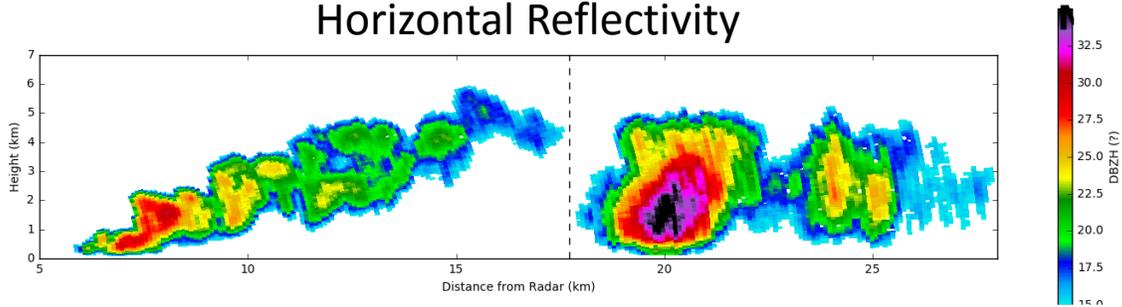


19th December 2015, Scotsburn Fire (Ballarat District)

Source: Australian Sky and Weather

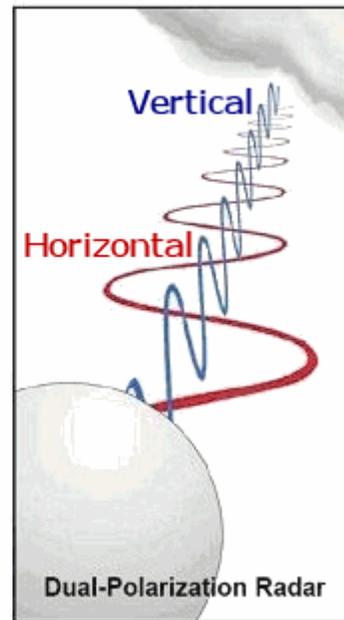
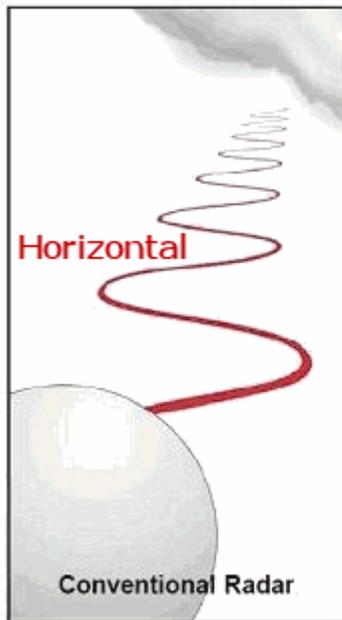
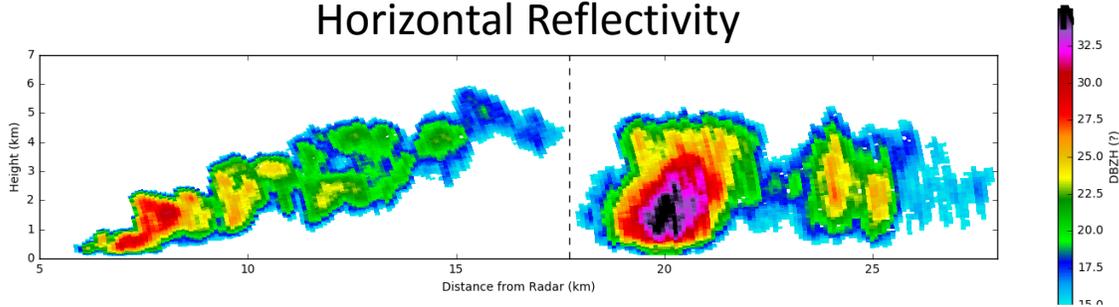
Downdrafts: Mt Bolton Bushfire Findings

Horizontal Reflectivity



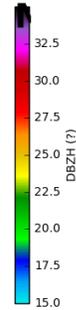
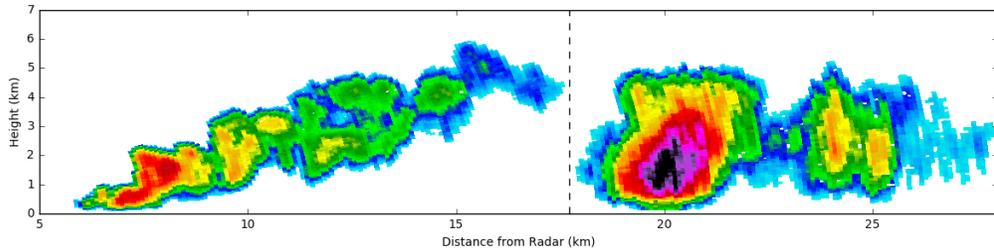
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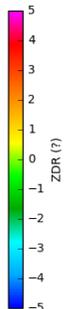
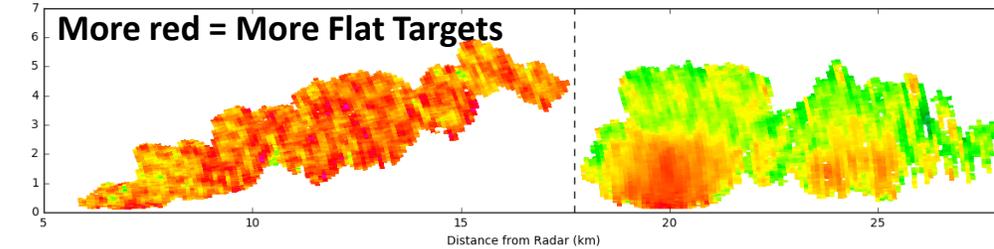
Downdrafts: Mt Bolton Bushfire Findings

Horizontal Reflectivity



Horizontal minus Vertical Reflectivity

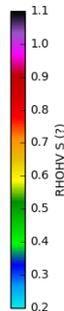
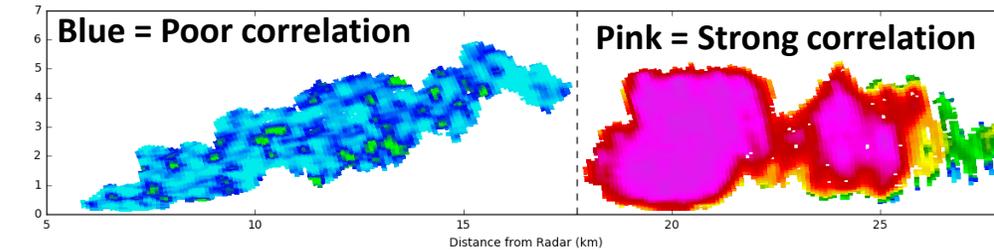
More red = More Flat Targets



Correlation between Horizontal and Vertical

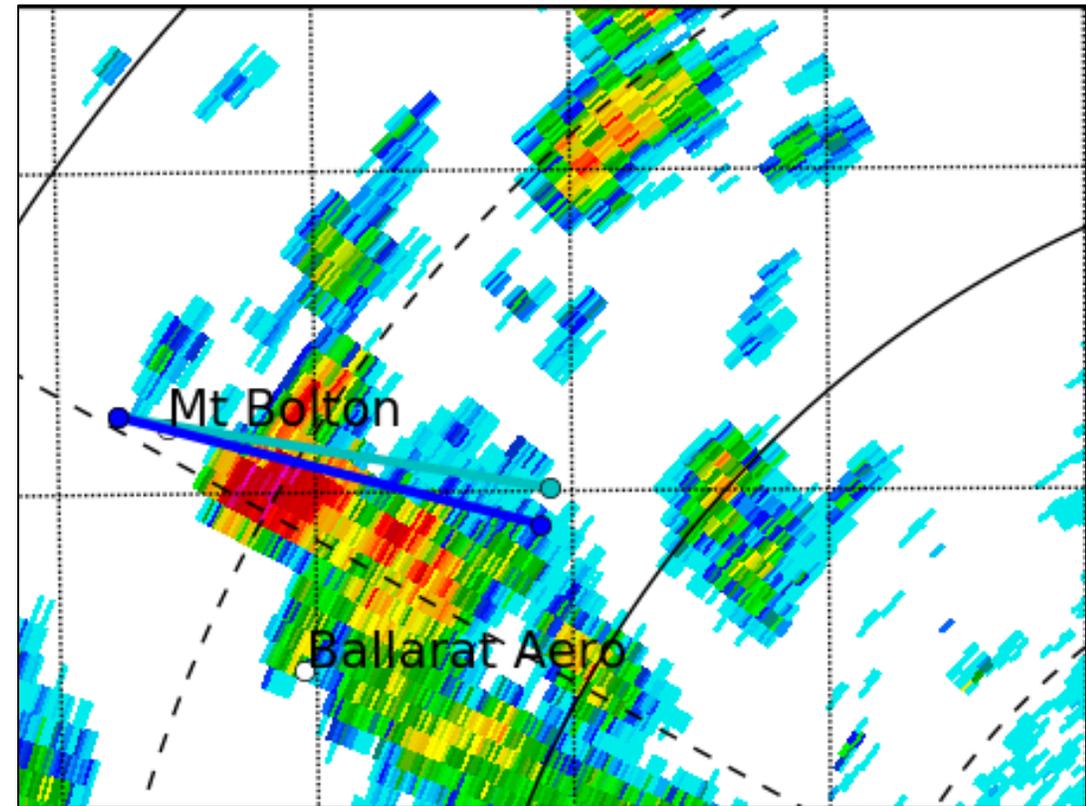
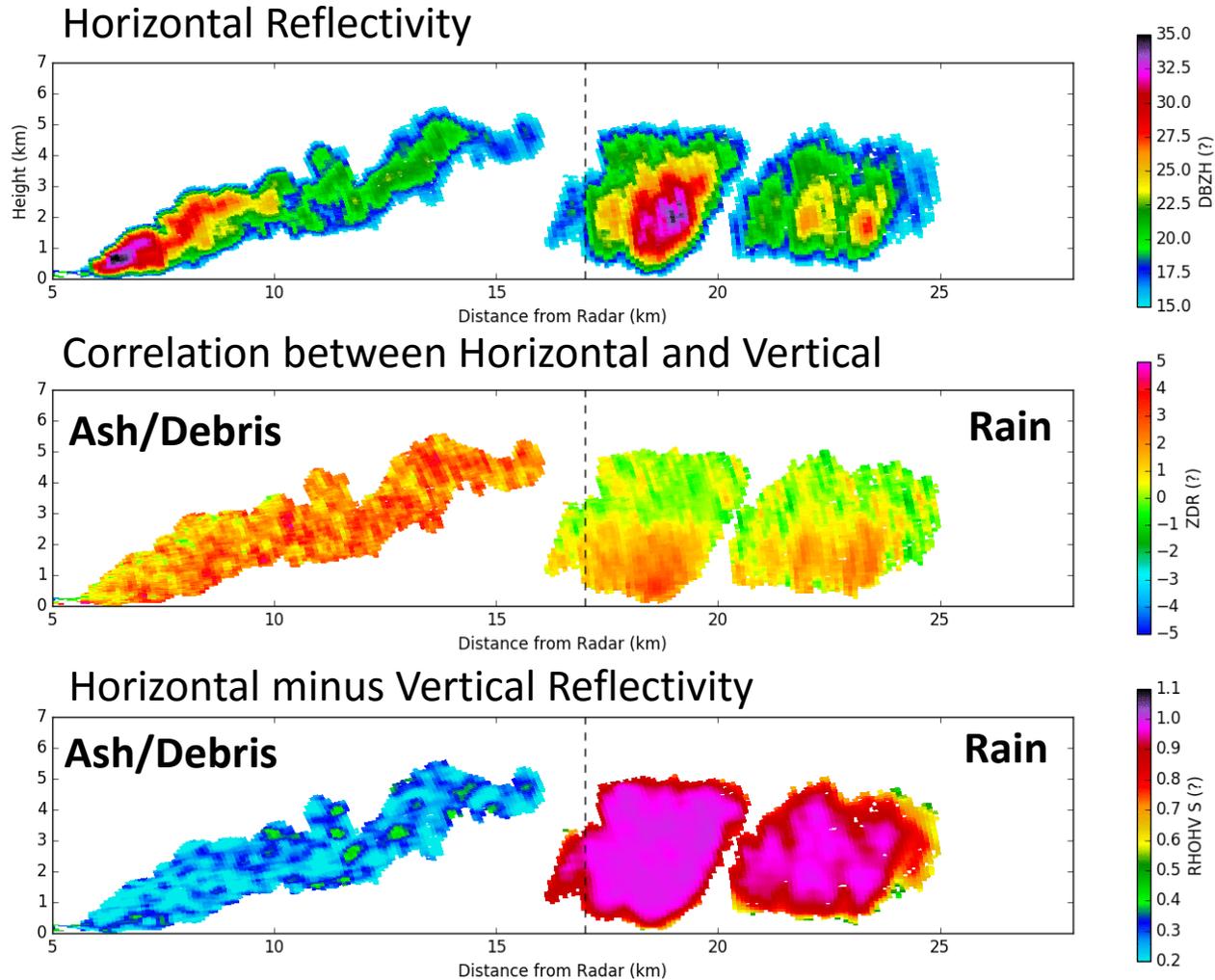
Blue = Poor correlation

Pink = Strong correlation



Downdrafts: Mt Bolton Bushfire Findings

RHI Scan over Mt Bolton Fire at 15:18:03 Local Time



The Problem of Vertical Velocity

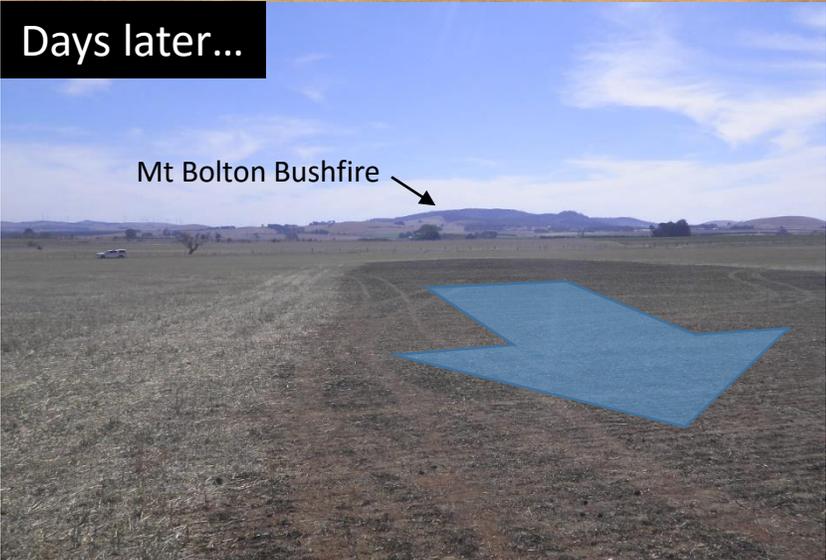
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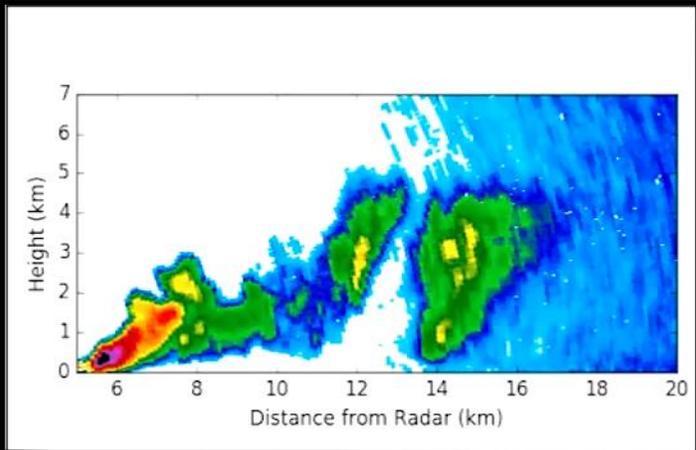


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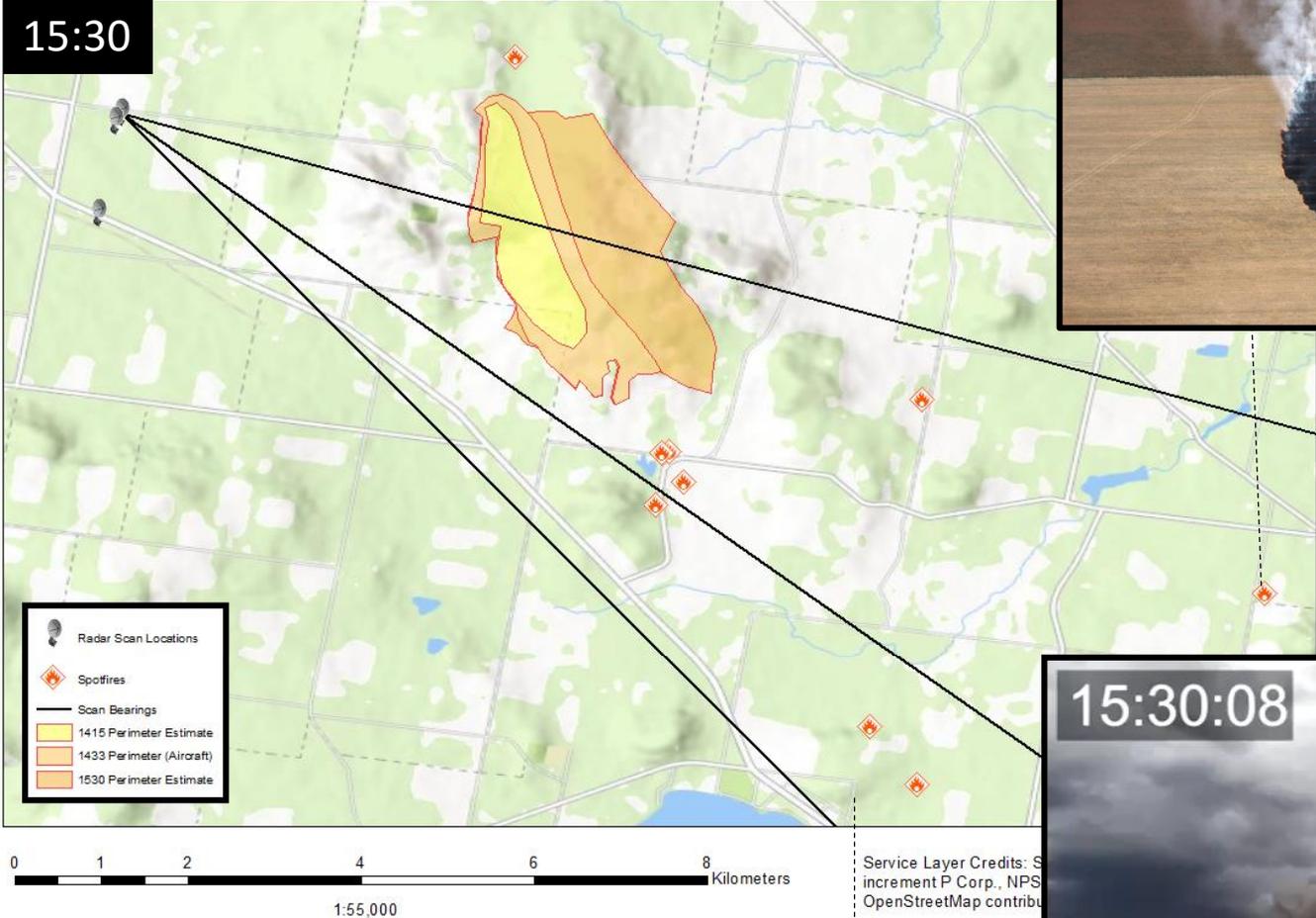
Spotting: Mt Bolton Bushfire Findings



Spotting: Mt Bolton Bushfire Findings



Radar and Timelapse 1



Timelapse 2

The Problem of Vertical Velocity

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Thank you!

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Twitter: @mccarthy_nfm



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- Queensland Fire and Emergency Services

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