



**Australian Government**

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**Geoscience Australia**

# **Using Spatial Science to Respond to Bushfires**

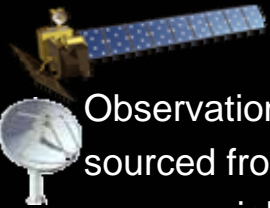
**Medhavy Thankappan  
National Earth Observation Group**

# NEO Business Model

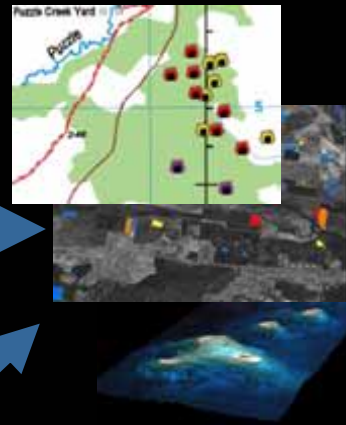
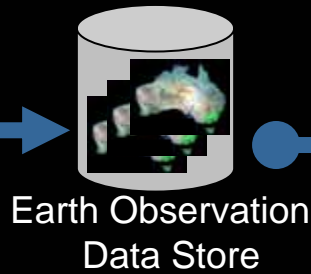
Acquire

Analyse

Deliver



Observation & downlink or sourced from commercial provider



Determine public good information

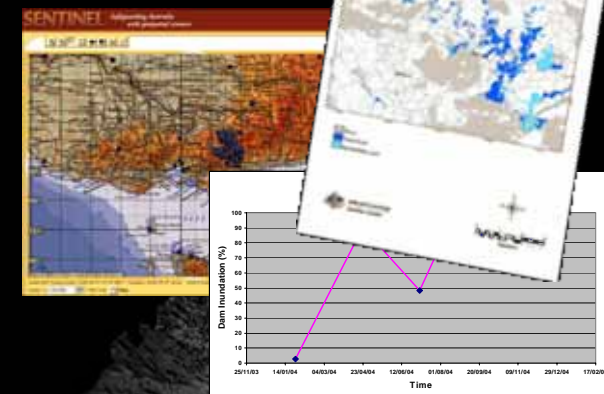
Processed imagery



Information and decision support



Integrate other data/models



# Emergency Response Framework

- Who contacts who, how and when?
- Information about the event?
- What are the response parameters?
- What are the costs?

- Capability versus hazards in the region
- Which satellites to task ?
- Is the data likely to be acquired on time?
- Choice of sensors?

- Pre and post event image analysis
- Rapid extraction of useful information from images
- Naming conventions and metadata
- Interpretation of information

- Maps showing extent of impact / damage
- Derived information in user-ready formats
- Access modes – web based interface etc

## INCIDENT

The ability to locate and map emergencies is critical to any emergency response. Using imagery from satellites, or Remote Sensing data, Geoscience Australia helps emergency services to locate and manage several types of emergencies.

## DATA CAPTURE

With satellite downlink facilities strategically placed around the nation, Geoscience Australia can acquire imagery quickly and deliver it to our clients in near real-time.

## ANALYSIS

Geoscience Australia's Remote Sensing Science team keeps up-to-date with cutting edge technology to develop the latest and most accurate techniques for our clients.

## OUTPUT

Geoscience Australia can create custom designed outputs to meet the needs of our customers.

# Victorian Bushfires February 2009

# Incident

- February 2009 - unprecedented heatwave in Victoria; lightning strikes, arson and other events cause catastrophic bushfires.
- Impact:
  - 173 fatalities
  - 2029 properties lost
  - 400,000 ha burnt

# Data Capture

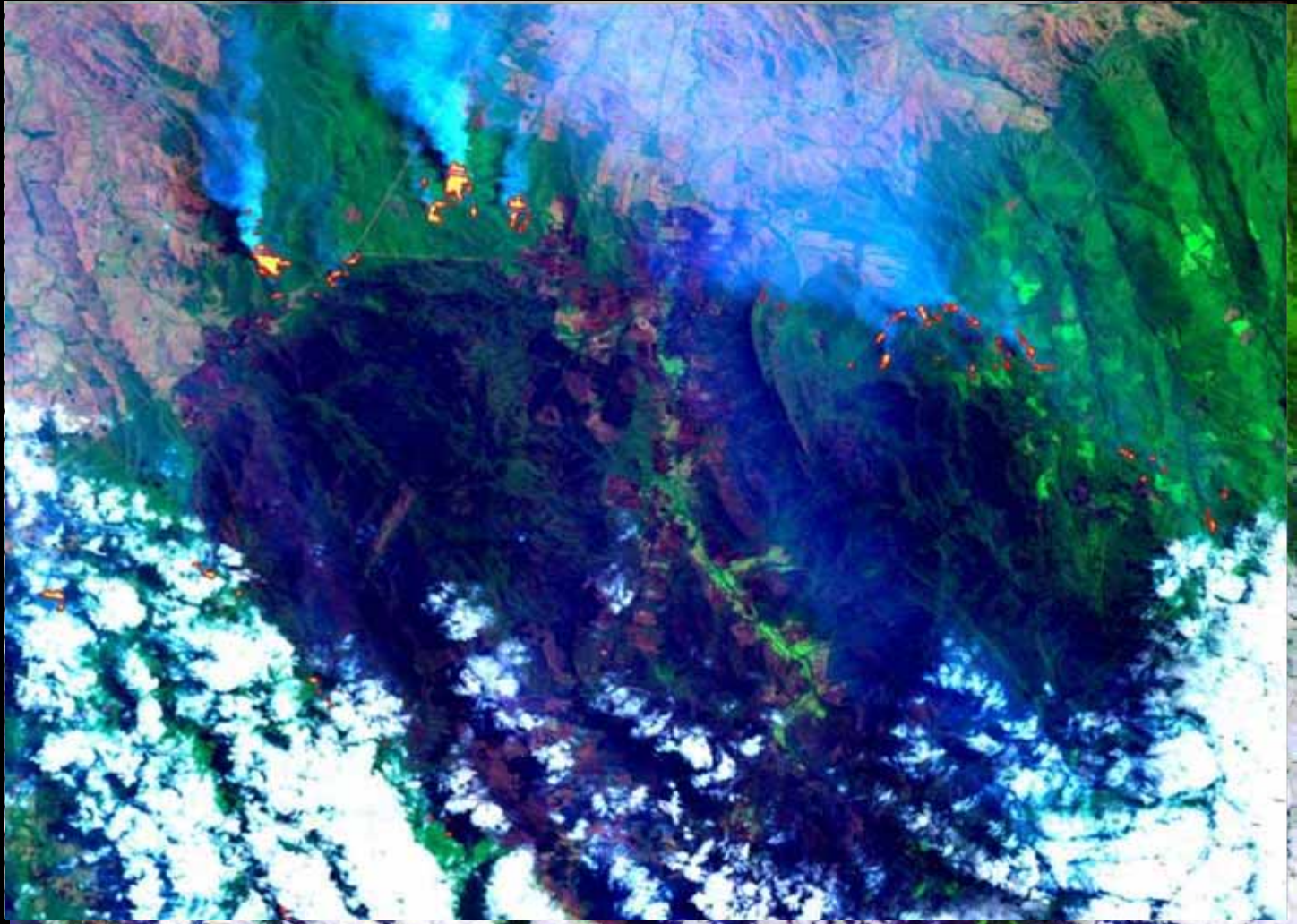
Satellite, sensor	Type	Resolution (m)	Acquired by	Scenes acquired
ALOS, AVNIR-2	Optical	10	GA	18
ALOS, PALSAR	RADAR	10-30	Sentinel Asia	16
Terra, MODIS	Optical/thermal	250	GA	24
Aqua, MODIS	Optical/thermal	250	GA	21
Landsat 5, TM	Optical	30	GA	11
Landsat 7, ETM	Optical	30	GA	10
KOMPSAT-2, MS	Optical	4	Informal (KARI)	3
<b>Total</b>				<b>103</b>

- Note: First cloud free image acquired 16<sup>th</sup> Feb by LS5
- Note: Data captured within a window between 7<sup>th</sup> – 26<sup>th</sup> of February 2009

# Analysis: MODIS



# Analysis: Landsat 7

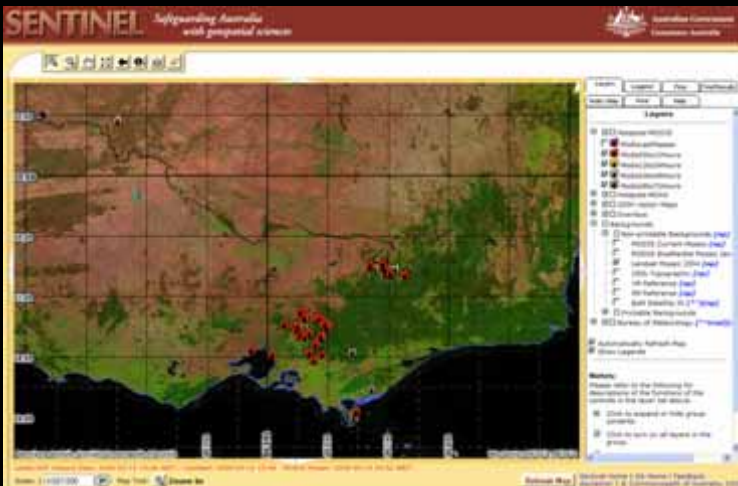
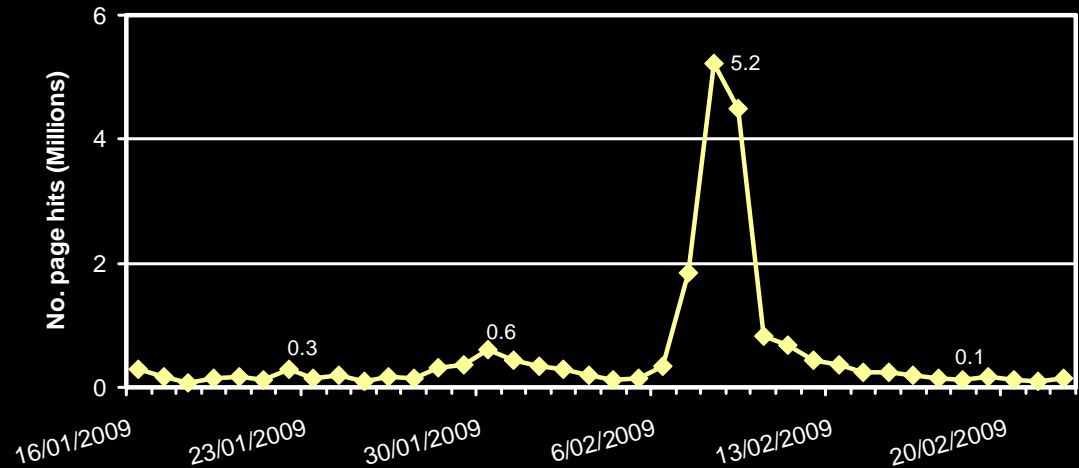


# Response: Usage of Sentinel Hotspots

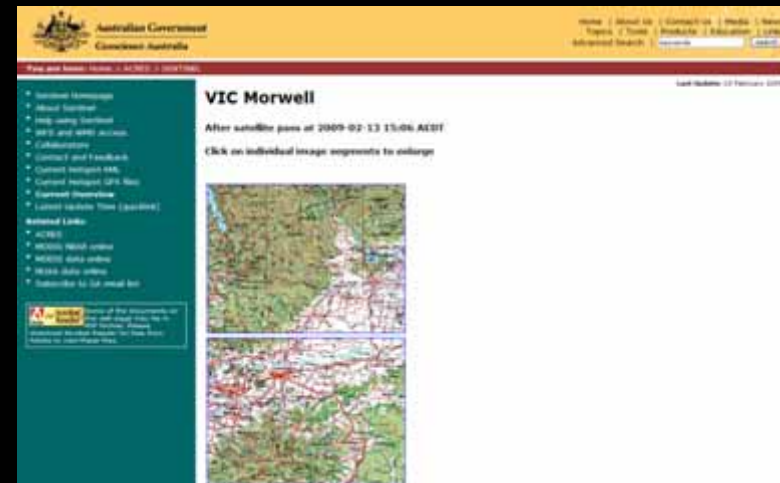
[http://sentinel.ga.gov.au/acres/sentinel/disclaimer\\_B.shtml](http://sentinel.ga.gov.au/acres/sentinel/disclaimer_B.shtml)

- Web mapping capability was removed from the public site to increase throughput
- Unprecedented usage

Sentinel webpage spike from Victorian bushfires



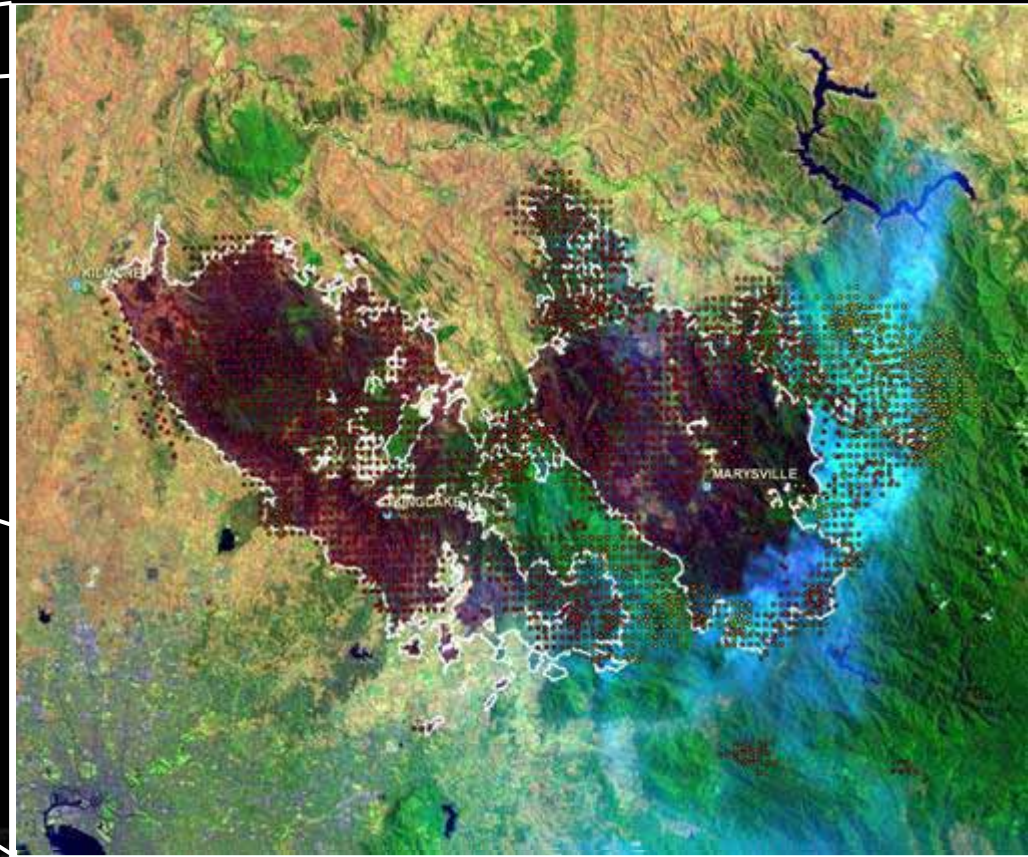
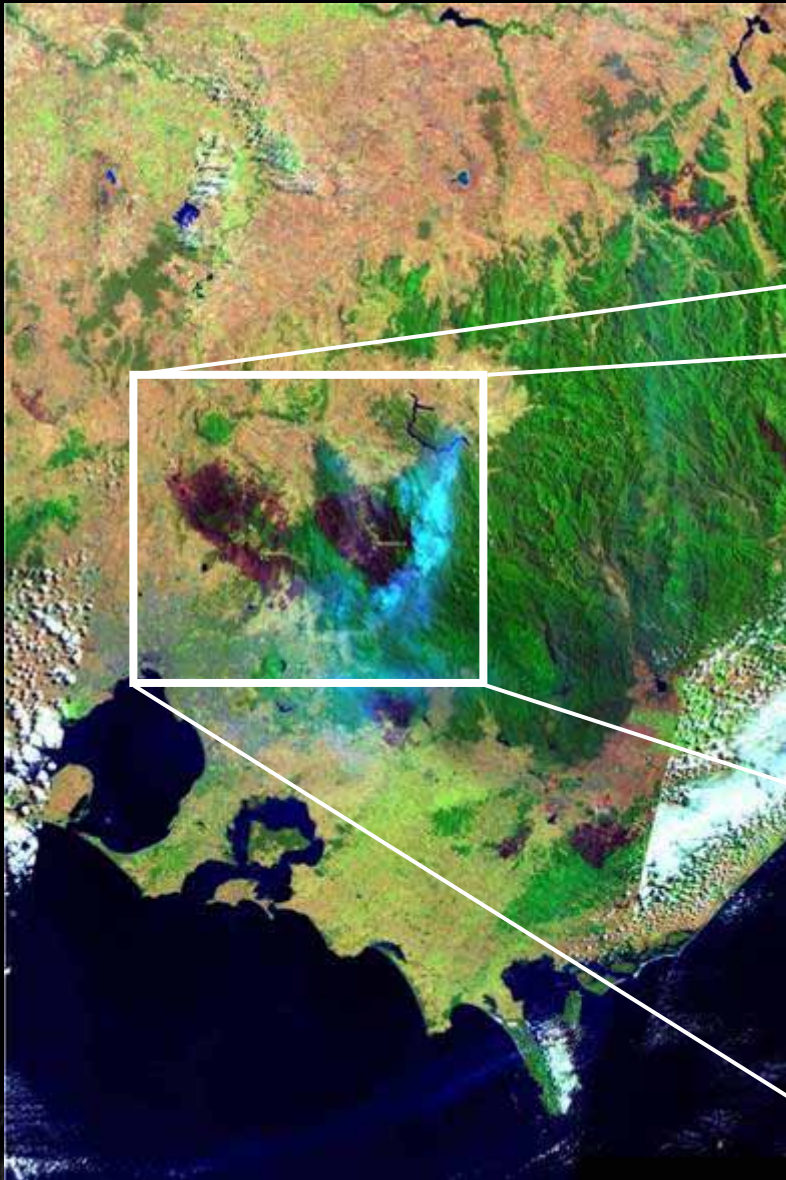
Dynamic > Static



# Analysis: Sentinel Hotspots

Cloud-free  
Landsat  
image

- Fire extent mapped
- Thermal hot-spots overlaid with mapped fire extent



# Response: Data Provision

- **Satellite dataset requests were received from:**
  - Country Fire Authority (VIC)
  - Department of Sustainability and Environment (VIC)
  - State Emergency Service (VIC)
  - ACT Emergency Services Agency
  - Department of Conservation and Land Management (WA)
  - CSIRO Sustainable Ecosystems
  - USGS Emergency Response Team
- **Hotspot dataset requests were received from:**
  - Insurance Australia Group (IAG)
  - Telstra
  - Numerous utility suppliers
- **Burn scar dataset requests were received from:**
  - Bureau of Rural Sciences on behalf of Centrelink
  - Bushfire CRC



THE HON MARTIN FERGUSON AM MP  
MINISTER FOR RESOURCES AND ENERGY  
MINISTER FOR TOURISM

PO BOX 6022  
PARLIAMENT HOUSE  
CANBERRA ACT 2600

12 FEB 2009

Dr Neil Williams  
Chief Executive Officer  
Geoscience Australia  
GPO Box 378  
CANBERRA ACT 2601

Dear Dr Williams *Neil,*

Thank you for your briefing of 11 February regarding Geoscience Australia's response to the Victorian bushfires and Queensland floods.

I write to thank you and the personnel at Geoscience for their contribution during these national emergencies. In particular, I note and commend the efforts of staff in keeping the Sentinel website operational during unprecedented demand on the website.

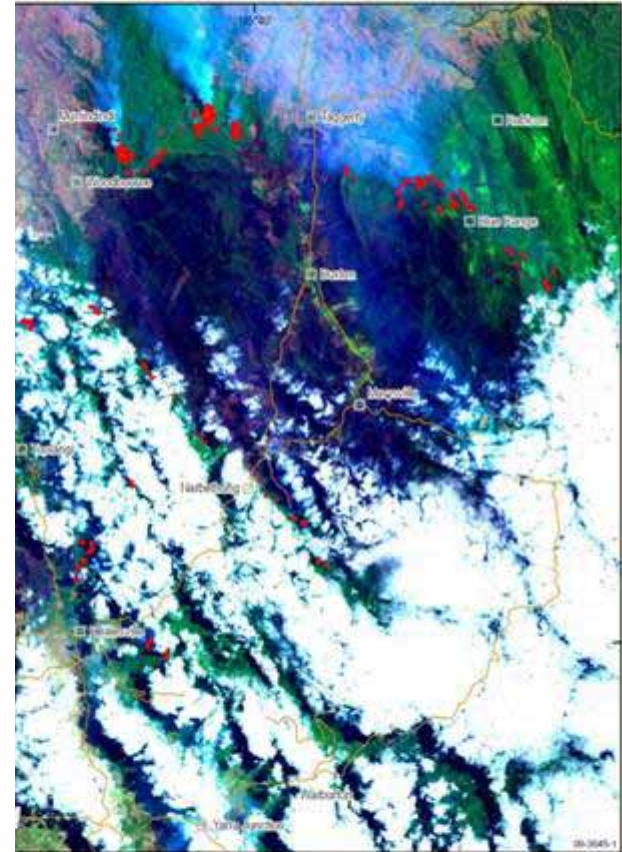
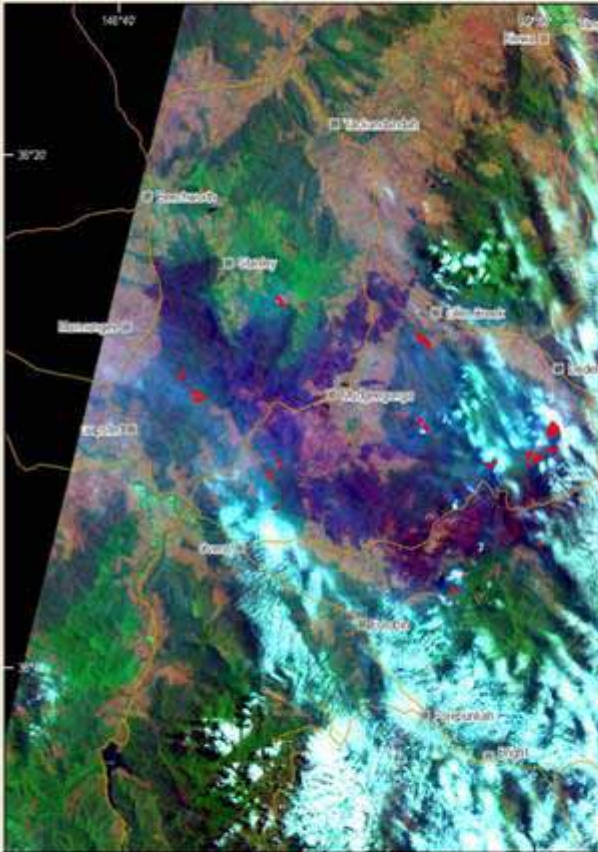
It is clear from your brief that the service Geoscience provides to state emergency services and the Australian Defence Force through Sentinel makes an important contribution to our national response to the Victorian bushfire emergency. Equally, that the Sentinel website received such public demand demonstrates to me the value of contribution that Geoscience and Sentinel makes to helping the Australian public to understand the enormity of emergency and to sympathise with those affected.

Please pass my appreciation to all involved.

Yours sincerely

Martin Ferguson

Telephone: (02) 6277 7930 Facsimile: (02) 6273 0434



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Geoscience Australia

0 20km  
TRANSVERSE MERCATOR PROJECTION  
CENTRAL MERIDIAN 147° E  
GEODESIC DATUM OF AUSTRALIA 1984

Fire front (10 Feb 09) Road Town



Image acquired and processed by Geoscience Australia  
© Commonwealth of Australia - Geoscience Australia  
Landsat-5 TM bands 5 4 2 - R G B, acquired: February 2009

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Geoscience Australia

0 20km  
TRANSVERSE MERCATOR PROJECTION  
CENTRAL MERIDIAN 147° E  
GEODESIC DATUM OF AUSTRALIA 1984

Fire front (9 Feb 09) Road Town



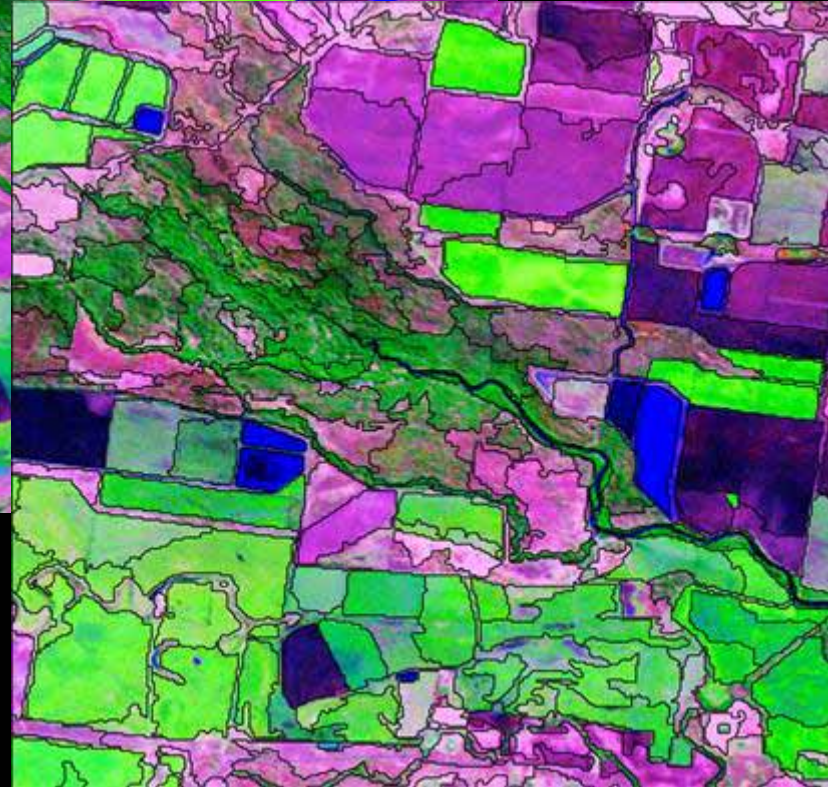
Image acquired and processed by Geoscience Australia  
© Commonwealth of Australia - Geoscience Australia  
Landsat-5 TM bands 5 4 2 - R G B, acquired: February 2009

# Rapid Information Extraction

- Breaks image into “natural” objects
  - combination of colour and shape information
  - spatial context
- Can analyse multiple resolutions simultaneously
- Can analyse time series



False-colour imagery using bands 5,4,2 as Red, Green, Blue



# Fire Scar Mapping

- Rapid response left no room for development of new methods
- Applied assisted visual interpretation
- Object oriented technique finds “natural” boundaries followed by user interpretation of each object as either burnt or not burnt
- Produced broad burn area extent

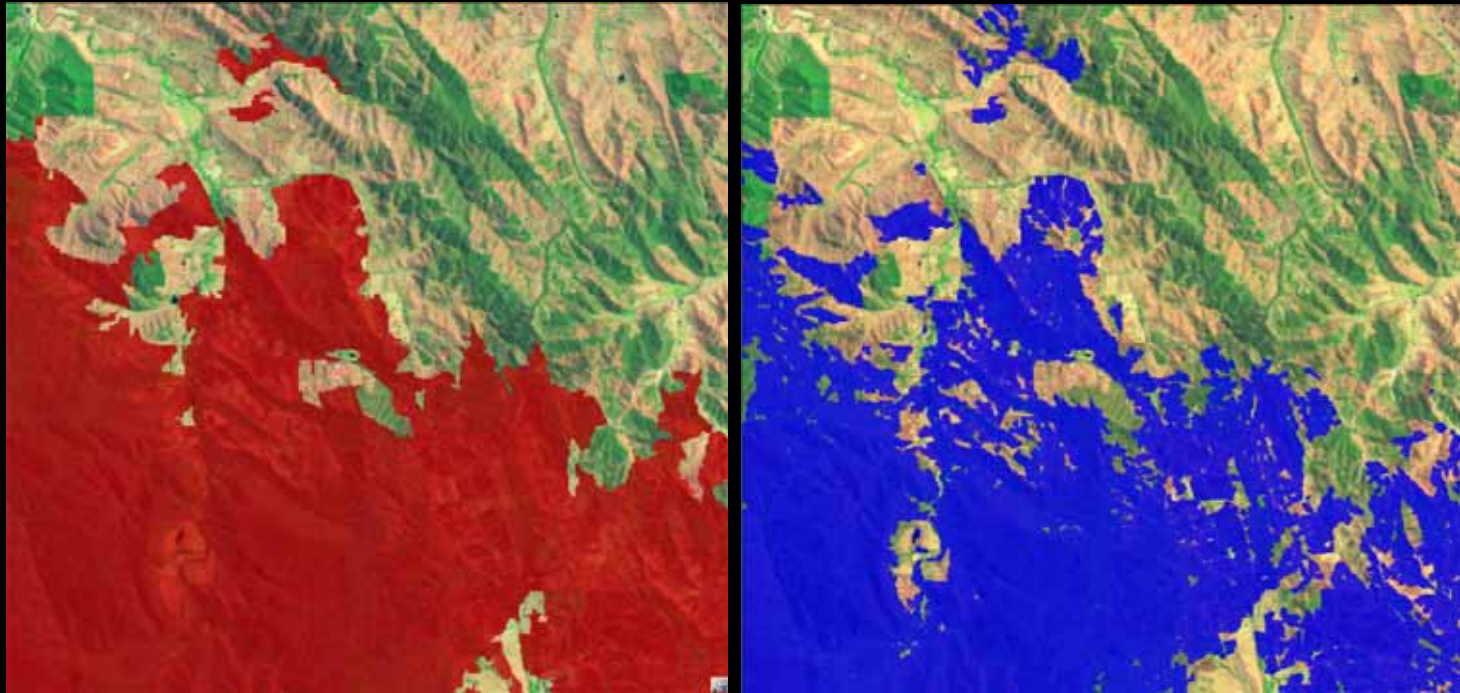


# Refinement of mapping techniques

- Faster and more accurate than visual interpretation and digitizing
- Based on change detection and near infra-red response
- More detailed burn area extent determination



# Refinement of mapping techniques



# Capability Development

- Canberra 2003 bushfire example
- Application of tools developed through the National Land Cover Project
- Time series analysis
  - MODIS Vegetation Index (VI) 16-day composite product from 2000 to 2006 – greenness measure
  - Over 300 measurements for every point in Australia
  - Characterises long term behaviour of areas in the landscape
  - Highlights changes to that behaviour

# 2003 Canberra Bushfire

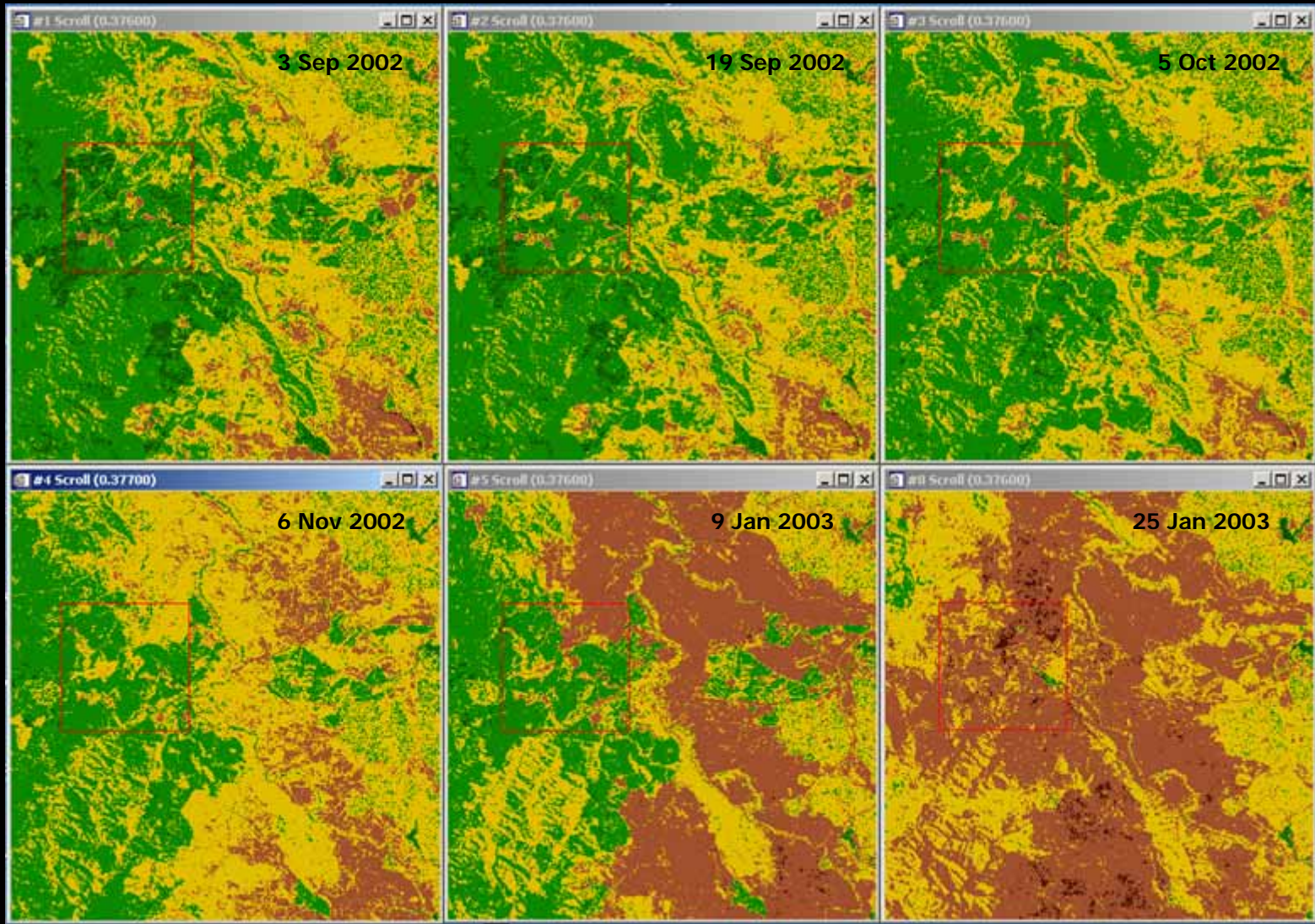


NATMAP Raster 250 K

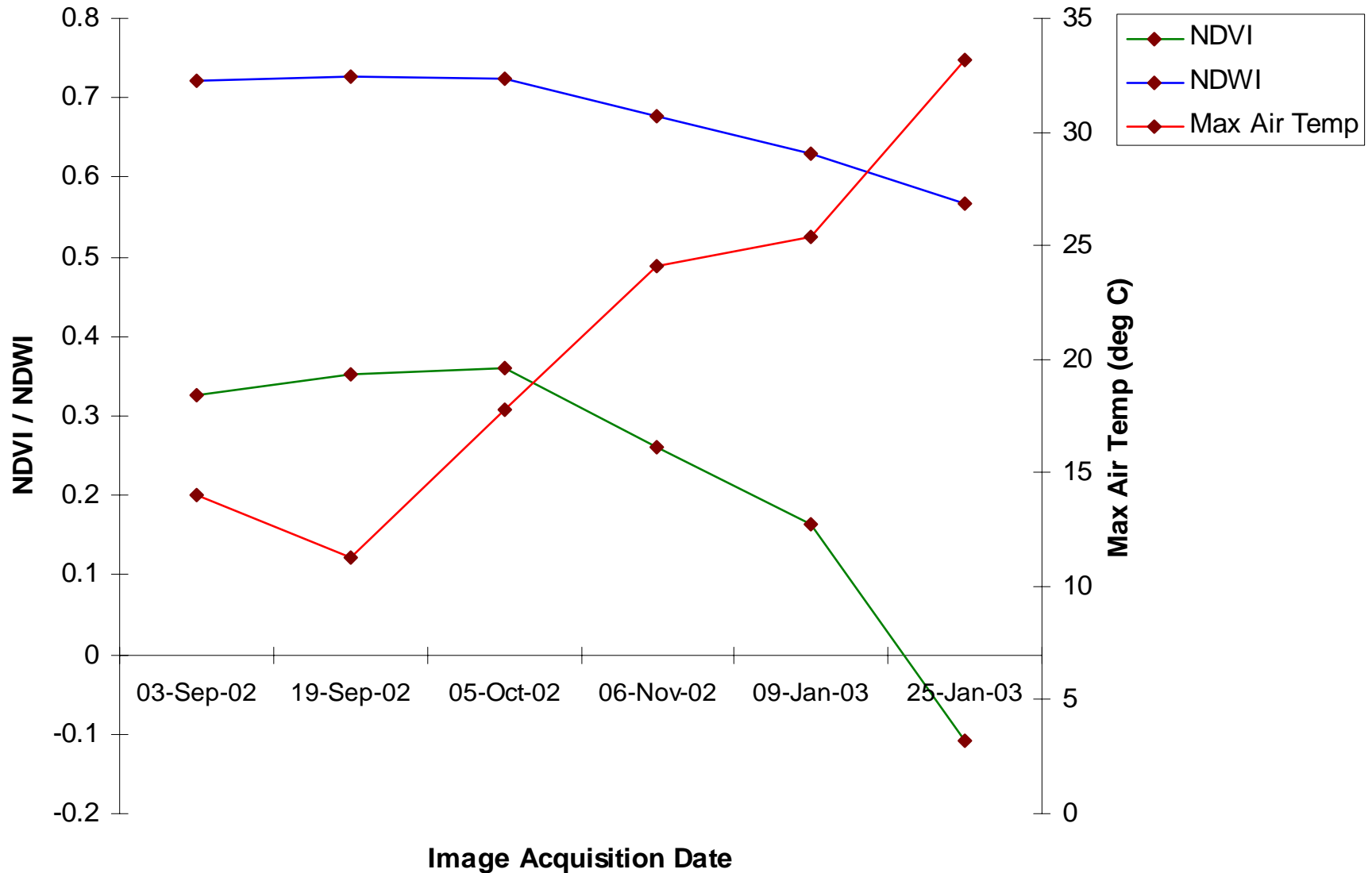


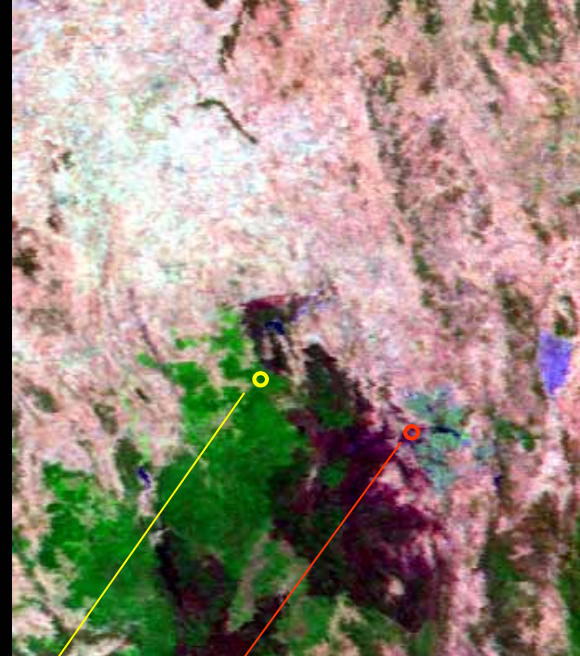
Before (Sep 2002) and after the fire (Feb 2003)

# What was happening before the fire?

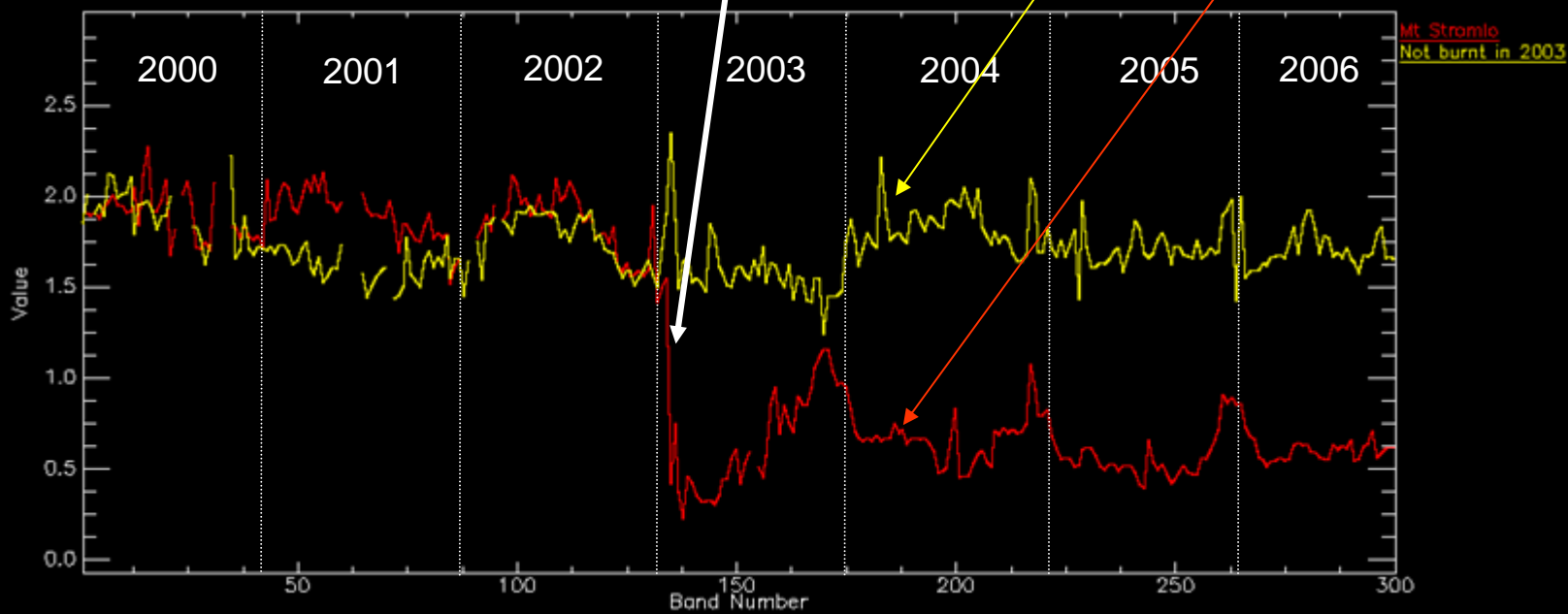


# What was happening before the fire?





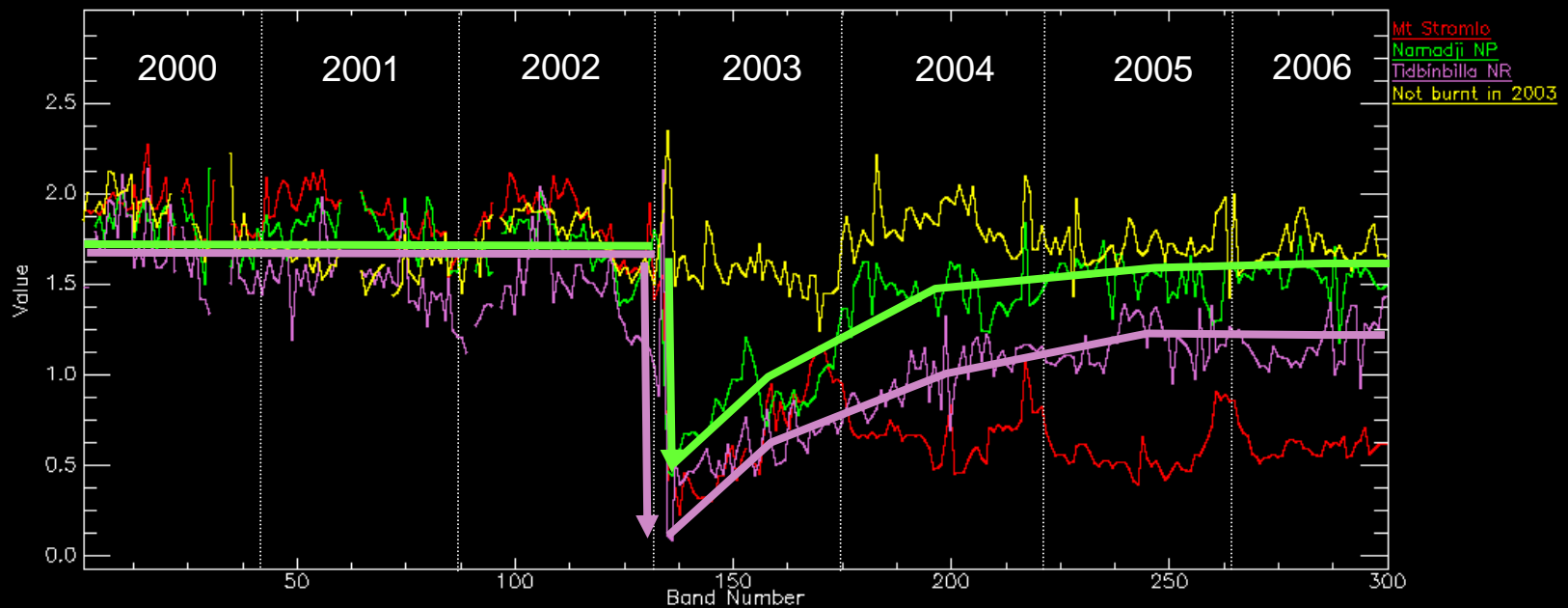
## 2003 Firestorm



# Time Series Analysis

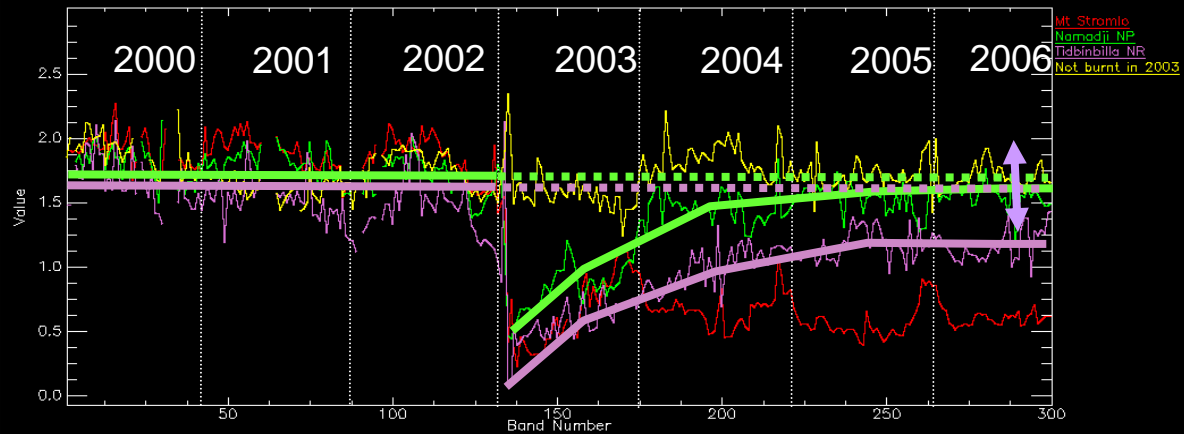
Basic pre-post statistical analysis:

- Mean VI prior to the fire
- Magnitude of the change in VI
- Annual mean VI post fire
- Time taken for VI to return to pre-fire mean

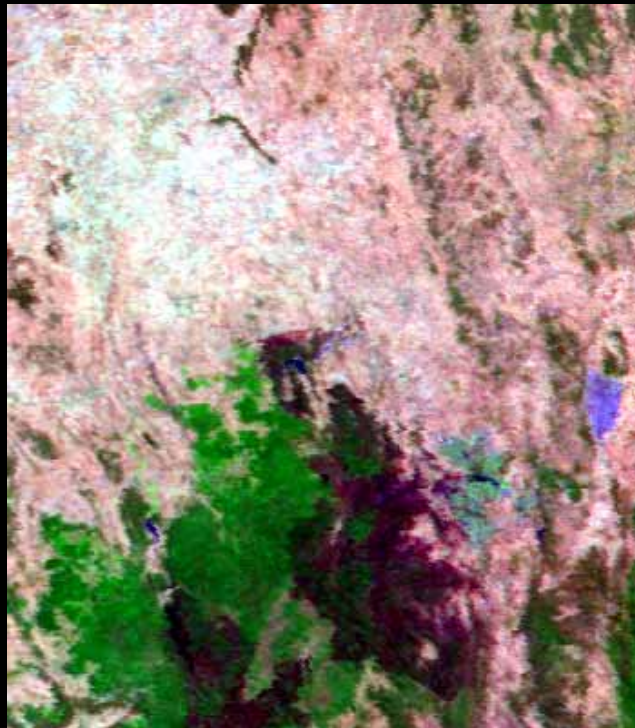


# Time taken for mean VI to return to pre-fire values

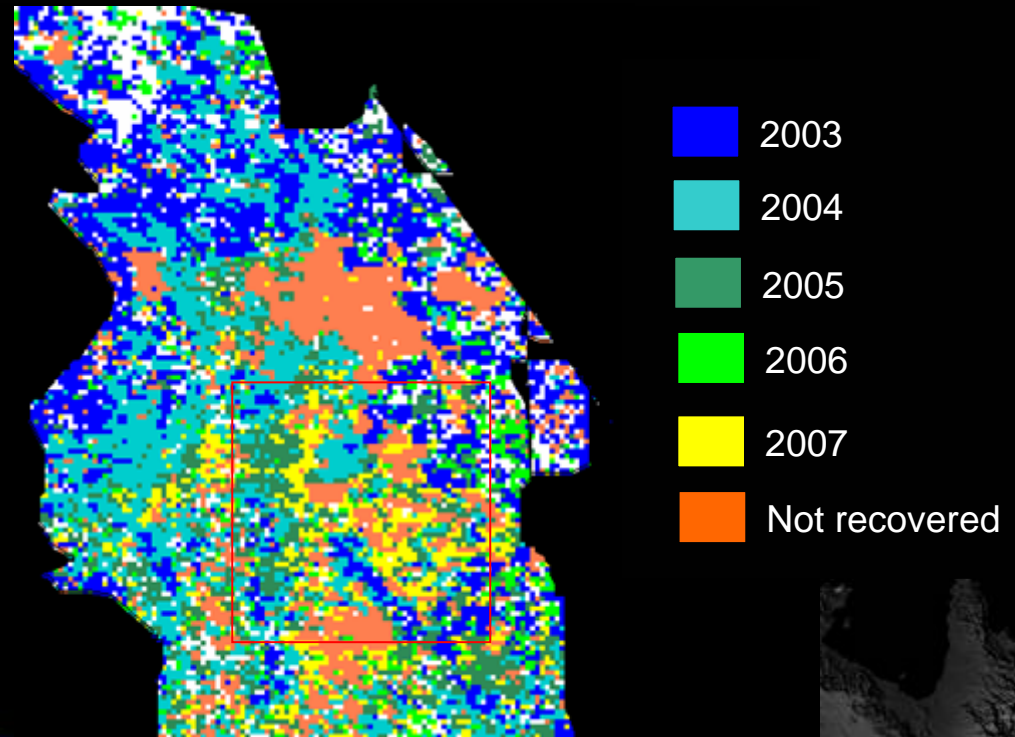
Time taken for "recovery"



Single date image



Year of return to pre-fire mean VI

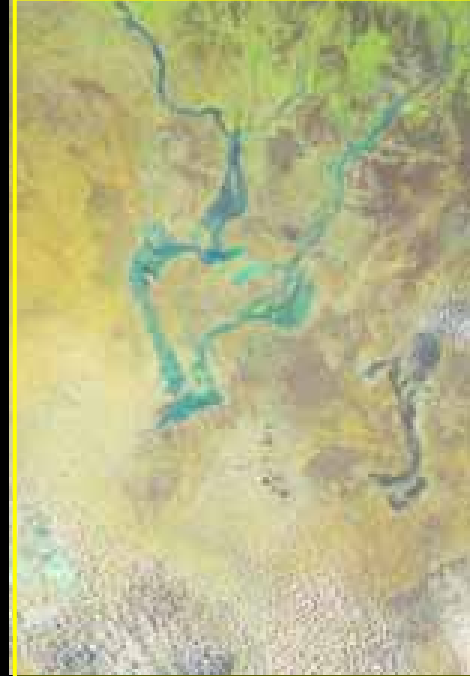


# Future Directions

- **Planning**
  - Sentinel hotspot analysis
    - Temperature & energy output
    - Fuel load analysis (pre-fire mean)
  - National burn area statistics (SoE)
- **Response**
  - Near Real Time mapping and impact assessment
    - Footprint determination eg fire front, fire scar
    - Change detection
    - Disaster footprint analysis
  - Delivery system
    - Fit for purpose public interface
    - Secure feed to emergency services
- **Recovery**
  - Recovery time mapping

# Summary

- Our response for bushfire events was mainly satellite data provision
- Unprecedented Sentinel usage showed demand for emergency mapping information
- Potential to contribute to the response phase of emergency management with value added science products



**Floods**

**THANK YOU**

**Thank you!**



**Fires**



**February 2009**