Australian Government
Department of the Environment

National Carbon Accounting Using Remote Sensing Data

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Key Issue

- Land sector is a key source of emissions and sink in Australia

Examples of Forest Types and clearing activity in Australia

Closed Forest (>80%) Barron River, Qld

Open Forest (50-80%) Wombeyan, NSW

Woodland Forest (20 – 50 %) -Undara NP, Qld

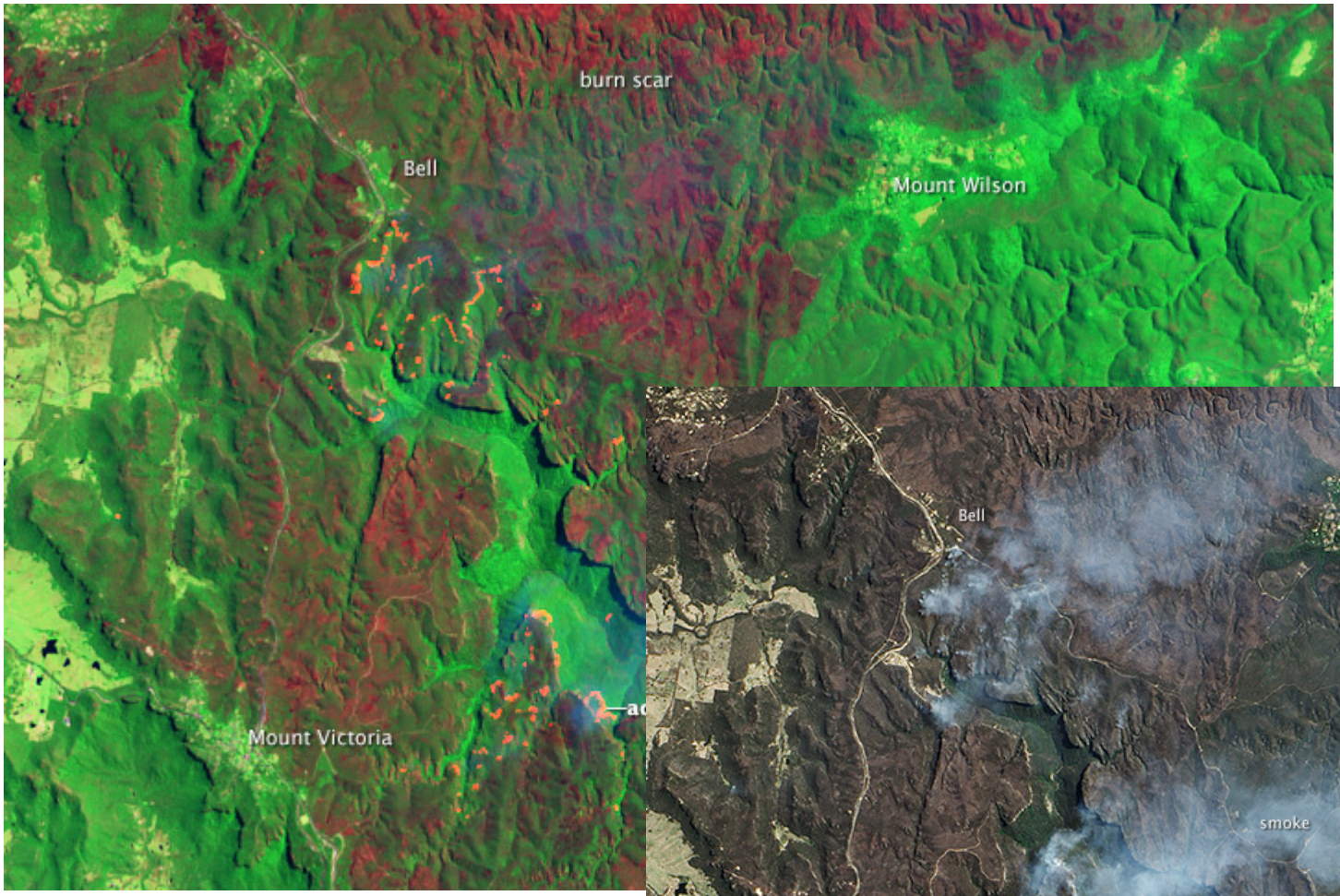
Sparse Woody Vegetation (5 - 20%) NT

Permanent forest conversion

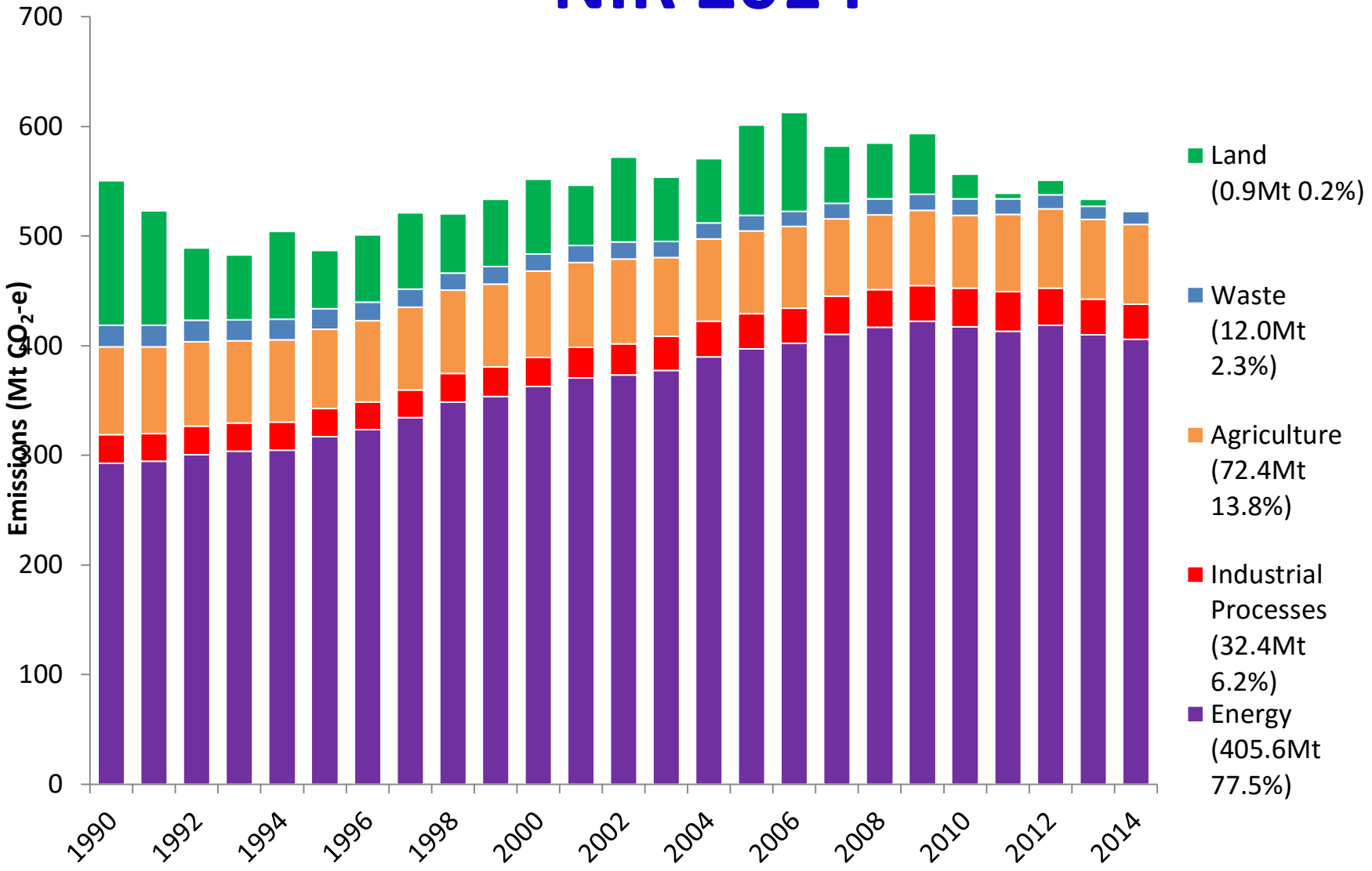
Clearing for fodder

Source - (top and centre row) ABARES (2013), (bottom left) ABC 2016, (bottom right) DNRM 2013)

Natural disturbance events - wildfires



Australia's Latest Emissions Profile
NIR 2014



Key considerations in designing our national inventory system

- National consistency
- Monitor change
- Develop baselines and reference years
- Report at relevant spatial scales (<1ha units)
- Report at relevant temporal scales (annual)
- Account for all pools (biomass, dead organic matter and soil) and gases (CO_2 and non-CO_2)
- Meet all reporting requirements (UNFCCC, Kyoto, markets, policy development)

Solution - Process based modelling system to support land sector reporting - *FullCAM*

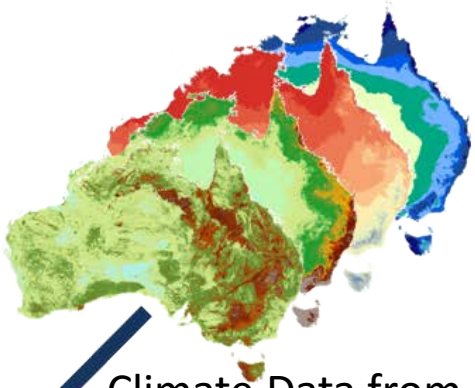
ABS

ABARES

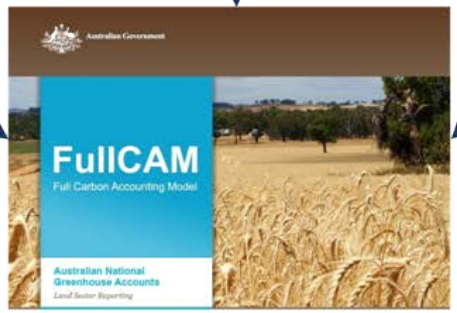
Landgate

CSIRO

Satellite data from GA

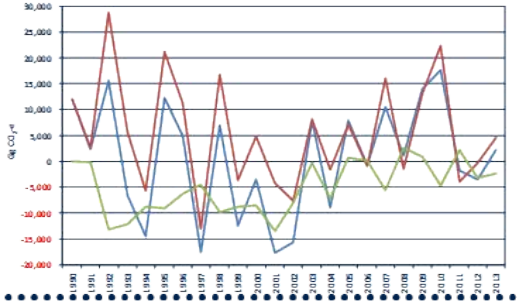


Climate Data from BoM / ANU



FullCAM Outputs

Output Database

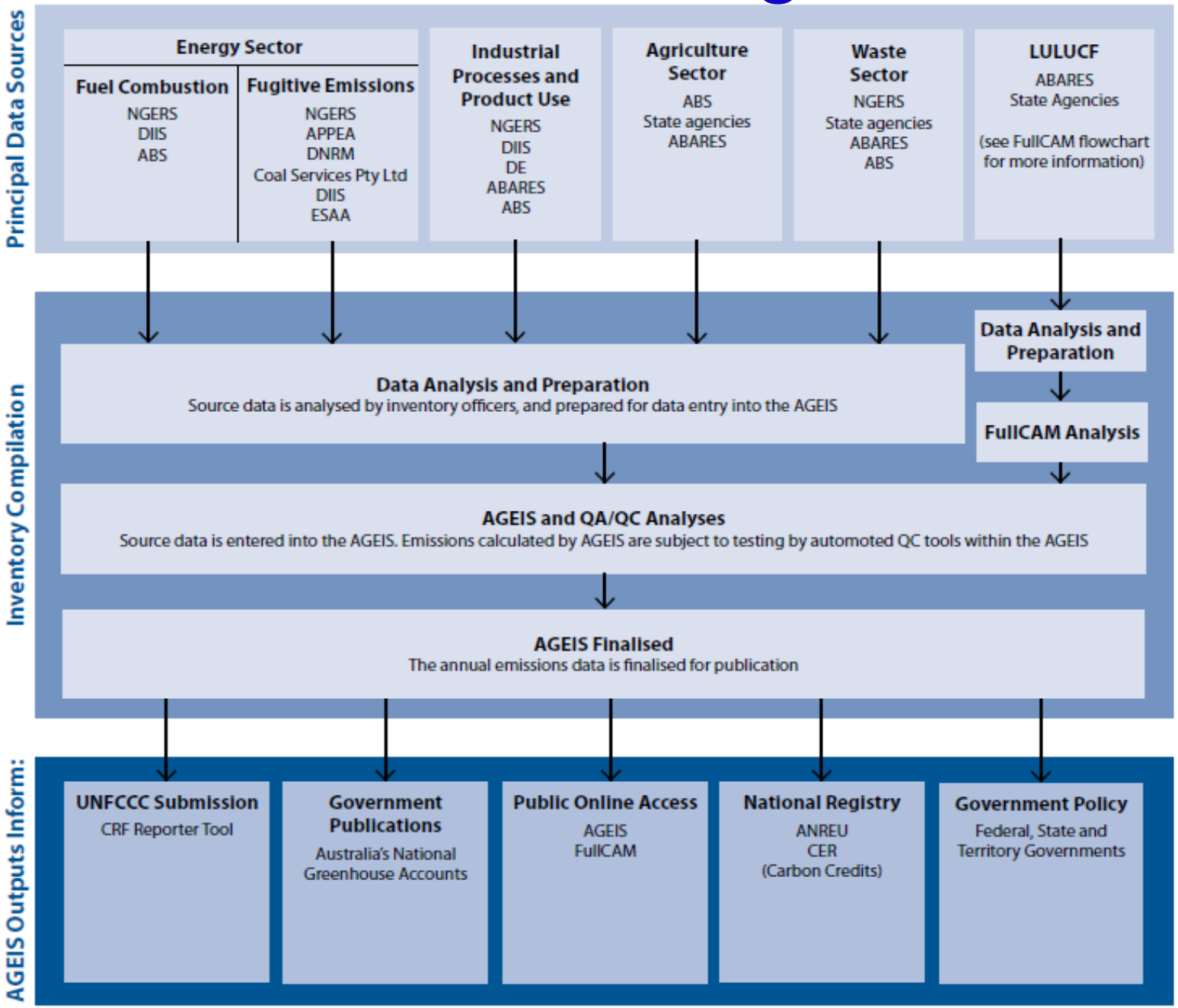


AGEIS

The Model is driven by Remote Sensing Land Cover Change Data

- We use Landsat satellite data to detect “where” and “when” the land conversion has taken place
  - Land converted to forest land
  - Forest land converted to other land use
- Extensive research and pilot studies have been undertaken during the early 2000s to assess the feasibility
- Since then we have made significant investment in developing and operationalising the methodology for Land Cover Change Programme
- Increasingly used by other countries for forest monitoring and national reporting – GEO/GFOI

Institutional Arrangements



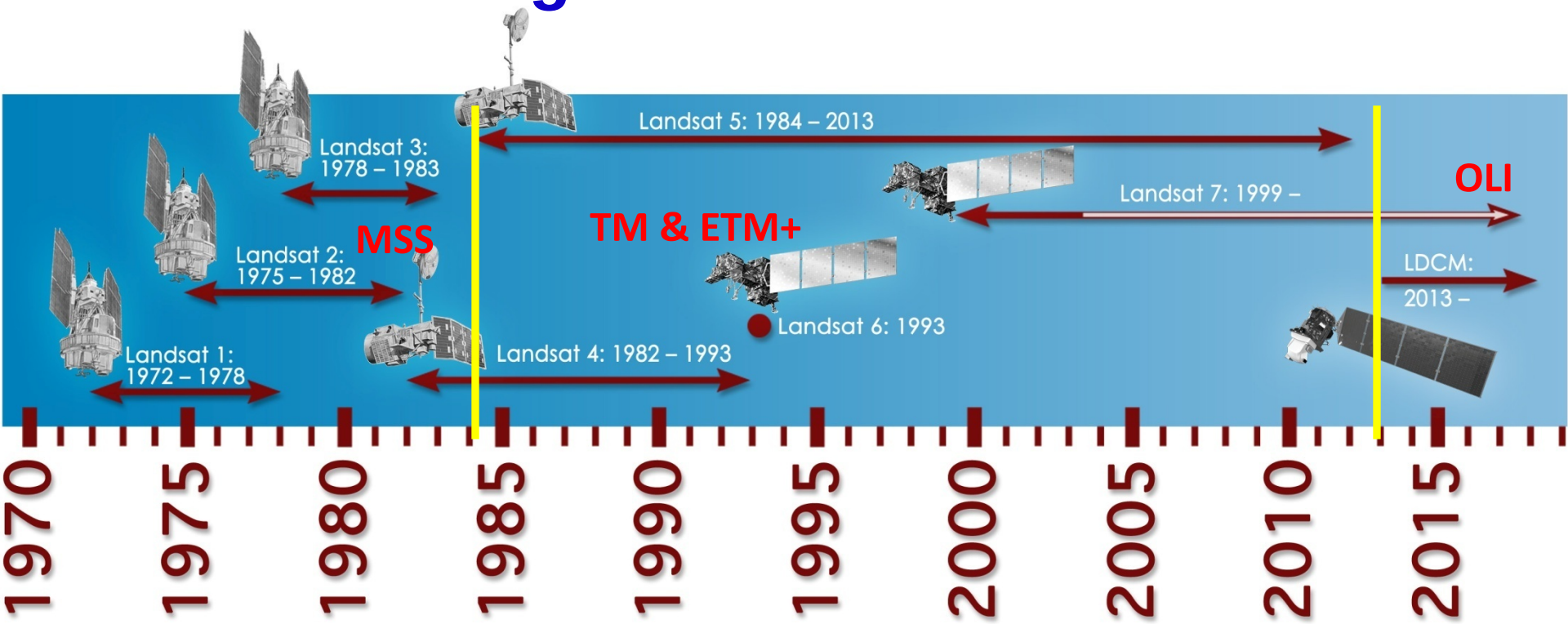
Institutional Arrangements

- Continental scale land cover data is produced annually in collaboration with multiple agencies

  - Commonwealth Scientific & Research Organisation (CSIRO) – Developed algorithms & overall design of the monitoring system & ongoing QA/QC
  - Geoscience Australia – supplies calibrated Landsat data and associated R&D
  - Private Sector – provides ongoing routine data processing support
  - Australian National University – Climate Data, FPI
  - Department of the Environment - Integration and Modelling

National Inventory - Land Cover Change

Riding on the back of Landsat



8 Landsat satellites (NASA – USGS)

~ 43 years of land cover history

-4 different sensors over the life of Landsat program

- 2 major sensor changes [MSS to TM & TM/ETM+ to OLI]

Advances in Satellite Data Processing - Data Cube

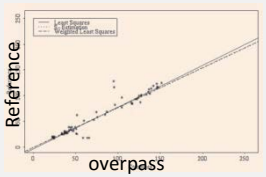
Faster, Better and Cost Effective!

Previous Methodology

1 Scene Selection

2 Data Dist

3 Reg & QA

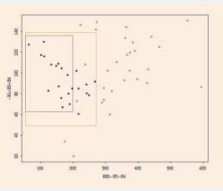


4 Cal & QA

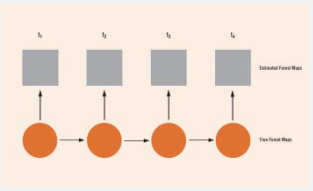
5 Cloud & QA

6 Mosaic & QA

Information Extraction



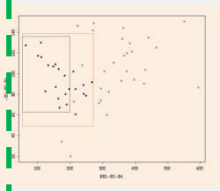
7 Image Classification



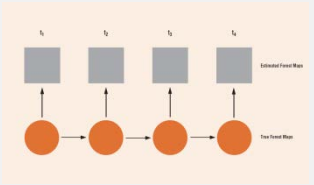
8 CPN

Current Methodology

Resource intensive tasks
no longer required – resulting
in significant savings and efficiency

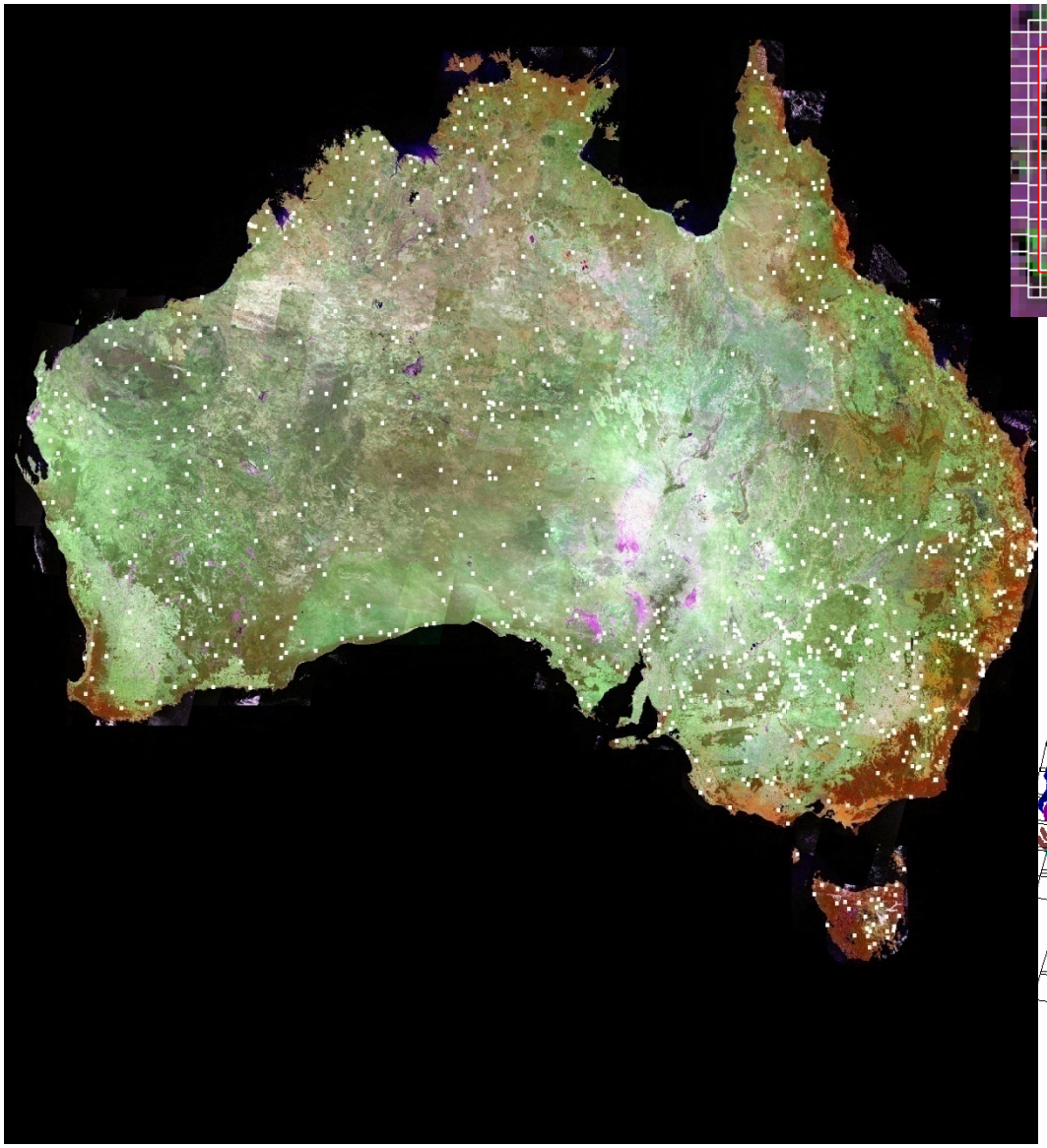


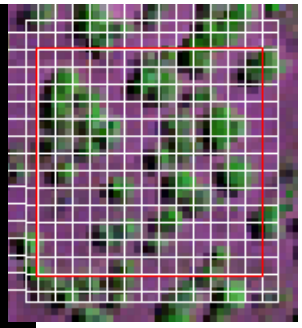
Classification
Req modification



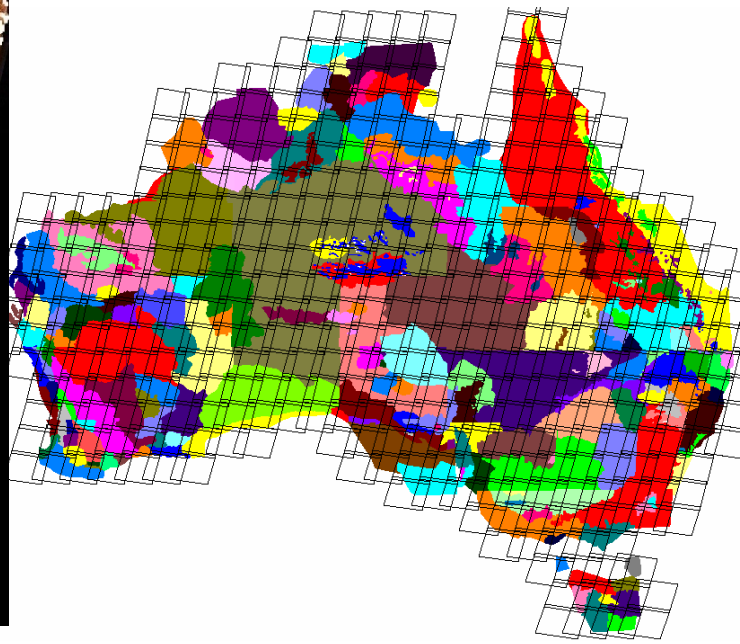
CPN
Req modification

Training the Image Classifier - 1





- “Ground truth”
- Analysis
- Processing
- Validation



Training the Image Classifier - 2

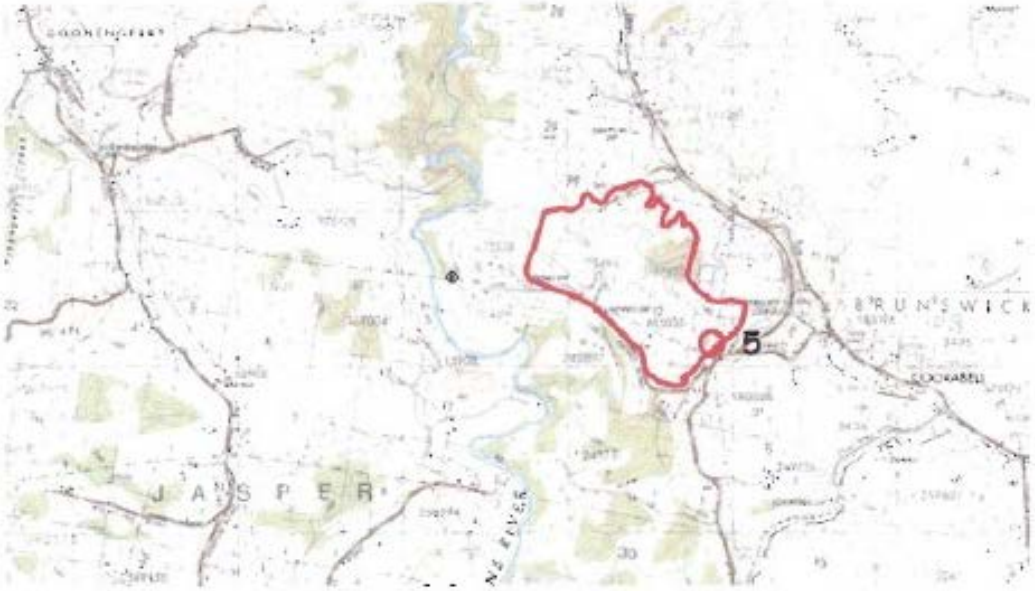
oto # 215, Run # 4, Film # 4848
26/06/2004, LPI NSW

Ground Photo # 005

Landsat 7

005
oord 546982
oord 6833207
October 2004

NC HWD 005.doc



Dunoon + Huonbrook 1:25 000 Topographic Maps, 95401S + 95401N

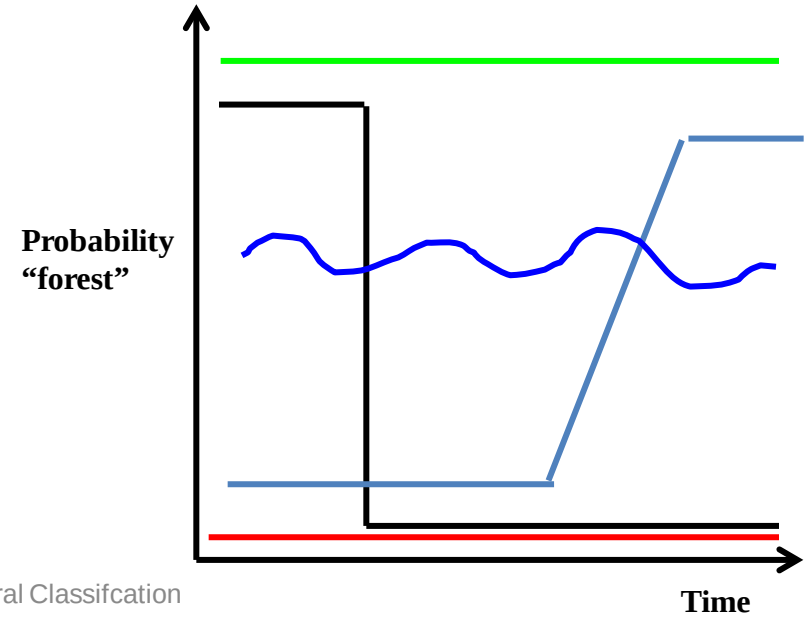
mb
CONSULTING GRO

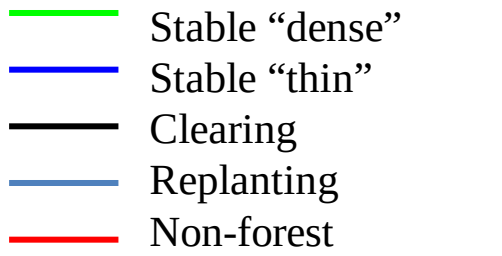
Multi-temporal Classification – CPN

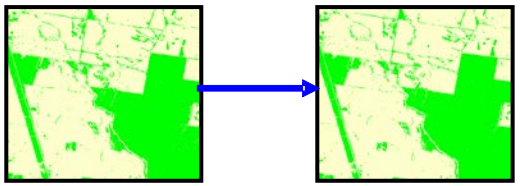
- Conditional probability models are used to combine probabilities from a number of years to give an overall assessment of the likelihood of land cover change
- False change due to single-date classification errors is reduced by using the whole time-series in the classification

Temporal Rules:

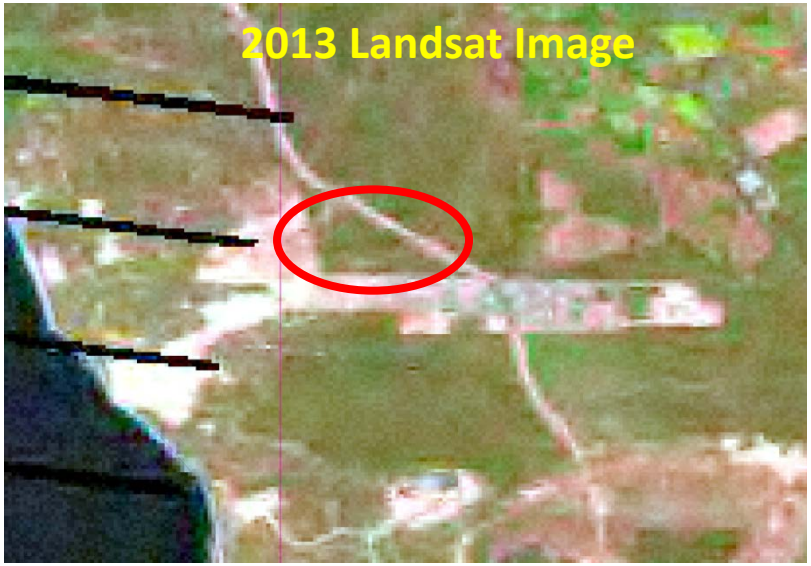
- Resolves the uncertain spectral region and more accurately detects genuine change by using the temporal trends in the probabilities of forest cover

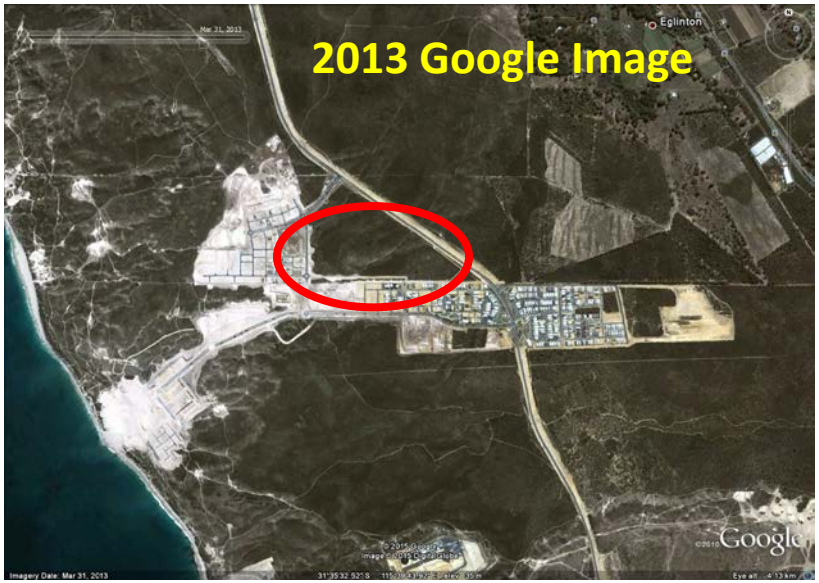




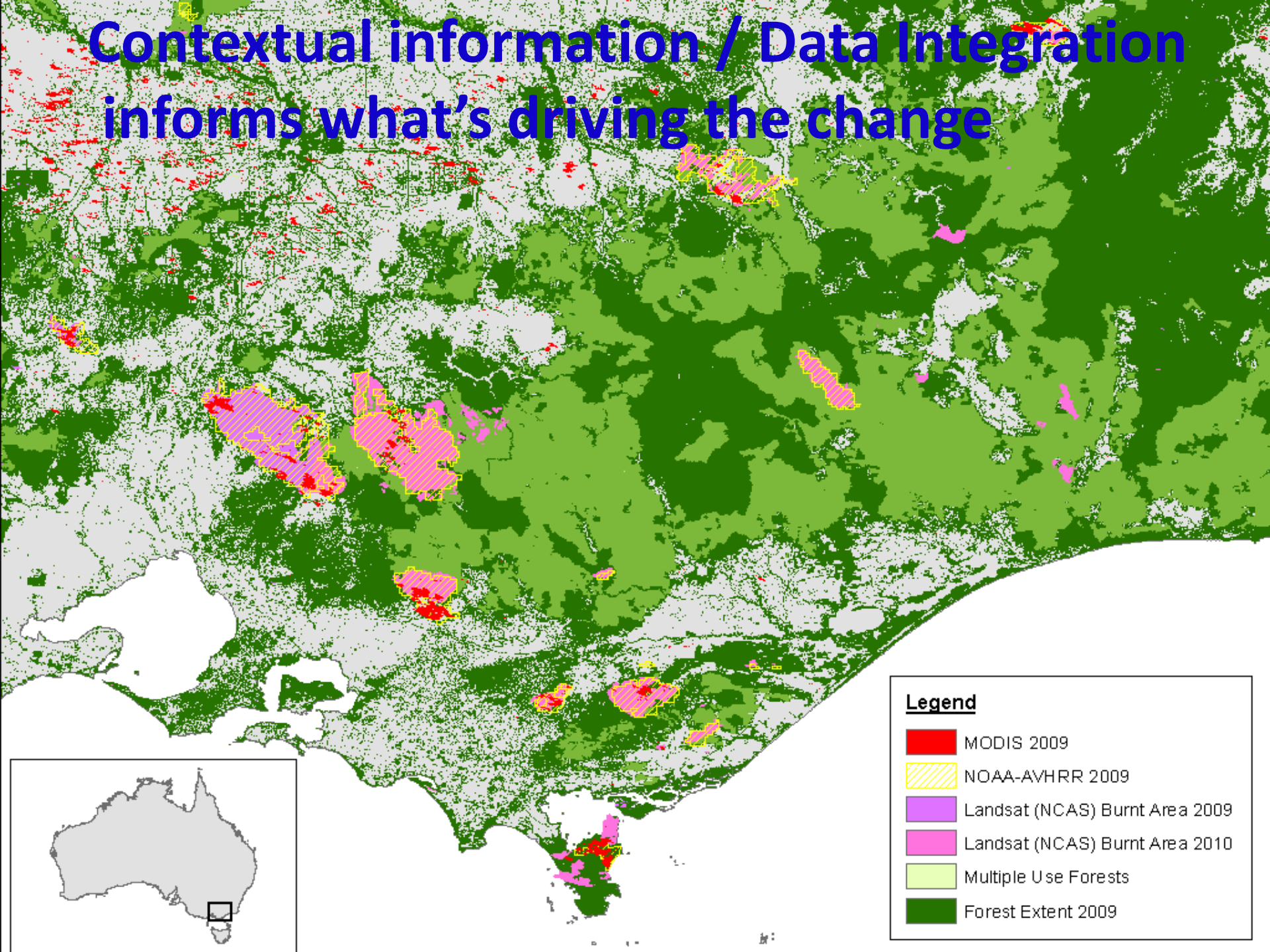


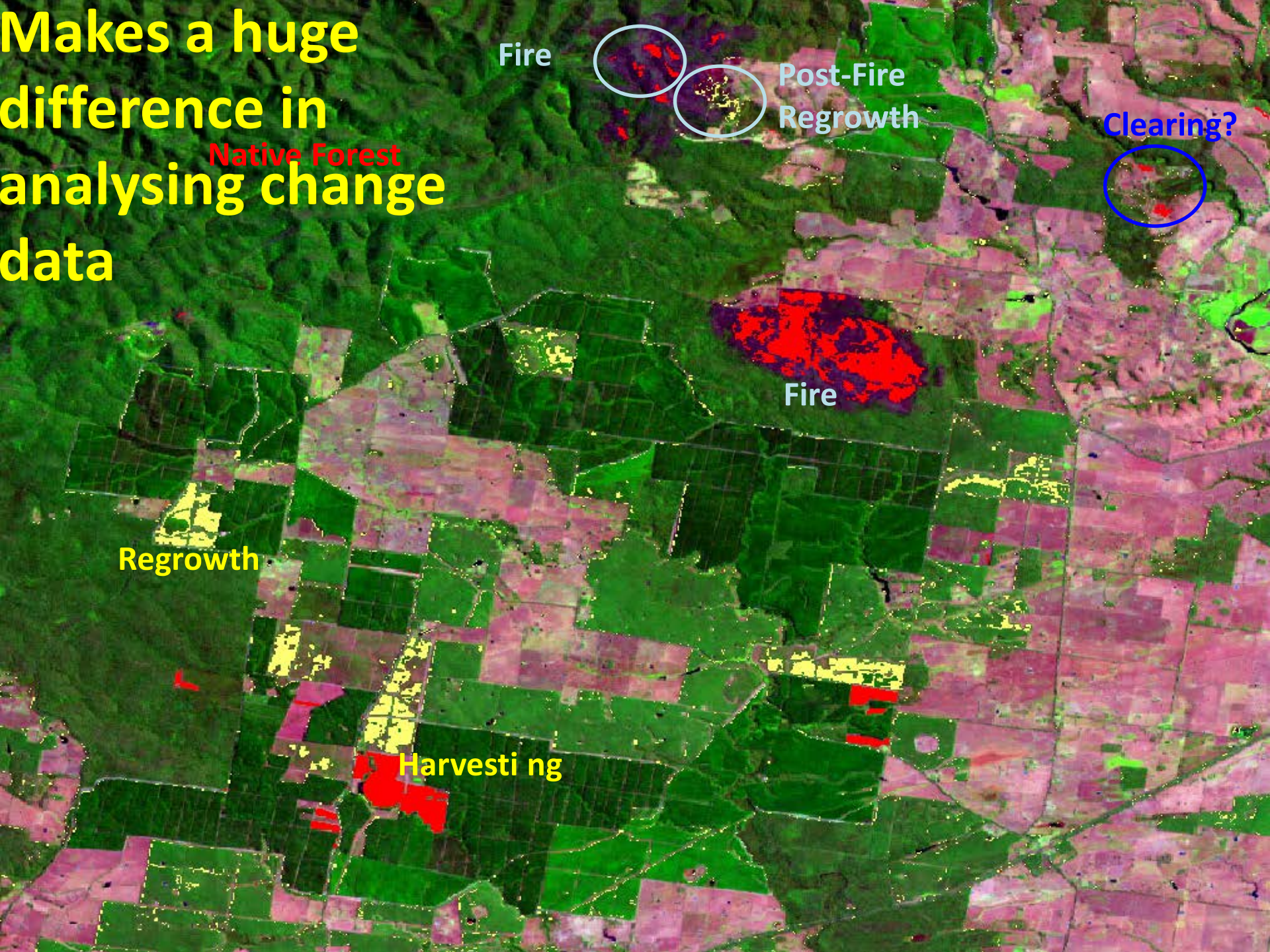
More Data Than Ever Before to Confirm Land Conversion



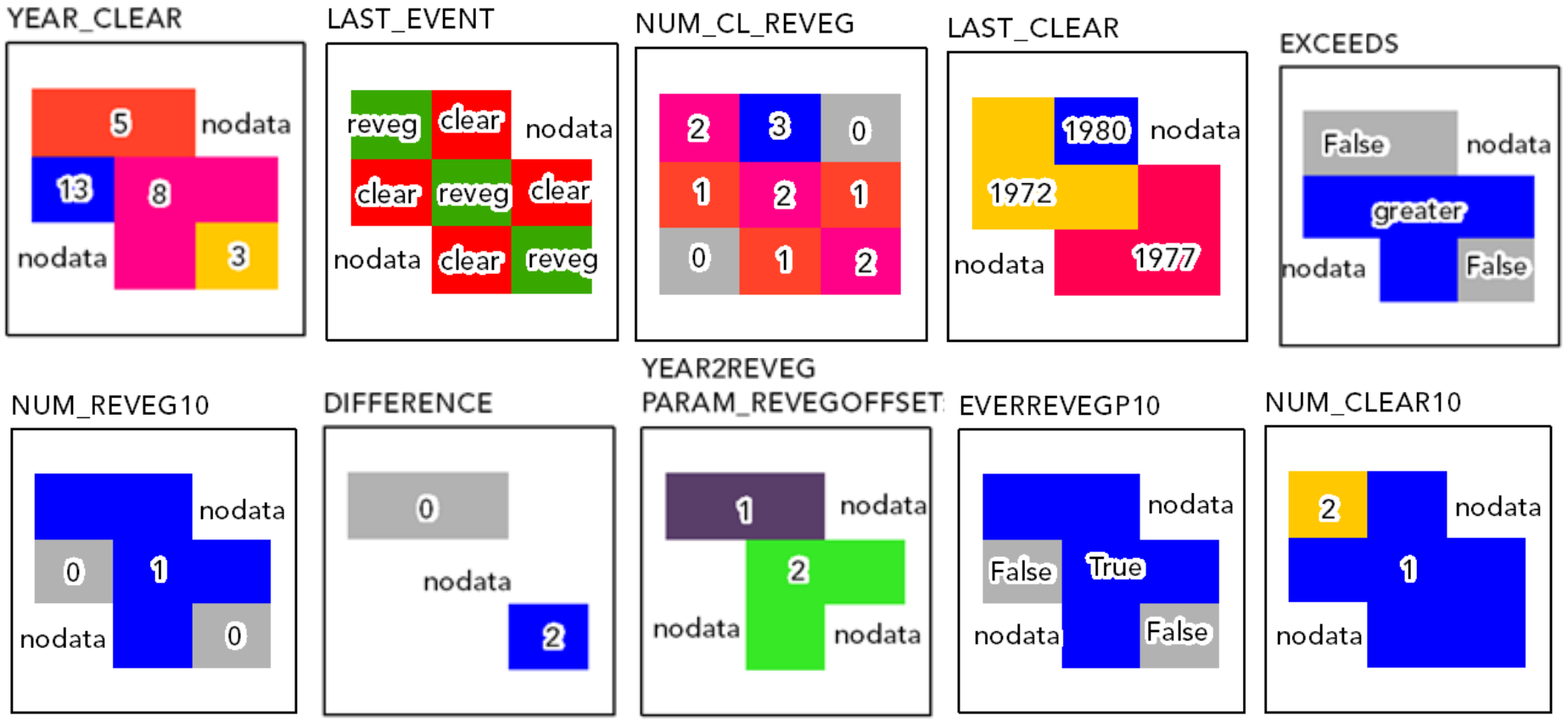


Contextual information / Data Integration informs what's driving the change



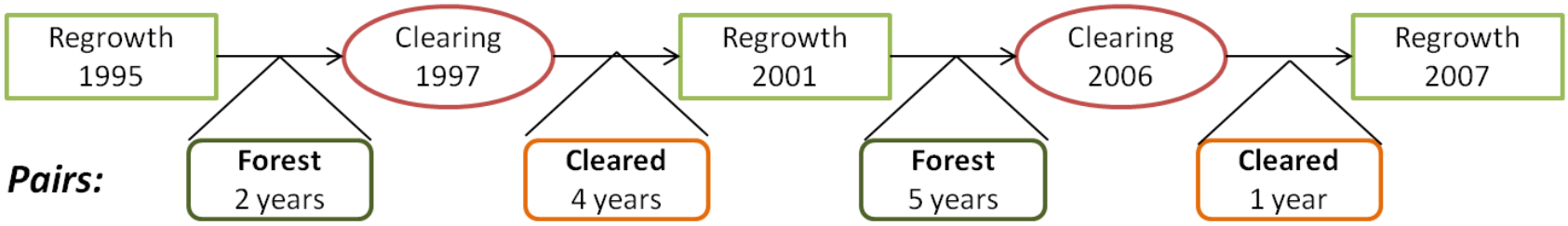

Makes a huge difference in analysing change data
Native Forest
Fire
Post-Fire Regrowth
Clearing?
Fire
Regrowth
Harvesti ng

40+ Years of Time Series Data
Very Useful For Information Extraction



Time series regrowth and clearing sequence - data mining

Sequence:



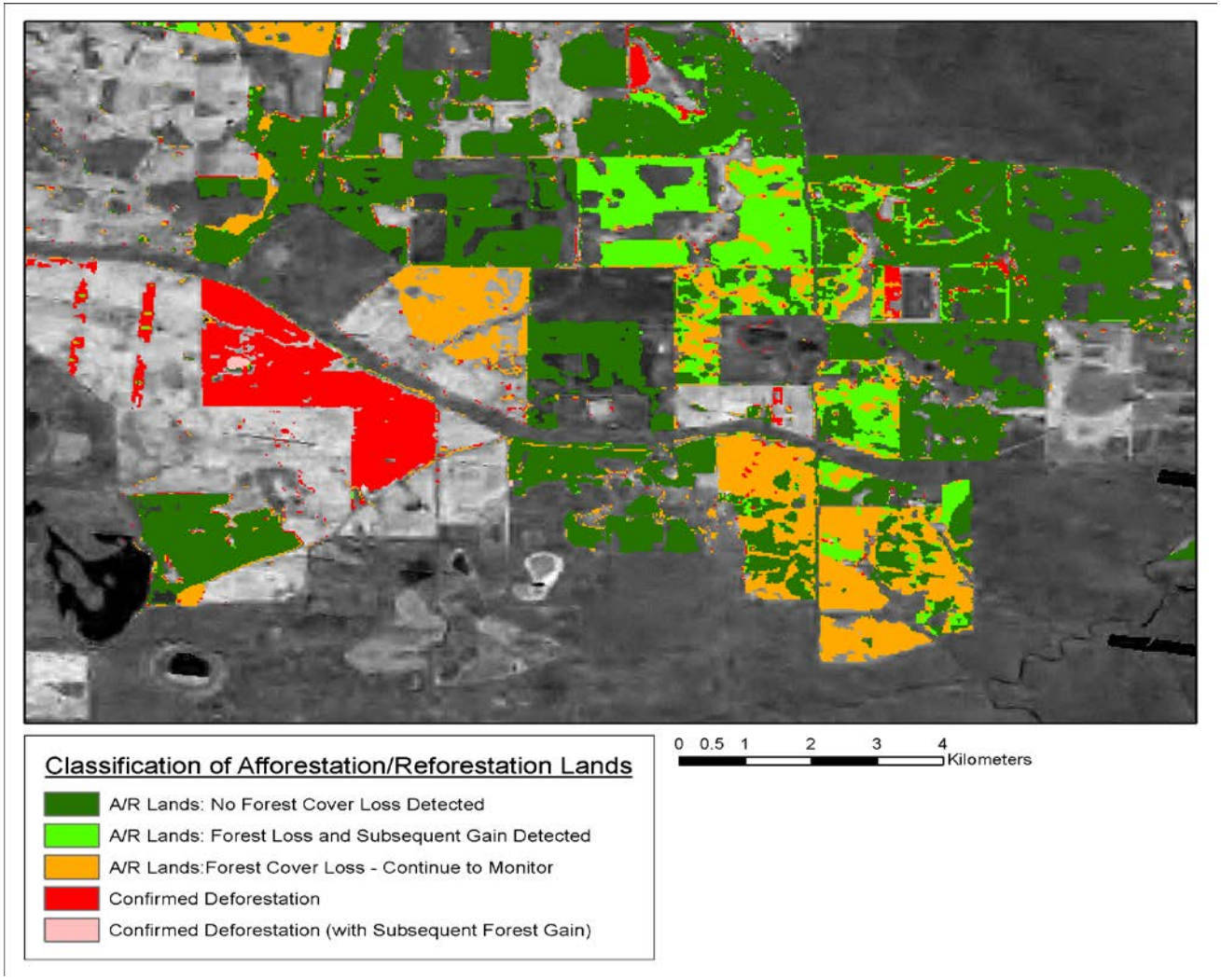
Attributes:

Attribute	Calculation	Value
No_Pairs		4

Attribute	Calculation	Value
Forest Pairs		
PAIRS_F_MIN	Min(2, 5)	2
PAIRS_F_MAX	Max(2, 5)	5
PAIRS_F_AVE	(2 + 5) / 2	3.5

Attribute	Calculation	Value
Cleared Pairs		
PAIRS_C_MIN	Min(4, 1)	1
PAIRS_C_MAX	Max(4, 1)	4
PAIRS_C_AVE	(4 + 1) / 2	2.5

To characterise land cover change



Some of the Challenges in Using RS Data

- Land Use vs Land Cover
- Land classification / definition
- Scale and sensor dependent variations
- Classification – Information Extraction
- Validation and verification
- Calibration & time series consistency
- Comparable & consistent with other forms of estimates

Conclusions

- We have developed an operational modelling system for carbon accounting using remote sensing data
- The system supports both the UNFCCC and KP reporting
- It has been reviewed annually for the last ten years by technical experts under the UNFCCC review process
- Our system is subject to ongoing improvements and uses latest research data and methods
- It supports domestic climate change programmes and policies