



Australian  
National  
University

# Australia's Environment in 2015

Briefing

27 April 2016, Canberra

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Water and Landscape Dynamics group  
Fenner School of Environment & Society  
The Australian National University



**Land cover change**



Bushfire



Water availability



Rivers and wetlands



Landscape condition

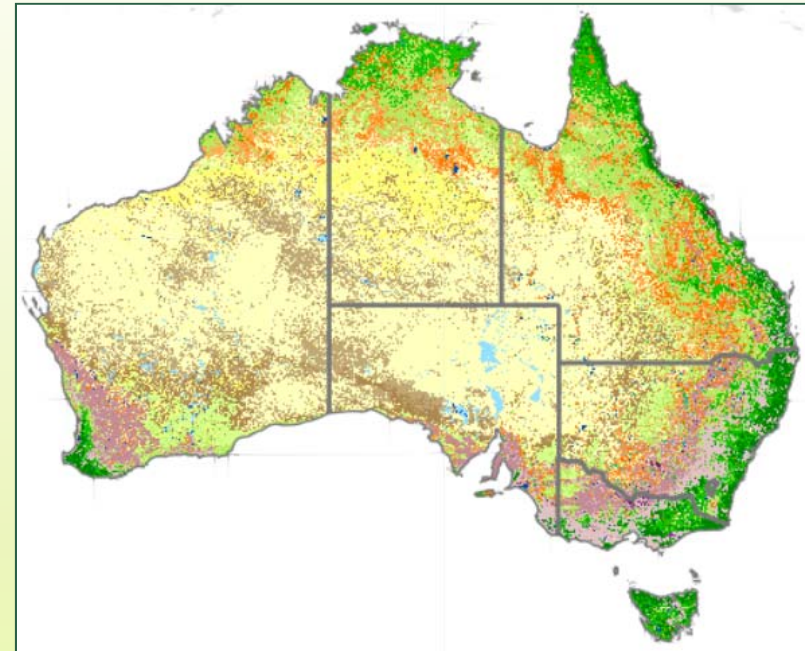


Carbon storage

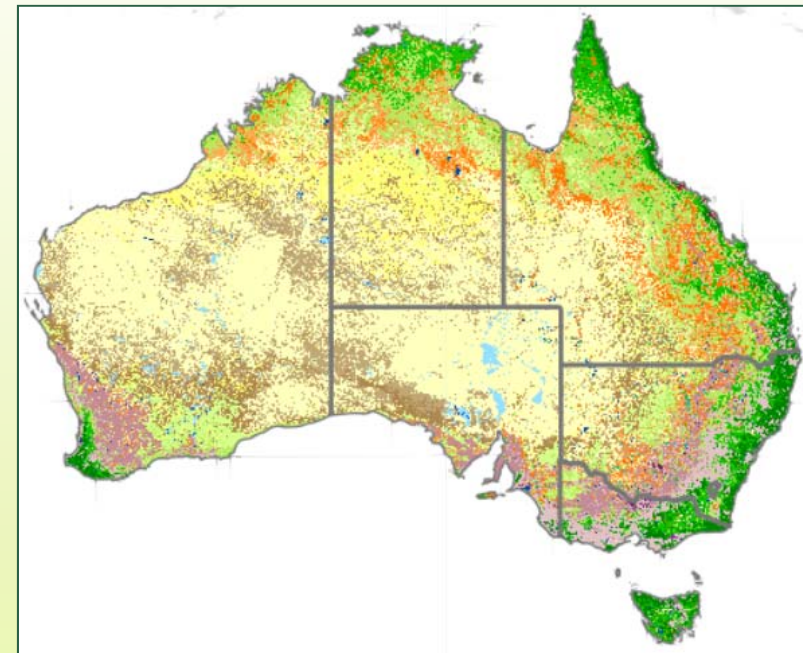
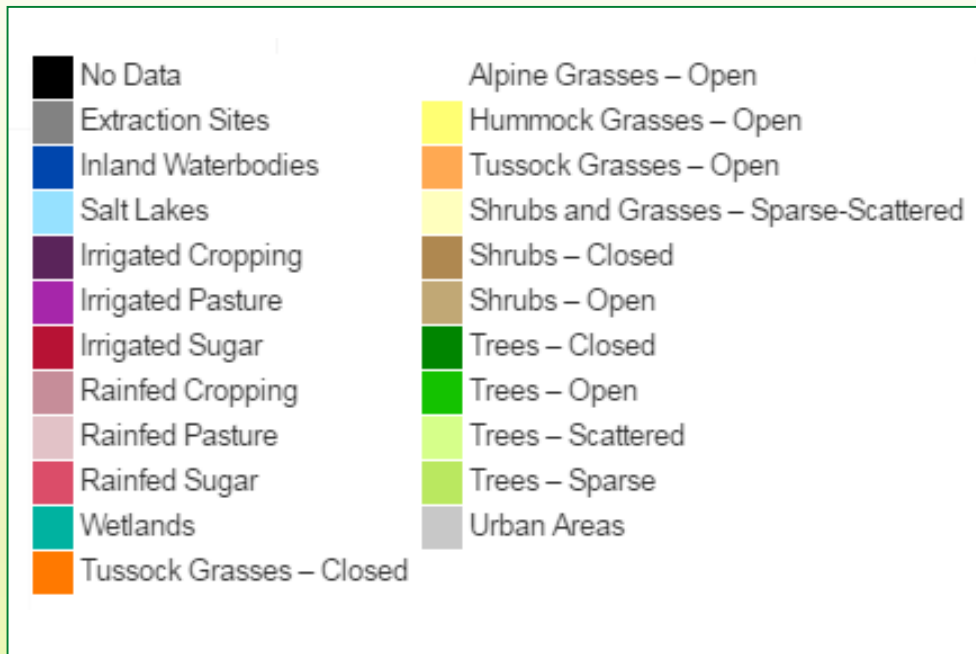


## Method

- Dynamic Land Cover Data, produced by Geoscience Australia
- Based on temporal greenness patterns using MODIS satellite data
- Produced annually at 250 m
- Most recent data for 2013, so not included as indicator for 2015
- Useful for interpretation of changes by land cover type



Lymburner et al. (2011) *Land Cover Map of Australia*, Geoscience Australia



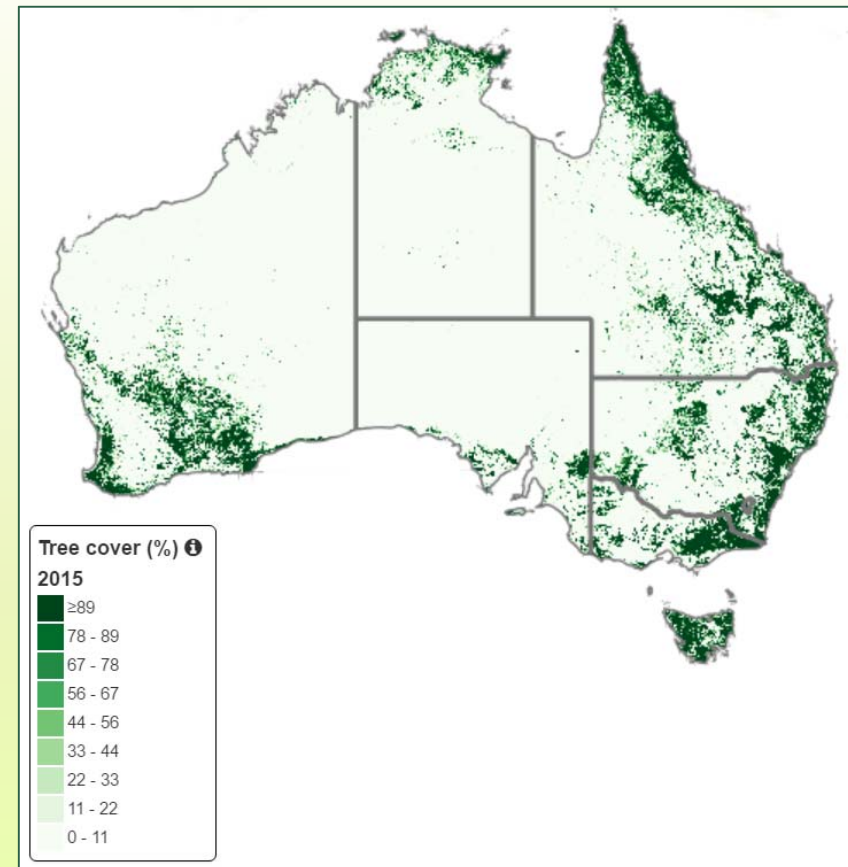
Lymburner et al. (2011) *Land Cover Map of Australia*, Geoscience Australia



## Method

- Forest: at least 20% canopy cover with potential to reach over 2 metres height (cf. Kyoto protocol)
  - 1972-2013: National Carbon Accounting System (NCAS) forest mapping
  - 2014-2015: we trained a data-mining algorithm to use GA Landsat imagery
  - Small inconsistencies can occur, but do not affect general patterns
- 25 m and semi-annual resolution

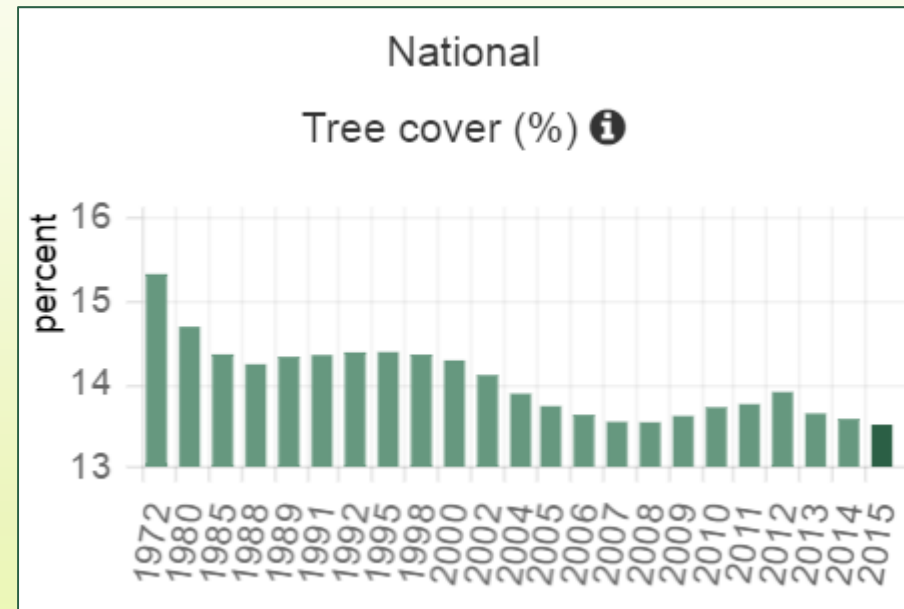
Furby et al. (2002) *Land cover change: specifications for remote sensing analysis*, Australian Greenhouse Office





## National view

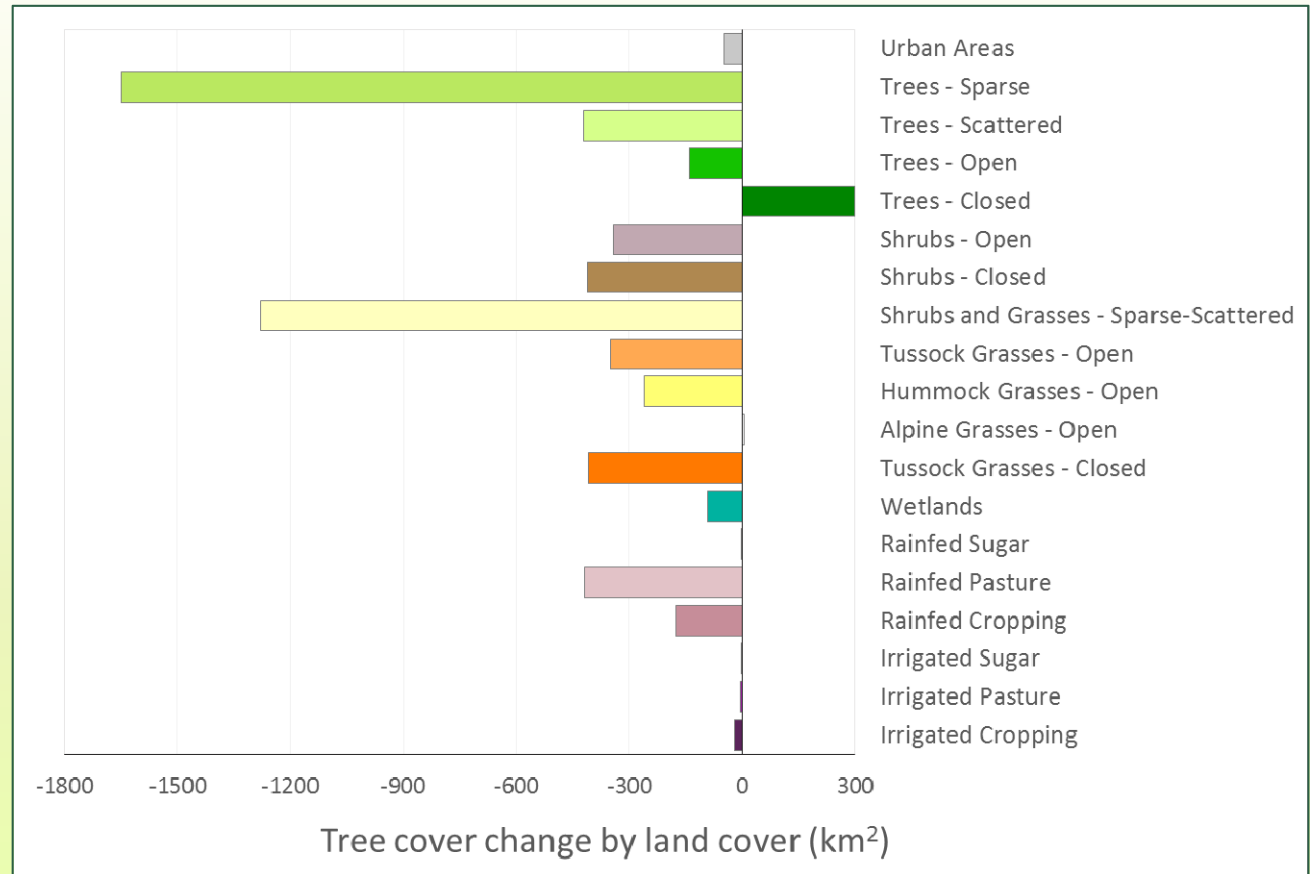
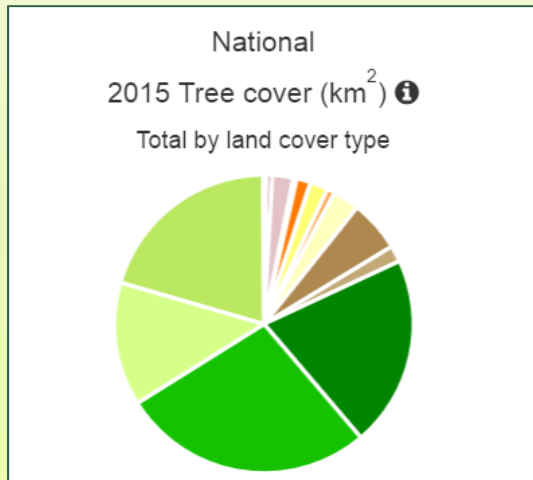
- Forest cover at lowest level since 1972
- In decline since 2012
- Reduction 530,000 ha or 0.5% of forest area in 2015





## National view

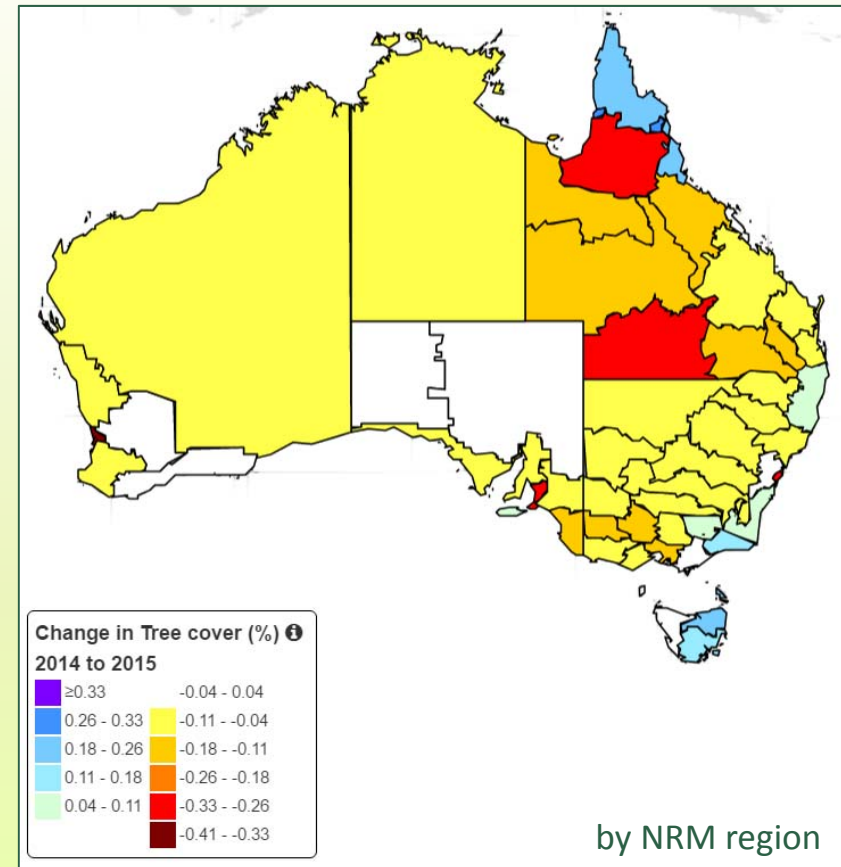
- Tree cover declined in all but one land cover type



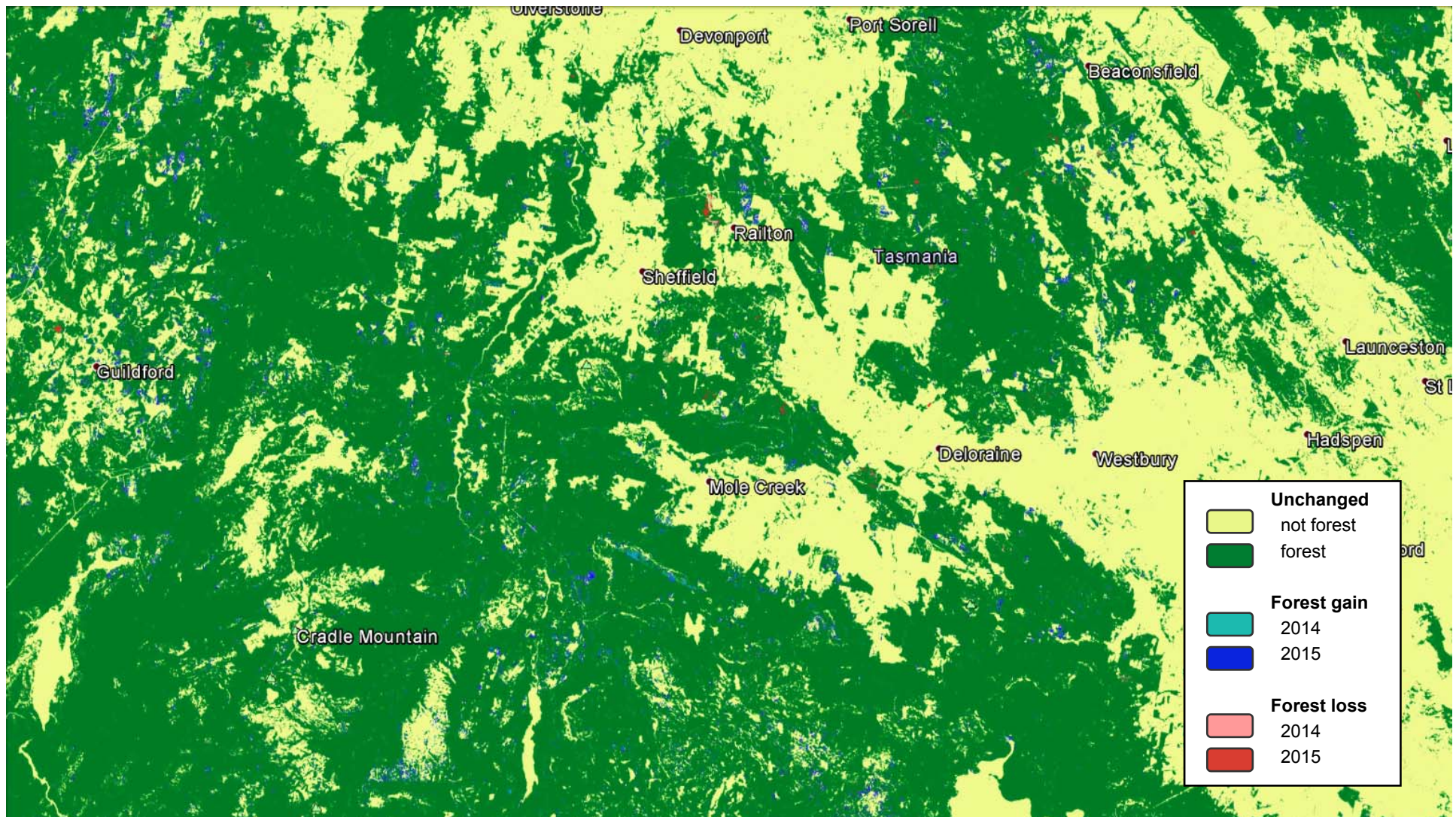


## Regional differences

- Largest losses in Queensland
- Tree cover loss in all capital regions
- Tasmania the only state to increase forest cover









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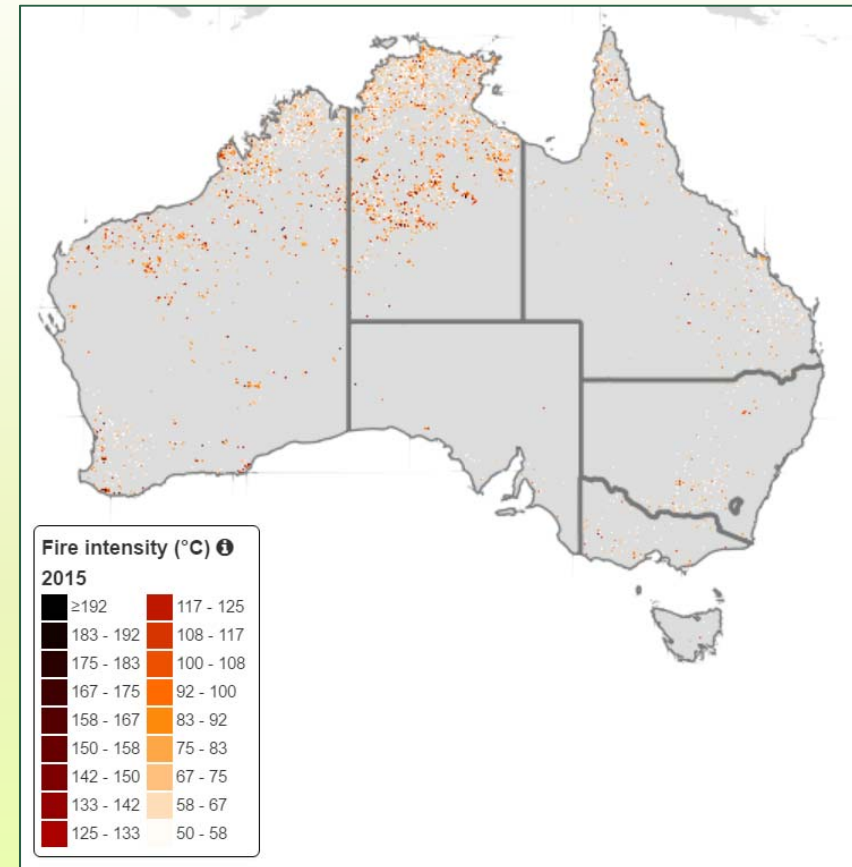


Carbon storage



## Method

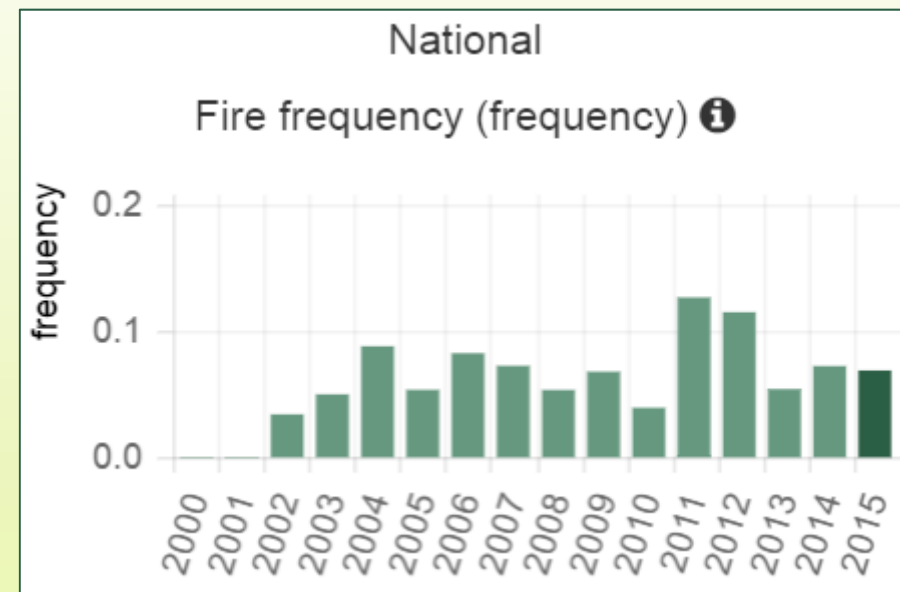
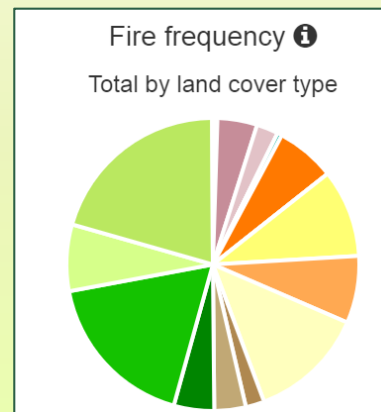
- Derived from GA's Sentinel Hotspots mapping system
- Uses thermal measurements to measure occurrence and fire intensity (°C)
- Sampled to daily and 2.5 km resolution
- Complete years from 2003 onwards
- Uses varying number of satellites, causing changing likelihood of observing fire over time.





## National view

- Number of bushfires returned to normal levels after 2011-2012 highs

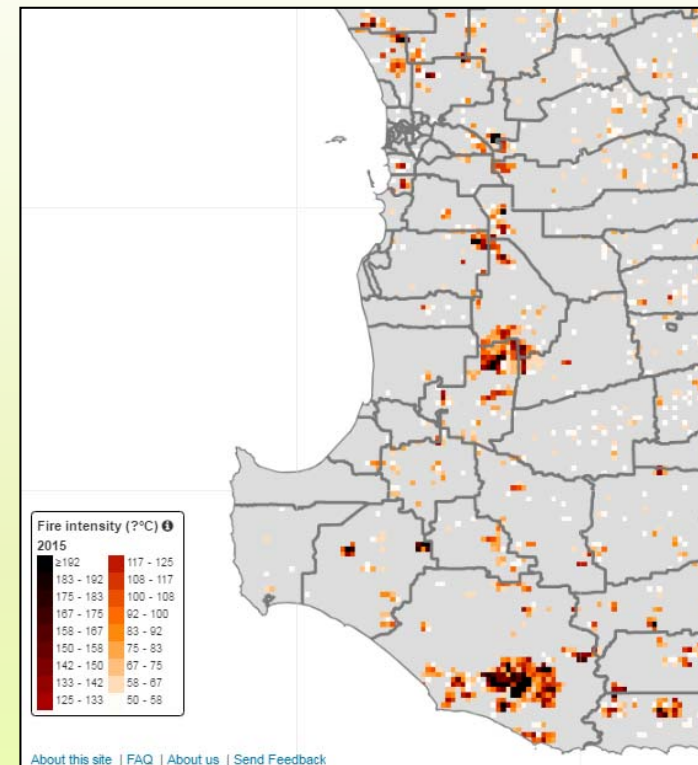






## Major events

- Sampson Flat, SA (Jan, 12,500 ha)
- North Perth, WA (Jan, 6,600 ha)
- Waroona, WA (Jan)
- Northcliffe, WA (Feb, 58,000 ha)
- Byfield, Qld (Mar)
- Pinery, SA (Nov, 85,000 ha)
- Otway, Vic (Dec/Jan, 2,500 ha)





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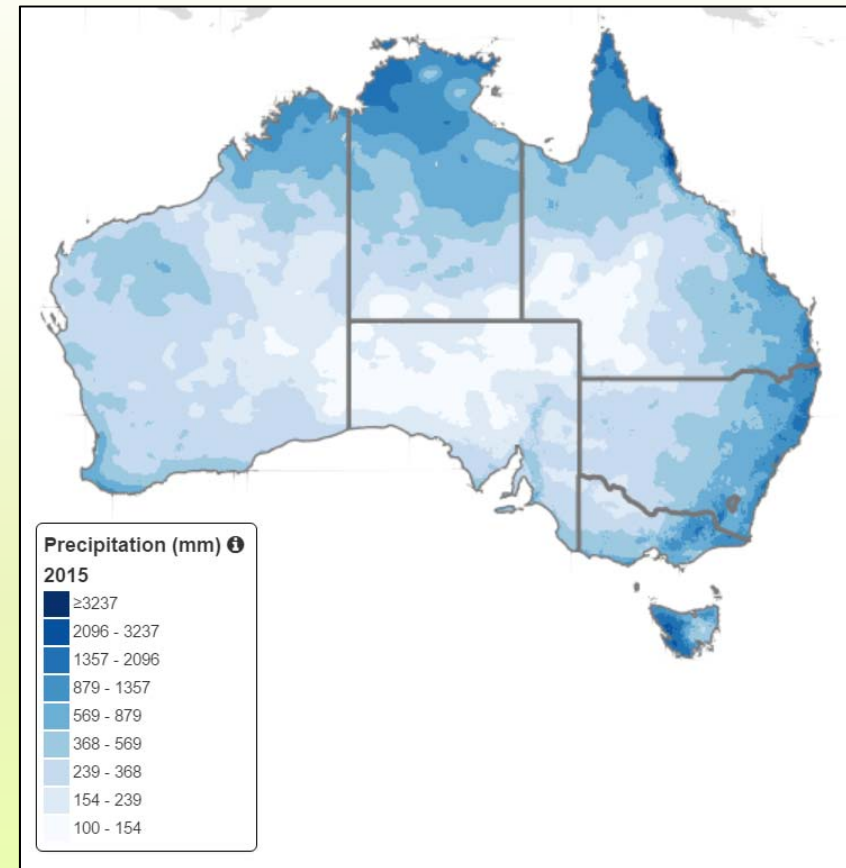


Carbon storage



## Method

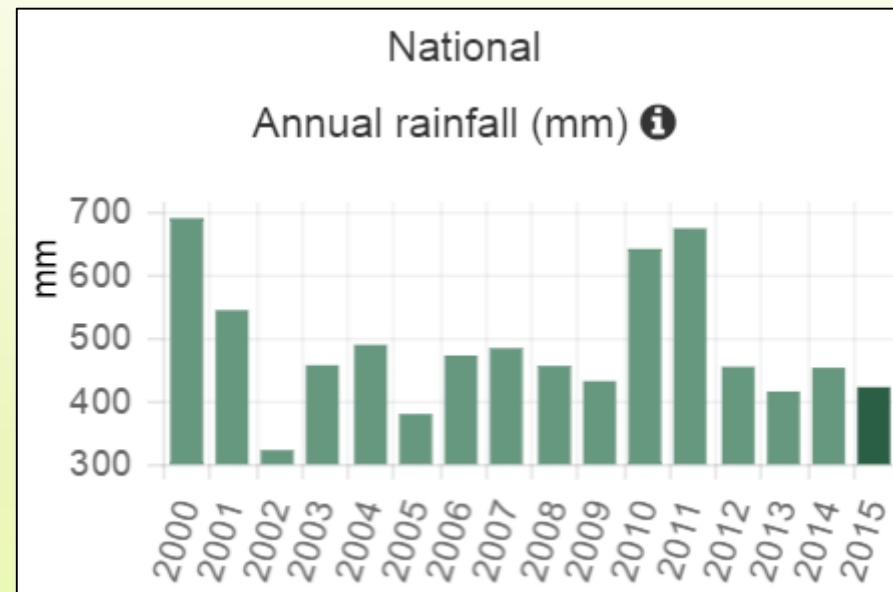
- Derived from ANU's Australian Water and Landscape Dynamics model-data fusion system (OzWALD).
- Merges gauge and satellite precipitation measurements
- Therefore can vary slightly from BoM estimates
- 5 km and daily resolution





## National view

- National average ca. 422 mm
- Below 1961-1990 mean of 465 mm\*
- 4<sup>th</sup> successive year of near-average rainfall nationally



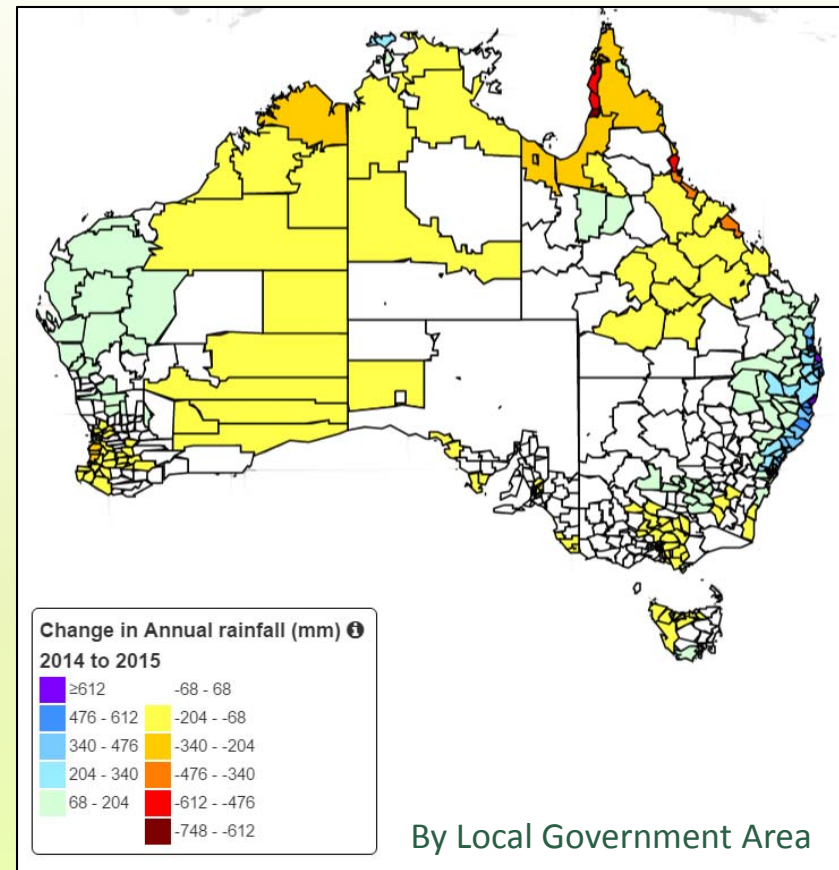
\*source: Bureau of Meteorology





## Regional differences

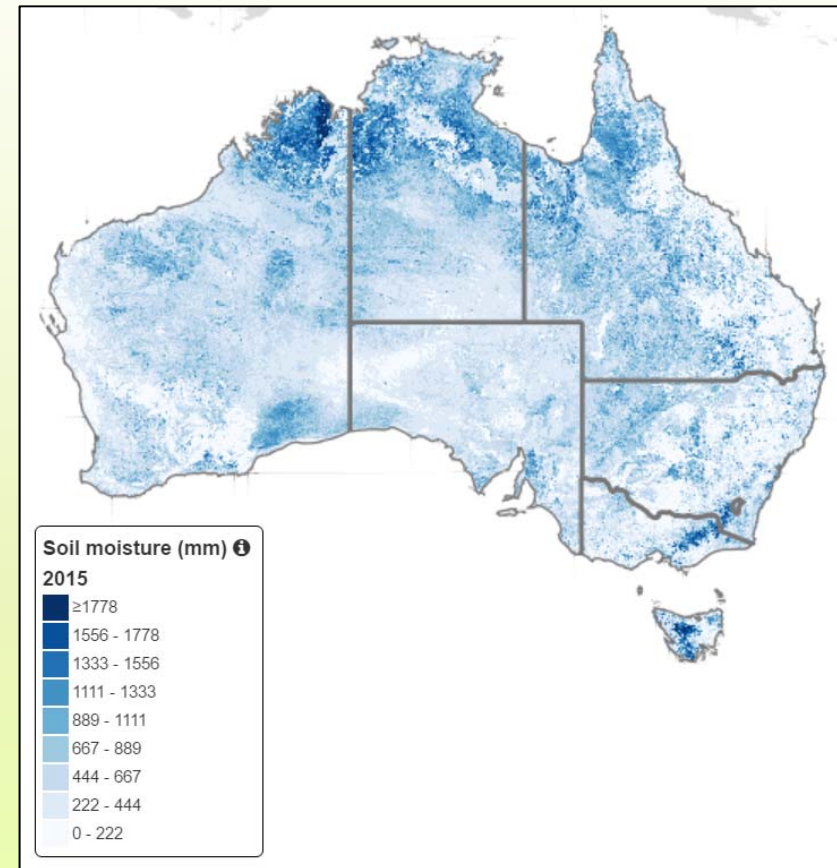
- Decline in northern Australia
- Continuing dry conditions in Queensland
- Lowest precipitation since at least 2000 in western Tasmania





## Method

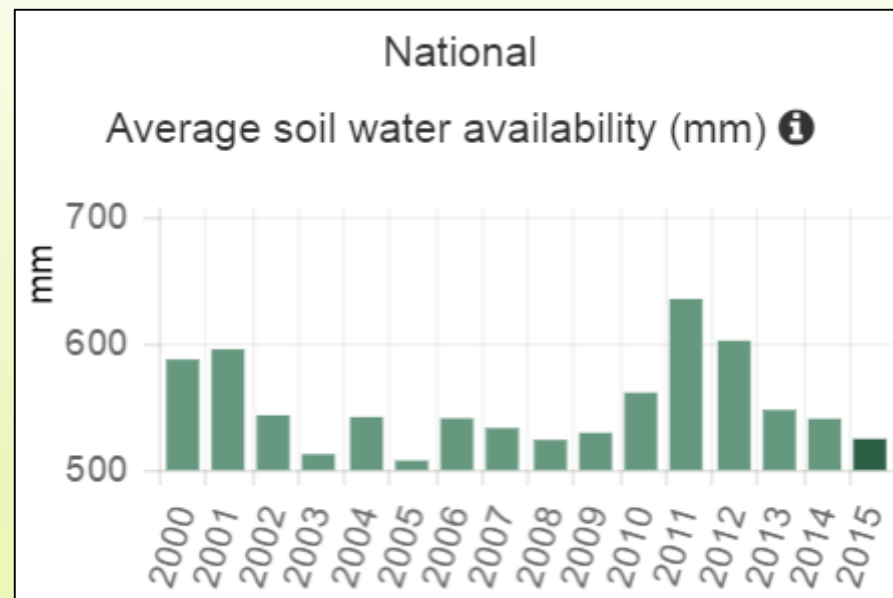
- Soil moisture: amount of water (mm) in the top 6 m soil profile
- Derived from OzWALD system
- Shares lineage with Bureau of Meteorology's Australian Water Resources Assessment (AWRA) model
- 5 km and daily resolution





## National view

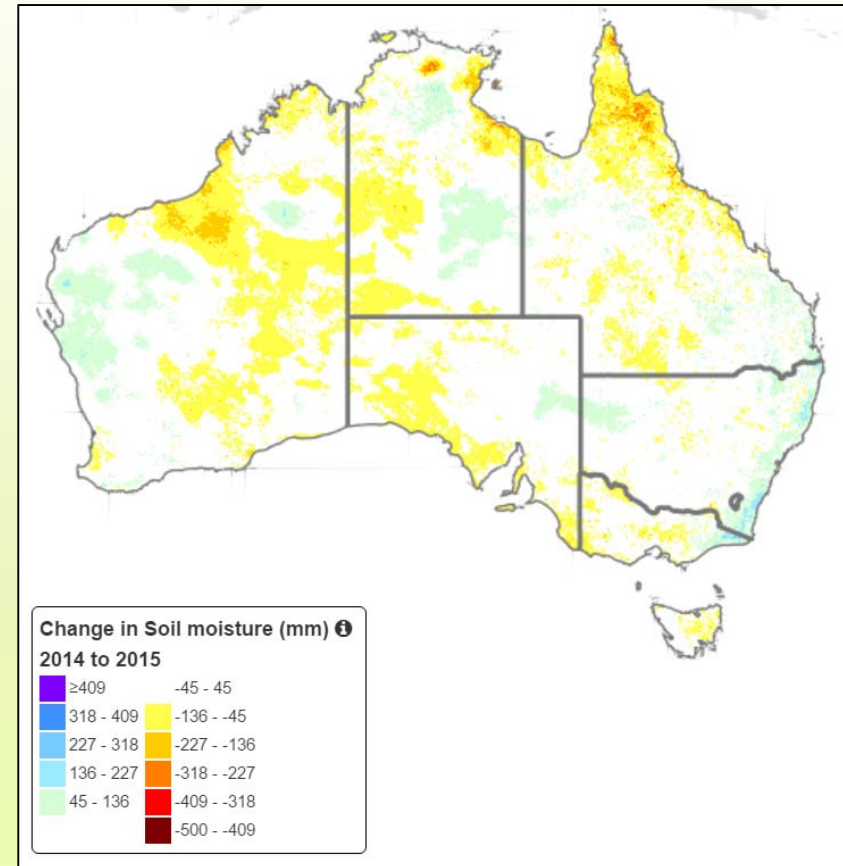
- Lowest level since 2005





## Regional differences

- Soil moisture decline from 2014 to 2015 across most of the country
- Well-below average in much of Queensland and western Victoria





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**Rivers and wetlands**



Landscape condition

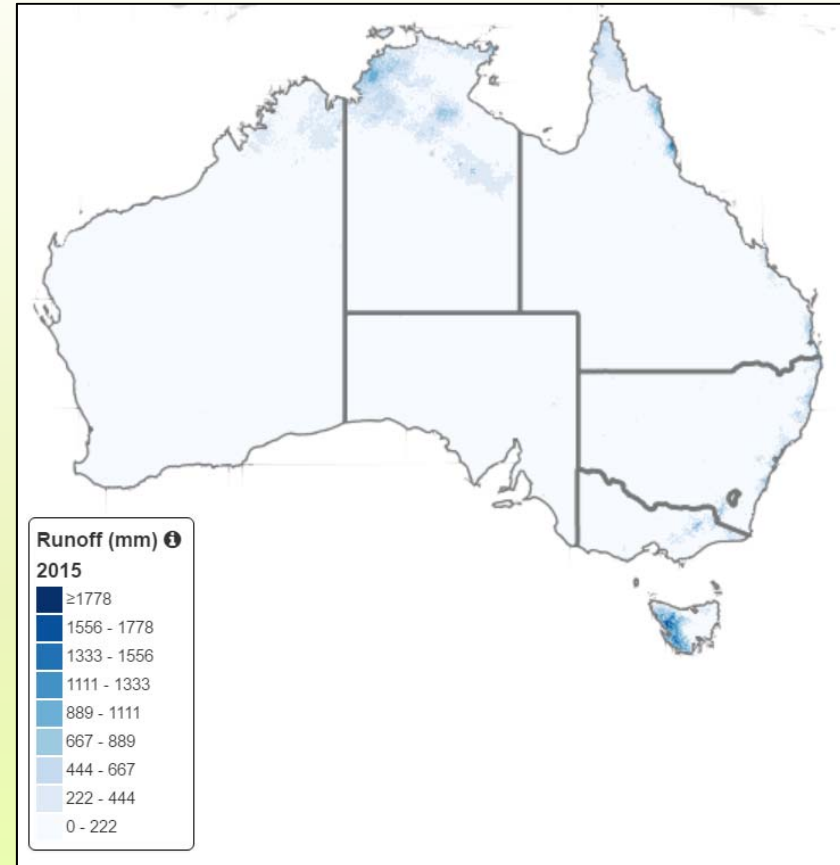


Carbon storage



## Method

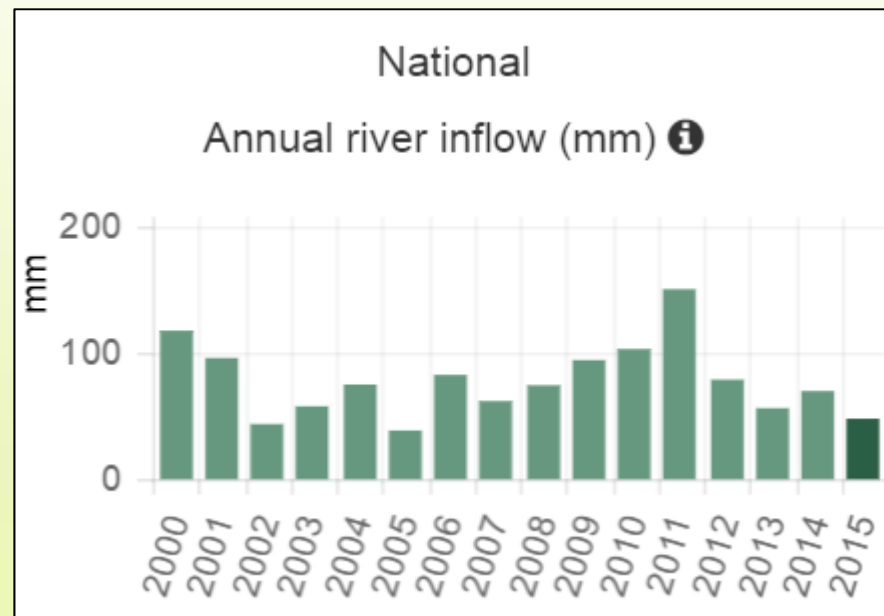
- Runoff (or River Inflow): the amount of water flowing into rivers per unit area of catchment (mm)
- Derived from ANU OzWALD system
- 5 km and daily resolution





## National view

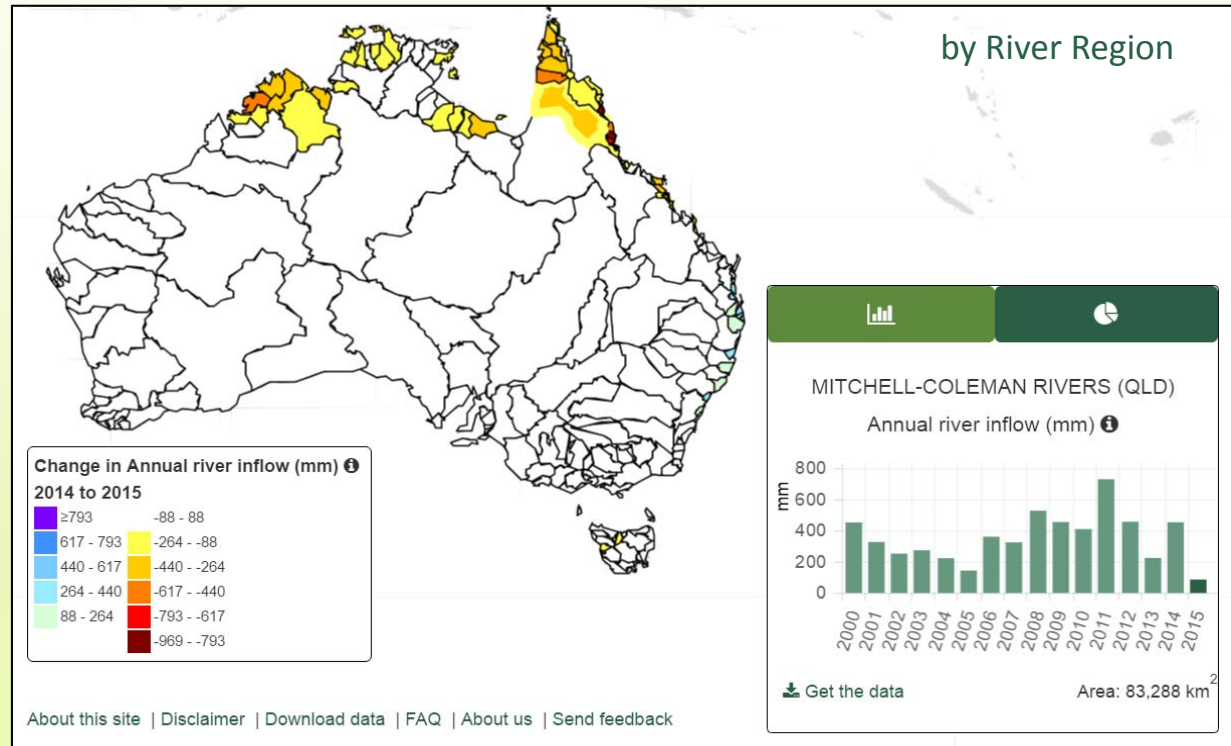
- Lowest total river inflows since 2005





# Regional differences

- Very low inflows in many northern rivers

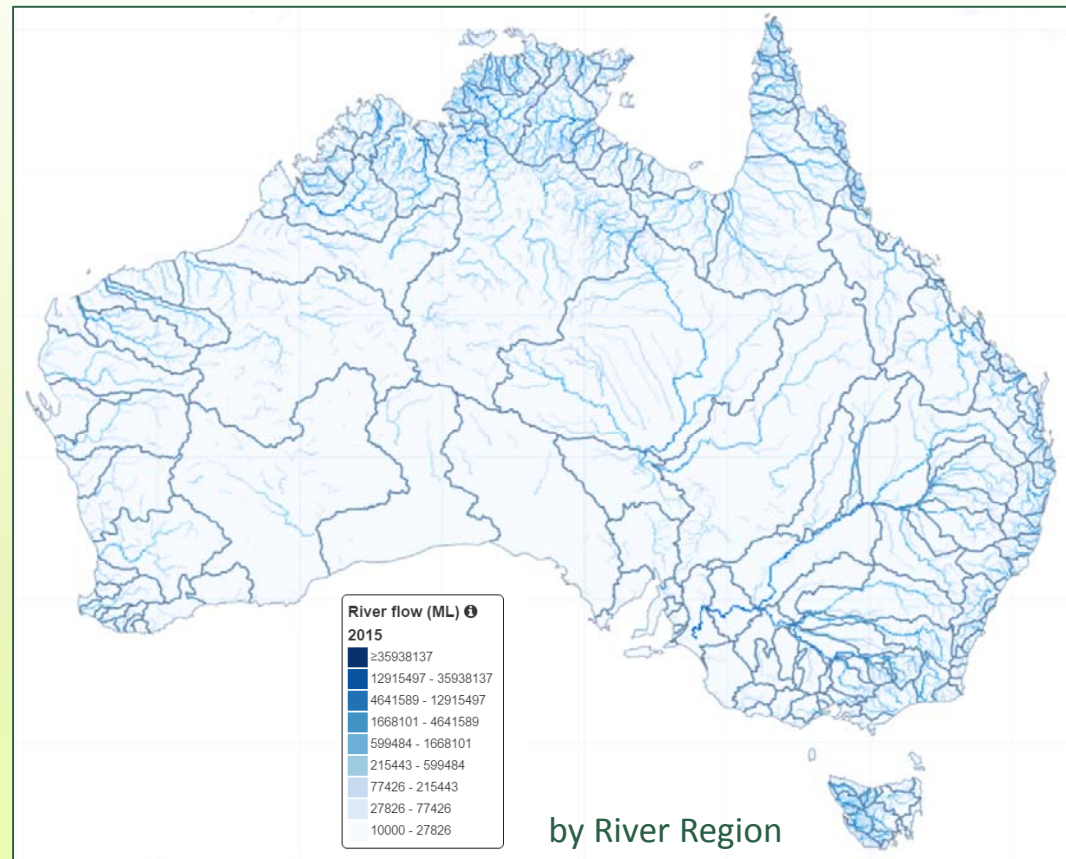






## Method

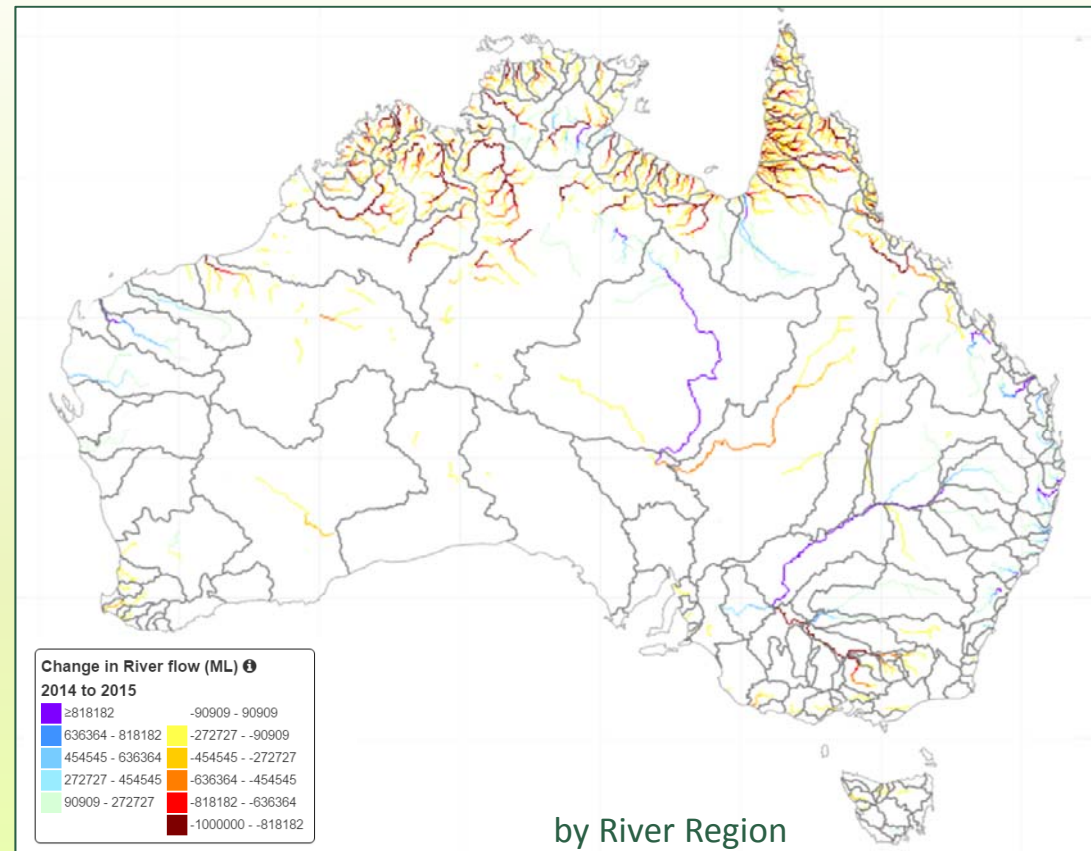
- Volume of water flowing through rivers (ML)
- Derived from ANU OzWALD system
- 5 km and daily resolution





## Regional differences

- Strong declines in many northern rivers
- Increased Darling and decreased Murray River flows
- High flows from Georgina River into Lake Eyre





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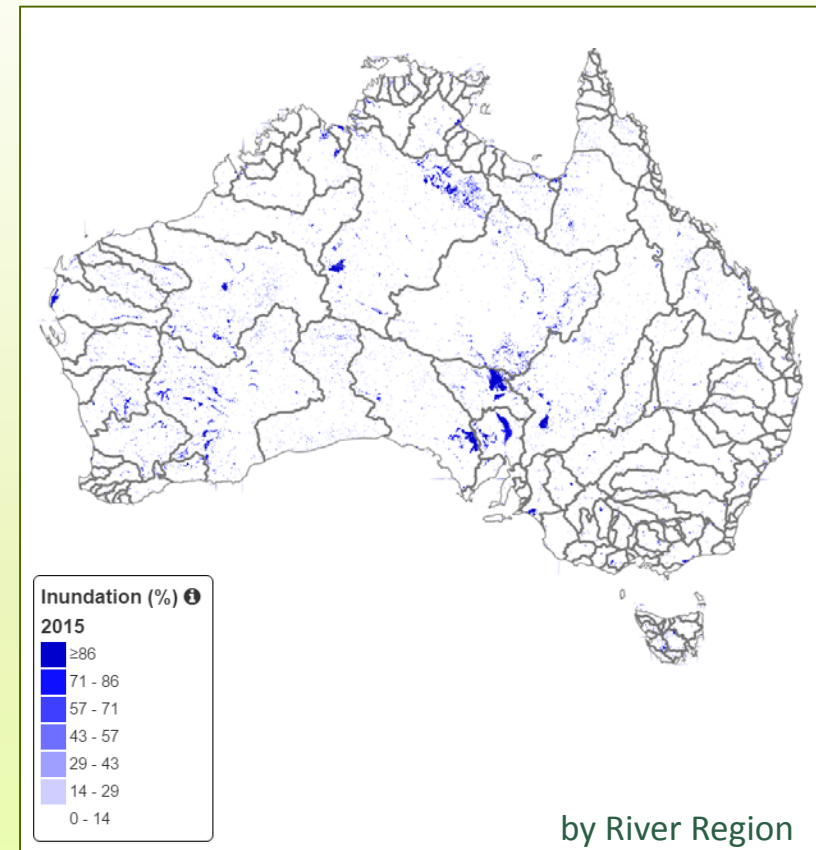
source: [Australian Wildlife Conservancy](#)



## Method

- Inundation fraction: the fraction area covered by water at least once
- Generated by CSIRO Land and Water and ANU using MODIS imagery
- Uses Open Water Likelihood mapping algorithm
- 500 m and 8 day resolution

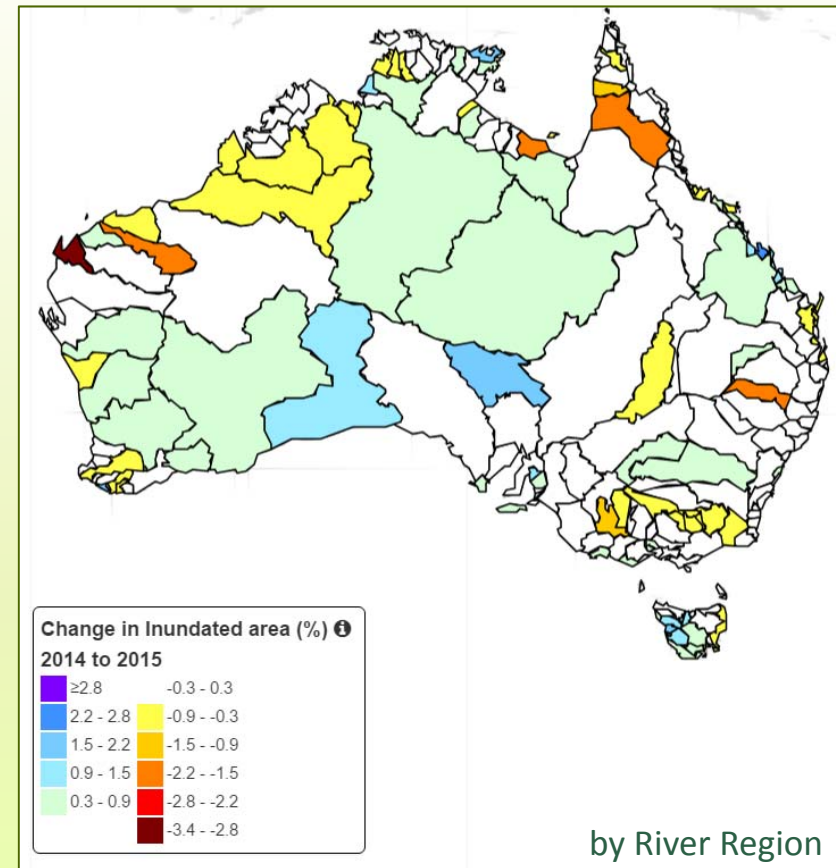
Guerschman et al. (2011) *MODIS-based standing water detection for flood and large reservoir mapping*, CSIRO





## Regional differences

- Generally less inundation in 2015 than in 2014
- Increased inundation in Lake Eyre Basin, Western Tasmania and selected dry basins
- Most of Murray-Darling Basin showed inundation typical of the Millennium Drought years

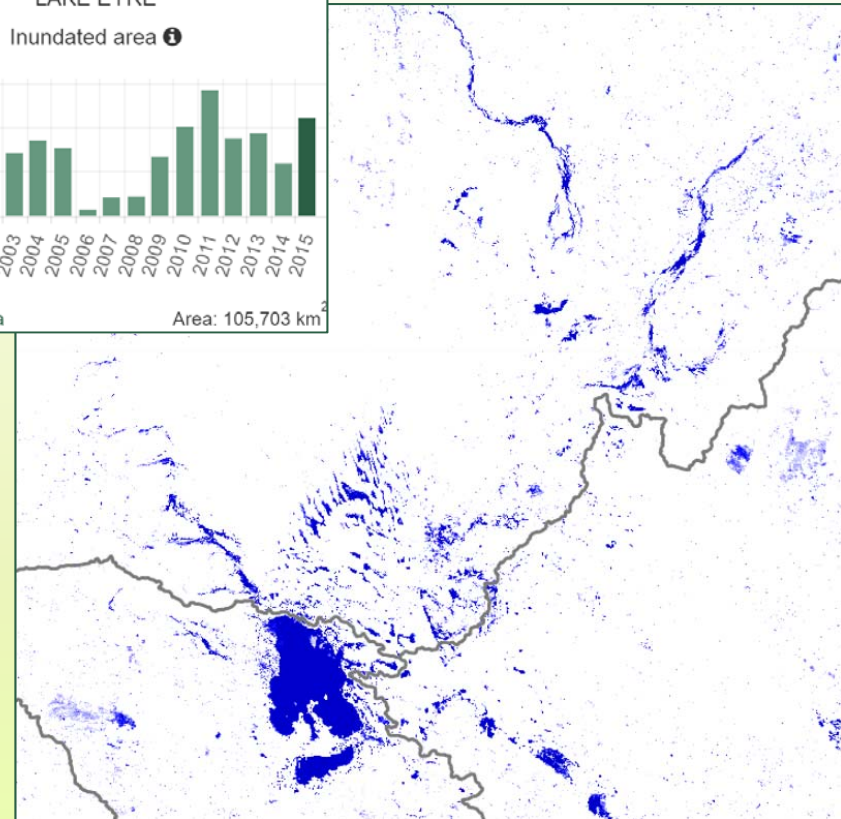
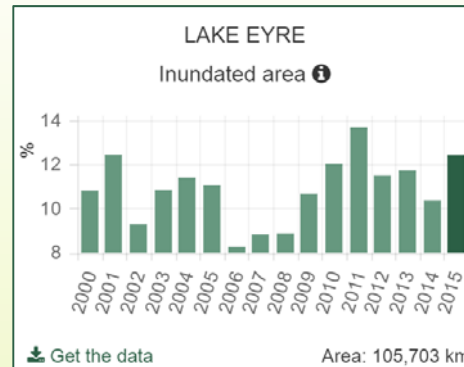






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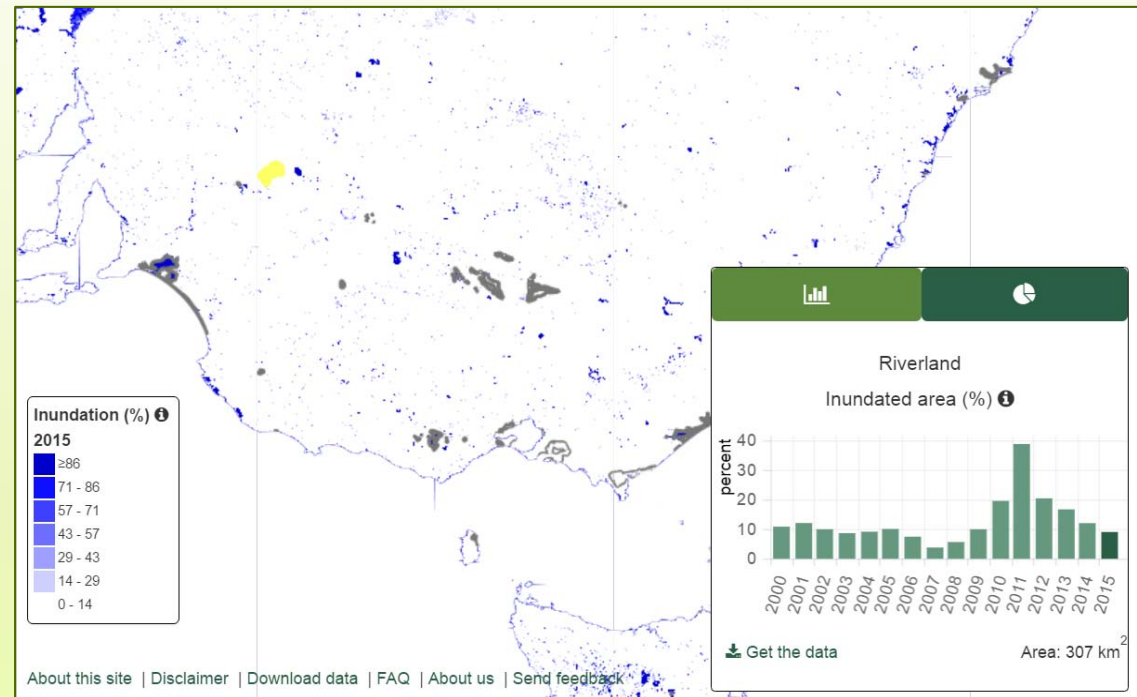




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### Ramsar wetlands





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**Landscape condition**



Carbon storage

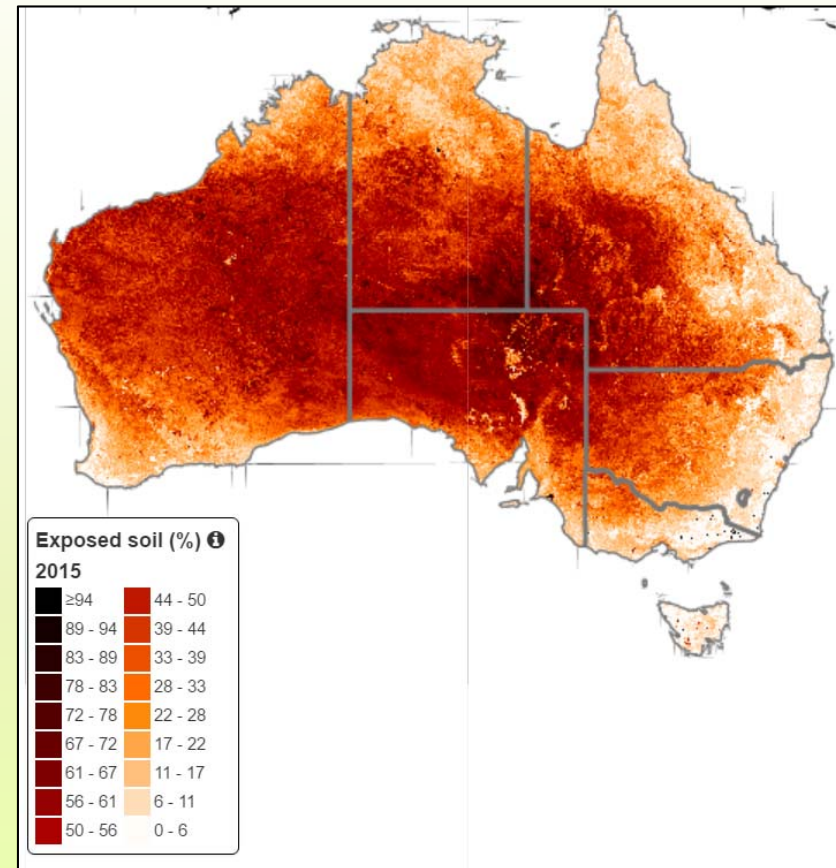




## Method

- Percentage of soil that is not protected by living or dead plant matter
- Generated by CSIRO Land and Water from MODIS imagery
- 500 m and 8 day resolution

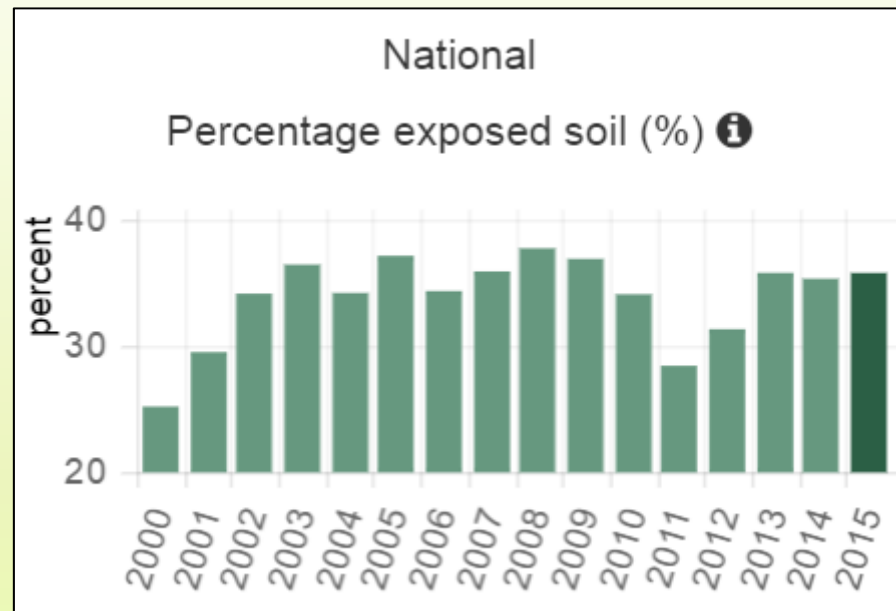
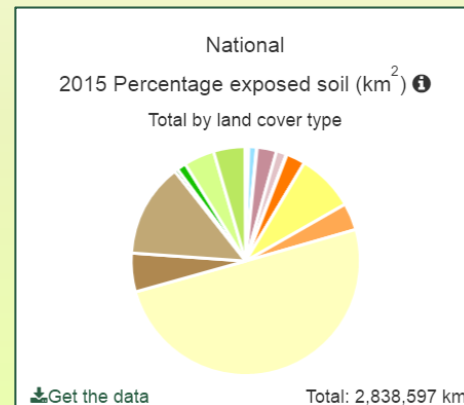
Guerschman et al. (2009) *Remote Sensing of Environment* 113: 928-945.





## National view

- Area of exposed soil increased by 4.7 million ha in 2015
- Return to normal levels after reduced soil exposure during wet 2010-2012



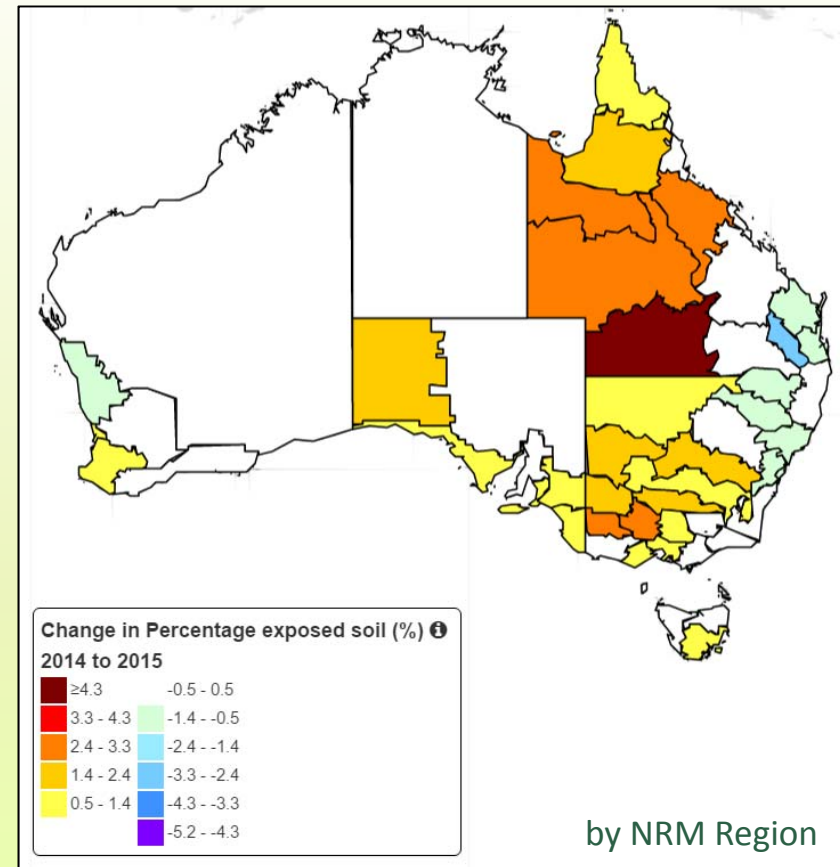


## Regional differences

- Largest increases in soil exposure in interior Qld and NSW



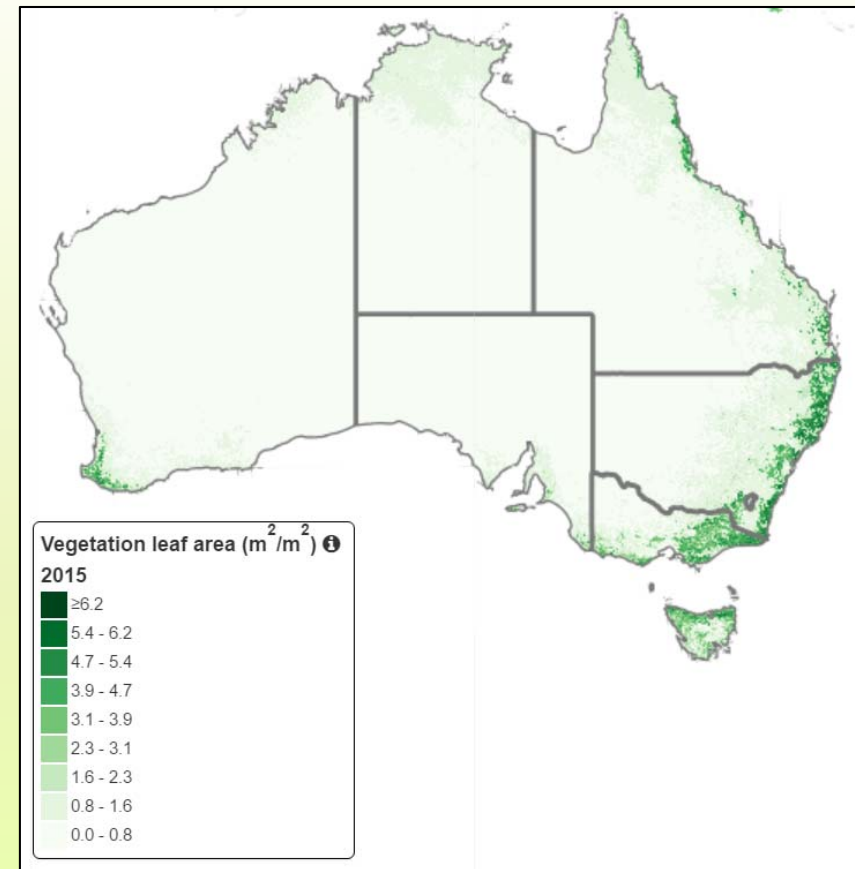
source: [Jenny Underwood](#)





## Method

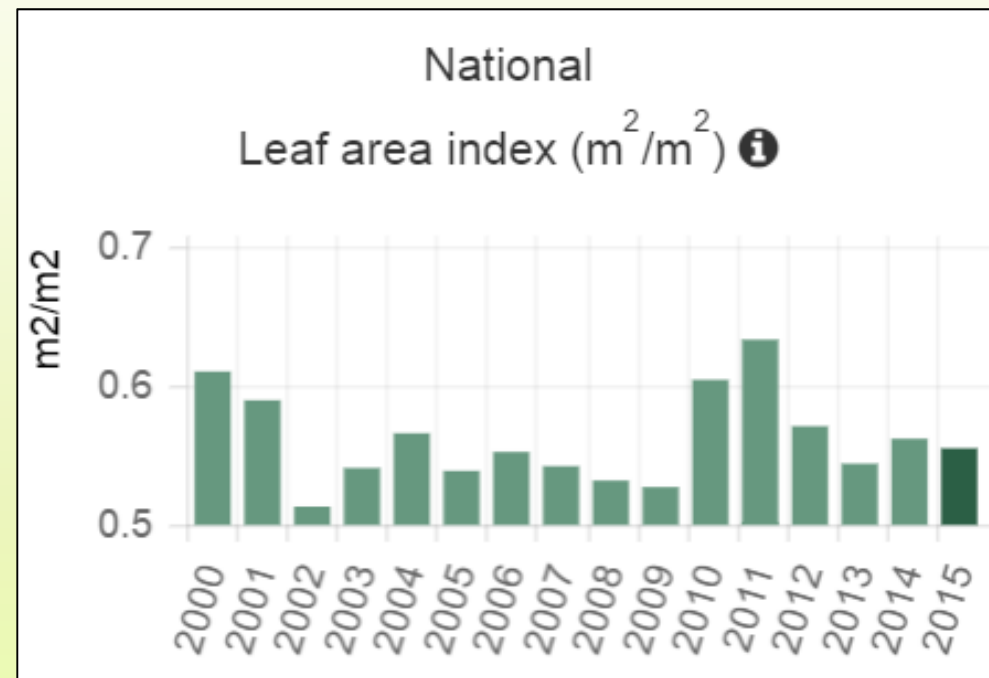
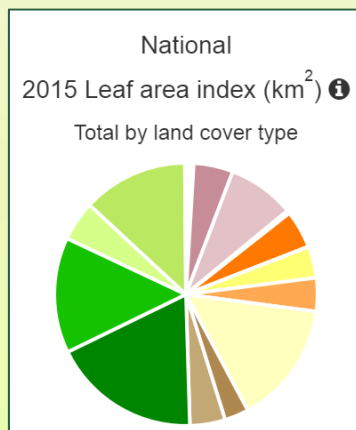
- Leaf area index: the one-sided area of living leaves per unit surface area ( $\text{m}^2/\text{m}^2$ )
- Produced by NASA using data from their MODIS satellite instruments.
- 1 km and 5 day resolution





## National view

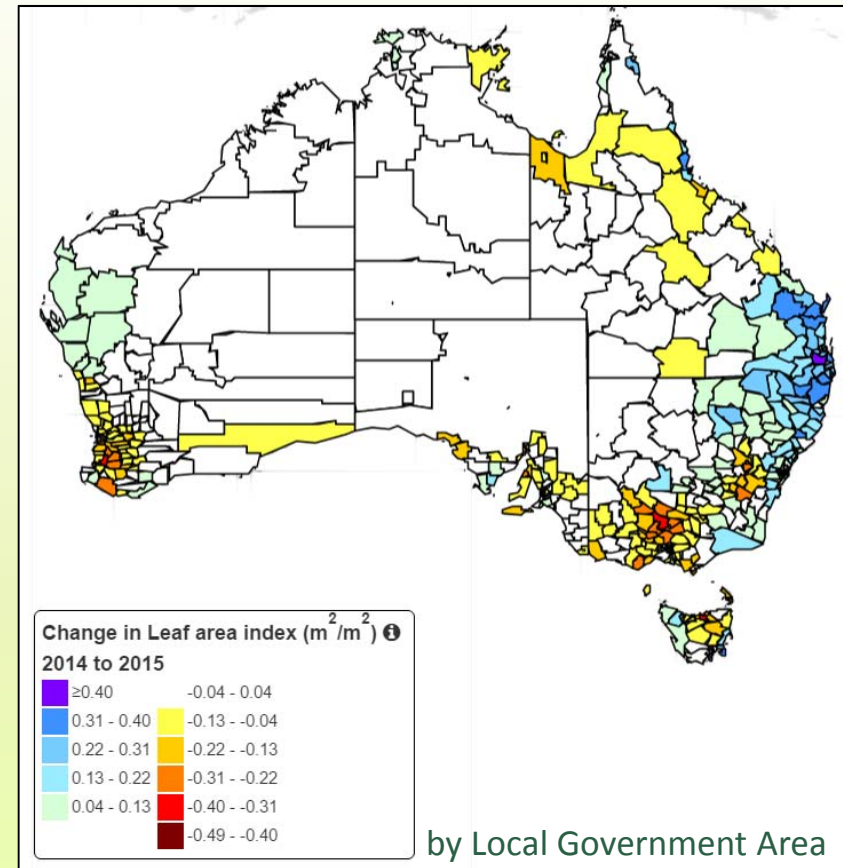
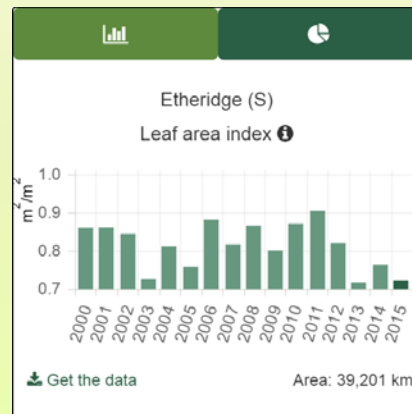
- Total leaf area fairly stable after record high in 2011





## Regional differences

- Leaf area declines in urbanised regions in WA, SA, Vic and ACT
- Increases along central east coast





Land cover change



Bushfire



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Landscape condition



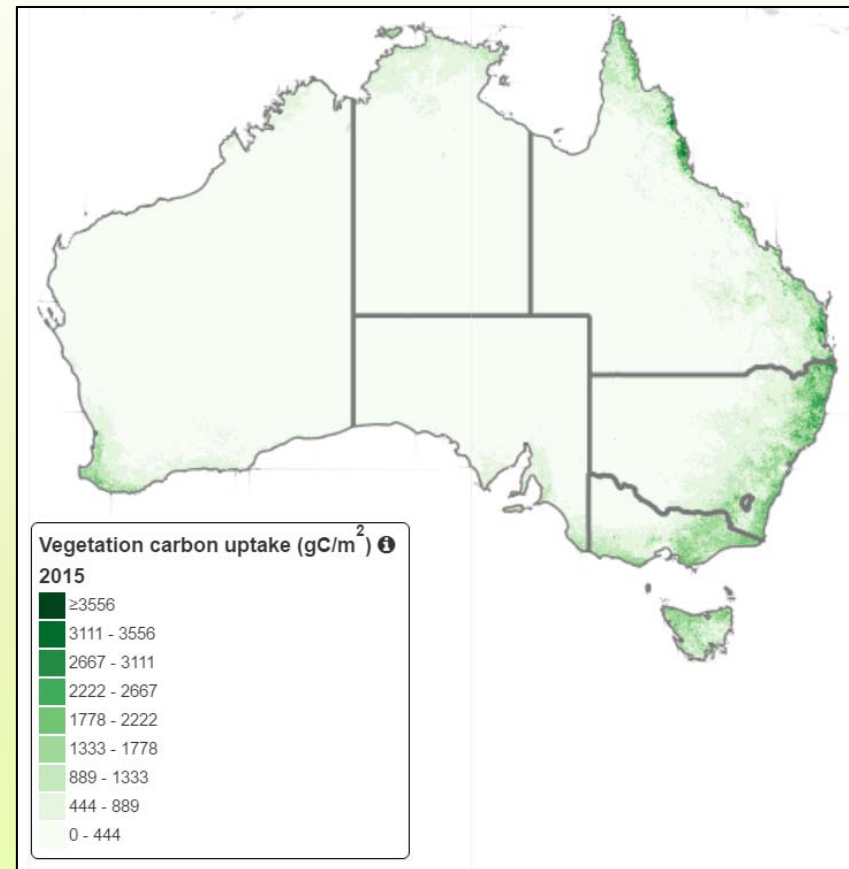
**Carbon storage**



### Method

- Gross Primary Production: the amount of carbon taken up by the vegetation for photosynthesis
- Derived from ANU OzWALD system
- 5 km and daily resolution

Yebara et al. (2015) *Remote Sensing of Environment*  
163: 206-216

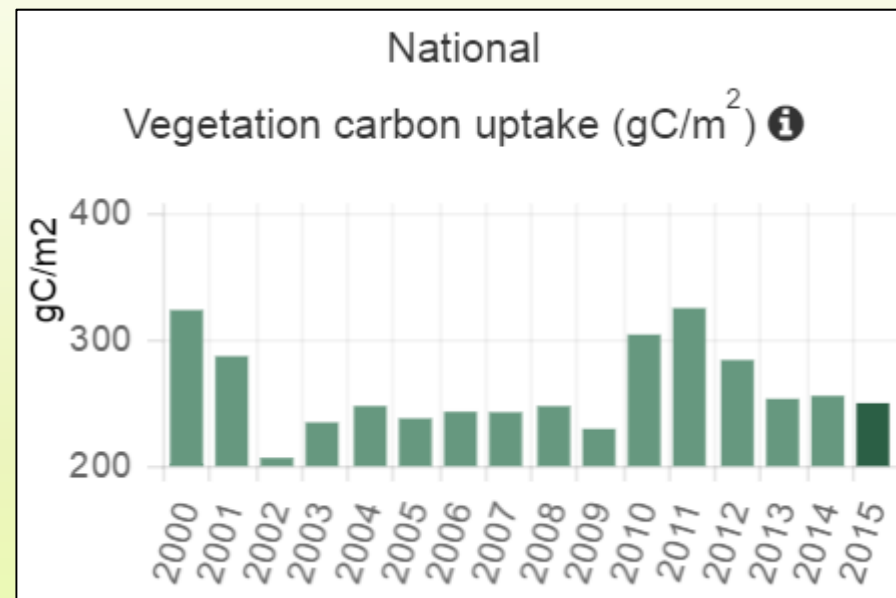






## National view

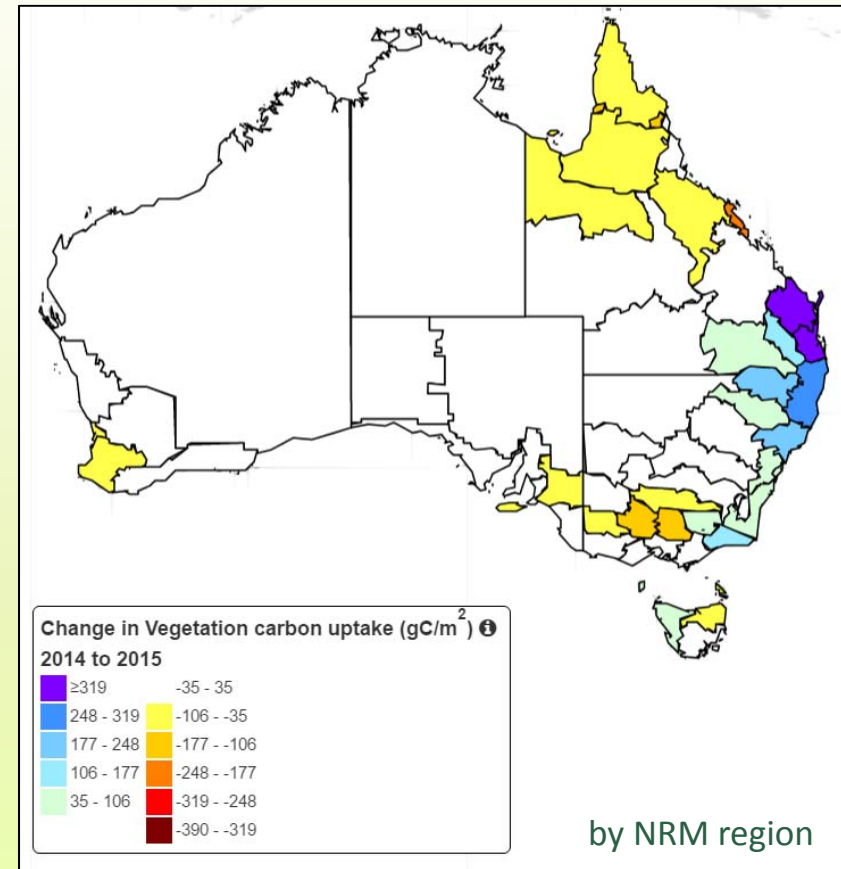
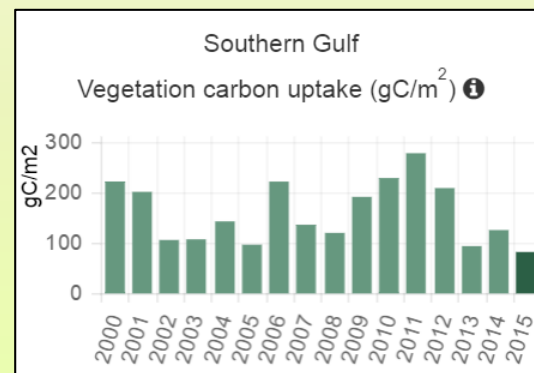
- Slight decline of continental carbon uptake
- Reaching lowest value since 2009





## Regional differences

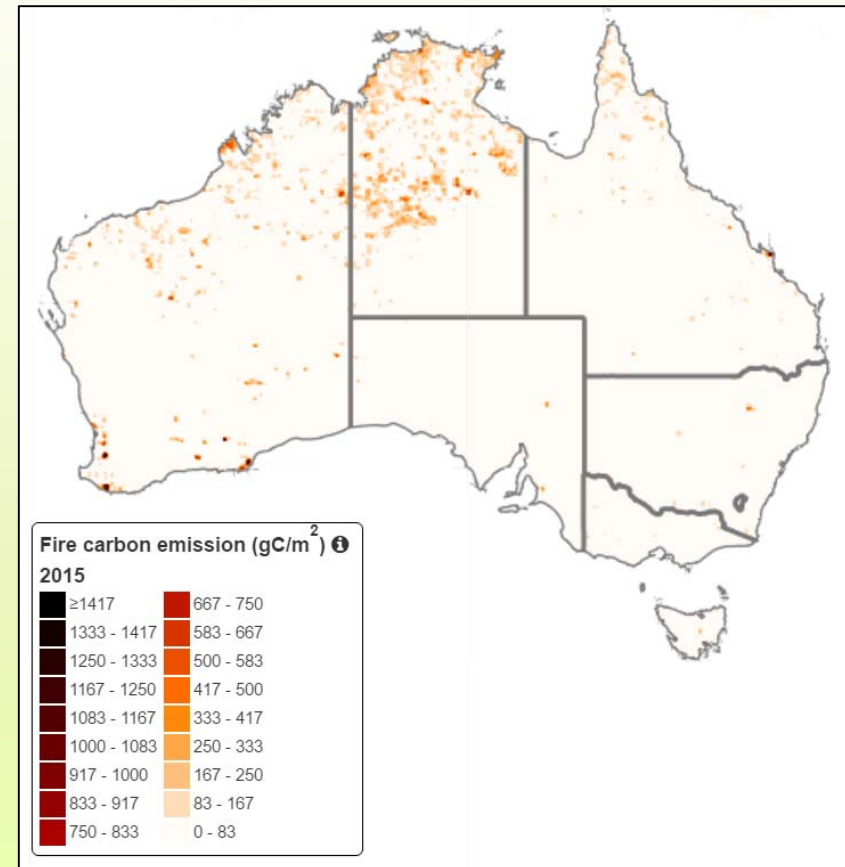
- Carbon uptake declines in most of Queensland and Victoria, in some cases to lowest value since 2000
- Increases along central east coast, partly because of below average values in 2014





## Method

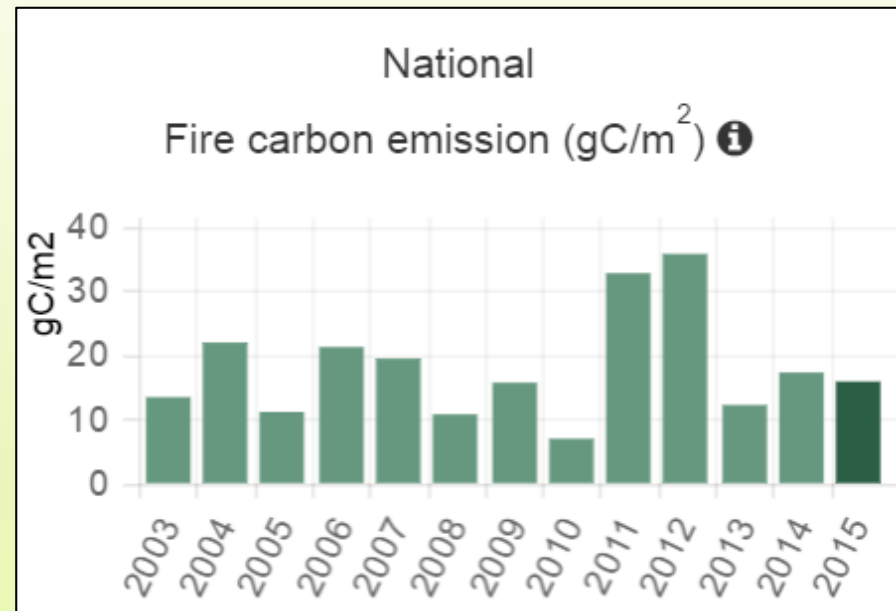
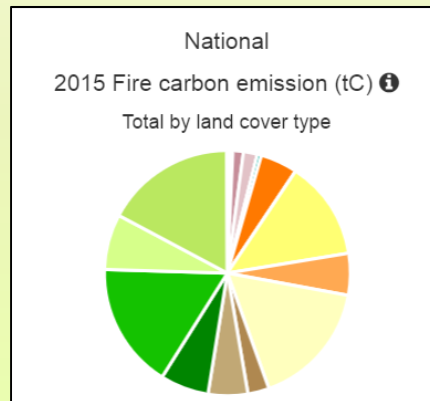
- Total carbon released to atmosphere by bushfire ( $\text{gC}/\text{m}^2$ )
- Estimated by Europe-based Global Fire Assimilation System (GFAS), combined model and satellite data.
- 10-km and daily resolution





## National view

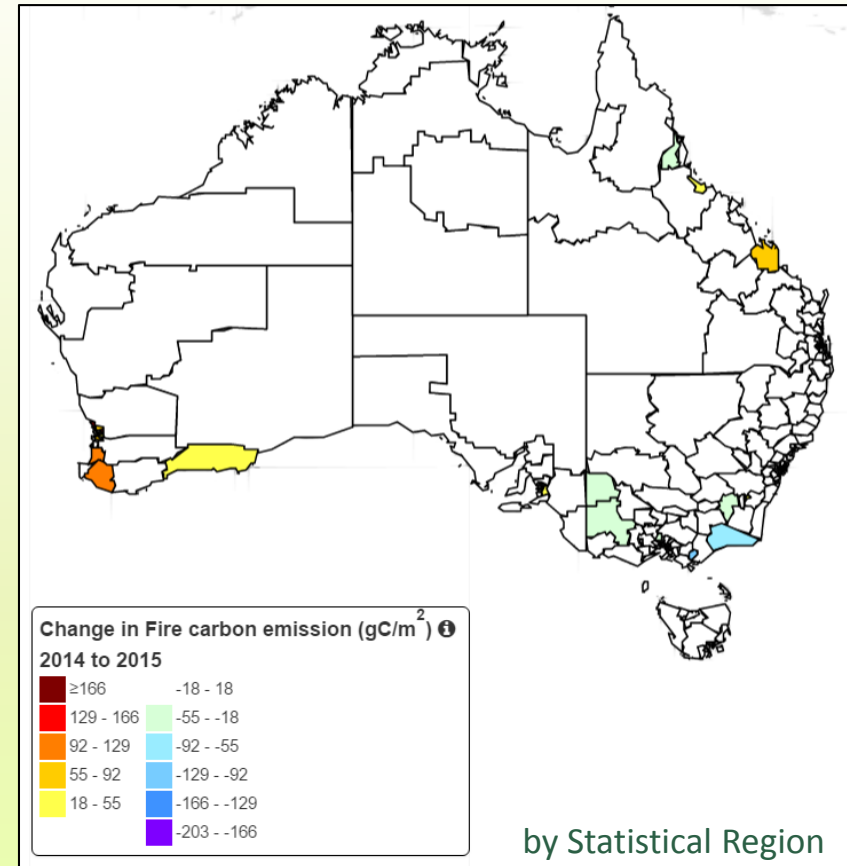
- Return to normal emission levels following peaks in 2011-2012
- Over half of emissions from woody ecosystems





## Regional differences

- Increased emissions in southwest WA and the central Queensland coast due to large fire events
- Decreased emissions in several Victorian regions after 2014 fires





## Headline indicators



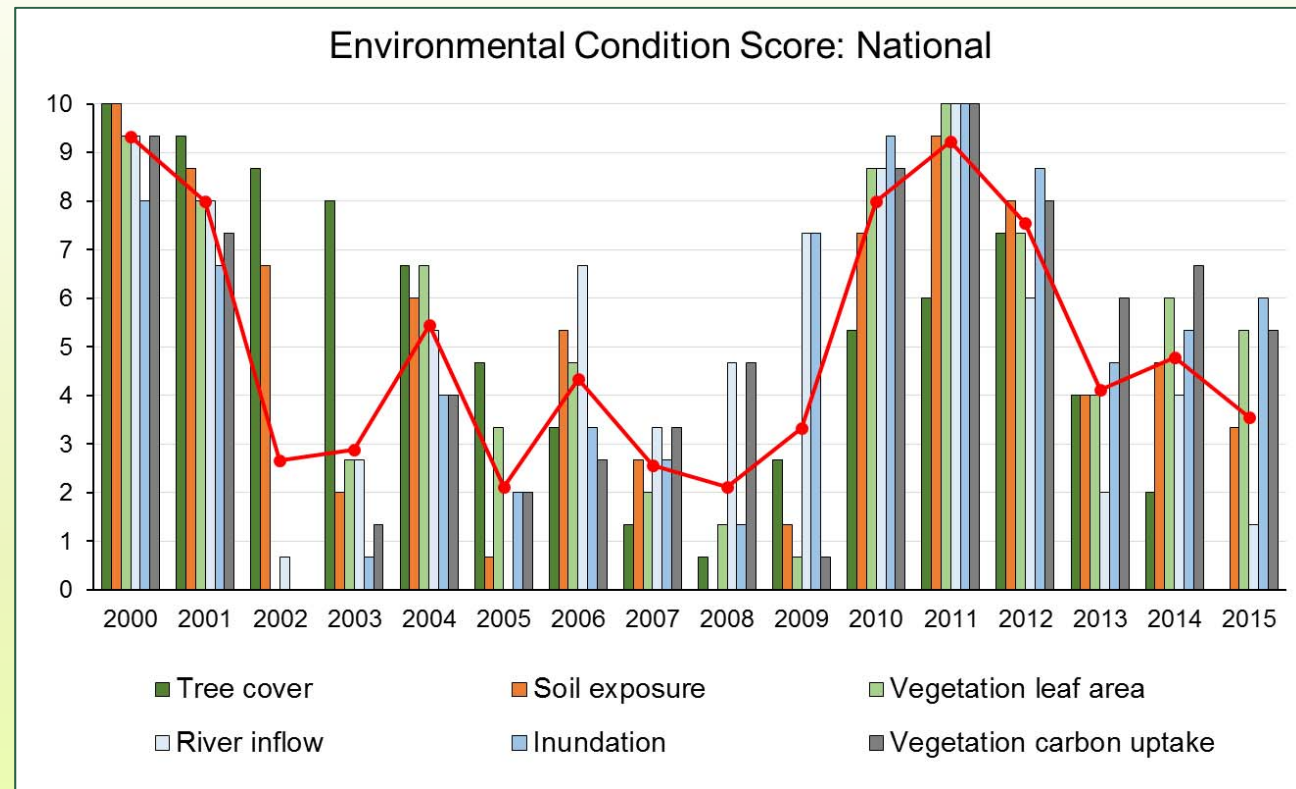
## Headline Indicators

- Combining indicators is obviously subjective - a fool's errand?
- Fortunately, many biophysical measures of our environment are closely related to water availability and hence correlated
- An experimental composite Environmental Condition Score (ECS) was calculated
- Simple average of ranking in 6 indicators, each scored from 0 to 10



National ECS fell for 2015 was 3.6, down 1.2 from 2014 and back to Millennium Drought levels

National  
3.6  
↓ -1.2

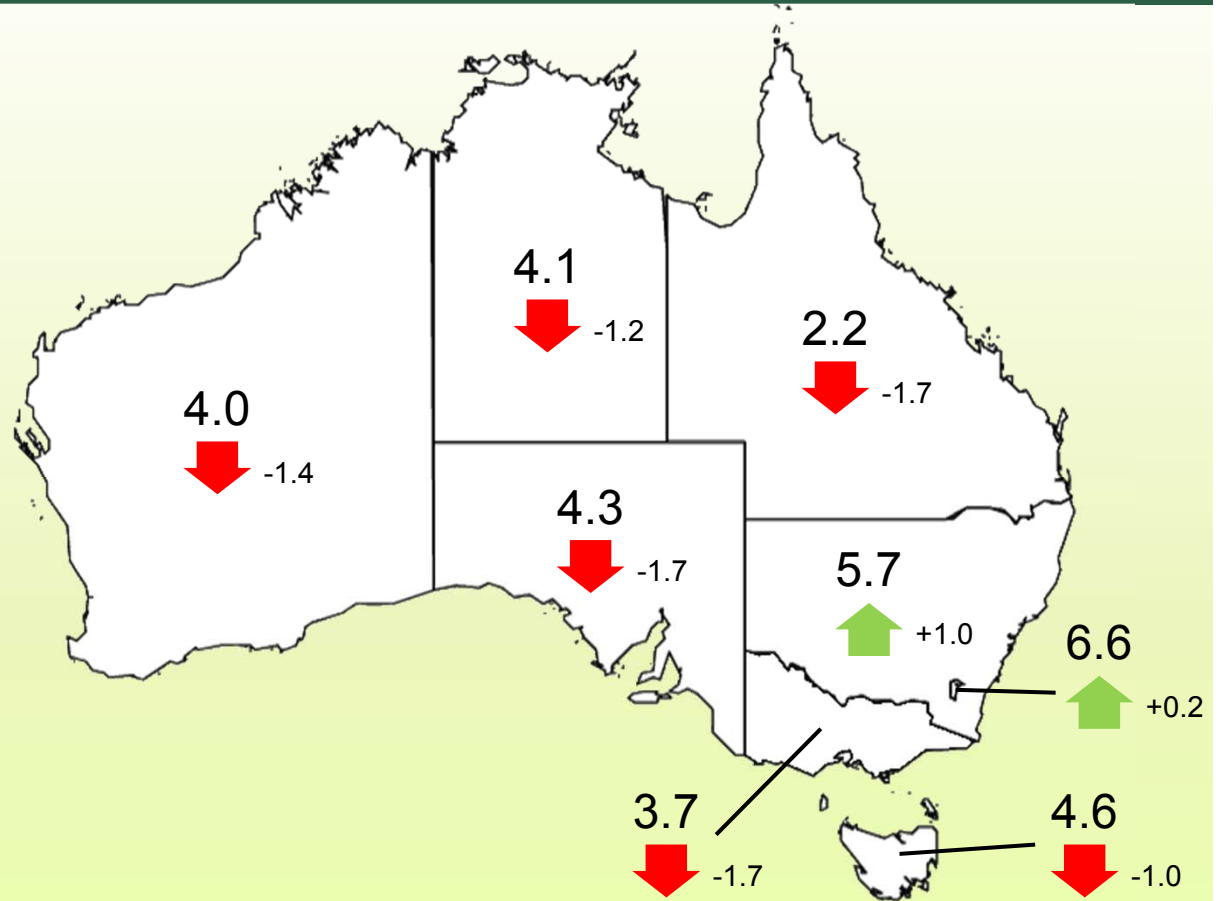






## Regional differences

- Improved ECS in NSW and ACT
- Further deterioration in Queensland
- Decline from above- to below-average in remaining states



National  
3.6  
↓ -1.2



## In Summary

- National indicators declined, reaching levels last seen during the Millennium Drought
- National tree cover continued long-term decline to lowest level since 1972
- Continued dry conditions in Queensland caused further environmental decline
- NSW and ACT experienced slightly above-average conditions