



# MAXIMUM ABOVE GROUND BIOMASS Version 2.0 (New\_M\_2017)

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## Abstract

The Full Carbon Accounting Model (FullCAM) was developed to estimate greenhouse gas emissions and removals from the land sector, for inclusion in Australia's annual national greenhouse gas inventory.

Maximum Above Ground Biomass (known here as  $M$ ) is embedded within the FullCAM database as a spatial input layer and is constant for any location in Australia. Computationally,  $M$  exerts a strong influence on forest growth, affecting the rate of above-ground biomass accumulation, as well as defining the upper maximum above-ground biomass limit or site potential.

As  $M$  represents biomass at forest maturity, it depicts the potential vegetation density that an area could support, not the current vegetation distribution which reflects past land management, such as clearing and regrowth of woody vegetation.

New\_M\_2017 was developed using the Random Forest ensemble machine learning algorithm, by combining TERN National Biomass Library data from 5,739 sites with minimally disturbed vegetation, with a variety of environmental predictor covariates (Roxburgh *et.al.*, 2017). In comparison, Original\_M\_2004 was developed by establishing a relationship between biomass and productivity for site locations with no reported disturbance, identified from Landsat imagery (Richards and Brack, 2004). Advances in technology and access to the extensive TERN database, enabled a more rigorous method to be developed using extensive field biomass measurements.

Analysis of the differences between New\_M\_2017 and Original\_M\_2004 (Roxburgh *et.al.*, 2017) indicated changes in maximum biomass predictions for woodlands were minimal, whereas the predicted maximum biomass in forests increased quite significantly (Figure 1). This was particularly noticeable at sub-continental scales. Independent data was used to assess the model predictions, which provides confidence in the predictions across a range of forest types and standing biomass densities.

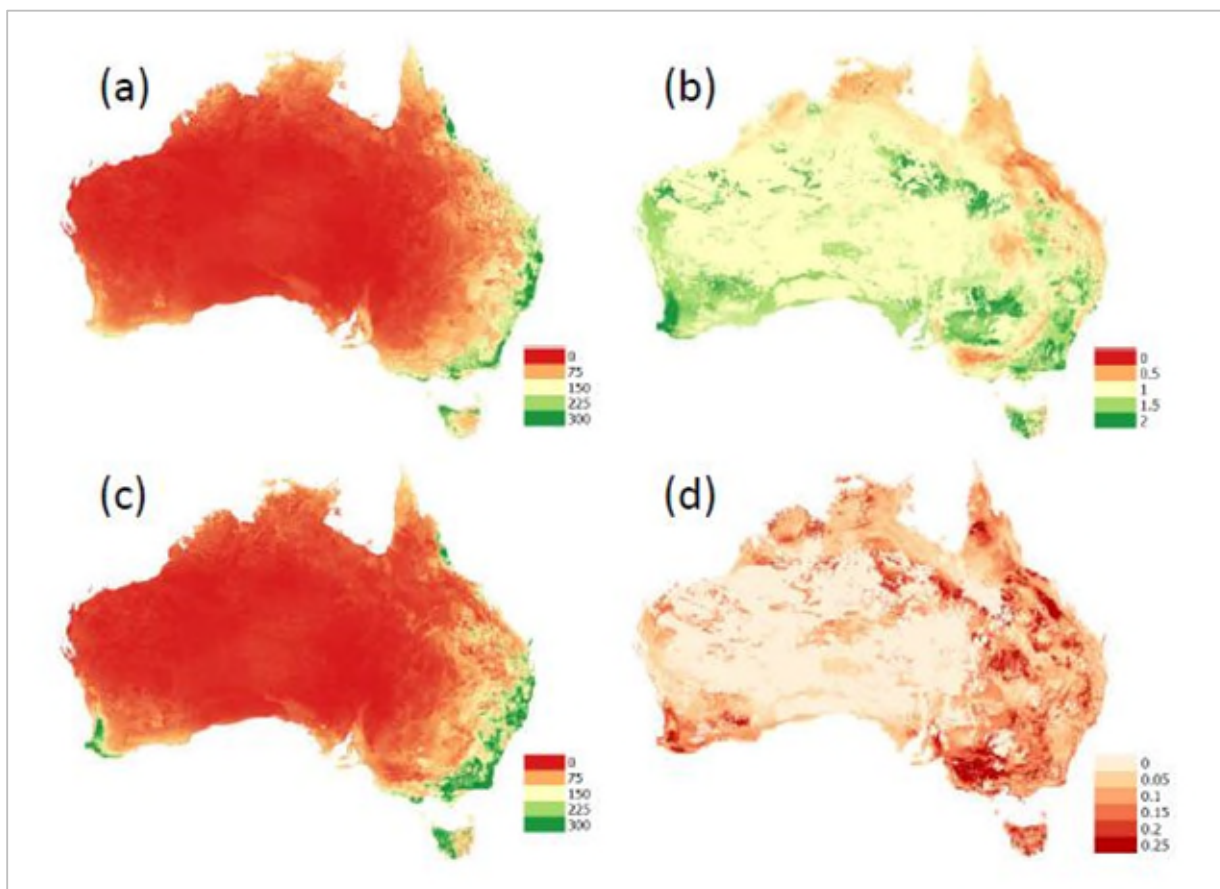
To determine the differences in maximum above ground biomass data at a given location between Original\_M\_2004 and New\_M\_2017, a modelled ratio product has been produced, and is available on [data.gov.au](http://data.gov.au).

## Defined region

Australia excluding external territories

## Maintenance and update frequency

As required



**Figure 1:** (a) Original\_M\_2004 maximum biomass layer ( $M$ , t DM ha<sup>-1</sup>). (b) Maximum biomass modifier layer predicted from the Random Forest model (dimensionless multiplier). (c) New\_M\_2017 maximum biomass layer, calculated from (a) x (b) ( $M^1$ , t DM ha<sup>-1</sup>). (d) Coefficient of variation (standard deviation / mean) of  $M^1$ , calculated over 100 Random Forest model fits.

## Conditions of use

This data is licensed under a Creative Commons Attribution Share Alike 4.0 International Licence (CC BY-SA 4.0).

It is designed to provide nationally consistent maximum above ground biomass data for use in FullCAM. Users should always consider the appropriateness of the data before using for other purposes.

## Lineage

Since the development of FullCAM and the Original  $M$  layer in the early 2000's, there has been a large increase in the availability of forest biomass field data across Australia. Original\_M\_2004 was updated in 2016 (Roxburgh *et.al*, 2017), using biomass data from 5739 sites from the TERN National Biomass Library deemed to contain mature and undisturbed vegetation. Landsat images back to the 1970's were used to confirm continuous vegetation cover at the sites.

The Random Forest machine learning algorithm was used to predict the difference (residual) between the Original\_M\_2004, and the TERN biomass estimates for the selected sites. Twenty-three continuous predictor variables were used in the analysis, including soil carbon content, elevation and bioclimatic factors from the WorldClim database. Model fitting was based on 1000 Random Forest regression decision trees, with model predictions calculated as the median prediction over all 1000 trees, with separate Random Forest models run for woodland and forest vegetation types.

Predictions of the residual were then interpolated spatially based on the NVIS v4.2 1750 Major Vegetation subgroups classification (NVIS 2016), and used to update Original\_M\_2004 to New\_M\_2017 across the country. A Monte-Carlo approach was used to assess the prediction error of the model fits, with the data randomly split into a 70% subset for model fitting, and a 30% subset excluded and retained for independent validation.

For full details of the methods and results, see Roxburgh *et.al*, 2019.

## References

Richards, G.P. (2002) Biomass estimation: Approaches for assessment of stocks and stock change. *National Carbon Accounting System Technical Report No. 27*. Australian Greenhouse Office, Canberra, Australia.

Richards, G.P. & Brack, C. (2004) A continental biomass stock and stock change estimation approach for Australia. *Australian Forestry*, **67**:284–288.

Roxburgh, S., Karunaratne, S., Paul, K., Lucas, R.M., Armston, J.D. & Sun, J. (2019) A revised above-ground maximum biomass layer for the Australian continent. *Forest Ecology and Management*, **432**, 264-275.

## Cell size

0.0025 decimal degrees (~250m)

## Coordinate system

Geographic Decimal Degrees, Datum: WGS 84 (GDA Compliant)

## Positional accuracy

Positional accuracy has not been assessed. However, Maximum Above Ground Tree Biomass data ingested into FullCAM has been aligned with FullCAM data layers using a snap raster approach.

## Dataset units

Tonnes of dry matter per hectare (t DM ha<sup>-1</sup>)

## Attribute completeness

Mainland Australia and most nearby islands

## Data format and delivery

Geotiff

**Dataset citation**

Department of Industry, Science, Energy and Resources (2017). Maximum Above Ground Biomass. Version 2.0. Commonwealth of Australia, Canberra.

**Data custodian**

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