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CMS: Forest Aboveground Biomass from FIA Plots across the Conterminous USA, 2009-2019

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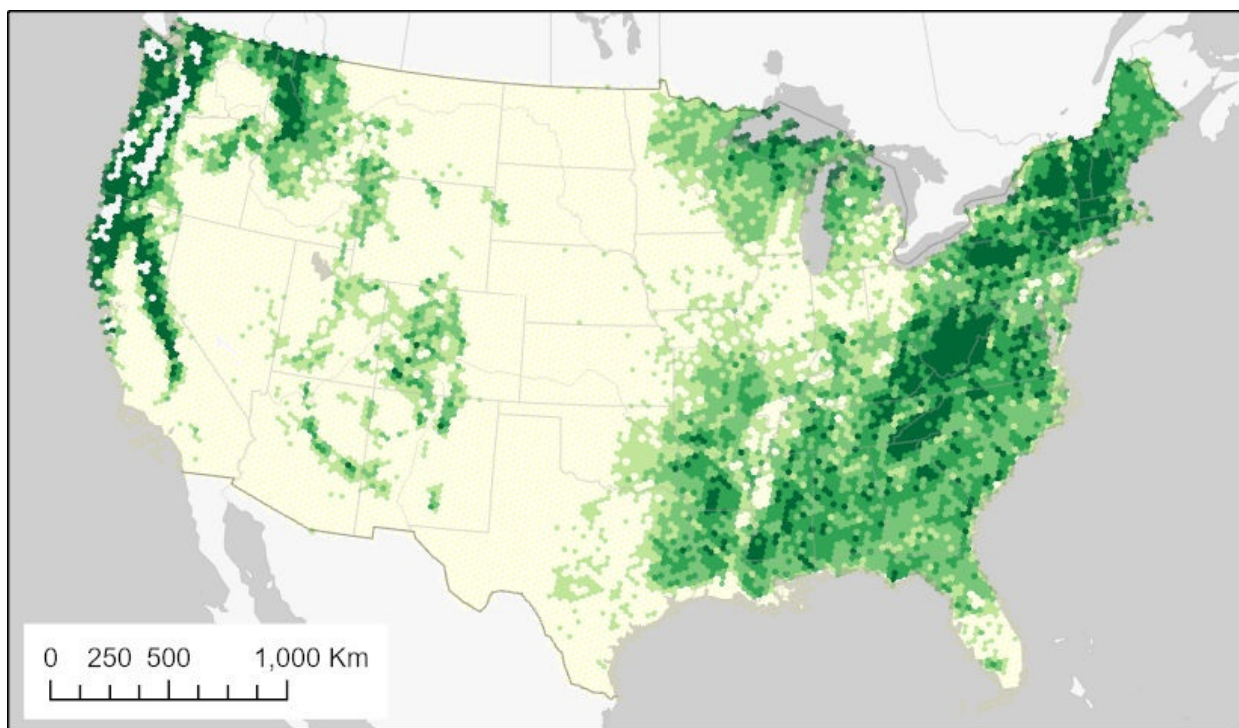
Documentation Revision Date: 2021-09-23

Dataset Version: 1

Summary

This dataset provides forest biomass estimates for the conterminous United States based on data from the USDA Forest Inventory and Analysis (FIA) program. FIA maintains uniformly measured field plots across the conterminous U.S. This dataset, derived from field survey data from 2009-2019, includes statistical estimates of biomass at the finest scale (64,000-hectare hexagons) allowed by FIA's sample density. Estimates include the mean (and standard error of the mean) biomass for both live and dead trees, calculated using three sets of allometric equations. There is also an estimate of the area of forestland in each hexagon. These data can be useful for assessing the accuracy of remotely sensed biomass estimates.

This dataset includes one compressed shapefile bundle in archive (*.zip) format and a corresponding file in compressed Keyhole-Markup Language (*.kmz) format for convenient viewing using Google Earth.



Aboveground Live Biomass (Mg ha⁻¹) - CRM

≤15.0 ≤40.0 ≤70.0 ≤100.0 ≤230.0

Figure 1. Estimates of aboveground biomass of live trees (diameter >2.54 cm) on forested lands in the conterminous U.S. Estimates were developed from the FIA component ratio method. Source: CONUSbiohex2020.shp

Citation

Menlove, J., and S.P. Healey. 2021. CMS: Forest Aboveground Biomass from FIA Plots across the Conterminous USA, 2009-2019. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1873>

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1. Dataset Overview

This dataset provides forest biomass estimates for the conterminous United States based on data from the USDA Forest Inventory and Analysis (FIA) program. FIA maintains uniformly measured field plots across the conterminous U.S. This dataset, derived from field survey data from 2009–2019, includes statistical estimates of biomass at the finest scale (64,000-hectare hexagons) allowed by FIA’s sample density. Estimates include the mean (and standard error of the mean) biomass for both live and dead trees, calculated using three sets of allometric equations. There is also an estimate of the area of forestland in each hexagon. These data can be useful for assessing the accuracy of remotely sensed biomass estimates.

Project: [Carbon Monitoring System](#)

The NASA Carbon Monitoring System (CMS) program is designed to make significant contributions in characterizing, quantifying, understanding, and predicting the evolution of global carbon sources and sinks through improved monitoring of carbon stocks and fluxes. The System uses NASA satellite observations and modeling/analysis capabilities to establish the accuracy, quantitative uncertainties, and utility of products for supporting national and international policy, regulatory, and management activities. CMS data products are designed to inform near-term policy development and planning.

Related Publication

Menlove, J. and S.P. Healy. 2020. A comprehensive forest biomass dataset for the USA allows customized validation of remotely sensed biomass estimates. *Remote Sensing* 12:4141. <https://doi.org/10.3390/rs12244141>

Related Datasets

Collatz, G.J., C. Williams, B. Ghimire, S. Goward, and J. Masek. 2014. CMS: Forest Biomass and Productivity, 1-degree and 5-km, Conterminous US, 2005. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1221>

Fekety, P.A., and A.T. Hudak. 2020. LiDAR Derived Forest Aboveground Biomass Maps, Northwestern USA, 2002-2016. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1766>

Filippelli, S.K., M.J. Falkowski, A.T. Hudak, and P.A. Fekety. 2020. CMS: Pinyon-Juniper Forest Live Aboveground Biomass, Great Basin, USA, 2000-2016. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1755>

Acknowledgments

This work was supported by NASA’s Carbon Monitoring System (grant 80HQTR18T0016).

2. Data Characteristics

Spatial Coverage: Conterminous United States

Spatial Resolution: 640 km² hexagonal cells

Temporal Coverage: 2009-01-01 to 2019-12-31

Temporal Resolution: Single estimate

Site Boundaries: Latitude and longitude are given in decimal degrees.

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Conterminous U.S.	-125.0094	-66.6916	49.5076	24.3192

Data File Information

This dataset includes one compressed shapefile bundle in archive (*.zip) format and a corresponding file in compressed Keyhole-Markup Language (*.kmz) format for convenient viewing using Google Earth.

The shapefile CONUSbiohex2020.zip contains polygon features, hexagons 640 km² in area, extending across the conterminous U.S. The attributes of each hexagon are listed in Table 1.

Data File Details

The Coordinate Reference System is EPSG:4008 (based on the Clarke 1866 ellipsoid).

Table 1. Feature attributes in the shapefile bundle CONUSbiohex2020.zip, and corresponding names and definitions provided in Menlove and Healey (2020).

Attribute	Publication	Units	Description
USHEXES_ID	USHEXES_ID		Hexagon identifier for FIA database.
EMAP_HEX	EMAP_HEX		FIADB EMAP hexagon identifier. The same as USHEXES_ID in the original EMAP GIS layer.
PROP_FORES	PROP_FOREST	1.0	Proportion of the area that is forest land. Ratio of forest land area over sampled area.
SE_PROP_FO	SE_PROP_FOREST_PCT	percent	Sampling error of the forest land proportion as a percent of the estimate.
CRM_LIVE	CRM_LIVE	Mg ha-1	Aboveground biomass of live trees (≥2.54 cm diameter) on forest land per hectare of sampled area using FIA component ratio method (CRM).
SE_CRM_LIV	SE_CRM_LIVE_PCT	percent	Sampling error of CRM live biomass as a percent of the estimate.
CRM_STND_D	CRM_STND_DEAD	Mg ha-1	Aboveground biomass of standing dead trees (≥12.7 cm diameter) on forest land per hectare of sampled area using FIA component ratio method (CRM).

SE_CRM_STN	SE_CRM_STND_DEAD_PCT	percent	Sampling error of CRM standing dead biomass as a percent of the estimate.
CRM_LIVE_D	CRM_LIVE_DEAD	Mg ha-1	Aboveground biomass of live trees (≥ 2.54 cm diameter) plus standing dead trees (≥ 5 inches diameter) on forest land per hectare of sampled area using FIA component ratio method (CRM).
SE_CRM_L_1	SE_CRM_LIVE_DEAD_PCT	percent	Sampling error of CRM live plus standing dead biomass as a percent of the estimate.
DRYBIOT_LI	DRYBIOT_LIVE	Mg ha-1	Aboveground biomass of live trees (≥ 2.54 cm diameter) on forest land per hectare of sampled area using retired FIA regional methods.
SE_DRYBIOT	SE_DRYBIOT_LIVE_PCT	percent	Sampling error of aboveground live biomass as a percent of the estimate.
DRYBIOT_ST	DRYBIOT_STND_DEAD	Mg ha-1	Aboveground biomass of standing dead trees (≥ 12.7 cm diameter) on forest land per hectare of sampled area using retired FIA regional methods.
SE_DRYBI_1	SE_DRYBIOT_STND_DEAD_PCT	percent	Sampling error of standing dead biomass as a percent of the estimate.
DRYBIOT__1	DRYBIOT_LIVE_DEAD	Mg ha-1	Aboveground biomass of live trees (≥ 2.54 cm diameter) plus standing dead trees (≥ 5 inches diameter) on forest land per hectare of sampled area using retired FIA regional methods.
SE_DRYBI_2	SE_DRYBIOT_LIVE_DEAD_PCT	percent	Sampling error of live plus standing dead biomass as a percent of the estimate.
JENK_LIVE	JENK_LIVE	Mg ha-1	Aboveground biomass of live trees (≥ 2.54 cm diameter) on forest land per hectare of sampled area using the Jenkins equations.
SE_JENK_LI	SE_JENK_LIVE_PCT	percent	Sampling error of Jenkins live biomass as a percent of the estimate.
JENK_STND_	JENK_STND_DEAD	Mg ha-1	Aboveground biomass of standing dead trees (≥ 12.7 cm diameter) on forest land per hectare of sampled area using the Jenkins equations.
SE_JENK_ST	SE_JENK_STND_DEAD_PCT	percent	Sampling error of Jenkins standing dead biomass as a percent of the estimate.
JENK_LIVE_	JENK_LIVE_DEAD	Mg ha-1	Aboveground biomass of live trees (≥ 2.54 cm diameter) plus standing dead trees (≥ 12.7 cm diameter) on forest land per hectare of sampled area using the Jenkins equations.
SE_JENK__1	SE_JENK_LIVE_DEAD_PCT	percent	Sampling error of Jenkins live plus standing dead biomass as a percent of the estimate.
EST_SAMPLE	EST_SAMPLED_HA	ha	Sampled hectares in the hexagon.
SAMPLED_PL	SAMPLED_PLOTS	count	Number of sampled plots in the hexagon.
NON_SAMPLE	NON_SAMPLED_PLOTS	count	Number of non-sampled plots in the hexagon.
AVG_INVYR	AVG_INVYR	year	Average of year of field sampling

3. Application and Derivation

Brown and Schroeder (1999) used FIA data to estimate forest biomass in the Eastern U.S. at the county level. This new dataset extends this approach to the entire conterminous U.S. and provides biomass estimates at the finest spatial grain supported by FIA's standard sample intensity, a 640 km² hexagon. Local-scale statistical estimates, based on ground measurements, may be used to evaluate remotely sensed biomass maps.

4. Quality Assessment

Each hexagon-level biomass estimate is accompanied by the standard error of that estimate. This formal uncertainty estimate is derived from FIA's sample design and represents only sampling uncertainty within the hexagon (Woudenberg et al., 2010). Potential field measurement error is disregarded. A major source of uncertainty is the allometry (biometric equations) used to translate the diameter measurements made by FIA into tree-level biomass observations. While allometric error is not considered in the standard error estimates, the dataset allows scrutiny of this factor by presenting population estimates generated by applying different sets of allometry to exactly the same sample for each hex. Allometries considered include: the Component Ratio Method (CRM; Woodall et al., 2011); Jenkins (Jenkins et al., 2004); and an obsolete FIA biomass variable called DRYBIOT.

5. Data Acquisition, Materials, and Methods

Biomass estimates were derived from field data obtained through the USDA Forest Service's Forest Inventory and Analysis (FIA) program (Bechtold and Patterson, 2005). FIA collects forest structure metrics across the conterminous United States. The sampling effort is organized by equal-area hexagons of 640 km². The approximate distance between hexagon centers is 27 km. There are approximately 27 field plots within each hexagon, and each field plot is surveyed every 5–10 years using a standard protocol.

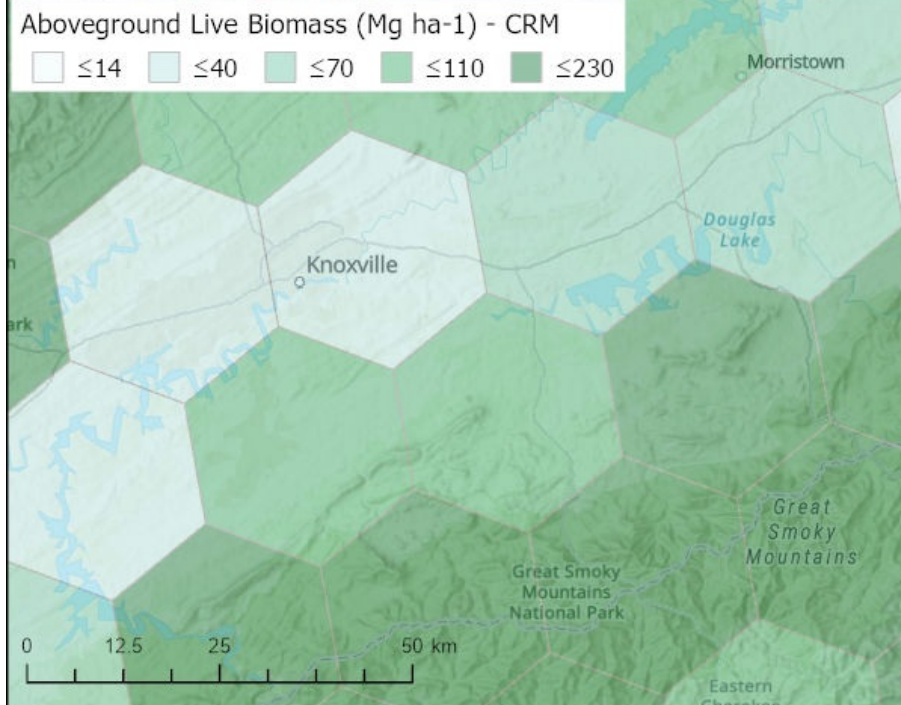


Figure 2. Selected hexagons in the vicinity of the Oak Ridge National Laboratory, Tennessee. Darker green hexagons have higher live biomass values. Source: CONUSbiohex2020.shp

Biomass estimates for each hexagon were derived from measurements pooled from plots with the respective hexagon. Biomass was estimated for living, dead, and both living+dead combined using allometric equations. Estimates were computed using standard FIA techniques (see Appendix J in Woudenberg et al., 2010) as well as two alternative methods: Jenkins allometry (Jenkins et al., 2004) and the Component Ratio Method (CRM; Woodall et al., 2011). The mean and standard error of each estimate is reported. See Table 1 for a list of estimated variables with definitions.

The variable *EST_SAMPLED_HA* communicates the estimated land area belonging to the U.S. within the hexagon. This number may be needed in some applications to, for example, calculate weighted biomass averages for particular regions. The number given is the FIA sample-based estimate, which is subject to sample error, especially given only ~27 plots per hex. A GIS process will likely return a more accurate number for this variable since both area of land area and administrative boundaries are generally mapped with fairly high accuracy.

See Menlove and Healey (2020) for additional information.

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

[CMS: Forest Aboveground Biomass from FIA Plots across the Conterminous USA, 2009-2019](#)

Contact for Data Center Access Information:

- E-mail: uso@daac.ornl.gov
- Telephone: +1 (865) 241-3952

7. References

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