

ArcGIS Server Image Service Metadata

Version 1; June 25, 2021

Purpose

In support of Washington State's 20-Year Forest Health Strategic Plan, this project was undertaken to produce forest condition spatial datasets from remotely sensed imagery known as Digital Aerial Photogrammetry (DAP). These forest condition datasets are being produced for the Washington State Department of Natural Resources (DNR) to use in developing a forest assessment and treatment framework for Eastern Washington. Because the imagery used to create the DAP data are collected every two years, it is possible for this approach to regularly produce forest condition datasets which can be used to monitor changing forest conditions and to monitor Forest Health Strategic Plan implementation and progress.

Description

"Masked" layers created using the Forest Mask layer to remove non-forested areas.

These models are a composite of 8 sub-models, one per FVS Variant and cover class. The Model Classes layer shows where each sub-model was used.

For more information see: <https://nrsig.org/projects/washington-forest-structure>

These data are research products and are likely to change. They are intended only as a research product and should not be used for other purposes.

Tags

Washington, Forest, Inventory, Digital, Aerial, Photogrammetry, DAP, Department of Natural Resources, University of Washington

Credits

This model was produced by the Natural Resource Spatial Informatics Group (<https://nrsig.org>), as part of a Washington Department of Natural Resources funded research project.

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Raster Information

Projection: NAD 1983 HARN, Washington State Plane South, US FEET. EPSG: 2927

Pixel Size: 66 feet

Models

Basal Area; BAA_GE6_LiveOrDead

Basal Area of live and dead trees with DBH ≥ 6 "

Units: Square feet per acre

Global model accuracy Pseudo-R²=0.6514, RMSE=83.05

Board foot Volume (FVS); fvsBdFt_GE6

Board foot volume, calculated using FVS, of live trees with DBH ≥ 6 ". See the FVS Variant Overview documentation for more details about the FVS volume calculations.

Units: Scribner board feet per acre for the PN, WC, and EC variants; Scribner Decimal C board feet per acre for the IE variant.

Global model accuracy Pseudo-R²=0.7016, RMSE=18295

Height, Large Trees; Ht_GE6_Top25Percent_LiveOrDead

Tree height of the top 25% (by diameter) of live and dead trees, with DBH ≥ 6 "

Units: Feet

Global model accuracy Pseudo-R²=0.7153, RMSE=19.94

Quadratic Mean Diameter; QMD_GE6_LiveOrDead

Quadratic Mean Diameter of live and dead trees, with DBH $\geq 6''$

Units: Inches

Global model accuracy Pseudo- $R^2=0.5363$, RMSE=4.013

Quadratic Mean Diameter, Large Trees; QMD_GE6_Top25Percent_LiveOrDead

Quadratic Mean Diameter of the top 25% (by diameter) of live and dead trees, with DBH $\geq 6''$

Units: Inches

Global model accuracy Pseudo- $R^2=0.6002$, RMSE=5.784

Stand Density Index; SDI_GE6_LiveOrDead

Stand Density Index of live and dead trees, with DBH $\geq 6''$

Units: Unitless

Global model accuracy Pseudo- $R^2=0.6546$, RMSE=115.1

Total Aboveground Biomass; TAGB_GE6

Total aboveground biomass, calculated using the Jenkins Equations, of live trees, with DBH $\geq 6''$

Units: Pounds per acre

Global model accuracy Pseudo- $R^2=0.6875$, RMSE=52.72

Cubic Foot Volume; TCuFt_GE6

Total cubic foot volume, calculated using the National Volume Estimator Library (NVEL), of live trees, with DBH $\geq 6''$

Units: Cubic feet per acre

Global model accuracy Pseudo- $R^2=0.7319$, RMSE=2972

Trees Per Acre; TPA_GE6_LiveOrDead

Trees per acre of live and dead trees, with DBH $\geq 6''$

Units: Unitless

Global model accuracy Pseudo- $R^2=0.4768$, RMSE=84.79

Trees Per Acre, Large Trees; TPA_GE6_Top25Percent_LiveOrDead

Trees per acre of the top 25% (by diameter) of live and dead trees, with DBH $\geq 6''$

Units: Unitless

Global model accuracy Pseudo- $R^2=0.4549$, RMSE=22.34

Structure Class

Forest structure class based on DAP-derived canopy cover and quadratic mean diameter values. The canopy cover data was directly calculated by the Fusion gridmetrics program. The QMD data was modeled in the QMD_GE6_Top25Percent_LiveOrDead model.

Class Number	Class Name	Diameter Range ₁	Cover Range ₂
1	Small Open		< 10%
		< 10"	≥ 10% and < 46%
2	Small Closed	< 10"	≥ 46%
3	Medium Open	≥ 10" and < 20"	≥ 10% and < 46%
4	Medium Moderate	≥ 10" and < 20"	≥ 46% and < 72%
5	Medium Closed	≥ 10" and < 20"	≥ 72%
6	Large Open	≥ 20"	≥ 10% and < 46%
7	Large Moderate	≥ 20"	≥ 46% and < 72%
8	Large Closed	≥ 20"	≥ 72%

₁ Tree diameter at breast height (DBH) was derived from modeling relationships between DAP metrics and tree diameters from field plots. Tree diameter used to define structure class is based on the mean diameter of the dominant and co-dominant trees in a field plot. It is calculated by deriving the quadratic mean diameter of trees whose diameters are in the top 25% of trees that are greater than 6" in diameter.

₂ Canopy Cover is derived from DAP using the percent of returns above 6 feet.

Units: Unitless

No accuracy assessment

Reference Rasters

Ground Model Source

A custom statewide ground model was developed for this project. The DNR provided a LIDAR-derived ground model for much of the state. It combines vendor produced LIDAR ground models into a single raster that crosses LIDAR acquisition boundaries. In areas where the DNR ground model did not have data, alternate data sources were used. The DNR LIDAR portal has additional LIDAR ground models that were not part of the DNR's dataset. These were added where possible, and any remaining areas without ground data were filled in using the USGS 3DEP 1/3rd Arc-Second Seamless DEM.

DAP 2017 QAQC

Information about the number of DAP returns per pixel for the 2017 Statewide DAP data.

This raster can be used to help identify why specific pixels are "No Data" in the final model prediction rasters.

Gridmetrics produces a count of the number of returns in each pixel. By default, gridmetrics will not calculate metrics for a pixel if it has less than four returns. Height thresholds are defined in gridmetrics for cover calculations, and to exclude returns below a specific height from being used for tree height

calculations. For this project, both thresholds were set to six feet. If a cell only has returns below these thresholds, cover and height metrics will not be calculated by gridmetrics.

Model Classes

The inventory models for this project were made by combining 8 separate sub-models, based on FVS Variant and canopy cover. Each sub-model has its own parameters and coefficients.

Class Number	FVS Variant	Canopy Cover
11	PN+AK	< 95%
12	PN+AK	≥ 95%
21	WC	< 95%
22	WC	≥ 95%
31	EC	< 95%"
32	EC	≥ 95%
41	IE+BM	< 95%
42	IE+BM	≥ 95%

Forest Mask

Forest / non-forest mask for Washington State. The mask was produced by combining two pre-existing layers, one for Eastern Washington and one for Western Washington. The eastern Washington layer was produced by the Washington Department of Natural Resources Forest Health and Resiliency Team in support of the 20-Year Forest Health Strategic Plan. The western Washington layer was produced for GNN, by LEMMA at Oregon State University.

The source data layers were reprojected from their source coordinate systems and into the 66' pixels used in the gridmetrics and model prediction rasters.