

This data set includes estimates of plant aboveground biomass (AGB), shrub AGB, and shrub dominance (shrubs AGB/plant AGB) for non-water portions of the Beaufort Coastal Plain and Brooks Foothills ecoregions of the North Slope of Alaska, and three sites in the NWT, Canada. The estimates were derived by linking biomass harvests from 28 published field site datasets with NDVI from a regional Landsat mosaic derived from Landsat 5 and 7 satellite imagery. The data are provided for the best estimate for each pixel in the mosaic at the 50th percentile, and also at the 2.5 and 97.5 percentiles for each data type (AGB, shrub and plant dominance) which together encompass 95% of predictions. Uncertainty was quantified using a Monte Carlo framework. The data cover the period 2007-06-01 to 2016-08-31.

The published field measurements of plant and shrub AGB used in the modeling were collected between July, 1998 and August 2008. The mean and standard error (SE) of plant and shrub AGB were also acquired or computed for the data at each site. The regional Landsat NDVI mosaic was derived from 1,721 summer scenes acquired between 2007 and 2016. Spectral reflectance information was extracted from these 'peak greenness' scenes on a per pixel basis. Empirical AGB-NDVI relationships were developed for the field sites and the relationships were applied to the mosaic. The Monte Carlo uncertainty analysis involved generating 1,000 regional maps of each ecosystem data type, where each map was produced by randomly permuting the underlying field and remote sensing data sets by their uncertainty due to sampling and sensor calibration errors. The data with this dataset are the 50th percentile (best estimates), the 2.5, and 97.5 percentiles of the 1,000 permutations.

**Spatial Coverage:** The study area encompassed sites on the Seward Peninsula, non-water portions of the Beaufort Coastal Plain and Brooks Foothills ecoregions of the North Slope of Alaska, and three sites in the Northwest Territories, (NWT) Canada.

**ABoVE Reference Locations:**

Domain: Core ABoVE

State/territory: Alaska

Grid cell(s):

**Spatial Resolution:** 30-m

**Temporal Coverage:** 2007-06-01 to 2016-08-31

**Temporal Resolution:** One time estimates

**Study Areas** (All latitude and longitude given in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Regions of the Beaufort Coastal Plain and Brooks Foothills, North slope, Alaska	-168.576	-139.932	70.915	66.915

Table 1. **File names and descriptions**

There are nine data files with this data set in GeoTIFF (.tif) format.

The data are best-estimates of plant AGB, shrub AGB, and shrub dominance for each pixel in the regional Landsat mosaic. The best-estimates were the 50<sup>th</sup> percentile of the 1,000 permutations for each pixel. Data are also included for the 2.5 and 97.5 percentiles of the 1,000 permutations.

Filename	Description
nslope_shrub_dominance_pcmt_of_agb_p97_5.tif	Shrub dominance (97.5 percentile) reported as a percent
nslope_shrub_dominance_pcmt_of_agb_p50.tif	Shrub dominance (50th percentile) reported as a percent
nslope_plant_agb_p50.tif	Plant AGB (50th percentile)
nslope_plant_agb_p97_5.tif	Plant AGB (97.5 percentile)

nslope_shrub_agb_p2_5.tif	Shrub AGB (2.5 percentile)
nslope_plant_agb_p2_5.tif	Plant AGB (2.5 percentile)
nslope_shrub_agb_p50.tif	Shrub AGB (50th percentile)
nslope_shrub_dominance_pcmt_of_agb_p2_5.tif	Shrub dominance (2.5 percentile) reported as a percent
nslope_shrub_agb_p97_5.tif	Shrub AGB (97.5 percentile)

Table 2. Attributes of the GeoTIFF files

Filename	Units	Minimum value	Maximum value	Mean value	Standdev Value	No data value
nslope_shrub_dominance_pcmt_of_agb_p97_5.tif	%	14	100	53.6	9.8	255
nslope_shrub_dominance_pcmt_of_agb_p50.tif	%	5	100	43.3	11.2	255
nslope_plant_agb_p50.tif	gm2	26	3325	734.3	283.4	65535
nslope_plant_agb_p97_5.tif	gm2	61	5031	908.1	344.8	65535
nslope_shrub_agb_p2_5.tif	gm2	0	2475	204.9	161.4	65535
nslope_plant_agb_p2_5.tif	gm2	9	2297	582.7	248.2	65535
nslope_shrub_agb_p50.tif	gm2	1	3984	346.4	219.3	65535
nslope_shrub_dominance_pcmt_of_agb_p2_5.tif	%	0	97	27.7	12.2	255
nslope_shrub_agb_p97_5.tif	gm2	6	7979	504.7	294.6	65535

## Site description

The study area included encompassed non-water portions of the Beaufort Coastal Plain and Brooks Foothills ecoregions of the North Slope, and three sites in the NWT. The Beaufort Coastal Plain supports extensive lowland tundra plant communities often dominated by sedges and small shrubs. The warmer Brooks Foothills supports tussock tundra, shrub tundra, and mixed tundra communities. These field measurements were derived from clip harvests at tundra sites on the North Slope (n=14), the Seward Peninsula (n=7), and in northern Canada (n=3).

## Methods

The uncertainty estimates provided in this dataset were derived from a Monte Carlo analysis and were evaluated through comparisons with (1) field measurements of shrub canopy height, (2) independent remote sensing estimates of shrub canopy cover, and (3) high-resolution satellite and aerial imagery.

## **Plant biomass data**

Published field measurements of plant and shrub AGB collected between July 1998 and August 2008 were used to develop empirical relationships between AGB and Landsat NDVI (Copass et al., 2007,a,b; Reynolds et al., 2008,2002; Vankoughnet and Grogan, 2016; Walker et al., 2012, 2003). These field measurements were derived from clip harvests at tundra sites on the North Slope (n=14), the Seward Peninsula (n=7), and in northern Canada (n=3) using similar sampling and measurement methods. Biomass was harvested during the period of peak AGB (mid-June to mid-August). The mean and standard error (SE) of plant and shrub AGB were acquired or computed for each site. Plant AGB included total live and standing dead AGB of all PFTs. Shrub AGB included deciduous and evergreen species with woody stems. The collection of field sites was supplemented with four nonvegetated sites that were situated in mountainous areas around the region. These sites were identified using high resolution satellite, aerial, and oblique imagery available on Google Earth. Together, these data provided estimates of plant and shrub AGB at 28 sites (Figure 1). These sites did not constitute a random or systematic sample of the study area, but encompassed a broad range of tundra plant communities. The companion file **Maps\_AGB\_North\_Slope\_AK\_FieldSites.csv** provides the site information, the mean and standard error (SE) of plant and shrub AGB used in this study. The companion file **tundra\_biomass\_harvest\_sites.kmz** provides the site locations in .kmz format for viewing in Google Earth.

## **Landsat mosaic**

Landsat 5 and 7 surface reflectance data sets were used to create a seamless multi-band composite mosaic of the study area and to determine NDVI at each of the 28 locations of plant and shrub AGB. The following process was used to create the mosaic:

- (1) All available scenes from Landsat 5 (n=361) and Landsat 7 (n=1,360) were acquired over the region from late June through late August between 2007 and 2016. Residual water, snow, clouds, and cloud shadows pixels were masked.
- (2) After extensive masking, the NDVI for each scene was computed.
- (3) The NDVI from Landsat 5 was bias corrected to match Landsat 7.
- (4) The 80th percentile NDVI values for each pixel from all available scenes was computed.
- (5) The scene was identified that had NDVI closest to the 80th percentile.
- (6) A multi-band Landsat composite mosaic was created of the study area by extracting spectral reflectance information from these 'peak greenness' scenes on a per pixel basis.

## **Plant biomass mapping and uncertainty assessment**

Plant AGB, shrub AGB, and shrub dominance were modeled over the study area by first developing empirical AGB-NDVI relationships at the field sites and then applying these

relationships to regional Landsat NDVI mosaics. Uncertainty in these predictions was tracked using a Monte Carlo approach (Harmon et al., 2007; Berner et al., 2017b):

- Uncertainty in the AGB-NDVI models resulting from sampling error in both variables within each site.
- Uncertainty in regional NDVI given uncertainty in sensor calibration (Markham and Helder, 2012).

The approach involved repeatedly ( $n=1,000$ ) permuting AGB and NDVI at each site, fitting nonlinear (exponential) models to the permuted field data, and then predicting regional AGB by combining each nonlinear model with a permutation of the regional NDVI mosaic. The models were fitted using the nonlinear least squares function in *R* and, after predicting AGB, shrub dominance was computed for each permutation. Lastly, for each of these plant attributes the pixel-wise median, 2.5 percentile, and 97.5 percentiles were computed among the suite of permutations. This yielded both a best estimate (median) and 95% confidence interval (CI) for each plant attribute at 30-m resolution for the North Slope. These CIs incorporated several important sources of uncertainty, but are not a full accounting of potential errors (e.g., atmospheric correction) and thus are a conservative estimate of uncertainty.