Pre-ABoVE: Arctic Vegetation Plots in Flux Tower Footprints, North Slope Alaska, 2014

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Documentation Revision Date: 2017-09-25

Data Set Version: 1

Summary

This data set provides vegetation, environmental, and soil data collected from plots located in the footprints of eddy covariance flux towers along a 300 km north-south latitudinal gradient from Barrow, to Atqasuk, and to Ivotuk across the North Slope of Alaska in 2014. Within each of the five flux tower footprints, 1x1-m quadrats were placed subjectively within widespread habitat or micro-habitat types to map the dominant vegetation communities and site environmental factors. Specific attributes included species cover data and environmental, soil and spectral data (active layer thaw depth, moss layer depth, organic horizon layer depth, standing water depth, soil moisture status, vegetation height, LAI).

Data were collected at three tower sites near Barrow spanning a well-drained wet coastal tundra site at NOAA Climate Monitoring and Diagnostics Laboratory (US-Brw), a medium well-drained wet coastal tundra site on the Barrow Environmental Observatory (US-Beo), and an inundated wet coastal tundra site at the location of the southern end of the previous Biocomplexity Experiment (US-Bes). The tower site at Atqasuk (US-Atq) is sandy, non-acidic, moist tussock tundra, and the tower at Ivotuk (US-Ivo) occupies a southern moist tussock tundra site in the foothills of the Brooks Range.

There are four data files in comma-separated format (.csv) with this data set and one companion file with plot photos.

Figure 1. Land cover types and topography at the flux tower field sites at Barrow, Atqasuk and Ivotuk, Alaska

Citation

Davidson, S.J., D. Zona, and D.A. Walker. 2017. Pre-ABoVE: Arctic Vegetation Plots in Flux Tower Footprints, North Slope Alaska, 2014. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1546

Table of Contents

1. Data Set Overview

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Data were collected at three tower sites near Barrow spanning a well-drained wet coastal tundra site at NOAA CMDL (US-Brw), a medium well-drained wet coastal tundra site on the Barrow Environmental Observatory (US-Beo), and an inundated wet coastal tundra site at the location of the southern end

of the previous Biocomplexity Experiment (US-Bes). The tower site at Atqasuk (US-Atq) is sandy, non-acidic, moist tussock tundra, and the tower at Ivotuk (US-Ivo) occupies a southern moist tussock tundra site in the foothills of the Brooks Range

Project: Arctic-Boreal Vulnerability Experiment (ABoVE)

The Arctic-Boreal Vulnerability Experiment (ABoVE) is a NASA Terrestrial Ecology Program field campaign that will take place in Alaska and western Canada between 2016 and 2021. Climate change in the Arctic and Boreal region is unfolding faster than anywhere else on Earth. ABoVE seeks a better understanding of the vulnerability and resilience of ecosystems and society to this changing environment.

Related Publications:

Davidson, S.J., V. L. Sloan, G. K. Phoenix, R. Wagner, J. P. Fisher, W. Oechel and D. Zona. 2016. Vegetation type dominates the spatial variability in CH4 Emissions across multiple arctic tundra landscapes. Ecosystems 19:1116-1132. https://doi.org/10.1007/s10021-016-9991-0

Davidson, S. J., M. J. Santos, V. Sloan, J. D. Watts, W. C. Oechel, and D. Zona. 2016. Mapping Arctic Tundra Vegetation Communities Using Field Spectroscopy and Multispectral Satellite Data in North Alaska, U.S.A. Remote Sensing. 8(12):978; https://doi.org/10.3390/rs8120978

Related Dataset:

Zona, D., W. Oechel, C.E. Miller, S.J. Dinardo, R. Commane, J.O.W. Lindaas, R.Y-W. Chang, S.C. Wofsy, C. Sweeney, and A. Karion. 2016. CARVE-ARCSS: Methane Loss From Arctic- Fluxes From the Alaskan North Slope, 2012-2014. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1300

Acknowledgements:

These data files were edited by Dr. Amy Breen and Lisa Druckenmiller and obtained from the Alaska Arctic Geoecological Atlas (http://agc.portal.gina.alaska.edu), which provides access to existing Arctic vegetation plot and map data in support of the ABoVE campaign.

2. Data Characteristics

Spatial Coverage: Flux tower sites across a 300 km north-south latitudinal gradient from Barrow, to Atqasuk, and to Ivotuk across the North Slope of Alaska

ABoVE Grid Location:

Domain: Core ABoVE region

State/territory: Alaska

Grid cells:

Barrow: Ahh1Avv0Bh2Bv1

Atqasuk: Ah01v00Bh01v01

Ivotuk: Ahh1Avv0Bh1Bv2

Spatial Resolution: Point resolution. Each plot had an area of 1 square meter.

Temporal Coverage: 20140718 to 20140731

Temporal Resolution: Each plot was sampled once.

Study Area: (All latitude and longitude given in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Flux tower sites at Barrow, Atqasuk, and Ivotuk, Alaska	-157.4143	-155.7467	71.3250	68.4850

Eddy Covariance Flux Tower Locations

Site	Latitude	Longitude	Tower Site Description
BES	71.28088	-156.596467	Barrow-BES tower (US-Bes) is located 10 km east of the town of Barrow, Alaska at the Barrow Environmental Observatory reserve. Elevation 3 m ASL. Instrument height 2 m. Vegetation at the site consists of moist acidic tundra

			- wet sedges, grasses, moss, and assorted lichens.
BEO	71.281001	-156.61235	Barrow-BEO tower is located 10 km east of the town of Barrow, Alaska at the Barrow Environmental Observatory reserve. Elevation 3 m ASL. Instrument height 3 m. Vegetation at the site consists of moist acidic tundra - wet sedges, grasses, moss, and assorted lichens.
CMDL	71.280881	-156.596467	Barrow-CMDL tower (US-Brw) is located 10 km east of the town of Barrow, Alaska, adjacent to the NOAA CMDL Laboratory. Elevation 4 m ASL. Instrument height 5 m. Vegetation at the site consists of moist acidic tundra - wet sedges, grasses, moss, and assorted lichens.
ATQ	70.469622	-157.408947	Atqasuk tower (US-Atq) is located 100 km south of Barrow. Elevation 25 m ASL. Instrument height 2 m. Vegetation at the site is a variety of moist-wet coastal sedge tundra and moist-tussock tundra surfaces in the more well-drained upland.
IVO	68.48649	-155.75022	Ivotuk tower (US-Ivo) is located 300 km south of Barrow at 579 m elevation in polar tundra. Instrument height 4 m.

Data File Information

This data set includes four data files:
flux_tower_zona_enivronmental_data.csv, *flux_tower_zona_soil_data.csv*, *flux_tower_zona_spectral_data.csv*, *flux_tower_zona_species_cover_data.csv* and one companion file: *flux_tower_zona_Photos.pdf*. File contents are described in Table 1.

Table 1. Data and companion files

Data File Name	Description
flux_tower_zona_species_data.csv	This file contains species cover data for the vegetation plots at the Flux Towers (Barrow, Atqasuk, Ivotuk)
flux_tower_zona_spectral_data.csv	This file contains the leaf area index of Ivotuk vegetation plots
flux_tower_zona_soil_data.csv	This file contains the soils data consisting of soil pH, depths of mosses and organic layer,thaw depth, and soil moisture in a range of two depths (ground surface and at 15 cm) for the vegetation plots at the Flux Towers (Barrow, Atqasuk, Ivotuk)
flux_tower_zona_enivronmental_data.csv	This file contains comprehensive set of environmental data for the vegetation plots at the Flux Towers (Barrow, Atqasuk, Ivotuk)
Companion File Name	**Description**
Flux_Tower_Zona_Veg_Plots_Photos.pdf	Photos of the individual plots at Barrow, Atqasuk, & Ivotuk.

Data Descriptions: The column names, their units and descriptions for each of the .csv data files are listed below.

Table 1. File flux_tower_zona_species_cover_data.csv

Column Numbers	Column Name	Units	Description

1	PASL_TAXON_SCIENTIFIC_NAME_NO_AUTHORS		Current Taxonomy according to the Panarctic Species List (PASL)
2	PASL_TAXON_SCIENTIFIC_NAME_WITH_AUTHOR(S)		Current Taxonomy according to the Panarctic Species List (PASL) includng authors names
3	DATASET_TAXON		Dataset taxonomy
4 to 143	TURBOVEG_NUMBER/PLOT_NUMBER		Column headings correspond to the plot sites that were surveyed at the Flux Towers. Barrow: BEO, BES, CMDL Atqasuk: ATQ, and Ivotuk: IVO

Table 2. File flux_tower_zona_spectral_data.csv

Column Name	Units	Description
PLOT_NUMBER		Plot number where the soil sample was collected
LEAF_AREA_INDEX		Leaf Area Index for the plot

Table 3. File flux_tower_zona_soil_data.csv

Column Name	Units	Description
PLOT_NUMBER		Plot number where the soil sample was collected
SOIL_PH		PH of the soil sample
DEPTH_TO_BASE_OF_GREEN_MOSS_CM	cm	Depth to the base of the green moss layer in the soil in the plots
BROWN_MOSS_LAYER_THICKNESS_CM	cm	Thickness of the green moss layer within the soil in the plots
DEPTH_TO_BASE_OF_BROWN_MOSS_CM	cm	Depth to the base of the brown moss layer in the soil in the plots
ORGANIC_HORIZON_THICKNESS_CM	cm	Thickness of the organic layer within the soil in the plots
DEPTH_TO_BASE_OF_ORGANIC_SOIL_CM	cm	Depth to the base of the organic layer in the soil in the plots
THAW_DEPTH_CM	cm	Depth to permafrost of the plots
SOIL_MOISTURE_0_5_CM_PERCENT	%	Soil moisture content within the top 5 cm of soil in the plots
SOIL_MOISTURE_15_20_CM_PERCENT	%	Soil moisture content within the top 15-20 cm of soil in the plots

Table 4. File flux_tower_zona_enivronmental_data.csv

Column Name	Units	Description
SURVEY_DATE	YYYYMMDD	Date of survey
MICROTOPOGRAPHY		Description of topography
LATITUDE	Decimal Degrees	Latitude of the center of the plots
LONGITUDE	Decimal Degrees	Longitude of the center of the plots
GPS_ACCURACY_M	m	GPS accuracy
COMMUNITY_NAME		Name of the vegetation community
SOIL_PH		PH of the soil within the plots
ORGANIC_LAYER_THICKNESS_CM	cm	Thickness of the organic layer within the soil in the plots
DEPTH_OF_STANDING_WATER_CM	cm	Depth of standing water within the plots
VEGETATION_MEAN_HEIGHT_CM	cm	Mean height of vegetation within the plots
HERB_LAYER_HEIGHT_CM	cm	Height of the herb layer within the plots
	cm	Height of moss within the plots
TREE_COVER_PERCENT	%	Percentage of tree cover in the plot
SHRUB_COVER_PERCENT	%	Percentage of shrub cover in the plot
TALL_SHRUB_COVER_PERCENT	%	Percentage of tall shrub cover in the plot
LOW_SHRUB_COVER_PERCENT	%	Percentage of low shrub cover in the plot
DWARF_SHRUB_COVER_PERCENT	%	Percentage of dwarf shrub cover in the plot
PROSTRATE_DWARF_SHRUB_COVER_PERCENT	%	Percentage of dwarf shrub cover in the plot
GRAMINOID_COVER_PERCENT	%	Percentage of graminoid cover in the plot
TUSSOCK_GRAMINOID_COVER_PERCENT	%	Percentage of tussock graminoid cover in the plot
FORB_COVER_PERCENT	%	Percentage of forb cover in the plot
SEEDLESS_VASCULAR_PLANT_COVER_PERCENT	%	Percentage of seedless vascular plant cover in the plot
MOSS_COVER_PERCENT	%	Percentage of moss cover within the plots

LICHEN_COVER_PERCENT	%	Percentage of lichen cover in the plot
CRUSTOSE_LICHEN_COVER_PERCENT	%	Percentage of crustose lichen cover in the plot
ALGAE_COVER_PERCENT	%	Percentage of algae cover in the plot
SOIL_COVER_PERCENT	%	Percentage of soil cover in the plot
ROCK_COVER_PERCENT	%	Percentage of rock cover in the plot
WATER_COVER_PERCENT	%	Percentage of water cover in the plot
LITTER_COVER_PERCENT	%	Percentage of litter cover in the plot
TOTAL_VEGETATION_COVER_PERCENT	%	Percentage of total vegetation cover in the plot
LOCATION_REMARKS		Remarks

3. Application and Derivation

The vegetation and spectral data were used to model the relationships between gross primary productivity, dissolved organic carbon, and CH4 fluxes which resulted in the finding that vegetation types are an important consideration when modeling CH4 emissions. Improved understanding of tundra vegetation distributions will also provide necessary insight into the ecological processes driving plant community assemblages in Arctic environments (Davidson et al., 2016a).

4. Quality Assessment

No specific quality assessment information provided.

5. Data Acquisition, Materials, and Methods

Plot Selection

Field surveys were conducted at five tower eddy covariance field sites across the North Slope of Alaska between 18 and 31 July 2014 (Davidson et al., 2016b).

Within each flux tower footprint, five or ten 1 x 1 m quadrats were placed subjectively within a widespread habitat or a micro-habitat type, as identified during initial walkover surveys.

- At the Barrow-BEO site, habitats consist of polygon rims, low centers (ponds), flat centers, high centers and wet troughs (50 quadrats).
- At the Barrow-BES site, quadrats were placed close to a boardwalk crossing a drained lake basin (10 quadrats).
- At the Barrow-CMDL site, habitats were polygon high centers and troughs, and a relatively flat homogenous area unaffected by thaw lake processes (20 quadrats).
- At Atqasuk-ATQ site, habitats included polygon low centers and ridges on sandy soils (30 quadrats).
- Ivotuk-IVO habitats comprise a stable plateau, wet meadows on the margin of a watercourse, and a north-west facing slope (30 quadrats).

Differential GPS coordinates were obtained for each plot on the date of survey.

Vegetation Surveys

The vegetation within the flux collars was subsequently surveyed at peak season (Ivotuk 18th July 2014, Barrow-BEO 22nd July 2014, Barrow-BES 23rd July 2014, Atqasuk 29th July 2014).

Percentage cover of all vascular and non-vascular plant species was recorded as 0.1 (present), 1 (occasional, few individuals) or 3 (occasional, more individuals), and to the nearest 5% thereafter (Davidson et al., 2016b).

Vascular plant identifications were made in the field according to Hultén (1968), and non-vascular plant identifications according to Vitt et al. (1988) respectively.

Environmental, Soil, and Spectral Data

Environmental, soils and spectral data (active layer thaw depth, moss layer depth, organic horizon layer depth, standing water depth, soil moisture status, vegetation height, LAI (Ivotuk)) were collected in the field.

- Thaw depth was measured with a metal rod with cm gradations. Values are averages of 3 - 5 measurements per plot.
- Green/brown moss and organic layer thickness were measured from a block cut with a 30 cm bread knife.
- Soil moisture was measured with a TDR 300 (FieldScout, Spectrum Technologies, Aurora, IL, USA) with 5 cm probes, measured once at top of soil (ground surface below any loose moss) and once at 15 cm depth, inserting head of probe through a knife slit.
- Leaf area index of the Ivotuk plots was measured with an LAI 2000 Plant Canopy Analyzer (LI-COR, Lincoln, USA), Ninety degree view cap, one above for reference, and four below measurements (N, S, E, W from plot center). These data are only available for Ivotuk because the vegetation elsewhere is either too short and sparse to measure reliably, or plots were in deep standing water.

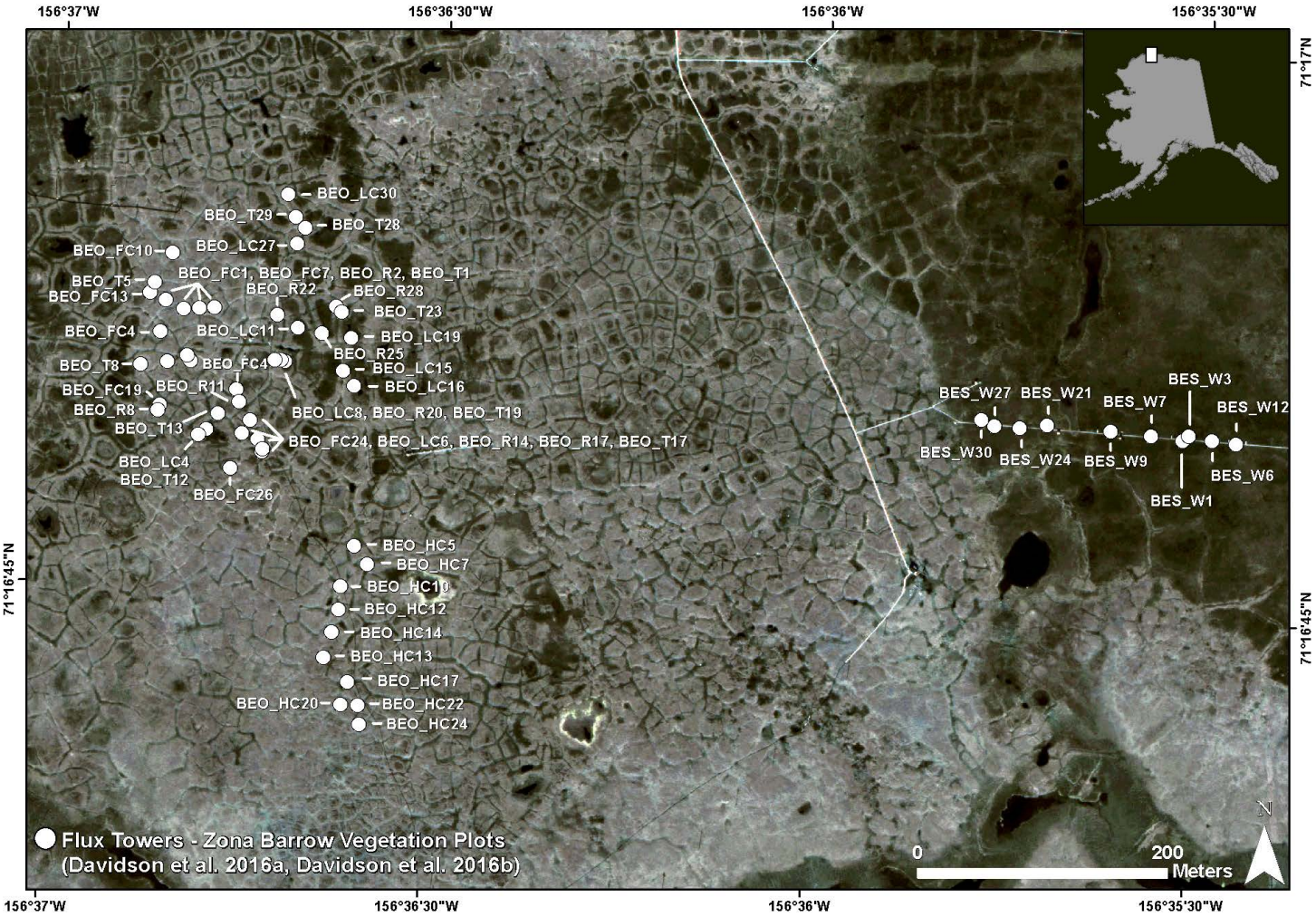

Figure 2: Location of the Barrow Environmental Observatory Flux Tower (BEO) and Barrow Biocomplexity Experiment South Tower (BES) sites.

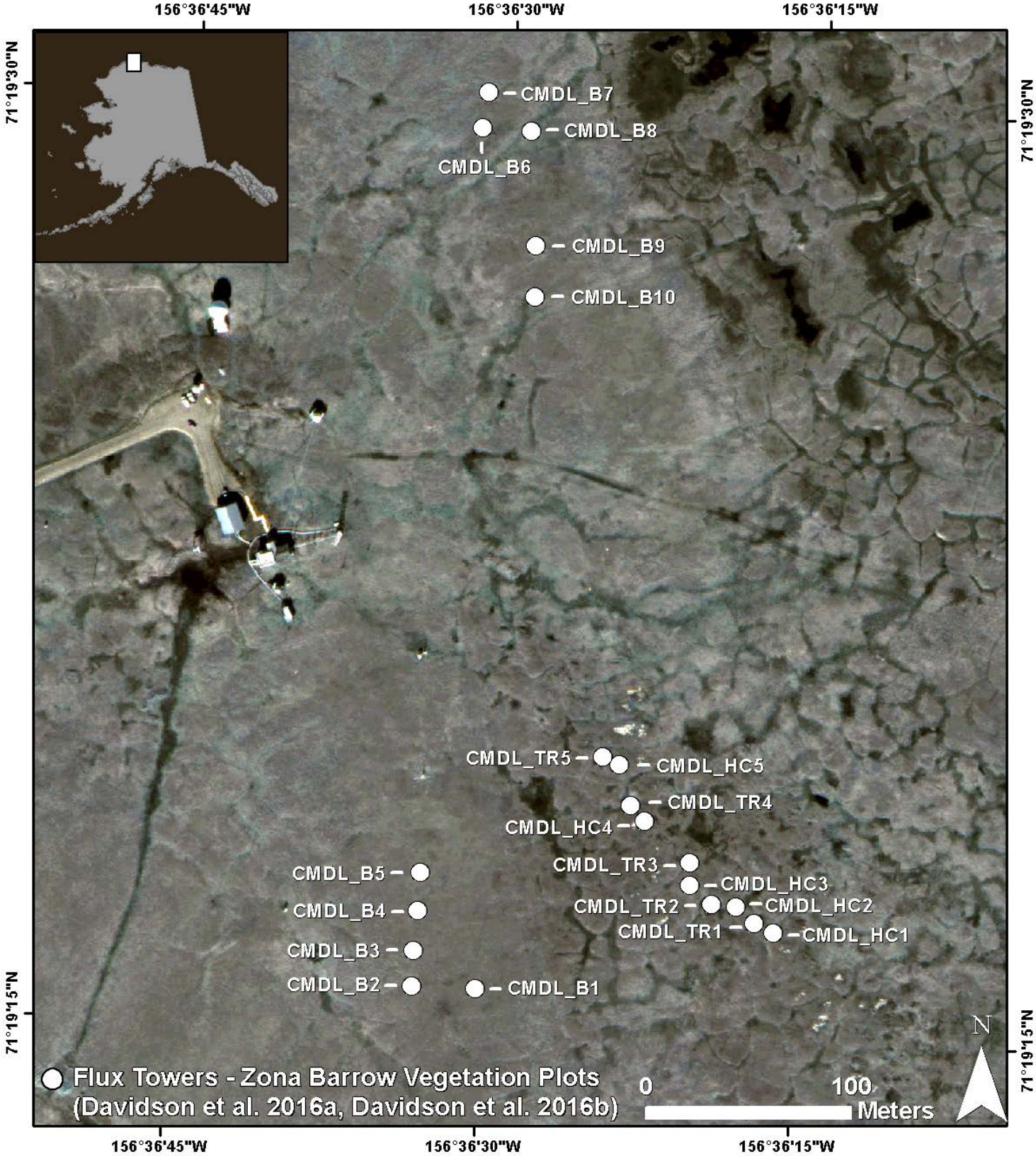

Figure 3: Location of the Climate Monitoring and Diagnostics Laboratory Flux Tower (CMDL) sites

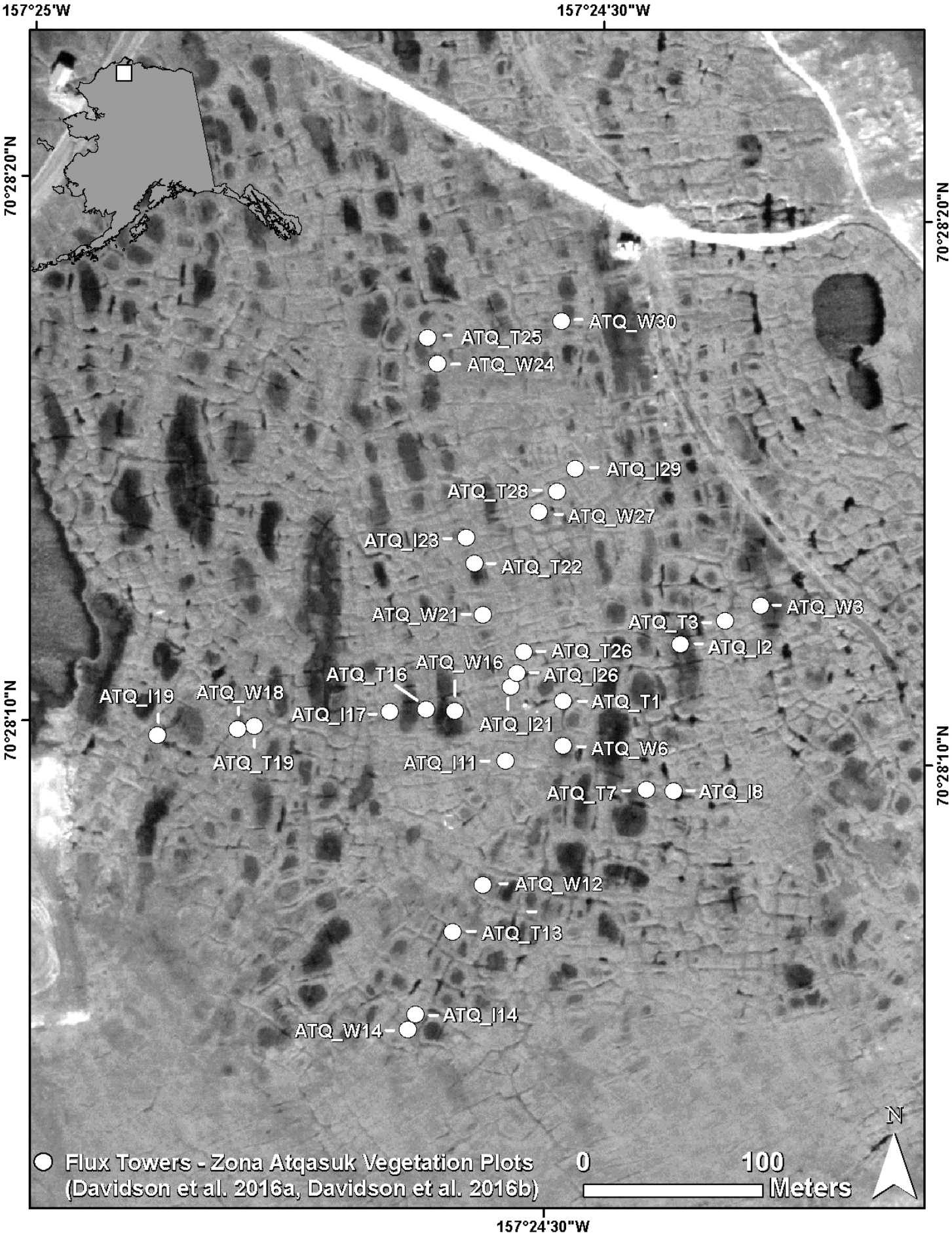
157°25'W
157°24'30"W
70°28'20"N
70°28'10"N
ATQ_W30
ATQ_T25
ATQ_W24
ATQ_I29
ATQ_T28
ATQ_W27
ATQ_I23
ATQ_T22
ATQ_W21
ATQ_W3
ATQ_T3
ATQ_I2
ATQ_T26
ATQ_W16
ATQ_T16
ATQ_I26
ATQ_I19
ATQ_W18
ATQ_I17
ATQ_T1
ATQ_I21
ATQ_T19
ATQ_W6
ATQ_I11
ATQ_T7
ATQ_I8
ATQ_W12
ATQ_T13
ATQ_I14
ATQ_W14
N
Flux Towers - Zona Atqasuk Vegetation Plots
(Davidson et al. 2016a, Davidson et al. 2016b)
0
100
Meters

Figure 4: Location of the Atqasuk sites

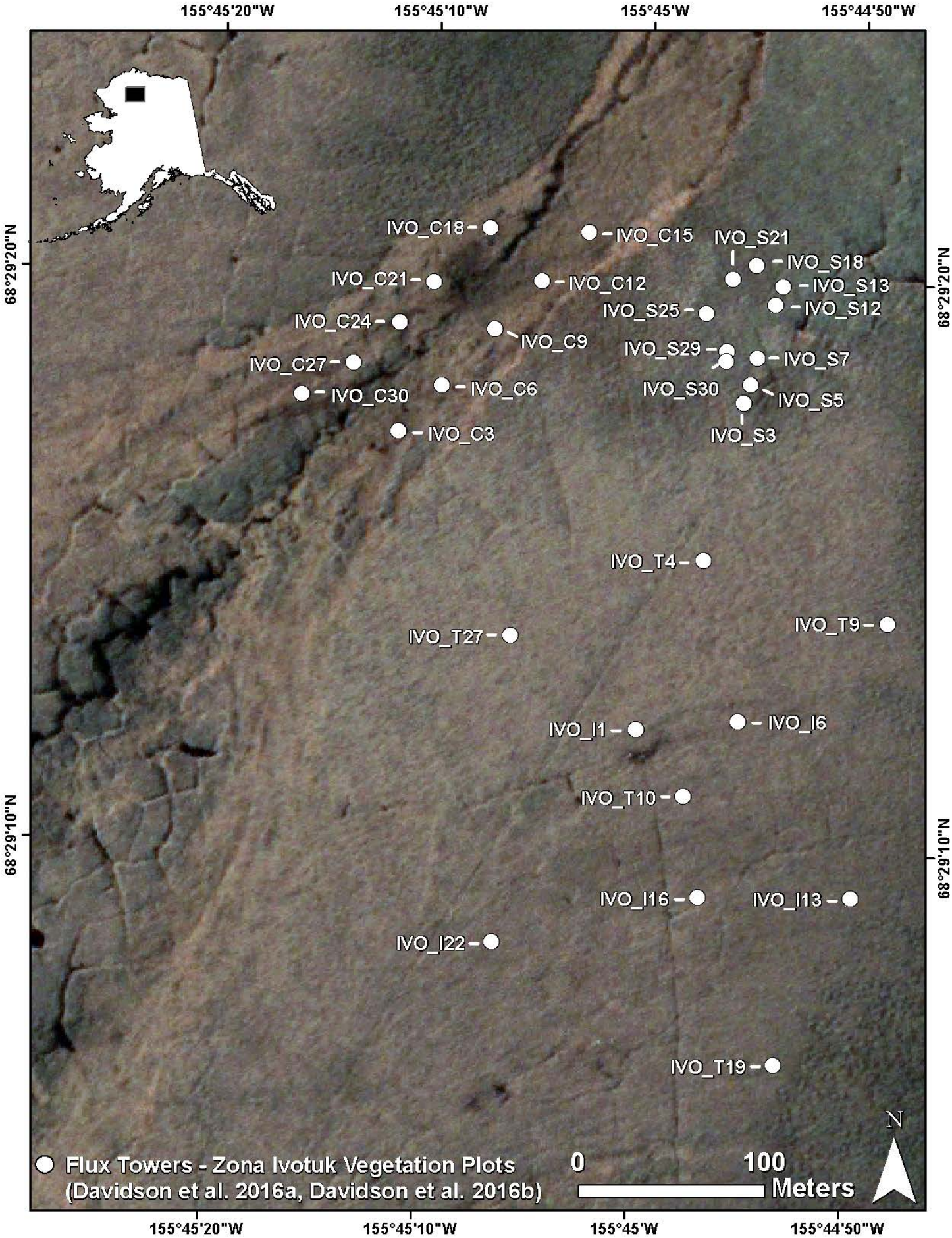
155°45'20"W
155°45'10"W
155°45'W
155°44'50"W
68°29'20"N
68°29'10"N
IVO_C18
IVO_C15
IVO_S21
IVO_S18
IVO_C21
IVO_C12
IVO_S13
IVO_S12
IVO_S25
IVO_C24
IVO_C9
IVO_S29
IVO_S7
IVO_C27
IVO_C6
IVO_S30
IVO_S5
IVO_C30
IVO_C3
IVO_S3
IVO_T4
IVO_T9
IVO_T27
IVO_I1
IVO_I6
IVO_T10
IVO_I16
IVO_I13
IVO_I22
IVO_T19
N
Flux Towers - Zona Ivotuk Vegetation Plots
(Davidson et al. 2016a, Davidson et al. 2016b)
0
100
Meters

Figure 5: Location of the Ivotuk sites

6. Data Access

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

Pre-ABoVE: Arctic Vegetation Plots in Flux Tower Footprints, North Slope Alaska, 2014

Contact for Data Center Access Information:

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7. References

Davidson, S.J., V. L. Sloan, G. K. Phoenix, R. Wagner, J. P. Fisher, W. Oechel and D. Zona. 2016. Vegetation type dominates the spatial variability in CH4 Emissions across multiple arctic tundra landscapes. Ecosystems 19:1116-1132. https://doi.org/10.1007/s10021-016-9991-0

Davidson, S. J., M. J. Santos, V. Sloan, J. D. Watts, W. C. Oechel, and D. Zona. 2016. Mapping Arctic Tundra Vegetation Communities Using Field Spectroscopy and Multispectral Satellite Data in North Alaska, U.S.A. Remote Sensing. 8(12):978; https://doi.org/10.3390/rs8120978

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Vitt, D.H.; Marsh, J.E.; Bovey, R.B. *Mosses, Lichens, and Ferns of Northwest North America*; Lone Pine: Edmonton, AB, Canada, 1998.