CARVE: L1 Daily Flight Path Geolocation and Aircraft Position Data, Alaska, 2012-2015

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Documentation Revision Date: 2017-02-22

Data Set Version: V1

Summary

This data set provides high-frequency geolocation, time, height, pitch, roll, and heading information for the C-23 Sherpa aircraft during airborne campaigns over the Alaskan and Canadian Arctic as part of the Carbon in Arctic Reservoirs Vulnerability Experiment (CARVE). The data were collected in situ using the Digital Air Data System (DADS) onboard the aircraft and are presented at 1-second intervals throughout each flight. Flight campaigns took place from 2012 to 2015 between the months of March and November to enable investigation of both seasonal and inter-annual variability in atmospheric gas content. The measurements included in this data set are useful for matching aircraft position with the scientific data collected by other CARVE airborne instruments.

These measurements are one part of an innovative multi-instrument remote sensing payload flown for the CARVE investigation.

There are 185 data files in netCDF (*.nc) format, one for each CARVE campaign flight, with this data set.

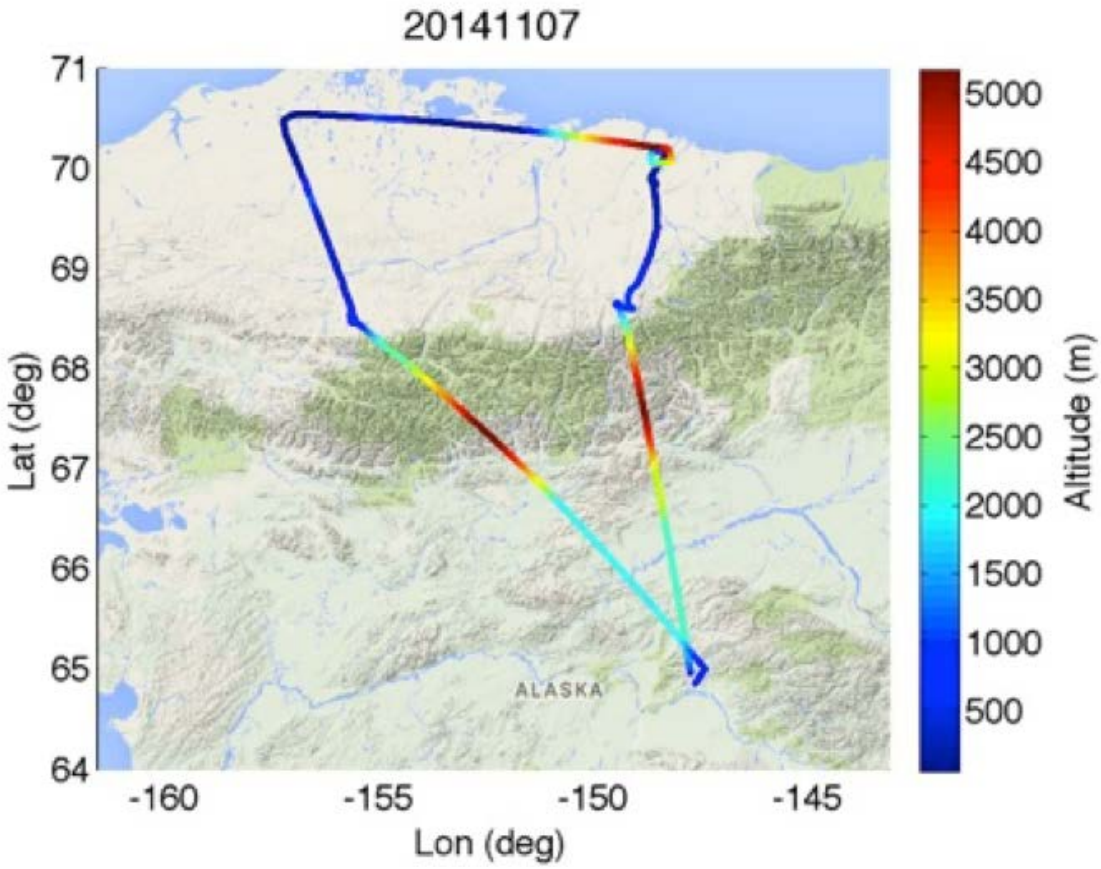

Figure 1: Altitude and flight path recorded during a CARVE flight from Fairbanks to the North Slope of Alaska on November 7, 2014.

Citation

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Table of Contents

1. Data Set Overview

Project: Carbon in Arctic Reservoirs Vulnerability Experiment (CARVE)

The Carbon in Arctic Reservoirs Vulnerability Experiment (CARVE) is a NASA Earth Ventures (EV-1) investigation designed to quantify correlations between atmospheric and surface state variables for Alaskan terrestrial ecosystems through intensive seasonal aircraft campaigns, ground-based observations, and analysis sustained over a 5-year mission. CARVE collected detailed measurements of greenhouse gases on local to regional scales in the Alaskan Arctic and demonstrated new remote sensing and improved modeling capabilities to quantify Arctic carbon fluxes and carbon cycle-climate processes. CARVE science fills a critical gap in Earth science knowledge and satisfies high priority objectives across NASA's Carbon Cycle and Ecosystems, Atmospheric Composition, and Climate Variability & Change focus areas as well as the Air Quality and Ecosystems elements of the Applied Sciences program. CARVE data also complements and enhances the science return from current NASA and non-NASA sensors.

Related Data:

A full list of CARVE data products is available at: https://carve.ornl.gov/dataproducts.html

2. Data Characteristics

Spatial Coverage: CARVE flights over the Alaskan and Canadian Arctic

Spatial Resolution: Point measurements

Temporal Coverage: 20120523 - 20151112

Temporal Resolution: The instruments were deployed on periodic flights during the growing season (approx. March - November)

Study Area (coordinates in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Alaska and Canadian Arctic	-168.111	-131.754	71.562	58.843

Data File Information

There are 185 files in NetCDF (*.nc) version 4 file format. Each file provides geolocation, altitude, aircraft heading, pitch, and roll recorded at 1-second intervals during a single flight.

Table 1. CARVE file naming convention. Example file name: carve_DADS_L1_b23_20120513_20150621190524.nc

Name element	Example value	Units
Project name	*carve*	
Instrument	*DADS*	
Processing level	*L1*	
Build ID	*b23*	
Flight date	*20120513*	*yyyymmdd*
Processing date and time	*20150621190524*	*yyyymmddhhmmss*

Data variables

Each file contains 8 geolocation and time variables and an additional 6 science measurement variables described in Table 2.

Table 2. Data variables in each netCDF file. Fill value or missing data were set to -999.9 for all variables.

Variable name	Description	Units
Geolocation measurements		
center_lat	latitude of (aircraft sampling) footprint center	Decimal degrees North

center_lat_standard_error	uncertainty of latitude	Decimal degrees North
center_lon	longitude of (aircraft sampling) footprint center	Decimal degrees East
center_lon_standard_error	uncertainty of longitude	Decimal degrees East
geolocation_qc	geolocation status flag	0 = Success, 1 = Error
height	height of aircraft above ground	meters
height_standard_error	uncertainty of height	meters
time	time	seconds since 1980-1-6 0:0:0 UTC
Science Measurements		
heading	aircraft heading	degrees
heading_qc	aircraft heading status flag	0 = Valid, 1 = Out of Range, 2 = Error
pitch	aircraft pitch angle	degrees
pitch_qc	aircraft pitch status flag	0 = Valid, 1 = Out of Range, 2 = Error
roll	aircraft roll angle	degrees
roll_qc	aircraft roll status flag	0 = Valid, 1 = Out of Range, 2 = Error

3. Application and Derivation

These data files contain high-frequency geolocation, time, height, pitch, roll, and heading information for the C-23 Sherpa aircraft during CARVE flights during 2012 to 2015. The CARVE project was designed to collect detailed measurements of important greenhouse gases on local to regional scales in the Alaskan Arctic and demonstrate new remote sensing and improved modeling capabilities to quantify Arctic carbon fluxes and carbon cycle-climate processes. The CARVE data provide insights into Arctic carbon cycling that may be useful in numerous applications.

4. Quality Assessment

Continuous measurements from the DADS system onboard the C-23 Sherpa aircraft were recorded at 1-second intervals during flight. Any questionable or erroneous data were flagged.

5. Data Acquisition, Materials, and Methods

CARVE Flights

These data represent one part of the data collected by the Carbon in Arctic Reservoirs Vulnerability Experiment (Miller et al. 2012). A C-23 Sherpa aircraft made frequent flights out of Fairbanks, Alaska between March and November over multiple years, observing the spring thaw, summer draw-down, and fall refreeze of the Arctic growing season. Flights concentrate observations on three study domains: the North Slope, the interior, and the Yukon River valley. North Slope flights cover regions of tundra and continuous permafrost and were anchored by flux towers in Barrow, Atqasuk, and Ivotuk. Flights to Prudhoe Bay characterize the CO2 and CH4 emissions from oil and natural gas processing plants. Flights over interior Alaska sample discontinuous permafrost, boreal forests, and wetlands. A complete list of CARVE flights can be found at: https://carve.ornl.gov/flights.html. Flight paths and atmospheric gas concentrations for CARVE surveys can be visualized through the CARVE Flight Data Visualization Tool (http://carve.ornl.gov/visualize) and are illustrated in Figure 2.

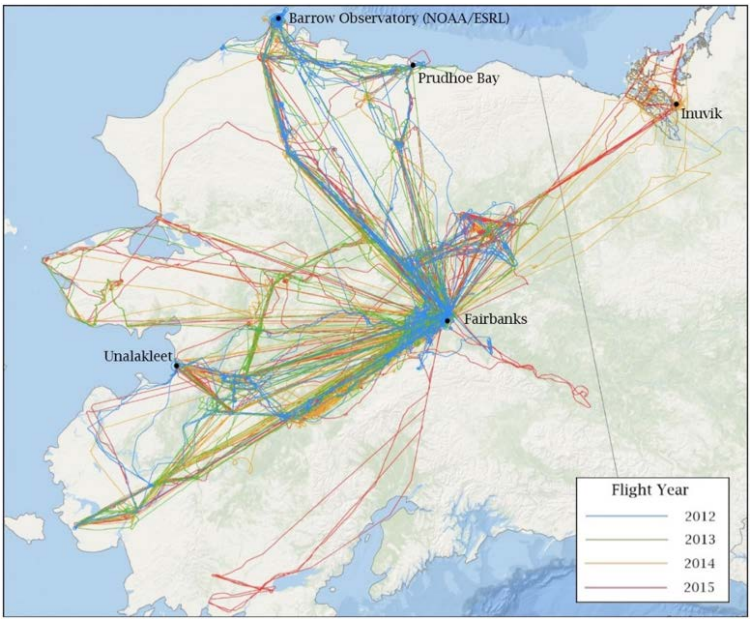

Figure 2. CARVE flights during 2012-2015 delivered measurements over continuous and discontinuous permafrost regimes.

The CARVE aircraft carried a remote sensing and atmospheric sampling payload consisting of the following instruments: a Fourier transform spectrometer (FTS), and an in situ gas analyzer suite (ISGA) with a gas analyzer and flask sampling system (see https://carve.ornl.gov/documentation.html). All instruments were controlled by a master computer system and UTC time stamped at 1 second intervals.

Digital Air Data System

The DADS Level 1 products contain Level 1 data in NetCDF 4 format from the Digital Air Data System (DADS) detailing flight path characteristics. The DADS system collects data from various instruments aboard the CARVE C-23 Sherpa aircraft owned and operated by NASA.

Even though the DADS instrument may generate a number of Level 0 files per flight day (number of files is dependent on how many times the system is rebooted since a new file is generated at each startup), all Level 0 files from the same flight day were combined into a single Level 1 file. Records within a given file are recorded every second.

6. Data Access

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

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Contact for Data Center Access Information:

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

7. References

Miller, C.E., Dinardo, S.J. et al. (2012). CARVE: The Carbon in Arctic Reservoirs Vulnerability Experiment., *2012 IEEE Aerospace Conference*. http://dx.doi.org/10.1109/AERO.2012.6187026