ASCENDS: Active Sensing of CO2 With AVOCET, California and Nevada, 2016

Get Data

Documentation Revision Date: 2022-12-29

Dataset Version: 1

Summary

This dataset provides in situ airborne measurements of atmospheric carbon dioxide (CO2) over California and Nevada on February 10-11, 2016. Measurements were taken onboard a DC-8 aircraft during this Active Sensing of CO2 Emissions over Nights, Days and Seasons (ASCENDS) airborne deployment. CO2 was measured with NASA's Atmospheric Vertical Observations of CO2 in the Earth's Troposphere (AVOCET) instrument while over California and Nevada. The objective of this deployment was to assess the performance of the 2016 version of the CO2 Sounder LiDAR. The two flights were flown to compare results from an experimental LiDAR sensor with the AVOCET instrument. Aircraft navigation and flight meteorological data are also provided. The data are provided in ICARTT and comma-separated values (CSV) formats.

There are two data files in ICARTT format (*.ict) and two files in comma-separated values (.csv) format included in this dataset.

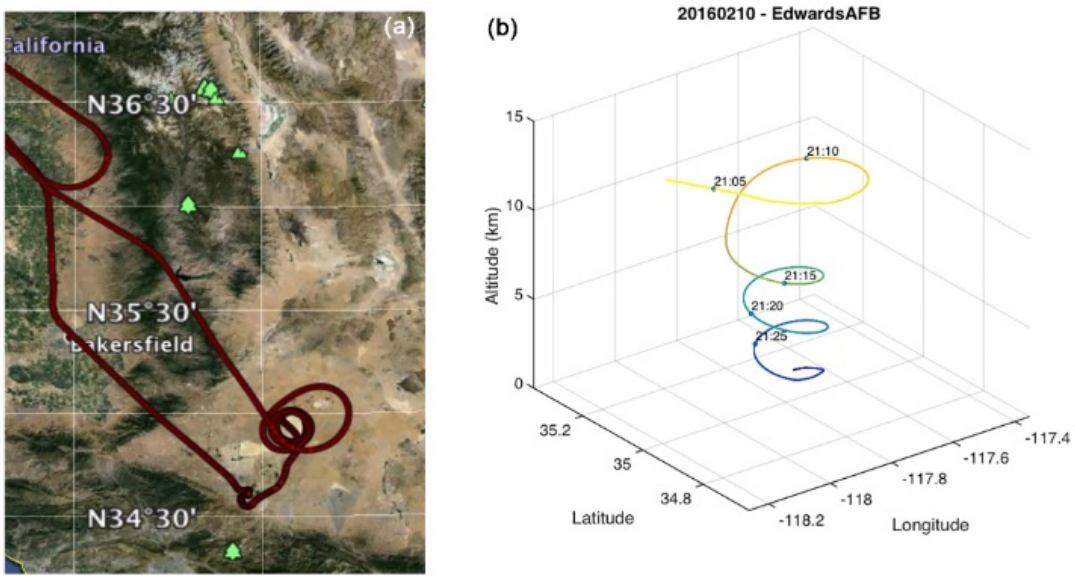

Figure 1. (a) Flight track for 10 February 2016 flight over Edwards AFB, California. (b) Time-tagged location and altitude plot for the spiral-down maneuver over Edwards AFB for the same flight (Abshire et al., 2018).

Citation

Abshire, J.B., J. Mao, H. Riris, S.R. Kawa, and X. Sun. 2022. ASCENDS: Active Sensing of CO2 With AVOCET, California and Nevada, 2016. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2115

Table of Contents

1. Dataset Overview

This dataset provides in situ airborne measurements of atmospheric carbon dioxide (CO2) over California and Nevada on February 10-11, 2016. Measurements were taken onboard a DC-8 aircraft during this Active Sensing of CO2 Emissions over Nights, Days and Seasons (ASCENDS) airborne deployment. CO2 was measured with NASA's Atmospheric Vertical Observations of CO2 in the Earth's Troposphere (AVOCET) instrument while over California and Nevada. The objective of this deployment was to assess the performance of the 2016 version of the CO2 Sounder LiDAR. The two flights were flown to compare results from an experimental LiDAR sensor with the AVOCET instrument. Aircraft navigation and flight meteorological data are also provided. The data are provided in ICARTT and comma-separated values (CSV) formats.

Related Datasets

Abshire, J.B., J. Mao, H. Riris, S.R. Kawa, and X. Sun. 2022. ABoVE/ASCENDS: Active Sensing of CO2, CH4, and Water Vapor, Alaska and Canada, 2017. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2050

Sun, X., P.T. Kolbeck, J.B. Abshire, S.R. Kawa, and J. Mao. 2022. ABoVE/ASCENDS: Atmospheric Backscattering Coefficient Profiles from CO2 Sounder, 2017. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2051

Related Publications

Abshire, J. B., A.K. Ramanathan, H. Riris, G.R. Allan, X. Sun, W.E. Hasselbrack, J. Mao, S. Wu, J. Chen, K. Numata, S.R. Kawa, M.Y.M. Yang, and J. DiGangi. 2018. Airborne measurements of CO_2 column concentrations made with a pulsed IPDA lidar using multiple-wavelength-locked laser and HgCdTe APD detector. Atmospheric Measurement Techniques (AMT) 11:2001-2025. https://doi.org/10.5194/amt-11-2001-2018

Allan, G.R., J.B. Abshire, H. Riris, J. Mao, W.E. Hasselbrack, K. Numata, J. Chen, R. Kawa, M. Rodriguez, and M. Stephen. 2018. Lidar measurements of CO_2 column concentrations in the Arctic region of North America from the ASCENDS 2017 airborne campaign. SPIE Proceedings volume 10779, Lidar Remote Sensing for Environmental Monitoring XVI, 1077906 (24 October 2018). https://doi.org/10.1117/12.2325908

Sun, X., J.B. Abshire, A. Ramanathan, S.R. Kawa, and J. Mao. 2021. Retrieval algorithm for the column CO_2 mixing ratio from pulsed multi-wavelength lidar measurements. Atmospheric Measurement Techniques 14:3909–3922. https://doi.org/10.5194/amt-14-3909-2021

Acknowledgement

This research was funded by the NASA Terrestrial Ecology program: ASCENDS.

2. Data Characteristics

Spatial Coverage: California and Nevada, US

Spatial Resolution: Point locations

Temporal Coverage: 2016-02-10 to 2016-02-12 with two single-day flights during the period.

Temporal Resolution: Every minute

Study Areas: Latitude and longitude are given in decimal degrees.

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
California and Nevada, US	-122.100	-113.530	41.615	34.553

Data File Information

There are two data files in ICARTT format (*.ict) and two files in comma-separated values (.csv) format included in this dataset.

The .ict files are named **ASCENDS-AVOCET_DC8_20160210_R0.ict** and **ASCENDS-AVOCET_DC8_20160211_R0.ict.** These files provide CO_2 observations collected from AVOCET.

The .csv files are named **ASCENDS-AVOCET_DC8_20160210_R0_navigation.csv** and **ASCENDS-AVOCET_DC8_20160211_R0_navigation.csv.** These files provide navigation and meteorological data. Refer to Table 1.

Table 1. Variables in the .csv files.

Variable	Units	Description
TimeStamp	YYYY-MM-_DDThh:mm:ss.sss	Date and time as year-month-day (YYYY-MM-DD)and time as hour:minute:seconds.fraction of second
Latitude	degrees_north	Latitude
Longitude	degrees_east	Longitude
GPS_Alt_MSL	m	Aircraft GPS altitude above mean sea level
GPS_Altitude	m	Aircraft GPS altitude above WGS84 ellipsoid
Pressure_Altitude	ft	Aircraft altitude from air pressure
Radar_Altitude	ft	Aircraft radar altitude
Ground_Speed	$m\ s^{-1}$	Aircraft ground speed
True_Air_Speed	kts	Aircraft true air speed
Indicated_Air_Speed	kts	Aircraft indicated air speed

Mach_Number	mach	Aircraft speed in mach number
Vertical_Speed	m s^{-1}	Aircraft vertical speed
True_Heading	degrees	Aircraft true heading, 0-360 degrees, clockwise from +y
Track_Angle	degrees	Aircraft track angle, 0-360 degrees, clockwise from +y
Drift_Angle	degrees	Aircraft drift angle, +/-180 degrees, clockwise from +y
Pitch_Angle	degrees	Aircraft pitch angle, +/-180 degrees, up+
Roll_Angle	degrees	Aircraft roll angle, +/-180 degrees, right+
Slip_Angle	degrees	*Slip angle* (values not provided)
Attack_Angle	degrees	Angle of attack (values not provided)
Static_Air_Temp	degrees Celsius	Static air temperature
Dew_Point	degrees Celsius	Dew point temperature
Total_Air_Temp	degrees Celsius	An intermediate product of air temperature measurement, not corrected for air motion
Static_Pressure	mb	Static air pressure
Dynamic_Pressure	mb	Dynamic pressure (values not provided)
Cabin_Pressure	mb	Aircraft cabin pressure
Wind_Speed	m s^{-1}	Wind speed, limited to where *Roll_Angle* <= 5 degrees
Wind_Direction	degrees	Wind direction, 0-360 degrees, clockwise from +y
Vertical_Wind_Speed	m s^{-1}	Vertical wind speed (values not provided)
Solar_Zenith_Angle	degrees	Solar zenith angle
Aircraft_Sun_Elevation	degrees	Sun elevation angle with respect to aircraft
Sun_Azimuth	degrees	Sun azimuth angle
Aircraft_Sun_Azimuth	degrees	Sun azimuth angle with respect to aircraft

Companion File Information

There are four companion files in .pdf format included in this dataset. The ***ASCENDS_AVOCET_CA_NV_Feb_2016.pdf*** is the dataset guide document. The ***NASA_TP_2018-219034_ASCENDS_ID1.pdf*** is the final report of the ASCENDS Ad Hoc Science Definition Team.
The ***Co2LidarBackscatProfiles_1-19-2021_ID4.pdf*** summarizes the algorithm and data processing used to obtain the attenuated atmospheric backscatter profiles measured by the pulsed CO2 Sounder lidar developed by the NASA Goddard Space Flight Center (GSFC) and deployed during the 2017 ASCENDS/ABoVE airborne campaign. The ***ASCENDSFinalDraft81915_ID0.pdf*** is the draft of the ASCENDS Science Mission Definition Study.

3. Application and Derivation

These data contribute to our understanding and predictive capabilities for modeling the land-atmospheric exchange of CO_2.

4. Quality Assessment

The results from both campaigns showed that the mean values of XCO_2 retrieved from the lidar consistently agreed with those based on the in situ sensor to within 1 ppm (Abshire et al., 2018).

5. Data Acquisition, Materials, and Methods

The 2016 campaign was a short (two flight) campaign flown over the Mojave Desert and Edwards AFB, California, and a snow flight over northeast Nevada. Measurements were taken onboard a DC-8 aircraft during this ASCENDS airborne deployment. The objective was to assess the performance of the 2016 version of the CO_2 Sounder lidar (Abhsire et al., 2018). Data were collected with the infrared absorption spectrometer on NASA's Atmospheric Vertical Observations of CO_2 in the Earth's Troposphere (AVOCET) instrument. The two flights were flown to compare results from an experimental lidar sensor with the AVOCET instrument. Lidar data are not available and are not included with this dataset.

The 2016 desert flight was made over the Mojave Desert and Edwards AFB, which was used for the spiral down location (refer to Figure 1). The spiral-down altitudes were between 7-10 km. The 2016 snow flight targeted a long series of measurements over fresh cold snow. Snow had recently fallen in northeast Nevada and the surface temperatures had stayed below 0°C, so the flight repeated a north–south route just south of Elko, Nevada. The Elko airport was the nearest location available for the spiral-down maneuvers (Figure 2). The flight altitudes of the north–south legs of this flight were between 6.6 and 9.5 km.

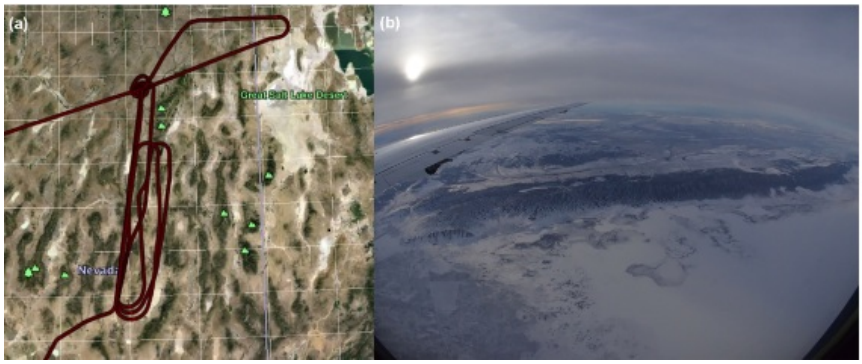

Figure 2. (a) Map of the ground track for the 2016 snow flight made over northeastern Nevada. The spiral-down location was centered on the airport at Elko NV and all subsequent measurements were made during the north–south tracks south of Elko. (b) Photograph of the snow-covered hills and desert floor made during the 2016 snow flight.

Refer to Abshire et al. (2018) for additional details.

6. Data Access

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

ASCENDS: Active Sensing of CO2 With AVOCET, California and Nevada, 2016

Contact for Data Center Access Information:

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

7. References

Abshire, J.B., J. Mao, H. Riris, S.R. Kawa, and X. Sun. 2022. ABoVE/ASCENDS: Active Sensing of CO2, CH4, and Water Vapor, Alaska and Canada, 2017. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2050

Abshire, J. B., A.K. Ramanathan, H. Riris, G.R. Allan, X. Sun, W.E. Hasselbrack, J. Mao, S. Wu, J. Chen, K. Numata, S.R. Kawa, M.Y.M. Yang, and J. DiGangi. 2018. Airborne measurements of CO_2 column concentrations made with a pulsed IPDA lidar using multiple-wavelength-locked laser and HgCdTe APD detector. Atmospheric Measurement Techniques (AMT) 11:2001-2025. https://doi.org/10.5194/amt-11-2001-2018

Allan, G.R., J.B. Abshire, H. Riris, J. Mao, W.E. Hasselbrack, K. Numata, J. Chen, R. Kawa, M. Rodriguez, and M. Stephen. 2018. Lidar measurements of CO_2 column concentrations in the Arctic region of North America from the ASCENDS 2017 airborne campaign. SPIE Proceedings volume 10779, Lidar Remote Sensing for Environmental Monitoring XVI, 1077906 (24 October 2018). https://doi.org/10.1117/12.2325908

Sun, X., P.T. Kolbeck, J.B. Abshire, S.R. Kawa, and J. Mao. 2022. ABoVE/ASCENDS: Atmospheric Backscattering Coefficient Profiles from CO2 Sounder, 2017. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2051

Sun, X., J.B. Abshire, A. Ramanathan, S.R. Kawa, and J. Mao. 2021. Retrieval algorithm for the column CO_2 mixing ratio from pulsed multi-wavelength lidar measurements. Atmospheric Measurement Techniques 14:3909–3922. https://doi.org/10.5194/amt-14-3909-2021