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CMS: Atmospheric CO2 and C Isotopes, Fossil Fuel Contributions, California, 2014-2015

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Documentation Revision Date: 2019-01-16

Data Set Version: 1

Summary

This dataset provides measurements of atmospheric CO2 concentrations, carbon isotopes d13C and D14C, and fossil fuel CO2 (ffCO2) estimates from nine observation sites in California over three month-long campaigns in separate seasons of 2014-2015. ffCO2 was quantified based on the CO2 concentration and D14C. Simulations of ffCO2 at the sites and times of the observations were conducted with the Vulcan v2.2 fossil fuel emissions estimate for 2002 and the Weather Research and Forecasting - Stochastic Time-Inverted Lagrangian Transport (WRF-STILT) atmospheric model. The observed and simulated ffCO2 were incorporated into Bayesian inverse estimates of ffCO2 to calculate California's ffCO2 emissions during the campaign period.

There is one comma separated data (*.csv) file for this dataset.
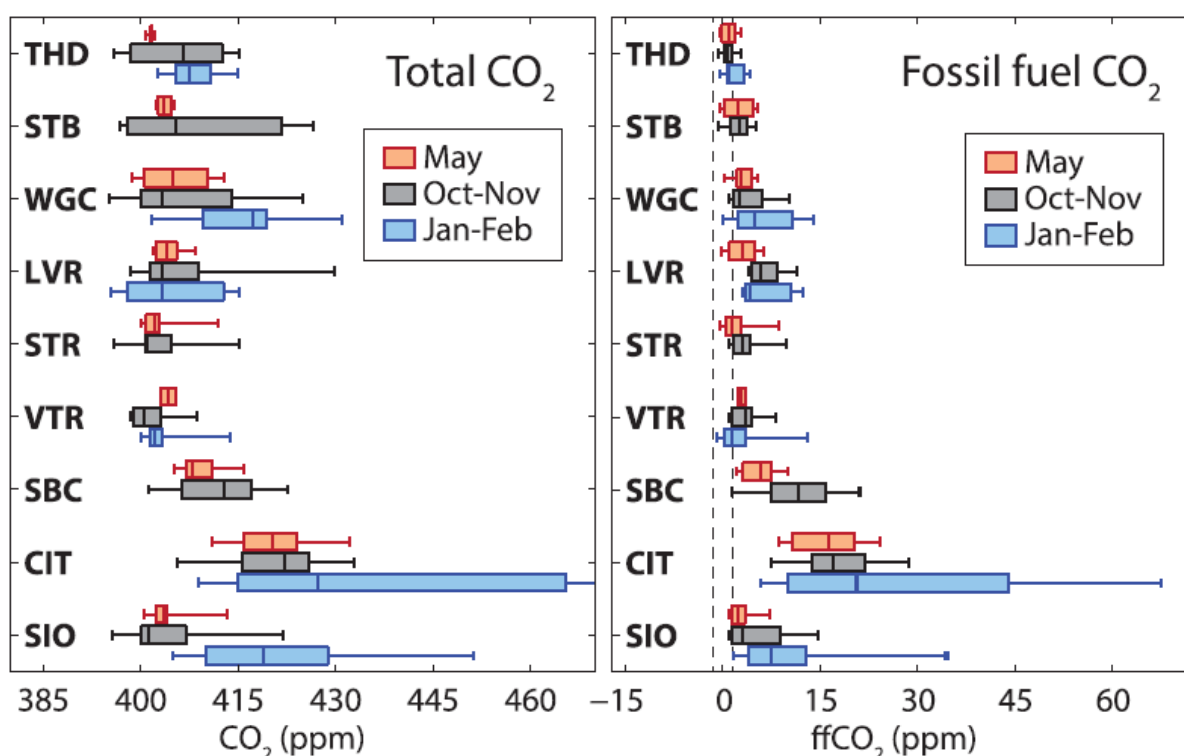

Figure 1. Boxplots showing seasonal quartiles of total CO2 concentrations and fossil fuel CO2 concentrations for each of the nine observation sites in California, 2014-2015. From Graven et al. (2018).

Citation

Graven, H., M.L. Fischer, T. Lueker, S. Jeong, T.P. Guilderson, R.F. Keeling, R. Bambha, K. Brophy, W. Callahan, X. Cui, C. Frankenberg, K.R. Gurney, B.W. Lafranchi, S. Lehman, H.A. Michelsen, J.B. Miller, S. Newman, W. Paplawsky, N.C. Parazoo, C. Sloop, and S.J. Walker. 2019. CMS: Atmospheric CO2 and C Isotopes, Fossil Fuel Contributions, California, 2014-2015. ORNL DAAC, Oak Ridge, Tennessee, USA.
https://doi.org/10.3334/ORNLDAAC/1641

Table of Contents

1. Data Set Overview

This dataset provides measurements of atmospheric CO_2 concentrations, carbon isotopes $\delta^{13}C$ and $\Delta^{14}C$ and, fossil fuel CO_2 ($ffCO_2$) estimates from nine observation sites in California over three month-long campaigns in separate seasons of 2014-2015. $ffCO_2$ was quantified based on the CO_2 concentration and $\Delta^{14}C$. Simulations of $ffCO_2$ at the sites and times of the observations were conducted with the Vulcan v2.2 fossil fuel emissions estimate for 2002 and the Weather Research and Forecasting - Stochastic Time-Inverted Lagrangian Transport (WRF-STILT) atmospheric model. The observed and simulated $ffCO_2$ were incorporated into Bayesian inverse estimates of $ffCO_2$ to calculate California's $ffCO_2$ emissions during the campaign period.

Project: Carbon Monitoring System (CMS)

The NASA Carbon Monitoring System (CMS) is designed to make significant contributions in characterizing, quantifying, understanding, and predicting the evolution of global carbon sources and sinks through improved monitoring of carbon stocks and fluxes. The System will use the full range of NASA satellite observations and modeling/analysis capabilities to establish the accuracy, quantitative uncertainties, and utility of products for supporting national and international policy, regulatory, and management activities. CMS will maintain a global emphasis while providing finer scale regional information, utilizing space-based and surface-based data and will rapidly initiate generation and distribution of products both for user evaluation and to inform near-term policy development and planning.

Related Publication:
Graven, H. D., Fischer, M. L., Lueker, T., Jeong, S., Guilderson, T. P., Keeling, R., Bambha, R. P., Brophy, K., Callahan, W., Cui, X., Frankenberg, C., Gurney, K. R., LaFranchi, B., Lehman, S., Michelsen, H., Miller, J. B., Newman, S., Paplawsky, W., Parazoo, N., Sloop, C., Walker, S. J. 2018. Assessing fossil fuel CO_2 emissions in California using atmospheric observations and models. Environmental Research Letters.
https://doi.org/10.1088/1748-9326/aabd43

Related Dataset:
Fischer, M.L., N.C. Parazoo, K. Brophy, X. Cui, S. Jeong, J. Liu, R. Keeling, T.E. Taylor, K.R. Gurney, T. Oda, and H. Graven. 2017. CMS: CO2 Signals Estimated for Fossil Fuel Emissions and Biosphere Flux, California. ORNL DAAC, Oak Ridge, Tennessee, USA.
https://doi.org/10.3334/ORNLDAAC/1381

Acknowledgements:
This project was funded by NASA Carbon Monitoring System (NNX13AP33G and NNH13AW56I).

2. Data Characteristics

Spatial Coverage: California, USA

Spatial Resolution: Point locations

Temporal Coverage: 2014-05-01 through 2015-02-16

Temporal Resolution: Seasonal

Study Area (All latitudes and longitudes are given in decimal degrees):

Sites	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
California, USA	-124.151	-117.257	41.055	32.867

Table 1. Observation sites in California.

Site	Code	Latitude	Longitude	Sampling height (magl)
Trinidad Head	THD	41.055	-124.15	20
Sutter Buttes	STB	39.206	-121.82	10
Walnut Grove	WGC	38.265	-121.49	91
Sutro	STR	37.755	-122.45	232
Sandia-Livermore	LVR	37.674	-121.71	27
Victorville	VTR	34.609	-117.29	90
Caltech	CIT	34.137	-118.13	10
San Bernardino	SBC	34.085	-117.31	58

Site	Code	Latitude	Longitude	Sampling height (magl)
Scripps Inst. Ocean	SIO	32.867	117.26	10

Data file information:

There are two comma separated data (*.csv) files for this dataset. The file names and general descriptions are provided in Table 2.

Table 2. Data file names and general descriptions

File Name	Description
graven_ca_co2_isotopes.csv	This file contains atmospheric CO_2 concentrations, $\Delta^{14}C$ of CO_2, $\delta^{13}C$ of CO_2, and fossil fuel CO_2 (ffCO_2) estimates from nine observation sites in California
sampling_sites_graven_ca_co2_isotopes.csv	This file contains location information for the nine observation sites.

The columns names, their units, and descriptions in **graven_ca_co2_isotopes.csv** are listed below. Missing values within the data file are reported as -9999.

Table 3. Variables in the data file.

Variable	Units/format	Description
Site	Text	One of the nine measurement sites.
Date	YYYY-MM-DD	Sampling date in UTC.
Time	hh:mm	Sampling time in UTC.
Time_zone	Text	Time zone for date and time columns.
CO_2	ppm	CO_2 concentration.
$\delta^{13}C$	per mil	Ratio of 13C to 12C in CO_2, relative to VPDB
$\Delta^{14}C$	per mil	Ratio of 14C to C in CO_2, relative to Modern and including fractionation and age corrections
beta	ppm	Correction for biospheric, non-fossil influences on $\Delta^{14}C$.
beta_unc	ppm	Calculated uncertainty in beta.
ffCO_2	ppm	Estimated fossil fuel CO_2 emissions.
ffCO_2_unc	ppm	Uncertainty in ffCO_2.
prior_ffCO_2	ppm	The simulated fossil fuel CO_2 concentration in the prior simulation using time-varying Vulcan emissions.
post_ffCO_2	ppm	The fossil fuel CO_2 concentration in the posterior simulation, after the emissions have been adjusted by the standard inversion.
outlier	1 or 0	A value of 1 indicates that a measurement was determined to be an outlier, based on two criteria: (1) simulated or observed ffCO_2 is greater than 5 ppm, and (2) absolute differences between simulated and observed ffCO_2 are greater than the average of the simulated and observed ffCO_2. Only samples that met both criteria were identified as outliers.

3. Application and Derivation

See Graven et al., 2018 for additional details.

4. Quality Assessment

See Graven et al., 2018 for more details.

5. Data Acquisition, Materials, and Methods

CO_2 concentration and $\Delta^{14}C$ in CO_2 was measured at nine existing observation sites within California as listed in Table 1 and shown in Figure 2. The measured CO_2 concentration and $\Delta^{14}C$ in CO_2 was used to observe fossil-derived CO_2 (fossil fuel CO_2 or ffCO_2) emissions over California and use the observations in a top-down calculation of California's ffCO_2 emissions using Vulcan v2.2 and WRF-STILT atmospheric transport model. See Graven et al., 2018 for more details.
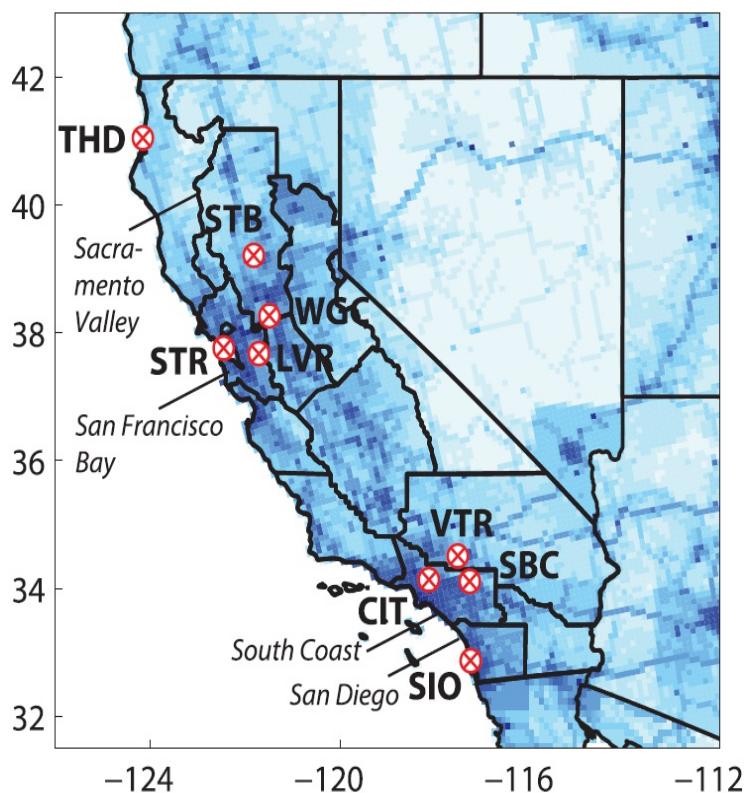
Figure 2. The sites in the observation network are shown as circles on the map: Trinidad Head (THD), Sutter Buttes (STB), Walnut Grove (WGC), Sutro (STR), Sandia-Livermore (LVR), Victorville (VTR), San Bernardino (SBC), Caltech (CIT) and Scripps Institute of Oceanography (SIO).

6. Data Access

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

CMS: Atmospheric CO2 and C Isotopes, Fossil Fuel Contributions, California, 2014-2015

Contact for Data Center Access Information:

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

7. References

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