CO_2 – USA
Data Archiving, Exchange and Synthesis –

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Help from Brian Swett to get here!!

CO_2 Urban Synthesis and Analysis Workshop
National Institutes of Standards and Technology
Gaithersburg, MD

07 November 2017

Data sharing is the cornerstone for the CO_2-USA synthesis project.

"We will build a shared dataset of observed CO_2 plus CH_4 (where available)" and associated tracers (CO, C_2H_6, isotoplogues of CO_2 and CH_4).

Multiple urban areas
Traceable, harmonized calibrations
Measurement rates (nominally hourly, or "custom").

Model results and codes

Consistent, on-going QA/QC
Common, accessible format to facilitate broad use

What are the goals our data exchange and archive?

Archiving and promptly releasing **data** and **model analysis** (emissions) enables stakeholders/users to realize the **value propositions**:

1. **Detect trends (efficacy of policies)**
2. **Assess the economic and social value of efforts and polices to reduce GHG emissions in cities.**
3. **Detect anomalous events and identify hot spots.**
4. **Guide and inform mitigation policies.**

The data archive is our legacy product whose value grows geometrically with time.

How do we envision our data exchange and archive?

The upload of data to the exchange should be prompt.

The data should go public in a defined time frame dictated by QA/QC (not longer than 1 year).

Two types of data on the exchange:

1. updated archived data with referencing to version numbers and dates (DOIs)
2. static data for published papers (separate DOIs).

The data protocol proscribes release of preliminary data.

The protocol impresses on users the importance of direct, timely engagement with, and co-authorship (as appropriate) for, the people making observations or running models.

What data sets do we anticipate?

- **Concentration time series**
- **Aircraft and ground based survey time series**
- **Ground based remote sensing: XCO2, XCH4, Lidar**
- **Weather time series**
- **Satellite data in/near the urban domain (GoSAT, OCO-2, *OCO-3*): XCO2, XCH4, SIF**
- **Emission maps – prior and posterior;**
  time resolved; multiple realizations
- ***Influence footprints, model data.***
- *Meteorological products, e.g. ARL or GRIB files*
- *Visualizations, Movies, Photographs*
- ***Traceability!! Metadata! Documentation!***

Why on earth would we participate?

- ***It is the best path to have an impact, taking advantage of the joint enterprise, … and you are required to make the data public!***
- NASA, NSF and NOAA require public data
- Major journals require public data availability
- *It will greatly enrich your own research*
- *It will vastly expand your visibility*
- *It will bring unexpected research opportunities*
- *It enable public agencies in cities, pollution districts, states, and Federal agencies to benefit, increasing your impact*

What urban projects have said they would participate?

City	Metro area & population	# Observing stations	Characteristics	Sample Citation/url
Boston, MA	4800 km^2 & 4.2 million	~10	Old & compact city; mesic	McKain et al. 2015
DC/ Baltimore, MD	3400 km^2 & 4.6 million	~16	Old & somewhat compact city; mesic	https://www.nist.gov/topics/greenhouse-gases/urban-test-beds
Indianapolis, IN	1800 km^2 & 1.5 million	~12	Low density; climate?;	Turnbull et al. 2015
Los Angeles, CA	4500 km2 & 12.2 million	~16	Large, sprawling; continued urban growth; arid	Verhulst et al. in review
Salt Lake City, UT	700 km^2 & 1 million	~7 stations & light rail	Small, sprawling; rapid urban growth; arid	McKain et al. 2012 http://air.utah.edu
San Francisco Bay Area, CA	1400 km^2 & 3.3 million	~5	Large, Mediterranean, marine influence	http://www.baaqmd.gov/plans-and-climate/climate-protection/climate-protection-program

Table 1. Summary of target cities and the associated observing network .

Search ORNL DAAC

Search

https://daac.ornl.gov/CMS/guides/CMS_Methane_Emissions_Boston.html

CMS: Atmospheric Methane Concentrations and Prior Emissions, Boston, MA, 2012-2014

Get Data

One click access from Google search
We specified the data format

Documentation Revision Date: 2015-10-06

Data Set Version: V1

Summary

This data set provides average hourly measured, modeled enhancements, and background methane (CH4) concentrations, atmospheric ethane (C2H6) measurements, prior CH4 flux fields by sector, and a spatial reconstruction of natural gas (NG) consumption in Boston, Massachusetts and the surrounding region. Atmospheric CH4 concentrations were measured continuously from September 2012 through August 2013 at four locations and atmospheric ethane was measured continuously for several months during 2012-2014 at one location. Spatial models of prior CH4 emissions and natural gas consumption are given for an ~18,000 km^2 area centered on Boston, MA.

This project was funded by NASA's Interdisciplinary Science (IDS) and Carbon Monitoring System (CMS) programs.

These data were used in combination with an atmospheric transport model to derive total average CH4 emissions from the urban region, the fractional contribution of natural gas to total methane emissions, and the loss rate of natural gas to the atmosphere.

There are eight comma-separated (*.csv) data files with this data set.

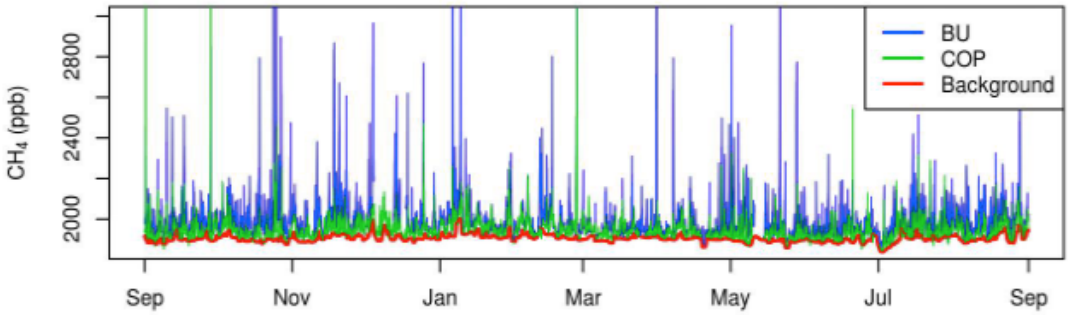

Figure 1. Mean hourly measured CH4 concentrations at two urban sites (BU and COP) and in the empirical background from September 1, 2012 through August 31, 2013

Citation

McKain, K., A. Down, S.M. Raciti, J.W. Budney, L.R. Hutyra, C. Floerchinger, S.C. Herndon, T. Nehrkorn, M.S. Zahniser, R.B. Jackson, N. Phillips, and

Citation

McKain, K., A. Down, S.M. Raciti, J.W. Budney, L.R. Hutyra, C. Floerchinger, S.C. Herndon, T. Nehrkorn, M.S. Zahniser, R.B. Jackson, N. Phillips, and S.C. Wofsy. 2015. CMS: Atmospheric Methane Concentrations and Prior Emissions, Boston, MA, 2012-2014. ORNL DAAC, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/1291 .

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1. Data Set Overview

Users are requested to reference the data citation (abo

McKain,K., A. Down, S.M. Racitie, J. Budney, L.R. Hutyra, C. Floerchinger, S.C. Herndon, T.Nehrkorn, M.S. Zahniser, R.B. Jackson, N. Phillips, and S.C. Wofsy. Methane emissions from natural gas infrastructure and use in the urban region of Boston, Massachusetts. PNAS. 112:1941-1946. DOI: 10.1073/pnas.1416261112.

Atmospheric CH4 concentrations were measured continuously from September 2012 through August 2013 at four locations: Boston University (BU), Copley Square (COP), Harvard Forest (HF) and Nahant (NHT). Ethane concentrations were measured with a laser spectrometer (Yacovitch et al., 2014) at BU for three months in the fall and winter of 2012–2013 and one month in the late spring of 2014.

Background concentrations in air flowing into the city were estimated by randomly sampling from a range (5th to 35th) of lower percentiles of CH4 measurements from two upwind stations (HF or NHT, depending on the direction of simulated air trajectories), averaged over a 48-h moving window.

Methane enhancements were modeled at BU and COP with the Stochastic Time-Inverted Lagrangian Transport (STILT) model (Lin et al., 2003) coupled to the Weather Research and Forecasting (WRF) meso-scale meteorological model run at 1-km2 grid resolution (Nehrkorn et al., 2010). A spatially resolved prior model of CH4 emissions was constructed for the study region and combined with WRF-STILT footprints to generate a set of simulated CH4 enhancement values for each hour at each measurement station. The emission inventory was scaled to estimate optimized CH4 emission rates for the region by season and as an annual average.

Project: Carbon Monitoring System (CMS)

This is where you end up after clicking the "Get Data" button – total of 2 clicks

CMS: Atmospheric Methane Concentrations and Prior Emissions, Boston, MA, 2012-2014

Download Data 3.0MB

Overview

Dataset	CMS: Atmospheric Methane Concentrations and Prior Emissions, Boston, MA, 2012-2014
DOI	https://doi.org/10.3334/ORNLDAAC/1291
Release date	2015-10-06
Project	CMS
Time period	2012-09-01 to 2014-06-30

Bounding box. *Lat: 43.20N to 41.50N, Long: 72.20W to 70.00W*

Usage Metrics

	Count	Earliest Date	Latest Date	Data Usage
Downloads	19	2015-12-09	2017-09-07	194 total files downloaded

Description

Dataset documentation

Citation

McKain, K., A. Down, S.M. Raciti, J.W. Budney, L.R. Hutyra, C. Floerchinger, S.C. Herndon, T. Nehrkorn, M.S. Zahniser, R.B. Jackson, N. Phillips, and S.C. Wofsy. 2015. CMS: Atmospheric Methane Concentrations and Prior Emissions, Boston, MA, 2012-2014. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1291

Download citation from Datacite

RIS BibTex Other

Crosscite Citation Formatter

See our Data Citations and Acknowledgements policy for more information.

Data Files

Sign in to download dataset files.

Show 25 entries

Filter:

Data File (Granule)	File Size	Dates
BU_C2H6_CH4_5min_May-Jun2014.csv	109.6KB	2014-05-01 to 2014-06-30
BU_C2H6_CH4_5min_Oct2012-Jan2013.csv	862.4KB	2012-10-01 to 2013-01-31
BU_CH4_Obs_Mod_Bg_Sep2012-Aug2013.csv	2.4MB	2012-09-01 to 2013-08-31
COP_CH4_Obs_Mod_Bg_Sep2012-Aug2013.csv	2.4MB	2012-09-01 to 2013-08-31
HF_CH4_Obs_Sep2012-Aug2013.csv	185.2KB	2012-09-01 to 2013-08-31
NHT_CH4_Obs_Sep2012-Aug2013.csv	185.5KB	2012-09-01 to 2013-08-31
Prior_flux_field_Scaling_Factors.csv	334 B	2012-09-01 to 2014-06-30
Prior_flux_fields.csv	1.4MB	2012-09-01 to 2014-06-30

Showing 1 to 8 of 8 entries

Companion Files

Expand for companion files

Hutyra

Search

Data | Website | DOI

Found 65 results

Website Search

ORNL DAAC LBA-ECO CD-10 H2O PROFILES AT KM 67 TOWER ...
https://daac.ornl.gov/LBA/guides/CD10_H2O_Profiles_Tapajos.html
With the permission of the author, Hutyra, L.R. 2007. Carbon and water exchange in Amazonian rainforests. Ph.D. Thesis, Department of Earth and Planetary ...

LBA-ECO CD-10 H2O Profiles at km 67 Tower Site, Tapajos ...
https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=861
See Appendix A of Hutyra (2007) for addition details about calibration methods. Co-located ... With the permission of the author, Hutyra, L.R. 2007. Carbon and ...

LBA-ECO CD-10 CO2 and H2O Eddy Flux Data at km 67 Tower Site ...
https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=860
With the permission of the author, Hutyra, L.R. 2007. Carbon and water exchange in Amazonian rainforests. Ph.D. Thesis, Department of Earth and Planetary ...

CMS: DARTE Annual On-road CO2 Emissions on a 1-km Grid ...
https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=1285

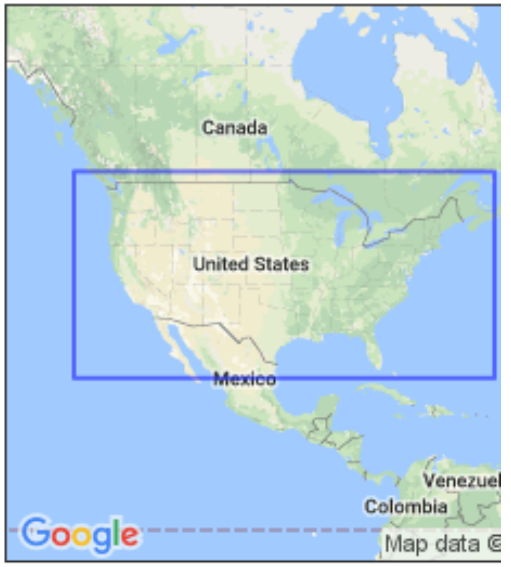
Gately, C. K., L.R. Hutyra, and I.S. Wing. 2015. CMS: DARTE Annual On-road CO2 Emissions on a 1-km Grid, Conterminous USA, 1980-2012. ORNL DAAC, Oak ...

CMS: DARTE Annual On-road CO2 Emissions on a 1-km Grid, Conterminous USA, 1980-2012

Download Data 4.8GB

Overview

Dataset	CMS: DARTE Annual On-road CO2 Emissions on a 1-km Grid, Conterminous USA, 1980-2012
DOI	https://doi.org/10.3334/ORNLDAAC/1285
Release date	2015-09-24
Project	CMS
Time period	1980-01-01 to 2012-12-31



Bounding box. *Lat: 50.31N to 24.09N, Lor*
130.26W to 62.04W

Usage Metrics

	Count	Earliest Date	Latest Date	Data Usage
Downloads	292	2015-10-06	2017-11-04	3575 total files downloaded

Description

This data set provides a 33-year, 1-km resolution inventory of annual on-road CO2 emissions for the conterminous United States based on roadwa level vehicle traffic data and state-specific emissions factors for multiple vehicle types on urban and rural roads as compiled in the Database of Ro Transportation Emissions (DARTE). CO2 emissions from the on-road transportation sector are provided annually for 1980-2012 as a continuous surface at a spatial resolution of 1 km.

Dataset documentation

Possible Formats

ICARTT
(standardized, ascii, self-documenting; format checkers and readers exist; *Excel compatible*)

– *gzip'd or zip'd ICARTT*

NetCDF-4
(standardized; excellent for maps; many packages already include read/write);

– *we would have to develop standards and checkers*

Images
(standardized; tiff or jpeg)

ICARTT Data Format

https://www-air.larc.nasa.gov/missions/etc/IcarttDataFormat.htm

ICARTT File Format Standards V1.1*

A. Aknan, G. Chen, J. Crawford, E. Williams

(March 2013)

ICARTT Data Format

* *Endorsed by NASA Earth Science Data Systems Standard Process Group for airborne field campaigns*

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3. REFERENCES

4. AUTHORS' ADDRESS

35,1001
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Harvard University, Cambridge, MA 02474 (Tel: 617-495-4566)
QCLS CO2ATom
1, 1
2016, 08, 03, 2017, 06, 08
0
START_UTC, seconds
1
1
-99999
CO2_QCLS,Dry Air Molar Mixing Ratio,[ppm]
0
20
PI_CONTACT_INFO: Bruce Daube, bdaube@fas.harvard.edu
PLATFORM: NASA DFRC DC8LOCATION: Aircraft location data in NAV file on this date
ASSOCIATED_DATA: NA
INSTRUMENT_INFO: Quantum Cascade Laser Spectrometer (QCLS)
DATA_INFO: Units are ppbv.
UNCERTAINTY: Accuracy & Precision 0.1 & 0.02 ppm
ULOD_FLAG: -7777
…
START_UTC,CO2_QCLS
67746,-99999
67747,-99999

Example Header File from ATom ICARTT format

- 1st order problem: data sharing
- data submission format and logistics
- data archival location – ORNL DAAC (provisional)
- fair-use policy
- Phased approach. Mixing ratios first.
- How to ingest higher resolution and additional detail.
- Develop a geospatial nested component.
- Making all prior data available
- QA/QC and metadata
- Working group for specifics.

Questions and discussion