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Metadata

A Global Database of Soil Respiration Data, Version 3.0

Get Data

Summary

This data set provides an update of the soil respiration database (SRDB), a near-universal compendium of published soil respiration (RS) data. Soil respiration, the flux of autotrophically- and heterotrophically-generated CO_2 from the soil to the atmosphere, remains the least well-constrained component of the terrestrial Carbon cycle. The database encompasses all published studies that report at least one of the following data measured in the field (not laboratory): annual RS, mean seasonal RS, a seasonal or annual partitioning of RS into its sources fluxes, RS temperature response (Q10), or RS at 10 degrees C. The SRDB's orientation is thus to seasonal and annual fluxes, not shorter-term or chamber-specific measurements, and the database is dominated by temperate, well-drained forest measurement locations. The data set includes a file of RS data and a linked file of study bibliographic data; both files are in comma-separated format.
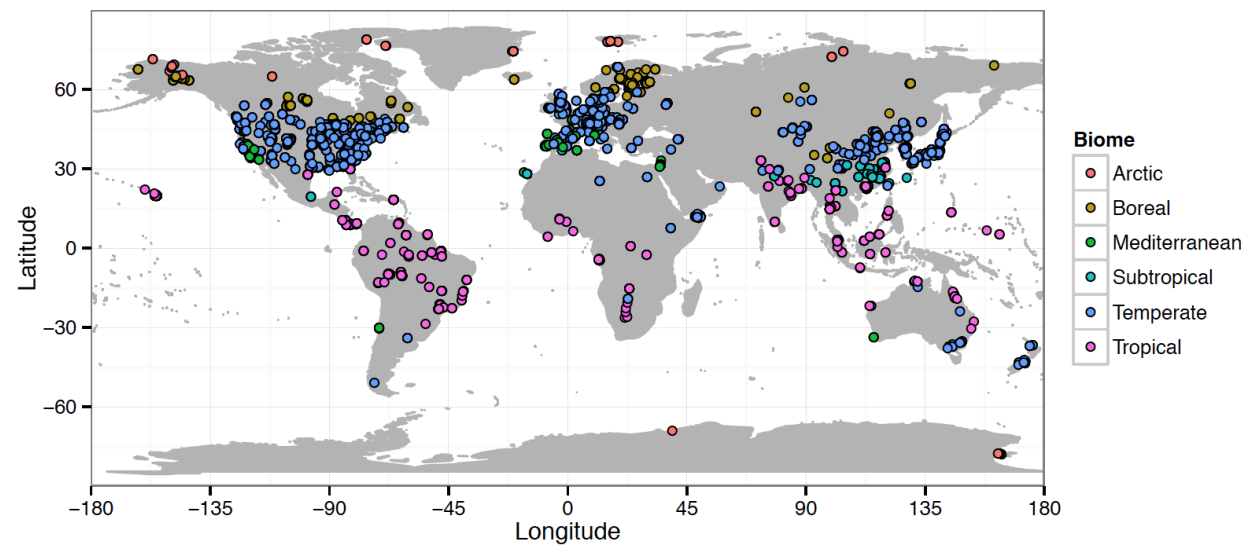

Figure 1. Locations of 5173 SRDB database observations, colored by biome. Map produced by the companion srdb.R script.

Data and Documentation Access:

Get Data: http://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=1235

Companion Files:

- **srdb.R**: An R-language script containing functions for error-checking and mapping of study locations.

- **calculations_worksheets_v3.zip**: A collection of Excel spreadsheets recording the calculation of annual flux for each included study.

Related Data Set:

Raich, J. W., and W. H. Schlesinger. 2001. Global Annual Soil Respiration Data (Raich and Schlesinger 1992). Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/622

Data Citation:

Cite this data set as follows:

Bond-Lamberty, B.P. and A.M. Thomson. 2014. A Global Database of Soil Respiration Data, Version 3.0. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/1235

Table of Contents:

1. Data Set Overview:

Project: Soil Collections

Investigators: B. Bond-Lamberty and A.M. Thomson.

The compilers of the SRDB database (Bond-Lamberty and Thomson, 2010) make it available to the scientific community both as a traditional static archive (ORNL DAAC) and as a dynamic community database that will be updated over time by interested users. The dynamic version of the database is hosted on Google Code: http://code.google.com/p/srdb/. We recommend that citations to this dynamic database always include a version number and download date.

The SRDB encompasses all published studies that report at least one of the following data measured in the field (not laboratory): annual RS, mean seasonal RS, a seasonal or annual partitioning of RS into its sources fluxes, RS temperature response (Q10), or RS at 10 degrees C. The SRDB was designed to capture and make available for analysis the large number of RS studies published since the 1960s. The data set includes a file of RS data and a linked file of study bibliographic data; both files are in comma-separated format. In Version 3.0, An R script with functions for error-checking and mapping of study locations is also included as a companion to the data set.

The ORNL DAAC released Version 1.0 in 2010, Version 2.0 in 2012, and Version 3.0 in 2014, and will update the database on an ongoing basis to incorporate changes and additions submitted by the RS community via the Google Code site and by Bond-Lamberty and Thomson. Transaction logs for the SRDB-data and SRDB-study files are maintained on the Google code site.

ORNL DAAC Version Record

SRDB Version	ORNL DAAC Release Date	Studies Included	Records	Date Range	Date Superseded
Version 3.0	2014/07/24	1,487	5,173	1961-2011	
Version 2.0	2012/03/01	1,021	4,387	1961-2009	2014/07/24
Version 1.0	2010/04/30	818	3,379	1961-2007	2012/03/01

Version 3.0: Data from 1,487 studies have been entered into the database, constituting 5,173 records. The data span the measurement years 1961-2011 and are dominated by temperate, well-drained forests. The source for Version 3.0 is srdb_20131218a from the Google Code website.

Versions 1.0 and 2.0: The source for Version 2.0 is srdb_20110524a from the Google Code website. Note that past versions are considered outdated and Version 3.0 should be accessed for updated data. For access to past versions of the database, please contact the DAAC as indicated in Section 6 of this document.

2. Data Description:

Spatial Coverage

Point-based measurements with global extent (see Fig. 1). Coordinates are provided for each sample location.

Site boundaries: (All latitude and longitude given in decimal degrees)

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude	Geodetic Datum
Global (point)	-162.2	175.5	78.1667	-78.02	Unknown

Temporal Coverage

Compilation of published measurements taken between 1961/01/01 and 2011/12/31. The study date of each record is provided in the data set.

Temporal Resolution

None

Data File Information

The main data file "**srdb-data-V3.csv**" is a comma-separated file of all the soil respiration and contextual data. Bibliographic information for the studies that appear in the main data file can be found in the "**srdb-studies-V3.csv**" file. The "Study_number" field is common to both files and indexes the srdb-studies to srdb-data.

Missing values: In both files, if a value (numeric or text) is missing for a study, that field is left blank.

File Description: srdb-data-V3.csv

Column Number	Column Name	Column Description and Units
1	Record_number	Record number
2	Entry_date	Entry date
3	Study_number	Study number; index into the studies database
4	Author	Name of first author
5	Duplicate_record	Is record a known duplicate? (Study number)
6	Quality_flag	Quality control. Quality control flags include: Q0 default/none Q01 estimated from figure Q02 data from another study Q03 data estimated--other Q04 potentially useful future data Q10 potential problem with data Q11 suspected problem with data Q12 known problem with data Q13 duplicate? Q14 inconsistency Further details can generally be found in the notes field (#107 below)
7	Contributor	Data contributor
Site and measurement data		
8	Country	Country
9	Region	State/province/region
10	Site_name	Name of study site
11	Study_midyear	Year study was performed (middle year if multiple years)
12	YearsOfData	Years of data; always ≥1
13	Latitude	Latitude, decimal; positive=north, negative=south
14	Longitude	Longitude, decimal; positive=east, negative=west
15	Elevation	Elevation, m
16	Manipulation	Manipulation performed (CO2, fertilization, etc.)
17	Manipulation_level	Degree of manipulation performed
18	Age_ecosystem	Time since ecosystem established, years. This is used when, e.g., the time of conversion of forest to agriculture is known
19	Age_disturbance	Time since disturbance, years

20	Species	Dominant species
21	Biome	Biome (boreal, temperate, etc). Subjective
22	Ecosystem_type	Ecosystem type (grassland, forest, etc). Subjective
23	Ecosystem_state	Ecosystem state (managed, unmanaged, natural). Subjective. Unmanaged means human management or disturbance in the past, but not currently.
24	Leaf_habit	Dominant leaf habit (deciduous, evergreen)
25	Stage	Developmental stage (aggrading, mature). Subjective
26	Soil_type	Soil description (classification and texture)
27	Soil_drainage	Soil drainage (dry, wet). Subjective. Dry means well-drained uplands; wet peatlands, swamps, etc.
28	Soil_BD	Soil bulk density, g cm-3
29	Soil_CN	Soil C:N ratio
30	Soil_sandsiltclay	Soil sand:silt:clay ratio
31	MAT	Reported mean annual temperature, C
32	MAP	Reported mean annual precipitation, mm
33	PET	Reported potential evapotranspiration, mm
34	Study_temp	Annual temperature in year of study, C
35	Study_precip	Annual precipitation in year study of study, mm
36	Chamber_method	Chamber method
37	Meas_method	CO_2 measurement method
38	Meas_interval	Mean interval between Rs measurements, days
39	Annual_coverage	Annual_coverage of Rs measurements, fraction (1.0= full year)
40	Partition_method	Method used to partition RS source fluxes, following Bond-Lamberty et al. (2004)
	Annual and seasonal RS fluxes	
41	Rs_annual	Annual C flux from soil respiration, g C m-2. This can either be reported directly by the study, calculated from reported mean fluxes, or estimated from a figure (in which case a quality control note is made, field 6)
42	Rs_annual_err	Error (typically plot-to-plot) for Rs_annual, g C m-2
43	Rs_interann_err	Interannual error reported for Rs_annual, g C m-2. This is occasionally reported by authors, or defined as the standard deviation between year 'i' and year 'i+1' (N=2)
44	Rs_max	Maximum RS flux, µmol m-2 s-1
45	Rs_maxday	Maximum RS flux day of year
46	Rs_min	Minimum RS flux, µmol m-2 s-1
47	Rs_minday	Minimum RS flux day of year
48	Rlitter_annual	Annual RS flux from litter, g C m-2 fraction
49	Ra_annual	Annual autotrophic RS flux, g C m-2
50	Rh_annual	Annual heterotrophic RS flux, g C m-2
51	Rc_annual	Root contribution to Rs_annual, annual fraction
52	Rs_spring	Mean spring RS flux, µmol m-2 s-1. Seasons are defined by authors
53	Rs_summer	Mean summer RS flux, µmol m-2 s-1
54	Rs_autumn	Mean autumn RS flux, µmol m-2 s-1
55	Rs_winter	Mean winter RS flux, µmol m-2 s-1
56	Rs_growing	Mean growing RS flux, µmol m-2 s-1
57	Rs_wet	Mean wet season RS flux, µmol m-2 s-1

58	Rs_dry	Mean dry season RS flux, µmol m-2 s-1
59	RC_seasonal	Root contribution to seasonal RS, fraction
60	RC_season	Season of RC_seasonal
Response of RS to temperature and moisture		
61	Model_type	Type of temperature-response model used
62	Model_effect	Temperature effect on RS (none, positive, negative)
63	Model_output_units	Temperature-response model output units
64	Model_temp_range	Soil temperature range over which model fitted
65	Model_N	Model N
66	Model_R2	Model r-squared
67	T_depth	Depth at which soil temperature recorded, cm. A value of -200 (i.e., 2 m above ground) is used for air temperature
68	Model_paramA	Model parameter A
69	Model_paramB	Model parameter B
70	Model_paramC	Model parameter C
71	Model_paramD	Model parameter D
72	Model_paramE	Model parameter E
73	WC_effect	Soil water effect on RS
74	R10	RS at 10 C, µmol m-2 s-1
75	Q10_0_10	Q10 temperature response, 0-10 C .Q10 values are either reported by authors, calculated from reported RS-temperature regressions, or occasionally estimated from figures (in which case a quality control note is made, field 6)
76	Q10_5_15	Q10 temperature response, 5-15 C
77	Q10_10_20	Q10 temperature response, 10-20 C
78	Q10_0_20	Q10 temperature response, 0-20 C
79	Q10_other1	Q10 temperature response, other temp range
80	Q10_other1_range	Temperature range of Q10_other1, C
81	Q10_other2	Q10 temperature response, other temp range
82	Q10_other2_range	Temperature range of Q10_other2, C
Ancillary pools and fluxes		
83	GPP	Annual gross primary production at site, g C m-2
84	ER	Annual ecosystem respiration at site, g C m-2
85	NEP	Annual net ecosystem production at site, g C m-2
86	NPP	Annual net primary production at site, g C m-2
87	ANPP	Annual aboveground NPP at site, g C m-2
88	BNPP	Annual belowground NPP at site, g C m-2
89	NPP_FR	Annual fine root NPP at site, g C m-2
90	TotDet_flux	Annual total litter flux, g C m-2. This should be the sum of Litter_fluxand Rootlitter_flux
91	TBCA	Total belowground carbon allocation at site, g C m-2
92	Rootlitter_flux	Annual aboveground litter flux, g C m-2. This is reported very inconsistently (leaf only, leaf and fine woody material, all material, etc). Generally this should not include large woody material
93	TotDet_flux	Annual total litter flux, g C m-2. This should be the sum of Litter_flux and Rootlitter_flux

94	Ndep	Annual nitrogen deposition, g N m-2
95	LAI	Leaf area index at site, m2 m-2. Hemispheric (one-sided) if possible
96	BA	Basal area at site, m2 ha-1
97	C_veg_total	Total carbon in vegetation, g C m-2. This should be the sum of C_AG and C_BG. For this and all "C_" fields, biomass is converted to carbon using a ratio of 0.5 unless study-specific values are available
98	C_AG	Total carbon in aboveground vegetation, g C m-2
99	C_BG	Total carbon in belowground vegetation, g C m-2
100	C_CR	Total carbon in coarse roots, g C m-2
101	C_FR	Total carbon in fine roots, g C m-2
102	C_litter	Total carbon in standing litter, g C m-2
103	C_soil	Total carbon in soil organic matter, g C m-2
104	C_soildepth	Depth to which soil C recorded, cm
105	Notes	Notes

File Description: srdb-studies-V3.csv

Column Number	Column Name	Column Description
1	Study_number	Study number; used as a lookup from srdb-data
2	Authors	Study authors
3	Title	Study title
4	Source	Study source (usually journal name)
5	Volume	Volume number
6	Issue	Issue number
7	BP	Beginning page
8	EP	Ending page
9	Pub_year	Publication year
10	Notes	Notes
11	Abstract	Abstract
12	Citations	Citations
13	DE	Data entry: entered into srdb-data (Y, N)?
14	DLD	Downloaded: study acquired (Y/N)?
15	DOI	Digital object identifier
16	nonEnglish	Is study in a non-English language (Y/N)?
17	Rank	Rank (1=highly relevant, 4=not relevant). Note this score is not an assessment of the study's scientific merit or validity; it's simply a judgment, based on reading the abstract and title, of how relevant this study is to the database (i.e., is it likely to have appropriate data?)
18	SearchDate	Date search performed
19	SearchTerm	Web of Science search term used

Companion File Information:

- An R script, srdb.R, containing functions for error-checking, mapping of study locations, summary statistics, and summary graphics is included. Note that this script requires installation of the following R packages: "ggplot2", "reshape2", "maps", and "mapdata". The script must be run from the same

directory that contains the data file (**srdb-data-V3.csv**). Error-checking functions include helper functions to check the valid range and data type of each field. Summary statistics include the breakdown of data by Biome, Ecosystem, Rs_annual, R_10, and Q_10. Scripts to create two maps are provided: the world map shown in Fig. 1 above, and a map of the data from North America. Summary graphics include: Rs summary distributions by Biome, Ecosystem, Ecosystem State, and Season, as well as a plot of Rs_annual vs Rh_annual.

- When it was necessary to calculate or estimate annual flux for one of the studies, these calculations and notes were recorded in an Excel spreadsheet. These spreadsheets are provided as a companion file and have been compiled and compressed into a single file, **calculations_worksheets_v3.zip**.

3. Data Application and Derivation:

This is a database compiled from published studies about soil surface CO_2 flux (soil respiration; RS) measured in the field and intended to serve as a resource for scientific analysis.

The primary RS units used were gC/m2/yr (for annual fluxes) and umol/m2/s (for mean seasonal fluxes); values were converted as necessary from those provided by study authors. A variety of ancillary data were also entered when reported, including site-related and experimental data, information on ecosystem structure and function, methods used, etc.; we assumed a 12:44 ratio of C to CO_2 molecular weights, and that biomass was 50% C (unless specified otherwise in the study).

4. Quality Assessment:

Data were crosschecked against a number of other RS data collections and meta-analyses (Hibbard et al., 2005; Chen and Tian, 2005; Burton et al., 2008; Sottaet al., 2004). Quality flags were assigned based on information provided in a given study and best judgment.

5. Data Acquisition Materials and Methods:

For the compilation of Version 1, investigators collected all available studies in the peer-reviewed scientific literature reporting RS measured in the field; lab incubation studies were not included. The ISI Web of Science constituted the primary source of published studies; search terms used included soil respiration, soil CO2 evolution, etc., and were conducted through the 2008 publication year. We used each study's title and abstract to decide whether to acquire it; ~40% of the almost 4700 studies were acquired and examined.

In version 2.0, publications from 2009, 2010 and from the first half of 2011 were included and RS data from 164 studies have been added. The Google Earth.kmz file of site locations was updated. Additionally, a number of corrections have been made. A number of Age_disturbance fields have been corrected and completed. The Partition_method field has been fixed for many records. Finally, three fields have been deleted: Chamber_method, CH4_flux, N2O_flux. These fields were inconsistent or almost never used.

In Version 3.0, publications from 2012 and RS data from a total of 466 new studies were added. Many corrections were made to older data and a new R script for error-checking and mapping was created. The Google Earth.kmz file was removed and the field CO2_method was renamed to Meas_method. Additionally, two new fields titled Meas_interval and Annual_coverage were added to the data.

Short term experiments (i.e., RS measurements made over less than 1-2 weeks) were not entered unless the study authors extrapolated their results to seasonal or annual values; the database is in general not designed to accommodate instantaneous or short-term measurements. In general we did not do additional research to find older publications that might not be listed in the Web of Science. To qualify for inclusion, a study had to report at least one of the following data:

- Annual RS
- Mean seasonal RS
- Annual or seasonal partitioning of RS sources
- Q10 and associated temperature range
- R10 (RS at 10 degrees C)

If at least one of these data was reported, or could be calculated with few or no assumptions, e.g., easily estimated from points in a figure, the study was entered into the database. For example, sometimes a study will show monthly soil respiration in a figure but not compute an annual flux, and so estimates were made from the figure. This was noted in a quality flag.

When it was necessary to calculate or estimate annual flux for one of the studies, these calculations and notes were recorded in an Excel spreadsheet (*.xlsx). File names start with the assigned four-digit "Study_number" that indexes the srdb-studies and srdb-data files. For example, "0020 WitkampEcology 1966.xlsx" and "4634 Webster JGR 2008.xlsx". These spreadsheets are provided as a companion file and have been compiled and compressed into a single file, calculations_worksheets_v3.zip.

6. Data Access:

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

Data Archive Center:

Contact for Data Center Access Information:
E-mail: uso@daac.ornl.gov
Telephone: +1 (865) 241-3952

7. References:

Bond-Lamberty, B. and A.M. Thomson. 2010. A global database of soil respiration measurements, Biogeosciences, 7, 1321-1344, doi:10.5194/bgd-7-1321-2010.

Burton, A. J., Melillo, J. M., and Frey, S. D. 2008.: Adjustment of forest ecosystem root respiration as temperature warms, Journal of Integrative Plant Biology, 50, 1467-1483, doi:10.1111/j.1744-7909.2008.00750.x.

Chen, H., and Tian, H.-Q. 2005. Does a general temperature-dependent Q(10) model of soil respiration exist at biome and global scale?, Journal of Integrative Plant Biology, 47, 1288-1302.

Hibbard, K. A., Law, B. E., and Sulzman, J. 2005. An analysis of soil respiration across northern hemisphere temperate ecosystems, Biogeochemistry, 73, 29-70, doi:10.1007/s10533-004-2946-0.

Sotta, E. D., Meir, P., Malhi, Y., Nobre, A. D., Hodnett, M., and Grace, J. 2004. Soil CO2 efflux in a tropical forest in the central Amazon, Global Change Biol., 10, 601-617, doi:10.1111/j.1529-8817.2003.00761.x.

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