

Package ‘ISRaD’

August 13, 2019

Title Tools and Data for the International Soil Radiocarbon Database

Version 0.1.2

Description This is the central location for data and tools for the development, maintenance, analysis, and deployment of the International Soil Radiocarbon Database. This database and package have been developed in collaboration between the U.S. Geological Survey Powell Center and the Max Planck Institute.

Depends R (>= 3.3.0)

Imports openxlsx, devtools, raster, dplyr, plyr, tidyr, RCurl, ggplot2, ggmap, assertthat, rcross-ref, pangaeear, tidyverse, usethis, stringr

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Encoding UTF-8

LazyData true

RoxygenNote 6.1.1

Suggests knitr,
rmarkdown

VignetteBuilder knitr

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checkTempletFiles	<i>Check ISRaD Templet files</i>
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Description

Check that the Templet information file and the templet file match appropriately.

Usage

```
checkTempletFiles(outfile = "")
```

Arguments

outfile	file to dump the output report. Defaults to an empty string that will print to standard output.
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Value

returns NULL

Examples

```
## Not run:
checkTempletFiles()

## End(Not run)
```

compile	<i>Compile ISRaD data product</i>
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Description

Construct data products to the International Soil Radiocarbon Database.

Usage

```
compile(dataset_directory, write_report = FALSE, write_out = FALSE,
        return_type = c("none", "list")[2], checkdoi = F)
```

Arguments

dataset_directory	string defining directory where completed and QC passed soilcarbon datasets are stored
write_report	boolean flag to write a log file of the compilation (FALSE will dump output to console). File will be in the specified in the dataset_directory at "database/ISRaD_log.txt". If there is a file already there of this name it will be overwritten.
write_out	boolean flag to write the compiled database file as .csv in dataset_directory (FALSE will not generate output file but will return)
return_type	a string that defines return object. Default is "none". Acceptable values are "none" or "list" depending on the format you want to have the database returned in.
checkdoi	set to F if you do not want the QAQC check to validate doi numbers

graven	<i>Graven dataset for delta delta calculation</i>
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Description

Data from Graven et al 2017 <https://www.geosci-model-dev.net/10/4405/2017/gmd-10-4405-2017.pdf>

Usage

```
graven
```

Format

```
dataframe
```

ISRaD.build	<i>ISRaD.build builds the database and updates objects in R package</i>
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Description

Wrapper function that combines tools for rapid deployment of R package data objects. Meant to be used by the maintainers/developers of ISRaD

Usage

```
ISRaD.build(ISRaD_directory = getwd(), geodata_clim_directory,
            geodata_pet_directory, geodata_soil_directory, citations = T)
```

Arguments

ISRaD_directory directory where the ISRaD package is found

geodata_clim_directory directory where geospatial climate datasets are found. Necessary to create ISRaD_Extra

geodata_pet_directory directory where geospatial pet dataset is found. Necessary to create ISRaD_Extra

geodata_soil_directory directory where geospatial soil datasets are found. Necessary to create ISRaD_Extra

citations T or F. Update citations.

Value

runs QAQC on all datafiles, moves files that fail QAQC, updates ISRaD_Data, updates ISRaD_Extra

Examples

```
## Not run:
ISRaD.build(ISRaD_directory="~/ISRaD/", geodata_clim_directory="~/geospatial_clim_datasets",
  geodata_pet_directory="~/geospatial_pet_dataset",
  geodata_soil_directory="~/geospatial_soil_datasets")

## End(Not run)
```

ISRaD.extra

ISRaD.extra

Description

Fills in transformed and geospatial data where possible, generatating an enhanced version of ISRaD.

Usage

```
ISRaD.extra(database, geodata_clim_directory, geodata_soil_directory,
  geodata_pet_directory)
```

Arguments

database soilcarbon dataset object

geodata_clim_directory directory where geospatial climate data are found

geodata_soil_directory directory where geospatial soil data are found

geodata_pet_directory directory where geospatial pet data are found

Details

Fills fraction modern, delta 14C, delta-delta values, profile coordinates, and SOC stocks frmo entered data; fills soil and climatic data from external geospatial data products

Value

returns new ISRaD_extra object with derived, transformed, and filled columns

ISRaD.extra.Cstocks	<i>ISRaD.extra.Cstocks</i>
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Description

Calculates soil organic carbon stock

Usage

```
ISRaD.extra.Cstocks(database)
```

Arguments

database ISRaD dataset object.

Details

Function first fills lyr_bd_samp and lyr_c_org. SOC stocks can only be calculated if organic carbon concentration and bulk density data are available. SOC stocks are then calculated for the fine earth fraction (<2mm).

Value

returns ISRaD_data object with filled columns

Author(s)

J. Beem-Miller

ISRaD.extra.delta_delta	<i>ISRaD.extra.delta_delta</i>
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Description

Calculates the difference between sample delta 14C and the atmosphere for the year of collection (delta-delta)

Usage

```
ISRaD.extra.delta_delta(database)
```

Arguments

database ISRaD dataset object.

Details

Creates new column for delta-delta value. Observation year and profile coordinates must be filled (use ISRaD.extra.fill_dates, and ISRaD.extra.fill_coords fxs). The relevant atmospheric d14C data (northern or southern hemisphere, or tropics) are determined by profile coordinates.

Value

returns ISRaD_data object with new delta delta columns in relevant tables

Author(s)

J. Beem-Miller and C. Hicks-Pries

References

Graven et al. 2017 <https://www.geosci-model-dev.net/10/4405/2017/gmd-10-4405-2017.pdf>

ISRaD.extra.fill_14c	<i>ISRaD.extra.fill_14c</i>
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Description

: Fills delta 14C from fraction modern if delta 14C not reported.

Usage

```
ISRaD.extra.fill_14c(database)
```

Arguments

database ISRaD dataset object.

Details

: Warning: xxx_obs_date_y columns must be filled for this to work!

Value

returns ISRaD_data object with filled delta 14C columns

Author(s)

: J. Beem-Miller & A. Hoyt

References

: Stuiver and Polach, 1977

```
ISRaD.extra.fill_coords  
ISRaD.extra.fill_coords
```

Description

Fills profile coordinates from site coordinates if profile coordinates not reported.

Usage

```
ISRaD.extra.fill_coords(database)
```

Arguments

database ISRaD dataset object.

Value

returns ISRaD_data object with filled profile coordinates

Author(s)

J. Beem-Miller

```
ISRaD.extra.fill_dates  
ISRaD.extra.fill_dates
```

Description

Fills frc_obs_date_y and inc_obs_date_y columns from lyr_obs_date_y if not reported.

Usage

```
ISRaD.extra.fill_dates(database)
```

Arguments

database ISRaD dataset object.

Details

This function must be run prior to the ISRaD.extra.fill_14c, ISRaD.extra.fill_fm, and ISRaD.extra.delta_delta for the layer and fraction tables.

Value

returns ISRaD_data object with filled obs_date_y columns

```
ISRaD.extra.fill_expert
      ISRaD.extra.fill_expert
```

Description

: Fills in columns of expert-reviewed full data with real data where available, and calculates missing carbon stocks with filled data.

Usage

```
ISRaD.extra.fill_expert(database)
```

Arguments

database ISRaD dataset object.

Details

:

Value

returns ISRaD_data object with the lyr_xxx_fill_extra columns containing both original and filled data

Author(s)

: Paul A. Levine

References

:

```
ISRaD.extra.fill_fm    ISRaD.extra.fill_fm
```

Description

Fills fraction modern from delta 14C if fraction modern not reported.

Usage

```
ISRaD.extra.fill_fm(database)
```

Arguments

database ISRaD dataset object.

Details

: Warning: xxx_obs_date_y columns must be filled for this to work!

Value

returns ISRaD_data object with filled fraction modern columns

Author(s)

: J. Beem-Miller & A. Hoyt

References

: Stuiver and Polach, 1977

ISRaD.extra.fill_soilorders
ISRaD.extra.fill_soilorders

Description

Fills pro_usda_soil_order field from pro_soil_taxon field.

Usage

```
ISRaD.extra.fill_soilorders(database)
```

Arguments

database ISRaD dataset object.

Details

This function is a static conversion script written at the Fall 2018 Powell Center workshop and therefore performance is not guaranteed for new entries.

Back fills pro_usda_soil_order based on USDA classifications

Value

returns ISRaD_data object with filled pro_usda_soil_order column

```
ISRaD.extra.geospatial.climate
      ISRaD.extra.geospatial.climate
```

Description

Extracts values from gridded (2.5' arc) climate data using ISRaD profile coordinates.

Usage

```
ISRaD.extra.geospatial.climate(database, geodata_clim_directory,
                                geodata_pet_directory)
```

Arguments

```
database          ISRaD dataset object.
geodata_clim_directory
                  directory where geospatial climate datasets are found.
geodata_pet_directory
                  directory where geospatial pet dataset is found.
```

Details

Adds new climate fields BIO1-BIO19, PET:

BIO1 = Annual Mean Temperature, BIO2 = Mean Diurnal Range (Mean of monthly (max temp - min temp)), BIO3 = Isothermality (BIO2/BIO7) (* 100), BIO4 = Temperature Seasonality (standard deviation *100), BIO5 = Max Temperature of Warmest Month, BIO6 = Min Temperature of Coldest Month, BIO7 = Temperature Annual Range (BIO5-BIO6), BIO8 = Mean Temperature of Wettest Quarter, BIO9 = Mean Temperature of Driest Quarter, BIO10 = Mean Temperature of Warmest Quarter, BIO11 = Mean Temperature of Coldest Quarter, BIO12 = Annual Precipitation, BIO13 = Precipitation of Wettest Month, BIO14 = Precipitation of Driest Month, BIO15 = Precipitation Seasonality (Coefficient of Variation), BIO16 = Precipitation of Wettest Quarter, BIO17 = Precipitation of Driest Quarter, BIO18 = Precipitation of Warmest Quarter, BIO19 = Precipitation of Coldest Quarter PET = Potential evapotranspiration, mm/yr (Penman-Monteith method for short-clipped grass w/ worldclim input data)

All BIO## variables are from <http://www.worldclim.org/bioclim> V1.4 at 2.5 resolution and are based on site lat and long

Value

An ISRaD_data object with additional rows containing values from geospatial datasets. See description for details.

Author(s)

J. Grey Monroe, Alison Hoyt

References

<http://www.worldclim.org/>; PET data from: Kramer, M. and O. Chadwick. 2018. Climate-driven thresholds in reactive mineral retention of soil carbon at the global scale. *Nature Climate Change* 8:1104–1108.

```
ISRaD.extra.geospatial.soil
```

ISRaD.extra.geospatial.soil

Description

Function to download and extract soil data from ISRIC spatial data products. WARNING: downloads large data files (>15 GB total)

Usage

```
ISRaD.extra.geospatial.soil(database, geodata_soil_directory)
```

Arguments

database	ISRaD dataset object.
geodata_soil_directory	directory where geospatial soil datasets are found, or to which can be downloaded.

Details

Uses site and profile latitude and longitude to extract soil classifications and characteristics from .tif geospatial files acquired from ISRIC (<https://www.isric.org/explore/soilgrids>). Currently includes USDA soil classifications and soil organic carbon to 100 cm, with new columns added at profile level for SOC at surface (0cm), 5, 15, 30, 60, and 100 cm depth. Points that are very near water bodies tend to produce NA values due to grid cell classification as water (which contains no data). All data are currently from 250 m grid cells.

Author(s)

Shane Stoner sstoner@bgc-jena.mpg.de

References

Hengl, T., Mendes de Jesus, J., Heuvelink, G. B.M., Ruiperez Gonzalez, M., Kilibarda, M. et al. (2017) SoilGrids250m: global gridded soil information based on Machine Learning. PLoS ONE 12(2): e0169748. doi:10.1371/journal.pone.0169748. Hengl T, de Jesus JM, MacMillan RA, Batjes NH, Heuvelink GBM, et al. (2014) SoilGrids1km — Global Soil Information Based on Automated Mapping. PLoS ONE 9(8): e105992. doi:10.1371/journal.pone.0105992. Shangguan, W., Hengl, T., de Jesus, J. M., Yuan, H. and Dai, Y. (2016), Mapping the global depth to bedrock for land surface modeling. J. Adv. Model. Earth Syst. doi:10.1002/2016MS000686.

ISRaD.flatten	<i>ISRaD.flatten</i>
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Description

: Joins tables in ISRaD based on linking variables and returns "flat" dataframes

Usage

```
ISRaD.flatten(database, table)
```

Arguments

database	ISRaD dataset object: e.g. ISRaD_data, or ISRaD_extra
table	ISRaD table of interest ("flux", "layer", "interstitial", "fraction", "incubation"). Must be entered with "".

Details

: ISRaD.extra.flatten generates flat files (2 dimensional matrices) for user specified ISRaD tables by joining higher level tables (metadata, site, profile, layer) to lower level tables (layer, fraction, incubation, flux, interstitial).

Value

returns a dataframe with nrow=nrow(table) and ncol=sum(ncol(meta),ncol(site),ncol(profile),...,ncol(table))

Author(s)

: J. Beem-Miller

References

:

ISRaD.getdata	<i>ISRaD.getdata</i>
---------------	----------------------

Description

ISRaD.getdata

Usage

```
ISRaD.getdata(directory = getwd(), dataset = "full", extra = F,  
force_download = F)
```

Arguments

directory	location of ISRaD_database_files folder. If not found, it will be download. The default is the current working directory.
dataset	Specify which data you want. Options are c("full", "flux", "interstitial", "incubation", "fraction", "layer")
extra	T or F. If T, the ISRaD_extra object will be returned. If F, ISRaD_data will be returned. Default is F.
force_download	T or F. If there are already ISRaD_database files in the directory you specify, new data will not be downloaded by default. However, if you set force_downlaod to T, the newest data from github will be downloaded regardless.

Value

ISRaD data object

ISRaD.save.xlsx	<i>ISRaD.save.xlsx</i>
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Description

saves data object as xlsx file in ISRaD template format

Usage

```
ISRaD.save.xlsx(database, template_file, outfile)
```

Arguments

database	ISRaD dataset object.
template_file	path and name of template file to use.
outfile	path and name to save the excel file

Author(s)

J Grey Monroe

QAQC	<i>QAQC</i>
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Description

Check the imported soil carbon dataset for formatting and entry errors

Usage

```
QAQC(file, writeQCreport = F, outfile = "", summaryStats = T,
      dataReport = F, checkdoi = T)
```

Arguments

file	directory to data file
writeQCreport	if TRUE, a text report of the QC output will be written to the outfile. Default is FALSE
outfile	filename of the output file if writeQCreport==TRUE. Default is NULL, and the outfile will be written to the directory where the dataset is stored, and named by the dataset being checked.
summaryStats	prints summary statistics. Default is TRUE
dataReport	prints list structure of database. Default is FALSE
checkdoi	set to F if you do not want the QAQC check to validate doi numbers

read_Treat2016	<i>Read in data for Treat 2016.</i>
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Description

Currently doesn't work and is under development

Usage

```
read_Treat2016(download = T, downloadDir = "temp",
  convertedDir = "~/Dropbox/USGS/ISRaD_data/Compilations/Treat/converted/",
  dois_file = "~/Dropbox/USGS/ISRaD_data/Compilations/Treat/dois.csv")
```

Arguments

download	boolean, if T the Treat datasets will be downloaded from pangea. Otherwise, they files in downloadDir will be used.
downloadDir	directory where data files will be downloaded
convertedDir	directory where data files that are converted to ISRaD template will be saved
dois_file	file with doi numbers

Value

writes out files for individual data objects

read_YujiHe2016	<i>Read He 2016</i>
-----------------	---------------------

Description

Read in the data from Yuji He's 2016 Science paper as a raw csv file

Usage

```
read_YujiHe2016(Yujie_file = NULL)
```

Arguments

Yujie_file The raw csv data

Value

ISRaD compliant file structure with only columns that overlap with original data

reports	<i>reports</i>
---------	----------------

Description

generate reports of ISRaD data

Usage

```
reports(database = NULL, report = "count_data")
```

Arguments

database	ISRaD data object
report	Parameter to define which type of report you want. The default is "count_data" other options include "entry_stats" and "site_map".

rep_count_data	<i>rep_count_data</i>
----------------	-----------------------

Description

generate a count of observations for each level of the database

Usage

```
rep_count_data(database = NULL)
```

Arguments

database	ISRaD data object
----------	-------------------

rep_entry_stats	<i>rep_entry_stats</i>
-----------------	------------------------

Description

generate report of entry statistics

Usage

```
rep_entry_stats(database = NULL)
```

Arguments

database	ISRaD data object
----------	-------------------

rep_frc_data	<i>rep_frc_data</i>
--------------	---------------------

Description

generate a count of fractionation observations including scheme and property

Usage

```
rep_frc_data(database = NULL)
```

Arguments

database	ISRaD data object
----------	-------------------

rep_site_map	<i>rep_site_map</i>
--------------	---------------------

Description

generate a world map with site locations plotted

Usage

```
rep_site_map(database = NULL)
```

Arguments

database	ISRaD data object
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