Package ‘isoWater’

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Type Package

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R topics documented:

<table>
<thead>
<tr>
<th>Function</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>dex</td>
<td>2</td>
</tr>
<tr>
<td>GMWL</td>
<td>3</td>
</tr>
<tr>
<td>iso</td>
<td>3</td>
</tr>
<tr>
<td>isoWater</td>
<td>4</td>
</tr>
</tbody>
</table>
Deuterium excess

Description

Calculates deuterium excess or line-conditioned excess.

Usage

dex(HO, form = "dex", MWL = NULL)

Arguments

HO data.frame. Hydrogen (column 1) and oxygen (column 2) isotope values for 1 or more water samples.

form character. Calculate deuterium excess ("dex"), line-conditioned excess ("lcex"), or "both".

MWL numeric. Vector the first two elements of which contain the meteoric water line slope and intercept (e.g., as created by mwl). The default value (if MWL = NULL) reflects the Global Meteoric Water Line estimated from a global precipitation compilation in Bowen, et al. (2019). Ignored for form = "dex".

Value

Returns a copy of HO with an added field(s) “dex” and/or “lcex” containing the calculated values. Deuterium excess is calculated following Dansgaard (1964) as: \( \text{dex} = \delta^{2}H - 8 \times \delta^{18}O \), and lc-excess following Landwehr & Coplen (2006) as \( \text{lcex} = \delta^{2}H - m \times \delta^{18}O - b \), where \( m \) and \( b \) are the slope and intercept of MWL, respectively.

References


Examples

0 = runif(10, -15, -2)
H = 0 * 8 + 10 + rnorm(10, 0, 6)
d = dex(data.frame(H, O), form = "both")
print(d)

GMWL

Global Meteoric Water Line

Description

Parameters for the Global Meteoric Water Line fit to a global precipitation compilation in Bowen,
et al. (2019).

Usage

data("GMWL")

Format

The format is: num [1:6] slope, intercept, average d18O, sum of squares in d18O, root mean square
error, number of samples

Source

Bowen et al. (2019) Isotopes in the water cycle: Regional- to global-Scale patterns and applications.

Examples

data(GMWL)

iso

Iso Object

Description

Creates objects of type "iso"

Usage

iso(H, O, Hsd, Osd, H0c = 0)
mixSource

Arguments

H numeric. Hydrogen isotope value or vector of hydrogen isotope values.
O numeric. Oxygen isotope value or vector of oxygen isotope values.
Hsd numeric. 1 standard deviation uncertainty of H (value or vector of values).
Osd numeric. 1 standard deviation uncertainty of O (value or vector of values).
HOc numeric. Covariance of H and O uncertainties.

Value

Returns an object of class “iso”, a data.frame containing the provided values.

Examples

obs = iso(-30, -5, 2, 0.2, 0.3)
str(obs)

mixSource

Water Source as a Mixture

Description

Given isotopic compositions of two or more potential sources, generate a posterior sample of source mixtures conditioned on one or more sample values.

Usage

mixSource(obs, sources, slope, prior = rep(1,nrow(sources)), shp = 1,
ngens = 1e5, ncores = 1)
mixSource

Arguments

- obs: `iso` object containing isotope values for one or more samples.
- sources: `iso` object containing isotope values for two or more sources which may have contributed to the observed samples.
- slope: numeric. Vector of length two specifying prior parameters for the evaporation line slope (mean, standard deviation).
- prior: numeric. Vector of length equal to the number of sources, giving prior estimates of relative contributions of different sources.
- shp: numeric. Shape parameter constant used in specifying prior estimates of source contributions (see Details).
- ngens: integer. Number of posterior samples to obtain (per chain).
- ncores: integer. Number of cores to use for parallel processing.

Details

The Dirichlet distribution is used to represent the fractional contribution of each source. The prior estimate is a Dirichlet where the shape parameter for source $i$ is given by \( \text{prior}[i] / \min(\text{prior}) \times \text{shp} \).

If \( \text{ncores} = 1 \), three chains will be run on a single core. If \( \text{ncores} > 1 \), \( \text{ncores} \) chains will be run in parallel on \( \text{ncores} \) cores.

Value

Returns an object of class “mixSource”, a list containing:

- summary: matrix. Summary table of JAGS MCMC results, including parameter posterior distributions and convergence statistics.
- results: data.frame. Posterior samples of model parameters.
- mixture_d2H: Hydrogen isotopic composition of unevaporated source mixture.
- mixture_d18O: Oxygen isotopic composition of unevaporated source mixture.
- sX_fraction: Fractional contribution of each source.
- S: Evaporation line slope.
- E: Evaporation index, equal to the difference between the sample and unevaporated source mixture oxygen isotope values.

Examples

```r
#Prep sources
O = runif(3, -15, -2)
H = O * 8 + 10 + rnorm(3, 0, 6)
sources = iso(H, O, 1, 0.2, 0.17)

#Sample data
obs = iso(-60, -6, 0.5, 0.1, 0)

#Evaporation slope
```
mwl

Description

Creates objects of type "mwl" containing statistics for a meteoric water line in H and O isotope space.

Usage

mwl(HO, plot = TRUE)

Arguments

HO          data.frame. Hydrogen (column 1) and oxygen (column 2) isotope values for 3 or more water samples.

plot        logical. Plot the data, MWL, and standard error of prediction?

Details

mwl will return an error if fewer than 3 sample values are provided and a warning if fewer than 10 samples are provided or if the correlation coefficient between H and O values is less than 0.7. Sample values should span a broad enough range of isotope values to strongly constrain the MWL. Model II (reduced major axis) regression is used to accommodate errors on both isotope values.

Value

Returns an object of class "mwl", a numeric vector containing meteoric water line statistics. See mwlSource.

Examples

O = runif(10, -15, -2)
H = O * 8 + 10 + rnorm(10, 0, 6)
MWL = mwl(data.frame(H, O))
str(MWL)
**mwlSource**

*Water Source Using Meteoric Water Line*

**Description**

Given parameters describing a meteoric water line in H-O isotope space, generate a posterior sample of unevaporated source water values conditioned on one or more sample values.

**Usage**

```r
mwlSource(obs, MWL = NULL, slope, stype = 1, ngens=1e4, ncores = 1)
```

**Arguments**

- `obs` *iso* object containing isotope values for one or more samples.
- `MWL` numeric. Vector of length 6 containing parameters describing a meteoric water line (see Details).
- `slope` numeric. Vector of length two specifying prior parameters for the evaporation line slope (mean, standard deviation).
- `stype` integer. Line statistic used to constrain the source prior: 1 = confidence interval, 2 = prediction interval (see Details).
- `ngens` integer. Number of posterior samples to obtain (per chain).
- `ncores` integer. Number of cores to use for parallel processing.

**Details**

The prior distribution of source values is constrained by `MWL`, which contains the parameters: slope, intercept, average d18O, sum of squares in d18O, root mean square error, and number of samples for an empirically-determined meteoric water line. This object can be created from a H and O isotope dataset using the function `mwl`. The default value (if `MWL = NULL`) reflects the Global Meteoric Water Line estimated from a global precipitation compilation in Bowen, et al. (2019). `stype` determines how the source uncertainty about the MWL is calculated; the default (1, confidence interval) is appropriate if the source is best represented as an integrated mixture of the samples defining the MWL, whereas option 2 (prediction interval) is appropriate if the source is best represented as a single sample.

If `ncores = 1`, three chains will be run on a single core. If `ncores > 1`, `ncores` chains will be run in parallel on `ncores` cores.

**Value**

Returns an object of class “mwlSource”, a list containing:

- `summary` matrix. Summary table of JAGS MCMC results, including parameter posterior distributions and convergence statistics.
- `results` data.frame. Posterior samples of model parameters.
source_d2H  Hydrogen isotopic composition of unevaporated source.
source_d18O  Oxygen isotopic composition of unevaporated source.
S  Evaporation line slope.
E  Evaporation index, equal to the difference between the sample and unevaporated source mixture oxygen isotope values.

References


Examples

```r
#Prep MWL
O = runif(10, -15, -2)
H = O * 8 + 10 + rnorm(10, 0, 6)
MWL = mwl(data.frame(H, O), plot = FALSE)

#Sample data
obs = iso(-60, -6, 0.5, 0.1, 0)

#Evaporation slope
slope = c(5, 0.3)

#Run and report...likely not converged!
ws = mwlSource(obs, MWL, slope, ngens = 1e3)
ws$summary

#A traceplot
plot(ws$results$source_d18O[1:1000], type = "l")
lines(ws$results$source_d18O[1001:2000], col = 2)
lines(ws$results$source_d18O[2001:3000], col = 3)
```

wiDB_data  Obtain data from wiDB using a query

Description

Obtain data from wiDB using a query

Usage

```r
wiDB_data(minLat = NULL, maxLat = NULL, minLong = NULL,
maxLong = NULL, minElev = NULL, maxElev = NULL, minDate = NULL,
maxDate = NULL, countries = NULL, states = NULL, types = NULL,
projects = NULL, fields = NULL, tmpdir = tempdir(), clean = TRUE)
```
Arguments

- **minLat**: numeric. Minimum latitude for query region, in decimal degrees. South negative.
- **maxLat**: numeric. Maximum latitude for query region, in decimal degrees. South negative.
- **minLong**: numeric. Minimum longitude for query region, in decimal degrees. West negative.
- **maxLong**: numeric. Maximum longitude for query region, in decimal degrees. West negative.
- **minElev**: numeric. Minimum elevation for query. Meters.
- **minDate**: character. Minimum date for query. Format: "YYYY-MM-DD".
- **maxDate**: character. Maximum date for query. Format: "YYYY-MM-DD".
- **countries**: character. Vector of one or more two-letter country codes for query.
- **states**: character. Vector of one or more two-letter state or province codes for query.
- **types**: character. Vector of one or more sample types for query. See vocabulary in the wiDB template.
- **projects**: character. Vector of one or more project codes for query.
- **fields**: character. Vector of one or more data fields to return from database. If omitted, returns all default fields. See here for details.
- **tmpdir**: character. Directory path to use for unpacking data object.
- **clean**: logical. Remove working files after data object is unpacked?

Details

One or more arguments must be provided.

Value

named list. See here for details.

- **data**: dataframe. Data records for isotope samples returned by query.
- **projects**: dataframe. Provenance information associated with samples returned by query.

Note that some data are embargoed or have been shared under a license that prohibits redistribution. In dataframe data values of 9999 indicate that a measurement is available but can’t be obtained directly from the wiDB. Project information in projects can be used to contact or visit the primary data source to learn about access to these data. Values of -9999 in data indicate no measurement.
Examples

```r
# Download data for US precipitation in the 1990s
vals = wiDB_data(minDate = "1990-01-01", maxDate = "2000-01-01",
countries = "US", types = "Precipitation")

# Download data for US Rivers and streams, requesting a subset of data fields
vals = wiDB_data(minDate = "1980-01-01", maxDate = "2000-01-01",
countries = "US", types = "River_or_stream",
fields = "Site_Name, Latitude, Longitude,d2H")
```

### wiDB_sites

Obtain information on wiDB sites using a query

#### Description

Obtain information on wiDB sites using a query

#### Usage

```r
wiDB_sites(minLat = NULL, maxLat = NULL, minLong = NULL, maxLong = NULL,
minElev = NULL, maxElev = NULL, minDate = NULL, maxDate = NULL,
countries = NULL, states = NULL, types = NULL, projects = NULL)
```

#### Arguments

- **minLat**: numeric. Minimum latitude for query region, in decimal degrees. South negative.
- **maxLat**: numeric. Maximum latitude for query region, in decimal degrees. South negative.
- **minLong**: numeric. Minimum longitude for query region, in decimal degrees. West negative.
- **maxLong**: numeric. Maximum longitude for query region, in decimal degrees. West negative.
- **minElev**: numeric. Minimum elevation for query. Meters.
- **minDate**: character. Minimum date for query. Format: "YYYY-MM-DD"
- **maxDate**: character. Maximum date for query. Format: "YYYY-MM-DD"
- **countries**: character. Vector of one or more two-letter country codes for query.
- **states**: character. Vector of one or more two-letter state or province codes for query.
- **types**: character. Vector of one or more sample types for query. See vocabulary in the wiDB template.
- **projects**: character. Vector of one or more project codes for query.
**wiDB_values**

**Details**

One or more arguments must be provided.

**Value**

dataframe. Contains location and summary information for all wiDB sites returned by query. See here for details.

**Examples**

```r
#Find all sites with tap water data since September, 2019
sites = wiDB_sites(minDate = "2019-09-01", types = "Tap")
```

---

**wiDB_values**

Obtain value lists for categorical fields in wiDB

**Description**

Obtain value lists for categorical fields in wiDB

**Usage**

```r
wiDB_values(fields)
```

**Arguments**

fields character. One or more field names for which to obtain value lists. Limited to: "countries", "states", "types", and "projects".

**Value**

named list. Each element is a vector or dataframe containing values for the named field.

**Examples**

```r
#List all projects in the wiDB
wiDB_values("projects")
```
Index

* datasets
  GMWL, 3
  dex, 2
  GMWL, 3
  iso, 3, 5, 7
  isoWater, 4
  mixSource, 4
  mwl, 2, 6, 7
  mwlSource, 6, 7

  wiDB_data, 8
  wiDB_sites, 10
  wiDB_values, 11