

Package ‘bayfoxr’

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Title Global Bayesian Foraminifera Core Top Calibration

Version 0.0.1

Description A Bayesian, global planktic foraminifera core top calibration to modern sea-surface temperatures. Includes four calibration models, considering species-specific calibration parameters and seasonality.

URL <https://github.com/brews/bayfoxr/>

BugReports <https://github.com/brews/bayfoxr/issues>

Depends R (>= 3.4)

License GPL (>= 3)

Encoding UTF-8

LazyData true

Suggests testthat, knitr, rmarkdown

RoxygenNote 6.1.1

VignetteBuilder knitr

NeedsCompilation no

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bassriver	<i>Bass River planktic foraminiferal calcite d18O.</i>
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Description

A data set containing marine sediment core samples from the Paleocene-Eocene Thermal Maximum (PETM) section with well preserved foraminifera calcite d18O.

Usage

```
bassriver
```

Format

A data frame with 62 rows and 2 column variables:

depth marine sediment down-core sample depth, in m

d18o *Morozovella spp.* shell calcite d18O, in ‰ VPDB

Source

John, C. M., S. M. Bohaty, J. C. Zachos, A. Sulijs, S. Gibbs, H. Brinkhuis, and T. J. Bralower (2008), North American continental margin records of the Paleocene-Eocene thermal maximum: Implications for global carbon and hydrological cycling, *Paleoceanography*, 23(2), doi:10.1029/2007PA001465.

get_available_forams	<i>Parse trace dataframe column names to get vector of available forams.</i>
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Description

Parse trace dataframe column names to get vector of available forams.

Usage

```
get_available_forams(d)
```

Arguments

d Data frame containing MCMC trace draws. Column names are model parameters with foram group name separated from model parameters name by "___"

Value

Character vector of available foram names.

get_draws	<i>Get MCMC trace draws.</i>
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Description

Get MCMC trace draws.

Usage

```
get_draws(foram = NULL, seasonal_seaemp = FALSE)
```

Arguments

foram	Optional. String or NULL. String indicating the foram species/subspecies to infer for hierarchical models. String must be one of "G. bulloides", "G. ruber white", "G. ruber pink", "G. sacculifer", "N. incompta", or "N. pachyderma sinistral". NULL indicates that a pooled model is desired.
seasonal_seaemp	Optional boolean indicating whether to use the seasonal sea-surface temperature calibrations. Default is FALSE, i.e. using annual SST calibrations.

Details

Four calibration models are available: an "annual pooled" model, a "seasonal pooled" model, an "annual hierarchical" model, and a "seasonal hierarchical" model. This function uses magic to determine which "pooled annual" model is used. Which is the simplest case with potential use for Deep Time reconstructions of nonexant foram species. Giving a valid string for foram will use a hierarchical model, which has foram-specific variability in calibration model parameters. Passing TRUE for seasonal_seaemp will use a model trained on season sea-surface temperatures. See reference paper for further details.

Value

Data frame with columns "alpha", "beta", "tau". Which are equal-length vectors of model parameter draws.

plot.prediction	<i>Plot a prediction object.</i>
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Description

Plot a prediction object.

Usage

```
## S3 method for class 'prediction'
plot(...)
```

Arguments

... Arguments passed on to predictplot.

See Also

[predictplot](#)

Examples

```
data(bassriver)

# Using the "pooled annual" calibration model:
sst <- predict_seatemp(bassriver$d18o, d18osw=0.0,
                      prior_mean=30.0, prior_std=20.0)

predictplot(x=bassriver$depth, y=sst, ylim=c(20, 40),
            ylab="SST (°C)", xlab="Depth (m)")
```

prediction

Constructor for S3 prediction class.

Description

Constructor for S3 prediction class.

Usage

```
prediction(ensemble)
```

Arguments

ensemble A matrix (m x n) of the prediction posteriors. Where m is the number of values inferred and n is the number of trace draws.

Value

A prediction object.

predictplot *Simple plot of prediction with intervals.*

Description

Simple plot of prediction with intervals.

Usage

```
predictplot(y, x = NULL, probs = c(0.05, 0.5, 0.95),
            poly_col = grDevices::rgb(0, 0, 0, 0.1), ...)
```

Arguments

`y` A prediction object to plot.

`x` Optional vector or NULL, indicating where prediction inferences fall along x-axis. Must be the same length as the inferred values in `y`.

`probs` Optional 3-member Vector of numerics indicating low, middle, and high probability intervals to plot. All must be ≤ 1 .

`poly_col` Optional color for interval polygon.

`...` Additional arguments passed to plot.

Examples

```
data(bassriver)

# Using the "pooled annual" calibration model:
sst <- predict_seatemp(bassriver$d18o, d18osw=0.0,
                      prior_mean=30.0, prior_std=20.0)

predictplot(x=bassriver$depth, y=sst, ylim=c(20, 40),
            ylab="SST (°C)", xlab="Depth (m)")
```

predict_d18oc *Predict d18O of foram calcite given seawater temperature and seawater d18O.*

Description

Predict d18O of foram calcite given seawater temperature and seawater d18O.

Usage

```
predict_d18oc(seatemp, d18osw, foram = NULL, seasonal_seatemp = FALSE,
              drawsfun = get_draws)
```

Arguments

seatemp	Numeric or vector of observed sea-surface temperatures (°C).
d18osw	Numeric or vector of observed seawater d18O (‰ VSMOW).
foram	Optional. String or NULL. String indicating the foram species/subspecies to infer for hierarchical models. String must be one of "G. bulloides", "G. ruber", "T. sacculifer", "N. incompta", or "N. pachyderma". NULL indicates that a pooled model is desired.
seasonal_seatemp	Optional boolean indicating whether to use the seasonal sea-surface temperature calibrations. Default is FALSE, i.e. using annual SST calibrations.
drawsfun	Optional function used to get get model parameter draws. Must take arguments for "foram" and "seasonal_seatemp" and return a list with members "alpha", "beta", "tau". This is for debugging and testing. See get_draws .

Details

Four calibration models are available: an "annual pooled" model, a "seasonal pooled" model, an "annual hierarchical" model, and a "seasonal hierarchical" model. This function uses magic to determine which "pooled annual" model is used. Which is the simplest case with potential use for Deep Time reconstructions of nonexant foram species. Giving a valid string for foram will use a hierarchical model, which has foram-specific variability in calibration model parameters. Passing TRUE for seasonal_seatemp will use a model trained on season sea-surface temperatures. See reference paper for further details.

Value

A prediction instance for inferred foraminiferal calcite d18O (‰ VPDB).

See Also

[predict_seatemp](#), [predictplot](#)

Examples

```
# Infer d18oc for a G. bulloides core top sample using annual hierarchical model.
# The true, d18oc for this sample is -2.16 ( VPDB).
delo_ann <- predict_d18oc(seatemp=28.6, d18osw=0.48, foram="G. bulloides")
head(quantile(delo_ann, probs=c(0.159, 0.5, 0.841))) # ± 1 standard deviation

# Now using seasonal hierarchical model:
delo_sea <- predict_d18oc(seatemp=28.6, d18osw=0.48, foram="G. bulloides",
                        seasonal_seatemp = TRUE)
head(quantile(delo_sea, probs=c(0.159, 0.5, 0.841))) # ± 1 standard deviation
```

predict_seatemp	<i>Predict sea-surface temperature given d18O of foram calcite and seawater d18O.</i>
-----------------	---

Description

Predict sea-surface temperature given d18O of foram calcite and seawater d18O.

Usage

```
predict_seatemp(d18oc, d18osw, prior_mean, prior_std, foram = NULL,
               seasonal_seatemp = FALSE, drawsfun = get_draws)
```

Arguments

d18oc	Numeric or vector of observed foram calcite d18O (‰ VPDB).
d18osw	Numeric or vector of observed seawater d18O (‰ VSMOW).
prior_mean	Numeric indicating prior mean for sea-surface temperature (°C).
prior_std	Numeric indicating prior standard deviation for sea-surface temperature (°C).
foram	Optional. String or NULL. String indicating the foram species/subspecies to infer for hierarchical models. String must be one of "G. bulloides", "G. ruber", "T. sacculifer", "N. incompta", or "N. pachyderma". NULL indicates that a pooled model is desired.
seasonal_seatemp	Optional boolean indicating whether to use the seasonal sea-surface temperature calibrations. Default is FALSE, i.e. using annual SST calibrations.
drawsfun	Optional function used to get get model parameter draws. Must take arguments for "foram" and "seasonal_seatemp" and return a list with members "alpha", "beta", "tau". This is for debugging and testing.

Details

Four calibration models are available: an "annual pooled" model, a "seasonal pooled" model, an "annual hierarchical" model, and a "seasonal hierarchical" model. This function uses magic to determine which "pooled annual" model is used. Which is the simplest case with potential use for Deep Time reconstructions of nonexant foram species. Giving a valid string for foram will use a hierarchical model, which has foram-specific variability in calibration model parameters. Passing TRUE for seasonal_seatemp will use a model trained on season sea-surface temperatures. See reference paper for further details.

Value

A prediction instance for inferred sea-surface temperature (°C).

See Also

[predict_d18oc](#)

Examples

```

data(bassriver)

# Using the "pooled annual" calibration model:
sst <- predict_seatemp(bassriver$d18o, d18osw=0.0,
                      prior_mean=30.0, prior_std=20.0)
head(quantile(sst)) # Show only the top few values

predictplot(x=bassriver$depth, y=sst, ylim=c(20, 40),
            ylab="SST (°C)", xlab="Depth (m)")

```

quantile.prediction *Quantiles for a prediction.*

Description

Quantiles for a prediction.

Usage

```

## S3 method for class 'prediction'
quantile(x, ...)

```

Arguments

x A prediction object.
... Arguments to be passed on to quantile.

target_timeseries_pred
Internal function for 'predict_seatemp()'.

Description

Internal function for 'predict_seatemp()'.

Usage

```

target_timeseries_pred(d18osw_now, alpha_now, beta_now, tau_now, proxy_ts,
                      prior_mu, prior_inv_cov)

```

Arguments

<code>d18osw_now</code>	Numeric or vector giving seawater d18O. Note, should be in units (‰ VPDB).
<code>alpha_now</code>	Numeric, alpha model parameter.
<code>beta_now</code>	Numeric, beta model parameter.
<code>tau_now</code>	Numeric, tau model parameter.
<code>proxy_ts</code>	Numeric or vector of proxy time series (foram d18O).
<code>prior_mu</code>	Matrix (n X 1) giving prior mean.
<code>prior_inv_cov</code>	Matrix (n X x) giving prior inverse covariance matrix.

Value

Sample of time time series vector conditional on the other args

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