Package 'BIKER'

February 14, 2022

Title Bayesian Inference of the K600 Evasion Rate

Version 1.0.0

Description Uses Bayesian inference + SWOT river measurements to estimate the normalized gas exchange velocity from rivers, no in situ info needed beyond a prior estimate on streamflow. Algorithm inputs are river width, water surface slope, the change in water surface area, and a prior estiate of average streamflow conditions. The algorithm returns the posterior mean (and 95% CIs) for the normalized river gas exchange velocity for the river reach over time. Note that prior hyperparameters are determined using just the SWOT observations, so all we need to provide BIKER are the SWOT observations and a mean flow estimate.

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Encoding UTF-8

LazyData true

Biarch true

Depends R (>= 3.4.0)

Imports methods, Rcpp (>= 0.12.0), rstan (>= 2.18.1), rstantools (>= 2.0.0), dplyr, reshape2, rlang, settings

LinkingTo BH (>= 1.66.0), Rcpp (>= 0.12.0), RcppEigen (>= 0.3.3.3.0), rstan (>= 2.18.1), StanHeaders (>= 2.18.0)

SystemRequirements GNU make

RoxygenNote 7.1.2

URL https://github.com/craigbrinkerhoff/BIKER

BugReports https://github.com/craigbrinkerhoff/BIKER/issues

NeedsCompilation yes

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Archs i386, x64

R topics documented:

BIKER-package   *The 'BIKER' package.*

Description

Uses Bayesian Inference + SWOT observations to estimate normalized gas transfer velocity from large rivers

References

Stan Development Team (2020). RStan: the R interface to Stan. R package version 2.19.3. https://mc-stan.org

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biker_check_args   *Performs the following checks: - types: - everything else matrix - dimensions: - all matrices have same dimensions*

Description

Performs the following checks: - types: - everything else matrix - dimensions: - all matrices have same dimensions

Usage

```
biker_check_args(datalist)
```

Arguments

datalist   A list of biker data inputs

---

biker_check_nas	*Add missing-data inputs to data list*

Description

Binary matrices indicating where data are/aren't missing are added to the data list. This is required in order to run ragged-array data structures in the stanfile.

Usage

```
biker_check_nas(datalist)
```

Arguments

datalist   a list of BIKER inputs

---

biker_data	*Preprocess data for BIKER estimation*

Description

Produces a bikerdata object that can be passed to biker_estimate function

Usage

```
biker_data(w, s, dA, priorQ, max_xs = 30L, seed = NULL)
```

Arguments

w	Matrix of widths: time as columns, space as rows
s	Matrix of slopes: time as columns, space as rows
dA	Matrix of area above base area: time as columns, space as rows
priorQ	Mean annual flow prior for Q as a matrix
max_xs	Maximum number of cross-sections to allow in data. Used to reduce sampling time. Defaults to 30.
seed	RNG seed to use for sampling cross-sections, if nx > max_xs.

---

biker_estimate   *Estimate BIKER*

Usage

```
biker_estimate(
  bikerdata,
  bikerpriors,
  cores = getOption("mc.cores", default = parallel::detectCores()),
  meas_error = FALSE,
  chains = 3L,
  iter = 1000L,
  CI = 0.95,
  chainExtract = "all",
  pars = NULL,
  include = FALSE,
  ...
)
```

Arguments

bikerdata	A bikerdata object, as produced by `biker_data()`
bikerpriors	A bikerpriors object.
cores	Number of processing cores for running chains in parallel. See `?rstan::sampling`. Defaults to `parallel::detectCores()`.
meas_error	Should we run with latent variables accounting for uncertainty in SWOT measurements. LEAVE THIS OFF, IT IS IN ACTIVE DEVELOPMENT
chains	A positive integer specifying the number of Markov chains. The default is 3.
iter	Number of iterations per chain (including warmup). Defaults to 1000.
pars	(passed to `rstan::sampling()`) A vector of character strings specifying parameters of interest to be returned in the stanfit object. If not specified, a default parameter set is returned.
include	(passed to `rstan::sampling()`) Defaults to FALSE, which excludes parameters specified in `pars` from the returned model.
...	Other arguments passed to rstan::sampling() for customizing the Monte Carlo sampler
CI:	Confidence intervals, defaults to 95
	\itemchainExtract:Which chains to use to construct the posterior k600. Defaults to all.
	Fits a BIKER model of one of several variants using Hamiltonian Monte Carlo.

---

biker_priors *Establish prior hyperparameters for BIKER estimation*

Description

Produces a bikerpriors object that can be passed to biker_estimate function

Usage

```
biker_priors(bikerdata, ...)
```

Arguments

bikerdata   An object of class bikerdata, as returned by `biker_data`

...   Optional manually set parameters. Unquoted expressions are allowed, e.g. `logk_sd = cv2sigma(0.8`
             Additionally, any variables present in `bikerdata` may be referenced, e.g. `lowerbound_logk = log(m`

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classify_func *Geomorphic river classification*

Description

Classify river for expert framework

Usage

```
classify_func(Wobs)
```

Arguments

Wobs   observed widths matrix

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compose_biker_inputs *Prepare biker object for stan model*

Description

"Decomposes" the structure of the bikerdata pbject into a form more easily read by the stan sampling functions (i.e. a big ole list)

Usage

```
compose_biker_inputs(bikerdata, priors = biker_priors(bikerdata))
```

Arguments

bikerdata   bikerdata object
priors   bikerpriors object

cv2sigma	*CV to sigma*

Description

Convert coefficient of variation to sigma parameter of lognormal distribution

Usage

```
cv2sigma(cv)
```

Arguments

cv   Coefficient of variation

estimate_A0SD	*logA0_sd prior estimation*

Description

Estimate median cross-sectional area SD prior hyperparameter using swot data

Usage

```
estimate_A0SD(Wobs)
```

Arguments

Wobs   Observed W,as a space-down, time-across matrix.

estimate_logA0	*logA0_hat prior estimation*

Description

Estimate median cross-sectional area prior hyperparameter using swot data

Usage

```
estimate_logA0(Wobs)
```

Arguments

Wobs   Observed W,as a space-down, time-across matrix

---

estimate_logk   *logk_hat prior estimation*

Description

Estimate k_hat prior hyperparameter using swot data

Usage

```
estimate_logk(Sobs, priorQ)
```

Arguments

Sobs	Observed S,as a space-down, time-across matrix
priorQ	mean annual flow estimate, single number

---

estimate_logksd   *logk_sd prior estimation*

Description

Estimate k sd prior hyperparameter using swot data

Usage

```
estimate_logksd(Sobs)
```

Arguments

Sobs	Observed S,as a space-down, time-across matrix

---

estimate_logn   *logn_hat prior estimation*

Description

Estimate manning's n prior hyperparameter using swot data

Usage

```
estimate_logn(Wobs, Sobs)
```

Arguments

Wobs	Observed W,as a space-down, time-across matrix
Sobs	Observed s, as a space-down, time-across matrix

---

estimate_lognSD   *logn_sd prior estimation*

Description

Estimate manning's n SD prior hyperparameter using swot data

Usage

```
estimate_lognSD(Wobs)
```

Arguments

Wobs   Observed W,as a space-down, time-across matrix.

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estimate_lowerboundA0   *lowerbound_A0 prior estimation*

Description

Estimate median cross-sectional area lowerbound prior hyperparameter using swot data

Usage

```
estimate_lowerboundA0(Wobs)
```

Arguments

Wobs   Observed W,as a space-down, time-across matrix.

---

estimate_upperboundA0   *Upperbound_A0 prior estimation*

Description

Estimate median cross-sectional area upperbound prior hyperparameter using swot data

Usage

```
estimate_upperboundA0(Wobs)
```

Arguments

Wobs   Observed W,as a space-down, time-across matrix.

---

prior_settings	*Options manager for BIKER default prior settings for k600 model*

Description

Options manager for BIKER default prior settings for k600 model

Usage

```
prior_settings(..., .__defaults = FALSE, .__reset = FALSE)
```

Arguments

`...`	(Optional) named settings to query or set.
`.__defaults`	See `?settings::option_manager`
`.__reset`	See `?settings::option_manager`

---

sample_xs	*Take a random sample of a bikerdata object's cross-sections.*

Description

Take a random sample of a bikerdata object's cross-sections.

Usage

```
sample_xs(bikerdata, n, seed = NULL)
```

Arguments

`bikerdata`	a bikerdata object, as returned by `biker_data()`
`n`	Number of cross-sections to
`seed`	option RNG seed, for reproducibility.

Index