Package 'loadflux'

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Type Package

Title Explore Intra-Event Suspended Sediment Dynamics

Version 0.0.2

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Description A collection of functions created to study water discharge (Q) and suspended sediment concentration (SSC) relationship.

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URL https://github.com/atsyplenkov/loadflux, https://atsyplenkov.github.io/loadflux/

BugReports https://github.com/atsyplenkov/loadflux/issues

Depends R (>= 3.5)

Imports dplyr (>= 1.0.0), dygraphs, ggplot2 (>= 3.0.0), lubridate, rlang (>= 0.2.0), tidyr, tsibble (>= 0.9.0), xts, zoo

Suggests brolgar, covr, fabletools, feasts, knitr, lifecycle, purrr, rmarkdown, stats, testthat (>= 3.0.0), utils

VignetteBuilder knitr

Config/testthat/edition 3

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NeedsCompilation no

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R topics documented:

`AHI` *Calculate Aich's Hysteresis Index*

Description

This function calculates Hysteresis Index proposed by *Aich et al.* (2014)

Usage

```
AHI(dataframe, q, ssc, .warn = TRUE)
```

Arguments

`dataframe`	A data set object.
`q`	numeric, water discharge variable.
`ssc`	numeric, suspended sediment concentration variable.
`.warn`	logical, indicating if the warning message should be displayed.

Value

a numeric value either NA

References

Aich V, Zimmermann A, Elsenbeer H. 2014. Quantification and interpretation of suspended-sediment discharge hysteresis patterns: How much data do we need? CATENA 122: 120–129 DOI: 10.1016/j.catena.2014.06.020

Examples

```
library(dplyr)
data(djan)
output_table <- hydro_events(dataframe = djan,
                             q = discharge,
                             datetime = time,
                             window = 21)

output_table %>%
  filter(he == 2) %>%
  AHI(q = discharge, ssc = SS)
```

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djan *Djankuat river water discharge and suspended sediment concentration measurements*

Description

Direct hydrological measurements at Djankuat river (Northen Caucasus) in 2017th ablation season. See *Tsyplenkov et al.* (2020) and *Rets et al.* (2019) for details.

Usage

```
data(djan)
```

Format

An object of class ‘"tibble"‘

References

Tsyplenkov A, Vanmaercke M, Golosov V, Chalov S. 2020. Suspended sediment budget and intra-event sediment dynamics of a small glaciated mountainous catchment in the Northern Caucasus. Journal of Soils and Sediments 20 (8): 3266–3281 DOI: 10.1007/s11368-020-02633-z

Rets EP, Popovnin VV, Toropov PA, Smirnov AM, Tokarev IV, Chizhova JN, Budantseva NA, Vasil'chuk YK, Kireeva MB, Ekaykin AA, et al. 2019. Djankuat glacier station in the North Caucasus, Russia: a database of glaciological, hydrological, and meteorological observations and stable isotope sampling results during 2007–2017. Earth System Science Data 11 (3): 1463–1481 DOI: 10.5194/essd-11-1463-2019

Examples

```
data(djan)
head(djan)
```

djanturb *Djankuat river turbidity logger measurements*

Description

Turbidity measurements at Djankuat river (Northen Caucasus) in June 2016. Data recorded by *Analite NEP-495*

Usage

```
data(djanturb)
```

Format

An object of class ‘"tibble"‘

References

Chalov SR, Tsyplenkov AS. 2020. Influence of macroturbulence on the dynamics of river water turbidity. Vestnik Moskovskogo universiteta. Seriya 5, Geografiya 0 (3): 34–46 (In Russ.)

Examples

```
data(djanturb)
head(djanturb)
```

event_plot *Visualize hydrological events interactively*

Description

This function creates an interactive plot using dygraphs package

Usage

```
event_plot(
  dataframe,
  q,
  datetime,
  he,
  ssc,
  ylabel = "Water discharge",
  y2label = "Suspended Sediment Concentration"
)
```

Arguments

dataframe	A data set object
q	Water discharge variable (or water stage)
datetime	Datetime variable (column in POSIXct format)
he	Hydrological event variable (or other day column)
ssc	Suspended sediment concentration variable (to plot on a second axis)
ylabel	Y-axis label
y2label	Second Y-axis label

Value

The ‘event_plot‘ function returns object of class "dygraphs", "htmlwidget"

Examples

```
library(dplyr)
data(djan)
djan %>%
  hydro_events(
    q = discharge,
    datetime = time,
    window = 21
  ) %>%
  event_plot(q = SS, datetime = time, he = he)
```

---

hydro_events *Splitting to hydrological events*

Description

This function demarcates hydrological events. Start and endpoint of each event are identified by Local Minimum method (*Sloto and Crouse, 1996*) within the specified time window.

Usage

```
hydro_events(dataframe, q, datetime, window = 1)
```

Arguments

dataframe	A data set object
q	Water discharge variable (or water stage)
datetime	Datetime variable (column in POSIXct format)
window	Indicate time period to search for a local minimum (in hours)

Value

A data frame with class `tbl_df` with a hydrological events column `he` added

References

Sloto, R.A., Crouse, M.Y., 1996. Hysep: a computer program for streamflow hydrograph separation and analysis, *U.S. Geological Survey Water-Resources Investigations Report* 96-4040.

Examples

```
data(djan)
output_table <- hydro_events(dataframe = djan, q = discharge, datetime = time, window = 21)
```

---

hysteresis_plot *Plot Q-SSC hysteresis plot*

Description

This function plots a water discharge (`Q`) and suspended sediment concentration (`SSC`) relationship.

Usage

```
hysteresis_plot(
  dataframe,
  datetime,
  q,
  ssc,
  base_font_size = 12,
  legend = "bottom",
  ...
)
```

Arguments

`dataframe`	A data set object
`datetime`	Datetime variable (column in POSIXct format), optional
`q`	Water discharge variable (or water stage)
`ssc`	Suspended sediment concentration variable
`base_font_size`	Font size (numeric, 12 by default)
`legend`	the position of legends ("none", "left", "right", "bottom", "top", or two-element numeric vector)
`...`	Other arguments passed to `ggpubr::theme_pubclean`

Value

A `ggplot2` object

Examples

```
library(dplyr)
library(ggplot2)
data(djan)
output_table <- hydro_events(
  dataframe = djan,
  q = discharge,
  datetime = time,
  window = 21
)

output_table %>%
  filter(he == 2) %>%
  hysteresis_plot(q = discharge, ssc = SS)
```

---

loadflux-features *Calculate features of a 'tsibble' object in conjunction with [features()]*

Description

You can calculate a series of summary statistics (features) of a given variable for a dataset. For example, a three number summary, the minimum, median, and maximum, can be calculated for a given variable. This is designed to work with the [features()] function shown in the examples. Other available features in 'loadflux' include:

Usage

```
feat_event(x)
```

Arguments

x	A vector to extract features from.

Examples

```
# You can use any of the features `feat_*` in conjunction with `features`
# like so:
library(dplyr)
library(fabletools)
library(tsibble)

djants <- djan %>%
  hydro_events(
    q = discharge,
    datetime = time,
    window = 21
  ) %>%
  as_tsibble(
```

```
    key = he,
    index = time
  )

djants %>%
  features(
    time, # variable you want to explore
    feat_event
  ) # the feature summarisation you want to perform
```

SHI *Calculate Simple Hysteresis Index (SHI)*

Description

This function calculates Simple Hysteresis Index (SHI) following the description from *Tsyplenkov et al.* (2020)

Usage

```
SHI(dataframe, q, ssc, .warn = TRUE)
```

Arguments

dataframe	A data set object.
q	numeric, water discharge variable.
ssc	numeric, suspended sediment concentration variable.
.warn	logical, indicating if the warning message should be displayed.

Value

A numeric variable

Author(s)

Matthias Vanmaercke and Anatoly Tsyplenkov

References

Tsyplenkov A, Vanmaercke M, Golosov V, Chalov S. 2020. Suspended sediment budget and intra-event sediment dynamics of a small glaciated mountainous catchment in the Northern Caucasus. Journal of Soils and Sediments 20 (8): 3266–3281 DOI: 10.1007/s11368-020-02633-z

Examples

```
library(dplyr)
data(djan)
output_table <- hydro_events(dataframe = djan,
                             q = discharge,
                             datetime = time,
                             window = 21)

output_table %>%
  filter(he == 2) %>%
  SHI(q = discharge, ssc = SS)
```

`TI` *Calculate Turbidity Index (TI)*

Description

This function calculates Turbidity Index (TI) following the description from *Chalov & Tsyplenkov* (2020)

Usage

```
TI(dataframe, ssc, datetime, round_time = "hour")
```

Arguments

`dataframe`	A data set object
`ssc`	Turbidity variable
`datetime`	a vector of date-time objects
`round_time`	unit a character string specifying a time unit or a multiple of a unit to be rounded to. Valid base units are ‘second‘, ‘minute‘, ‘hour‘, ‘day‘, ‘week‘, ‘month‘, ‘bimonth‘, ‘quarter‘, ‘season‘, ‘halfyear‘ and ‘year‘. See `lubridate::round_date`

Value

A numeric variable

Author(s)

Anatoly Tsyplenkov and Sergey Chalov

References

Chalov SR, Tsyplenkov AS. 2020. Influence of macroturbulence on the dynamics of river water turbidity. Vestnik Moskovskogo universiteta. Seriya 5, Geografiya 0 (3): 34–46 (In Russ.)

Examples

```
library(dplyr)
data(djanturb)
output_table <- hydro_events(
  dataframe = djanturb,
  q = discharge,
  datetime = time,
  window = 21
)

output_table %>%
  filter(he == 2) %>%
  TI(
    ssc = discharge,
    datetime = time
  )
```

Index