Package ‘adc’

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Type Package

Title Calculate Antecedent Discharge Conditions

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License GPL (>= 3)


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`bf.sep_lh` Baseflow Separation

Description

Implements the Lyne and Hollick filter for baseflow separation. This function utilizes the approach in Ladson et al. (2013).

Usage

`bf.sep_lh(discharge, a = 0.98, n = 3, reflect = 30)`

Arguments

- `discharge` numeric vector of daily discharge values
- `a` alpha, numeric values between [0-1].
- `n` number of passes for the filter. Must be a numeric value, defaults to 3.
- `reflect` the number of values to reflect at the start and end of `discharge` to reduce "warm-up" and "cool-down" issues with the recursive filter. Must be less than or equal to the length of `discharge`. For long discharge records this value does not matter much, for short records the reflection should approach the length of `discharge`. The default is 30 as implemented in Ladson et al. (2013).

Details

This function implements the Lyne-Hollick filter (Lyne and Hollick, 1979) using the approach detailed in Ladson et al. (2013). The filter is:

\[ Y_k = \alpha \times Y_{k-1} + \frac{1+\alpha}{2} \times (Q_k - Q_{k-1}), \]

where \( Y_k \) is the filtered quick response at the \( k^{th} \) sample, \( Q_k \) if the original streamflow and \( \alpha \) is the filter parameter between [0-1].

Ladson et al. (2013) suggest a standardized approach for applying the filter by: (1) reflecting streamflow at the start and end of the series to address warm-up and cool-down; (2) specify the initial value of each pass as the measured flow; and (3) using three passes for the filter (forward, backward, forward); Ladson et al. (2013) also provide additional suggestions for handling missing values and appropriate alpha parameter values that are not covered here.
Value

vector of numeric values representing estimated baseflow.

Note

This function an updated and modified version of the baseflows() function in the hydrostats package by Nick Bond. The hydrostats version returns additional summary measures and utilizes different starting values. Outputs between the two packages will slightly vary.

Author(s)

Nick Bond n.bond@latrobe.edu.au modified by Michael Schramm

References


Examples

```r
bf <- bf_sep_lh(lavaca$Flow, a = 0.975)
head(bf)
```

---

### clean_flows

**Clean Flow Record**

**Description**

Function to replace zeros in the flow record with specified value and replace negative discharge values with NA.

**Usage**

```r
clean_flows(discharge, replace_0 = 0.001, replace_neg = NA)
```

**Arguments**

- `discharge`: numeric vector of discharges.
- `replace_0`: numeric value or NA to replace zeros with. Defaults to 0.001.
- `replace_neg`: numeric value or NA to replace negative values with. Defaults to NA.
Value

numeric vector same length as values provided in discharge.

---

fa

Calculate Flow Anomalies

Description

Flow anomalies are a dimensionless term that reflects the difference in in current discharges compared to past discharges. A positive flow anomaly indicates the current time period, $T_1$, is wetter than the precedent time period, $T_2$.

Usage

fa(discharge, dates, T_1, T_2, clean_up = FALSE, transform = "log10")

Arguments

discharge numeric vector of daily discharges
dates vector of dates corresponding to daily discharge measurements. Must be class "Date".
T_1 size of period $T_1$ preceding a given day $t$. Specified in the same way as the by argument in seq.POSIXt.
T_2 size of period $T_2$ preceding a given day $t$. Specified in the same way as the by argument in seq.POSIXt. Period $T_2$ is expected to be longer than $T_1$.
clean_up logical. runs ... prior to ...
transform on of NA, log, log10.

Details

The FA term describes how different the antecedent discharge conditions are for a selected temporal period compared to a selected period or day of analysis. Ryberg and Vecchia (2014) and Vechia et al. (2009) describe the flow anomaly (FA) term as:

$$ FA(t) = X_{T_1}(t) - X_{T_2}(t) $$

The $T_1$ and $T_2$ arguments can be specified as character strings containing one of "sec", "min", "hour", "day", "DSTday", "week", "month", "quarter", or "year". This is generally preceded by an integer and a space. Can also be followed by an "s". Additionally, $T_2$ accepts "period" which corresponds with the mean of the entire flow record.

Value

vector of numeric values corresponding to $X_{T_1}(t) - X_{T_2}(t)$.
lavaca

References


Examples

## examples from Ryberg & Veitia 2012
## Long-term Flow Anomaly LTFA

LTFA <- fa(lavaca$Flow,
    dates = lavaca$Date,
    T_1 = "1 year",
    T_2 = "period",
    clean_up = TRUE,
    transform = "log10")

## Mid-term Flow Anomaly MTFA

MTFA <- fa(lavaca$Flow,
    dates = lavaca$Date,
    T_1 = "1 month",
    T_2 = "1 year",
    clean_up = TRUE,
    transform = "log10")

## Short-term Flow Anomaly STFA

STFA <- fa(lavaca$Flow,
    dates = lavaca$Date,
    T_1 = "1 day",
    T_2 = "1 month",
    clean_up = TRUE,
    transform = "log10")

lavaca Daily streamflows from USGS gage at Lavaca River

Description

A dataset containing dates and mean daily streamflows from USGS gage 08164000, Lavaca River in Texas.
rate_of_change

Usage
lavaca

Format
A data frame with 9132 rows and 5 variables:

  agency_cd agency code, character
  site_no site number, character
  Date date, Date format
  Flow mean daily stream flow, numeric
  Flow_cd tag indicate data quality, character ...

Source
https://waterdata.usgs.gov/nwis/dv/?site_no=08164000&agency_cd=USGS

rate_of_change Approximate the Instantaneous Rate of Change

Description
Estimate the rate of change or first derivative of the raw mean daily streamflow or the smoothed cubic spline fit between time and mean daily streamflow.

Usage
rate_of_change(discharge, dates, smooth = TRUE)

Arguments
discharge numeric vector of mean daily discharges
dates vector of dates corresponding to daily discharge measurements. Must be class "Date".
smooth logical indicating if the first derivative is calculated using a cubic smoothing spline function. Defaults is TRUE.

Value
Numeric vector with the estimated streamflow rate of change.
## Examples

```r
# calculate the first deriv of the smoothed function between Date and streamflow
rate <- rate_of_change(lavaca$Flow, lavaca$Date)
head(rate)

# Return the first deriv on raw measurements
rate2 <- rate_of_change(lavaca$Flow, lavaca$Date, smooth = FALSE)
head(rate2)
```

### sdf

**Smooth Discounted Flow**

#### Description

Applies exponential smoothing to discharge data.

#### Usage

```r
sdf(discharge, delta = 0.95)
```

#### Arguments

- `discharge`: vector of discharge data (numeric).
- `delta`: the discount factor which can be any value between (0,1), defaults to 0.95. As `delta` approaches one, the average discounted flow approaches mean flow. Small values of `delta` return values closer to the current daily flow.

#### Details

The smooth discounted flow (SDF) was proposed by Kuhnert et al. (2012). The premise of SDF is to incorporate the influence of historical flows on flux:

\[
SDF(\delta) = d\kappa_{i-1} + (1 - \delta)\hat{q}_{i-1},
\]

and

\[
\kappa_i = \sum_{m=1}^{i} \hat{q}_m,
\]

for discount factor \(\delta\), where \(\kappa_i\) represents cumulative flow up to the \(i\)th day.

#### Value

vector of values the same length as `discharge`. 
References


Examples

# Standard use case
ma <- sdf(lavaca$Flow, delta=0.95)
head(ma)
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