

Package ‘FlowRegEnvCost’

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Type Package

Title The Environmental Costs of Flow Regulation

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Description An application to calculate the daily environmental costs of river flow regulation by dams based on García de Jalon et al. 2017 <doi:10.1007/s11269-017-1663-0>.

Depends R (>= 2.10)

URL <https://github.com/garciadejalon/FlowRegEnvCost>

BugReports <https://github.com/garciadejalon/FlowRegEnvCost/issues>

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adm_range	<i>Calculates the admissible range of flow variability</i>
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Description

Calculates the admissible range of flow variability

Usage

adm_range(First_year, Last_year, Year_impact)

Arguments

- | | |
|-------------|---|
| First_year | First year to consider in the analysis starting on October 1st (e.g.: First_year = 1964) |
| Last_year | First year to consider in the analysis finishing on September 30th (e.g.: Last_year = 2011) |
| Year_impact | Year when the human impact started (the construction of a dam) (e.g.: Year_impact = 1988) |

Value

Calculates the admissible range of flow variability based on the flow data during the pre-impact period.

Examples

```
data(flowdata)
adm_range(First_year=1964, Last_year=2011, Year_impact=1988)
```

adm_range_plot	<i>Plots the admissible range of flow variability</i>
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Description

Plots the admissible range of flow variability

Usage

```
adm_range_plot(River_name, First_year, Last_year, Year_impact)
```

Arguments

River_name	Name of the river as character (e.g.: River_name = "Esla")
First_year	First year to consider in the analysis starting on October 1st (e.g.: First_year = 1964)
Last_year	First year to consider in the analysis finishing on September 30th (e.g.: Last_year = 2011)
Year_impact	Year when the human impact started (the construction of a dam) (e.g.: Year_impact = 1988)

Value

Plots the admissible range of flow variability based on the flow data during the pre-impact period.

Examples

```
data(flowdata)
adm_range_plot(River_name = "Esla", First_year=1964, Last_year=2011, Year_impact=1988)
```

col_per_year	<i>Sorts the flow data per years - Each year is a column</i>
--------------	--

Description

Sorts the flow data per years - Each year is a column

Usage

```
col_per_year(First_year, Last_year)
```

Arguments

First_year	First year to consider in the analysis starting on October 1st (e.g.: First_year = 1964)
Last_year	Last year to consider in the analysis finishing on September 30th (e.g.: Last_year = 2011)

Value

The transformed dataframe per year is ready for calculations

Examples

```
data(flowdata)
col_per_year(First_year=1964,Last_year=2011)
```

daily_cost

Calculates the daily environmental costs of flow regulation

Description

Calculates the daily environmental costs of flow regulation

Usage

```
daily_cost(First_year, Last_year, Year_evaluated, Year_impact, a_low, a_high,
           b_low, b_high)
```

Arguments

First_year	First year to consider in the analysis starting on October 1st (e.g.: First_year = 1964)
Last_year	First year to consider in the analysis finishing on September 30th (e.g.: Last_year = 2011)
Year_evaluated	Year when the environmental impact is evaluated (e.g.: Year_evaluated = 2010)
Year_impact	Year when the human impact started (the construction of a dam) (e.g.: Year_impact = 1988)
a_low	Coefficient a of Low-flow impact of function ku (e.g.: a_low = 0.05)
a_high	Coefficient a of High-flow impact of function ku (e.g.: a_high = 0.01)
b_low	Coefficient b of Low-flow impact of function ku (e.g.: b_low = 2)
b_high	Coefficient b of High-flow impact of function ku (e.g.: b_high = 2)

Value

Calculates the daily environmental costs of flow regulation for a specific year evaluated.

Examples

```
data(flowdata)
daily_cost(First_year=1964, Last_year=2011,Year_evaluated=2010,
           Year_impact=1988, a_low = 0.05, a_high = 0.01, b_low = 2, b_high = 2)
```

daily_cost_plot

Plots the daily environmental costs of flow regulation

Description

Plots the daily environmental costs of flow regulation

Usage

```
daily_cost_plot(River_name, First_year, Last_year, Year_evaluated, Year_impact,  
               a_low, a_high, b_low, b_high)
```

Arguments

River_name	Name of the river written as character (e.g.: River_name = "Esla")
First_year	First year to consider in the analysis starting on October 1st (e.g.: First_year = 1964)
Last_year	First year to consider in the analysis finishing on September 30th (e.g.: Last_year = 2011)
Year_evaluated	Year when the environmental impact is evaluated (e.g.: Year_evaluated = 2010)
Year_impact	Year when the human impact started (the construction of a dam) (e.g.: Year_impact = 1988)
a_low	Coefficient a of Low-flow impact of function ku (e.g.: a_low = 0.05)
a_high	Coefficient a of High-flow impact of function ku (e.g.: a_high = 0.01)
b_low	Coefficient b of Low-flow impact of function ku (e.g.: b_low = 2)
b_high	Coefficient b of High-flow impact of function ku (e.g.: b_high = 2)

Value

Plots the daily environmental costs of flow regulation for a specific year evaluated.

Examples

```
data(flowdata)  
daily_cost_plot(River_name = "Esla", First_year=1964, Last_year=2011,  
               Year_evaluated=2010, Year_impact=1988, a_low = 0.05, a_high = 0.01,  
               b_low = 2, b_high = 2)
```

flowdata	<i>River water flow data.</i>
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Description

A dataset containing daily river water flow data for the Esla river at the Riaño dam (Northern Spain) from 01/10/1964 to 30/09/2011.

Usage

```
flowdata
```

Format

An example data frame with 17166 rows and 2 variables:

Date Date

Flow Water flow, in m³/s

Source

<https://doi.org/10.1007/s11269-017-1663-0>

impact_reg	<i>Calculates the daily environmental impact of flow regulation (high- and low-flow impact)</i>
------------	---

Description

Calculates the daily environmental impact of flow regulation (high- and low-flow impact)

Usage

```
impact_reg(First_year, Last_year, Year_evaluated, Year_impact)
```

Arguments

First_year	First year to consider in the analysis starting on October 1st (e.g.: First_year = 1964)
Last_year	First year to consider in the analysis finishing on September 30th (e.g.: Last_year = 2011)
Year_evaluated	Year when the environmental impact is evaluated (e.g.: Year_evaluated = 2010)
Year_impact	Year when the human impact started (the construction of a dam) (e.g.: Year_impact = 1988)

Value

Calculates the daily environmental impact of flow regulation (high- and low-flow impact).

Examples

```
data(flowdata)
impact_reg(First_year=1964, Last_year=2011, Year_evaluated=2010, Year_impact=1988)
```

`impact_reg_multi_plot` *Plots the daily environmental impact of flow regulation for multiple years*

Description

Plots the daily environmental impact of flow regulation for multiple years

Usage

```
impact_reg_multi_plot(Row, Column, sp_years, River_name, First_year, Last_year,
  Year_impact)
```

Arguments

Row	Number of rows in the figure to compare multiple years in separated graphs (e.g.: Row = 2)
Column	Number of columns in the figure to compare multiple years in separated graphs (e.g.: Column = 5)
sp_years	A vector specifying the years to be plotted (e.g.: <code>sp_years = c(1965,1966,1967,1968,1969,2006,2007,2008)</code>)
River_name	Name of the river written as character (e.g.: <code>River_name = "Esla"</code>)
First_year	First year to consider in the analysis starting on October 1st (e.g.: <code>First_year = 1964</code>)
Last_year	First year to consider in the analysis finishing on September 30th (e.g.: <code>Last_year = 2011</code>)
Year_impact	Year when the human impact started (the construction of a dam) (e.g.: <code>Year_impact = 1988</code>)

Value

Plots the daily environmental impact of flow regulation for multiple years.

Examples

```
data(flowdata)
impact_reg_multi_plot(Row = 1, Column = 2,
  sp_years = c(1965,2010),
  River_name = "Esla", First_year=1964, Last_year=2011,
  Year_impact=1988)
```

impact_reg_plot	<i>Plots the daily environmental impact of flow regulation (high- and low-flow impact)</i>
-----------------	--

Description

Plots the daily environmental impact of flow regulation (high- and low-flow impact)

Usage

```
impact_reg_plot(River_name, First_year, Last_year, Year_evaluated, Year_impact)
```

Arguments

River_name	Name of the river written as character (e.g.: River_name = "Esla")
First_year	First year to consider in the analysis starting on October 1st (e.g.: First_year = 1964)
Last_year	First year to consider in the analysis finishing on September 30th (e.g.: Last_year = 2011)
Year_evaluated	Year when the environmental impact is evaluated (e.g.: Year_evaluated = 2010)
Year_impact	Year when the human impact started (the construction of a dam) (e.g.: Year_impact = 1988)

Value

Plots the daily environmental impact of flow regulation (high- and low-flow impact).

Examples

```
data(flowdata)
impact_reg_plot(River_name = "Esla", First_year=1964,
Last_year=2011, Year_evaluated=2010, Year_impact=1988)
```

structure_date	<i>Transforms and reorders the flow data</i>
----------------	--

Description

Transforms and reorders the flow data

Usage

```
structure_date(dafra = "flowdata", S_Day = 1, S_Month = 4, S_Year = 7)
```


Arguments

dafra	Data frame with river flow data (default value is empty)
S_Day	Position in Date string of the first digit of two-digits day (default value is 1)
S_Month	Position in Date string of the first digits of two-digits month (default value is 4)
S_Year	Position in Date string of the first digits of four-digits year (default value is 7)

Value

A transformed data frame on a daily basis ready for further calculations

Examples

```
data(flowdata)
structure_date(dafra='flowdata', S_Day=1, S_Month=4, S_Year=7)
```

summary_flow	<i>Provides a summary of flow data during the pre-impact period</i>
--------------	---

Description

Provides a summary of flow data during the pre-impact period

Usage

```
summary_flow(First_year, Last_year, Year_impact)
```

Arguments

First_year	First year to consider in the analysis starting on October 1st (e.g.: First_year = 1964)
Last_year	First year to consider in the analysis finishing on September 30th (e.g.: Last_year = 2011)
Year_impact	Year when the human impact started (the construction of a dam) (e.g.: Year_impact = 1988)

Value

Provides a dataframe on a daily basis of mean, min, p10, p25, median, p75, p90 and max values during the pre-impact period.

Examples

```
data(flowdata)
summary_flow(First_year=1964, Last_year=2011, Year_impact=1988)
```

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