Package 'gmwmx2'

April 11, 2025

Title Estimate Functional and Stochastic Parameters of Linear Models with Correlated Residuals and Missing Data

Version 0.0.2

Description Implements the Generalized Method of Wavelet Moments with Exogenous Inputs estimator (GMWMX) presented in Voirol, L., Xu, H., Zhang, Y., Insolia, L., Molinari, R. and Guerrier, S. (2024) <doi:10.48550/arXiv.2409.05160>.
The GMWMX estimator allows to estimate functional and stochastic parameters of linear models with correlated residuals in presence of missing data.
The 'gmwmx2' package provides functions to load and plot Global Navigation Satellite System (GNSS) data from the Nevada Geodetic Laboratory and functions to estimate linear model model with correlated residuals in presence of missing data.

License AGPL-3

Encoding UTF-8

RoxygenNote 7.3.1

Language en-US

Depends R (>= 4.0.0)

VignetteBuilder knitr

LinkingTo Rcpp, RcppArmadillo

Imports Rcpp, data.table, dplyr, magrittr, wv, Matrix, httr2, rlang

Suggests knitr, rmarkdown, knitcitations, raster, rnaturalearth, shape, tibble, tidygeocoder, sf, geodata

URL https://github.com/SMAC-Group/gmwmx2

BugReports https://github.com/SMAC-Group/gmwmx2/issues

LazyData true

NeedsCompilation yes

Author Lionel Voirol [aut, cre] (<https://orcid.org/0000-0003-1696-1407>), Haotian Xu [aut] (<https://orcid.org/0000-0001-8336-4536>), Yuming Zhang [aut] (<https://orcid.org/0000-0003-2293-9601>), Luca Insolia [aut] (<https://orcid.org/0000-0003-4169-5446>), Roberto Molinari [aut] (<https://orcid.org/0000-0001-8766-6902>), Stéphane Guerrier [aut] (<https://orcid.org/0000-0003-0002-8794>)

Maintainer Lionel Voirol <lionelvoirol@hotmail.com>

Repository CRAN

Date/Publication 2025-04-10 22:20:02 UTC

Contents

`df_estimated_velocities_gmwmx`
Estimated northward and eastward velocity and their standard deviation using the GMWMX estimator

---

Description

Estimated northward and eastward velocity and standard deviation for a subset of 1202 GNSS station with more than 10 years of daily data.

Usage

```
df_estimated_velocities_gmwmx
```

Format

A data frame with 1202 rows and 12 variables:

station_name Name of the GNSS station.

estimated_trend_N Estimated northward velocity trend (in meters per day).

std_estimated_trend_N Standard deviation of the estimated northward velocity trend.

estimated_trend_E Estimated eastward velocity trend (in meters per day).

std_estimated_trend_E Standard deviation of the estimated eastward velocity trend.

length_signal Length of the signal (in days).

estimated_trend_N_scaled Scaled estimated northward velocity trend (multiplying by 365.25 for yearly values).

std_estimated_trend_N_scaled Scaled standard deviation of the estimated northward velocity trend.

estimated_trend_E_scaled Scaled estimated eastward velocity trend (multiplying by 365.25 for yearly values).

std_estimated_trend_E_scaled Scaled standard deviation of the estimated eastward velocity trend.

latitude Latitude of the GNSS station.

longitude Longitude of the GNSS station.

`download_all_stations_ngl`

Download all stations name and location from the Nevada Geodetic Laboratory

---

Description

Download all stations name and location from the Nevada Geodetic Laboratory

Usage

```
download_all_stations_ngl(verbose = FALSE)
```

Arguments

`verbose`	A `boolean` that controls the level of detail in the output of the `wget` command used to load data. Default is `FALSE`.

Value

Return a `data.frame` with all stations name, latitude, longitude and heights.

Examples

```
df_all_stations <- download_all_stations_ngl()
head(df_all_stations)
```

`download_estimated_velocities_ngl`

Download estimated velocities provided by the Nevada Geodetic Laboratory for all stations.

Description

Download estimated velocities provided by the Nevada Geodetic Laboratory for all stations.

Usage

```
download_estimated_velocities_ngl(verbose = FALSE)
```

Arguments

verbose	A boolean that controls the level of detail in the output of the wget command used to load data. Default is FALSE.

Value

Return a data.frame with all stations name, information about the time series for each station, estimated velocities and estimated standard deviation of the estimated velocities.

Examples

```
df_estimated_velocities <- download_estimated_velocities_ngl()
head(df_estimated_velocities)
```

---

download_station_ngl *Download GNSS position time series and steps reference from the Nevada Geodetic Laboratory with IGS14 reference frame.*

Description

Download GNSS position time series and steps reference from the Nevada Geodetic Laboratory with IGS14 reference frame.

Usage

```
download_station_ngl(station_name, verbose = FALSE)
```

Arguments

station_name	A string specifying the station name.
verbose	A boolean that controls the level of detail in the output of the wget command used to load data. Default is FALSE.

Value

A list of class gnss_ts_ngl that contains three data.frame: The data.frame df_position which contains the position time series extracted from the .tenv3 file available from the Nevada Geodetic Laboratory, the data.frame df_equipment_software_changes which specify the equipment or software changes for that stations and the data.frame df_earthquakes that specify the earthquakes associated with that station.

Examples

```
station_1LSU <- download_station_ngl("1LSU")
attributes(station_1LSU)
```

gmwmx2 *Estimate a trajectory model for a* gnss_ts_ngl *object considering a white noise plus colored noise as the stochastic model for the residuals and model missingness with a Markov process using the GMWMX estimator.*

Description

Estimate a trajectory model for a gnss_ts_ngl object considering a white noise plus colored noise as the stochastic model for the residuals and model missingness with a Markov process using the GMWMX estimator.

Usage

```
gmwmx2(
  x,
  n_seasonal = 2,
  vec_earthquakes_relaxation_time = NULL,
  component = "N",
  toeplitz_approx_var_cov_wv = TRUE,
  stochastic_model = "wn + fl"
)
```

Arguments

x	A gnss_ts_ngl object.
n_seasonal	An integer specifying the number of seasonal signals in the time series. "1" specify only one annual periodic signal and "2"specify an annual and a semiannual periodic signal.
vec_earthquakes_relaxation_time	A vector specifying the relaxation time for each earthquakes indicated for the time series.
component	A string with value either "N", "E" or "V" that specify which component to estimate (Northing, Easting or Vertical).
toeplitz_approx_var_cov_wv	A boolean that specify if the variance of the wavelet variance should be computed based on a toeplitz approximation of the variance covariance matrix of the residuals.
stochastic_model	A string that specify the stochastic model considered for the residuals. Either "wn + fl" for white noise and flicker/pink noise or "wn + pl" for white noise and stationary power-law noise.

Examples

```
x <- download_station_ngl("CHML")
fit <- gmwmx2(x, n_seasonal = 2, component = "N")
```

plot.fit_gnss_ts_ngl *Plot a* fit_gnss_ts_ngl *object*

Description

Plot a fit_gnss_ts_ngl object

Usage

```
## S3 method for class 'fit_gnss_ts_ngl'
plot(x, ...)
```

Arguments

x	A fit_gnss_ts_ngl object.
...	Additional graphical parameters.

Value

No return value. Plot a fit_gnss_ts_ngl object.

Examples

```
x <- download_station_ngl("0AMB")
fit_N <- gmwmx2(x, n_seasonal = 2, component = "N")
plot(fit_N)
fit_E <- gmwmx2(x, n_seasonal = 2, component = "E")
plot(fit_E)
```

plot.gnss_ts_ngl *Plot a* gnss_ts_ngl *object*

Description

Plot a gnss_ts_ngl object

Usage

```
## S3 method for class 'gnss_ts_ngl'
plot(x, component = NULL, ...)
```

Arguments

x	A gnss_ts_ngl object.
component	A string with value either "N", "E" or "V" that specify which component to plot (Northing, Easting or Vertical).
...	Additional graphical parameters.

Value

No return value. Plot a gnss_ts_ngl object.

Examples

```
station_1LSU <- download_station_ngl("1LSU")
plot(station_1LSU)
plot(station_1LSU, component = "N")
plot(station_1LSU, component = "E")
plot(station_1LSU, component = "V")
```

---

summary.fit_gnss_ts_ngl

Extract estimated parameters from a fit_gnss_ts_ngl

Description

Extract estimated parameters from a fit_gnss_ts_ngl

Usage

```
## S3 method for class 'fit_gnss_ts_ngl'
summary(object, scale_parameters = FALSE, ...)
```

Arguments

object	A fit_gnss_ts_ngl object.
scale_parameters	A boolean indicating whether or not to scale estimated parameters so that the returned estimated trend is provided in m/year instead of m/day. Default is FALSE.
...	Additional parameters.

Examples

```
x <- download_station_ngl("P820")
fit1 <- gmwmx2(x, n_seasonal = 2, component = "N", stochastic_model = "wn + pl")
summary(fit1)
summary(fit1, scale_parameters = TRUE)
fit2 <- gmwmx2(x, n_seasonal = 2, component = "N", stochastic_model = "wn + fl")
summary(fit2)
```

Index