Package 'vineyard'

September 24, 2019

Type Package

Title Budburst, Phenological and Yield Models for Vineyards

Version 0.1.0

Author D. Molitor [aut]
J. Junk [aut]
M. Sulis [aut]
J. A. Torres-Matallana [cre, aut]
S. Bhattacharya [ctb]
U. Leopold [ctb]
Luxembourg Institute of Science and Technology (LIST) [cph]

Maintainer J. A. Torres-Matallana <arturo.torres@list.lu>

Description Late frosts are a significant risk to grape production in
frost-prone viticultural regions. Increasing air temperature because
of climate change is likely to advance grape budburst and last frost
events in spring. So far, it is unclear whether one trend will be more
pronounced than the other, and hence, whether the risk of late frost
damage will increase or decrease. The aim of this package is to provide
tools for investigating e.g. the future frost risk in winegrowing regions
by assessing the effect of simulated future climate conditions on the
timing of budburst and last frost date. Late frost risk can be assessed
by the implementation of phenological models for budburst of the grapevine.

License What license is it under?

Encoding UTF-8

LazyData true

RoxygenNote 6.1.1

R topics documented:

DD.double.threshold	*Compute the degree days by the lower and upper temperature thresholds*

Description

Implementation to compute the degree days by the lower and upper temperature thresholds by Molitor et al., (2014).

Usage

```
DD.double.threshold(t.mean, a, b)
```

Arguments

t.mean	daily mean air temperature vector in Celsius degrees.
a	numeric, lower threshold temperature (in Celsius degrees) for vine growth.
b	numeric, upper threshold temperature (in Celsius degrees) for vine growth.

Value

a vector with the degree days (in Celsius degrees) for vine growth.

References

Daniel Molitor, Jürgen Junk, Danièle Evers, Lucien Hoffmann, and Marco Beyer (2014). A high-resolution cumulative degree day-based model to simulate phenological development of grapevine. Am. J. Enol. Vitic., (65:1):72–80.

DD.LUH *Compute the degree days by a lower, upper and heat threshold temperatures*

Description

Implementation to compute the degree days by a lower, upper and heat threshold temperatures by Molitor et al., (2014).

Usage

```
DD.LUH(t.mean, a, b, c)
```

Arguments

t.mean	daily mean air temperature vector in Celsius degrees.
a	numeric, lower threshold temperature (in Celsius degrees) for vine growth.
b	numeric, upper threshold temperature (in Celsius degrees) for vine growth.
c	numeric, heat threshold temperature (in Celsius degrees) for vine growth.

Value

a vector with the degree days (in Celsius degrees) for vine growth.

References

Daniel Molitor, Jürgen Junk, Danièle Evers, Lucien Hoffmann, and Marco Beyer (2014). A high-resolution cumulative degree day-based model to simulate phenological development of grapevine. Am. J. Enol. Vitic., (65:1):72–80.

DD.LUH.cumulative *Compute cumulative degree days by the lower, upper and heat temperature thresholds*

Description

Implementation to compute cumulative degree days by the lower, upper and heat temperature threshold by Molitor et al., (2014).

Usage

```
DD.LUH.cumulative(dd, start.cdd, cdd)
```

Arguments

dd	vector with the degree days (in Celsius degrees) for vine growth in xts format as provided by "DD.LUH" function.
start.cdd	numeric, mean cumulative heat sum (in Celsius Degrees) for bud break.
cdd	vector with the cumulative degree days (in Celsius degrees) for bud break.

Value

the cumulative degree days (in Celsius degrees) for vine growth plus an additional column with the comulative degree days (in Celsius degrees) for bud break.

References

Nendel, Class (2010). Grapevine bud break prediction for cool winter climates. Int. J. Biometeorol., 54, 231–241.

Daniel Molitor, Jürgen Junk, Danièle Evers, Lucien Hoffmann, and Marco Beyer (2014). A high-resolution cumulative degree day-based model to simulate phenological development of grapevine. Am. J. Enol. Vitic., (65:1):72–80.

DD.single.threshold   *Compute degree days by the single temperature threshold*

Description

Implementation to compute degree days by the single temperature threshold by Molitor et al., (2014).

Usage

```
DD.single.threshold(t.mean, a)
```

Arguments

t.mean	daily mean air temperature vector in Celsius degrees.
a	numeric, threshold temperature (in Celsius degrees) for vine growth.

Value

a vector with the degree days.

References

Daniel Molitor, Jürgen Junk, Danièle Evers, Lucien Hoffmann, and Marco Beyer (2014). A high-resolution cumulative degree day-based model to simulate phenological development of grapevine. Am. J. Enol. Vitic., (65:1):72–80.

```
DD.single.threshold.cumulative
```
Compute the cumulative degree days by the single temperature threshold

---

Description

Implementation to compute the cumulative degree days by the single temperature threshold by Molitor et al., (2014).

Usage

```
DD.single.threshold.cumulative(data, t.mean.col, a)
```

Arguments

`data`	input data in xts format.
`t.mean.col`	numeric, column position in data for the daily mean air temperature vector in Celsius degrees.
`a`	numeric, threshold temperature (in Celsius degrees) for vine growth.

Value

list per year for the input data plus an additional column with the cumulative degree days (in Celsius degrees) for vine growth. The output for each year is a "xts" time series object.

References

Daniel Molitor, Jürgen Junk, Danièle Evers, Lucien Hoffmann, and Marco Beyer (2014). A high-resolution cumulative degree day-based model to simulate phenological development of grapevine. Am. J. Enol. Vitic., (65:1):72–80.

```
DD.single.treshold.phenology
```
Cumulative degree days (CDD) by the single threshold algorithm for phenology

---

Description

Implementation to compute the cumulative degree days by the single threshold algorithm by Molitor et al. (2010) for phenology.

Usage

```
DD.single.treshold.phenology(cdd.stt, chs.mean)
```

Arguments

cdd.stt	cumulative degree days (in Celsius degrees) for vine growth in xts format as provided by "DD.single.treshold.cumulative" function.
chs.mean	numeric, mean cumulative heat sum for bud break (in Celsius degrees).

Value

the cumulative degree days (in Celsius degrees) for vine growth plus an additional column with the comulative degree days (in Celsius degrees) for phenology.

References

Daniel Molitor, Jürgen Junk, Danièle Evers, Lucien Hoffmann, and Marco Beyer (2014). A high-resolution cumulative degree day-based model to simulate phenological development of grapevine. Am. J. Enol. Vitic., (65:1):72–80.

DD.single.triangle   *Degree days by the single triangle algorithm for bud break*

Description

Implementation to compute the degree days by the single triangle algorithm by Nendel (2010) for bud break.

Usage

```
DD.single.triangle(t.zero, t.min, t.mean, t.max)
```

Arguments

t.zero	numeric, threshold temperature (in Celsius degrees) for vine growth.
t.min	daily minimum air temperature vector in Celsius degrees.
t.max	daily maximum air temperature vector in Celsius degrees.

Value

a vector with the degree-days (in Celsius degrees) for vine growth.

References

Nendel, Class (2010). Grapevine bud break prediction for cool winter climates. Int. J. Biometeorol., 54, 231–241.

```
DD.single.triangle.budbreak
```
Cumulative degree days (CDD) by the single triangle algorithm for bud break

---

Description

Implementation to compute the cumulative degree days by the single triangle algorithm by Nendel (2010) for bud break.

Usage

```
DD.single.triangle.budbreak(cdd, start.date)
```

Arguments

cdd	cumulative degree days (in Celsius degrees) for vine growth in xts format as provided by "DD.single.triangle.cumulative" function.
start.date	numeric, calculated optimum starting date in day of year.

Value

the cumulative degree days (in Celsius degrees) for vine growth plus an additional column with the comulative degree days (in Celsius degrees) for bud break.

References

Nendel, Class (2010). Grapevine bud break prediction for cool winter climates. Int. J. Biometeorol., 54, 231–241.

```
DD.single.triangle.cumulative
```
Cumulative degree days (CDD) by the single triangle algorithm

---

Description

Implementation to compute the cumulative degree days by the single triangle algorithm by Nendel (2010).

Usage

```
DD.single.triangle.cumulative(data, t.zero, t.min.col, t.mean.col,
  t.max.col)
```

Arguments

`data`	input data in xts format.
`t.zero`	numeric, threshold temperature (in Celsius degrees) for vine growth.
`t.min.col`	numeric, column position in data for the daily minimum air temperature vector in Celsius degrees.
`t.mean.col`	numeric, column position in data for the daily mean air temperature vector in Celsius degrees.
`t.max.col`	numeric, column position in data for the daily maximum air temperature vector in Celsius degrees.
`start.date`	numeric, calculated optimum starting date in day of year.

Value

list per year for the input data plus an additional column with the cumulative degree days (in Celsius degrees) for vine growth. The output for each year is a "xts" time series object.

References

Nendel, Class (2010). Grapevine bud break prediction for cool winter climates. Int. J. Biometeorol., 54, 231–241.

`FillNA`	*Fill NA data in time series*

Description

Fill NA data in time series

Usage

```
FillNA(x)
```

Arguments

`x`	the input time series as xts object.

Value

a time series with the NAs replaced by data according to the na.locf zoo function.

GrowthStage_CDD *Cumulative degree days and growth stages*

Description

A sample dataset containing the cumulative degree days (CDD) with optimized lower, upper, and heat threshold triplets (5, 20, 22°C) per growth stages according to Table 4 from Molitor et al. (2014).

References

Daniel Molitor, Jürgen Junk, Danièle Evers, Lucien Hoffmann, and Marco Beyer. A high-resolution cumulative degree day-based model to simulate phenological development of grapevine. Am. J. Enol. Vitic., (65:1):72–80, 2014.

Id.na *Find indexes for NA data in time series*

Description

Find indexes for NA data in time series

Usage

```
Id.na(x)
```

Arguments

x   the input time series as xts object.

Value

a vector with the index for NA data in the time series.

Phenology.stages.row   *Compute phenological stages*

Description

Implementation to compute phenological stages by Molitor et al., (2014).

Usage

```
Phenology.stages.row(cdd.phen, ref.data, stage)
```

Arguments

cdd.phen	list, cumulative degree days (in Celsius degrees) for vine growth in xts format as provided by "DD.single.treshold.phenology" function.
ref.data	data.frame, reference dataset to define the phenological stages e.g. "Gowth-Stage_CDD" dataset.

Value

list per year, with each list containing a data.frame with the phenological stages for vine growth.

References

Daniel Molitor, Jürgen Junk, Danièle Evers, Lucien Hoffmann, and Marco Beyer (2014). A high-resolution cumulative degree day-based model to simulate phenological development of grapevine. Am. J. Enol. Vitic., (65:1):72–80.

---

plot.na   *Plot NA data in time series*

Description

Plot NA data in time series

Usage

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

Arguments

x	the input time series as xts object.
ids.na	the vector which coniains indexes for NA data as provided by the Id.na function.

Value

plots with the NAs highlighted.

Raw2xts   *Raw data to xts object*

Description

Raw data to xts object

Usage

```
Raw2xts(data)
```

Arguments

data   the dataframe to convert to xts time series.

Value

the xts object for the input dataframe.

Remich   *Sample time series of meteorological data for Remich station.*

Description

A sample dataset containing time series of meteorological data for Remich station located in the Grand-Duchy of Luxembourg obtained by the Institut Viti-vinicole in Remich. The data covers the period from 1970 to 2017 at daily time interval.

References

<https://agriculture.public.lu/de/weinbau-oenologie.html>

Index