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Author Kristina Veljkovic

Maintainer Kristina Veljkovic <mackikac@gmail.com>

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Description

Functions for selection of visual meteor data, calculations of Zenithal Hourly Rate (ZHR) and population index, graphics of population index, ZHR and magnitude distribution.

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MetFns-package

Analysis of Visual Meteor Data

Description

Functions for selection of visual meteor data, calculations of Zenithal Hourly Rate (ZHR) and population index, graphics of population index, ZHR and magnitude distribution.

Details

Package: MetFns
Type: Package
Version: 2.1.0
Date: 2016-06-01
License: GPL-2 | GPL-3

Author(s)

Kristina Veljkovic

Maintainer: Kristina Veljkovic <mackikac@gmail.com>

filter

Global filter

Description

Various data selections for a given visual meteor data. Wrapper function for filters by shower code, date, time period, IMO observer code, observer's name, geographical coordinates, site, country, limiting magnitude, correction factor for field-of-view obstruction, solar longitude, radiant elevation and total correction factor.

Usage

```
filter(data,year = NULL,month.beg = NULL,month.end=month.beg,day.beg = NULL,
day.end = day.beg,time.beg=0,time.end=2359,shw = NULL,imocode = NULL,
long.low = 0,long.up = 180,ew = c("E", "W"),lat.low = 0,lat.up = 90,
ns = c("N", "S"),name = NULL,fname = NULL,site = NULL,country = NULL,
mag.low = 3,mag.up = 8,F.low = 1,F.up = 3,sol.low = 0,sol.up = 360,
Ralpha = NULL,Delta = NULL,h.low = 10,h.up = 90,r = NULL,C = 5)
```

Arguments

<code>data</code>	data frame consisting of visual meteor data (rate or magnitude data).
<code>year</code>	numeric vector of length 4 specifying year.
<code>month.beg</code>	numeric vector specifying the beginning month.
<code>month.end</code>	numeric vector specifying the ending month. By default, <code>month.end</code> is set to be equal to <code>month.beg</code> .
<code>day.beg</code>	numeric vector specifying the beginning day.
<code>day.end</code>	numeric vector specifying the ending day. By default, <code>day.end</code> is set to be equal to <code>day.beg</code> .
<code>time.beg</code>	numeric vector (0-2359) specifying lower boundary of time in hours and minutes, corresponding to <code>day.beg</code> . By default, <code>time.beg</code> is set to be equal to 0.
<code>time.end</code>	numeric vector(0-2359) specifying upper boundary of time in hours and minutes, corresponding to <code>day.end</code> . By default, <code>time.end</code> is set to be equal to 2359.
<code>shw</code>	character string consisting of three capital letters which represent meteor shower code.
<code>imocode</code>	character string consisting of five capital letters which represent IMO observer code.
<code>long.low</code>	numeric vector taking a value between 0 (default) and 180, specifying lower boundary of longitude in degrees.
<code>long.up</code>	numeric vector taking a value between 0 and 180 (default), specifying upper boundary of longitude in degrees.
<code>ew</code>	character vector (E,W), specifying east or west position from the prime meridian.
<code>lat.low</code>	numeric vector taking a value between 0 (default) and 90, specifying lower boundary of latitude in degrees.
<code>lat.up</code>	numeric vector taking a value between 0 and 90 (default), specifying upper boundary of latitude in degrees.
<code>ns</code>	character vector (N,S), specifying north or south position from equator.
<code>name</code>	character string representing observer's last name.
<code>fname</code>	character string representing observer's first name.
<code>site</code>	character string specifying name of the observing site.
<code>country</code>	character string specifying name of the country.
<code>mag.low</code>	numeric vector with value between 3.0 (default) and 8.0, specifying lower boundary of limiting magnitude.
<code>mag.up</code>	numeric vector with value between 3.0 and 8.0 (default), specifying upper boundary of limiting magnitude.
<code>F.low</code>	numeric vector with value between 1.0 (default) and 3.0, specifying lower boundary of correction factor for field-of-view obstruction.
<code>F.up</code>	numeric vector with value between 1.0 and 3.0 (default), specifying upper boundary of correction factor for field-of-view obstruction.

sol.low	numeric vector with value between 0 (default) and 360, specifying lower boundary of solar longitude in degrees.
sol.up	numeric vector with value between 0 and 360 (default), specifying upper boundary of solar longitude in degrees.
Ralpha	numeric vector with value between 0 and 360, specifying right ascension of the radiant, in degrees.
Delta	numeric vector with value between -90 and +90, specifying declination of the radiant, in degrees.
h.low	numeric vector with value between 10 (default) and 90, specifying lower boundary of radiant elevation in degrees.
h.up	numeric vector with value between 10 and 90 (default), specifying upper boundary of radiant elevation in degrees.
r	numeric vector specifying population index of a meteor shower.
C	numeric vector specifying total correction factor. C=5 is set as a default value.

Details

Depending on the given arguments, the function `filter` calls one or more particular filters for selection of visual meteor data.

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

`filter.shw`, `filter.datetime`, `filter.imocode`, `filter.obsname`, `filter.site`, `filter.country`, `filter.gc`, `filter.mag`, `filter.F`, `filter.sol`, `filter.h`, `filter.totcor`

Examples

```
## select rate and magnitude data for observations of 1997 Perseids, time period 28th July
## to 16th August, radiant elevation higher than 20 degrees,
## total correction factor smaller than 5(default)
data(rate97)
filter(rate97,year=1997,month.beg=7,month.end=8,day.beg=28,day.end=16,shw="PER",h.low=20)

data(magn97)
filter(magn97,year=1997,month.beg=7,month.end=8,day.beg=28,day.end=16,shw="PER",h.low=20)
```

filter.country	<i>Selection of visual meteor data by country</i>
----------------	---

Description

Selects data for a given visual meteor dataset and specified country.

Usage

```
filter.country(data, country)
```

Arguments

data	data frame consisting of visual meteor data (rate or magnitude data).
country	character string specifying the name of the country.

Details

List of the countries can be found in the data frame [vmdbsite](#). Data selection is performed using [filter.site](#) which filters data by codes of all sites belonging to the specified country.

Value

filter.country returns data frame with the same number of columns as argument data, containing observations corresponding to the specified country.

Note

Argument data has to consist of the column named "sitecode".

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

[filter](#)

Examples

```
## select visual meteor data for the year 2009 from Serbia

## rate data for the year 2009
data(rate09)
filter.country(rate09, country="Serbia")

## magnitude data for the year 2009
data(magn09)
filter.country(magn09, country="Serbia")
```

filter.datetime	<i>Selection of visual meteor data by date(s)</i>
-----------------	---

Description

Selects data for a given visual meteor dataset and specified year, month (s), day (s) and time period.

Usage

```
filter.datetime(data, year, month.beg, month.end=month.beg, day.beg,
day.end = day.beg, time.beg=0, time.end=2359)
```

Arguments

data	data frame consisting of visual meteor data (rate or magnitude data).
year	numeric vector of length 4 specifying year.
month.beg	numeric vector specifying the beginning month.
month.end	numeric vector specifying the ending month. By default, month.end is set to be equal to month.beg.
day.beg	numeric vector specifying the beginning day.
day.end	numeric vector specifying the ending day. By default, day.end is set to be equal to day.beg.
time.beg	numeric vector (0-2359) specifying lower boundary of time in hours and minutes, corresponding to day.beg. By default, time.beg is set to be equal to 0.
time.end	numeric vector(0-2359) specifying upper boundary of time in hours and minutes, corresponding to day.end. By default, time.end is set to be equal to 2359.

Details

Day given in meteor datasets corresponds to the beginning of the observing time period. In selection of the data, day corresponding to the middle of the observing time period is used.

If argument day.end is not provided, the function filter.datetime selects data for a given date, otherwise it selects data for a period of days, bounded by day.beg and day.end, in one or more

months, bounded by month.beg and month.end. Arguments time.beg and time.end correspond to day.beg and day.end, respectively. If they are provided, the middle of the observing time period is used in data selection.

Data selection is performed using filter.sol which filters data by solar longitudes corresponding to specified dates.

Value

filter.datetime returns data frame with the same number of columns as the argument data, containing observations which correspond to the specified time period.

Note

Argument data has to consist of the columns named "year" and "sollong".

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

[filter](#), [filter.sol](#)

Examples

```
## select visual meteor data for the period from 5-15 August 2007

## rate data for the year 2007
data(rate07)
filter.datetime(rate07, year=2007, month.beg=8, day.beg=5, day.end=15)

## magnitude data for the year 2007
data(magn07)
filter.datetime(magn07, year=2007, month.beg=8, day.beg=5, day.end=15)

##select rate data for the period from 25 July 20h to 20 August, 3h
filter.datetime(rate07, year=2007, month.beg=7, month.end=8, day.beg=25, day.end=20,
time.beg=2000, time.end=300)
```

filter.F	<i>Selection of visual meteor data by correction factor for field-of-view obstruction</i>
----------	---

Description

Selects data for a given visual meteor rate dataset and specified correction factor or interval of correction factors for field-of-view obstruction.

Usage

```
filter.F(data,F.low = 1,F.up = 3)
```

Arguments

data	data frame consisting of visual meteor rate data.
F.low	numeric vector with value between 1 (default) and 3, specifying lower boundary of correction factor for field-of-view obstruction.
F.up	numeric vector with value between 1 and 3 (default), specifying upper boundary of correction factor for field-of-view obstruction.

Details

Correction factor F is calculated by the formula $F=1/(1-p)$, where p is a fraction ($0 < p < 1$) of field-of-view obstruction.

Value

filter.F returns data frame with the same number of columns as the argument data, containing observations with the correction factors for field-of-view obstruction between F.low and F.up.

Note

Argument data has to consist of the column named "F".

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

[filter](#), [filter.totcor](#)

Examples

```
## select visual meteor data for the period between 15-30th October 2005 and
## correction factor for field-of-view obstruction below 1.25 (p=20%)

## rate data for the year 2005
data(rate05)
rateOct<-filter.datetime(rate05,year=2005,month.beg=10,day.beg=15,day.end=30)
filter.F(rateOct,F.up=1.25)
```

 filter.gc

Selection of visual meteor data by geographical coordinates

Description

Selects data for a given visual meteor dataset and specified geographical coordinates of the observing site or interval of geographical coordinates.

Usage

```
filter.gc(data,long.low = 0,long.up = 180,ew = c("E", "W"),lat.low = 0,
lat.up = 90,ns = c("N", "S"))
```

Arguments

data	data frame consisting of visual meteor data (rate or magnitude data).
long.low	numeric vector taking a value between 0 (default) and 180, specifying lower boundary of longitude in degrees.
long.up	numeric vector taking a value between 0 and 180 (default), specifying upper boundary of longitude in degrees.
ew	character vector (E,W), specifying east or west position from the prime meridian.
lat.low	numeric vector taking a value between 0 (default) and 90, specifying lower boundary of latitude in degrees.
lat.up	numeric vector taking a value between 0 and 90 (default), specifying upper boundary of latitude in degrees.
ns	character vector (N,S), specifying north or south position from equator.

Details

If values of arguments long.low and long.up, as well as lat.low and lat.up, are the same, filter.gc selects data for particular observing site.

filter.gc enables one to select data only by longitude or latitude, with geographical coordinates being between given boundaries, less, greater or equal to a boundary.

Value

filter.gc returns data frame with the same number of columns as the argument data, containing observations corresponding to geographical coordinates with longitude between long.low and long.up and latitude between lat.low and lat.up.

Note

Argument data has to consist of the columns named "long", "EW", "lat" and "NS".

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

[filter](#)

Examples

```
## select visual meteor data for 2004, site with longitude 19.7E and latitude 44.2N

## rate data for the year 2004
data(rate04)
filter.gc(rate04,long.low=19.7,long.up=19.7,ew="E",lat.low=44.2,lat.up=44.2,ns="N")

## magnitude data for the year 2004
data(magn04)
filter.gc(magn04,long.low=19.7,long.up=19.7,ew="E",lat.low=44.2,lat.up=44.2,ns="N")

## select visual meteor data corresponding to sites with latitude 44.2N and above
filter.gc(rate04,lat.low=44.2,ns="N")
filter.gc(magn04,lat.low=44.2,ns="N")
```

filter.h

Selection of visual meteor data by radiant elevation

Description

Selects data for a given visual meteor dataset, specified shower and its radiant elevation or interval of radiant elevations.

Usage

```
filter.h(data,shw,Ralpha = NULL,Delta = NULL,h.low = 10,h.up = 90)
```

Arguments

data	data frame consisting of visual meteor data (rate or magnitude data).
shw	character string consisting of three capital letters which represent meteor shower code.
Ralpha	numeric vector with value between 0 and 360, specifying right ascension of the radiant, in degrees.
Delta	numeric vector with value between -90 and +90, specifying declination of the radiant, in degrees.
h.low	numeric vector with value between 10 (default) and 90, specifying lower boundary of radiant elevation in degrees.
h.up	numeric vector with value between 10 and 90 (default), specifying upper boundary of radiant elevation in degrees.

Details

Radiant elevation h is measured from the observer's horizon towards zenith and it takes value between 10 and 90 degrees.

If right ascension and declination of shower radiant are not specified, the values from the data frame [radiant](#) are used.

Value

filter.h returns data frame containing observations corresponding to the radiant elevation between h.low and h.up.

Note

Argument data has to consist of the column named "SPO" in rate data frames (placed before the columns for showers) and columns "zero" and "Shw" in magnitude data frames.

Also, data has to consist of the columns named "long", "EW", "lat", "day", "month", "year".

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

[filter](#),[filter.totcor](#)

Examples

```
## select visual meteor data for the elevation of Perseids radiant between 30 and 60 degrees,
## period between 1-20th August 2011

## rate data for the year 2011
data(rate11)
ratePer<-filter.datetime(rate11,year=2011,month.beg=8,day.beg=1,day.end=20)
filter.h(ratePer,shw="PER", h.low=30,h.up=60)

## magnitude data for the year 2011
data(magn11)
magnPer<-filter.datetime(magn11,year=2011,month.beg=8,day.beg=1,day.end=20)
filter.h(magnPer,shw="PER",h.low=30,h.up=60)
```

<code>filter.imocode</code>	<i>Selection of visual meteor data by IMO observer code</i>
-----------------------------	---

Description

Selects data for a given visual meteor dataset and specified IMO observer code.

Usage

```
filter.imocode(data, imocode)
```

Arguments

<code>data</code>	data frame consisting of visual meteor data (rate or magnitude data).
<code>imocode</code>	character string consisting of five capital letters which represent IMO observer code.

Details

IMO observer code is a combination of the first three letters of the last name and the first two letters of the first name. List of IMO observer codes can be found in the dataframe [vmdbpers](#). IMO observer codes are unique, meaning that if 5-letter combination is already used, the observer gets modified IMO code.

Value

`filter.imocode` returns data frame with the same number of columns as the argument `data`, containing values corresponding to the observer with specified IMO code.

Note

Argument `data` has to consist of the column named "IMOcode".

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

[filter](#), [filter.obsname](#)

Examples

```
## select visual meteor data for 2010. corresponding to the observer with IMO code SAVBR

## rate data for the year 2010
data(rate10)
filter.imocode(rate10,imocode="SAVBR")

## magnitude data for the year 2010
data(magn10)
filter.imocode(magn10,imocode="SAVBR")
```

filter.mag

Selection of visual meteor data by limiting magnitude

Description

Selects data for a given visual meteor dataset and specified limiting magnitude or interval of magnitudes.

Usage

```
filter.mag(data,mag.low = 3,mag.up = 8)
```

Arguments

data	data frame consisting of visual meteor data (rate or magnitude data).
mag.low	numeric vector with value between 3 (default) and 8, specifying lower boundary of limiting magnitude.
mag.up	numeric vector with value between 3 and 8 (default), specifying upper boundary of limiting magnitude.

Value

filter.mag returns data frame with the same number of columns as the argument data, containing observations with the limiting magnitudes between mag.low and mag.up.

Note

Argument data has to consist of the column named "lmg".

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

[filter](#), [filter.totcor](#)

Examples

```
## select visual meteor data for 13th August 2007, limiting magnitude between 5.5 and 6.5
```

```
## rate data for the year 2007
data(rate07)
rate1308<-filter.datetime(rate07,year=2007,month.beg=8,day.beg=13)
filter.mag(rate1308,mag.low=5.5,mag.up=6.5)
```

```
## magnitude data for the year 2007
data(magn07)
magn1308<-filter.datetime(magn07,year=2007,month.beg=8,day.beg=13)
filter.mag(magn1308,mag.low=5.5,mag.up=6.5)
```

```
## select visual meteor data for the 13th August 2007 and limiting magnitude above 5.5
filter.mag(rate1308,mag.low=5.5)
filter.mag(magn1308,mag.low=5.5)
```

filter.obsname	<i>Selection of visual meteor data by observer's first and last name</i>
----------------	--

Description

Selects data for a given visual meteor dataset and specified observer's first and last name.

Usage

```
filter.obsname(data,name,fname)
```

Arguments

data	data frame consisting of visual meteor data (rate or magnitude data).
name	character string specifying observer's last name.
fname	character string specifying observer's first name.

Details

List of observer's names can be found in the data frame [vmdbpers](#).

`filter.obsname` can be used when one is not certain of IMO observer code (due to possible non-uniqueness of five letter combination).

Value

`filter.obsname` returns data frame with the same number of columns as the argument data, containing values which correspond to the observer with specified first and last name.

Note

Argument data has to consist of the column named "IMOcode".

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

[filter.imocode](#), [filter](#)

Examples

```
## select visual meteor data for the year 2004 corresponding to Ivana Marjanovic

## rate data for the year 2004
data(rate04)
filter.obsname(rate04,name="Marjanovic",fname="Ivana")

## magnitude data for the year 2004
data(magn04)
filter.obsname(magn04,name="Marjanovic",fname="Ivana")
```

`filter.shw`*Selection of visual meteor data by shower code*

Description

Selects data for a given visual meteor dataset and specified shower code.

Usage

```
filter.shw(data, shw)
```

Arguments

<code>data</code>	data frame consisting of visual meteor data (rate or magnitude data).
<code>shw</code>	character string consisting of three capital letters which represent meteor shower code.

Details

List of meteor shower codes can be found in the dataframe [shw_list](#).

Value

`filter.shw` returns data frame containing observations which correspond to specified meteor shower.

Note

Argument `data` has to consist of the column named "SPO" in rate data frames (placed before the columns for showers) and columns "zero" and "Shw" in magnitude data frames.

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

[filter](#)

Examples

```
## select visual meteor data for Perseids 2000

## rate data for the year 2000
data(rate00)
filter.shw(rate00,shw="PER")

## magnitude data for the year 2000
data(magn00)
filter.shw(magn00,shw="PER")
```

filter.site	<i>Selection of visual meteor data by observing site</i>
-------------	--

Description

Selects data for a given visual meteor dataset and specified observing site.

Usage

```
filter.site(data,site)
```

Arguments

data	data frame consisting of visual meteor data (rate or magnitude data).
site	character string specifying name of the observing site.

Details

List of site names can be found in the dataframe [vmdbsite](#).

Value

filter.site returns data frame with the same number of columns as the argument data, containing observations which correspond to specified observing site.

Note

Argument data has to consist of the column named "sitecode".

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

[filter](#), [filter.country](#)

Examples

```
## select visual meteor data for the year 2009 from Debelo brdo site

## rate data for the year 2009
data(rate09)
filter.site(rate09,site="Debelo brdo")

## magnitude data for the year 2009
data(magn09)
filter.site(magn09,site="Debelo brdo")
```

filter.sol

Selection of visual meteor data by solar longitude

Description

Selects data for a given visual meteor dataset and specified solar longitude or interval of solar longitudes.

Usage

```
filter.sol(data,sol.low = 0,sol.up = 360)
```

Arguments

data	data frame consisting of visual meteor data (rate or magnitude data).
sol.low	numeric vector with value between 0 (default) and 360, specifying lower boundary of solar longitude in degrees.
sol.up	numeric vector with value between 0 and 360 (default), specifying upper boundary of solar longitude in degrees.

Value

filter.sol returns data frame with the same number of columns as the argument data, containing observations with solar longitudes between sol.low and sol.up.

Note

Argument data has to consist of the columns named "year" and "sollong".

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

[filter,solar.long](#)

Examples

```
## select visual meteor data for 2005. with solar longitudes between 200 and 215 degrees

## rate data for the year 2005
data(rate05)
filter.sol(rate05,sol.low=200,sol.up=215)

## magnitude data for the year 2005
data(magn05)
filter.sol(magn05,sol.low=200,sol.up=215)
```

filter.totcor

Selection of visual meteor data by total correction factor

Description

Selects data for a given visual meteor rate dataset, specified shower, population index and total correction factor.

Usage

```
filter.totcor(data,shw,Ralpha = NULL,Delta = NULL,r,C = 5)
```

Arguments

data	data frame consisting of visual meteor rate data.
shw	character string consisting of three capital letters which represent meteor shower code.
Ralpha	numeric vector with value between 0 and 360, specifying right ascension of the radiant, in degrees.
Delta	numeric vector with value between -90 and +90, specifying declination of the radiant, in degrees.
r	numeric vector specifying population index of a meteor shower.
C	numeric vector specifying total correction factor. C=5 is set as a default value.

Details

Total correction factor accounts for all non-ideal observing conditions such as clouds, low radiant, low limiting magnitude.

Total correction factor is equal to $C=r^{(6.5-lmg)F/\sin(h)}$, where r is population index, lmg limiting magnitude, F correction factor for field-of-view obstruction, h radiant elevation.

If right ascension and declination of shower radiant are not specified, the values from the data frame `radiant` are used.

Value

`filter.totcor` returns data frame containing observations with total correction factors upper bounded by argument `C`.

Note

Argument data has to consist of the columns named "SPO" (placed before the columns for showers), "long", "EW", "lat", "day", "month", "year", "lmg" and "F".

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

`filter`, `filter.F`, `filter.mag`, `zhr`

Examples

```
## select visual meteor data for the period between 15-30 October 2006 and then
## select observations of Orionids with total correction factor equal to 5

## rate data for the year 2006
data(rate06)
rateOri<-filter.datetime(rate06,year=2006,month.beg=10,day.beg=15,day.end=30)
filter.totcor(rateOri,shw="ORI",r=2.5)
```

 mag.distr

Summarized magnitude distribution

Description

Table and graphical representation of summarized magnitude distribution for a given magnitude dataset, specified meteor shower and time period.

Usage

```
mag.distr(data, year, month.beg, month.end=month.beg, day.beg, day.end=day.beg,
time.beg=0, time.end=2359, shw)
```

Arguments

data	data frame consisting of visual meteor magnitude data.
year	numeric vector of length 4 specifying year.
month.beg	numeric vector specifying the beginning month.
month.end	numeric vector specifying the ending month. By default, month.end is set to be equal to month.beg.
day.beg	numeric vector specifying the beginning day.
day.end	numeric vector specifying the ending day. By default, day.end is set to be equal to day.beg.
time.beg	numeric vector (0-2359) specifying lower boundary of time in hours and minutes, corresponding to day.beg. By default, time.beg is set to be equal to 0.
time.end	numeric vector(0-2359) specifying upper boundary of time in hours and minutes, corresponding to day.end. By default, time.end is set to be equal to 2359.
shw	character string consisting of three capital letters which represent meteor shower code.

Details

Summarized magnitude distribution is formed by summing frequencies of all observers for each magnitude value.

Value

Table and plot of summarized magnitude distribution consisting of histogram and boxplot.

The histogram cells are intervals of length 1, with midpoints at magnitude values.

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

See Also

[pop.index](#)

Examples

```
## select data for observations of Perseids, period 12-14th August 2007
## and make graphics of magnitude distribution
data(magn07)
magnPer<-filter(magn07,shw="PER", year=2007, month.beg=8, day.beg=12, day.end=14)
mag.distr(magnPer,year=2007, month.beg=8, day.beg=12, day.end=14, shw="PER")
```

magn00

Magnitude data for the year 2000

Description

Visual meteor magnitude dataset for the year 2000.

Usage

magn00

Format

A data frame with 9311 observations on the following 29 variables.

IMOcode factor IMO observer code

sitcode numeric IMO site code

long numeric Longitude of the observing site in degrees

EW factor East (E) or west (W) position from the prime meridian

lat numeric Latitude of the observing site in degrees

NS factor North (N) or south (S) position from the equator

day numeric Day of the month

month numeric Month of the year

year numeric Year 2000

start numeric Beginning of the observing time period

stop numeric End of the observing time period

sollong numeric Solar longitude of the middle of observing time period

Shw factor Abbreviation of the observed shower

lmg numeric Limiting magnitude

m6 numeric Number of observed meteors of -6 magnitude
 m5 numeric Number of observed meteors of -5 magnitude
 m4 numeric Number of observed meteors of -4 magnitude
 m3 numeric Number of observed meteors of -3 magnitude
 m2 numeric Number of observed meteors of -2 magnitude
 m1 numeric Number of observed meteors of -1 magnitude
 zero numeric Number of observed meteors of 0 magnitude
 p1 numeric Number of observed meteors of +1 magnitude
 p2 numeric Number of observed meteors of +2 magnitude
 p3 numeric Number of observed meteors of +3 magnitude
 p4 numeric Number of observed meteors of +4 magnitude
 p5 numeric Number of observed meteors of +5 magnitude
 p6 numeric Number of observed meteors of +6 magnitude
 p7 numeric Number of observed meteors of +7 magnitude
 N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

magn01	<i>Magnitude data for the year 2001</i>
--------	---

Description

Visual meteor magnitude dataset for the year 2001.

Usage

magn01

Format

A data frame with 13731 observations on the following 29 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month

month numeric Month of the year
 year numeric Year 2001
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 Shw factor Abbreviation of the observed shower
 lmg numeric Limiting magnitude
 m6 numeric Number of observed meteors of -6 magnitude
 m5 numeric Number of observed meteors of -5 magnitude
 m4 numeric Number of observed meteors of -4 magnitude
 m3 numeric Number of observed meteors of -3 magnitude
 m2 numeric Number of observed meteors of -2 magnitude
 m1 numeric Number of observed meteors of -1 magnitude
 zero numeric Number of observed meteors of 0 magnitude
 p1 numeric Number of observed meteors of +1 magnitude
 p2 numeric Number of observed meteors of +2 magnitude
 p3 numeric Number of observed meteors of +3 magnitude
 p4 numeric Number of observed meteors of +4 magnitude
 p5 numeric Number of observed meteors of +5 magnitude
 p6 numeric Number of observed meteors of +6 magnitude
 p7 numeric Number of observed meteors of +7 magnitude
 N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

magn04

Magnitude data for the year 2004

Description

Visual meteor magnitude dataset for the year 2004.

Usage

magn04

Format

A data frame with 12742 observations on the following 29 variables.

IMOcode factor IMO observer code

sitocode numeric IMO site code

long numeric Longitude of the observing site in degrees

EW factor East (E) or west (W) position from the prime meridian

lat numeric Latitude of the observing site in degrees

NS factor North (N) or south (S) position from the equator

day numeric Day of the month

month numeric Month of the year

year numeric Year 2004

start numeric Beginning of the observing time period

stop numeric End of the observing time period

sollong numeric Solar longitude of the middle of observing time period

Shw factor Abbreviation of the observed shower

lmg numeric Limiting magnitude

m6 numeric Number of observed meteors of -6 magnitude

m5 numeric Number of observed meteors of -5 magnitude

m4 numeric Number of observed meteors of -4 magnitude

m3 numeric Number of observed meteors of -3 magnitude

m2 numeric Number of observed meteors of -2 magnitude

m1 numeric Number of observed meteors of -1 magnitude

zero numeric Number of observed meteors of 0 magnitude

p1 numeric Number of observed meteors of +1 magnitude

p2 numeric Number of observed meteors of +2 magnitude

p3 numeric Number of observed meteors of +3 magnitude

p4 numeric Number of observed meteors of +4 magnitude

p5 numeric Number of observed meteors of +5 magnitude

p6 numeric Number of observed meteors of +6 magnitude

p7 numeric Number of observed meteors of +7 magnitude

N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

magn05

*Magnitude data for the year 2005***Description**

Visual meteor magnitude dataset for the year 2005.

Usage

magn05

Format

A data frame with 7271 observations on the following 29 variables.

IMOcode factor IMO observer code

sitcode numeric IMO site code

long numeric Longitude of the observing site in degrees

EW factor East (E) or west (W) position from the prime meridian

lat numeric Latitude of the observing site in degrees

NS factor North (N) or south (S) position from the equator

day numeric Day of the month

month numeric Month of the year

year numeric Year 2005

start numeric Beginning of the observing time period

stop numeric End of the observing time period

sollong numeric Solar longitude of the middle of observing time period

Shw factor Abbreviation of the observed shower

lmg numeric Limiting magnitude

m6 numeric Number of observed meteors of -6 magnitude

m5 numeric Number of observed meteors of -5 magnitude

m4 numeric Number of observed meteors of -4 magnitude

m3 numeric Number of observed meteors of -3 magnitude

m2 numeric Number of observed meteors of -2 magnitude

m1 numeric Number of observed meteors of -1 magnitude

zero numeric Number of observed meteors of 0 magnitude

p1 numeric Number of observed meteors of +1 magnitude

p2 numeric Number of observed meteors of +2 magnitude

p3 numeric Number of observed meteors of +3 magnitude

p4 numeric Number of observed meteors of +4 magnitude

p5 numeric Number of observed meteors of +5 magnitude
 p6 numeric Number of observed meteors of +6 magnitude
 p7 numeric Number of observed meteors of +7 magnitude
 N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

magn06

Magnitude data for the year 2006

Description

Visual meteor magnitude dataset for the year 2006.

Usage

magn06

Format

A data frame with 5801 observations on the following 29 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 2006
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 Shw factor Abbreviation of the observed shower
 lmg numeric Limiting magnitude
 m6 numeric Number of observed meteors of -6 magnitude
 m5 numeric Number of observed meteors of -5 magnitude
 m4 numeric Number of observed meteors of -4 magnitude
 m3 numeric Number of observed meteors of -3 magnitude

m2 numeric Number of observed meteors of -2 magnitude
 m1 numeric Number of observed meteors of -1 magnitude
 zero numeric Number of observed meteors of 0 magnitude
 p1 numeric Number of observed meteors of +1 magnitude
 p2 numeric Number of observed meteors of +2 magnitude
 p3 numeric Number of observed meteors of +3 magnitude
 p4 numeric Number of observed meteors of +4 magnitude
 p5 numeric Number of observed meteors of +5 magnitude
 p6 numeric Number of observed meteors of +6 magnitude
 p7 numeric Number of observed meteors of +7 magnitude
 N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

magn07	<i>Magnitude data for the year 2007</i>
--------	---

Description

Visual meteor magnitude dataset for the year 2007.

Usage

magn07

Format

A data frame with 5249 observations on the following 29 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 2007
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period

sollong numeric Solar longitude of the middle of observing time period
 Shw factor Abbreviation of the observed shower
 lmg numeric Limiting magnitude
 m6 numeric Number of observed meteors of -6 magnitude
 m5 numeric Number of observed meteors of -5 magnitude
 m4 numeric Number of observed meteors of -4 magnitude
 m3 numeric Number of observed meteors of -3 magnitude
 m2 numeric Number of observed meteors of -2 magnitude
 m1 numeric Number of observed meteors of -1 magnitude
 zero numeric Number of observed meteors of 0 magnitude
 p1 numeric Number of observed meteors of +1 magnitude
 p2 numeric Number of observed meteors of +2 magnitude
 p3 numeric Number of observed meteors of +3 magnitude
 p4 numeric Number of observed meteors of +4 magnitude
 p5 numeric Number of observed meteors of +5 magnitude
 p6 numeric Number of observed meteors of +6 magnitude
 p7 numeric Number of observed meteors of +7 magnitude
 N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

magn08

Magnitude data for the year 2008

Description

Visual meteor magnitude dataset for the year 2008.

Usage

magn08

Format

A data frame with 729 observations on the following 29 variables.

IMOcode factor IMO observer code
sitecode numeric IMO site code
long numeric Longitude of the observing site in degrees
EW factor East (E) or west (W) position from the prime meridian
lat numeric Latitude of the observing site in degrees
NS factor North (N) or south (S) position from the equator
day numeric Day of the month
month numeric Month of the year
year numeric Year 2008
start numeric Beginning of the observing time period
stop numeric End of the observing time period
sollong numeric Solar longitude of the middle of observing time period
Shw factor Abbreviation of the observed shower
lmg numeric Limiting magnitude
m6 numeric Number of observed meteors of -6 magnitude
m5 numeric Number of observed meteors of -5 magnitude
m4 numeric Number of observed meteors of -4 magnitude
m3 numeric Number of observed meteors of -3 magnitude
m2 numeric Number of observed meteors of -2 magnitude
m1 numeric Number of observed meteors of -1 magnitude
zero numeric Number of observed meteors of 0 magnitude
p1 numeric Number of observed meteors of +1 magnitude
p2 numeric Number of observed meteors of +2 magnitude
p3 numeric Number of observed meteors of +3 magnitude
p4 numeric Number of observed meteors of +4 magnitude
p5 numeric Number of observed meteors of +5 magnitude
p6 numeric Number of observed meteors of +6 magnitude
p7 numeric Number of observed meteors of +7 magnitude
N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

magn09

*Magnitude data for the year 2009***Description**

Visual meteor magnitude dataset for the year 2009.

Usage

magn09

Format

A data frame with 3486 observations on the following 29 variables.

IMOcode factor IMO observer code

sitcode numeric IMO site code

long numeric Longitude of the observing site in degrees

EW factor East (E) or west (W) position from the prime meridian

lat numeric Latitude of the observing site in degrees

NS factor North (N) or south (S) position from the equator

day numeric Day of the month

month numeric Month of the year

year numeric Year 2009

start numeric Beginning of the observing time period

stop numeric End of the observing time period

sollong numeric Solar longitude of the middle of observing time period

Shw factor Abbreviation of the observed shower

lmg numeric Limiting magnitude

m6 numeric Number of observed meteors of -6 magnitude

m5 numeric Number of observed meteors of -5 magnitude

m4 numeric Number of observed meteors of -4 magnitude

m3 numeric Number of observed meteors of -3 magnitude

m2 numeric Number of observed meteors of -2 magnitude

m1 numeric Number of observed meteors of -1 magnitude

zero numeric Number of observed meteors of 0 magnitude

p1 numeric Number of observed meteors of +1 magnitude

p2 numeric Number of observed meteors of +2 magnitude

p3 numeric Number of observed meteors of +3 magnitude

p4 numeric Number of observed meteors of +4 magnitude

p5 numeric Number of observed meteors of +5 magnitude
 p6 numeric Number of observed meteors of +6 magnitude
 p7 numeric Number of observed meteors of +7 magnitude
 N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

magn10	<i>Magnitude data for the year 2010</i>
--------	---

Description

Visual meteor magnitude dataset for the year 2010.

Usage

magn10

Format

A data frame with 5426 observations on the following 29 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 2010
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 Shw factor Abbreviation of the observed shower
 lmg numeric Limiting magnitude
 m6 numeric Number of observed meteors of -6 magnitude
 m5 numeric Number of observed meteors of -5 magnitude
 m4 numeric Number of observed meteors of -4 magnitude
 m3 numeric Number of observed meteors of -3 magnitude

m2 numeric Number of observed meteors of -2 magnitude
 m1 numeric Number of observed meteors of -1 magnitude
 zero numeric Number of observed meteors of 0 magnitude
 p1 numeric Number of observed meteors of +1 magnitude
 p2 numeric Number of observed meteors of +2 magnitude
 p3 numeric Number of observed meteors of +3 magnitude
 p4 numeric Number of observed meteors of +4 magnitude
 p5 numeric Number of observed meteors of +5 magnitude
 p6 numeric Number of observed meteors of +6 magnitude
 p7 numeric Number of observed meteors of +7 magnitude
 N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

magn11	<i>Magnitude data for the year 2011</i>
--------	---

Description

Visual meteor magnitude dataset for the year 2011.

Usage

magn11

Format

A data frame with 5426 observations on the following 29 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 2011
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period

solong numeric Solar longitude of the middle of observing time period
 Shw factor Abbreviation of the observed shower
 lmg numeric Limiting magnitude
 m6 numeric Number of observed meteors of -6 magnitude
 m5 numeric Number of observed meteors of -5 magnitude
 m4 numeric Number of observed meteors of -4 magnitude
 m3 numeric Number of observed meteors of -3 magnitude
 m2 numeric Number of observed meteors of -2 magnitude
 m1 numeric Number of observed meteors of -1 magnitude
 zero numeric Number of observed meteors of 0 magnitude
 p1 numeric Number of observed meteors of +1 magnitude
 p2 numeric Number of observed meteors of +2 magnitude
 p3 numeric Number of observed meteors of +3 magnitude
 p4 numeric Number of observed meteors of +4 magnitude
 p5 numeric Number of observed meteors of +5 magnitude
 p6 numeric Number of observed meteors of +6 magnitude
 p7 numeric Number of observed meteors of +7 magnitude
 N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

magn95

Magnitude data for the year 1995

Description

Visual meteor magnitude dataset for the year 1995.

Usage

magn95

Format

A data frame with 7751 observations on the following 29 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 1995
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 Shw factor Abbreviation of the observed shower
 lmg numeric Limiting magnitude
 m6 numeric Number of observed meteors of -6 magnitude
 m5 numeric Number of observed meteors of -5 magnitude
 m4 numeric Number of observed meteors of -4 magnitude
 m3 numeric Number of observed meteors of -3 magnitude
 m2 numeric Number of observed meteors of -2 magnitude
 m1 numeric Number of observed meteors of -1 magnitude
 zero numeric Number of observed meteors of 0 magnitude
 p1 numeric Number of observed meteors of +1 magnitude
 p2 numeric Number of observed meteors of +2 magnitude
 p3 numeric Number of observed meteors of +3 magnitude
 p4 numeric Number of observed meteors of +4 magnitude
 p5 numeric Number of observed meteors of +5 magnitude
 p6 numeric Number of observed meteors of +6 magnitude
 p7 numeric Number of observed meteors of +7 magnitude
 N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

 magn97

 Magnitude data for the year 1997

Description

Visual meteor magnitude dataset for the year 1997.

Usage

magn97

Format

A data frame with 9208 observations on the following 29 variables.

IMOcode factor IMO observer code

sitcode numeric IMO site code

long numeric Longitude of the observing site in degrees

EW factor East (E) or west (W) position from the prime meridian

lat numeric Latitude of the observing site in degrees

NS factor North (N) or south (S) position from the equator

day numeric Day of the month

month numeric Month of the year

year numeric Year 1997

start numeric Beginning of the observing time period

stop numeric End of the observing time period

sollong numeric Solar longitude of the middle of observing time period

Shw factor Abbreviation of the observed shower

lmg numeric Limiting magnitude

m6 numeric Number of observed meteors of -6 magnitude

m5 numeric Number of observed meteors of -5 magnitude

m4 numeric Number of observed meteors of -4 magnitude

m3 numeric Number of observed meteors of -3 magnitude

m2 numeric Number of observed meteors of -2 magnitude

m1 numeric Number of observed meteors of -1 magnitude

zero numeric Number of observed meteors of 0 magnitude

p1 numeric Number of observed meteors of +1 magnitude

p2 numeric Number of observed meteors of +2 magnitude

p3 numeric Number of observed meteors of +3 magnitude

p4 numeric Number of observed meteors of +4 magnitude

p5 numeric Number of observed meteors of +5 magnitude
 p6 numeric Number of observed meteors of +6 magnitude
 p7 numeric Number of observed meteors of +7 magnitude
 N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

magn98

Magnitude data for the year 1998

Description

Visual meteor magnitude dataset for the year 1998.

Usage

magn98

Format

A data frame with 10520 observations on the following 29 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 1998
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 Shw factor Abbreviation of the observed shower
 lmg numeric Limiting magnitude
 m6 numeric Number of observed meteors of -6 magnitude
 m5 numeric Number of observed meteors of -5 magnitude
 m4 numeric Number of observed meteors of -4 magnitude
 m3 numeric Number of observed meteors of -3 magnitude

m2 numeric Number of observed meteors of -2 magnitude
 m1 numeric Number of observed meteors of -1 magnitude
 zero numeric Number of observed meteors of 0 magnitude
 p1 numeric Number of observed meteors of +1 magnitude
 p2 numeric Number of observed meteors of +2 magnitude
 p3 numeric Number of observed meteors of +3 magnitude
 p4 numeric Number of observed meteors of +4 magnitude
 p5 numeric Number of observed meteors of +5 magnitude
 p6 numeric Number of observed meteors of +6 magnitude
 p7 numeric Number of observed meteors of +7 magnitude
 N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

magn99	<i>Magnitude data for the year 1999</i>
--------	---

Description

Visual meteor magnitude dataset for the year 1999.

Usage

magn99

Format

A data frame with 13140 observations on the following 29 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 1999
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period

sollong numeric Solar longitude of the middle of observing time period
 Shw factor Abbreviation of the observed shower
 lmg numeric Limiting magnitude
 m6 numeric Number of observed meteors of -6 magnitude
 m5 numeric Number of observed meteors of -5 magnitude
 m4 numeric Number of observed meteors of -4 magnitude
 m3 numeric Number of observed meteors of -3 magnitude
 m2 numeric Number of observed meteors of -2 magnitude
 m1 numeric Number of observed meteors of -1 magnitude
 zero numeric Number of observed meteors of 0 magnitude
 p1 numeric Number of observed meteors of +1 magnitude
 p2 numeric Number of observed meteors of +2 magnitude
 p3 numeric Number of observed meteors of +3 magnitude
 p4 numeric Number of observed meteors of +4 magnitude
 p5 numeric Number of observed meteors of +5 magnitude
 p6 numeric Number of observed meteors of +6 magnitude
 p7 numeric Number of observed meteors of +7 magnitude
 N numeric Total number of observed meteors

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

pop.index

Calculation of population index

Description

Calculates and plots population index of a meteor shower for a given magnitude data, specified time period, magnitude values and bin size.

Usage

```
pop.index(data, year, month.beg, month.end=month.beg, day.beg, day.end=day.beg,
time.beg=0, time.end=2359, shw, mag.range=-6:7, k, add.plot=FALSE, xlim1=NULL,
xlim2=NULL, xinc=NULL, ylim1=NULL, ylim2=NULL, yinc=NULL)
```


Arguments

data	data frame consisting of visual meteor magnitude data.
year	numeric vector of length 4 specifying year.
month.beg	numeric vector specifying the beginning month.
month.end	numeric vector specifying the ending month. By default, month.end is set to be equal to month.beg.
day.beg	numeric vector specifying the beginning day.
day.end	numeric vector specifying the ending day. By default, day.end is set to be equal to day.beg.
time.beg	numeric vector (0-2359) specifying lower boundary of time in hours and minutes, corresponding to day.beg. By default, time.beg is set to be equal to 0.
time.end	numeric vector (0-2359) specifying upper boundary of time in hours and minutes, corresponding to day.end. By default, time.end is set to be equal to 2359.
shw	character string consisting of three capital letters which represent meteor shower code.
mag.range	numeric vector specifying range of magnitudes. It should consist of at least 5 magnitude classes.
k	numeric vector specifying bin size in degrees of solar longitude.
add.plot	logical vector. If TRUE, the population index is plotted.
xlim1	numeric vector specifying minimum value on x-axis.
xlim2	numeric vector specifying maximum value on x-axis.
xinc	numeric vector specifying increment between labels on x-axis.
ylim1	numeric vector specifying minimum value on y-axis.
ylim2	numeric vector specifying maximum value on y-axis.
yinc	numeric vector specifying increment between labels on y-axis.

Details

Probabilities of perception are incorporated in magnitude distributions for each observing interval. Cummulative summarized magnitude distribution $\Phi(m)$ is formed by summing cummulative frequencies of all observers for each magnitude class m .

Using the relationship for population index $r = \Phi(m+1)/\Phi(m)$ and substituting $0, 1, \dots, m$ magnitudes, equation $\Phi(m) = \Phi(0)r^m$ (or $\ln(\Phi(m)) = \ln(\Phi(0)) + r \log(m)$ in logarithmic form) can be written. Then, population index r is calculated by the method of least squares, for chosen range of magnitude values.

Standard error of population index is approximated with

$$\sigma_r = r \sqrt{\sum e_i^2 / ((n-2) \sum m_i^2)},$$

where $i=1, 2, \dots, n$, n is number of magnitude values, e_i regression residuals, $i=1, 2, \dots, n$.

Value

Data frame containing following vectors

start factor Calendar date and time in UTC at the time interval beginning

stop factor Calendar date and time in UTC at the time interval end

sollong numeric Solar longitude corresponding to the middle of time interval

mag factor Range of magnitude values

nINT numeric Number of observing time intervals

nSHW numeric Number of observed meteors belonging to the shower

pop.index numeric Population index

sigma.r numeric Standard error of population index

If `add.plot` is TRUE, additionally xy plot of population index is made. Solar longitude is on x-axis and population index on y-axis. Population index is represented with black filled circles and 68% confidence intervals. Values of limits (minimum and maximum values) on x and y axis (`xlim1,xlim2,ylim1,ylim2`), as well as increments between the axis labels (`xinc,yinc`) should be provided to function call.

Note

The interval for regression is chosen such that: there is at least 3 meteors per magnitude class, the magnitude classes $m \leq 5$ are included and there are at least 5 magnitude classes available. All these conditions are fulfilled for the range of magnitude values printed in results.

Author(s)

Kristina Veljkovic

References

Koschack R. and Rendtel J. (1990). Determination of spatial number density and mass index from visual meteor observations (1). *WGN, Journal of the IMO*, 18(2), 44 - 58.

Koschack R. and Rendtel J. (1990). Determination of spatial number density and mass index from visual meteor observations (2). *WGN, Journal of the IMO*, 18(4), 119 - 140.

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

See Also

[mag.distr,pop.index2,zhr](#)

Examples

```
## calculate population index for observations of 1997 Perseids, time period
## 27th July to 16th August, radiant elevation higher than 20 degrees,
## total correction factor smaller than 5, bin size 1 degree
## First select magnitude data for Perseids activity - time period 15th July to 24th August,
## radiant elevation higher than 20 degrees, total correction factor smaller than 5
```

```
## data(magn97)
## magn<-filter(magn97,year=1997,month.beg=7,month.end=8,day.beg=15,day.end=24,
## shw="PER",h.low=20)
## pop.index(magn,year=1997,month.beg=7,month.end=8,day.beg=27,day.end=16,shw="PER",k=1)

## make graphic of population index
## x-axis limits: min(sollong)=124.549, max(sollong)=144.111
## y-axis limits: min(pop.index-sigma.r)=1.94,max(pop.index+sigma.r)=2.81
## pop.index(magn,year=1997,month.beg=7,month.end=8,day.beg=27,day.end=16,shw="PER",
## k=1,add.plot=TRUE,xlim1=124,xlim2=145,xinc=1,ylim1=1.9,ylim2=2.9,yinc=0.1)
```

pop.index2	<i>Calculation of population index based on average distance from the limiting magnitude</i>
------------	--

Description

Calculates and plots population index of a meteor shower for a given magnitude data, specified time period, minimum and maximum bin size, and number of meteors.

Usage

```
pop.index2(data,year,month.beg,month.end=month.beg,day.beg,day.end=day.beg,
time.beg=0,time.end=2359,shw,k1=0.01,k2=1,num,add.plot=FALSE,xlim1=NULL,
xlim2=NULL,xinc=NULL,ylim1=NULL,ylim2=NULL,yinc=NULL)
```

Arguments

data	data frame consisting of visual meteor magnitude data.
year	numeric vector of length 4 specifying year.
month.beg	numeric vector specifying the beginning month.
month.end	numeric vector specifying the ending month. By default, month.end is set to be equal to month.beg.
day.beg	numeric vector specifying the beginning day.
day.end	numeric vector specifying the ending day. By default, day.end is set to be equal to day.beg.
time.beg	numeric vector (0-2359) specifying lower boundary of time in hours and minutes, corresponding to day.beg. By default, time.beg is set to be equal to 0.
time.end	numeric vector (0-2359) specifying upper boundary of time in hours and minutes, corresponding to day.end. By default, time.end is set to be equal to 2359.
shw	character string consisting of three capital letters which represent meteor shower code.

k1	numeric vector specifying minimum bin size, in degrees of solar longitude. By default, it is equal to 0.01.
k2	numeric vector specifying maximum bin size, in degrees of solar longitude. By default, it is equal to 1.
num	numeric vector specifying total number of meteors per interval.
add.plot	logical vector. If TRUE, the population index is plotted.
xlim1	numeric vector specifying minimum value on x-axis.
xlim2	numeric vector specifying maximum value on x-axis.
xinc	numeric vector specifying increment between labels on x-axis.
ylim1	numeric vector specifying minimum value on y-axis.
ylim2	numeric vector specifying maximum value on y-axis.
yinc	numeric vector specifying increment between labels on y-axis.

Details

Adaptive-bin size algorithm is used. It tries to maintain a user-defined optimum meteor number per bin. For the case that not enough meteors are available, a maximum bin size is used.

Average distance from the limiting magnitude, as difference between the limiting magnitude and average meteor magnitude, is calculated for each observing time interval. Final average distance from the limiting magnitude is calculated as a weighted average of all individual average distances, where numbers of meteors in each observing interval represent weights. Conversion of average distance from limiting magnitude to population index is done using natural spline interpolation spline of table values [popind](#). Error margins of population index are calculated using bivariate Krige interpolation `krigeInterp` of table values [popind.err](#)

Value

Data frame containing following vectors

start factor Calendar date and time in UTC of left bound of time interval

stop factor Calendar date and time in UTC of right bound of time interval

sollong numeric Solar longitude corresponding to the middle of time interval

nINT numeric Number of observing time intervals

nSHW numeric Number of observed meteors belonging to the shower

pop.index numeric Population index

r.error numeric Error margins of population index

If `add.plot` is TRUE, additionally xy plot of population index is made. Solar longitude is on x-axis and population index on y-axis. Population index is represented with black filled circles and 68% confidence intervals. Values of limits (minimum and maximum values) on x and y axis (`xlim1`, `xlim2`, `ylim1`, `ylim2`), as well as increments between the axis labels (`xinc`, `yinc`) should be provided to function call.

Author(s)

Kristina Veljkovic

References

Arlt, R. (2003). Bulletin 19 of the International Leonid Watch: Population index study of the 2002 Leonid meteors. *WGN, Journal of the IMO*,31:3, 77-87.

See Also

[pop.index,zhr](#)

Examples

```
## calculate population index for observations of 1997 Perseids, time period
## 27th July to 16th August, radiant elevation higher than 20 degrees,
## total correction factor smaller than 5, bin sizes 1 degree
## First select magnitude data for Perseids activity - time period 15th July to 24th August,
## radiant elevation higher than 20 degrees, total correction factor smaller than 5
## data(magn97)
## magn<-filter(magn97,year=1997,month.beg=7,month.end=8,day.beg=15,day.end=24,
## shw="PER",h.low=20)
## pop.index2(magn,year=1997,month.beg=7,month.end=8,day.beg=27,day.end=16,shw="PER",
## k1=1,num=300)

## make graphic of population index
## x-axis limits: min(sollong)=124.549, max(sollong)=144.111
## y-axis limits: min(pop.index-sigma.r)=1.91,max(pop.index+sigma.r)=3.07
## pop.index2(magn,year=1997,month.beg=7,month.end=8,day.beg=27,day.end=16,shw="PER",
## k1=1,num=300,add.plot=TRUE,xlim1=124,xlim2=145,xinc=1,ylim1=1.9,ylim2=3.1,yinc=0.1)

## calculate population index around maximum activity of 1997 Perseids, time period
## 10th August 19h to 14th August 7h, radiant elevation higher than 20 degrees,
## total correction factor smaller than 5
## pop.index2(magn,year=1997,month.beg=8,day.beg=10,day.end=14,time.beg=1900,
## time.end=700,shw="PER",num=300)

## make graphic of population index around max activity of 1997 Perseids
## x-axis limits: min(sollong)=138.272, max(sollong)=141.397
## y-axis limits: min(pop.index-sigma.r)=1.59,max(pop.index+sigma.r)=2.79
## pop.index2(magn,year=1997,month.beg=8,day.beg=10,day.end=14,time.beg=1900,
## time.end=700,shw="PER",num=300,add.plot=TRUE,xlim1=138.2,xlim2=141.4,xinc=0.1,
## ylim1=1.5,ylim2=2.8,yinc=0.1)
```

Description

The data represents conversion from the average distance from the limiting magnitude to the population index.

Usage

popind

Format

A data frame with the following two numeric variables.

r Population index

avdeltam Average distance from the limiting magnitude

Source

Arlt, R. (2003). Bulletin 19 of the International Leonid Watch: Population index study of the 2002 Leonid meteors. *WGN, Journal of the IMO*,31:3, 77-87.

popind.err

Error margins for population index

Description

The data represents error margins for the population index with a given number of meteors and value of the population index.

Usage

popind.err

Format

A data frame with the following three numeric variables.

r Population index

n Number of meteors

r.err Error margins for the population index

Source

Arlt, R. (2003). Bulletin 19 of the International Leonid Watch: Population index study of the 2002 Leonid meteors. *WGN, Journal of the IMO*,31:3, 77-87.

 radiant

Coordinates of radiants of meteor showers

Description

Coordinates of radiants of meteor showers during the year.

Usage

radiant

Format

A data frame with 365 observations on the following 58 variables.

Day numeric Day of the month

Month numeric Month of the year

ANT.Alpha numeric Right ascension of Antihelion Source radiant

ANT.Delta numeric Declination of Antihelion Source radiant

QUA.Alpha numeric Right ascension of Quadrantids radiant

QUA.Delta numeric Declination of Quadrantids radiant

DLM.Alpha numeric Right ascension of December Leonis Minorids radiant

DLM.Delta numeric Declination of December Leonis Minorids radiant

ACE.Alpha numeric Right ascension of Alpha-Centaurids radiant

ACE.Delta numeric Declination of Alpha-Centaurids radiant

GNO.Alpha numeric Right ascension of Gamma-Normids radiant

GNO.Delta numeric Declination of Gamma-Normids radiant

LYR.Alpha numeric Right ascension of Lyrids radiant

LYR.Delta numeric Declination of Lyrids radiant

PPU.Alpha numeric Right ascension of Pi-Puppids radiant

PPU.Delta numeric Declination of Pi-Puppids radiant

ETA.Alpha numeric Right ascension of Eta-Aquarids radiant

ETA.Delta numeric Declination of Eta-Aquarids radiant

ELY.Alpha numeric Right ascension of Eta-Lyrids radiant

ELY.Delta numeric Declination of Eta-Lyrids radiant

JBO.Alpha numeric Right ascension of June Bootids radiant

JBO.Delta numeric Declination of June Bootids radiant

CAP.Alpha numeric Right ascension of Alpha-Capricornids radiant

CAP.Delta numeric Declination of Alpha-Capricornids radiant

SDA.Alpha numeric Right ascension of Southern Delta-Aquarids radiant

SDA.Del ta numeric Declination of Southern Delta-Aquarids radiant
 PER.Alpha numeric Right ascension of Perseids radiant
 PER.Del ta numeric Declination of Perseids radiant
 PAU.Alpha numeric Right ascension of Piscis Austrinids radiant
 PAU.Del ta numeric Declination of Piscis Austrinids radiant
 KCG.Alpha numeric Right ascension of Kappa-Cygnids radiant
 KCG.Del ta numeric Declination of Kappa-Cygnids radiant
 AUR.Alpha numeric Right ascension of Alpha-Aurigids radiant
 AUR.Del ta numeric Declination of Alpha-Aurigids radiant
 SPE.Alpha numeric Right ascension of September Epsilon-Perseids radiant
 SPE.Del ta numeric Declination of September Epsilon-Perseids radiant
 STA.Alpha numeric Right ascension of Southern Taurids radiant
 STA.Del ta numeric Declination of Southern Taurids radiant
 ORI.Alpha numeric Right ascension of Orionids radiant
 ORI.Del ta numeric Declination of Orionids radiant
 DAU.Alpha numeric Right ascension of Delta-Aurigids radiant
 DAU.Del ta numeric Declination of Delta-Aurigids radiant
 EGE.Alpha numeric Right ascension of Epsilon-Geminids radiant
 EGE.Del ta numeric Declination of Epsilon-Geminids radiant
 NTA.Alpha numeric Right ascension of Northern Taurids radiant
 NTA.Del ta numeric Declination of Northern Taurids radiant
 LMI.Alpha numeric Right ascension of Leo Minorids radiant
 LMI.Del ta numeric Right ascension of Leo Minorids radiant
 LEO.Alpha numeric Right ascension of Leonids radiant
 LEO.Del ta numeric Declination of Leonids radiant
 AMO.Alpha numeric Right ascension of Alpha-Monocerotids radiant
 AMO.Del ta numeric Declination of Alpha-Monocerotids radiant
 PHO.Alpha numeric Right ascension of Phoenicids radiant
 PHO.Del ta numeric Declination of Phoenicids radiant
 PUP.Alpha numeric Right ascension of Puppids/Velids radiant
 PUP.Del ta numeric Declination of Puppids/Velids radiant
 GEM.Alpha numeric Right ascension of Geminids radiant
 GEM.Del ta numeric Declination of Geminids radiant

Details

Coordinates of radiants of meteor showers are given on 5-days intervals on IMO site. Natural spline interpolation was used to calculate radiant coordinates for in-between days.

Source

Meteor Shower Calendar, <http://www.imo.net/calendar>

rate00	<i>Rate data for the year 2000</i>
--------	------------------------------------

Description

Visual meteor rate data for the year 2000.

Usage

rate00

Format

A data frame with 12328 observations on the following 34 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 2000
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 fovRA numeric Right ascension of the center of the field of view
 fovDEC numeric Declination of the center of the field of view
 Teff numeric Effective observing time
 F numeric Correction factor for field-of-view obstruction
 lmg numeric Limiting magnitude
 SPO numeric Number of observed sporadics
 Shw1 factor Abbreviation of the first shower
 N1 numeric Number of meteors belonging to the first shower
 Shw2 factor Abbreviation of the second shower
 N2 numeric Number of meteors belonging to the second shower
 Shw3 factor Abbreviation of the third shower
 N3 numeric Number of meteors belonging to the third shower
 Shw4 factor Abbreviation of the forth shower

N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower
 Shw7 factor Abbreviation of the 7th shower
 N7 numeric Number of meteors belonging to the 7th shower
 Shw8 factor Abbreviation of the 8th shower
 N8 numeric Number of meteors belonging to the 8th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate01	<i>Rate data for the year 2001</i>
--------	------------------------------------

Description

Visual meteor rate data for the year 2001.

Usage

rate01

Format

A data frame with 20244 observations on the following 34 variables.

IM0code factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 2001
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 fovRA numeric Right ascension of the center of the field of view

fovDEC numeric Declination of the center of the field of view
 Teff numeric Effective observing time
 F numeric Correction factor for field-of-view obstruction
 lmg numeric Limiting magnitude
 SP0 numeric Number of observed sporadics
 Shw1 factor Abbreviation of the first shower
 N1 numeric Number of meteors belonging to the first shower
 Shw2 factor Abbreviation of the second shower
 N2 numeric Number of meteors belonging to the second shower
 Shw3 factor Abbreviation of the third shower
 N3 numeric Number of meteors belonging to the third shower
 Shw4 factor Abbreviation of the forth shower
 N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower
 Shw7 factor Abbreviation of the 7th shower
 N7 numeric Number of meteors belonging to the 7th shower
 Shw8 factor Abbreviation of the 8th shower
 N8 numeric Number of meteors belonging to the 8th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate02

Rate data for the year 2002

Description

Visual meteor rate data for the year 2002.

Usage

rate02

Format

A data frame with 13380 observations on the following 34 variables.

IMOcode factor IMO observer code
sitecode numeric IMO site code
long numeric Longitude of the observing site in degrees
EW factor East (E) or west (W) position from the prime meridian
lat numeric Latitude of the observing site in degrees
NS factor North (N) or south (S) position from the equator
day numeric Day of the month
month numeric Month of the year
year numeric Year 2002
start numeric Beginning of the observing time period
stop numeric End of the observing time period
solllong numeric Solar longitude of the middle of observing time period
fovRA numeric Right ascension of the center of the field of view
fovDEC numeric Declination of the center of the field of view
Teff numeric Effective observing time
F numeric Correction factor for field-of-view obstruction
lmg numeric Limiting magnitude
SP0 numeric Number of observed sporadics
Shw1 factor Abbreviation of the first shower
N1 numeric Number of meteors belonging to the first shower
Shw2 factor Abbreviation of the second shower
N2 numeric Number of meteors belonging to the second shower
Shw3 factor Abbreviation of the third shower
N3 numeric Number of meteors belonging to the third shower
Shw4 factor Abbreviation of the forth shower
N4 numeric Number of meteors belonging to the forth shower
Shw5 factor Abbreviation of the fifth shower
N5 numeric Number of meteors belonging to the fifth shower
Shw6 factor Abbreviation of the 6th shower
N6 numeric Number of meteors belonging to the 6th shower
Shw7 factor Abbreviation of the 7th shower
N7 numeric Number of meteors belonging to the 7th shower
Shw8 factor Abbreviation of the 8th shower
N8 numeric Number of meteors belonging to the 8th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate04	<i>Rate data for the year 2004</i>
--------	------------------------------------

Description

Visual meteor rate data for the year 2004.

Usage

rate04

Format

A data frame with 13742 observations on the following 34 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 2004
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 fovRA numeric Right ascension of the center of the field of view
 fovDEC numeric Declination of the center of the field of view
 Teff numeric Effective observing time
 F numeric Correction factor for field-of-view obstruction
 lmg numeric Limiting magnitude
 SPO numeric Number of observed sporadics
 Shw1 factor Abbreviation of the first shower
 N1 numeric Number of meteors belonging to the first shower
 Shw2 factor Abbreviation of the second shower
 N2 numeric Number of meteors belonging to the second shower
 Shw3 factor Abbreviation of the third shower
 N3 numeric Number of meteors belonging to the third shower
 Shw4 factor Abbreviation of the forth shower

N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower
 Shw7 factor Abbreviation of the 7th shower
 N7 numeric Number of meteors belonging to the 7th shower
 Shw8 factor Abbreviation of the 8th shower
 N8 numeric Number of meteors belonging to the 8th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate05	<i>Rate data for the year 2005</i>
--------	------------------------------------

Description

Visual meteor rate data for the year 2005.

Usage

rate05

Format

A data frame with 6949 observations on the following 34 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 2005
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 fovRA numeric Right ascension of the center of the field of view

fovDEC numeric Declination of the center of the field of view
 Teff numeric Effective observing time
 F numeric Correction factor for field-of-view obstruction
 lmg numeric Limiting magnitude
 SP0 numeric Number of observed sporadics
 Shw1 factor Abbreviation of the first shower
 N1 numeric Number of meteors belonging to the first shower
 Shw2 factor Abbreviation of the second shower
 N2 numeric Number of meteors belonging to the second shower
 Shw3 factor Abbreviation of the third shower
 N3 numeric Number of meteors belonging to the third shower
 Shw4 factor Abbreviation of the forth shower
 N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower
 Shw7 factor Abbreviation of the 7th shower
 N7 numeric Number of meteors belonging to the 7th shower
 Shw8 factor Abbreviation of the 8th shower
 N8 numeric Number of meteors belonging to the 8th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate06

Rate data for the year 2006

Description

Visual meteor rate data for the year 2006.

Usage

rate06

Format

A data frame with 5066 observations on the following 34 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 2006
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 fovRA numeric Right ascension of the center of the field of view
 fovDEC numeric Declination of the center of the field of view
 Teff numeric Effective observing time
 F numeric Correction factor for field-of-view obstruction
 lmg numeric Limiting magnitude
 SP0 numeric Number of observed sporadics
 Shw1 factor Abbreviation of the first shower
 N1 numeric Number of meteors belonging to the first shower
 Shw2 factor Abbreviation of the second shower
 N2 numeric Number of meteors belonging to the second shower
 Shw3 factor Abbreviation of the third shower
 N3 numeric Number of meteors belonging to the third shower
 Shw4 factor Abbreviation of the forth shower
 N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower
 Shw7 factor Abbreviation of the 7th shower
 N7 numeric Number of meteors belonging to the 7th shower
 Shw8 factor Abbreviation of the 8th shower
 N8 numeric Number of meteors belonging to the 8th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate07	<i>Rate data for the year 2007</i>
--------	------------------------------------

Description

Visual meteor rate data for the year 2007.

Usage

rate07

Format

A data frame with 4249 observations on the following 30 variables.

IMOcode factor IMO observer code

sitcode numeric IMO site code

long numeric Longitude of the observing site in degrees

EW factor East (E) or west (W) position from the prime meridian

lat numeric Latitude of the observing site in degrees

NS factor North (N) or south (S) position from the equator

day numeric Day of the month

month numeric Month of the year

year numeric Year 2007

start numeric Beginning of the observing time period

stop numeric End of the observing time period

sollong numeric Solar longitude of the middle of observing time period

fovRA numeric Right ascension of the center of the field of view

fovDEC numeric Declination of the center of the field of view

Teff numeric Effective observing time

F numeric Correction factor for field-of-view obstruction

lmg numeric Limiting magnitude

SPO numeric Number of observed sporadics

Shw1 factor Abbreviation of the first shower

N1 numeric Number of meteors belonging to the first shower

Shw2 factor Abbreviation of the second shower

N2 numeric Number of meteors belonging to the second shower

Shw3 factor Abbreviation of the third shower

N3 numeric Number of meteors belonging to the third shower

Shw4 factor Abbreviation of the forth shower

N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate08	<i>Rate data for the year 2008</i>
--------	------------------------------------

Description

Visual meteor rate data for the year 2008.

Usage

rate08

Format

A data frame with 1178 observations on the following 30 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 2008
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 fovRA numeric Right ascension of the center of the field of view
 fovDEC numeric Declination of the center of the field of view
 Teff numeric Effective observing time
 F numeric Correction factor for field-of-view obstruction
 lmg numeric Limiting magnitude

SP0 numeric Number of observed sporadics
 Shw1 factor Abbreviation of the first shower
 N1 numeric Number of meteors belonging to the first shower
 Shw2 factor Abbreviation of the second shower
 N2 numeric Number of meteors belonging to the second shower
 Shw3 factor Abbreviation of the third shower
 N3 numeric Number of meteors belonging to the third shower
 Shw4 factor Abbreviation of the forth shower
 N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate09

Rate data for the year 2009

Description

Visual meteor rate data for the year 2009.

Usage

rate09

Format

A data frame with 3746 observations on the following 30 variables.

IM0code factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 2009

start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 fovRA numeric Right ascension of the center of the field of view
 fovDEC numeric Declination of the center of the field of view
 Teff numeric Effective observing time
 F numeric Correction factor for field-of-view obstruction
 lmg numeric Limiting magnitude
 SP0 numeric Number of observed sporadics
 Shw1 factor Abbreviation of the first shower
 N1 numeric Number of meteors belonging to the first shower
 Shw2 factor Abbreviation of the second shower
 N2 numeric Number of meteors belonging to the second shower
 Shw3 factor Abbreviation of the third shower
 N3 numeric Number of meteors belonging to the third shower
 Shw4 factor Abbreviation of the forth shower
 N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate10

Rate data for the year 2010

Description

Visual meteor rate data for the year 2010.

Usage

rate10

Format

A data frame with 5295 observations on the following 32 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 2010
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 fovRA numeric Right ascension of the center of the field of view
 fovDEC numeric Declination of the center of the field of view
 Teff numeric Effective observing time
 F numeric Correction factor for field-of-view obstruction
 lmg numeric Limiting magnitude
 SPO numeric Number of observed sporadics
 Shw1 factor Abbreviation of the first shower
 N1 numeric Number of meteors belonging to the first shower
 Shw2 factor Abbreviation of the second shower
 N2 numeric Number of meteors belonging to the second shower
 Shw3 factor Abbreviation of the third shower
 N3 numeric Number of meteors belonging to the third shower
 Shw4 factor Abbreviation of the forth shower
 N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower
 Shw7 factor Abbreviation of the 7th shower
 N7 numeric Number of meteors belonging to the 7th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate11	<i>Rate data for the year 2011</i>
--------	------------------------------------

Description

Visual meteor rate data for the year 2011.

Usage

rate11

Format

A data frame with 4519 observations on the following 30 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 2011
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 fovRA numeric Right ascension of the center of the field of view
 fovDEC numeric Declination of the center of the field of view
 Teff numeric Effective observing time
 F numeric Correction factor for field-of-view obstruction
 lmg numeric Limiting magnitude
 SPO numeric Number of observed sporadics
 Shw1 factor Abbreviation of the first shower
 N1 numeric Number of meteors belonging to the first shower
 Shw2 factor Abbreviation of the second shower
 N2 numeric Number of meteors belonging to the second shower
 Shw3 factor Abbreviation of the third shower
 N3 numeric Number of meteors belonging to the third shower
 Shw4 factor Abbreviation of the forth shower

N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate95	<i>Rate data for the year 1995</i>
--------	------------------------------------

Description

Visual meteor rate data for the year 1995.

Usage

rate95

Format

A data frame with 5924 observations on the following 34 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 1995
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 fovRA numeric Right ascension of the center of the field of view
 fovDEC numeric Declination of the center of the field of view
 Teff numeric Effective observing time
 F numeric Correction factor for field-of-view obstruction
 lmg numeric Limiting magnitude

SP0 numeric Number of observed sporadics
 Shw1 factor Abbreviation of the first shower
 N1 numeric Number of meteors belonging to the first shower
 Shw2 factor Abbreviation of the second shower
 N2 numeric Number of meteors belonging to the second shower
 Shw3 factor Abbreviation of the third shower
 N3 numeric Number of meteors belonging to the third shower
 Shw4 factor Abbreviation of the forth shower
 N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower
 Shw7 factor Abbreviation of the 7th shower
 N7 numeric Number of meteors belonging to the 7th shower
 Shw8 factor Abbreviation of the 8th shower
 N8 numeric Number of meteors belonging to the 8th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate96

Rate data for the year 1996

Description

Visual meteor rate data for the year 1996.

Usage

rate96

Format

A data frame with 7531 observations on the following 34 variables.

IM0code factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees

NS factor North (N) or south (S) position from the equator
day numeric Day of the month
month numeric Month of the year
year numeric Year 1996
start numeric Beginning of the observing time period
stop numeric End of the observing time period
solllong numeric Solar longitude of the middle of observing time period
fovRA numeric Right ascension of the center of the field of view
fovDEC numeric Declination of the center of the field of view
Teff numeric Effective observing time
F numeric Correction factor for field-of-view obstruction
lmg numeric Limiting magnitude
SP0 numeric Number of observed sporadics
Shw1 factor Abbreviation of the first shower
N1 numeric Number of meteors belonging to the first shower
Shw2 factor Abbreviation of the second shower
N2 numeric Number of meteors belonging to the second shower
Shw3 factor Abbreviation of the third shower
N3 numeric Number of meteors belonging to the third shower
Shw4 factor Abbreviation of the forth shower
N4 numeric Number of meteors belonging to the forth shower
Shw5 factor Abbreviation of the fifth shower
N5 numeric Number of meteors belonging to the fifth shower
Shw6 factor Abbreviation of the 6th shower
N6 numeric Number of meteors belonging to the 6th shower
Shw7 factor Abbreviation of the 7th shower
N7 numeric Number of meteors belonging to the 7th shower
Shw8 factor Abbreviation of the 8th shower
N8 numeric Number of meteors belonging to the 8th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate97

*Rate data for the year 1997***Description**

Visual meteor rate data for the year 1997.

Usage

rate97

Format

A data frame with 9162 observations on the following 34 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 1997
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 fovRA numeric Right ascension of the center of the field of view
 fovDEC numeric Declination of the center of the field of view
 Teff numeric Effective observing time
 F numeric Correction factor for field-of-view obstruction
 lmg numeric Limiting magnitude
 SPO numeric Number of observed sporadics
 Shw1 factor Abbreviation of the first shower
 N1 numeric Number of meteors belonging to the first shower
 Shw2 factor Abbreviation of the second shower
 N2 numeric Number of meteors belonging to the second shower
 Shw3 factor Abbreviation of the third shower
 N3 numeric Number of meteors belonging to the third shower
 Shw4 factor Abbreviation of the forth shower

N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower
 Shw7 factor Abbreviation of the 7th shower
 N7 numeric Number of meteors belonging to the 7th shower
 Shw8 factor Abbreviation of the 8th shower
 N8 numeric Number of meteors belonging to the 8th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate98	<i>Rate data for the year 1998</i>
--------	------------------------------------

Description

Visual meteor rate data for the year 1998.

Usage

rate98

Format

A data frame with 12141 observations on the following 34 variables.

IMocode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 1998
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 fovRA numeric Right ascension of the center of the field of view

fovDEC numeric Declination of the center of the field of view
 Teff numeric Effective observing time
 F numeric Correction factor for field-of-view obstruction
 lmg numeric Limiting magnitude
 SP0 numeric Number of observed sporadics
 Shw1 factor Abbreviation of the first shower
 N1 numeric Number of meteors belonging to the first shower
 Shw2 factor Abbreviation of the second shower
 N2 numeric Number of meteors belonging to the second shower
 Shw3 factor Abbreviation of the third shower
 N3 numeric Number of meteors belonging to the third shower
 Shw4 factor Abbreviation of the forth shower
 N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower
 Shw7 factor Abbreviation of the 7th shower
 N7 numeric Number of meteors belonging to the 7th shower
 Shw8 factor Abbreviation of the 8th shower
 N8 numeric Number of meteors belonging to the 8th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

rate99

Rate data for the year 1999

Description

Visual meteor rate data for the year 1999.

Usage

rate99

Format

A data frame with 22137 observations on the following 34 variables.

IMOcode factor IMO observer code
 sitecode numeric IMO site code
 long numeric Longitude of the observing site in degrees
 EW factor East (E) or west (W) position from the prime meridian
 lat numeric Latitude of the observing site in degrees
 NS factor North (N) or south (S) position from the equator
 day numeric Day of the month
 month numeric Month of the year
 year numeric Year 1999
 start numeric Beginning of the observing time period
 stop numeric End of the observing time period
 sollong numeric Solar longitude of the middle of observing time period
 fovRA numeric Right ascension of the center of the field of view
 fovDEC numeric Declination of the center of the field of view
 Teff numeric Effective observing time
 F numeric Correction factor for field-of-view obstruction
 lmg numeric Limiting magnitude
 SP0 numeric Number of observed sporadics
 Shw1 factor Abbreviation of the first shower
 N1 numeric Number of meteors belonging to the first shower
 Shw2 factor Abbreviation of the second shower
 N2 numeric Number of meteors belonging to the second shower
 Shw3 factor Abbreviation of the third shower
 N3 numeric Number of meteors belonging to the third shower
 Shw4 factor Abbreviation of the forth shower
 N4 numeric Number of meteors belonging to the forth shower
 Shw5 factor Abbreviation of the fifth shower
 N5 numeric Number of meteors belonging to the fifth shower
 Shw6 factor Abbreviation of the 6th shower
 N6 numeric Number of meteors belonging to the 6th shower
 Shw7 factor Abbreviation of the 7th shower
 N7 numeric Number of meteors belonging to the 7th shower
 Shw8 factor Abbreviation of the 8th shower
 N8 numeric Number of meteors belonging to the 8th shower

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

read.magn	<i>Read magnitude data</i>
-----------	----------------------------

Description

Reads magnitude data from IMO site or saved file.

Usage

```
read.magn(data)
```

Arguments

data the name of the file or connection to read from.

Details

Argument data represents path to the file to be opened or a complete URL.

Value

A data frame containing a representation of the data in the file.

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

See Also

[read.rate](#)

Examples

```
## read magnitude data for the year 2011 from IMO site
read.magn("http://www.imo.net/files/data/vmdb/MAGN_11.TXT")
```

read.rate	<i>Read rate data</i>
-----------	-----------------------

Description

Reads rate data from IMO site or saved file.

Usage

```
read.rate(data)
```

Arguments

data the name of the file or connection to read from.

Details

Argument data represents path to the file to be opened or a complete URL.

Value

A data frame containing a representation of the data in the file.

Author(s)

Kristina Veljkovic

References

<http://www.imo.net/data/visual>

See Also

[read.magn](#)

Examples

```
## read rate data for the year 2011 from IMO site
read.rate("http://www.imo.net/files/data/vmdb/RATE_11.TXT")
```

shw_list	<i>List of meteor showers</i>
----------	-------------------------------

Description

The data consists of a list of visual meteor showers.

Usage

```
shw_list
```

Format

A data frame with 33 observations on the following 11 variables.

Shw factor Three-letter shower code

Name factor Shower name

Activity.beg factor The beginning of the activity period

Activity.end factor The end of the activity period

Max factor The date of maximum activity

Sollong numeric Solar longitude of the date of maximum

Alpha numeric Right ascension of radiant at date of maximum

Delta numeric Declination of radiant at date of maximum

V numeric Geocentric velocity of the stream

r numeric Population index of a meteor shower

ZHR numeric Zenithal Hourly Rate of meteor shower during maximum activity

Source

Meteor Shower Calendar, <http://www.imo.net/calendar>

solar.long	<i>Calculation of solar longitude</i>
------------	---------------------------------------

Description

Calculates solar longitude with respect to the equinox of 2000.0 for given year, month, day and time.

Usage

```
solar.long(year, month, day, time, prec=11)
```


Arguments

year	numeric vector of length 4 specifying year.
month	numeric vector specifying month of the year.
day	numeric vector specifying day.
time	numeric vector specifying time in hours.
prec	numeric vector specifying number of decimals of calculated solar longitude. By default it is equal to 11.

Value

solar.long returns numeric vector with a value between 0 and 360.

Author(s)

Kristina Veljkovic

References

Steyaert C. (1991). Calculating the Solar Longitude 2000.0, *WGN, Journal of the IMO*, 19:2, 31-34.

See Also

[filter.sol](#)

Examples

```
## calculate solar longitude for June 22, 2006, at 4h UT, rounded to 3 decimals
solar.long(year=2006,month=6,day=22,time=4,prec=3)
```

sollong_date

Calculation of date and time corresponding to given solar longitude

Description

Calculates calendar date and time corresponding to specified values of solar longitude and year.

Usage

```
sollong_date(year,value,month.beg=1,month.end=12,day.beg=1,day.end=31,
time.beg=0,time.end=2359)
```

Arguments

year	numeric vector of length 4 specifying year.
value	numeric vector specifying solar longitude.
month.beg	numeric vector specifying the beginning month. By default, month.beg is set to be equal to 1.
month.end	numeric vector specifying the ending month. By default, month.end is set to be equal to 12.
day.beg	numeric vector specifying the beginning day. By default, day.beg is set to be equal to 1.
day.end	numeric vector specifying the ending day. By default, day.end is set to be equal to 31.
time.beg	numeric vector (0-2359) specifying lower boundary of time in hours and minutes, corresponding to day.beg. By default, time.beg is set to be equal to 0.
time.end	numeric vector (0-2359) specifying upper boundary of time in hours and minutes, corresponding to day.end. By default, time.end is set to be equal to 2359.

Value

solar.long returns object of POSIXct class - calendar date plus time in hours, minutes and seconds, in UTC.

Author(s)

Kristina Veljkovic

See Also

[solar.long](#)

Examples

```
## calculate date and time corresponding to 0.9 solar longitude for year 2000,
## search between 1 and 31 March
sollong_date(year=2000,value=0.9,month.beg=3,month.end=3,day.beg=1,day.end=31)
```

vmdbpers

List of observers

Description

The data consists of a list of observers.

Usage

vmdbpers

Format

A data frame with 5920 observations on the following 4 factor variables.

Obsvr IMO observer code
 Name Observer's last name
 Firstname Observer's first name
 Country Observer's country

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

vmdbsite	<i>List of observing sites</i>
----------	--------------------------------

Description

The data consists of a list of observing sites.

Usage

vmdbsite

Format

A data frame with 2911 observations on the following 11 variables.

Site numeric IMO site code
 Name factor Name of the site
 Country factor Country of the observing site
 long.deg numeric Degrees component of longitude of the observing site
 long.min numeric Minutes component of longitude of the observing site
 long.sec numeric Seconds component of longitude of the observing site
 ew factor East (E) or west (W) position from the prime meridian
 lat.deg numeric Degrees component of latitude of the observing site
 lat.min numeric Minutes component of latitude of the observing site
 lat.sec numeric Seconds component of latitude of the observing site
 ns factor North (N) or south (S) position from the equator

Source

Visual Meteor Database, <http://www.imo.net/data/visual>

zhr	<i>Calculates zenithal hourly rate (ZHR)</i>
-----	--

Description

Calculates and plots average zenithal hourly rate of a meteor shower for a given rate data, specified shower, period of days, population index, minimum and maximum bin sizes, number of meteors and ZHR correction.

Usage

```
zhr(data, year, month.beg, month.end=month.beg, day.beg, day.end=day.beg,
time.beg=0, time.end=2359, shw, r=NULL, Ralpha=NULL, Delta=NULL, k1=0.01, k2=1, num, c=1,
data2=NULL, add.plot=FALSE, xlim1=NULL, xlim2=NULL, xinc=NULL, ylim1=NULL, ylim2=NULL,
yinc=NULL)
```

Arguments

data	data frame consisting of visual meteor rate data.
year	numeric vector of length 4 specifying year.
month.beg	numeric vector specifying the beginning month.
month.end	numeric vector specifying the ending month. By default, month.end is set to be equal to month.beg.
day.beg	numeric vector specifying the beginning day.
day.end	numeric vector specifying the ending day. By default, day.end is set to be equal to day.beg.
time.beg	numeric vector (0-2359) specifying lower boundary of time in hours and minutes, corresponding to day.beg. By default, time.beg is set to be equal to 0.
time.end	numeric vector (0-2359) specifying upper boundary of time in hours and minutes, corresponding to day.end. By default, time.end is set to be equal to 2359.
shw	character string consisting of three capital letters which represent meteor shower code.
r	numeric vector specifying population index of a meteor shower.
Ralpha	numeric vector with value between 0 and 360, specifying right ascension of the radiant, in degrees.
Delta	numeric vector with value between -90 and +90, specifying declination of the radiant, in degrees.
k1	numeric vector specifying minimum bin size, in degrees of solar longitude. By default, it is equal to 0.01.
k2	numeric vector specifying maximum bin size, in degrees of solar longitude. By default, it is equal to 1.
num	numeric vector specifying total number of meteors per interval.

<code>c</code>	numeric vector specifying value of ZHR correction. By default, it is equal to 1.
<code>data2</code>	data frame consisting of corresponding visual meteor magnitude data.
<code>add.plot</code>	logical vector. If TRUE, the population index is plotted.
<code>xlim1</code>	numeric vector specifying minimum value on x-axis.
<code>xlim2</code>	numeric vector specifying maximum value on x-axis.
<code>xinc</code>	numeric vector specifying increment between labels on x-axis.
<code>ylim1</code>	numeric vector specifying minimum value on y-axis.
<code>ylim2</code>	numeric vector specifying maximum value on y-axis.
<code>yinc</code>	numeric vector specifying increment between labels on y-axis.

Details

Adaptive-bin size algorithm is used. It tries to maintain a user-defined optimum meteor number per bin. For the case that not enough meteors are available, a maximum bin size is used.

Average zenithal hourly rate is calculated by the formula

$$ZHR = (c + \sum_i n_i) / (\sum_i T_{eff,i} / C_i), \quad i=1,2,\dots,k$$

where k is the number of observing periods, n_i - the raw number of meteors seen by each observer in observing period i , $T_{eff,i}$ - the effective time or amount of time an observer actually scans the sky for meteors during observing period i , and C_i - total correction factor that accounts for all the imperfections in the observing period i such as clouds, low radiant, low limiting magnitude.

Total correction factor is equal to

$$C_i = r^{(6.5 - lmg_i)} F_i / \sin(h_i),$$

where r is population index, lmg_i limiting magnitude, F_i correction factor for field-of-view obstruction, h_i radiant elevation for each observer in observing period i .

In the numerator, c is included to correct for the asymmetric high and low end possibilities in a Poisson distribution (distribution of the number of observed meteors).

Standard error of the average zenithal rate is calculated by the formula

$$\sigma = ZHR / \sqrt{c + \sum_i n_i}.$$

The spatial number density of meteoroids producing meteors of magnitude at least 6.5 is (per 10^9 km^3)

$$\rho = (10.65r - 12.15) ZHR / (3600 \cdot 178700 r^{(-1.82)} V),$$

where V is stream's geocentric velocity.

Standard error of spatial number density is approximated with

$$\sigma_{\rho} = \sigma \rho / ZHR.$$

If right ascension and declination of shower radiant are not specified, the values from the data frame `radiant` are used. If population index is not specified, it is calculated using the function `pop.index2` and then incorporated in the calculation of ZHR.

Value

Data frame containing following vectors

start factor Calendar date and time in UTC of left bound of time interval

stop factor Calendar date and time in UTC of right bound of time interval

sollong numeric Solar longitude corresponding to the middle of time interval

nINT numeric Number of observing time intervals

nSHW numeric Number of observed meteors. String SHW is replaced with the code of meteor shower.

ZHR numeric Zenithal Hourly Rate

st.err numeric Standard error of ZHR

density numeric Spatial number density

dens.err numeric Standard error of spatial number density

If `add.plot` is TRUE, additionally xy plot of Zenithal Hourly Rate is made. Solar longitude is on x-axis and population index on y-axis. ZHR is represented with black filled circles and 68% confidence intervals. Values of limits (minimum and maximum values) on x and y axis (`xlim1,xlim2,ylim1,ylim2`), as well as increments between the axis labels (`xinc,yinc`) should be provided to function call.

Author(s)

Kristina Veljkovic

References

Rendtel J. and Arlt R., editors (2008). *IMO Handbook For Meteor Observers*. IMO, Potsdam.

Bias, P.V. (2011). A Note on Poisson inference and extrapolations under low raw data and short interval observation conditions. *WGN, Journal of the IMO*,39:1, 14-19.

See Also

[pop.index2](#)

Examples

```
## calculate ZHR for observations of 1997 Perseids, time period
## 27th July to 16th August, radiant elevation higher than 20 degrees,
## total correction factor smaller than 5, bin size 1 degree, population index 2.2
## First select rate data for Perseids activity - time period 15th July to 24th August,
## radiant elevation higher than 20 degrees, total correction factor smaller than 5
## data(rate97)
## rate<-filter(rate97,year=1997,month.beg=7,month.end=8,day.beg=27,day.end=16,
## shw="PER",h.low=20)
## zhr(rate,year=1997,month.beg=7,month.end=8,day.beg=27,day.end=16,
## shw="PER",r=2.2,k1=1,num=300)

## make graphic of ZHR
```

```
## x-axis limits: min(sollong)=124.549, max(sollong)=144.110
## y-axis limits: min(ZHR-st.err)=5.1,max(ZHR+st.err)=68.6
## zhr(rate,year=1997,month.beg=7,month.end=8,day.beg=27,day.end=16,shw="PER",r=2.2,
## k1=1,num=300,add.plot=TRUE,xlim1=124,xlim2=145,xinc=1,ylim1=5,ylim2=70,yinc=5)

## calculate ZHR around maximum activity of 1997 Perseids, time period 10th August 19h
## to 14th August 7h, radiant elevation higher than 20 degrees, total correction
## factor smaller than 5 and population index calculated from magnitude data
## data(magn97)
## magn<-filter(magn97,year=1997,month.beg=7,month.end=8,day.beg=15,day.end=24,
## shw="PER",h.low=20)
## zhr(rate,year=1997,month.beg=8,day.beg=10,day.end=14,time.beg=1900,time.end=700,
## shw="PER",data2=magn,num=300)

## make graphic of ZHR around max activity of 1997 Perseids
## x-axis limits: min(sollong)=138.252, max(sollong)=141.471
## y-axis limits: min(ZHR-st.err)=24.7,max(ZHR+st.err)=141.4
## zhr(rate,year=1997,month.beg=8,day.beg=10,day.end=14,time.beg=1900,time.end=700,
## shw="PER",data2=magn,num=300,add.plot=TRUE,xlim1=138.2,xlim2=141.5,xinc=0.1,
## ylim1=20,ylim2=150,yinc=10)
```

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