Software for analysis of visual meteor data

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SOFTWARE

- R package MetFns
  cran.r-project.org/web/packages/MetFns/

- Java application MetRApp
  bitbucket.org/ivail/mettrapp
CONTENTS

- data frames containing visual meteor data
- functions for manipulation of the data
Data

- rateXX - yearly rate data
- magnXX - yearly magnitude data
- accompanying data:
  - radiant - coordinates of shower radiant throughout the year
  - shw_list - list of observed meteor showers
  - vmdbpers - list of observers
  - vmdbsite - list of observing sites
 FUNCTIONS

- Read visual meteor data from IMO site
  - *read.rate(data)* - read rate data
  - *read.magn(data)* - read magnitude data
- Select (filter) data by one or more criteria
- Perform calculations over data
- Draw graphics
Filter functions

- `filter.shw(data, shw)` filter by shower code
- `filter.date(data, year, month, day.beg, day.end=day.beg)` filter by date(s)
- `filter.time(data, time.low, time.up)` filter by time period
- `filter.imocode(data, imocode)` filter by IMO observer code
- `filter.obsname(data, name, fname)` filter by observer’s first and last name
FILTER FUNCTIONS

- `filter.gc(data,long.low=0,long.up=180, ew=c("E","W"), lat.low=0,lat.up=90, ns=c("N","S"))` filter by geographical coordinates
- `filter.site(data, site)` filter by name of the site
- `filter.country(data, country)` filter by country
- `filter.sol(data,sol.low=0,sol.up=359.999)` filter by solar longitude
- `filter.F(data,F.low=1.0,F.up=3.0)` filter by correction factor for clouds (rate data)
FILTER FUNCTIONS

- `filter.mag(data,mag.low=2.0,mag.up=7.5)` filter by limiting magnitude
- `filter.h(data,shw,Ralpha=NULL,Delta=NULL,h.low=10,h.up=90)` filter by radiant elevation
- `filter.totcor(data,shw,Ralpha=NULL,Delta=NULL,r,C=5)` filter by total correction factor (rate data)
- `filter` global filter - various data selections, wrapper function for all filters
Filter functions

- Example: select rate data for observations of Orionids, period 21-22th October 2006, limiting magnitude of 5.5 and above, total correction factor below 5.

```r
filter(rate06, shw="ORI", year=2006, month=10, day.beg=21, day.end=22, mag.low=5.5, r=2.5)
```

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Calculation functions

- `solar.long(year, month, day, time)` - calculation of solar longitude with respect to the equinox of 2000.0
- `pop.index(data, year, month, day.beg, day.end=day.beg, shw, mag=-6:7)` - calculation of population index of a meteor shower
- `zhr(data, year, month, day.beg, day.end, shw, r=NULL, Ralpha=NULL, Delta=NULL, k, c=1)` calculates average zenithal hourly rate (ZHR)
Calculation functions

Example: select visual meteor data for observation of Orionids, period 20-24th October 2006, 12hrs time intervals, and calculate ZHR

\[
\text{rateOri} \leftarrow \text{filter(rate06, shw="ORI", year=2006, month=10, day.beg=20, day.end=24)}
\]
\[
\text{zhr(rateOri, year=2006, month=10, day.beg=20, day.end=24, shw="ORI", r=2.5, k=12)}
\]
## Calculation functions

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DRAWING GRAPHS FUNCTIONS

- zhr.graph(data, year, month, day.beg, day.end=day.beg, shw, r=NULL, Ralpha=NULL, Delta=NULL, k,c=1,type=c("UTC","sol")) - graphic of Zenithal Hourly Rate
  - xy plot of Zenithal Hourly Rate
  - time (UTC) or solar longitude on x-axis and ZHR on y-axis
  - ZHR -black filled circles with one sigma error bars

- mag.distr(data, year, month, day.beg, day.end=day.beg, shw) - graphic of magnitude distribution
  - histogram
  - boxplot
**Motivation**

- Provide easy-to-use environment for R package
- Enable anyone to use our software without any necessary knowledge of R programming language
DEPENDENCIES

Because there is none programmatical access to IMO data, our app has many dependencies.
FILTERS

![Image of filter settings in MetFns application]

- Filters can be applied by various criteria such as date, observer's IMO code, observer's first and last name, latitude and longitude, observer's site name, country, limiting magnitude, time period, solar longitude, and elevation.
- Options include selecting specific parameters like year, month, day begin, day end, IMO code, first name, last name, lower and upper longitude, lower and upper latitude, lower and upper magnitude, and specific time periods.
- The application allows for global filtering options as well.
Dataset representation
SOFTWARE ARCHITECTURE

- Data tier (possible problems with maintainability of versions of data)
- Logic tier ((Almost) all R filters had to be re-implemented)
- Presentation tier (At some point, this app should be moved to the web)
CONCLUSION

- All software is made to be upgradeable
- All resources are publicly available