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/metrapp`

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.

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

IMOcode	sitecode	day	month	year	start	stop	sollong	Teff	F	lmg	SPO	Shw	N
BADPI	16131	21	10	6	10	120	207.392	1	1	6.4	9	ORI	19
RENJU	11152	21	10	6	55	113	207.405	0.3	1	6.16	3	ORI	9
RENJU	11152	21	10	6	113	143	207.421	0.5	1.02	6.15	4	ORI	18
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
STOWE	25971	22	10	6	1116	1132	208.828	0.25	1	7	4	ORI	21
STOWE	25971	22	10	6	1132	1147	208.839	0.25	1	7.1	6	ORI	22
STOWE	25971	22	10	6	1147	1203	208.85	0.25	1	7.1	3	ORI	13

CALCULATION FUNCTIONS

- *solar.long(year, month, day, time)* - calculation of solar longitude with respect to the equainox 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

```
rateOri<-filter(rate06,shw="ORI",year=2006,month=10
day.beg=20,day.end=24)
zhr(rateOri,year=2006,month=10,day.beg=20,
day.end=24,shw="ORI",r=2.5,k=12)
```

CALCULATION FUNCTIONS

day	month	year	start	stop	sollong	nINT	nORI	ZHR	st.err	density	dens.err
20	10	2006	0	12	206.617	33	389	30	1.5	54.3	2.7
20	10	2006	12	24	207.114	14	157	39.4	3.17	71.1	5.7
21	10	2006	0	12	207.611	38	810	46.6	1.6	84.3	3
21	10	2006	12	24	208.108	54	690	53.1	2	95.9	3.6
22	10	2006	0	12	208.606	122	1882	52.1	1.2	94.2	2.2
22	10	2006	12	24	209.104	24	240	38.8	2.5	70	4.5
23	10	2006	0	12	209.602	43	644	47.5	1.9	85.7	3.4
23	10	2006	12	24	210.1	5	54	49.6	6.7	89.6	12.1
24	10	2006	0	12	210.598	23	326	39.2	2.2	70.8	3.9
24	10	2006	12	24	211.096	8	30	20.7	3.7	37.3	6.7

DRAWING GRAPHS FUNCTIONS

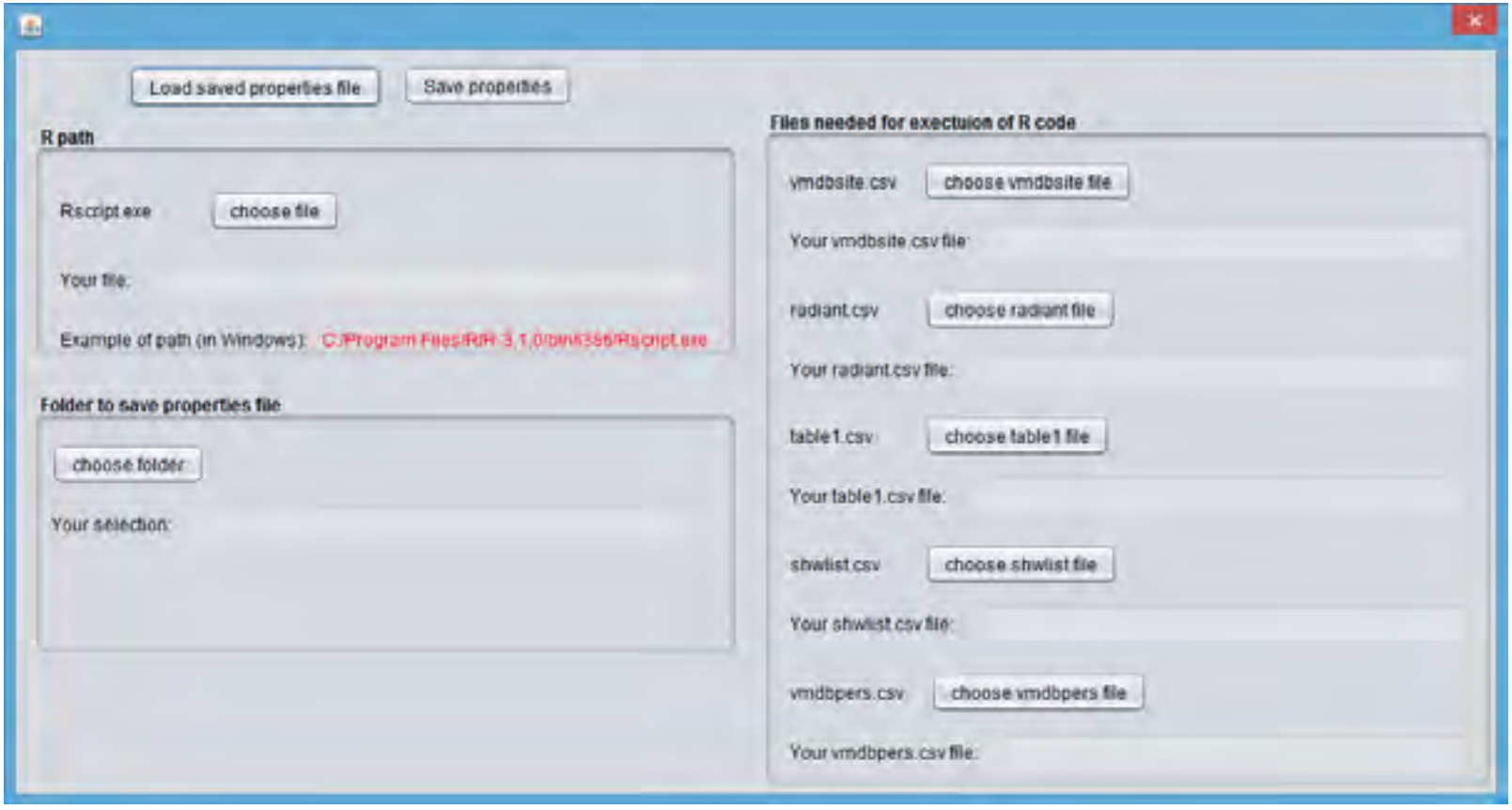
- *zhr.graph(data,year,month, day.beg, day.end=day.beg,shw, r=NULL, Ralpha=NULL, Delta=NULL, k,c=1,type=c("UTC","sol"))* - graphic of Zenithal Hourly Rate
  - xy plot of Zenithal Hourly Rate
  - time (UTC) or solar longitude on x-axis and ZHR on y-axis
  - ZHR -black filled circles with one sigma error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

MOTIVATION

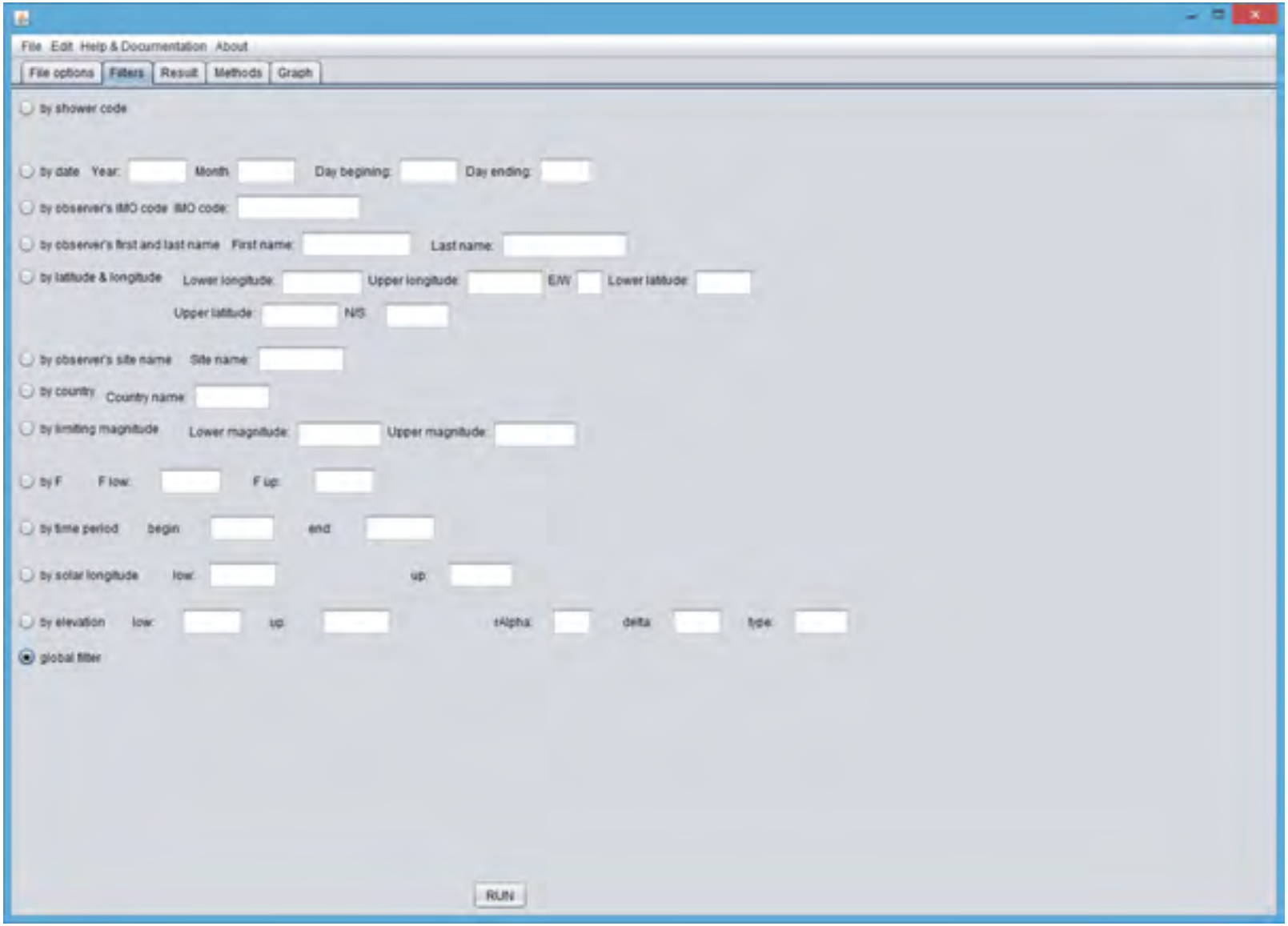
- Provide easy-to-use environment for R package
- Enable anyone to use our software without any necessary knowledge of R programming language

DEPENDENCIES

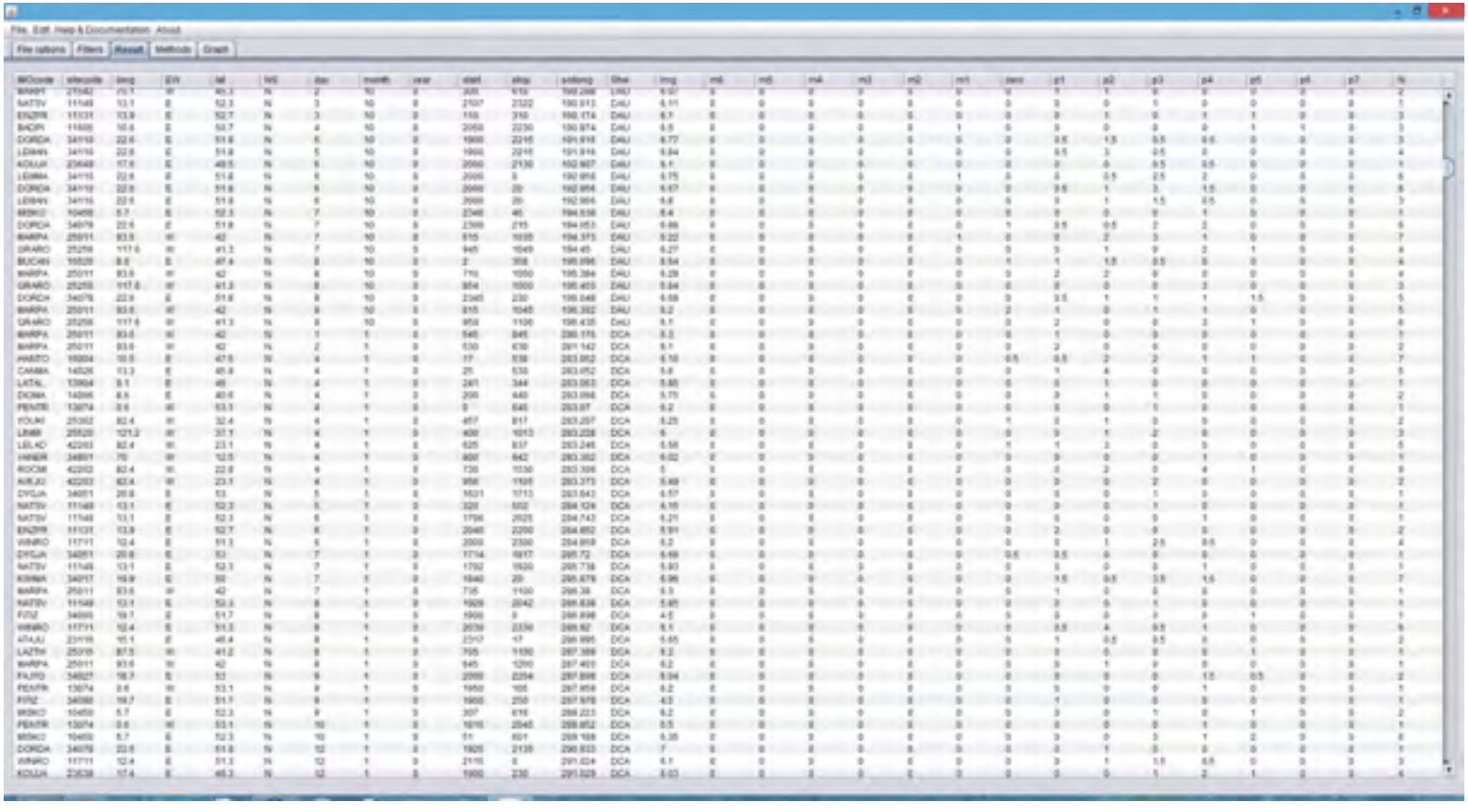
Because there is none programmatical access to IMO data, our app has many dependencies.



FILTERS


File Edit Help & Documentation About
File options
Filters
Result
Methods
Graph
by shower code
by date Year: Month: Day begining: Day ending:
by observer's IMO code IMO code:
by observer's first and last name First name: Last name:
by latitude & longitude Lower longitude: Upper longitude: E/W: Lower latitude:
Upper latitude: N/S:
by observer's site name Site name:
by country Country name:
by limiting magnitude Lower magnitude: Upper magnitude:
by F F low: F up:
by time period begin: end:
by solar longitude low: up:
by elevation low: up: rAlpha: delta: type:
global filter
RUN

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