Some chronobiologic applications of the Chronomics Analysis Toolkit in R

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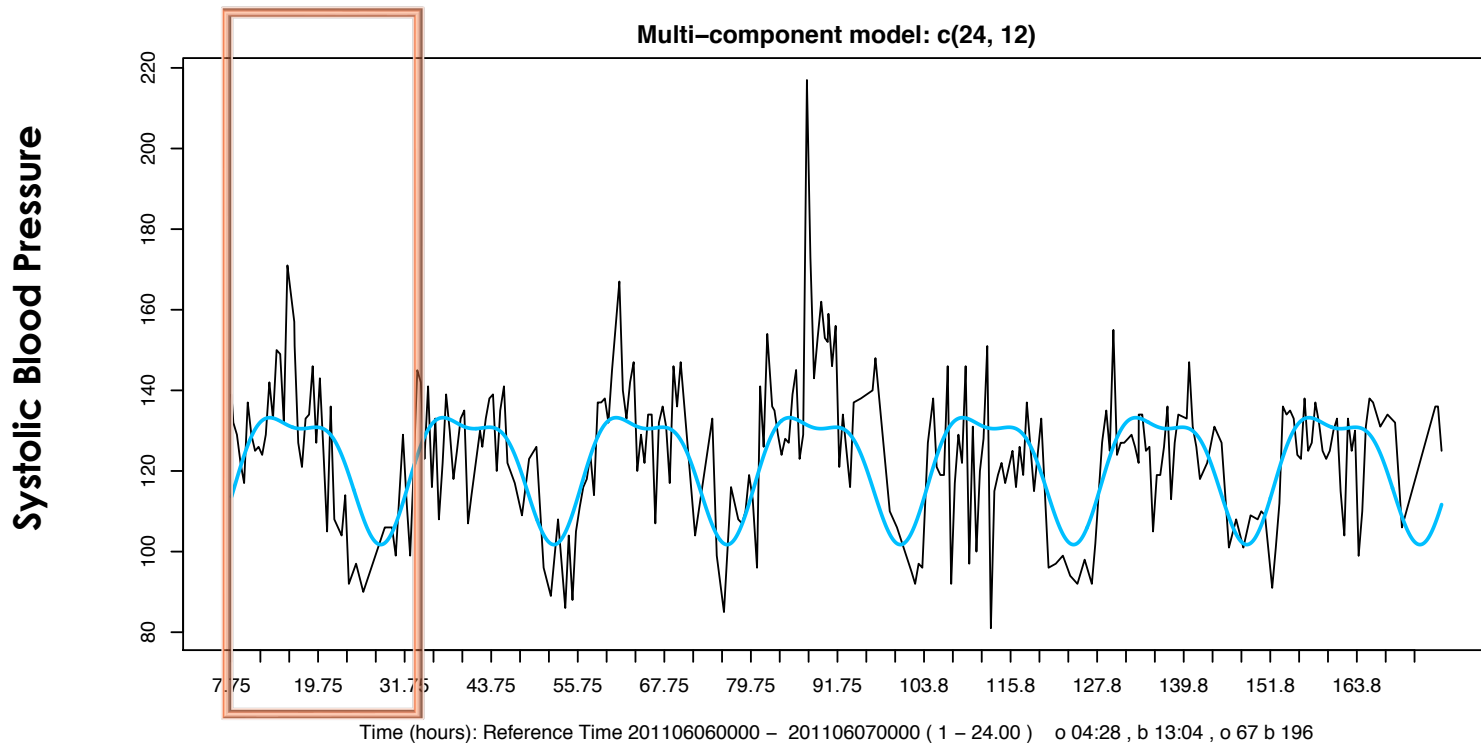# CATkit, R suite, performs rhythm analyses

Visual Assessment

- ☐ Actogram,
- ☐ Smoothing,
- ☐ Autocorrelation,
- ☐ Crosscorrelation,
- ☐ Periodogram by FFT

Only equidistant data

Quantitative results

- ☐ **Single-component cosinor;**
- ☐ **Multiple-component cosinor;**
- ☐ **Least squares spectrum;**
- ☐ **Serial section cosinor;**
- ☐ **Gliding spectrum**

Multiple-component cosinor model: SBP variation over 7 days

Multi–component model: c(24, 12)

Systolic Blood Pressure

Time (hours): Reference Time 201106060000 – 201106070000 (1 – 24.00)   o 04:28 , b 13:04 , o 67 b 196
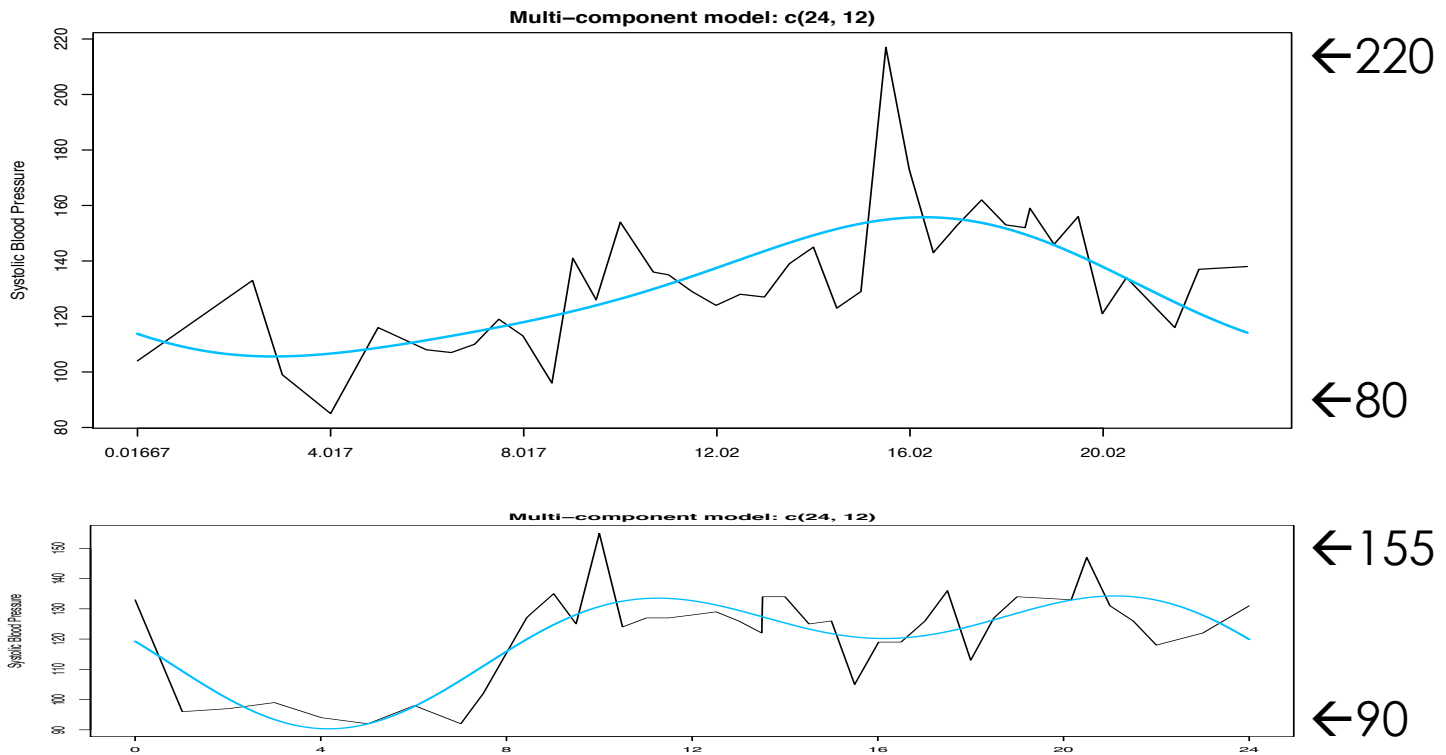
Multiple-component cosinor model

Two sinus waves are fitted to one week of data: 24 hours & 12 hours
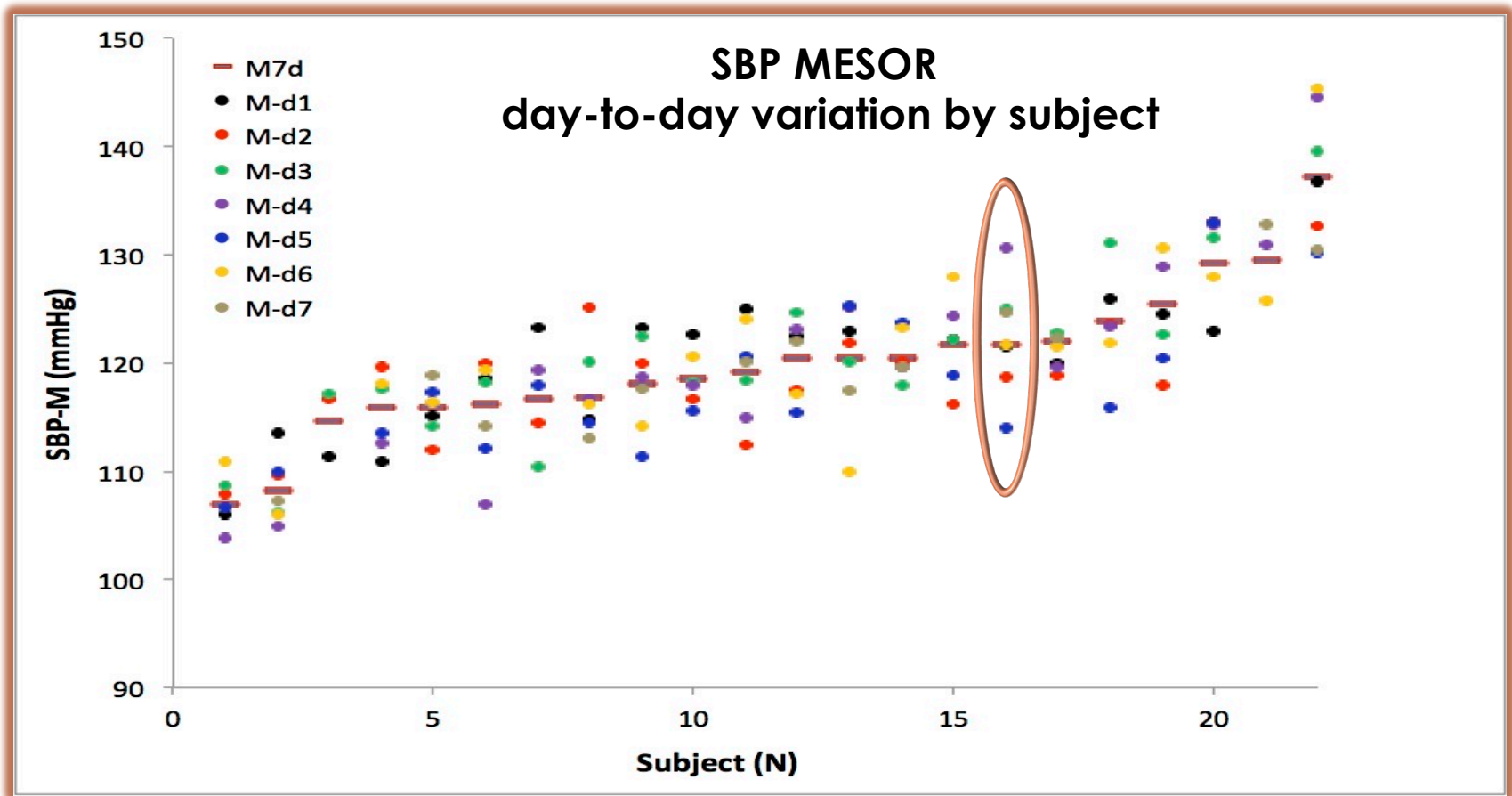7 full compound cycles can be seen in the 7 day plot. Siegelova.

Multiple-component cosinor model: 24 & 12 hours
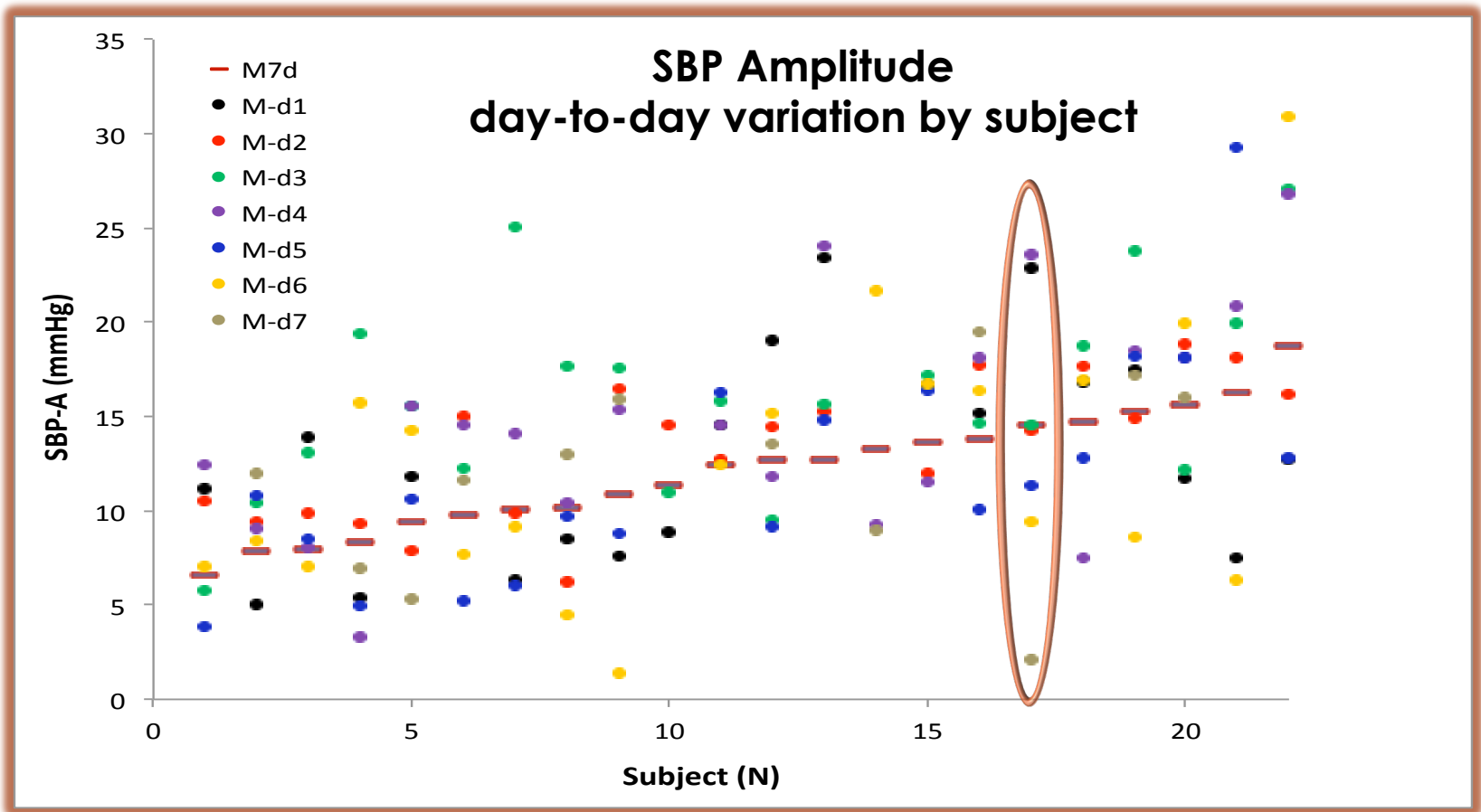**Subject 7: SBP variation on day 4**

Multiple-component cosinor model

Two sinus waves are fitted to one day of data: 24 hours;   12 hours
1 full compound cycles.

SBP MESOR
day-to-day variation by subject

Daily SBP MESOR by Subject

SD of MESOR of SBP varies from 6.4 to 1.6 between days. Average Average MESOR of SBP varies from 107 to 137 between subjects.

Daily SBP Amplitude by Subject

SD of Amplitude of SBP varies from 8.5 to 1.3 between days. Average Amplitude of SBP varies from 6.6 to 18.7 between subjects.

Bland-Altman	N	SD	LOA-	LOA	Bias	Paired-t	P
			MESOR				
M		3.7	-7.5	7.1	-0.2	0.490	0.625
Day-to-Day avg – 7-day avg --- Vs --- 7-day Average							
F		3.7	-7.4	7.0	-0.2	0.436	0.664
			24-hour Amplitude				
M		4.9	-8.4	11.0	1.3	2.554	0.012
Day-to-Day avg – 7-day avg --- Vs --- 7-day Average							
F		3.1	-5.5	6.8	0.6	2.008	0.048
F	Diff Ex vs No Ex	20	3.6	-4.7	9.4	2.3	2.920	0.009

Bland-Altman: difference from mean

Angina pectoris incidence by time of day and week
14 years of data stacked over 1 week,
Sunday to Saturday

Column: 2 ;   2000−12−31 00:00 −− 2001−01−07 00:00

Time (hour) from reference date: 2000−12−31
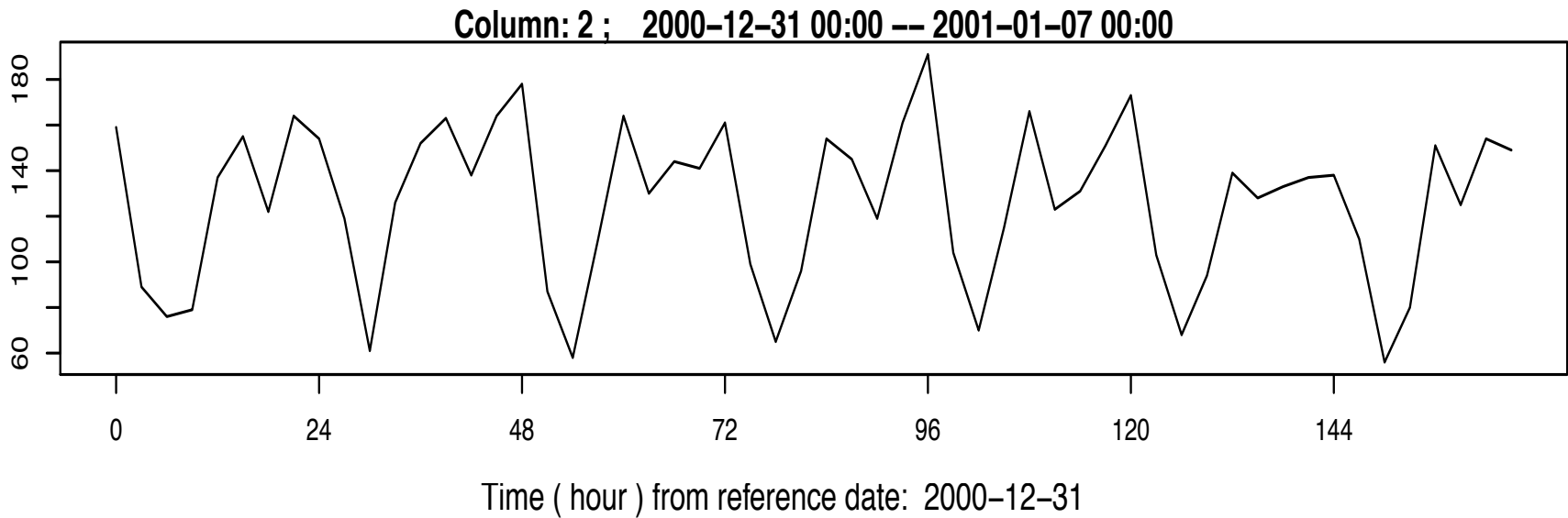
Angina pectoris by time of day

Ambulance calls related to angina pectoris (ICD10, code I20)
(Khanty database, D Gubin, Siberia)

**Angina pectoris incidence 1:10 by time of day and week**
14 years of data stacked over 1 week

24 hrs   12 hrs

1/Cycle[CycleLen:1]

1/Cycle[CycleLen:1]
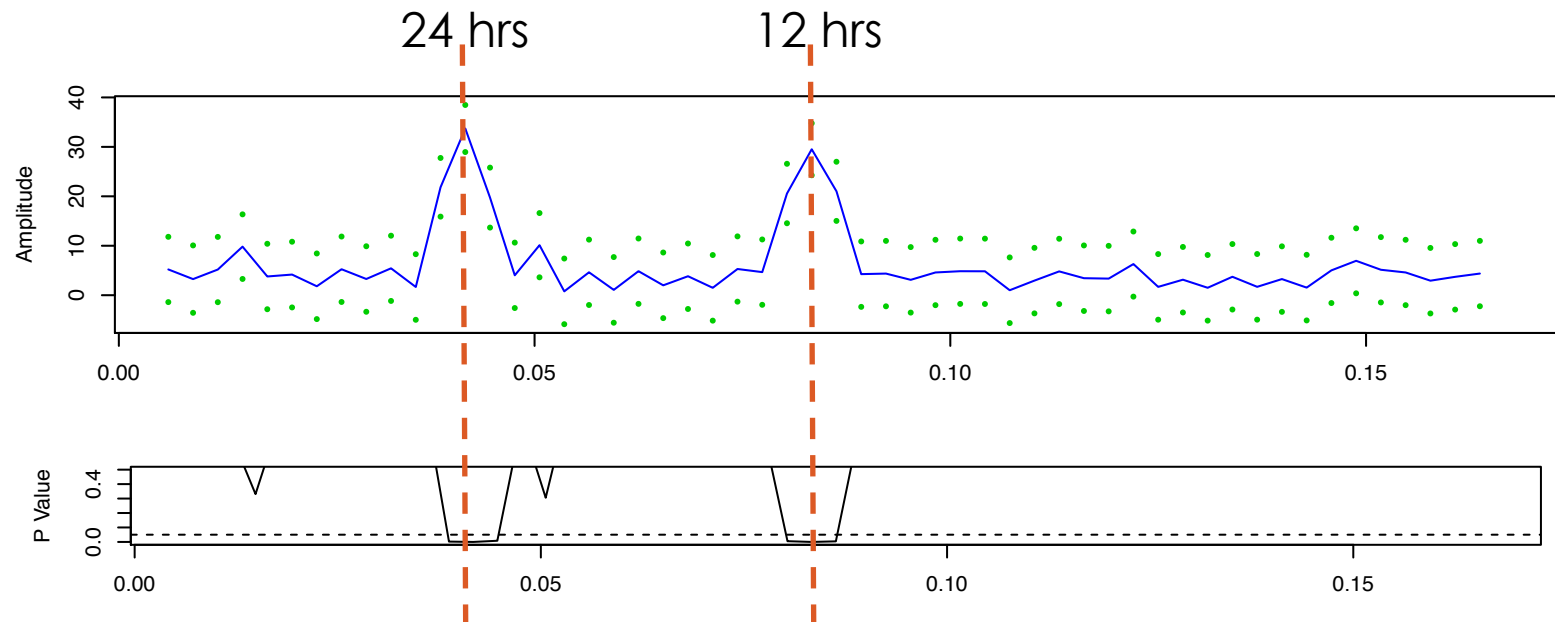
Least Squares spectrum by Cosinor

Two harmonics show up clearly: 24 hours and 12 hours
P values show statistical significance for both.

Angina pectoris incidence by time of day and week
14 years of data stacked over 1 week
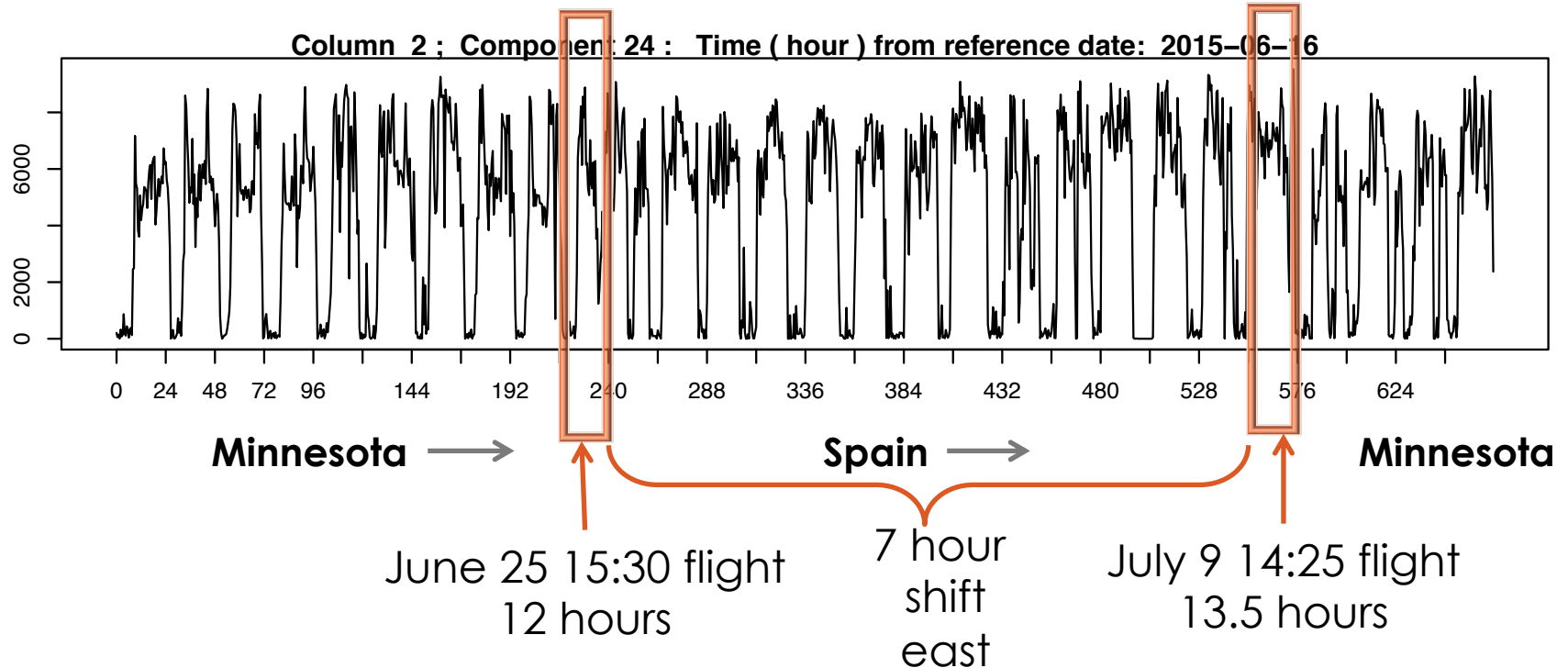
Multi−component model: c(24, 12)
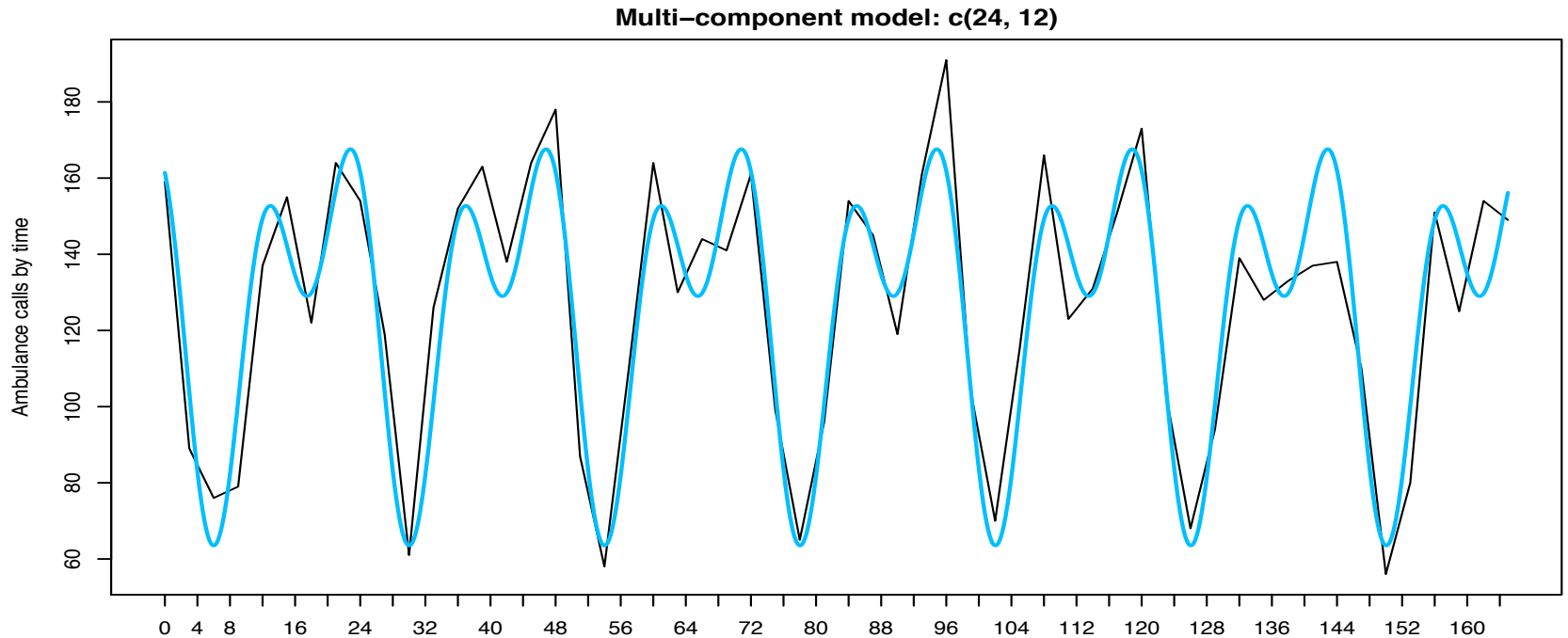
Multiple Components cosinor model

24 and 12 hour cosines used to model the data, overlaid with data.

Ambulance calls for ICD10, code I20 for angina pectoris.

Actigraphy: ZCM activity data

Transatlantic flight shifts circadian activity rhythm
June 16, 2015 to July 13, 2015

Column 2 ; Component: 24 : Time (hour) from reference date: 2015-06-16

Minnesota → **Spain** → **Minnesota**
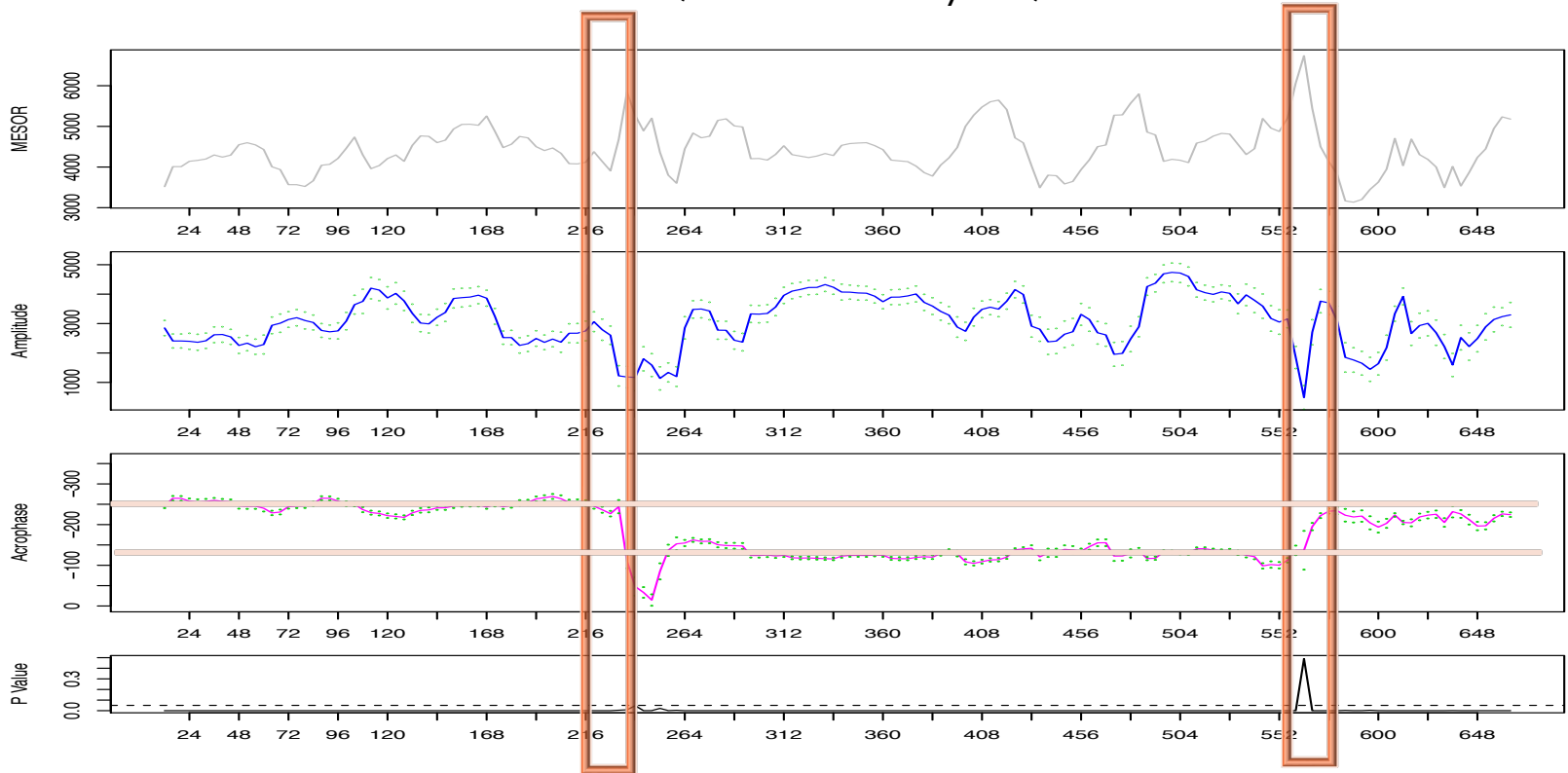
June 25 15:30 flight
12 hours

7 hour
shift
east

July 9 14:25 flight
13.5 hours

Data collected before, during and after a transatlantic shift in time zones. June 25 – July 9 are 7 hours different.

Transatlantic flight shifts circadian activity rhythms
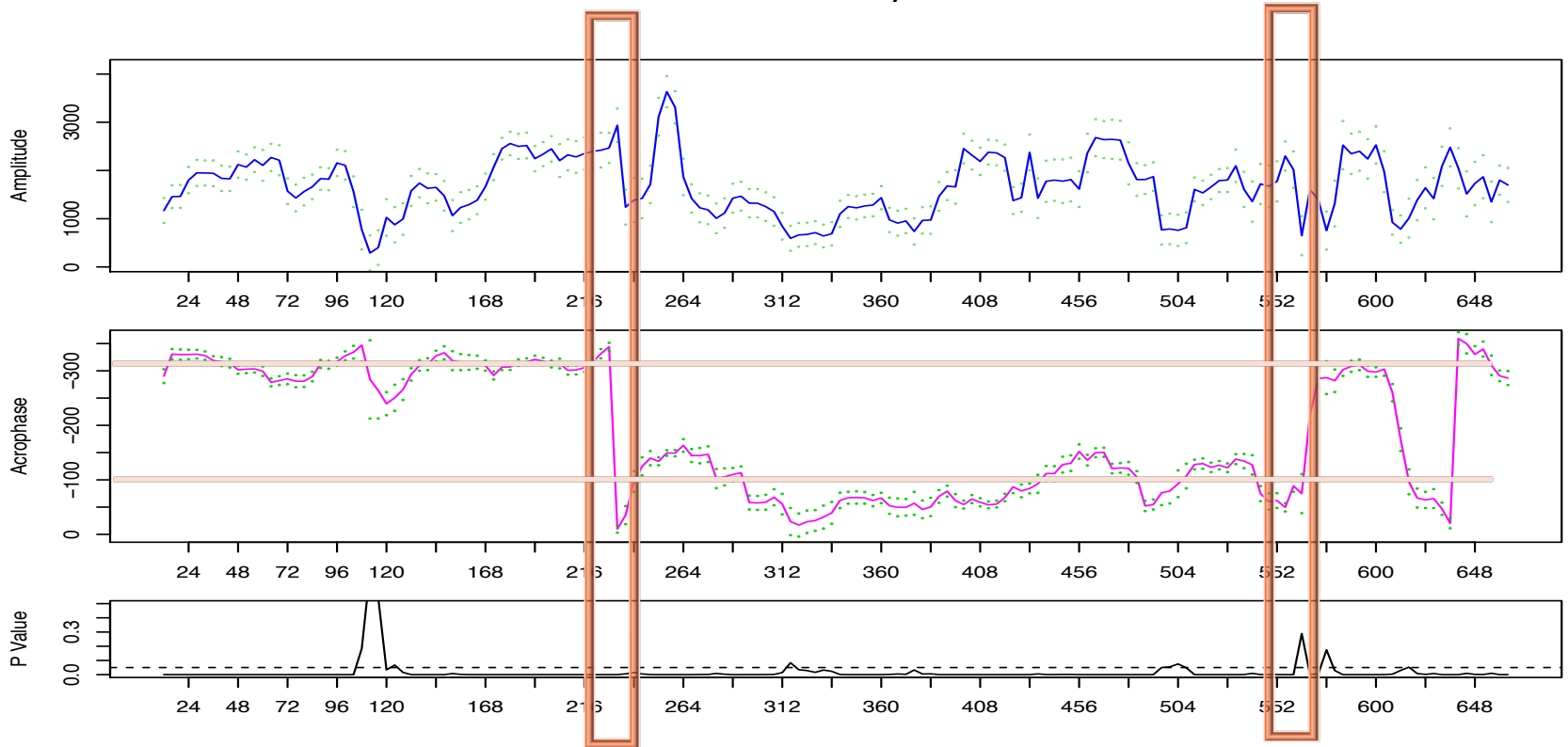June 16, 2015 to July 13, 2015

24-hr period. Serial section 24-hr spans moved by 4 hrs. (from multi-component fit)

Phase shift due to time change: Δφ ~ 7 hrs

Transatlantic flight shifts circadian activity rhythms
June 16, 2015 to July 13, 2015

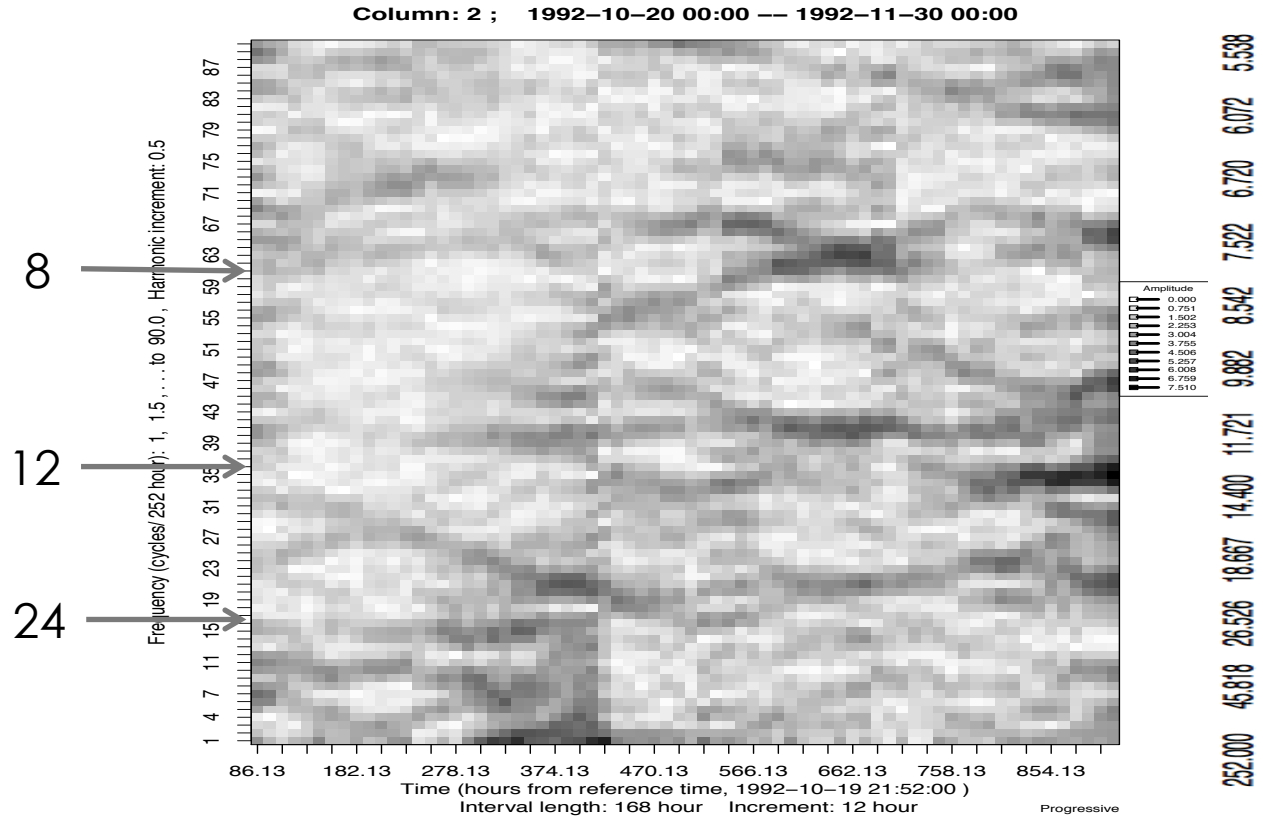12-hr period: Serial section 24-hr spans moved by 4 hrs. (from multi-component fit)

Phase shift due to time change: Δφ ~ 7 hrs

Gliding Spectrum: 40 days   1992/10/20 19:48:00 to 1992/11/29 17:02:00
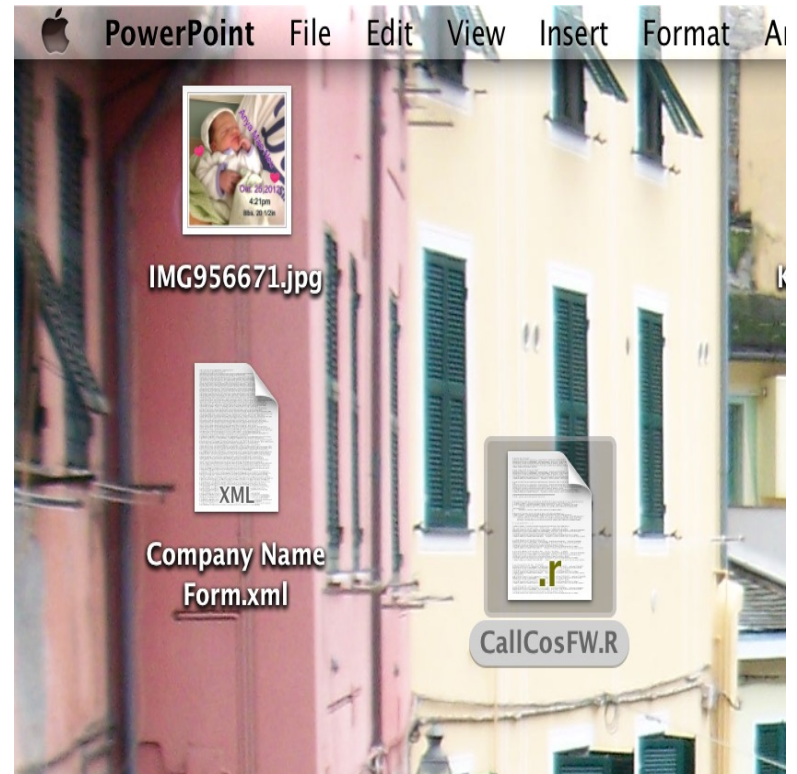
Gliding Spectrum: days 0 – 40 (960 h)

A spectrum of SBP frequencies is assessed for successive, overlapping spans of 168 hours moved by 12 hours, giving a 3-dimensional visual readout.

Running CATkit

- Install R

- z.umn.edu/CATkit

- .r file on the desktop

- Double click to run

- Slight changes in the script are madefor each new technique

Call to CATkit

```
CATCosinor(
TimeCol=1,Y=c(2,5), Components=1,

RefDateTime="199210192152",
timeFormat="%Y%m%d%H%M",
RangeDateTime=list(Start="199211230000", End="199211300000"),
fileName=fileName, functionName="FWeditedLWK-HRsp"

Progressive=list(Interval=0, Increment=0),

Period=list(Set=0,Start=168,Increment=.5,End=5.5),
)
```
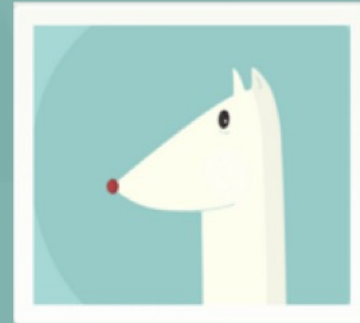
Thank you!

Halberg Chronobiology Center

CATkit: z.umn.edu/CATkit