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LECTURE 07

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# Temporal Data Visualization



75% of 4000 sample of graphics  
from newspapers and magazines  
(‘74 – ’80) were time-series data!



# Time Series

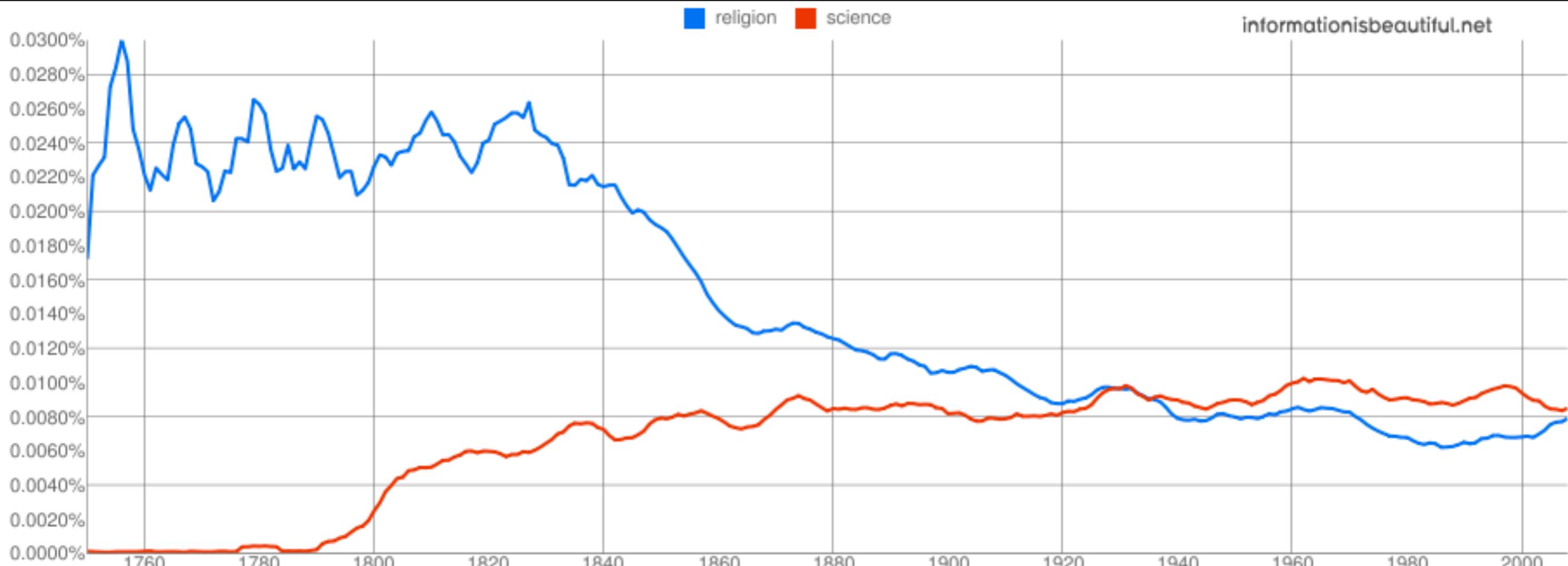
- ▶ A Sequences of events/observations which are ordered in one dimension - TIME!
- ▶ continuous: sampled at every instance of time
- ▶ discrete: sampled only by regular/irregular time interval



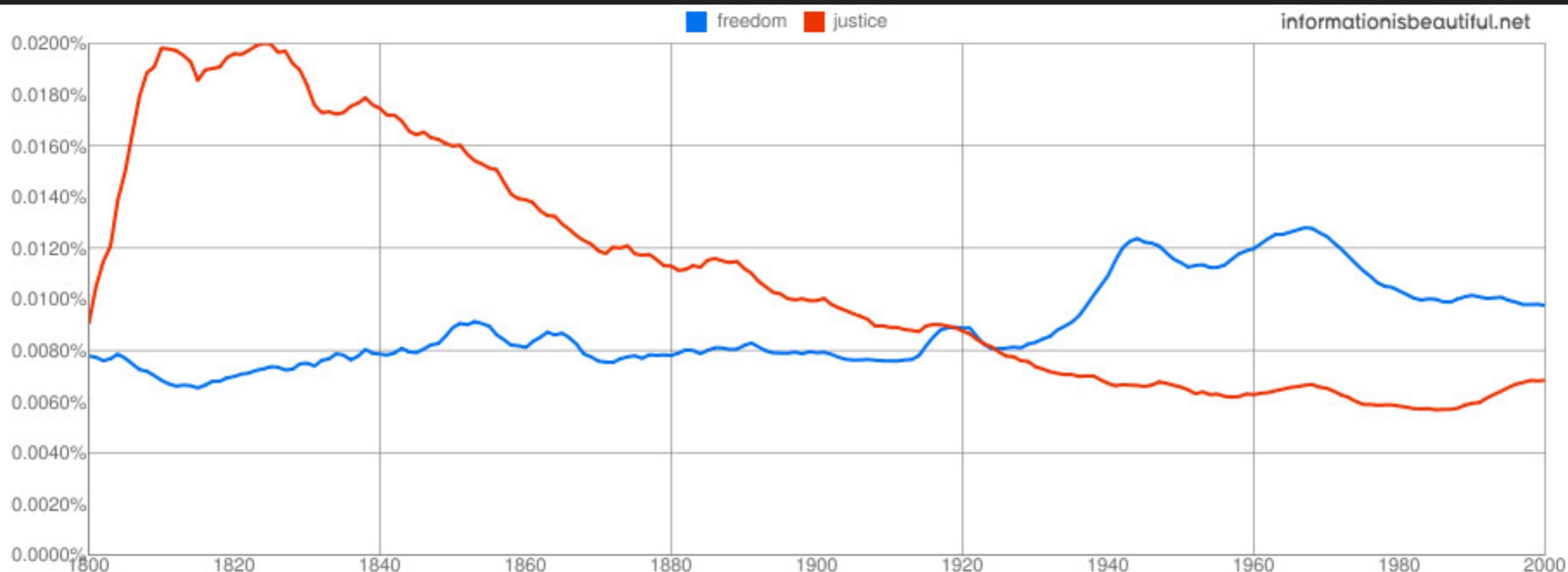
# Examples Of Time Series

- ▶ Streams of email
- ▶ Stocks prices
- ▶ Logs of activity of users (in websites, software or other stuff)
- ▶ Soccer games
- ▶ Medicine taken
- ▶ Cities visited
- ▶ Sunspot activity
- ▶ ...

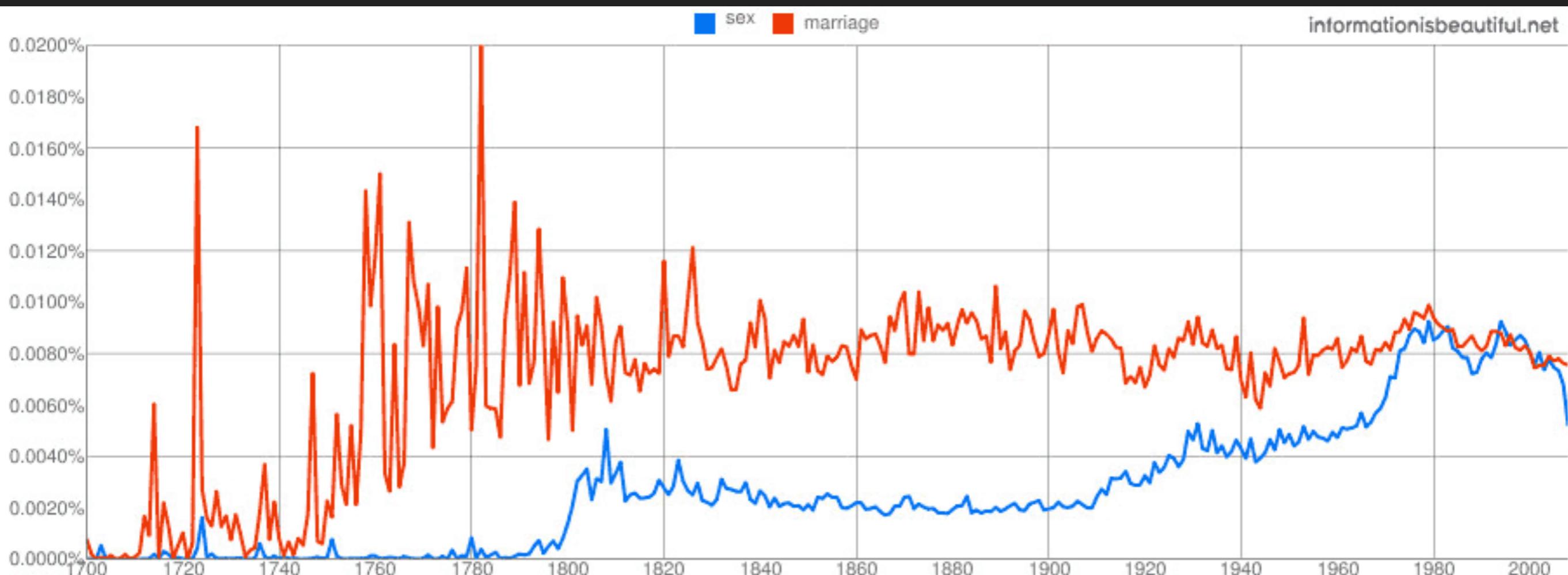
**5 Million Books over 500 Years**



What is more important, **religion** or **science**?



What is more important, freedom or justice?



sex vs. marriage

# Analysis Goals

- ▶ Forecasting (predicting future values of a time series)  

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- ▶ Identifying patterns in time series data  

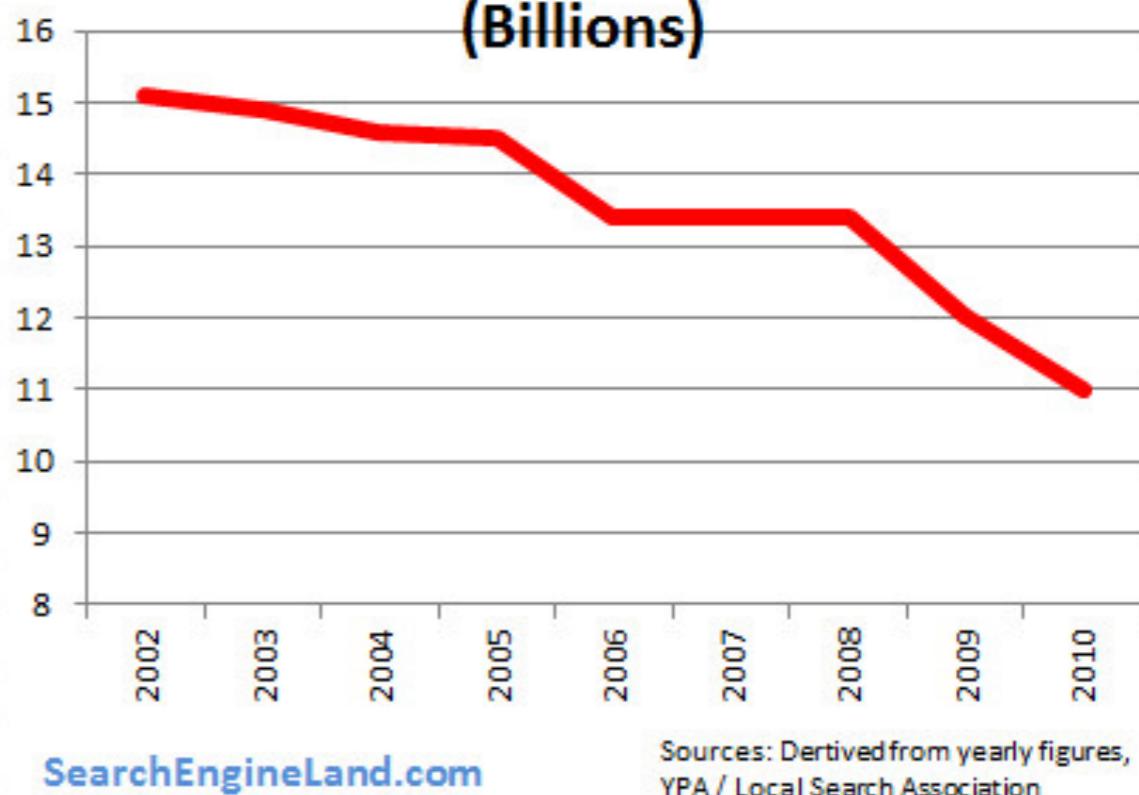
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- ▶ Systematic patterns and random noise
- ▶ Trends (increase, decrease)
- ▶ Seasonality

# Standard Representation

### Stock Price Changes Since June 1, 2007



### Printed Yellow Pages References (Billions)



Week of Nov 1, 2010 :

■ AAPL 317.13



# Categorization Of Time Series Visualizations

- ▶ What are the characteristics of the time-oriented data?

TIME

- ▶ What is analyzed?

DATA

- ▶ How is it represented?

REPRESENTATION

# Time Series Characteristics

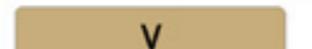
## Time Points

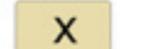
a

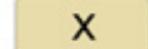
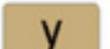
 equals ( $x, y$ )  


 before ( $x, y$ )  


b

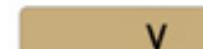
 equals ( $x, y$ )  


 meets ( $x, y$ )  


 before ( $x, y$ )  


## Time Intervals

 during ( $x, y$ )  

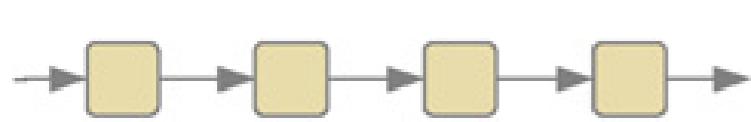

 starts ( $x, y$ )  


 overlaps ( $x, y$ )  


 finishes ( $x, y$ )  

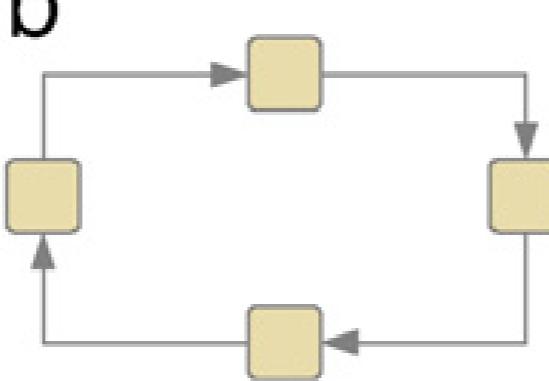

## Linear

a



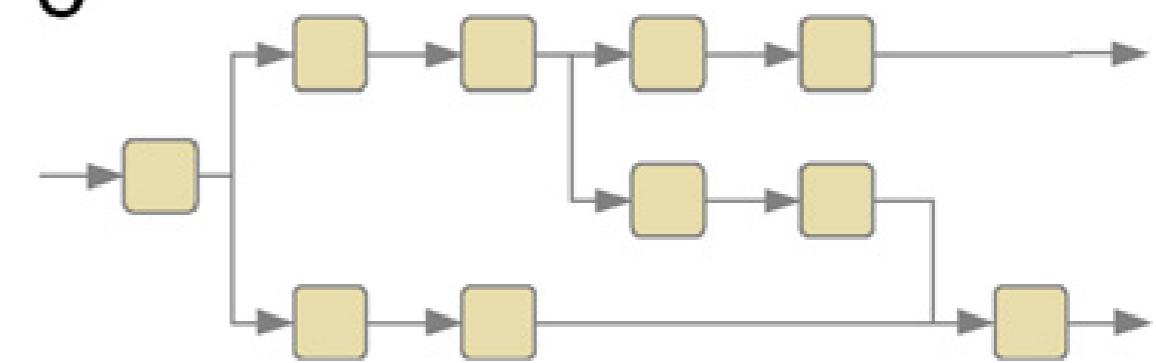
## Cyclic

b



## Branching

c



- ▶ What are the characteristics of the time-oriented data?

TIME

- ▶ What is analyzed?

DATA

- ▶ How is it represented?

REPRESENTATION

# Data

- ▶ CONTEXT
  - ▶ abstract vs. spatial
- ▶ NUMBER OF VARIABLES
  - ▶ univariate vs. multivariate
- ▶ LEVEL OF ABSTRACTION
  - ▶ aggregation vs. features vs. events

# Representation

# Calendar-based



1 - 7 Feb 2010



Mon, 1 Feb

Tue, 2 Feb

Wed, 3 Feb

Thu, 4 Feb

Fri, 5 Feb

Sat, 6 Feb

Sun, 7 Feb

All Day				Lynette Dee's birthd	Return library books		
8 am							
9 am	School class meeting						
10 am		Reading in class		Coffee with John			
11 am							
12 pm	Lunch with Brenda						
1 pm							
2 pm	Pick up shopping				Dentist Appointment		
3 pm			Football Practice				
4 pm				School Performance Rehearsal			
5 pm							
6 pm	Swimming					Sleepover at Jennie's	
7 pm		Scouts					
8 pm			Dinner with Simon & Sarah				
9 pm						NBA LA Lakers v Sacramento	
10 pm							



Home



Notes



Calendar



Mail



Address Book



Shopping



Recipes



Internet



Settings

# WHATEVER THE WEATHER

An overview of the weather conditions during the last twenty years of the Design Week in Milan has shown that this has never been a lucky week for the meteorological weather.

In 2003, in fact, the Design week was even covered with snow and the average of temperature was 9°C: not really the kind of weather expected in April! The best Design week for weather was

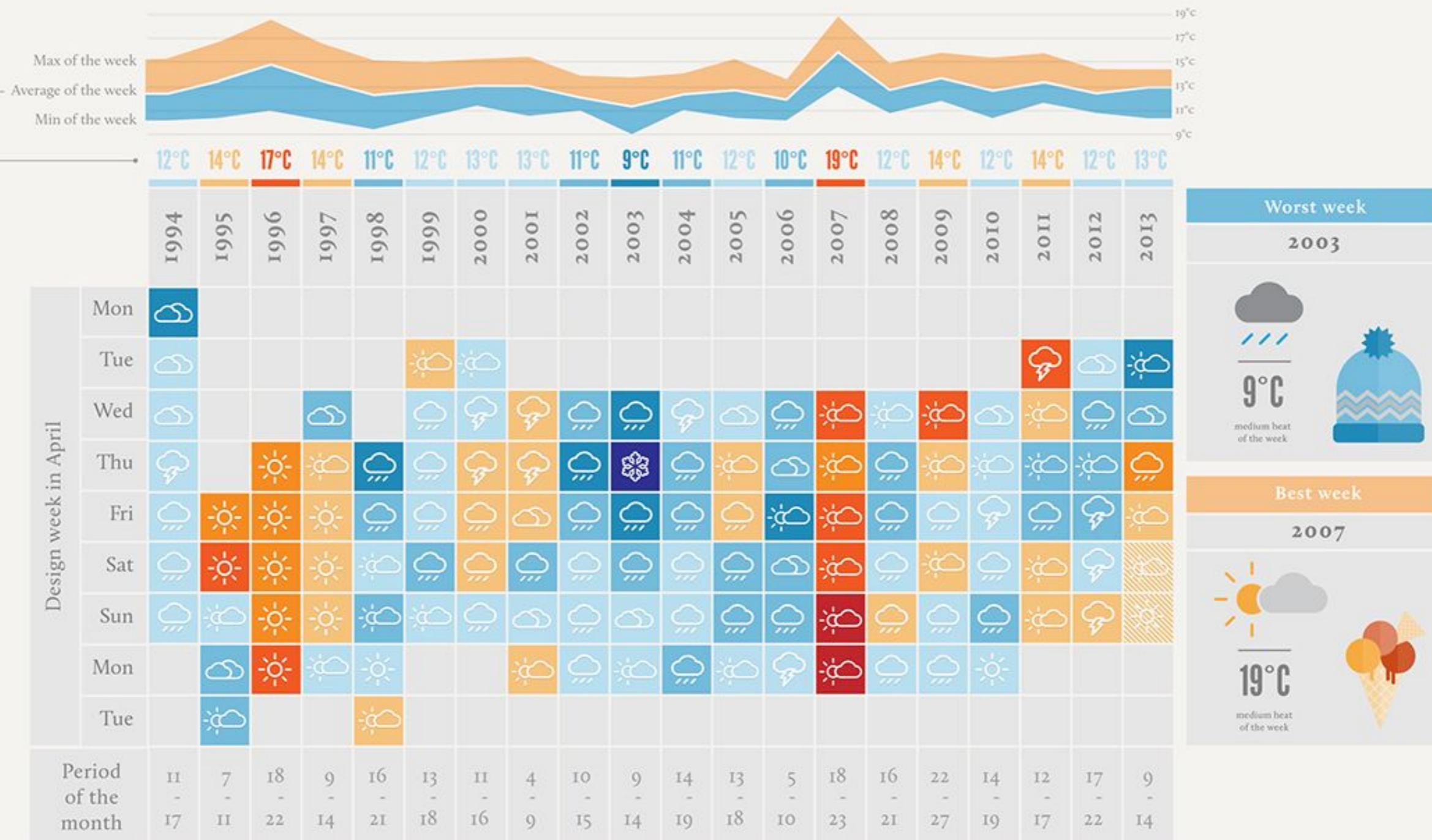
instead in 2007 when the average of temperature was 19°C: a really good time for an ice-cream. No matter the bad or good weather, we all know we're gonna do a tour around the city during the

Design week as it is one of the most important event for design in Milan. The data set was taken from the archive of meteo.it and wunderground.com.

PROJECT BY:  
Gabriele Calvi  
Martina Elisa Cecchi

## Legend

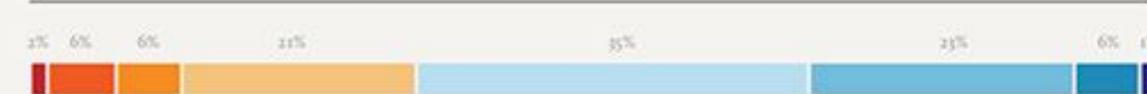
Temperature in °c degree
> 19°C
18 - 19°C
16 - 17°C
14 - 15°C
12-13°C
10-11°C
8-9°C
< 8°C
Forecasts



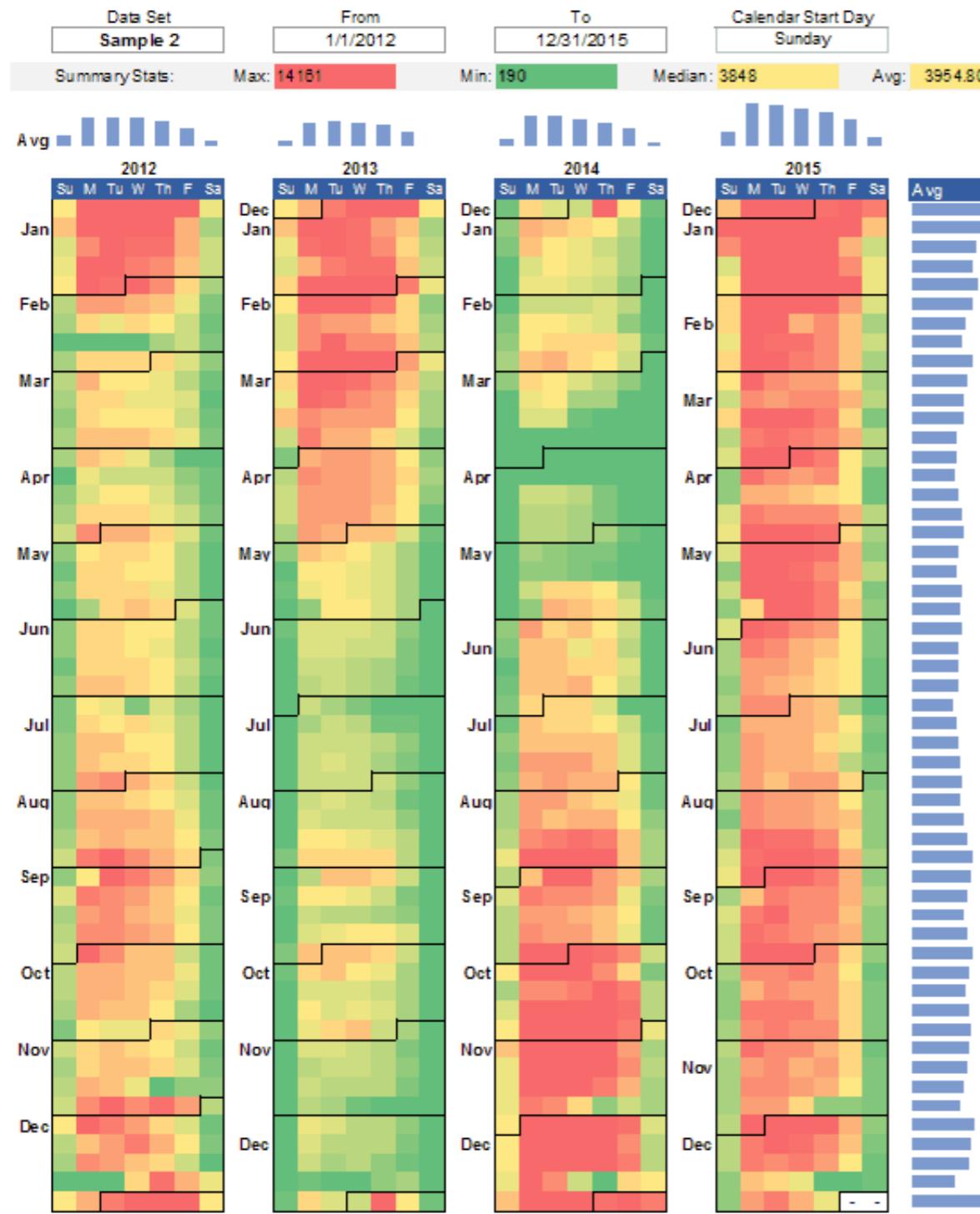
Weather conditions percentage during 20 years



Temperature percentage during 20 years

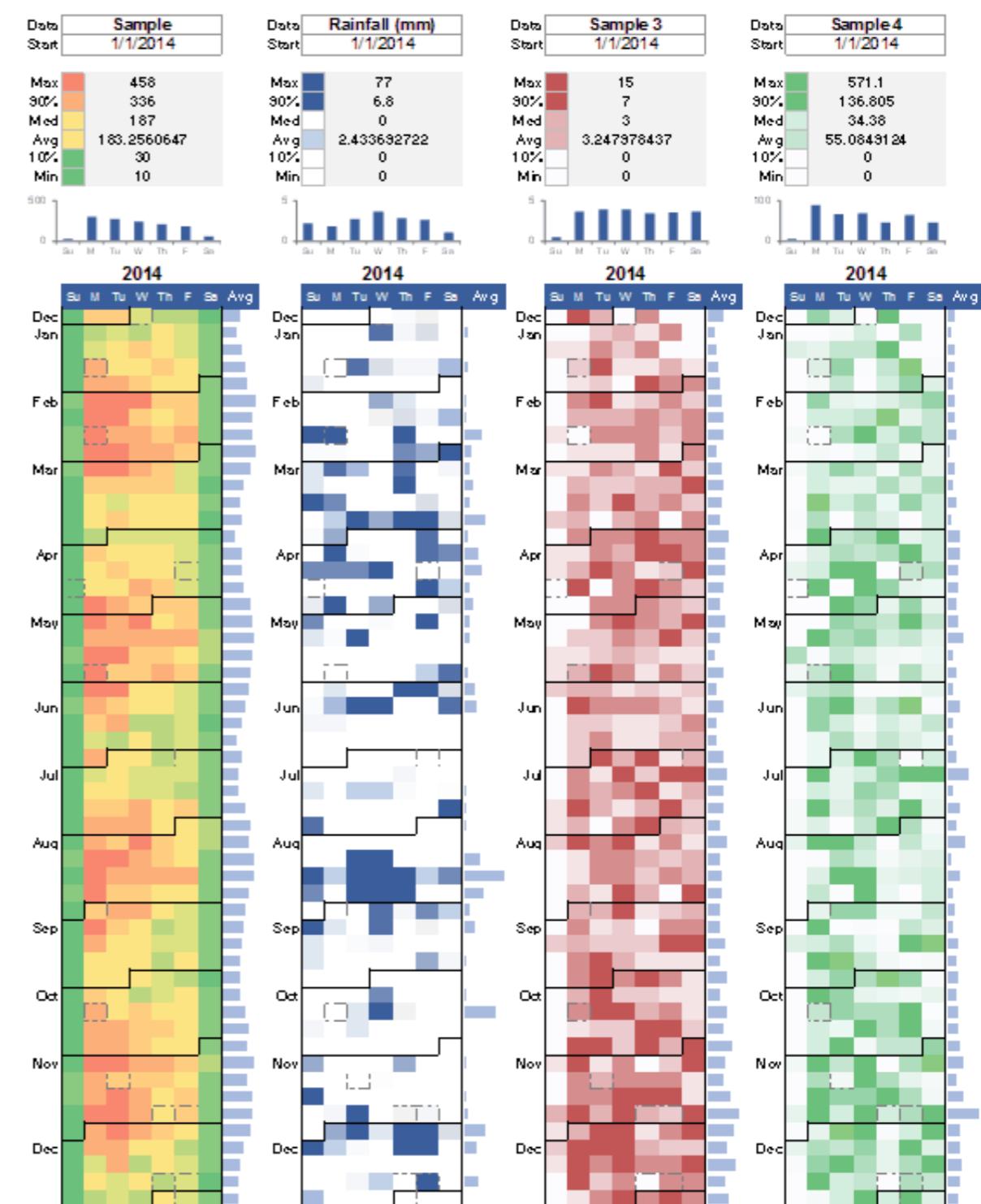


## Calendar Chart



<http://www.vertex42.com/ExcelTemplates/calendar-chart.html>

## Calendar Chart

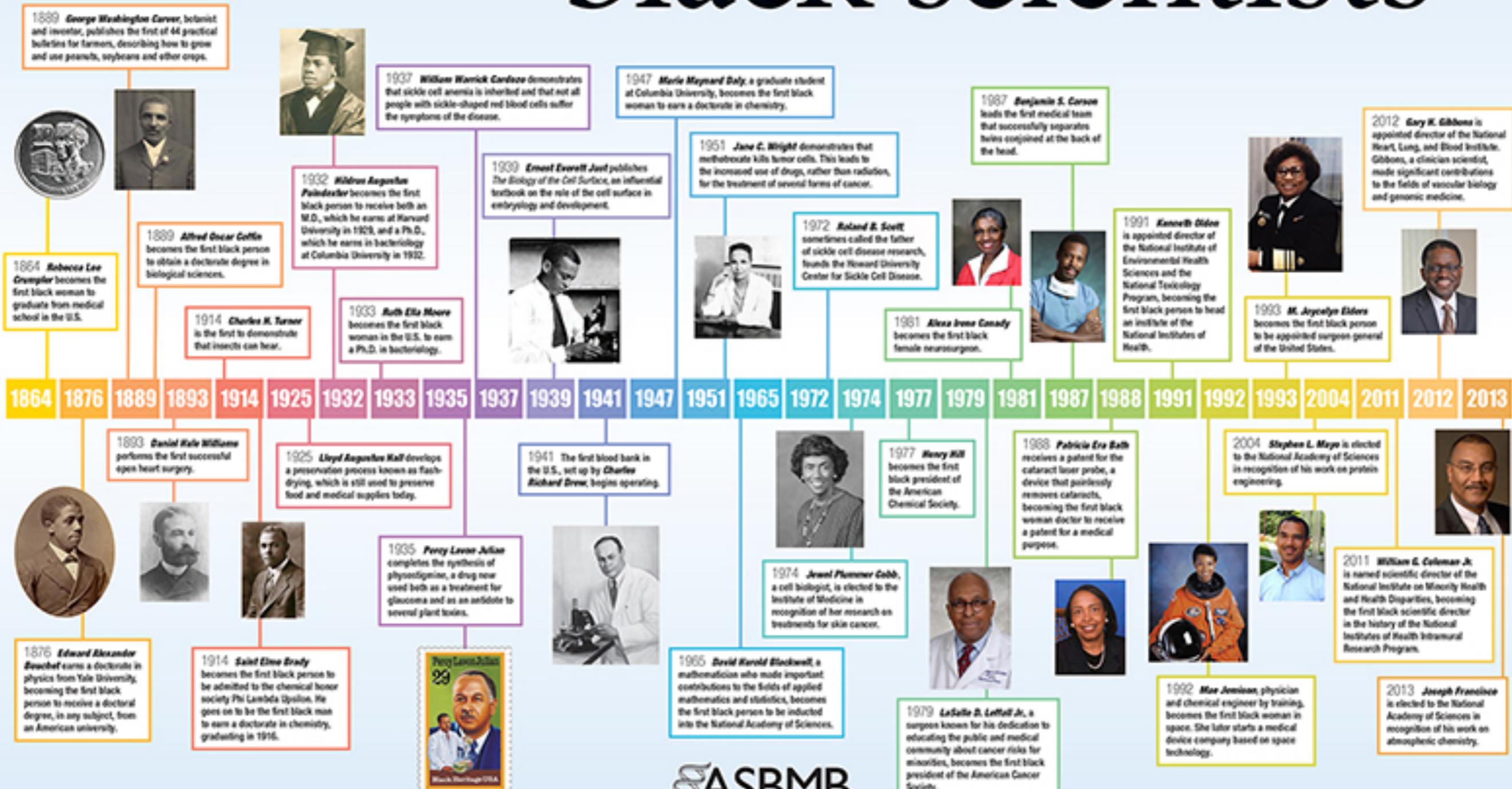


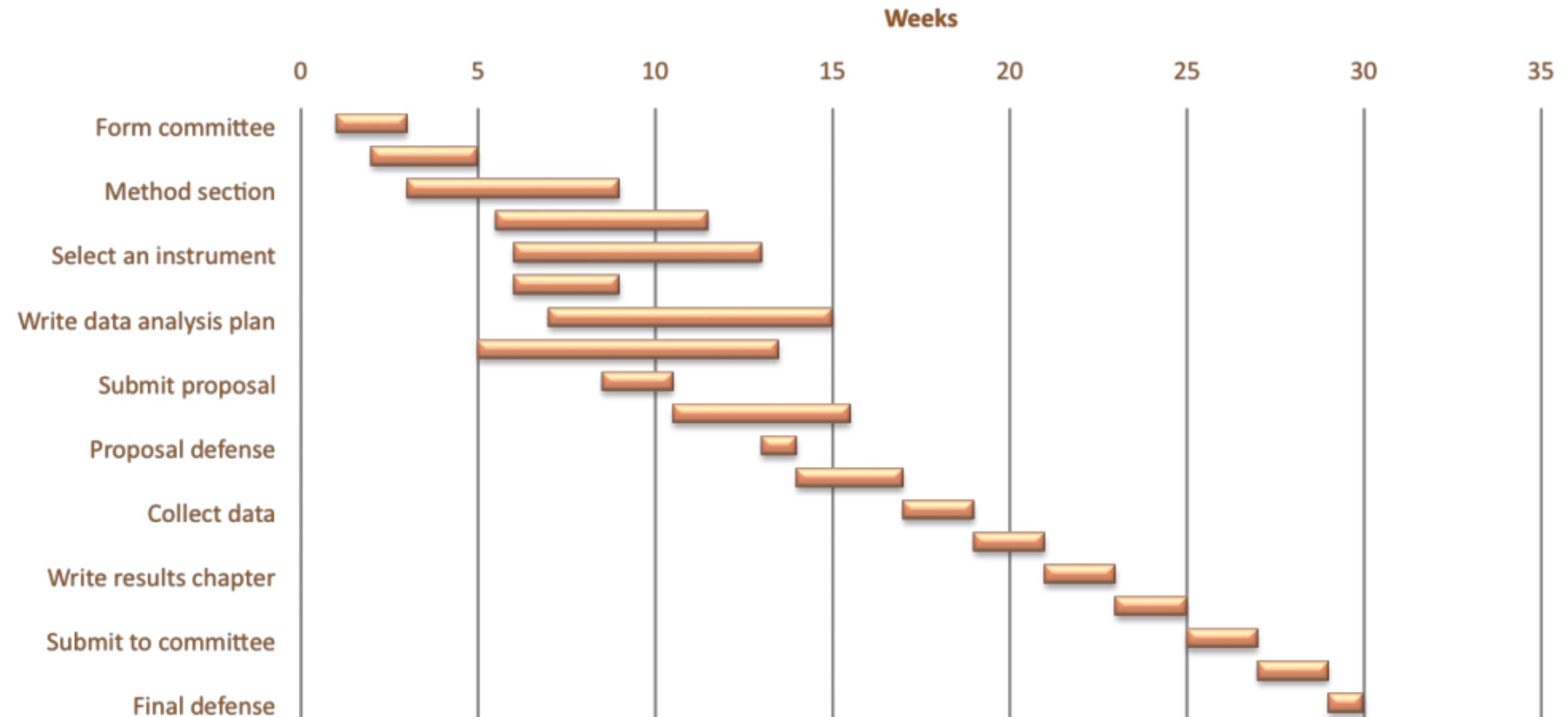
<http://www.vertex42.com/ExcelTemplates/calendar-chart.html>

Calendar Chart Template © 2016 by Vertex42.com

# **Timeline-based**

# A HISTORY OF black scientists

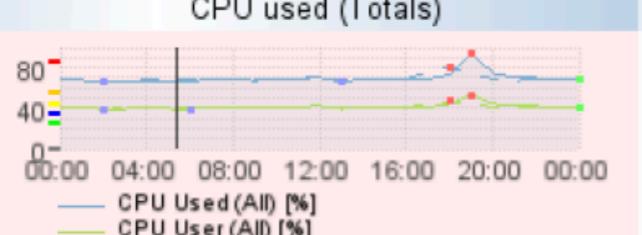




## Sample Dissertation /Thesis Tasks and Timeline

**Manual**

swamp

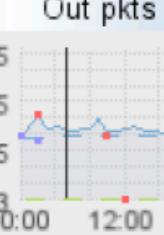


Load

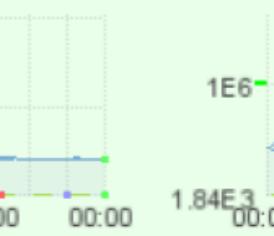
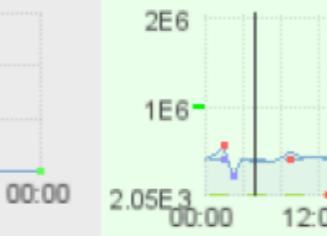
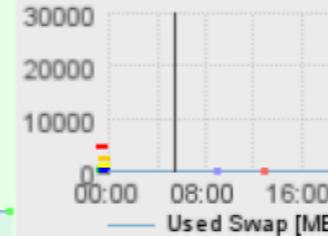
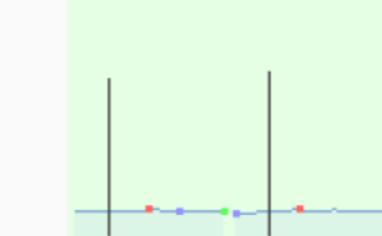
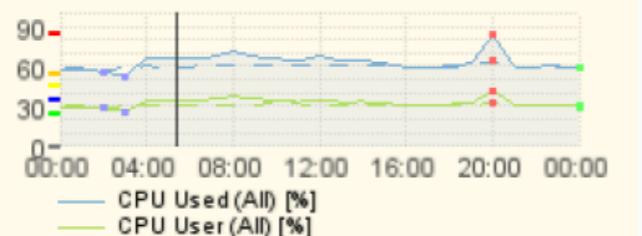
# Procs

Memory

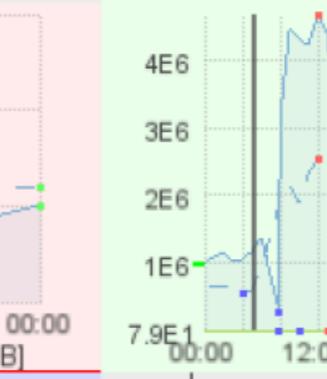
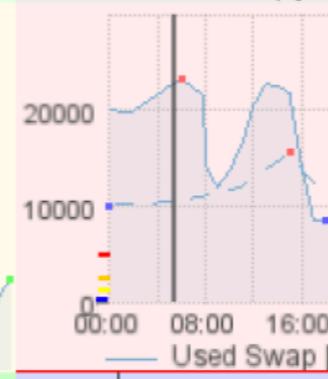
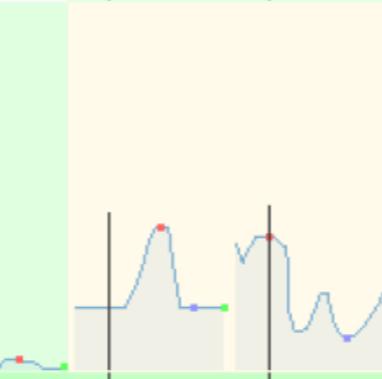
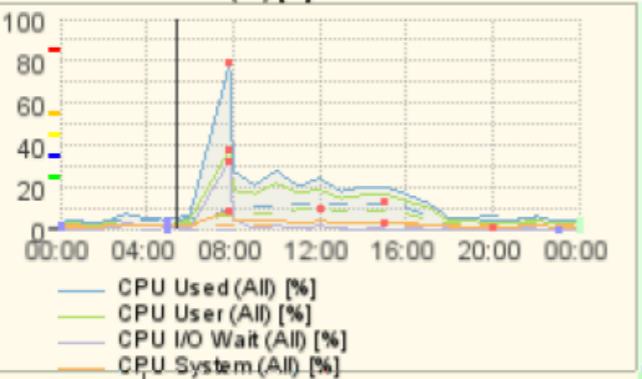
Swap used



sobriety



spire



joint

tang

haversack

puzzle

blowout

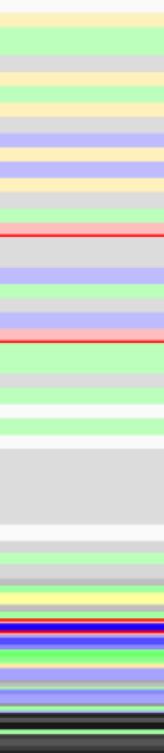
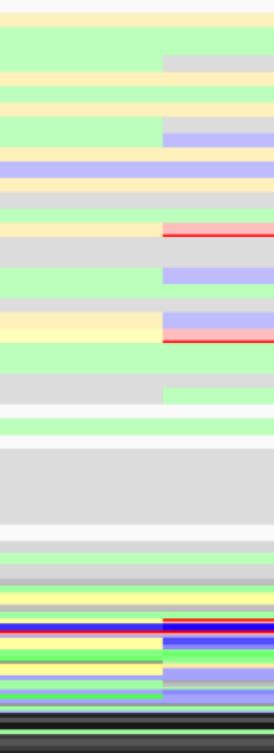
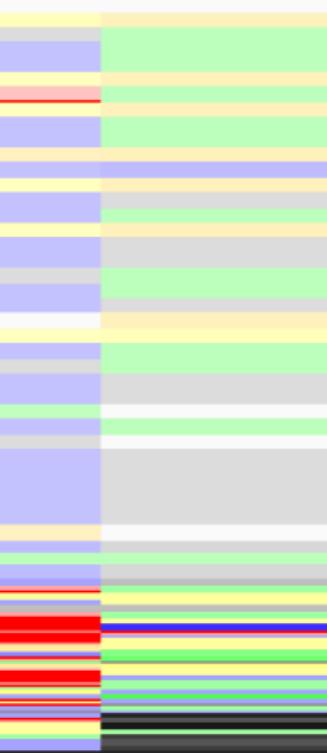
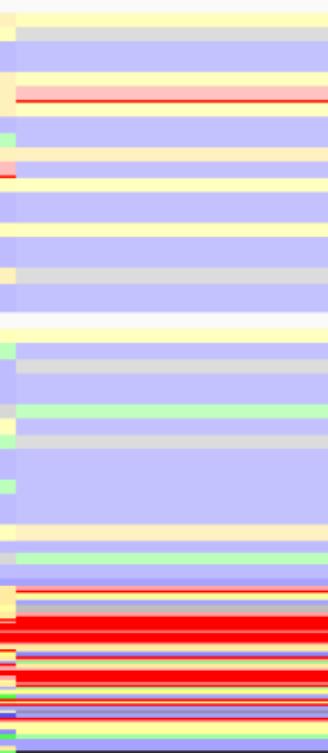
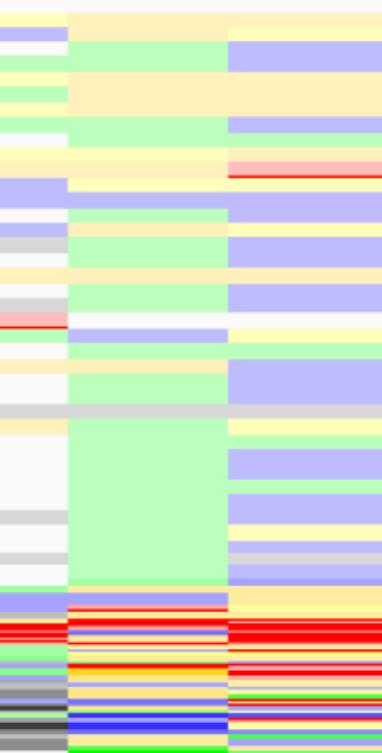
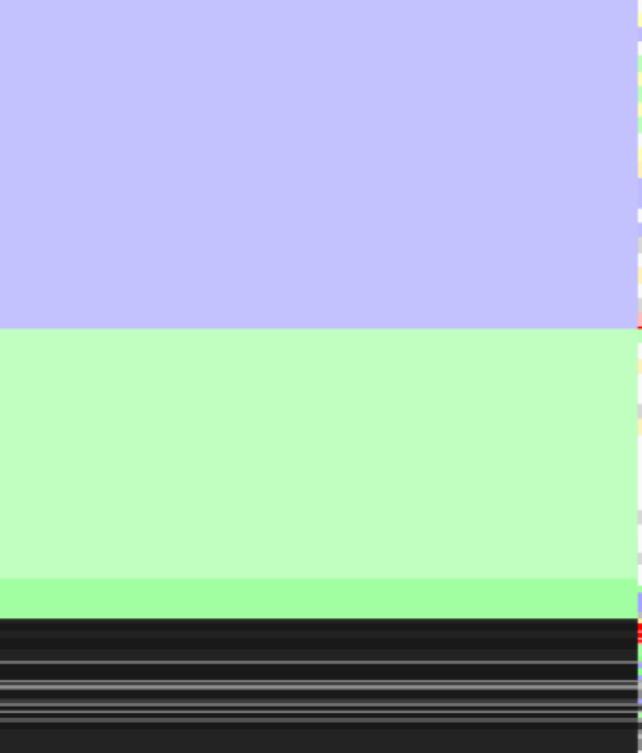
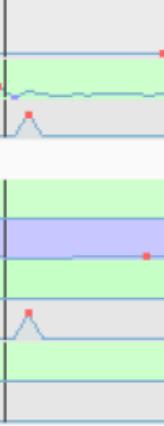
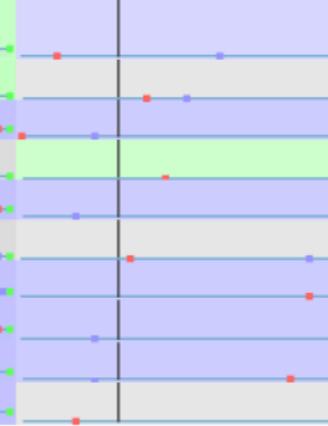
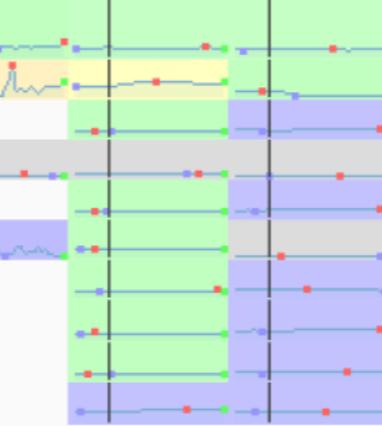
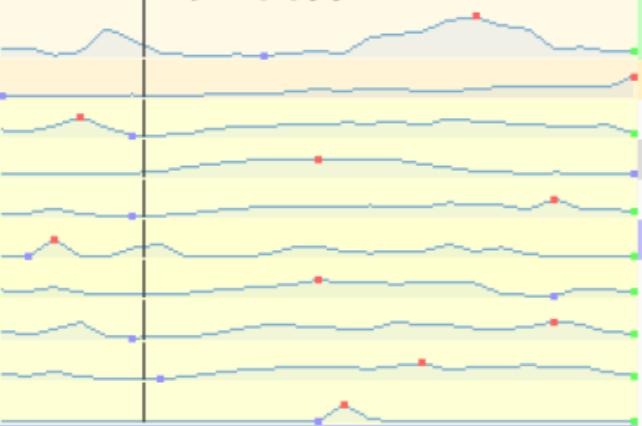
port

mortality

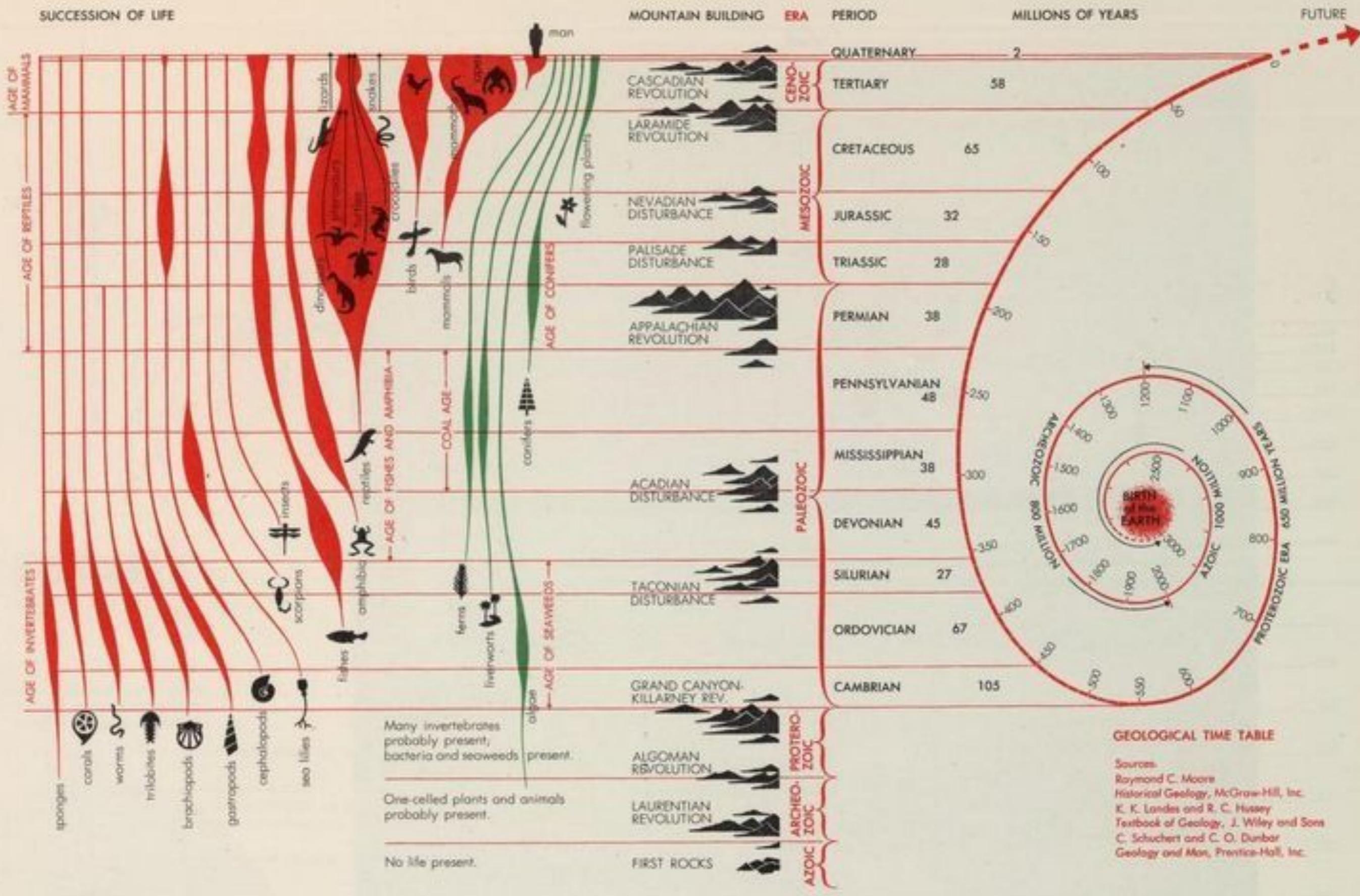
tier

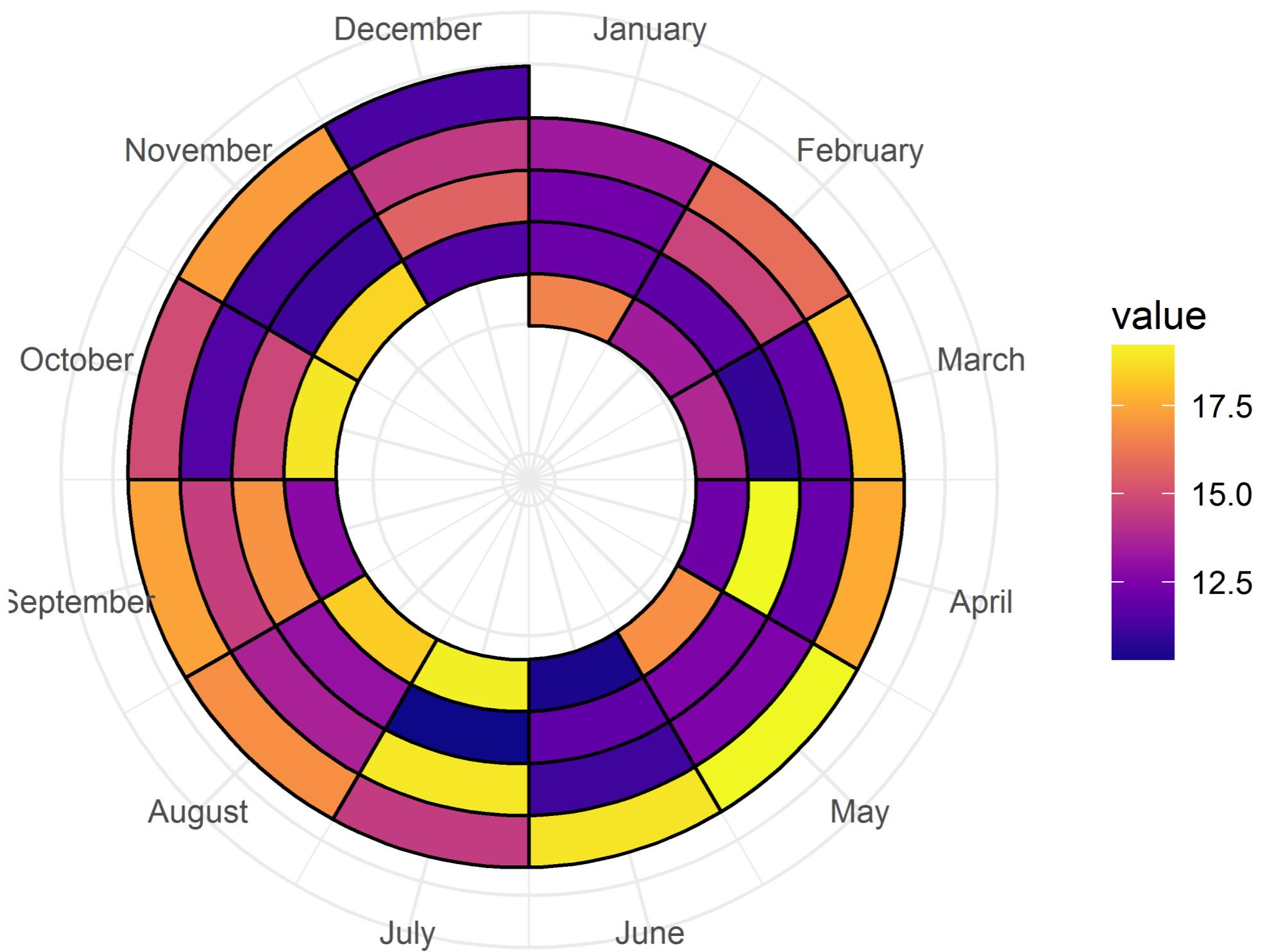
potpourri

liberty

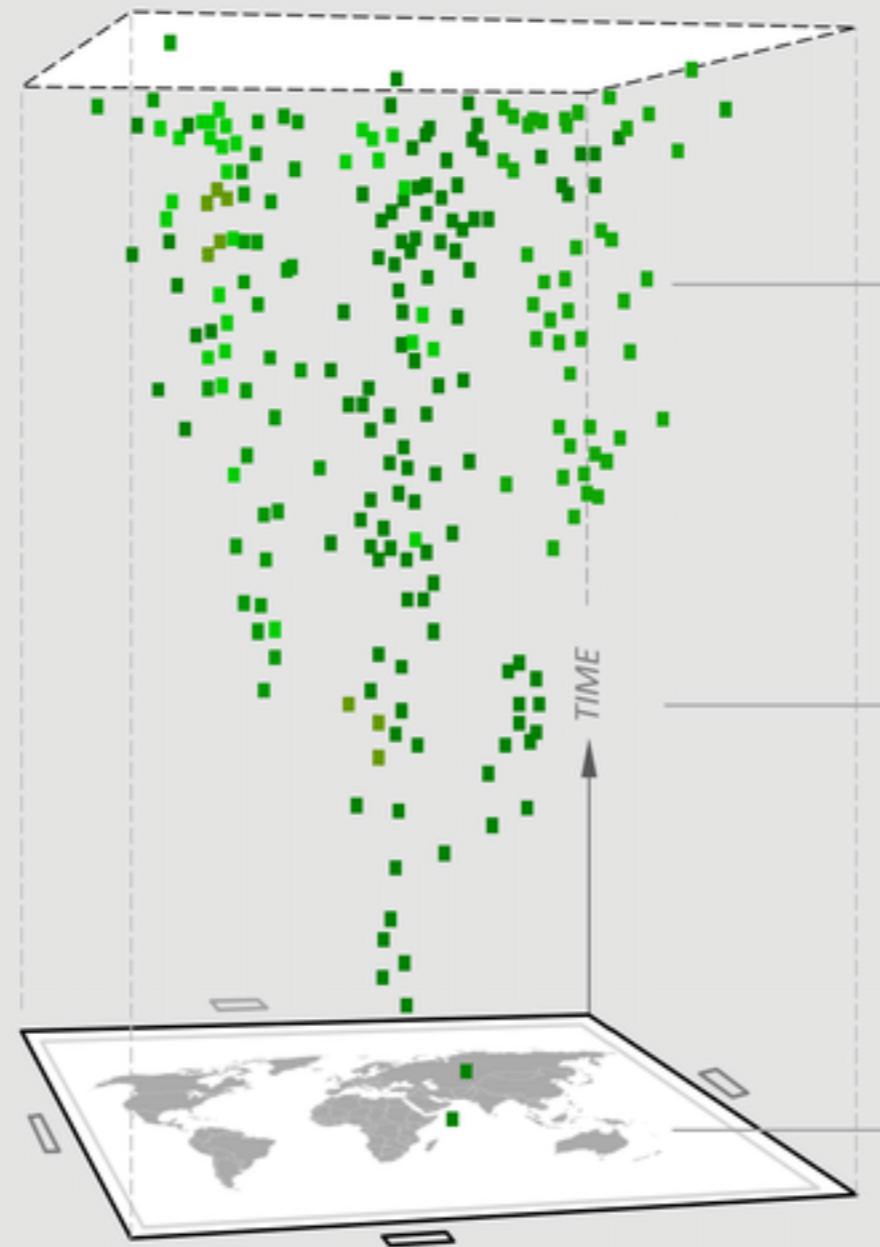


# Spiral Timeline





# Spatial Time Cube



**point cloud**

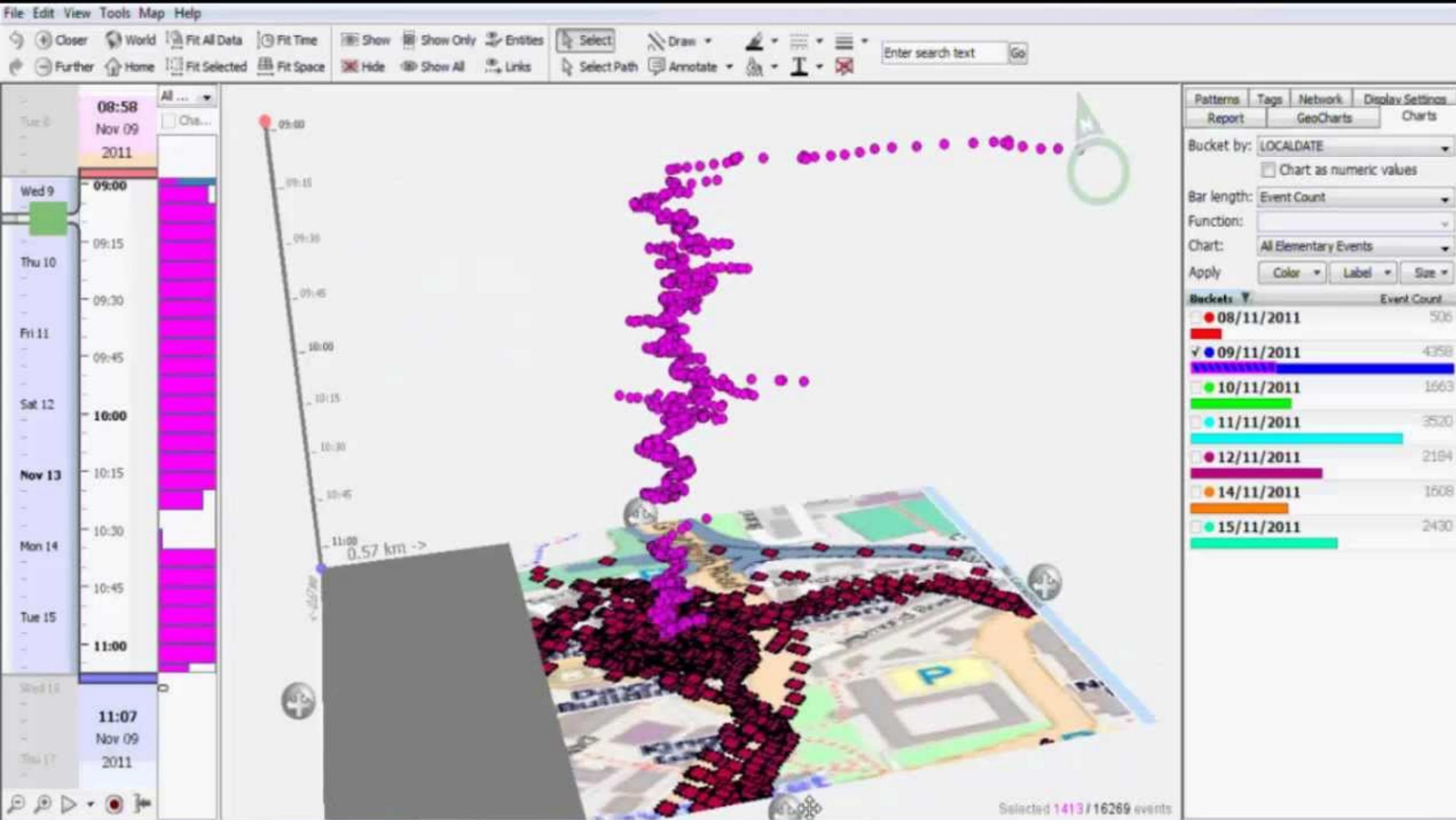
representing spatio-temporal  
points of origin

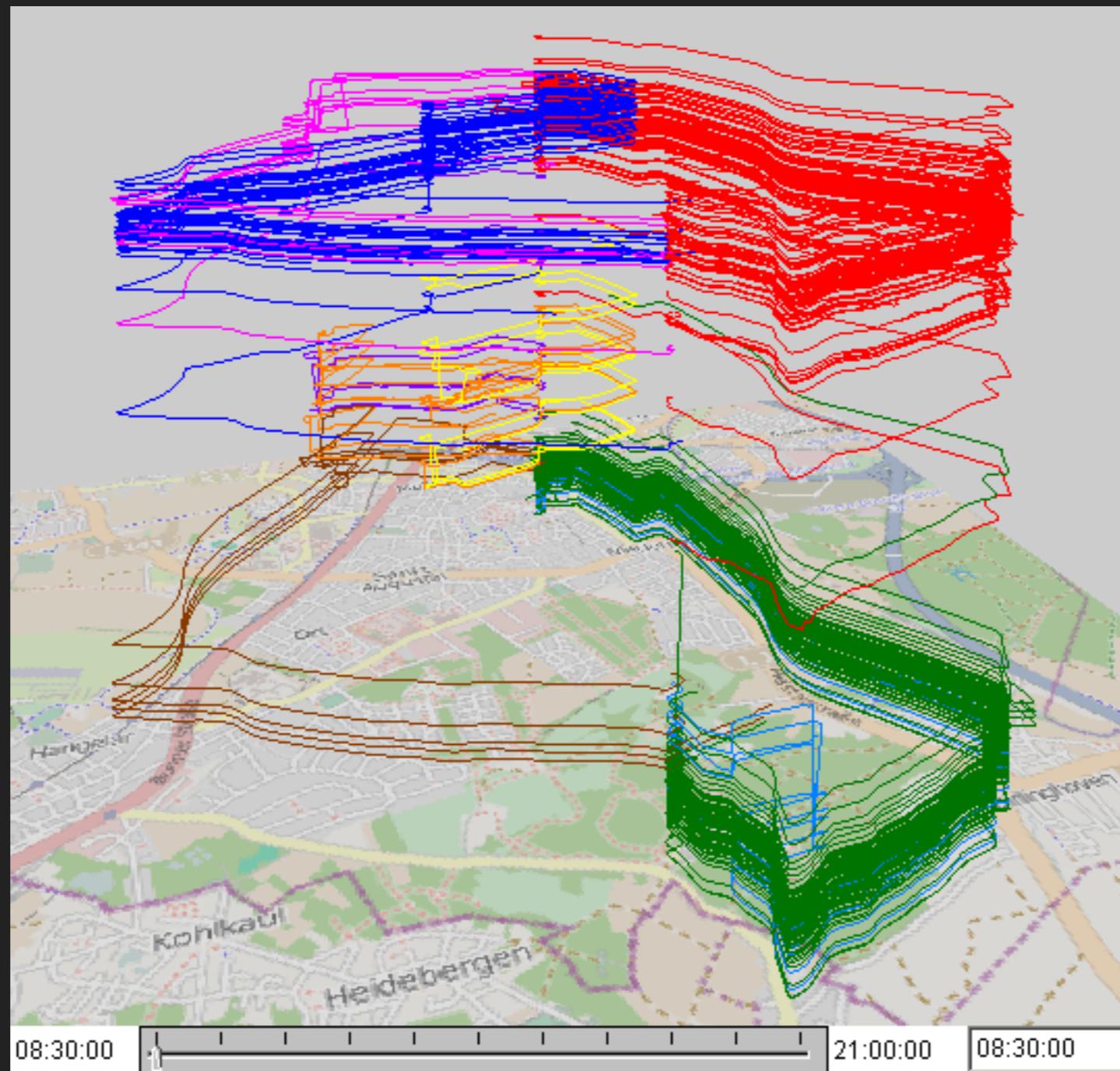
**time axis**

representing the temporal dimension

**data plane**

displaying a geo-spatial layout





# Small Multiples

# A year of sunshine.

Avg. daily sunlight, by month, 1979-2011 (measured in kilojoules of solar radiation per square meter)

