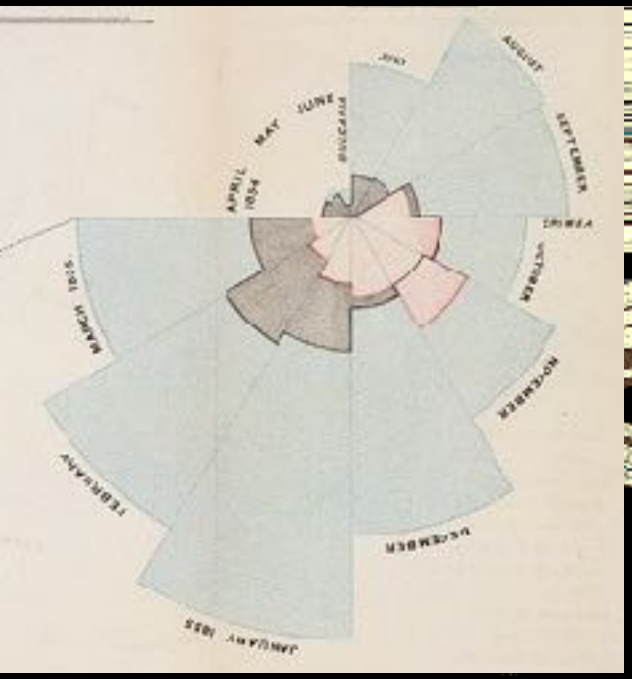
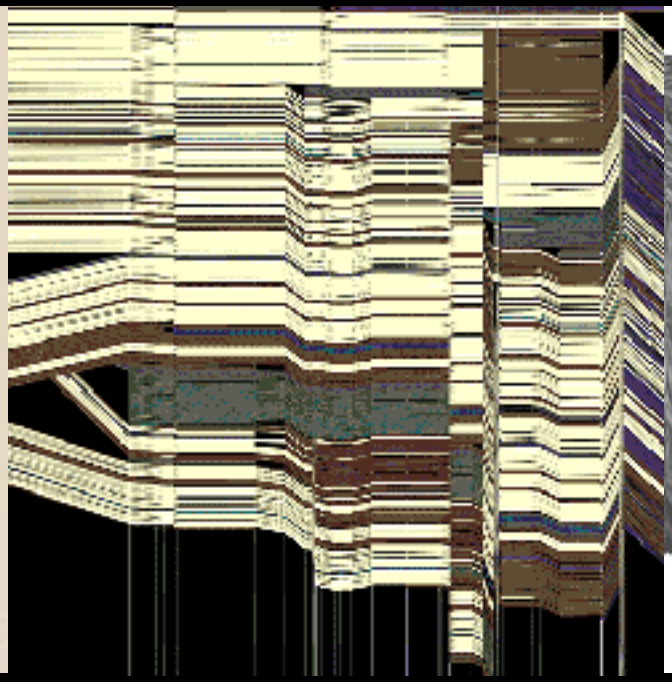
CSE 512 - Data Visualization

A1 Review

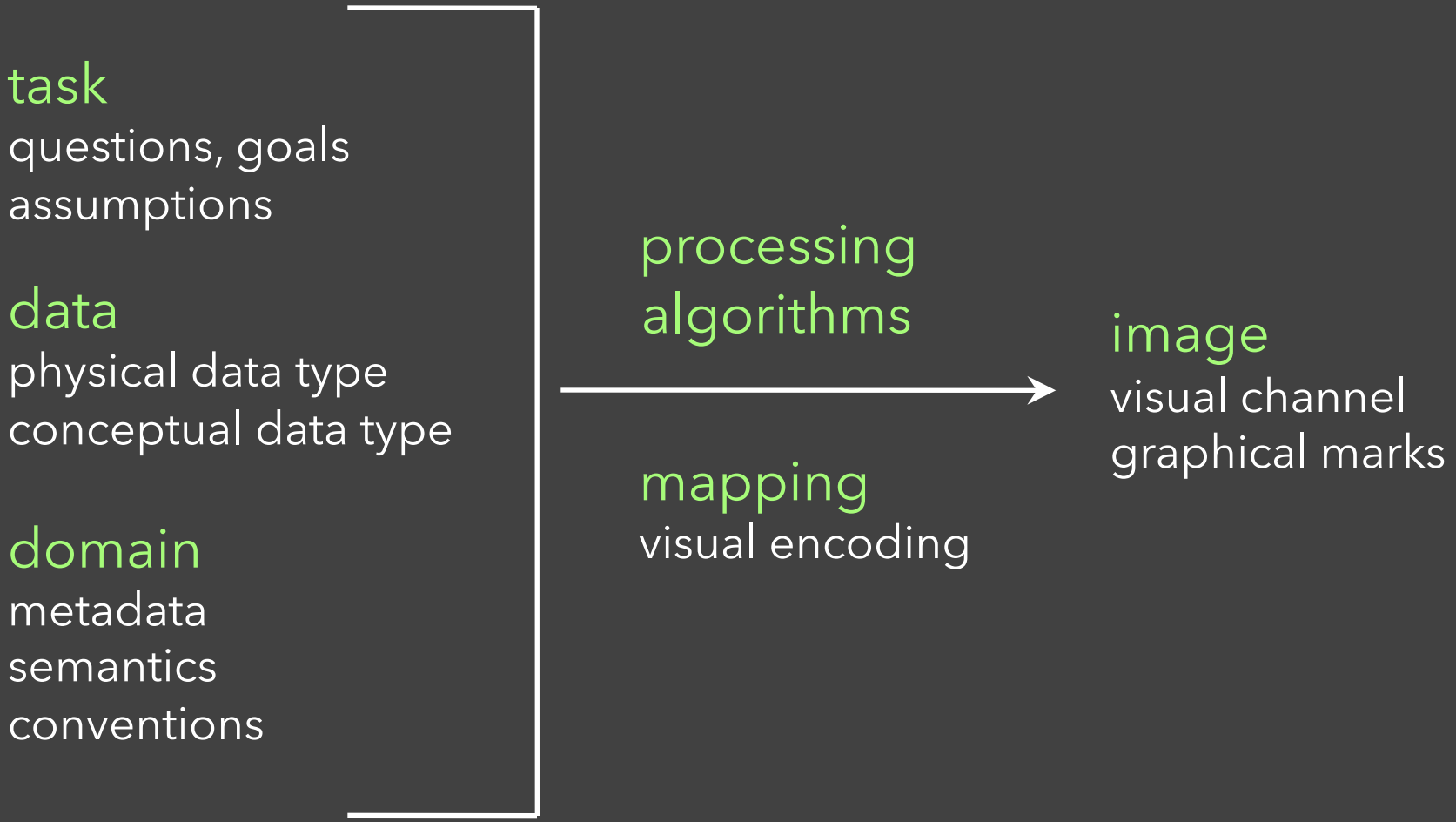




Jeffrey Heer University of Washington

Last Time:
Data & Image Models

The Big Picture



Nominal, Ordinal & Quantitative

N - Nominal (labels or categories)

- Operations: =, ≠

O - Ordered

- Operations: =, ≠, <, >

Q - Interval (location of zero arbitrary)

- Operations: =, ≠, <, >, -
- Can measure distances or spans

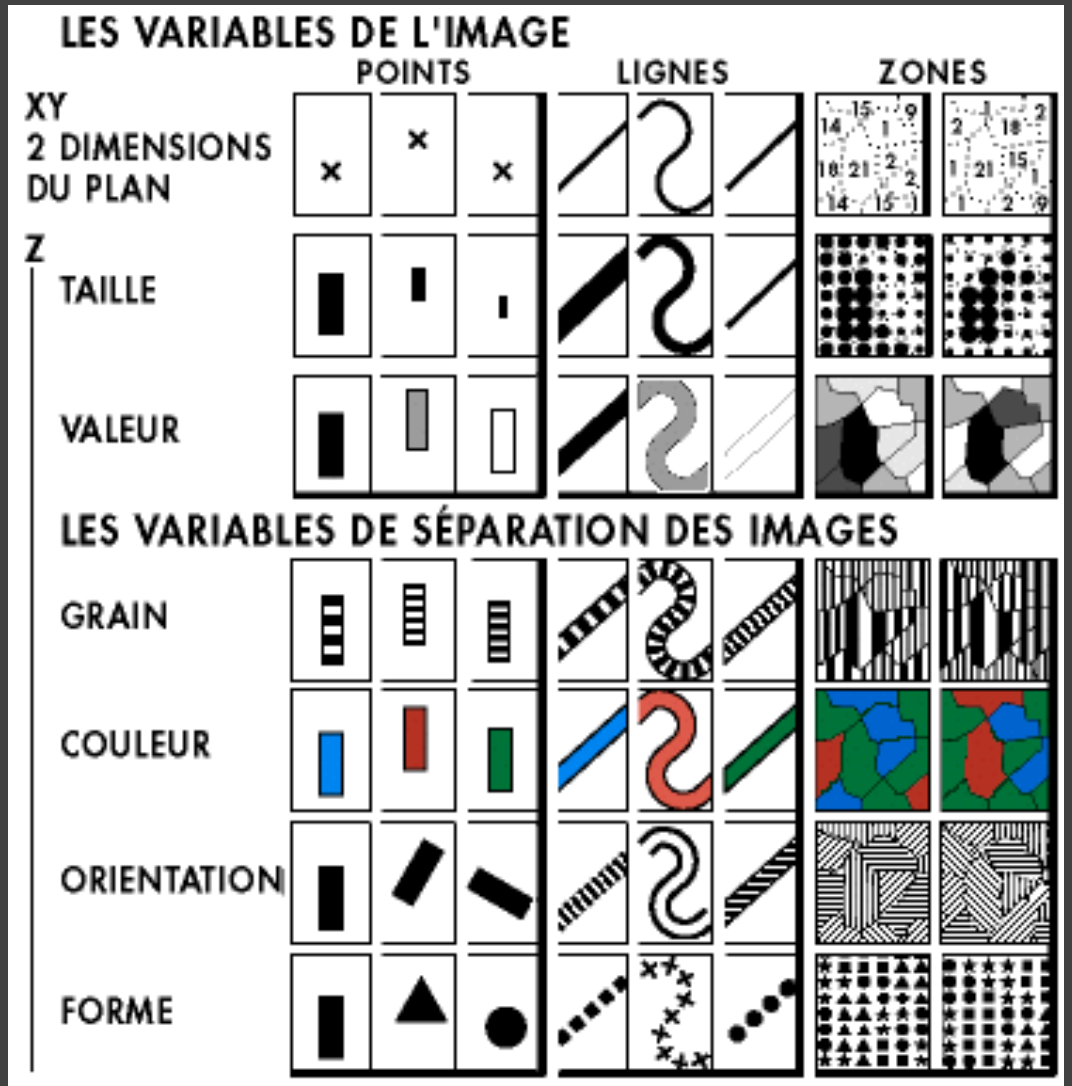
Q - Ratio (zero fixed)

- Operations: =, ≠, <, >, -, %
- Can measure ratios or proportions

Visual Encoding Variables

Position (x 2)
Size
Value
Texture
Color
Orientation
Shape

Others?



Bertin's "Levels of Organization"

Position	N	O	Q
Size	N	O	Q
Value	N	O	q
Texture	N	o	
Color	N		
Orientation	N		
Shape	N		

Nominal

Ordinal

Quantitative

Note: **Q** ⊂ **O** ⊂ **N**

Choosing Visual Encodings

Assume *k* visual encodings and *n* data attributes. We would like to pick the "best" encoding among a combinatorial set of possibilities of size $(n+1)^k$

Principle of Consistency
The properties of the image (visual variables) should match the properties of the data.

Principle of Importance Ordering
Encode the most important information in the most effective way.

Design Criteria [Mackinlay 86]

Expressiveness
A set of facts is *expressible* in a visual language if the sentences (i.e. the visualizations) in the language express all the facts in the set of data, and only the facts in the data.

Effectiveness
A visualization is more *effective* than another visualization if the information conveyed by one visualization is more readily perceived than the information in the other visualization.

Design Criteria *Translated*

Tell the truth and nothing but the truth
(don't lie, and don't lie by omission)

Use encodings that people decode better
(where better = faster and/or more accurate)

Effectiveness Rankings [Mackinlay 86]

QUANTITATIVE	ORDINAL	NOMINAL
Position	Position	Position
Length	Density (Value)	Color Hue
Angle	Color Sat	Texture
Slope	Color Hue	Connection
Area (Size)	Texture	Containment
Volume	Connection	Density (Value)
Density (Value)	Containment	Color Sat
Color Sat	Length	Shape
Color Hue	Angle	Length
Texture	Slope	Angle
Connection	Area (Size)	Slope
Containment	Volume	Area
Shape	Shape	Volume

Effectiveness Rankings [Mackinlay 86]

QUANTITATIVE	ORDINAL	NOMINAL
Position	**Position**	**Position**
Length	Density (Value)	Color Hue
Angle	Color Sat	Texture
Slope	Color Hue	Connection
Area (Size)	Texture	Containment
Volume	Connection	Density (Value)
Density (Value)	Containment	Color Sat
Color Sat	Length	Shape
Color Hue	Angle	Length
Texture	Slope	Angle
Connection	Area (Size)	Slope
Containment	Volume	Area
Shape	Shape	Volume

Effectiveness Rankings [Mackinlay 86]

QUANTITATIVE	ORDINAL	NOMINAL
Position	Position	Position
Length	Density (Value)	**Color Hue**
Angle	Color Sat	Texture
Slope	**Color Hue**	Connection
Area (Size)	Texture	Containment
Volume	Connection	Density (Value)
Density (Value)	Containment	Color Sat
Color Sat	Length	Shape
Color Hue	Angle	Length
Texture	Slope	Angle
Connection	Area (Size)	Slope
Containment	Volume	Area
Shape	Shape	Volume

A1 Review

A1 Submission Designs

Fields: Sunshine, Latitude, Precipitation, Temperature, Physical Activity, Mental Health, …

Transforms: Sums, Averages, Differences, Percentages, Proportions, Filter

Chart Types: Line, Area, Bar, Scatter, Heatmaps, Maps, Radial, Compositions

Design Considerations

Title, labels, legend, captions, source!

Expressiveness and Effectiveness
Avoid unexpressive marks (lines? gradients?)
Use perceptually effective encodings
Don’t distract: faint gridlines, pastel highlights/fills
The “elimination diet” approach – start minimal

Support comparison and pattern perception
Between elements, to a reference line, or to totals

Use reader-friendly units and labels
Statistical soundness (regression, interpolation)

Design Considerations

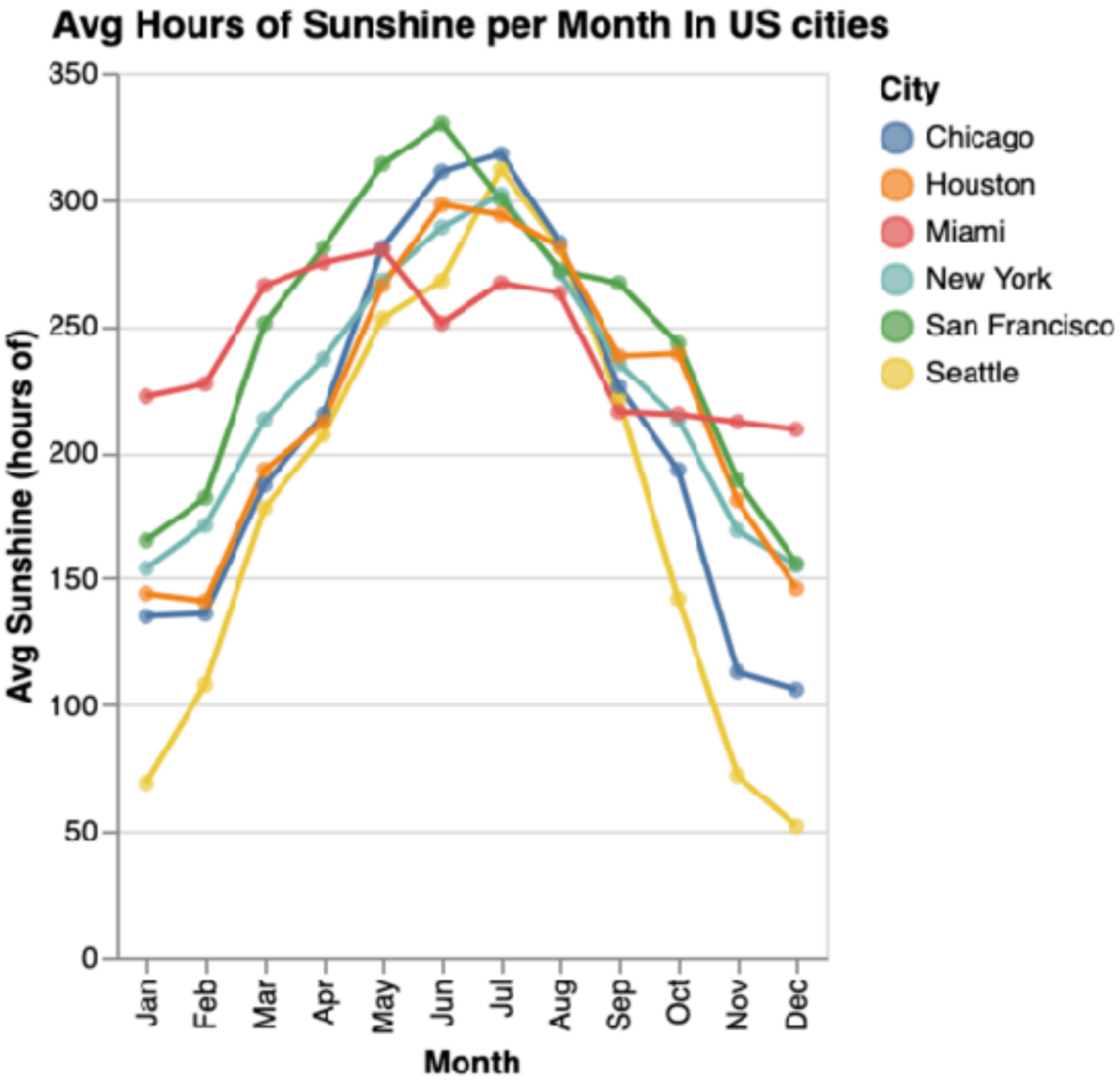
Transform data (e.g., filter, log, normalize)

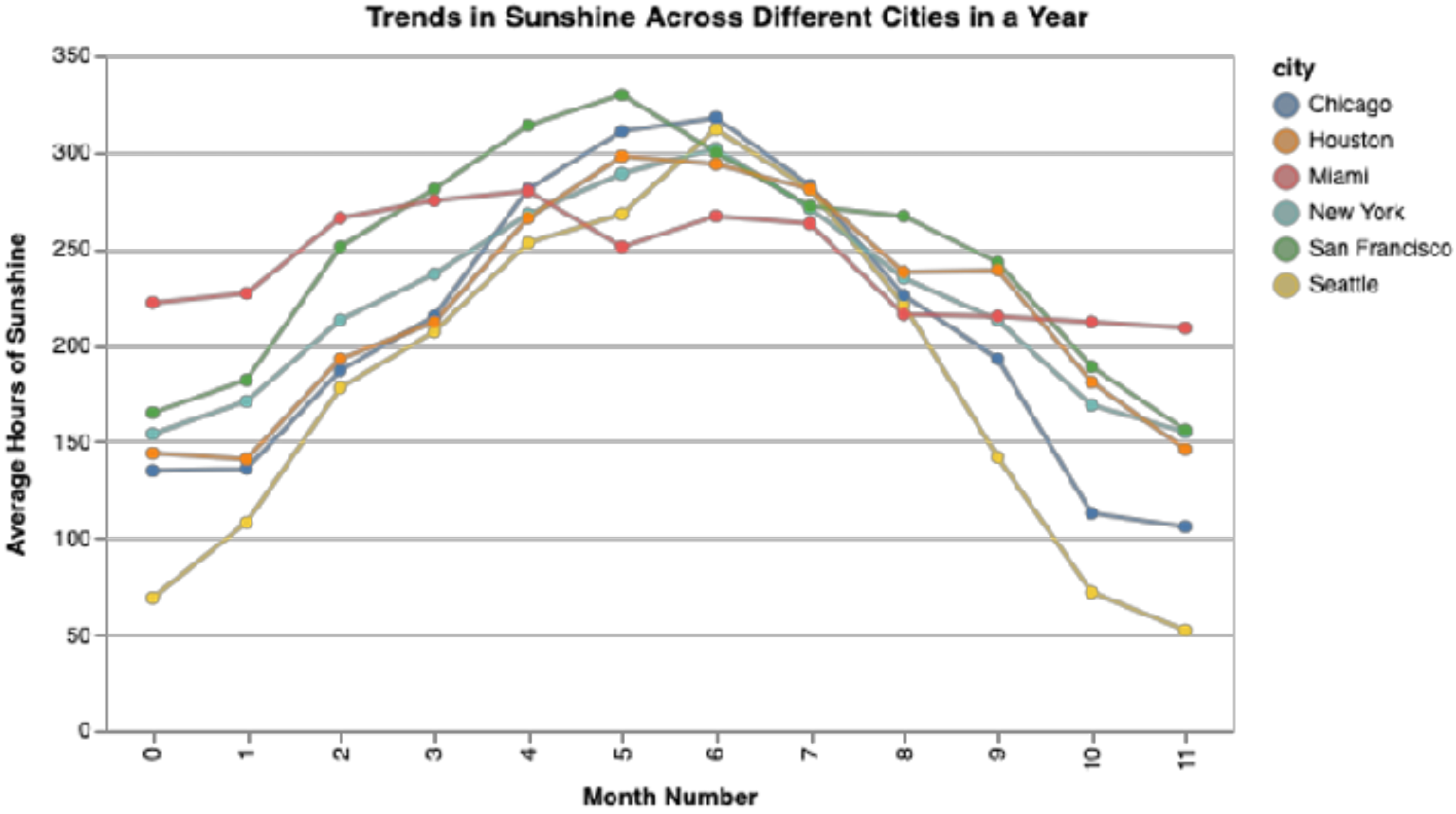
Group / sort data by meaningful dimensions

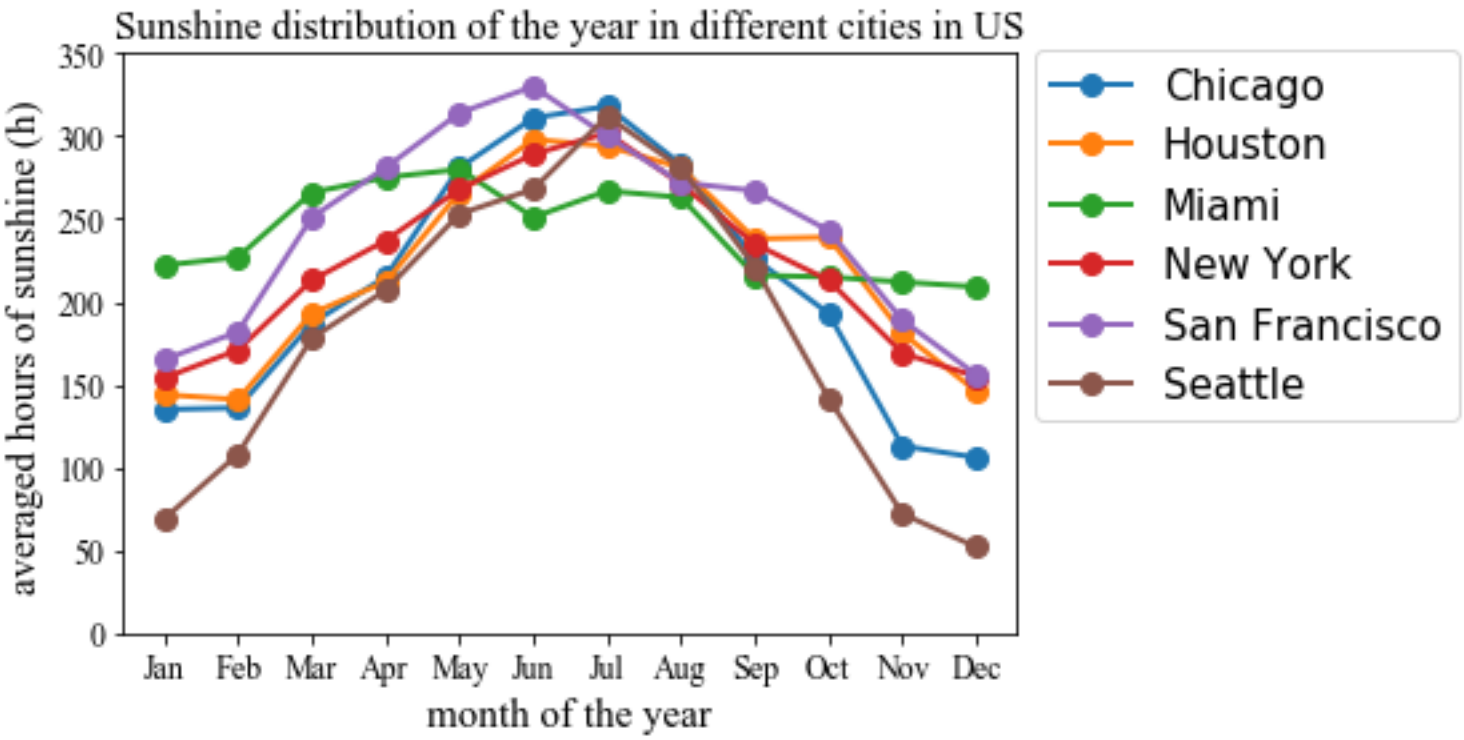
Reduce cognitive overhead
Minimize visual search, minimize ambiguity
Appropriate size, aspect ratio, legible text
Avoid legend lookups if direct labeling works
Avoid color mappings with indiscernible colors

Be consistent! Visual inferences should consistently support data inferences.

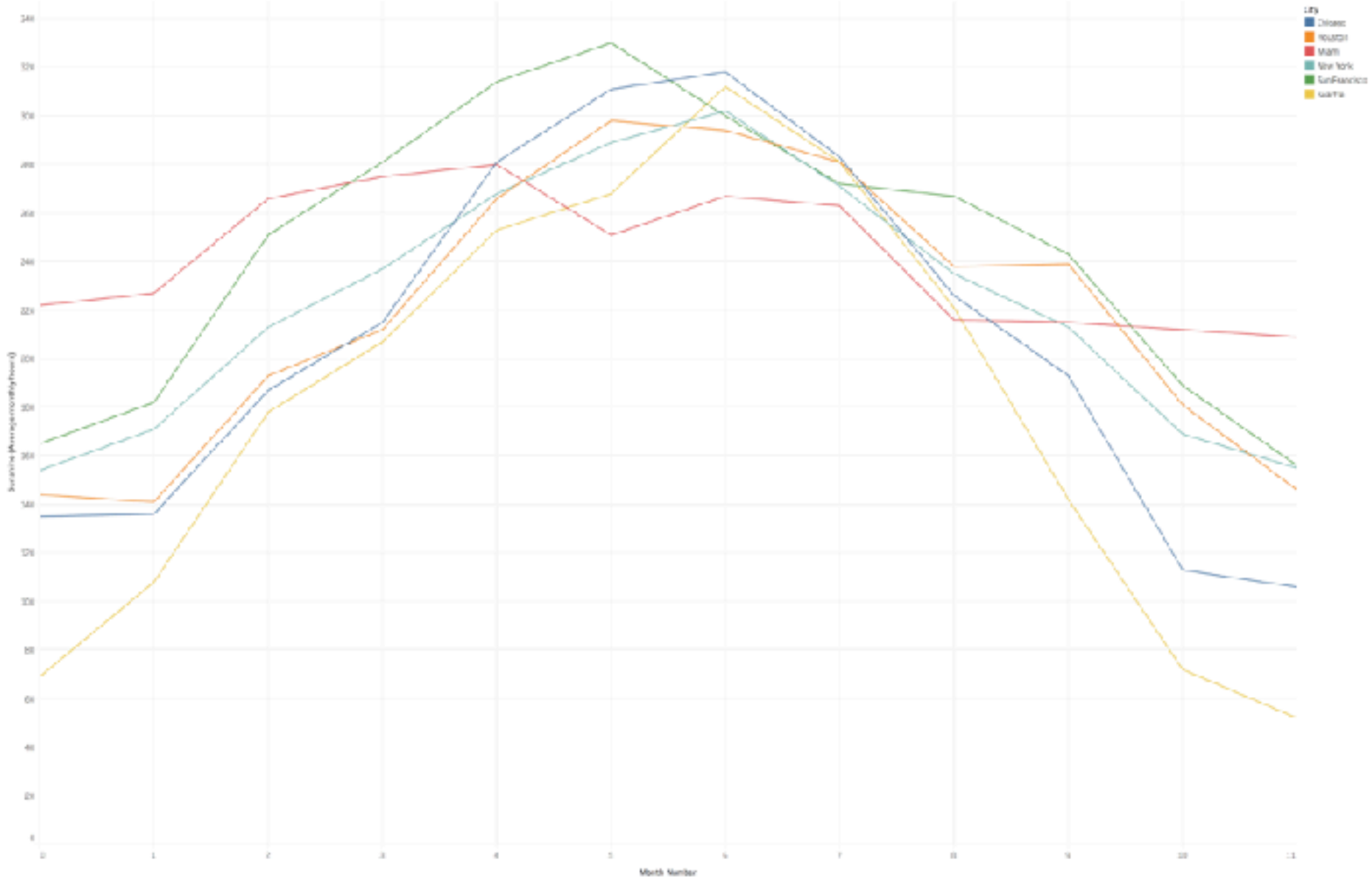
Line Charts


Avg Hours of Sunshine per Month In US cities
Avg Sunshine (hours of)
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
City
Chicago
Houston
Miami
New York
San Francisco
Seattle

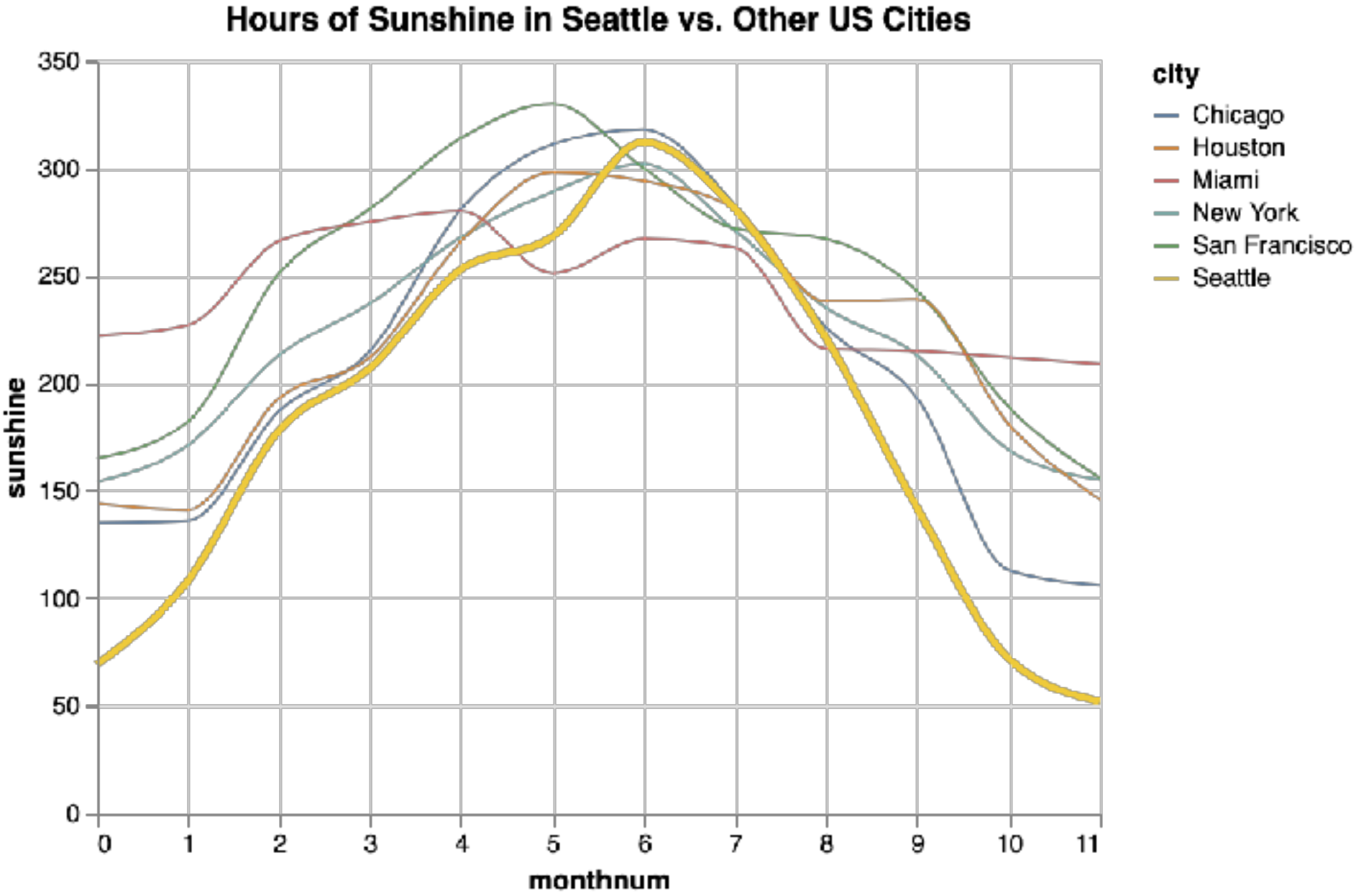

Trends in Sunshine Across Different Cities in a Year
Average Hours of Sunshine
350
300
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
9
10
11
Month Number
city
Chicago
Houston
Miami
New York
San Francisco
Seattle

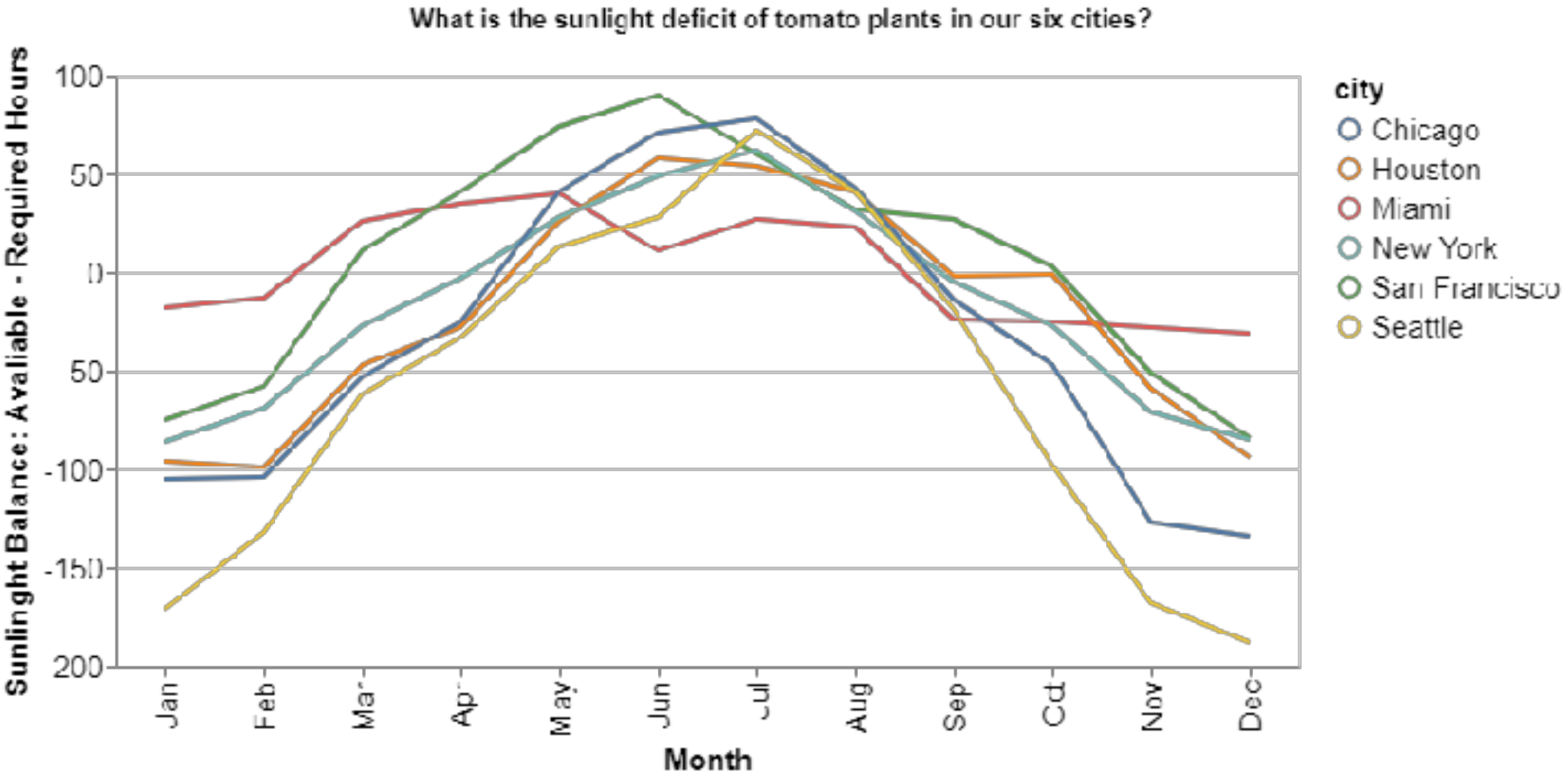

Sunshine distribution of the year in different cities in US
averaged hours of sunshine (h)
0
50
100
150
200
250
300
350
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
month of the year
Chicago
Houston
Miami
New York
San Francisco
Seattle

What are the Sunlight trends in different cities throughout the year?

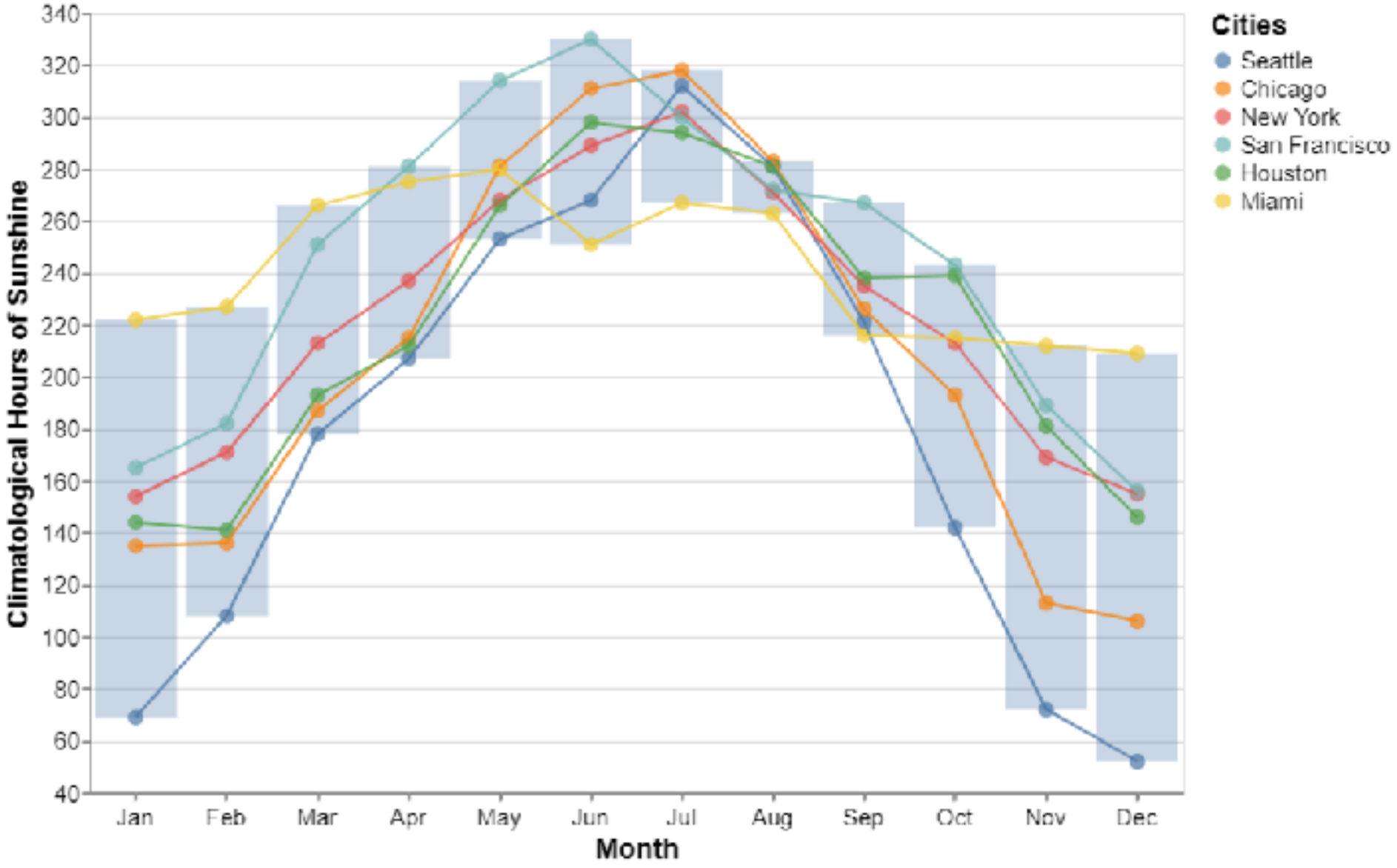


The trend of sum of Sunshine for Month Num. Color shows details about City.

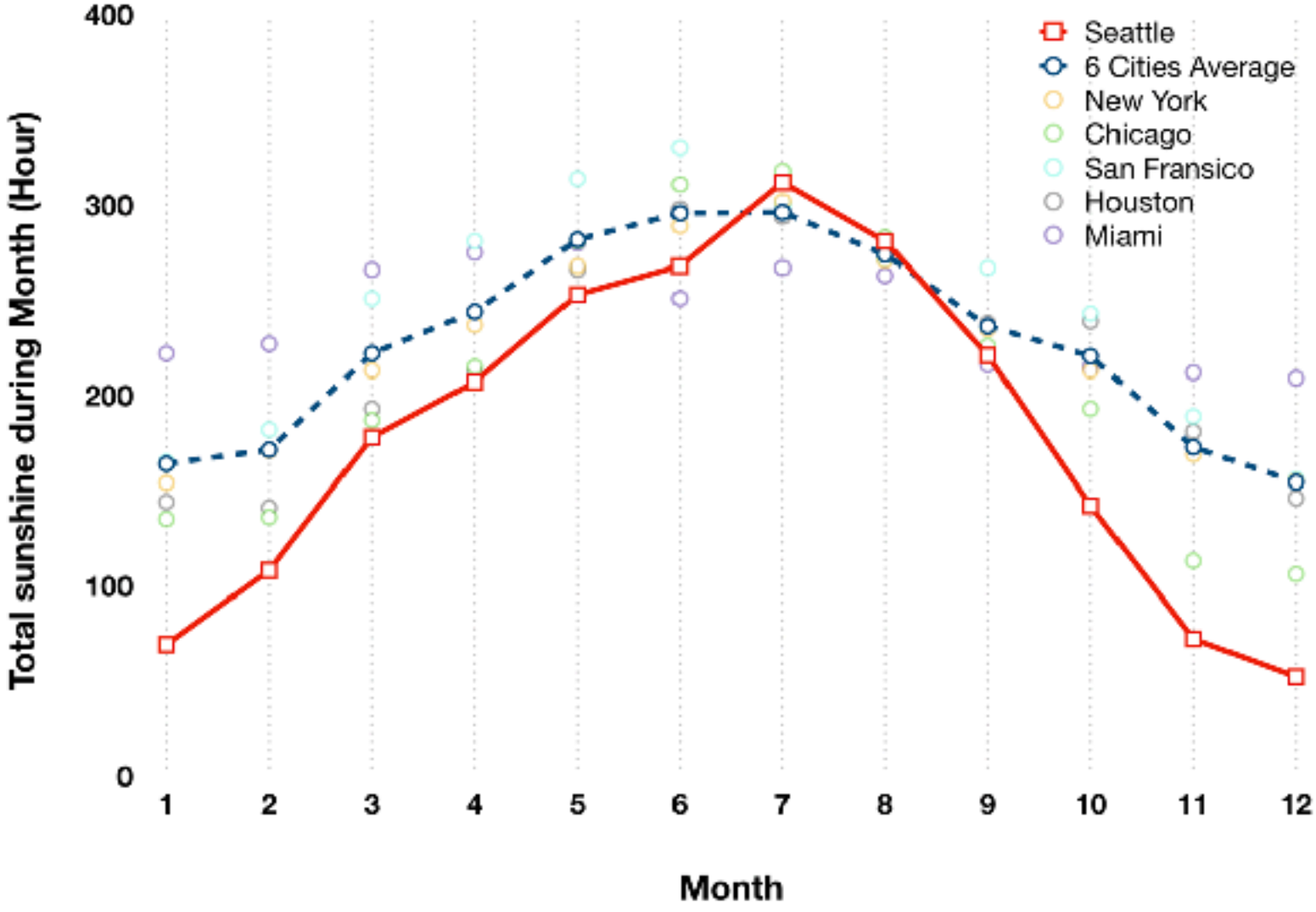

Hours of Sunshine in Seattle vs. Other US Cities
sunshine
350
300
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
9
10
11
monthnum
city
Chicago
Houston
Miami
New York
San Francisco
Seattle

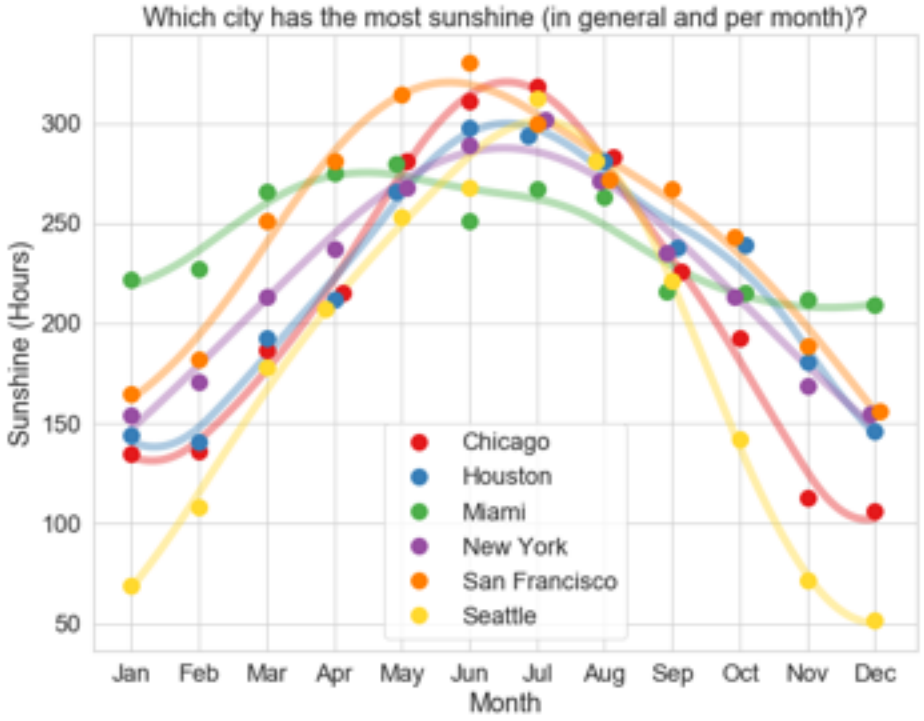

What is the sunlight deficit of tomato plants in our six cities?
Sunlinght Balance: Avaliable - Required Hours
100
50
0
-50
-100
-150
-200
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
city
Chicago
Houston
Miami
New York
San Francisco
Seattle

How Does the Range of Sunshine Hours Vary by Month Across Select US Cities?



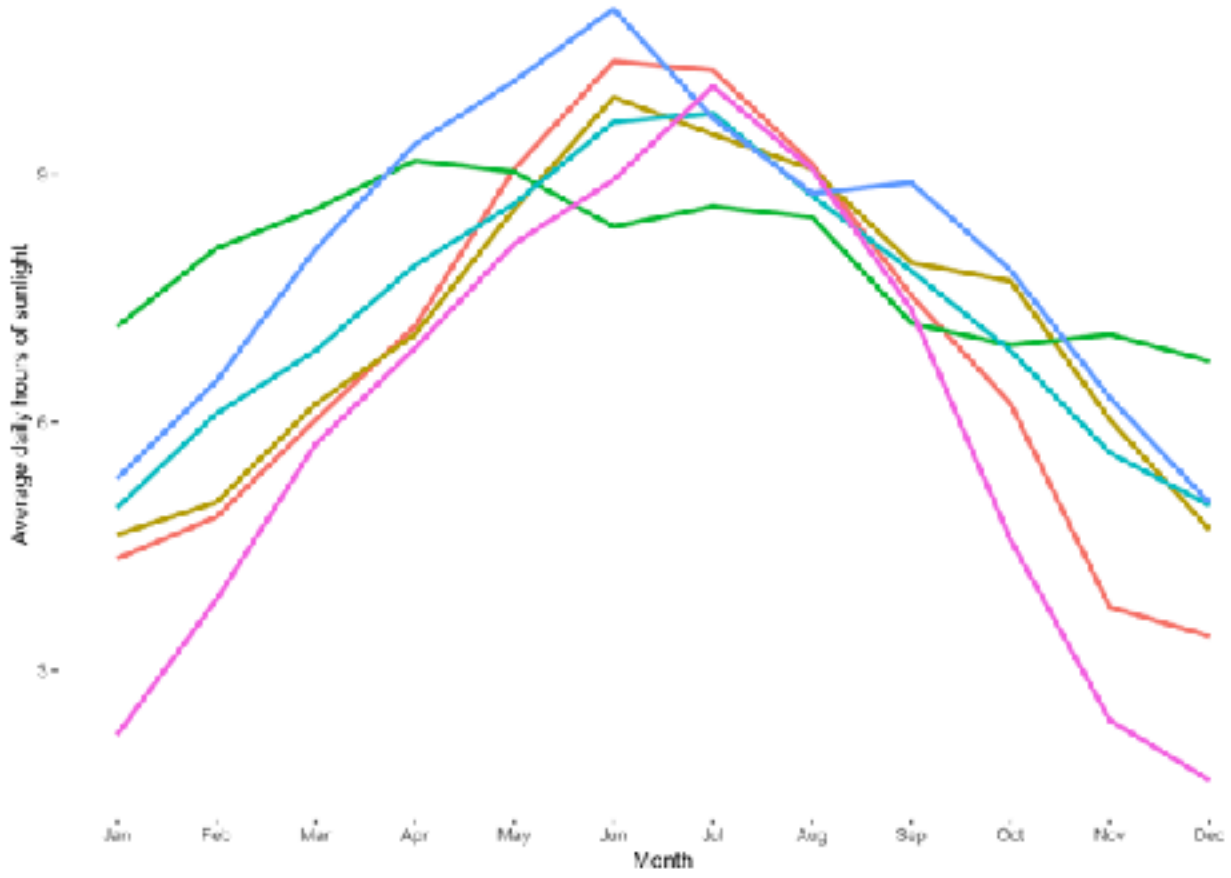
Is Seattle really not sunny?

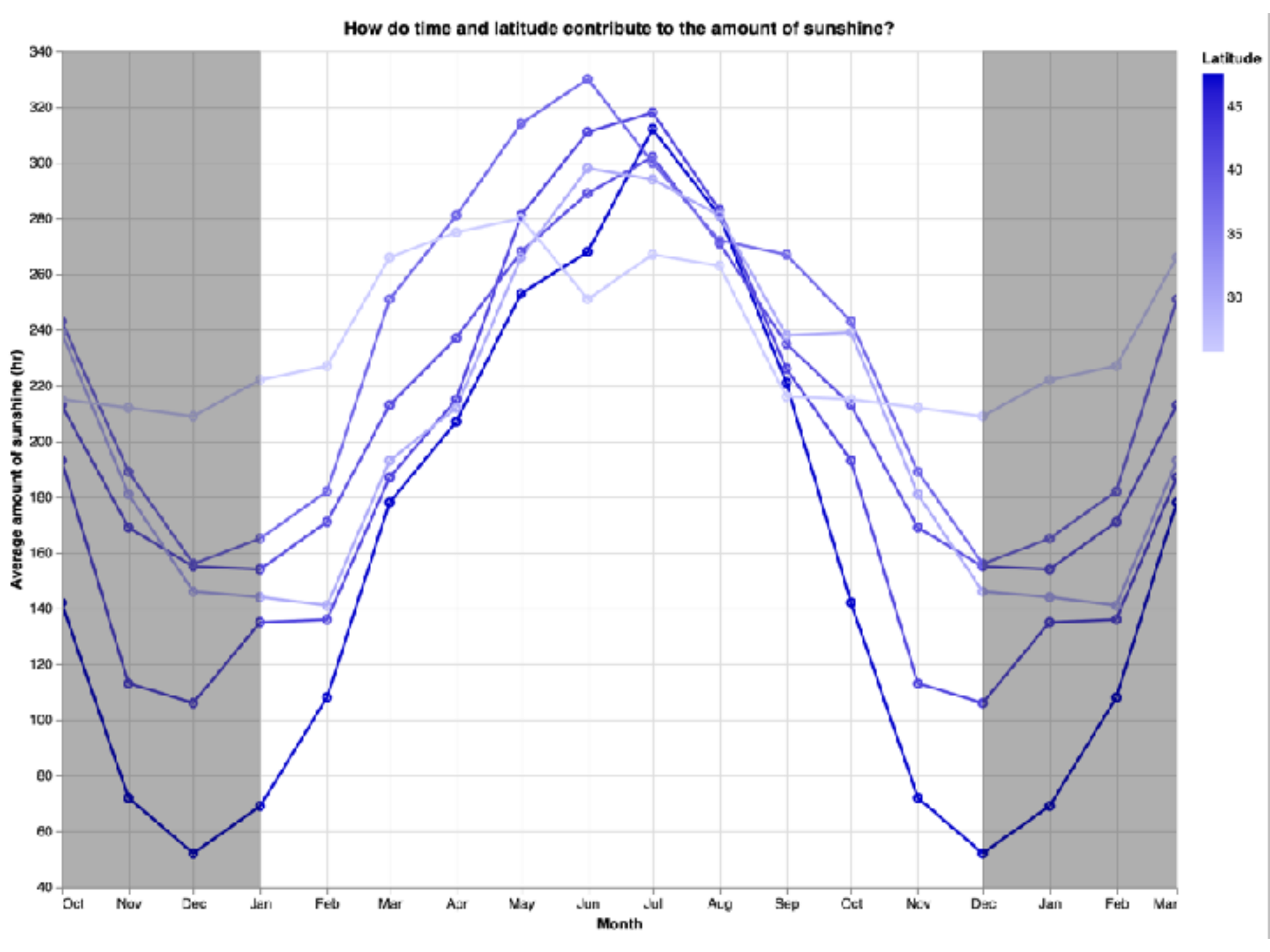


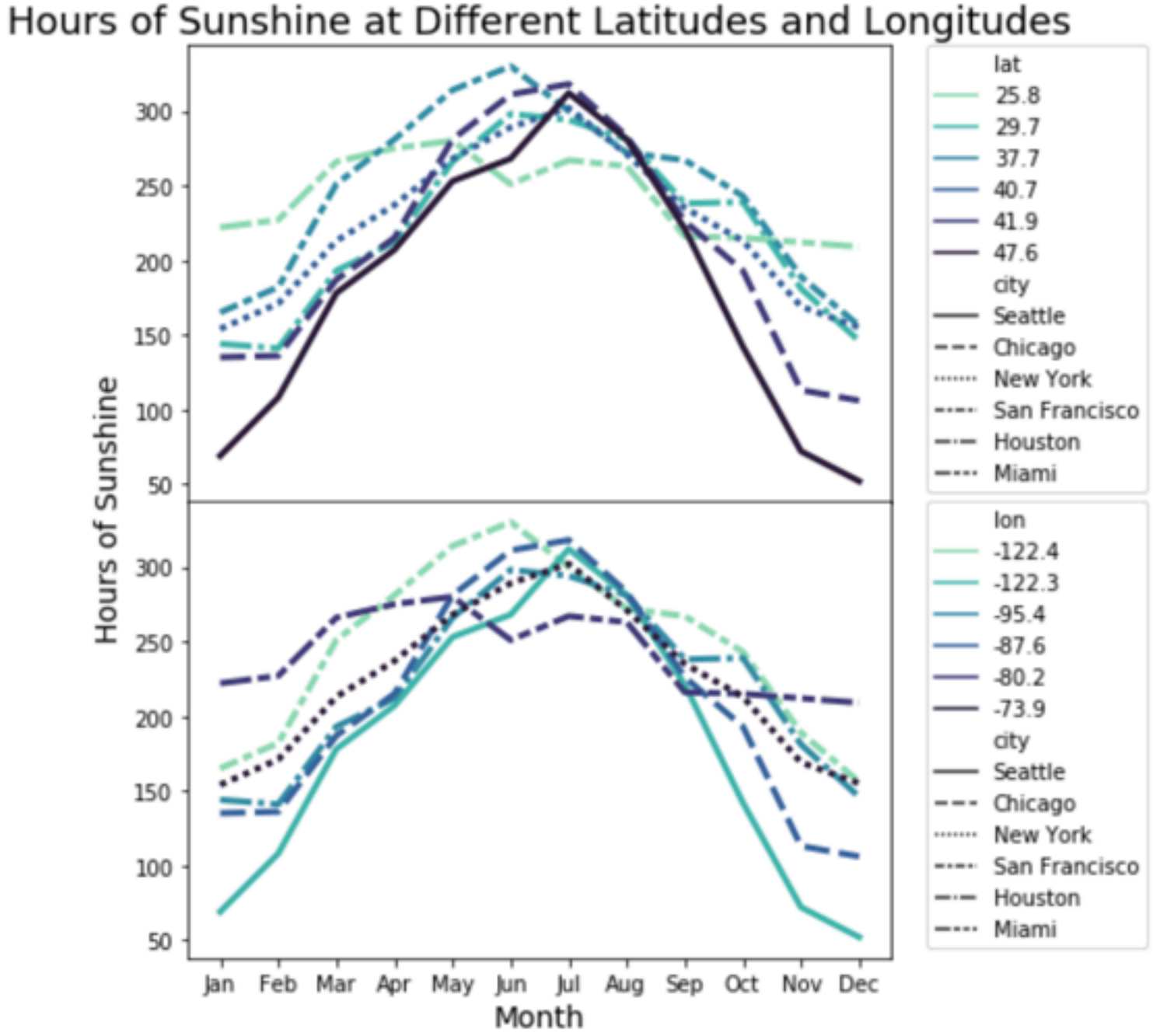

Which city has the most sunshine (in general and per month)?
Sunshine (Hours)
300
250
200
150
100
50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Chicago
Houston
Miami
New York
San Francisco
Seattle

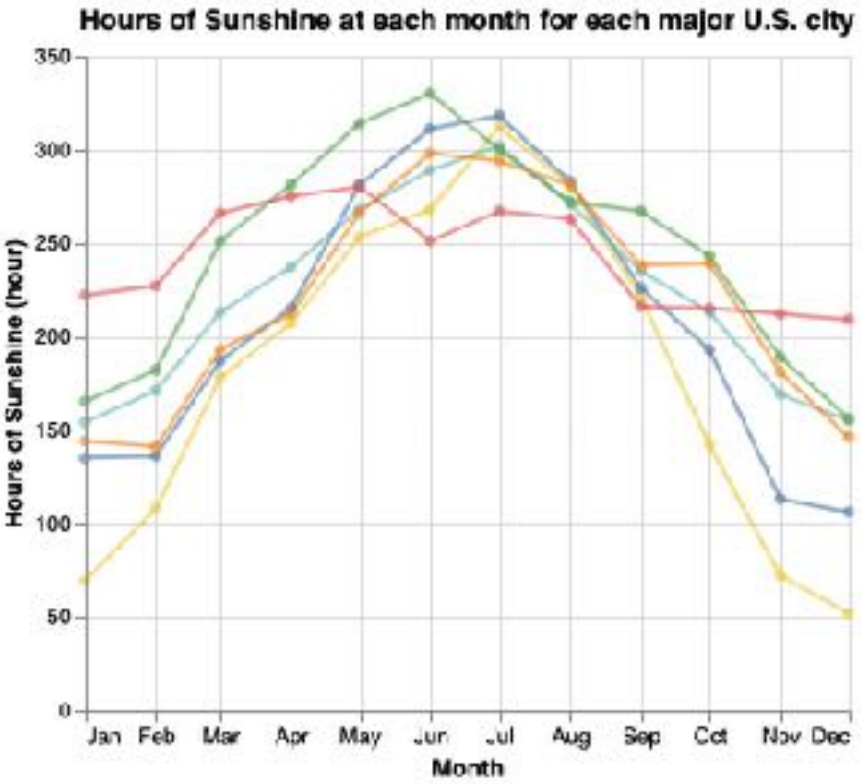

Legend
Latitude
50
45
40
35
30
25
Seattle
Chicago
New York
San Francisco
Houston
Miami
−120
−110
−100
−90
−80
−70
Longitude

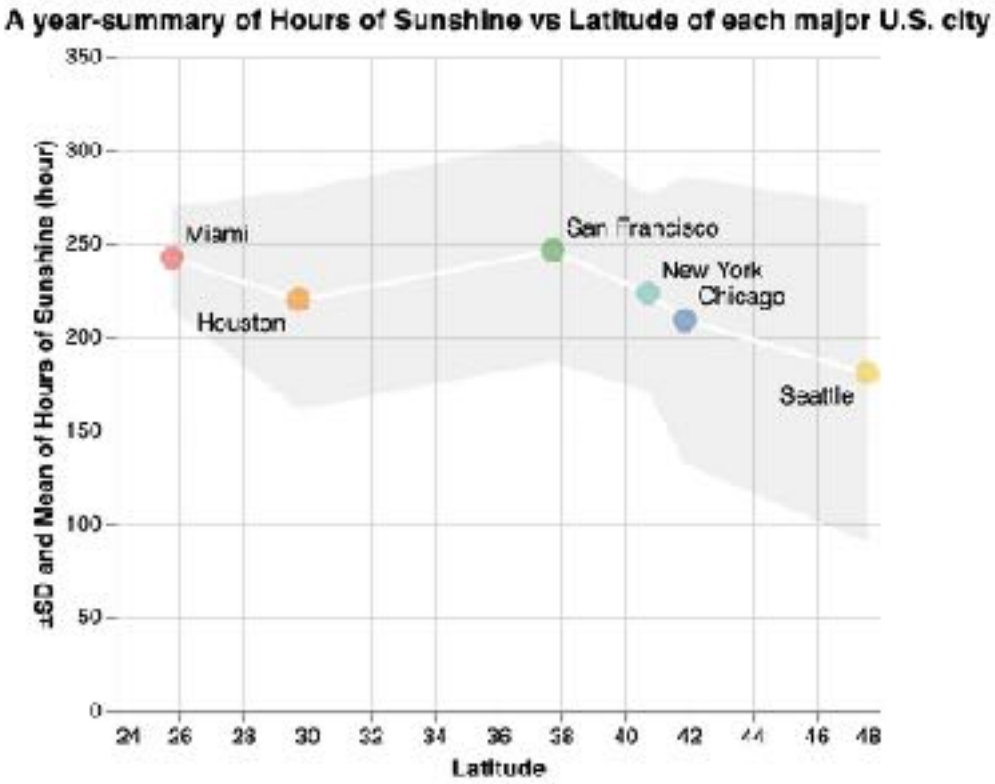
Does latitude predict average daily hours of sunlight?

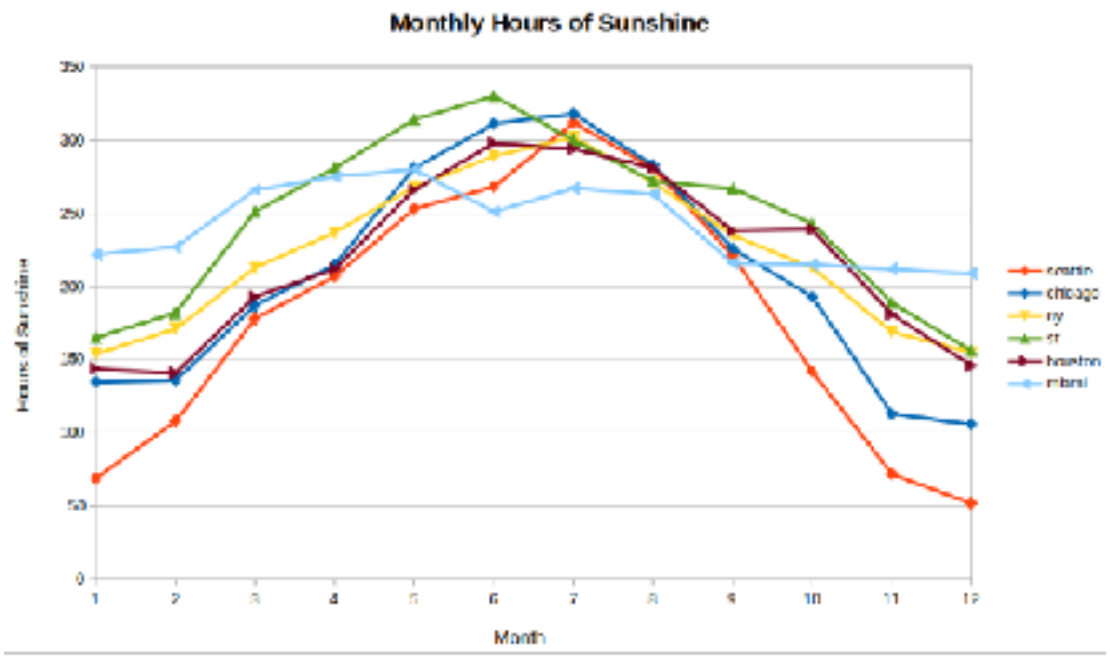


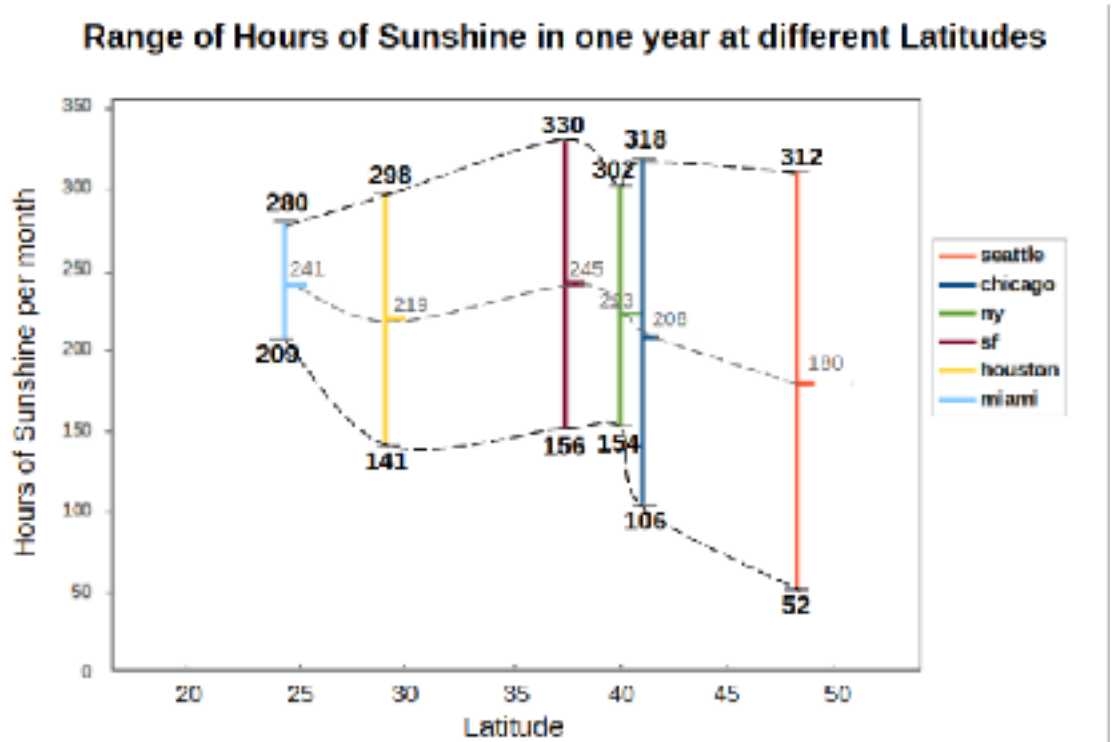

How do time and latitude contribute to the amount of sunshine?
Average amount of sunshine (hr)
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Month
Latitude
45
40
35
30


Hours of Sunshine at Different Latitudes and Longitudes
Hours of Sunshine
300
250
200
150
100
50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
lat
25.8
29.7
37.7
40.7
41.9
47.6
city
Seattle
Chicago
New York
San Francisco
Houston
Miami
lon
-122.4
-122.3
-95.4
-87.6
-80.2
-73.9
city
Seattle
Chicago
New York
San Francisco
Houston
Miami

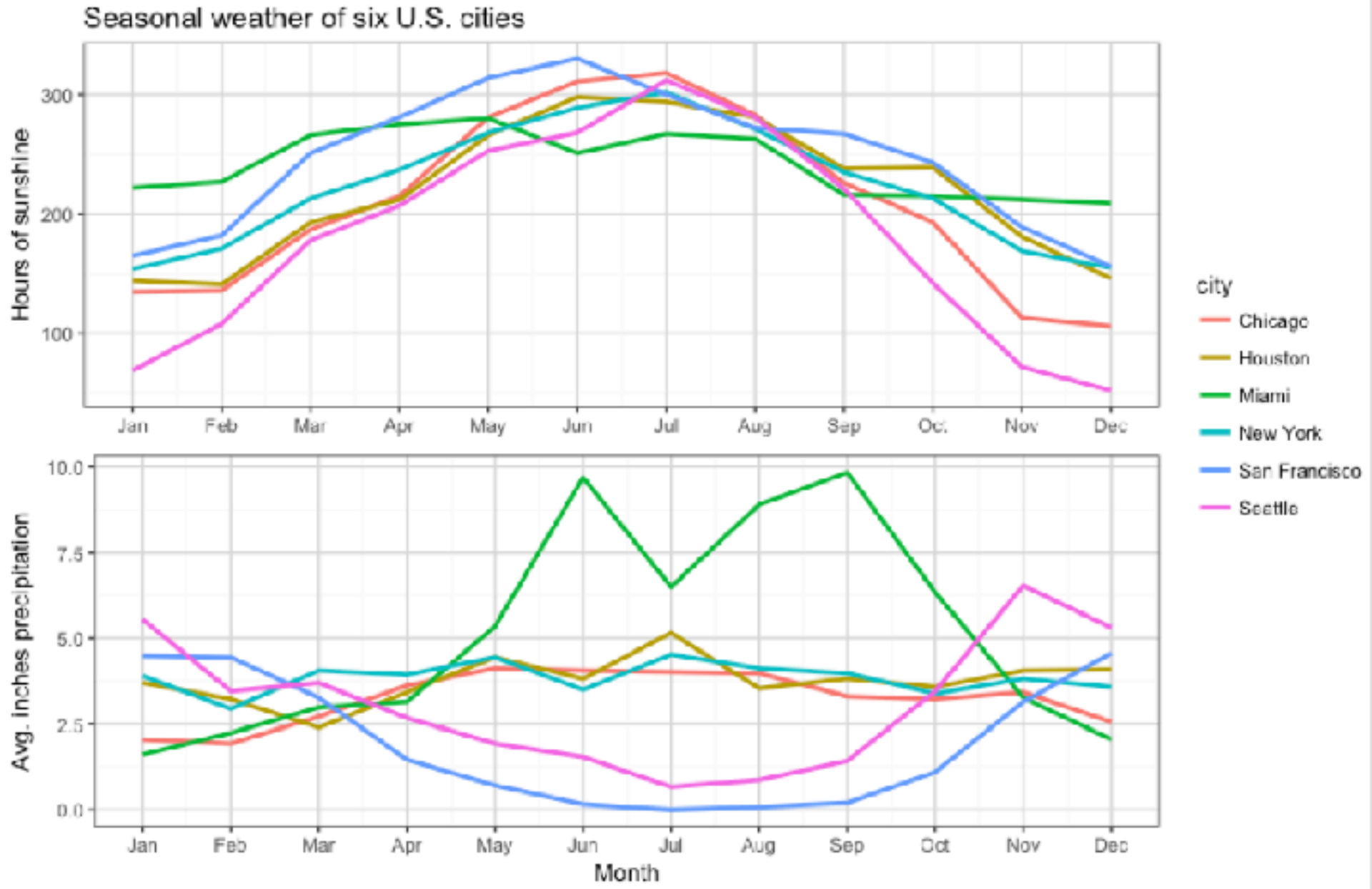

Hours of Sunshine at each month for each major U.S. city
Hours of Sunshine (hour)
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

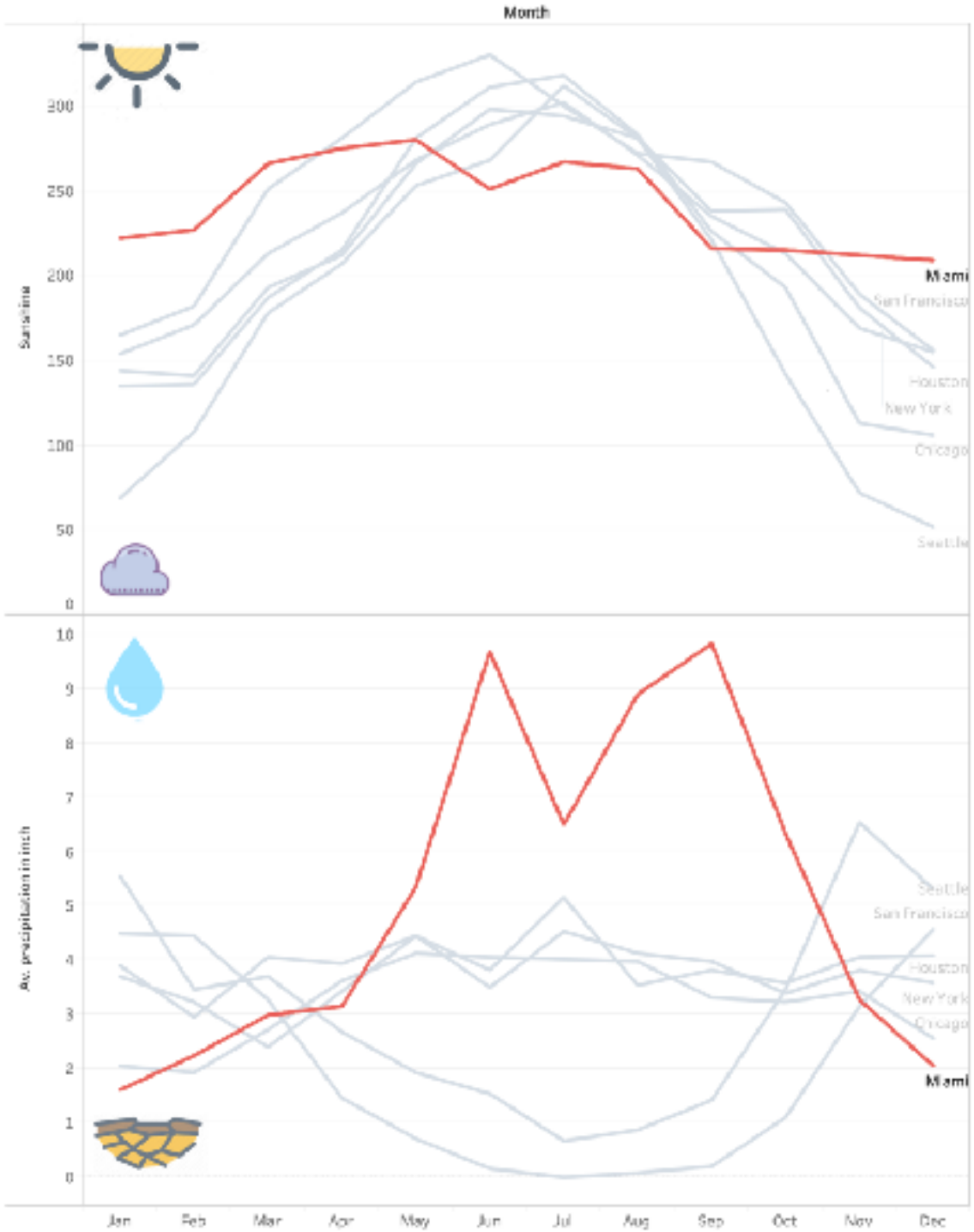

A year-summary of Hours of Sunshine vs Latitude of each major U.S. city
±SD and Mean of Hours of Sunshine (hour)
350
300
250
200
150
100
50
0
Miami
Houston
San Francisco
New York
Chicago
Seattle
24
26
28
30
32
34
36
38
40
42
44
46
48
Latitude


Monthly Hours of Sunshine
Hours of Sunshine
Month
chicago
ny
sf
houston
miami

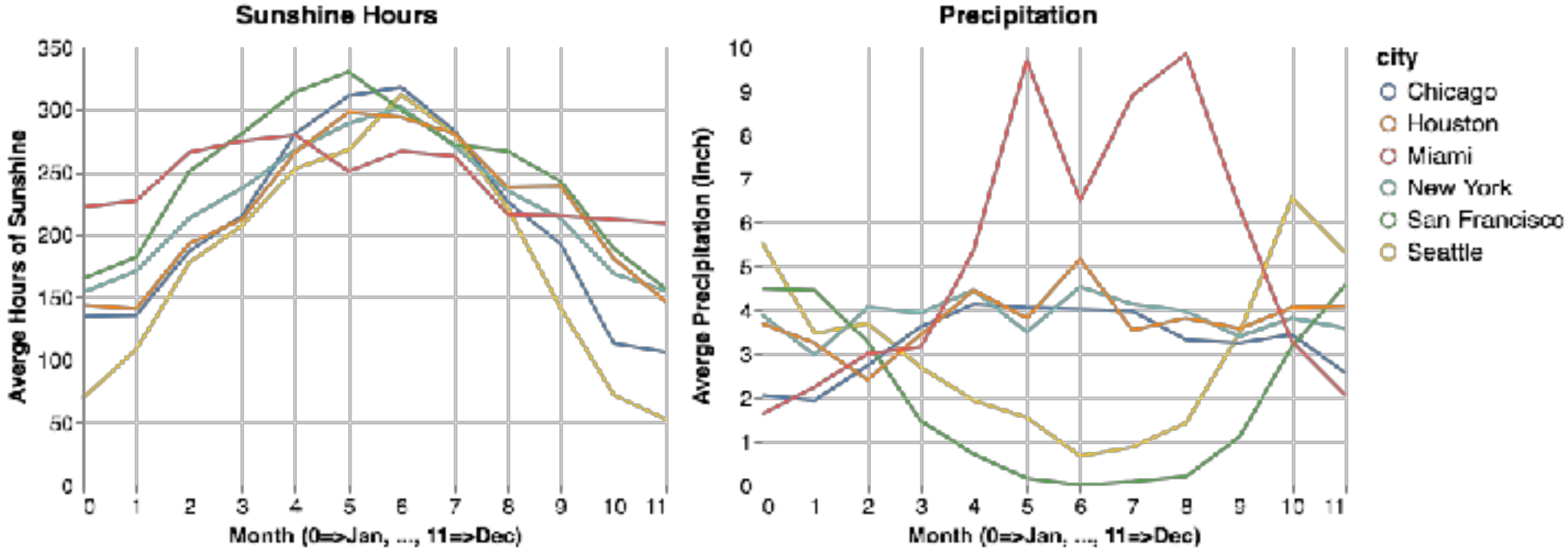

Range of Hours of Sunshine in one year at different Latitudes
Hours of Sunshine per month
Latitude
seattle
chicago
ny
sf
houston
miami
330
318
312
302
298
280
241
245
219
209
208
180
156
154
141
106
52

Line Charts
(+ Precipitation)


Seasonal weather of six U.S. cities
Hours of sunshine
300
200
100
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Avg. Inches precipitation
10.0
7.5
5.0
2.5
0.0
Month
city
Chicago
Houston
Miami
New York
San Francisco
Seattle

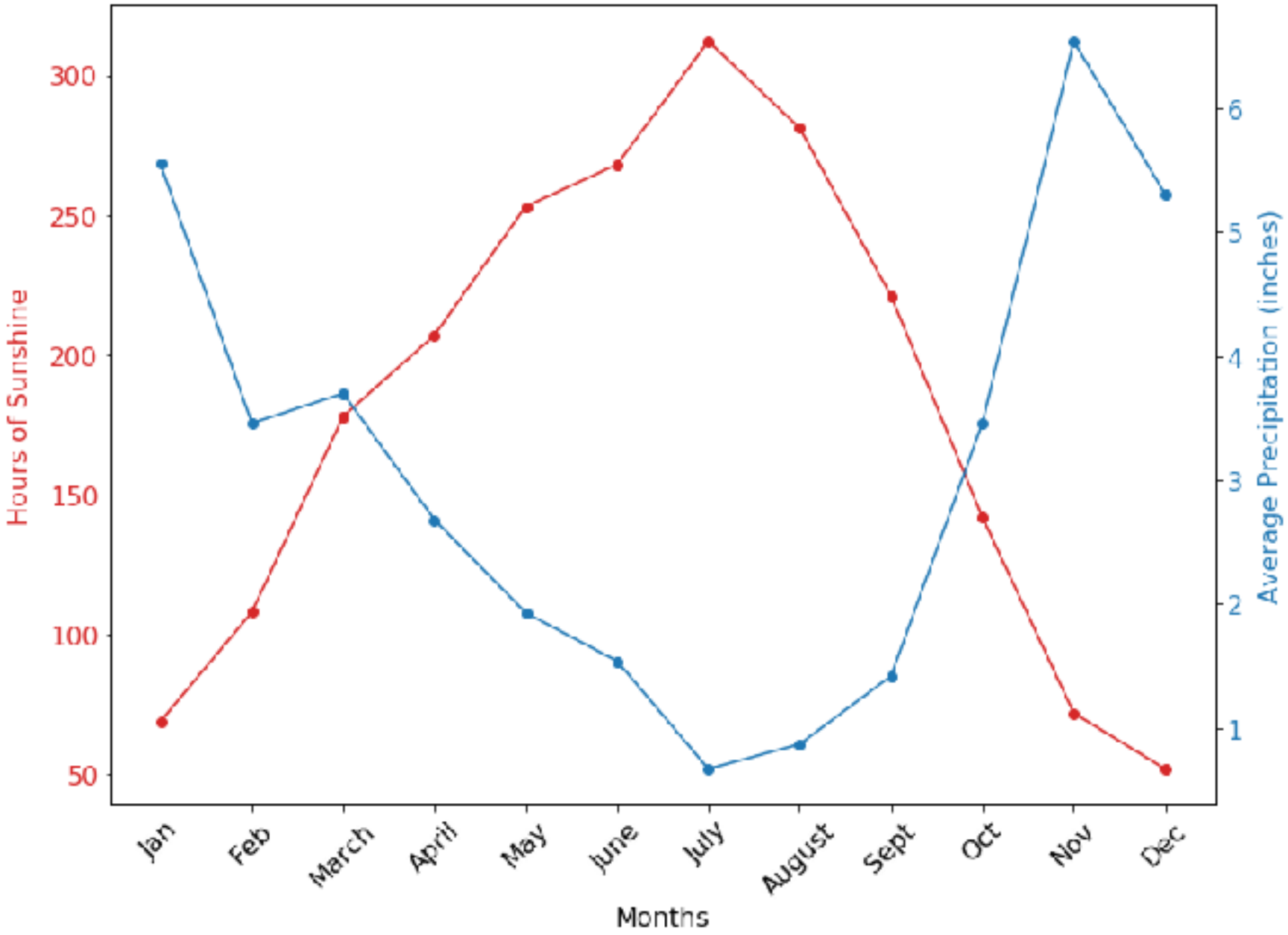

Month
Sunshine
300
250
200
150
100
50
0
Miami
Av. precipitation in inch
10
9
8
7
6
5
4
3
2
1
0
Miami
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

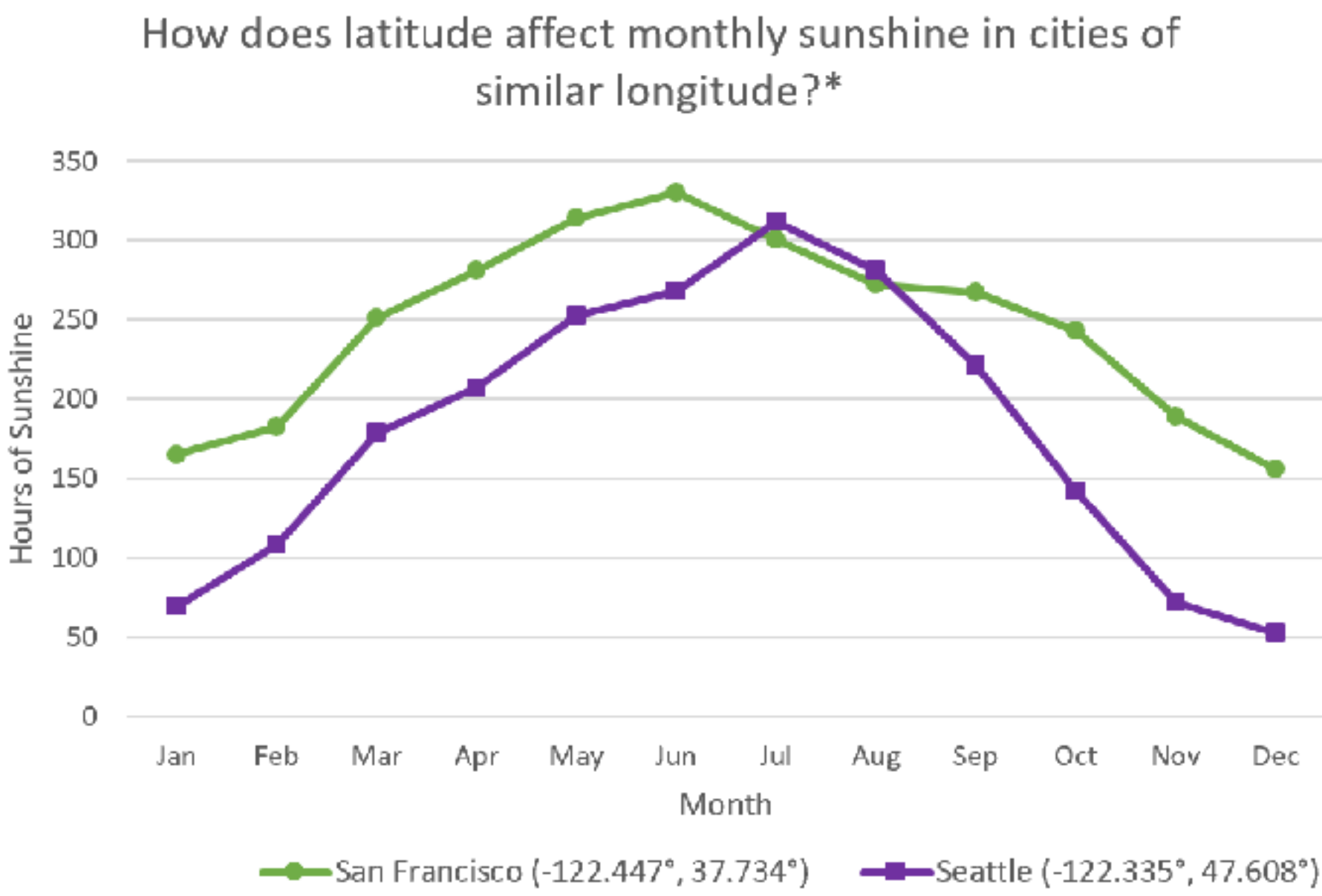
Are Sunshine Hours and Precipitation Correlated?



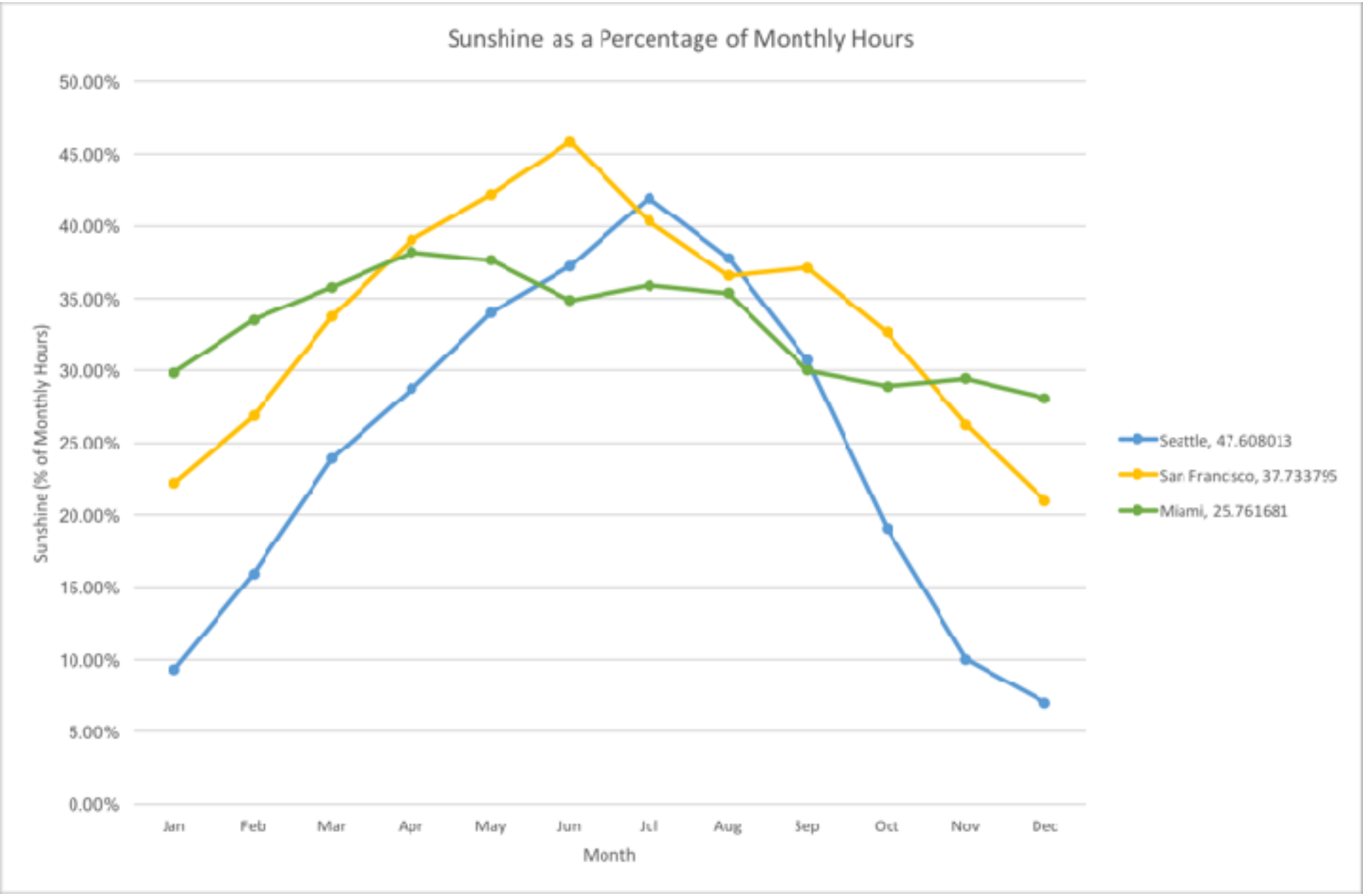
Line Charts (Filtered)

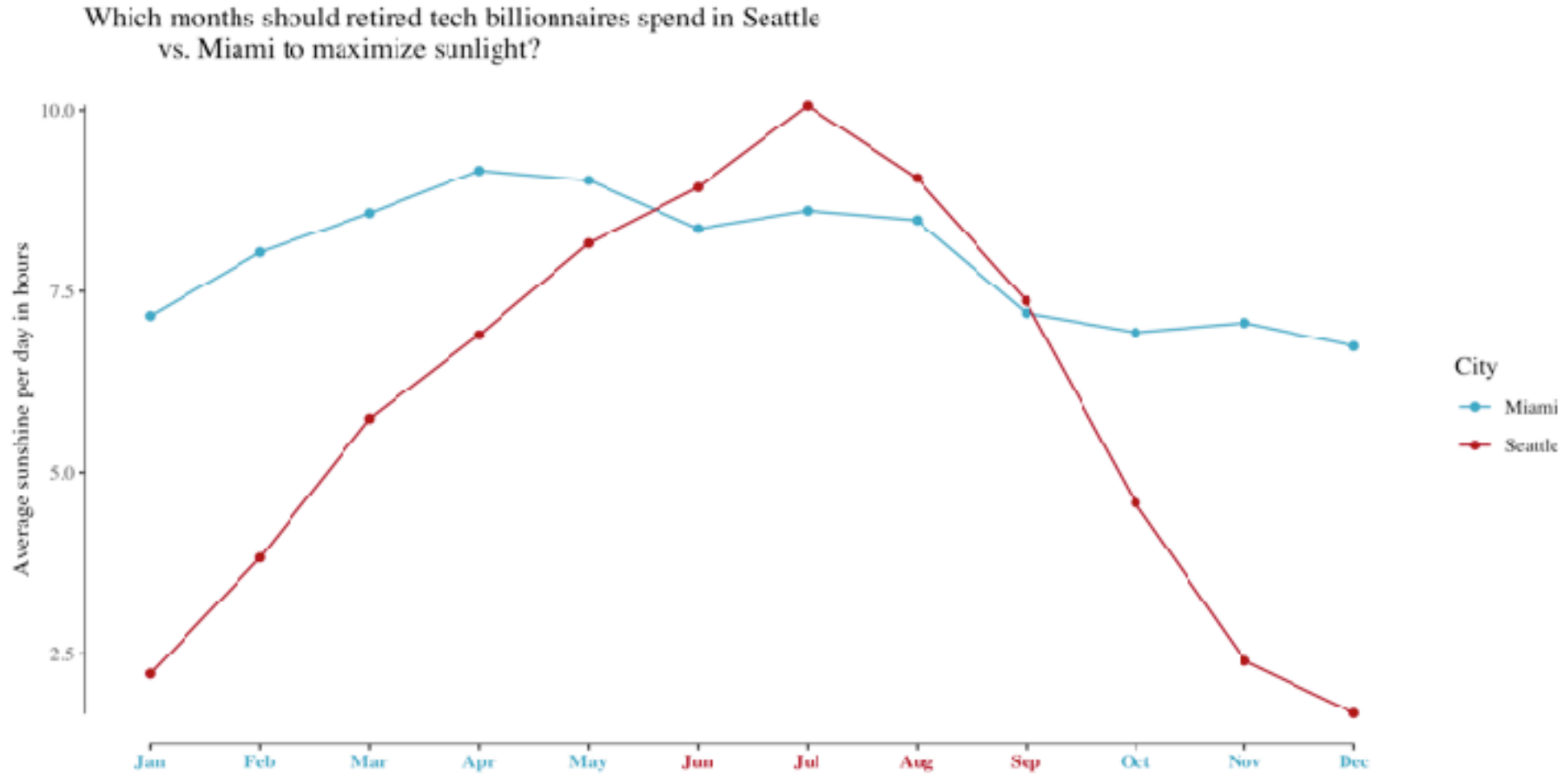
Is there a correlation between hours of sunshine and average precipitation in Seattle?



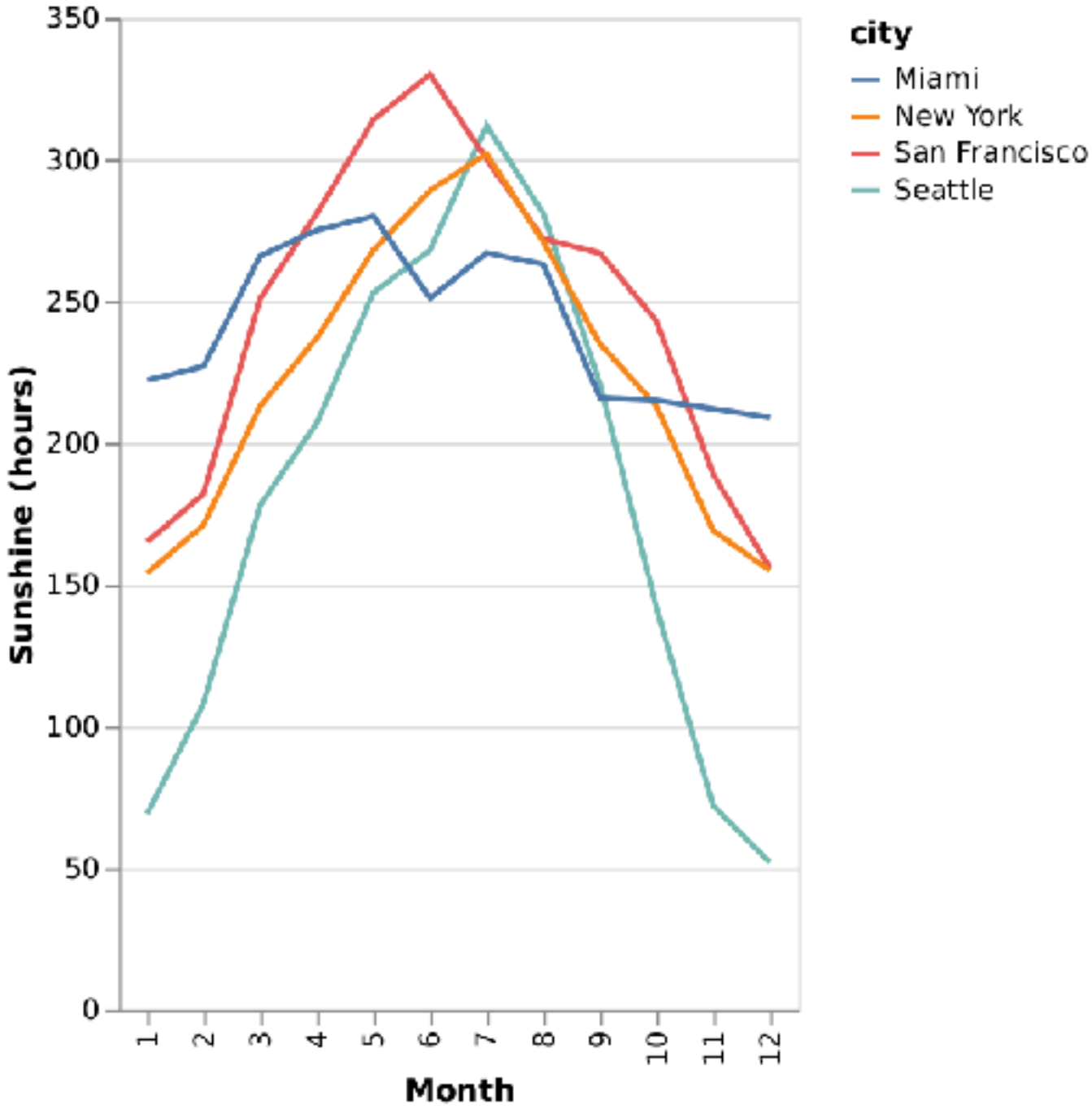


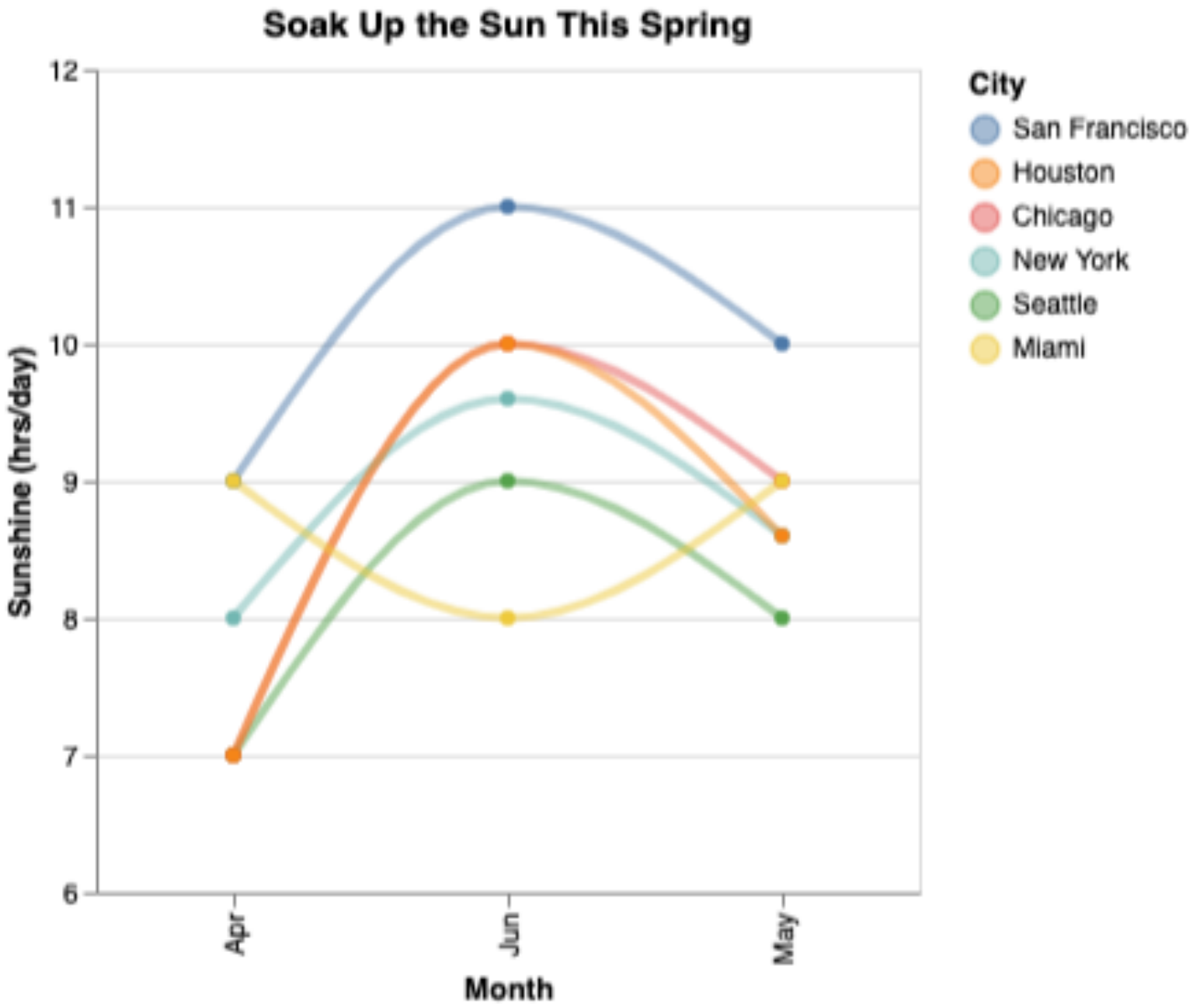
*Data collected by Jeff Heer from usclimatedata.com and latlong.net

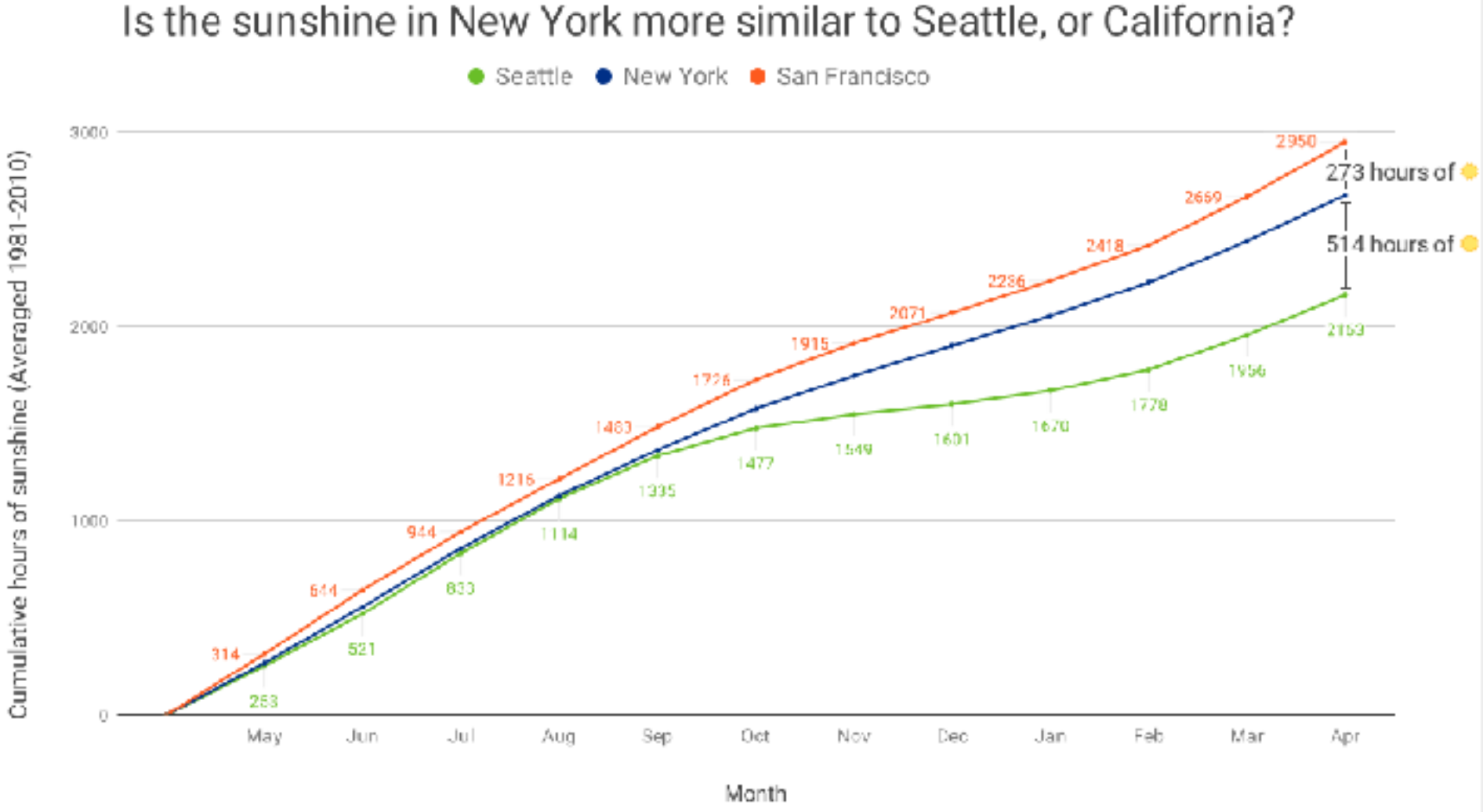

Sunshine as a Percentage of Monthly Hours
50.00%
45.00%
40.00%
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
Sunshine (% of Monthly Hours)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Seattle, 47.608013
San Francisco, 37.733795
Miami, 25.761681


Which months should retired tech billionnaires spend in Seattle vs. Miami to maximize sunlight?
Average sunshine per day in hours
10.0
7.5
5.0
2.5
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
City
Miami
Seattle

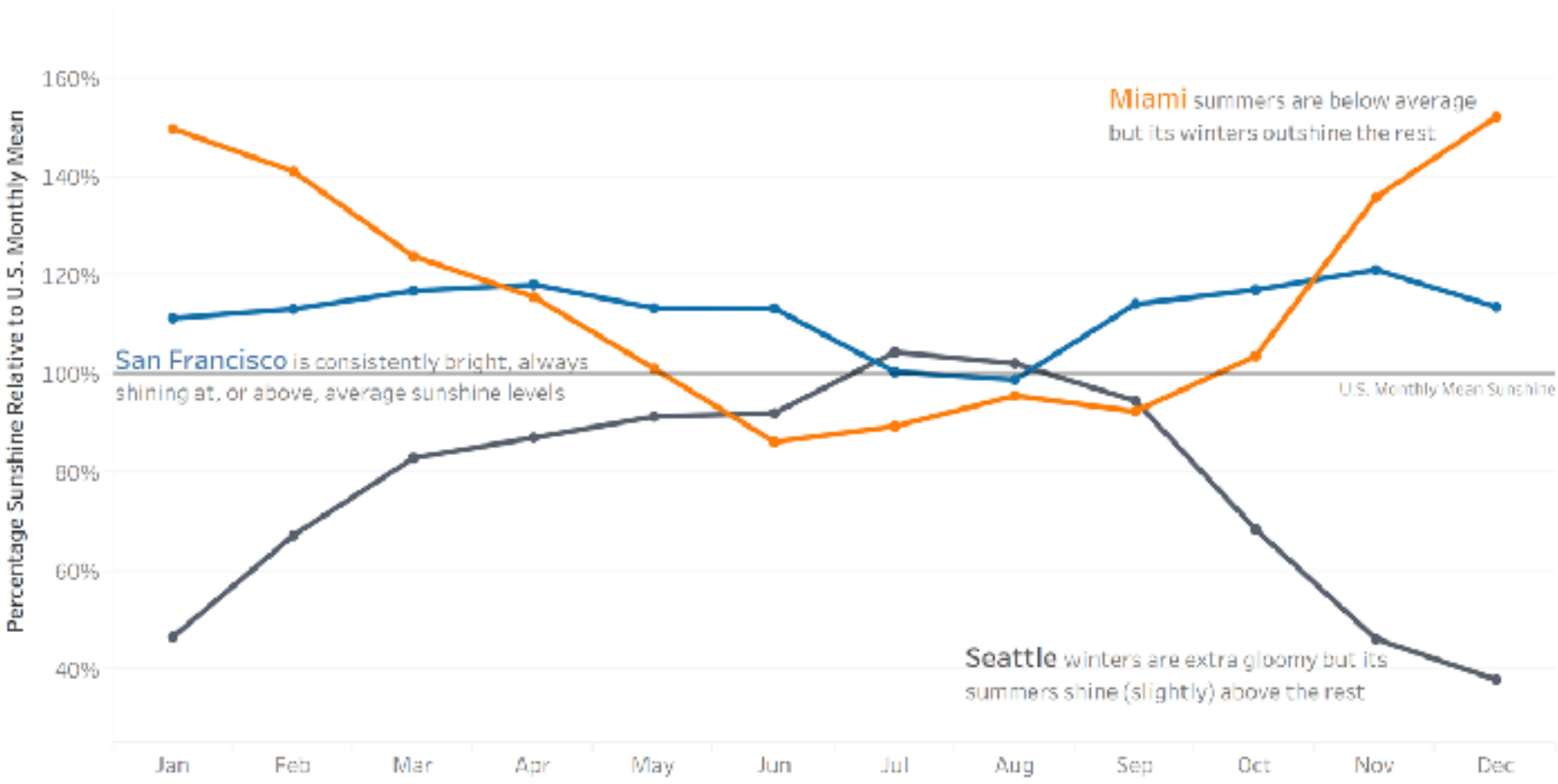
Which Coastal US Cities get the most sunshine each month?




Soak Up the Sun This Spring
12
11
10
9
8
7
6
Sunshine (hrs/day)
Apr
Jun
May
Month
City
San Francisco
Houston
Chicago
New York
Seattle
Miami

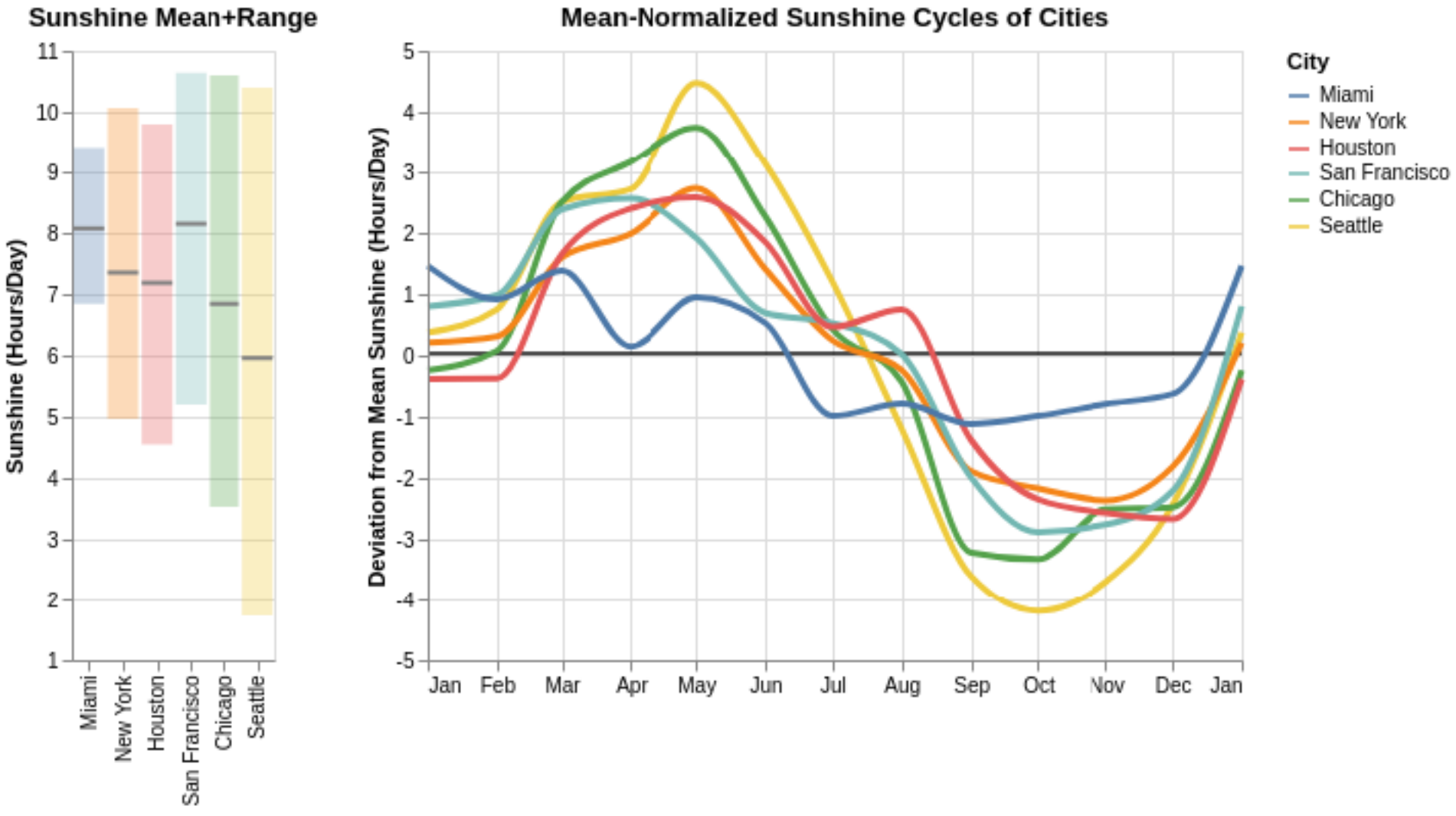

Is the sunshine in New York more similar to Seattle, or California?
Seattle
New York
San Francisco
Cumulative hours of sunshine (Averaged 1981-2010)
3000
2000
1000
0
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
Month
314
644
944
1216
1463
1726
1915
2071
2236
2418
2659
2950
253
521
803
1114
1335
1477
1549
1601
1670
1778
1956
2153
273 hours of
514 hours of

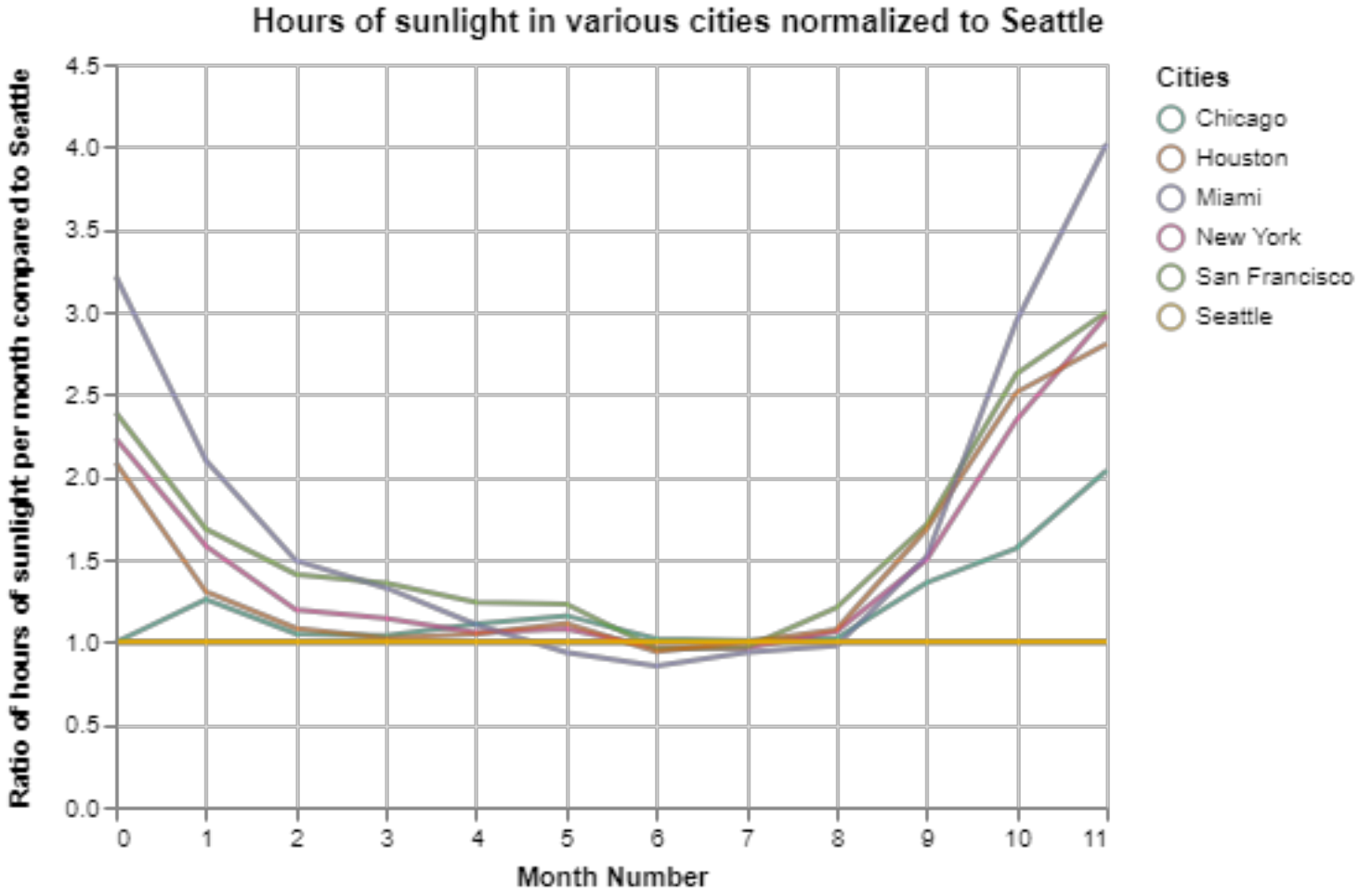
Which U.S. city is the sunniest each month?

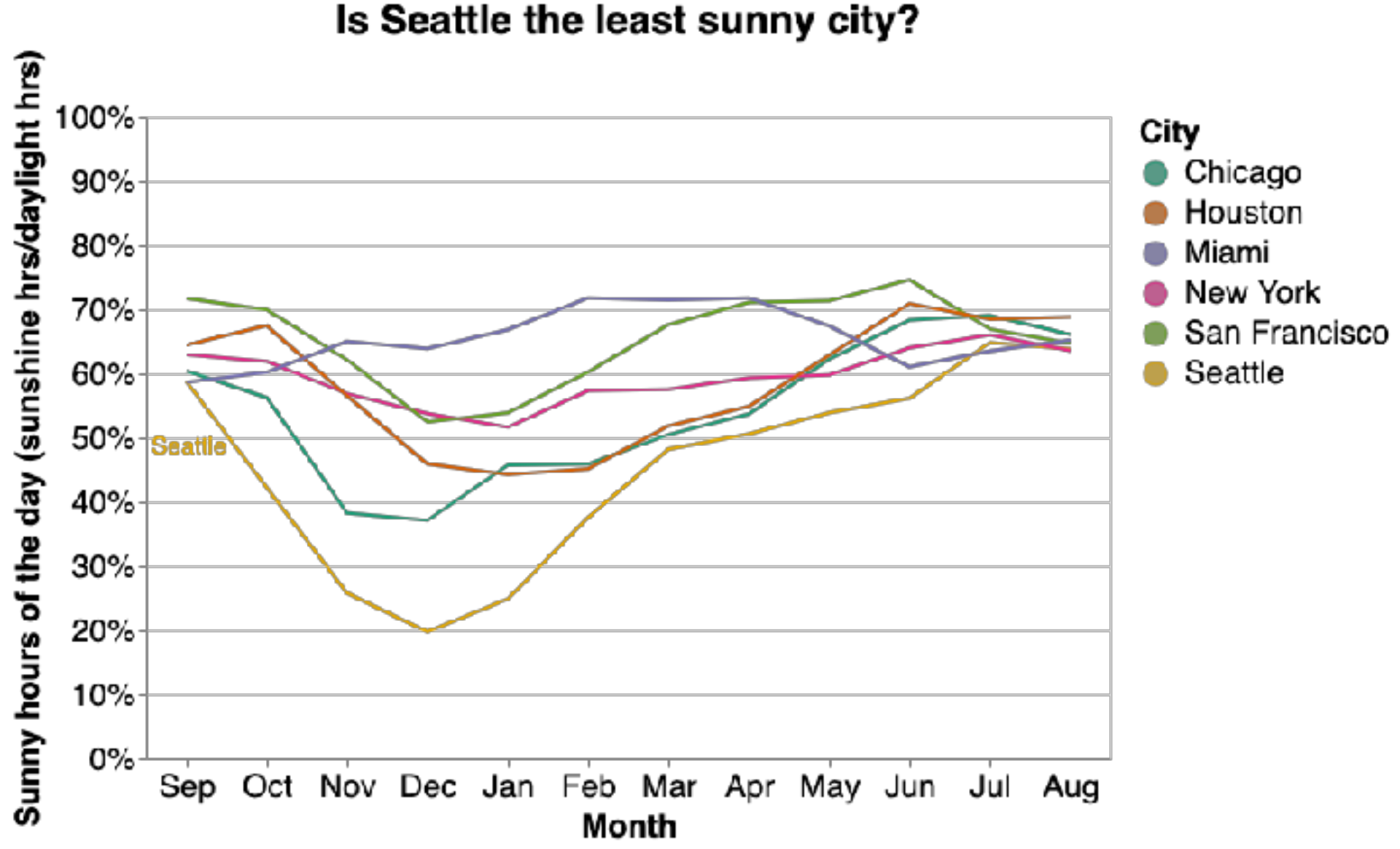


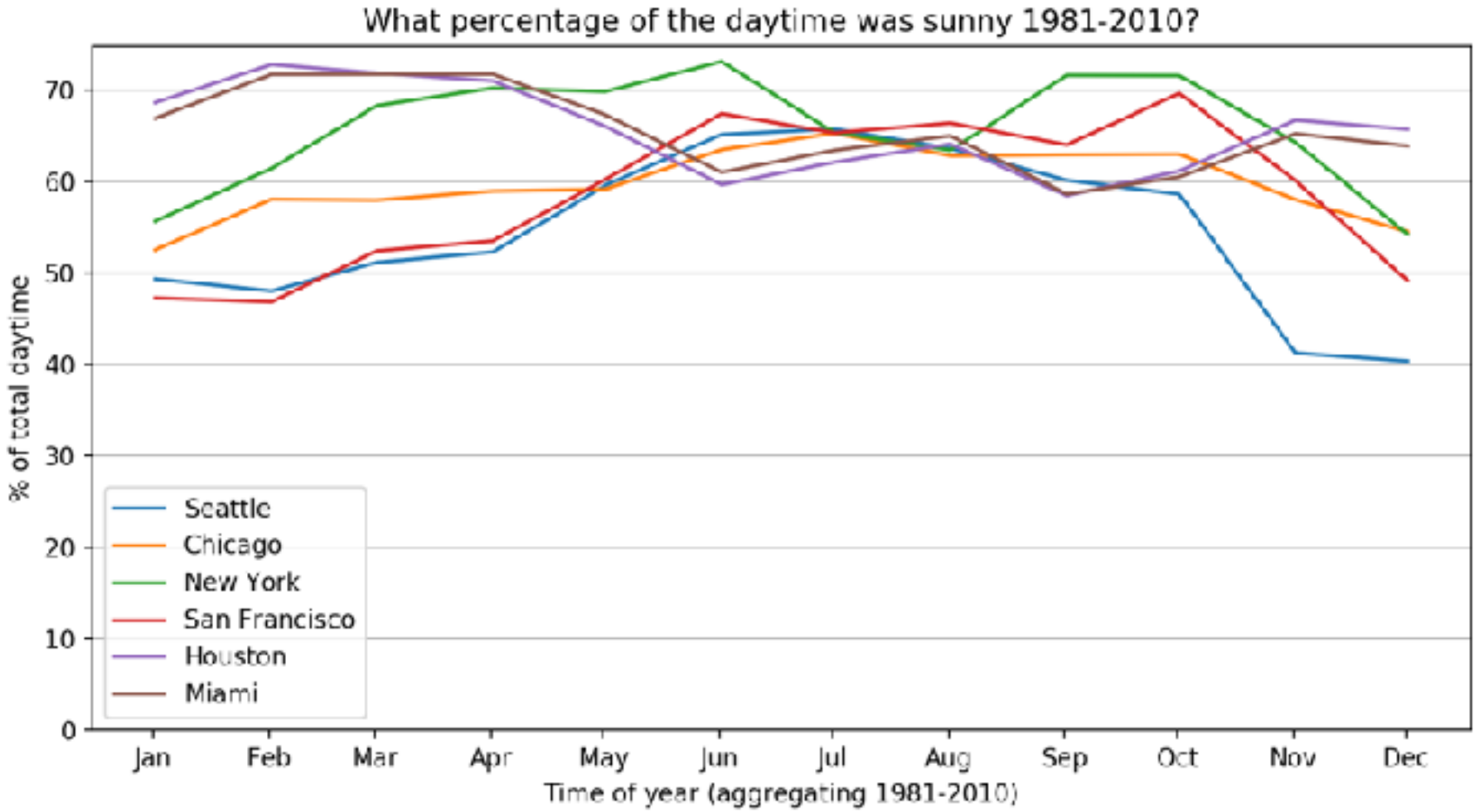
Line Charts (Normalized)

Q: Do different cities cycle from sunny to cloudy in different ways?

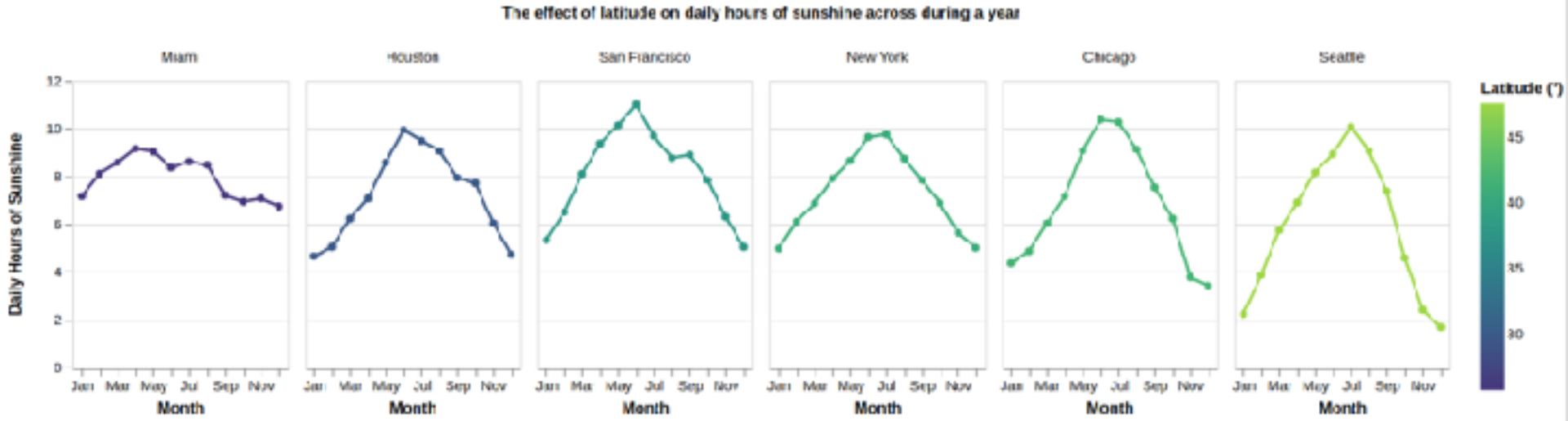


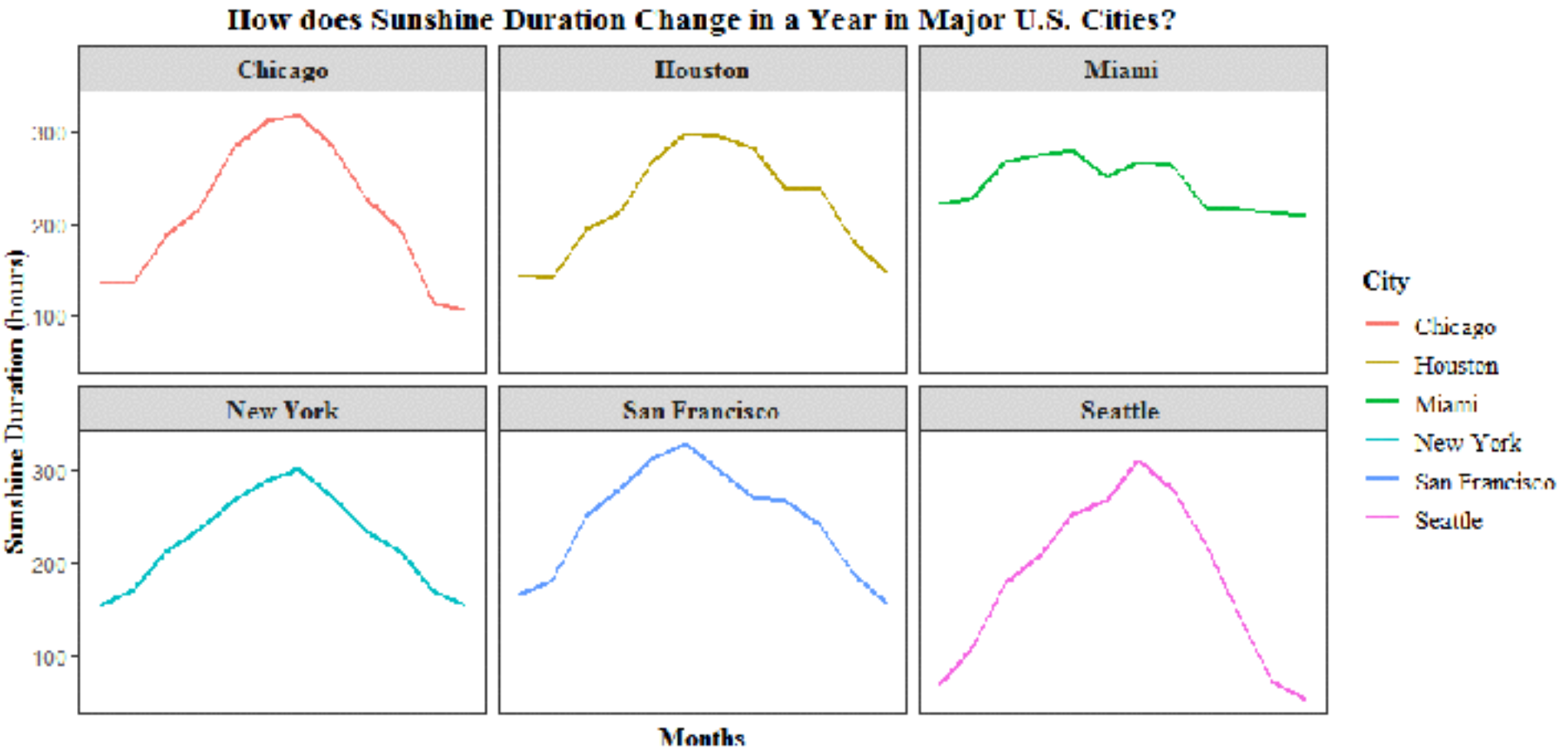

Hours of sunlight in various cities normalized to Seattle
Ratio of hours of sunlight per month compared to Seattle
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
1
2
3
4
5
6
7
8
9
10
11
Month Number
Cities
Chicago
Houston
Miami
New York
San Francisco
Seattle


Is Seattle the least sunny city?
Sunny hours of the day (sunshine hrs/daylight hrs)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Seattle
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Month
City
Chicago
Houston
Miami
New York
San Francisco
Seattle

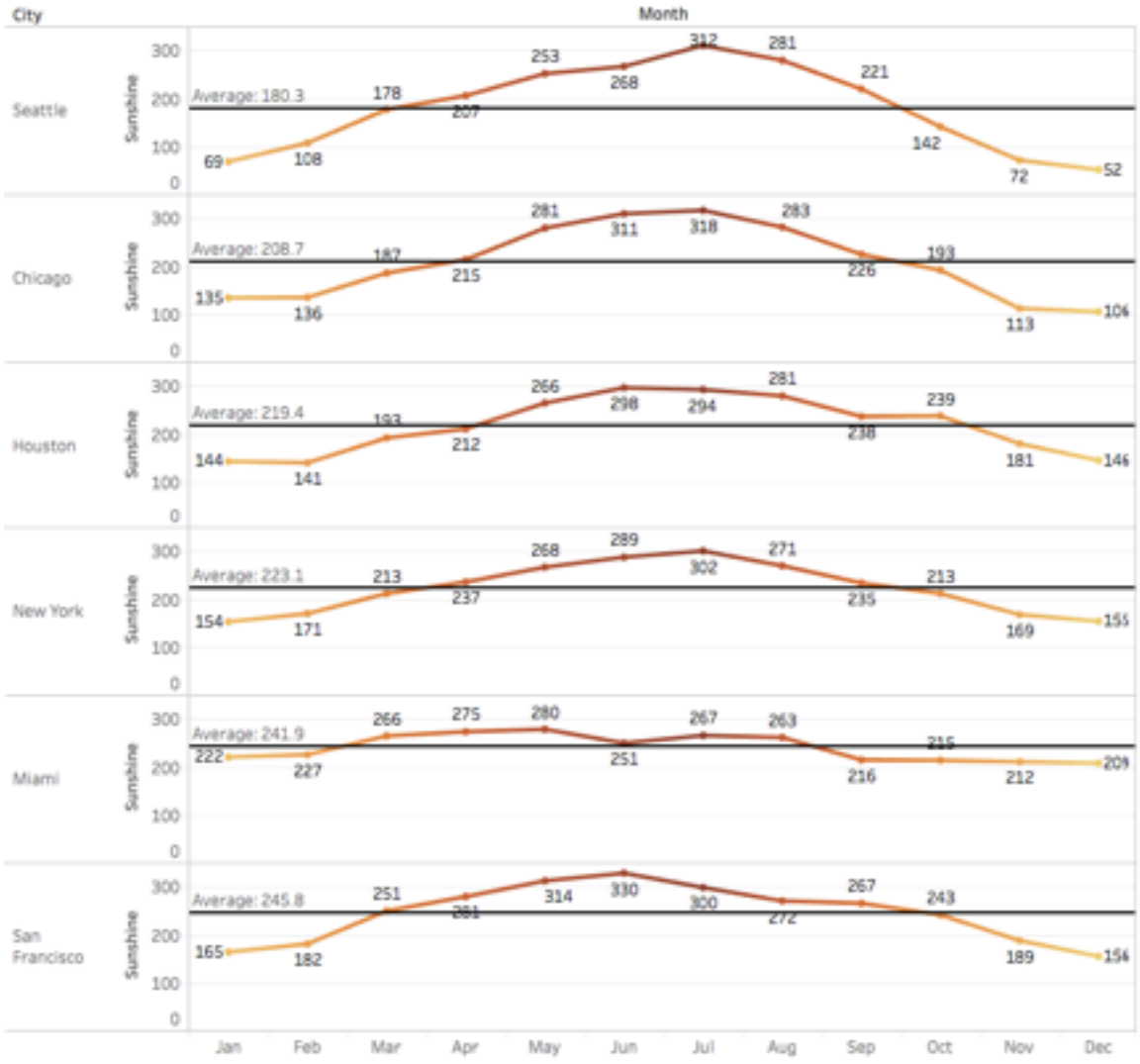

What percentage of the daytime was sunny 1981-2010?
% of total daytime
0
10
20
30
40
50
60
70
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Time of year (aggregating 1981-2010)
Seattle
Chicago
New York
San Francisco
Houston
Miami

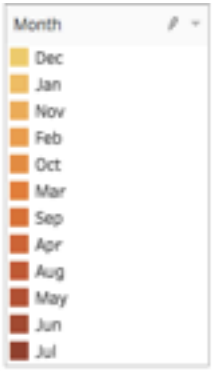
Line Charts (Small Multiples)


The effect of latitude on daily hours of sunshine across during a year
Miami
Houston
San Francisco
New York
Chicago
Seattle
Daily Hours of Sunshine
0
2
4
6
8
10
12
Jan
Mar
May
Jul
Sep
Nov
Month
Latitude (°)
30
35
40
45


How does Sunshine Duration Change in a Year in Major U.S. Cities?
Chicago
Houston
Miami
New York
San Francisco
Seattle
Sunshine Duration (hours)
100
200
300
Months
City
Chicago
Houston
Miami
New York
San Francisco
Seattle

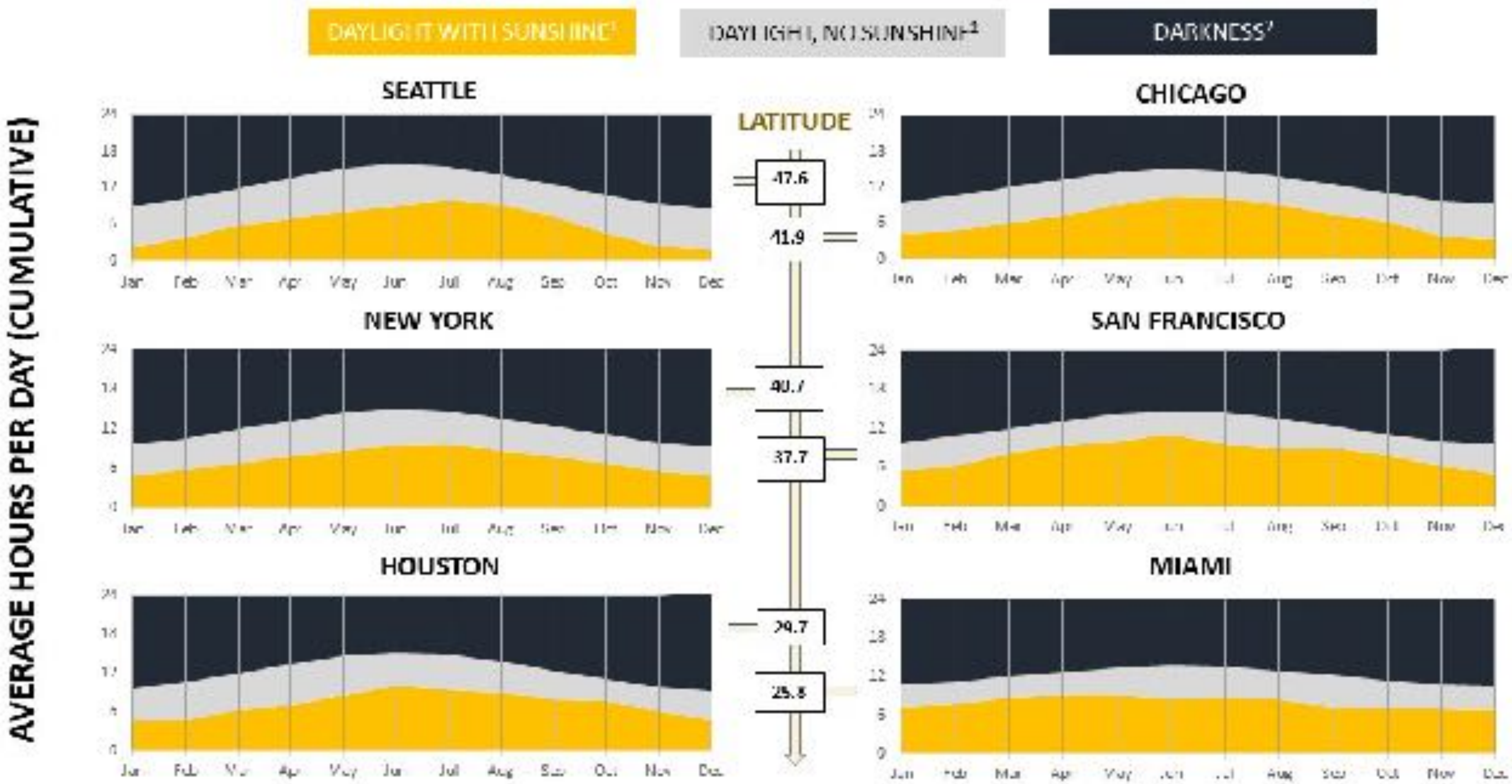
How much sunshine do US cities receive on an average all year round (low to high)?





Area Charts

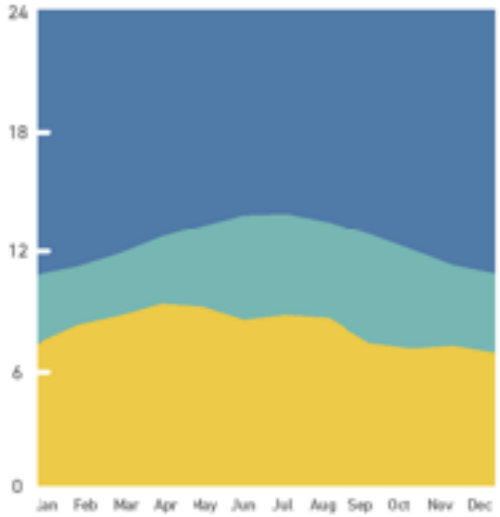
SUNSHINE IN THE CITY: AVERAGE DAILY DOSE



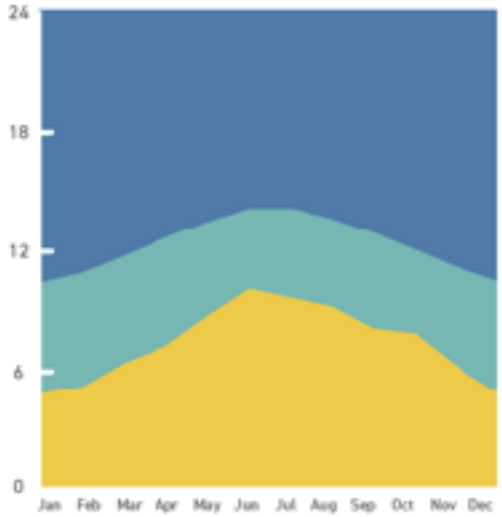
1. Hours of sunshine per month, averaged over 1981-2010. U.S. Climate Data 2. 1996 monthly average hours of daylight. Astronomical Applications Dept. of U.S. Navy

Where is the sun?

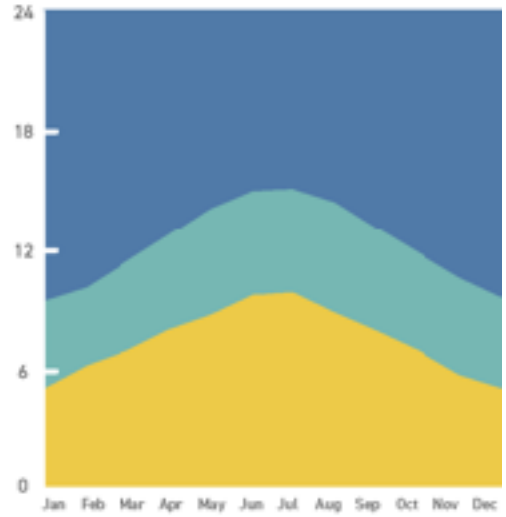
Miami



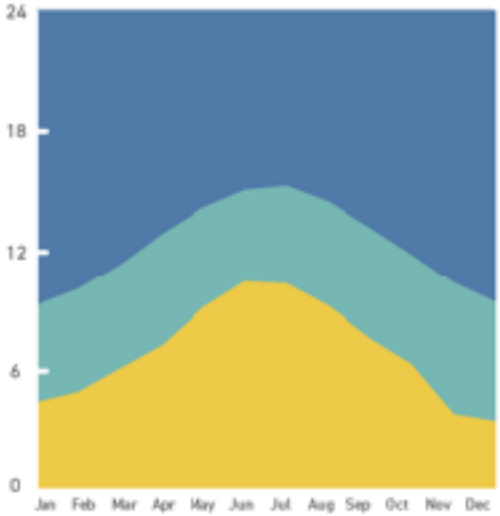
Houston



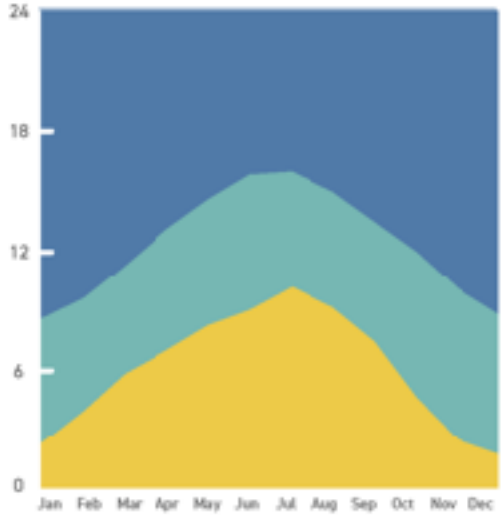
New York



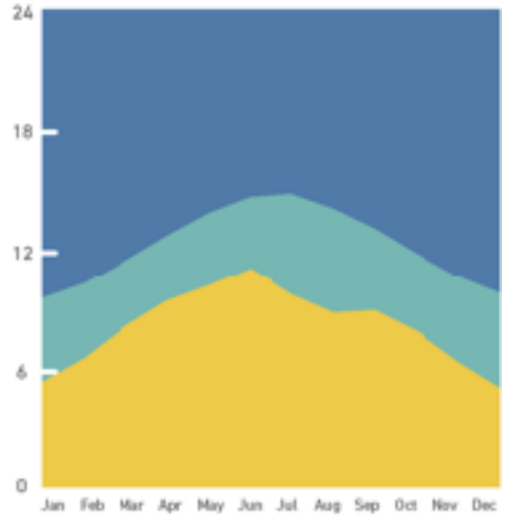
Chicago



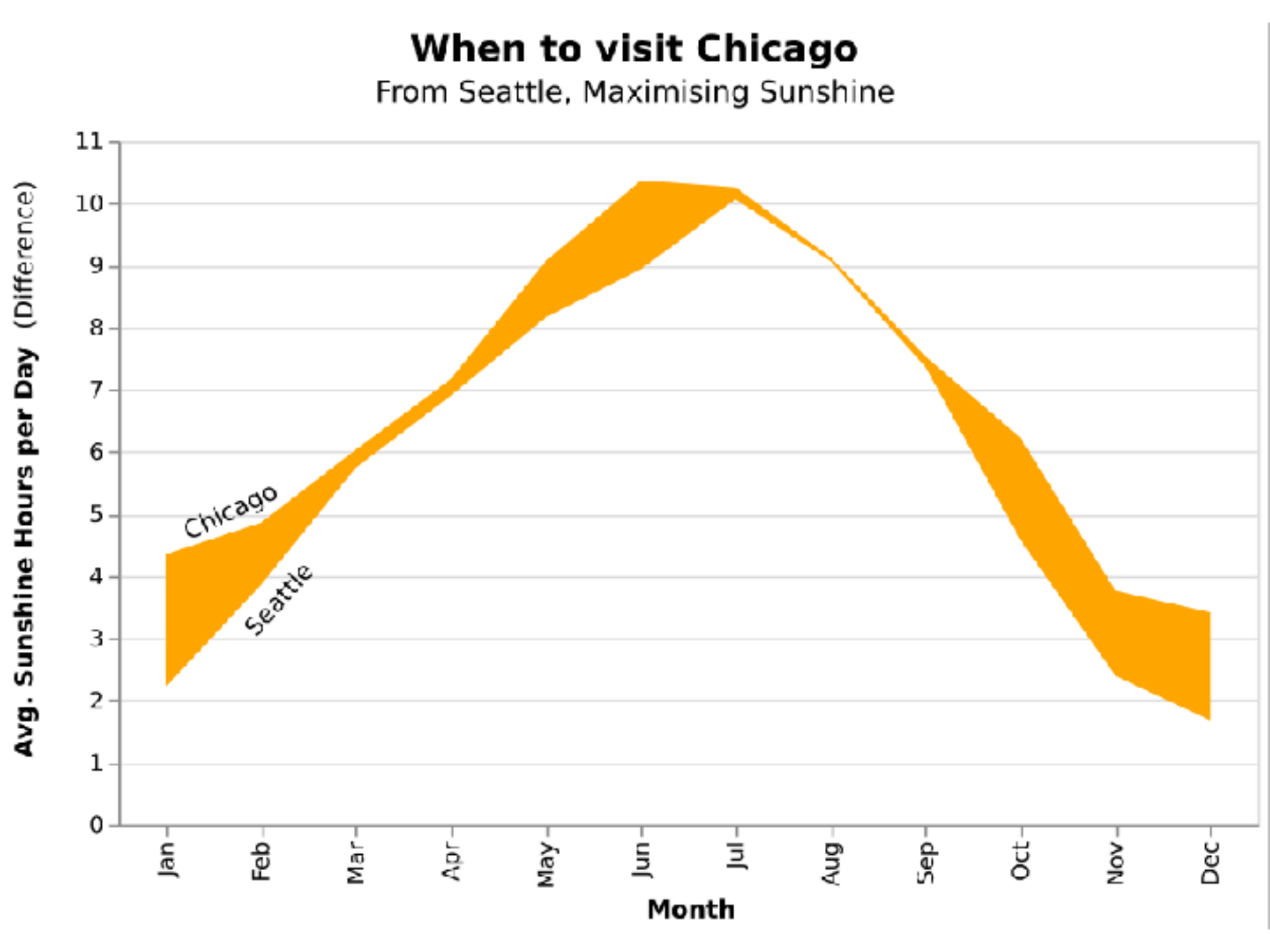
Seattle



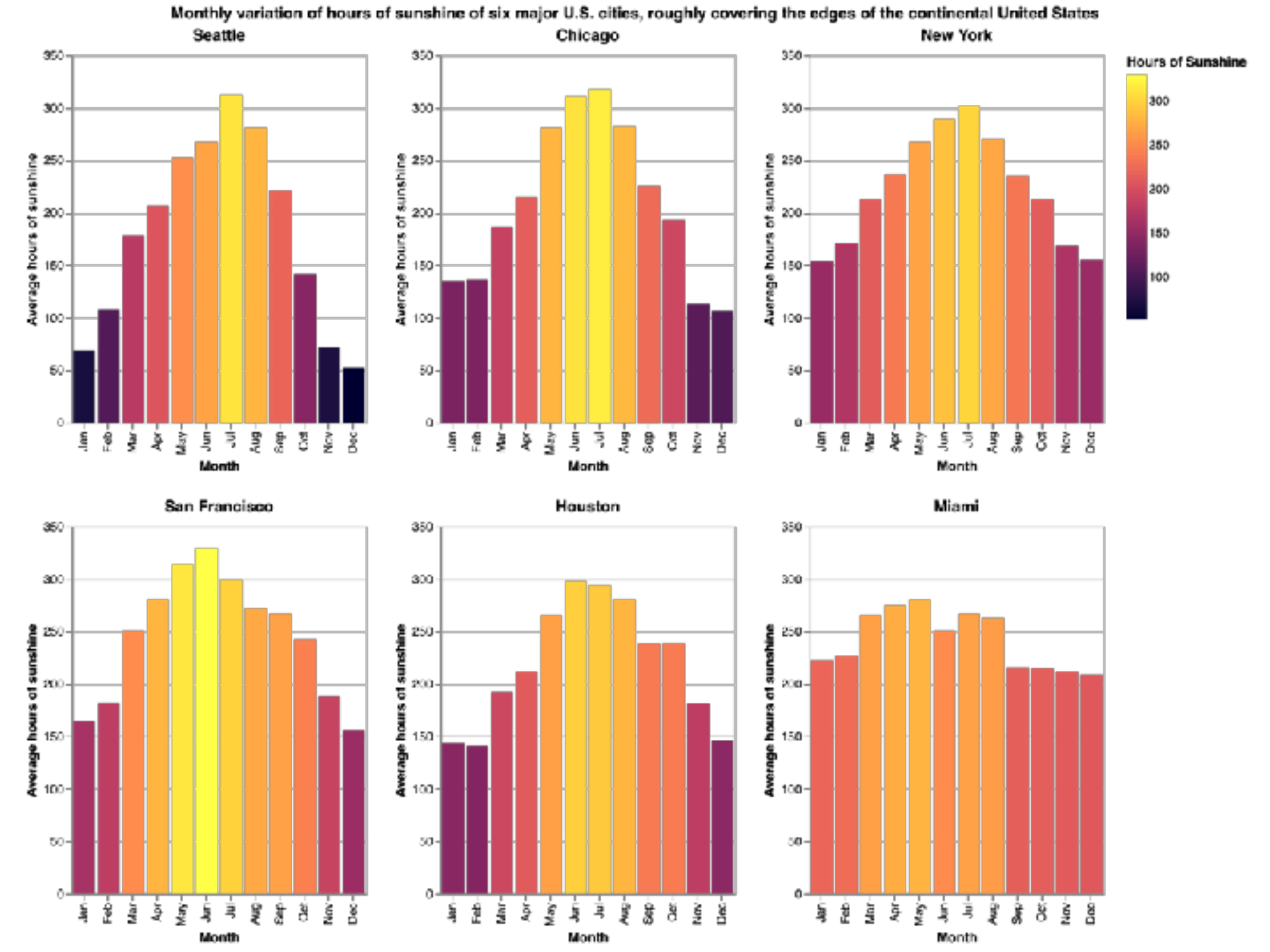
San Francisco

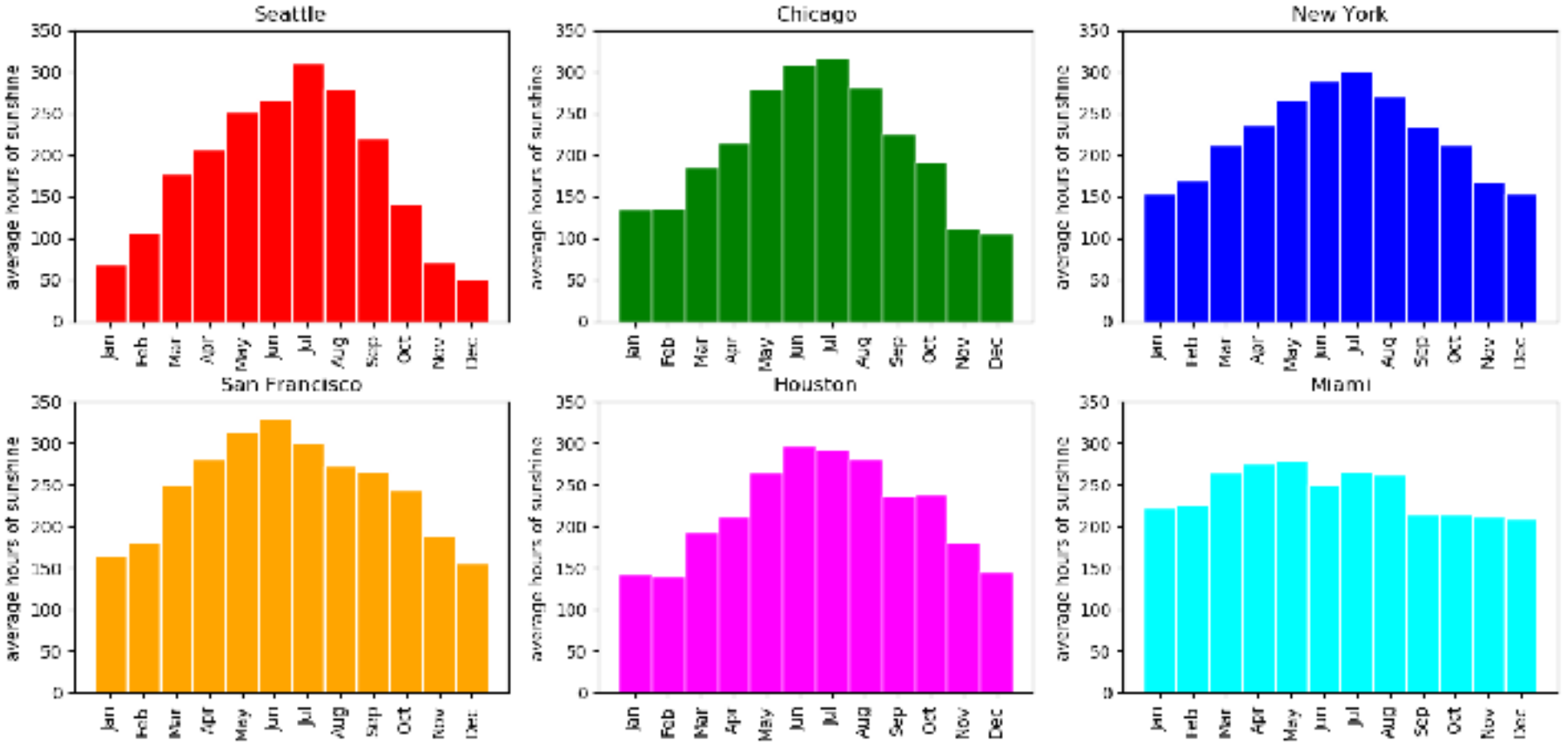



How sunny are the following five major cities compared to Seattle?
Chicago
Houston
Miami
New York
San Francisco


When to visit Chicago
From Seattle, Maximising Sunshine
Avg. Sunshine Hours per Day (Difference)
11
10
9
8
7
6
5
4
3
2
1
0
Chicago
Seattle
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

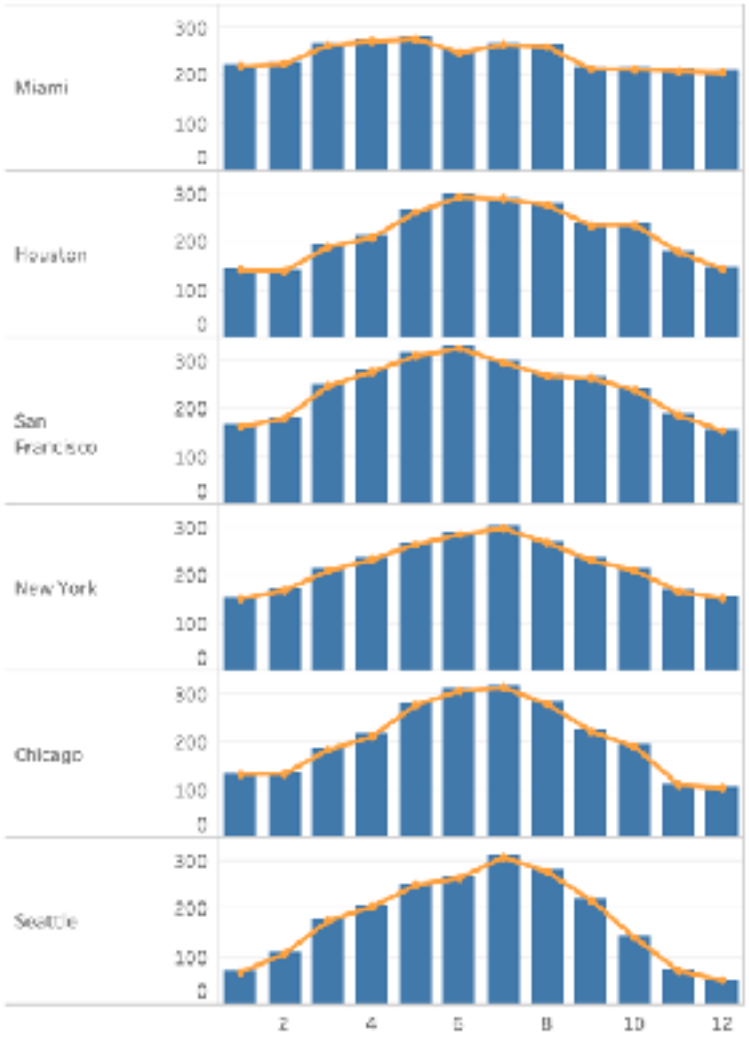
Bar Charts


Monthly variation of hours of sunshine of six major U.S. cities, roughly covering the edges of the continental United States
Seattle
Chicago
New York
San Francisco
Houston
Miami
Average hours of sunshine
Month
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
0
50
100
150
200
250
300
350
Hours of Sunshine

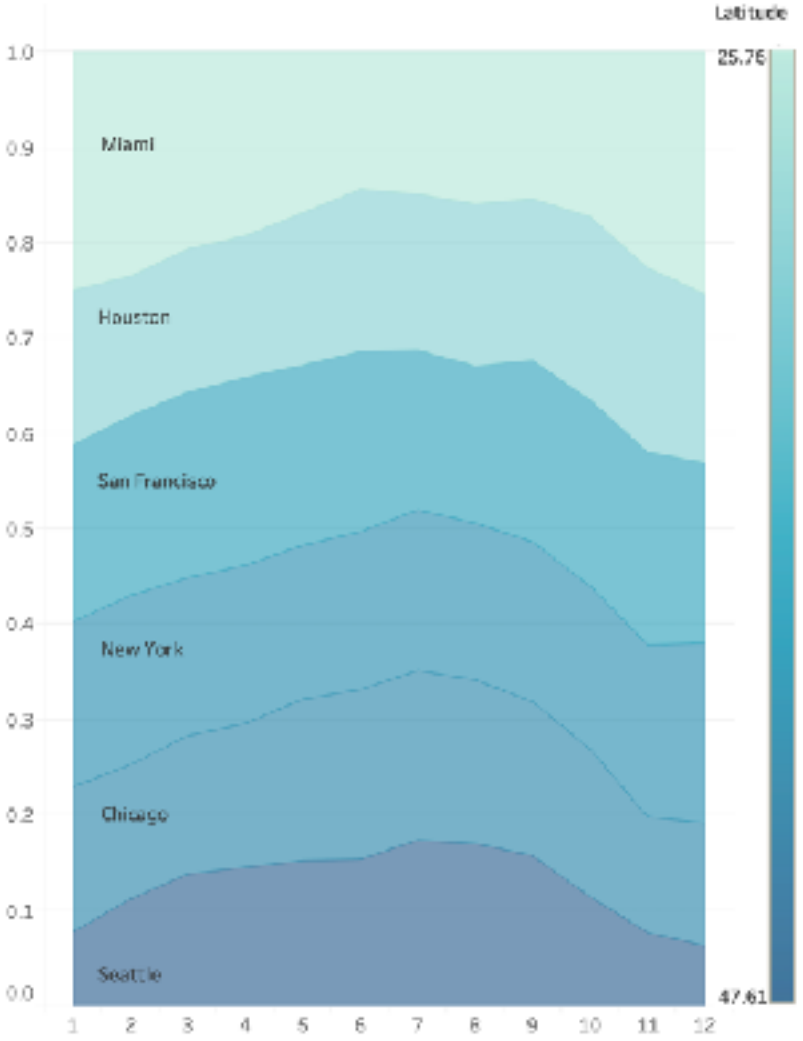

How amount of sunshine changes in a city over time?
Seattle
Chicago
New York
San Francisco
Houston
Miami
average hours of sunshine
0
50
100
150
200
250
300
350
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

How Could Latitude Have an Impact on the City Monthly Sunshine Hour?

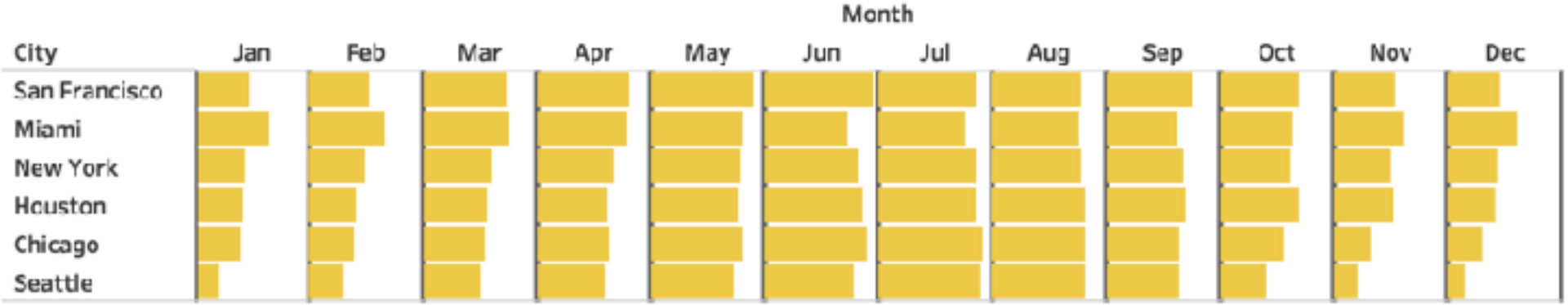
City Monthly Sunshine Curve



Relative City Sunshine Ratio

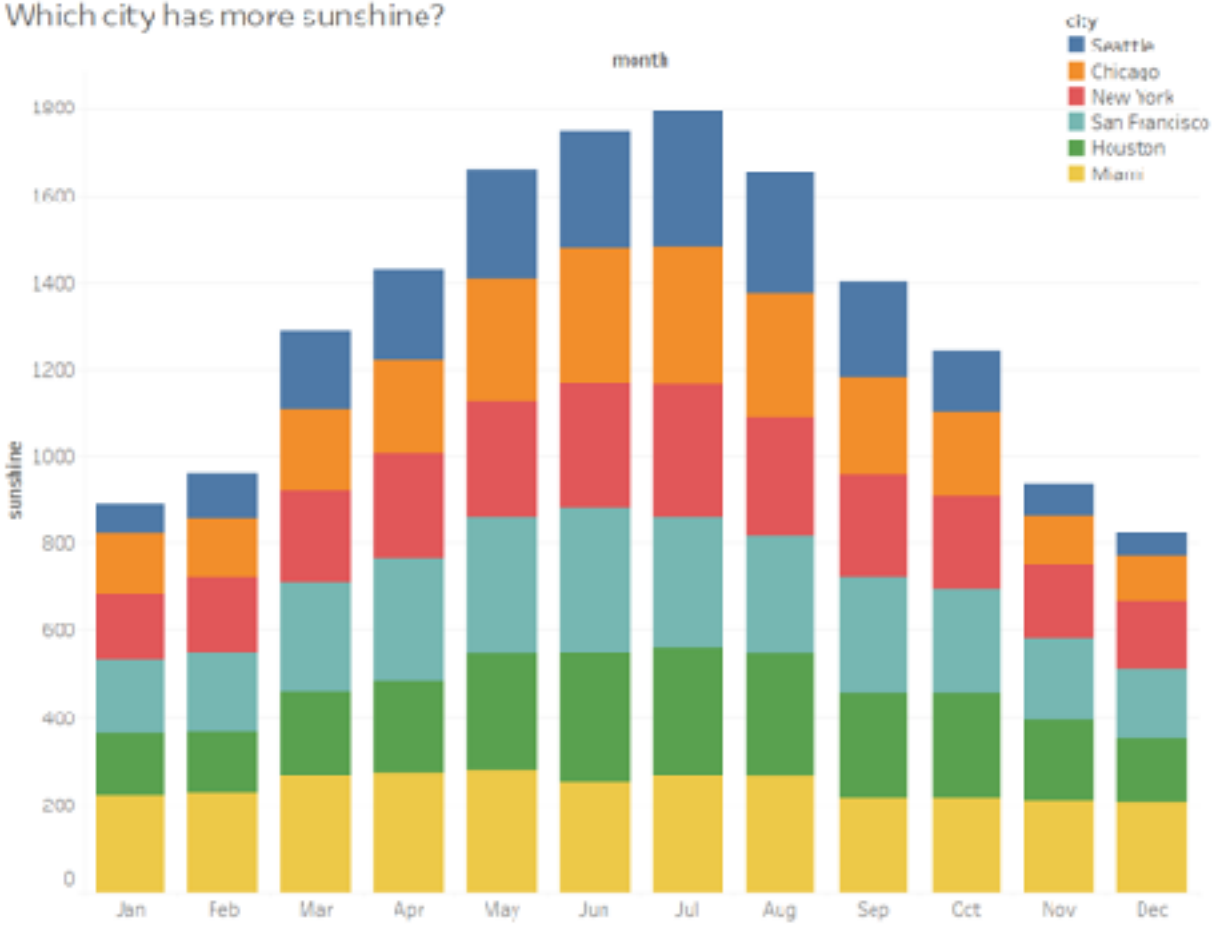


Where should a sun-chaser vacation?

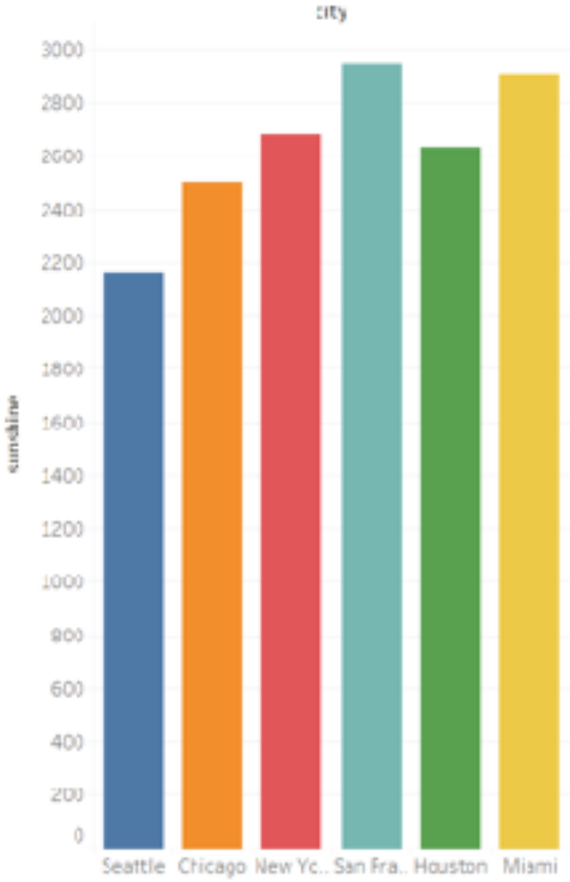


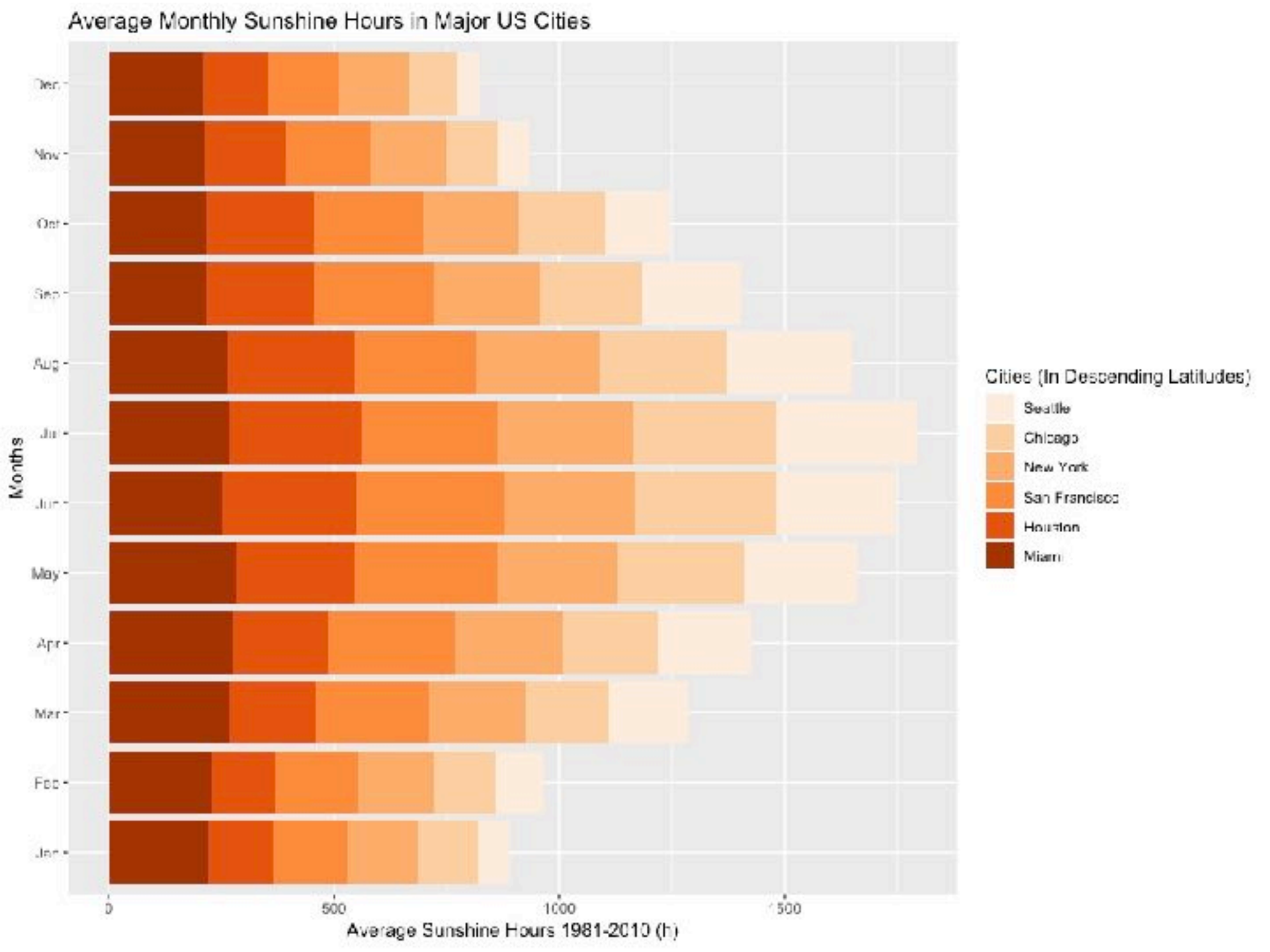
Average hours of sunshine between 1981 and 2010 (size of bar) broken down by month vs. city. Cities are ordered by total hours of sunlight per year (highest to lowest) on average between 1981 and 2010.

Which city has more sunshine?



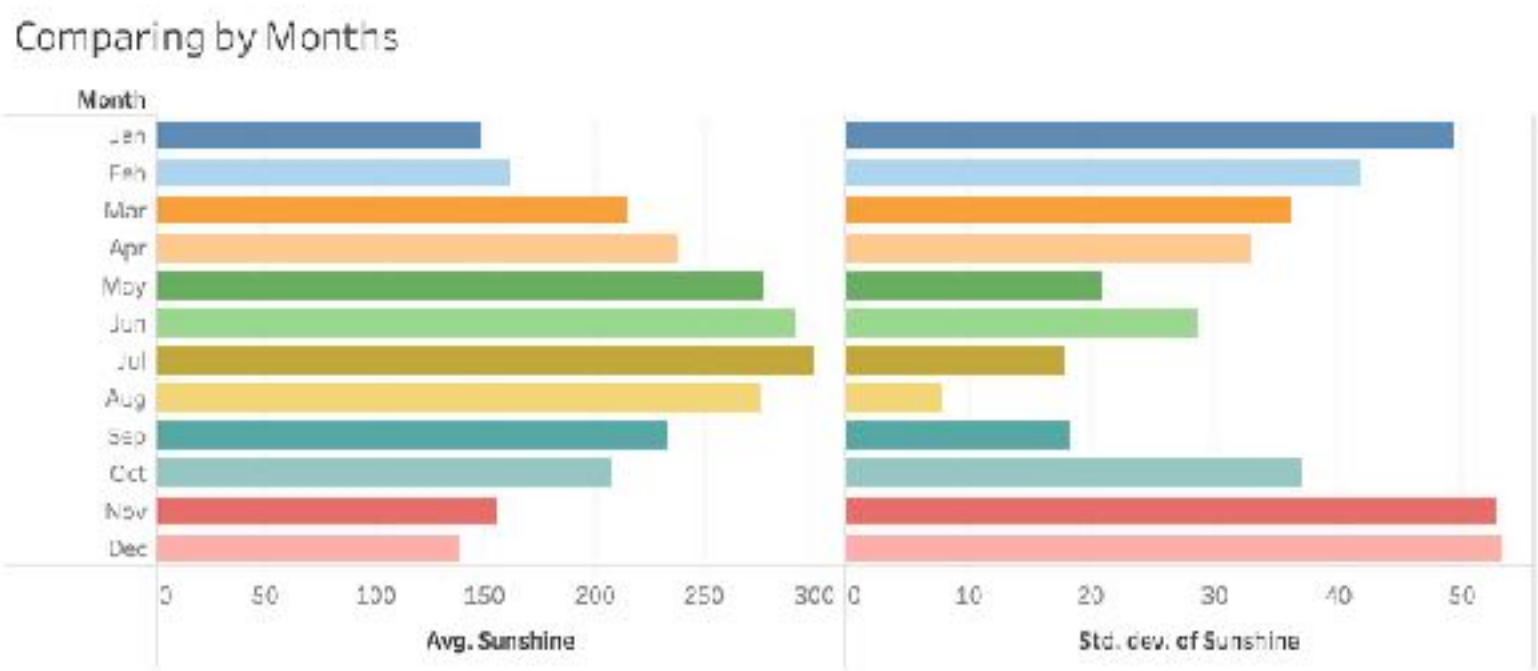
Annual Sunshine Hours



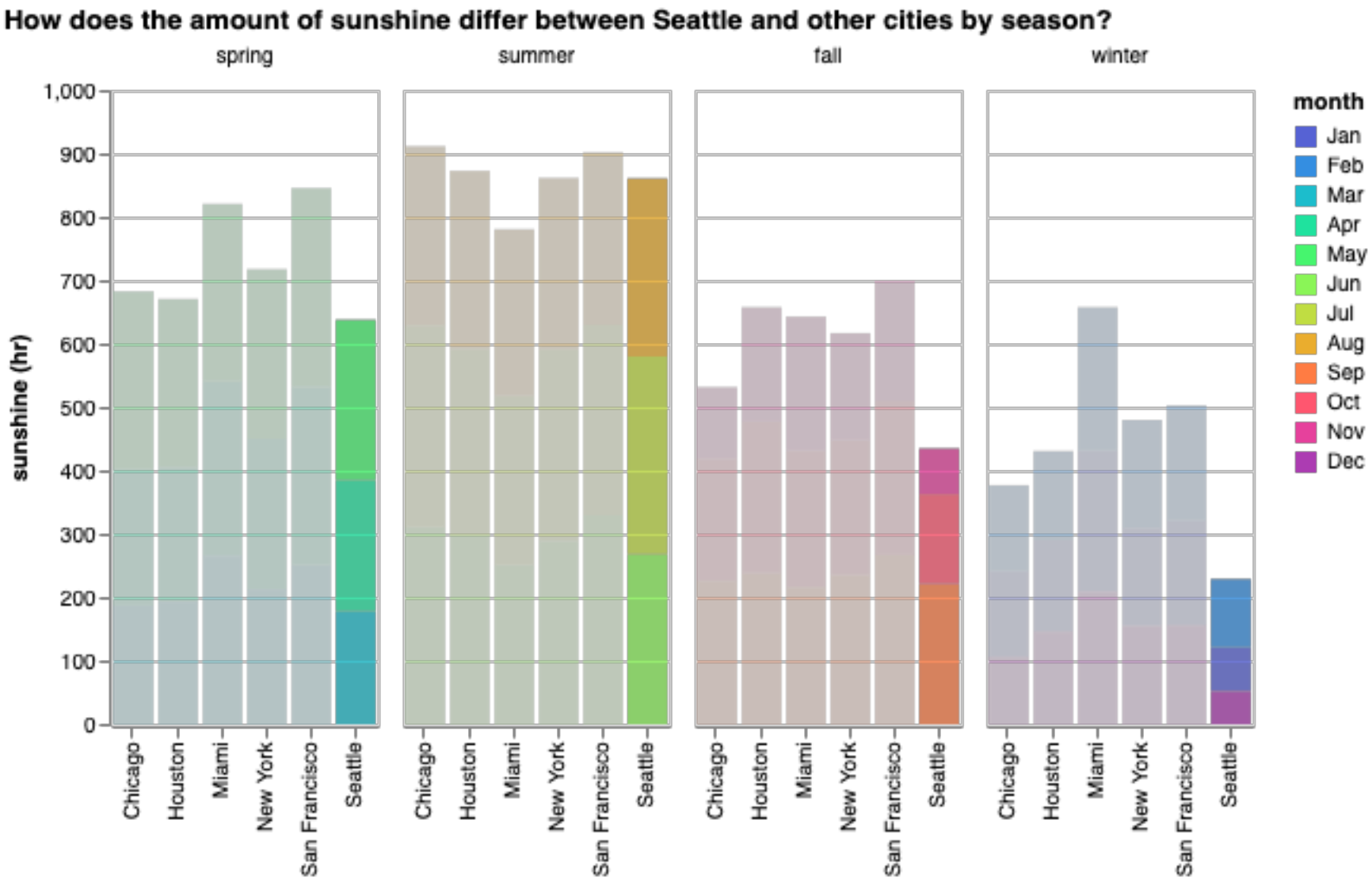

Average Monthly Sunshine Hours in Major US Cities
Months
Dec
Nov
Oct
Sep
Aug
Jul
Jun
May
Apr
Mar
Feb
Jan
0
500
1000
1500
Average Sunshine Hours 1981-2010 (h)
Cities (In Descending Latitudes)
Seattle
Chicago
New York
San Francisco
Houston
Miami

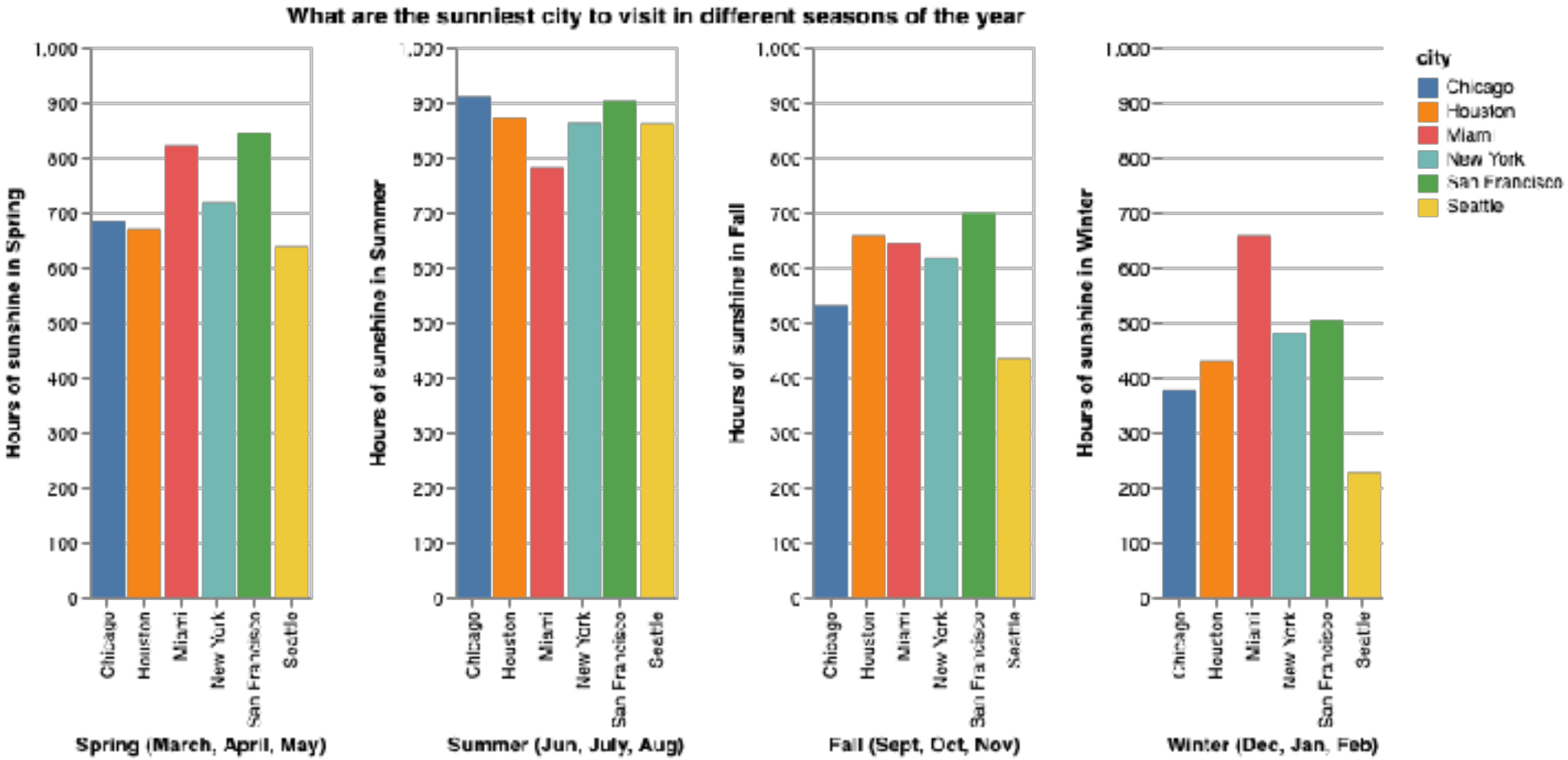
Sunshine Distribution: the Richer, the More Equal

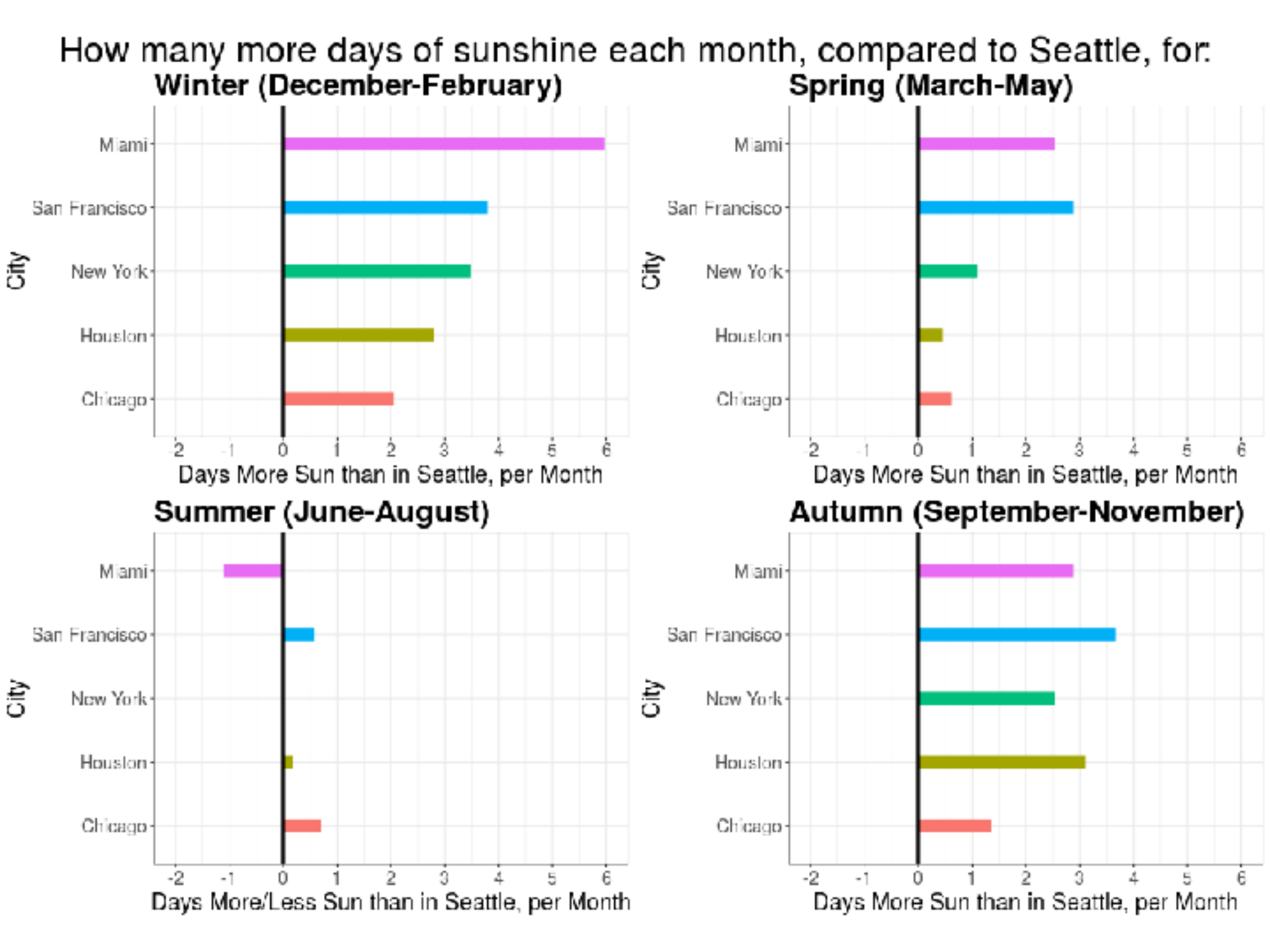
Comparing by Months

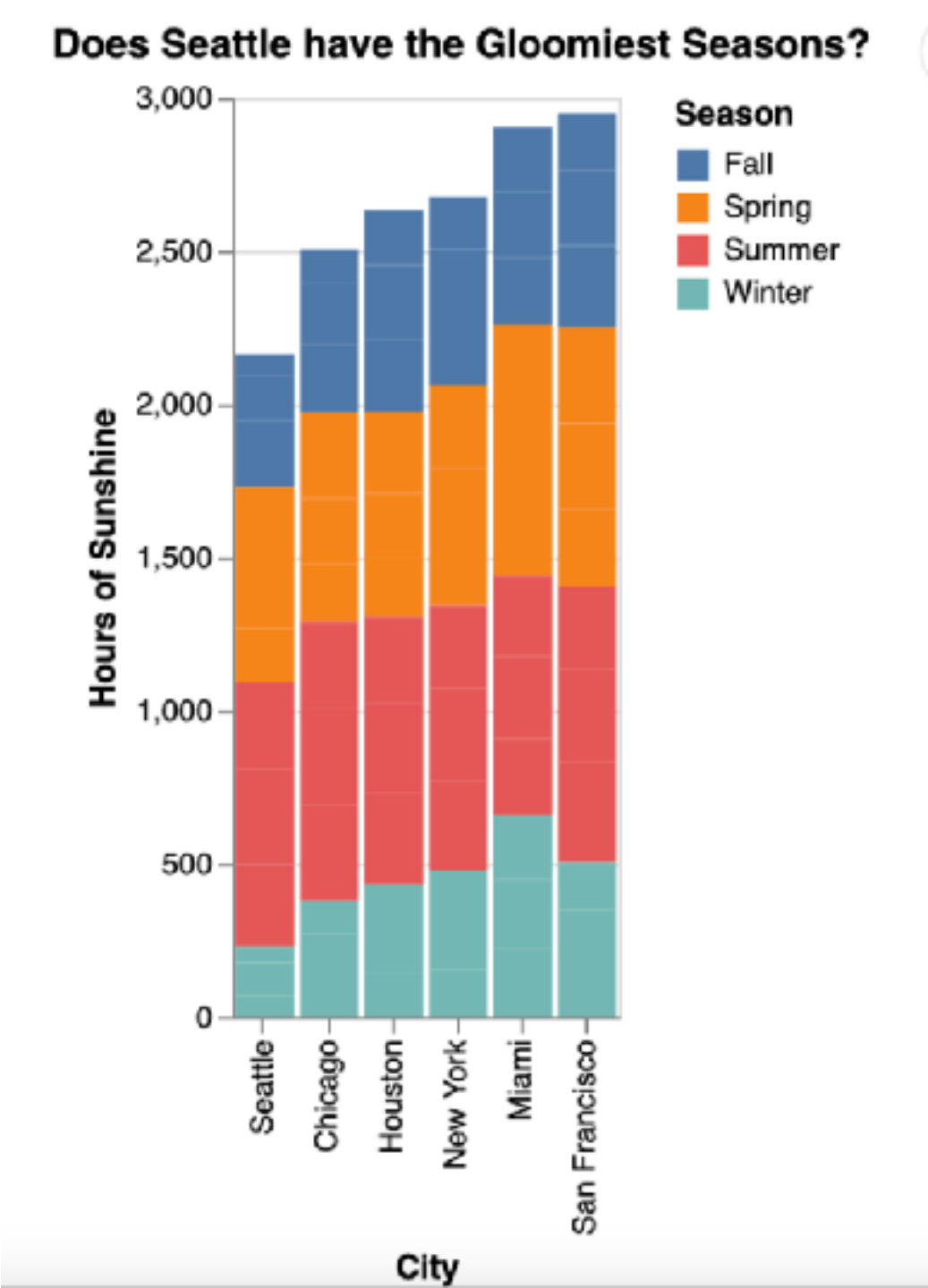


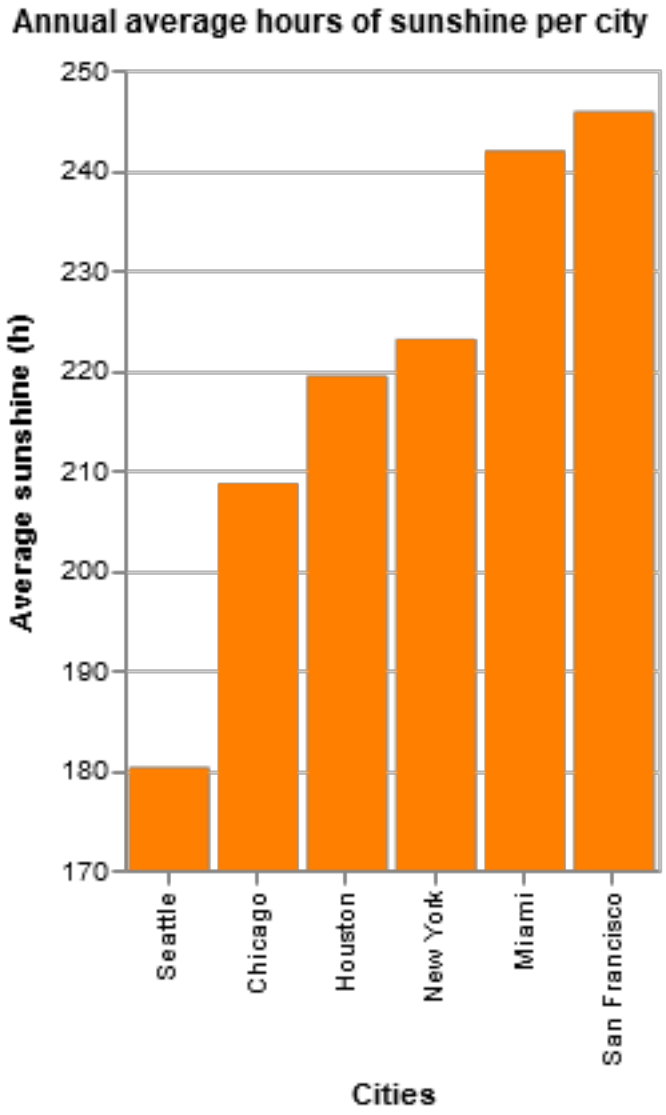
Comparing by Cities

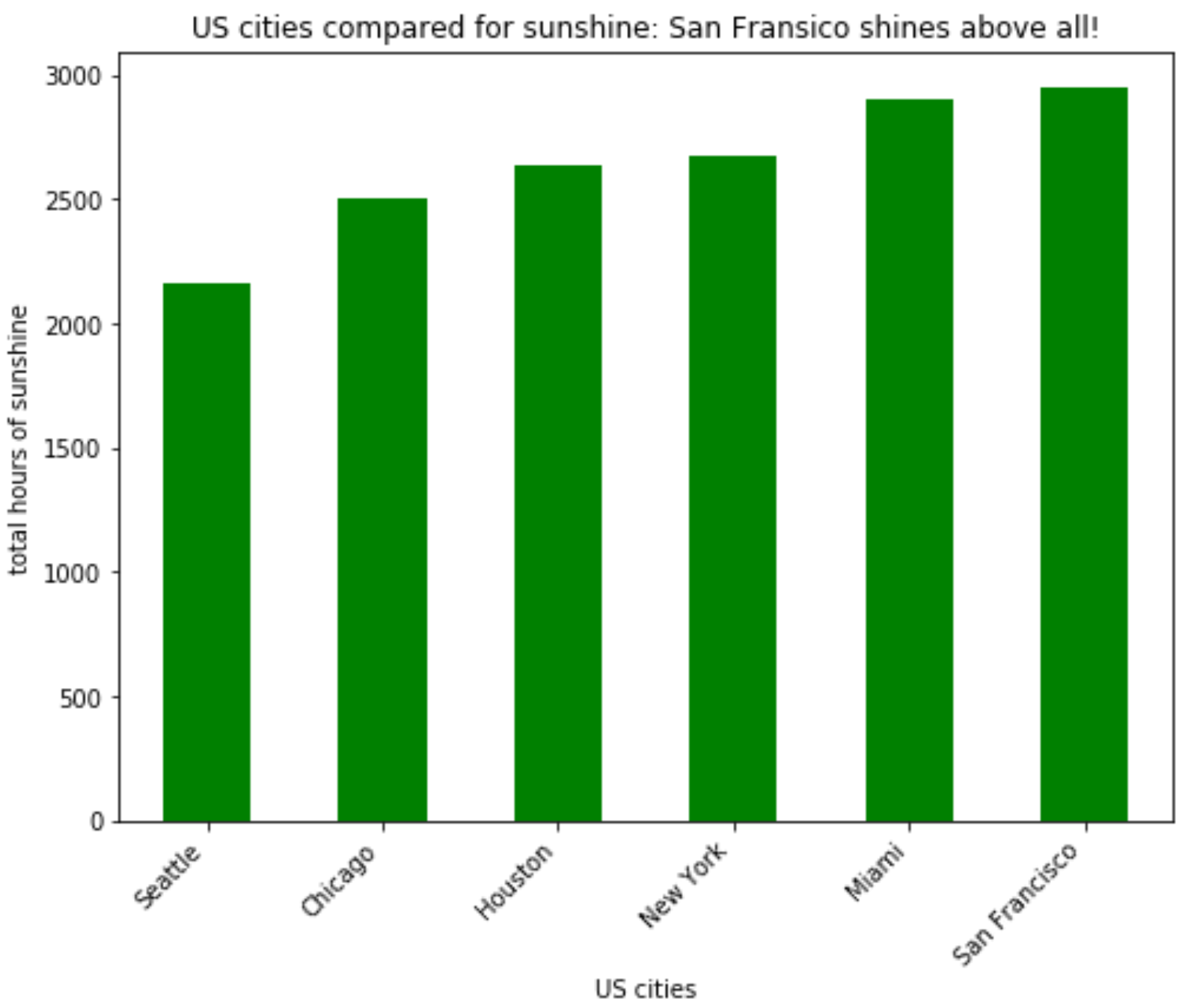

How does the amount of sunshine differ between Seattle and other cities by season?
spring
summer
fall
winter
sunshine (hr)
1,000
900
800
700
600
500
400
300
200
100
0
Chicago
Houston
Miami
New York
San Francisco
Seattle
month
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

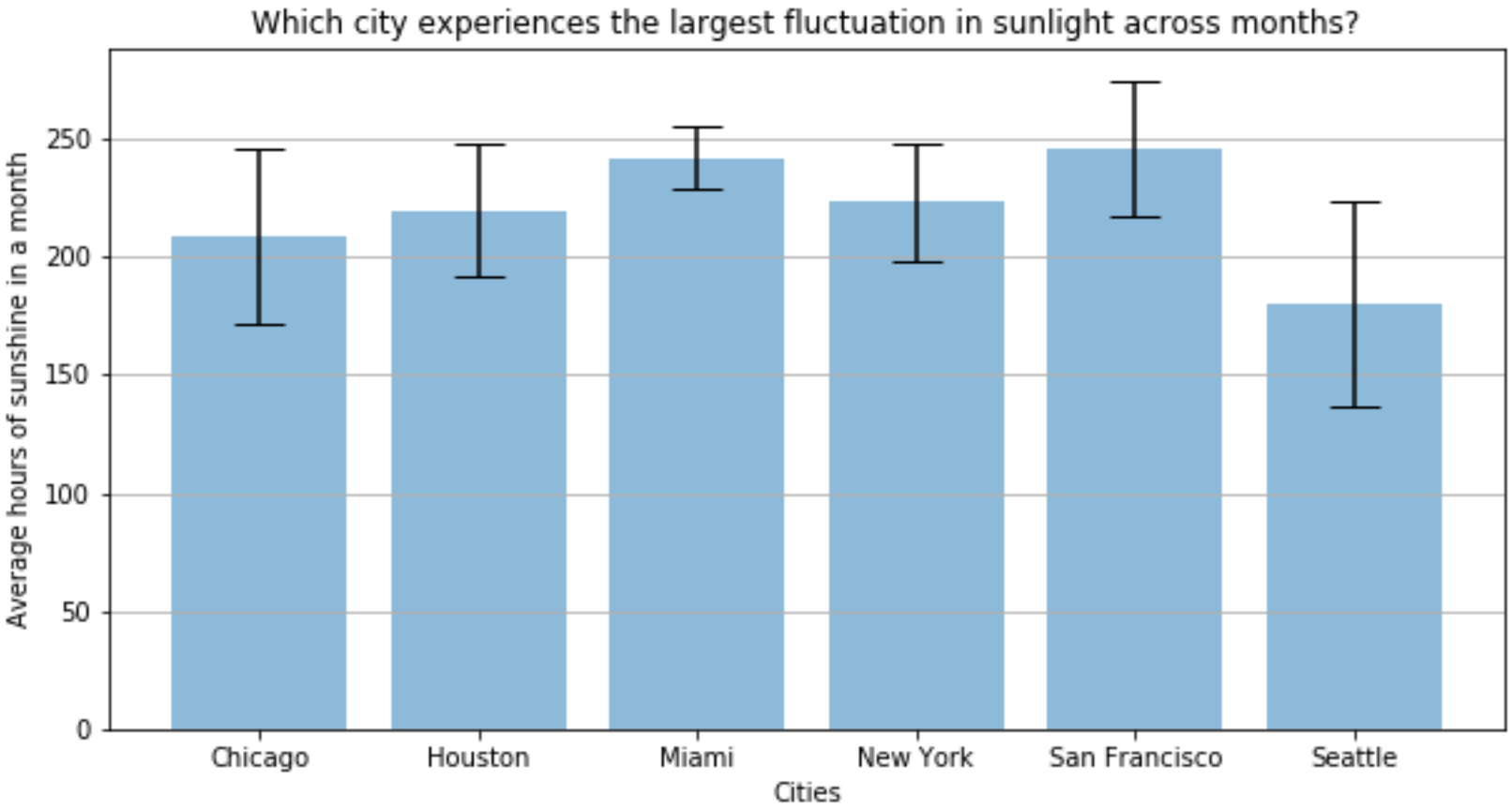

What are the sunniest city to visit in different seasons of the year
Hours of sunshine in Spring
Hours of sunshine in Summer
Hours of sunshine in Fall
Hours of sunshine in Winter
1,000
900
800
700
600
500
400
300
200
100
0
Chicago
Houston
Miami
New York
San Francisco
Seattle
Spring (March, April, May)
Summer (Jun, July, Aug)
Fall (Sept, Oct, Nov)
Winter (Dec, Jan, Feb)
city
Chicago
Houston
Miami
New York
San Francisco
Seattle

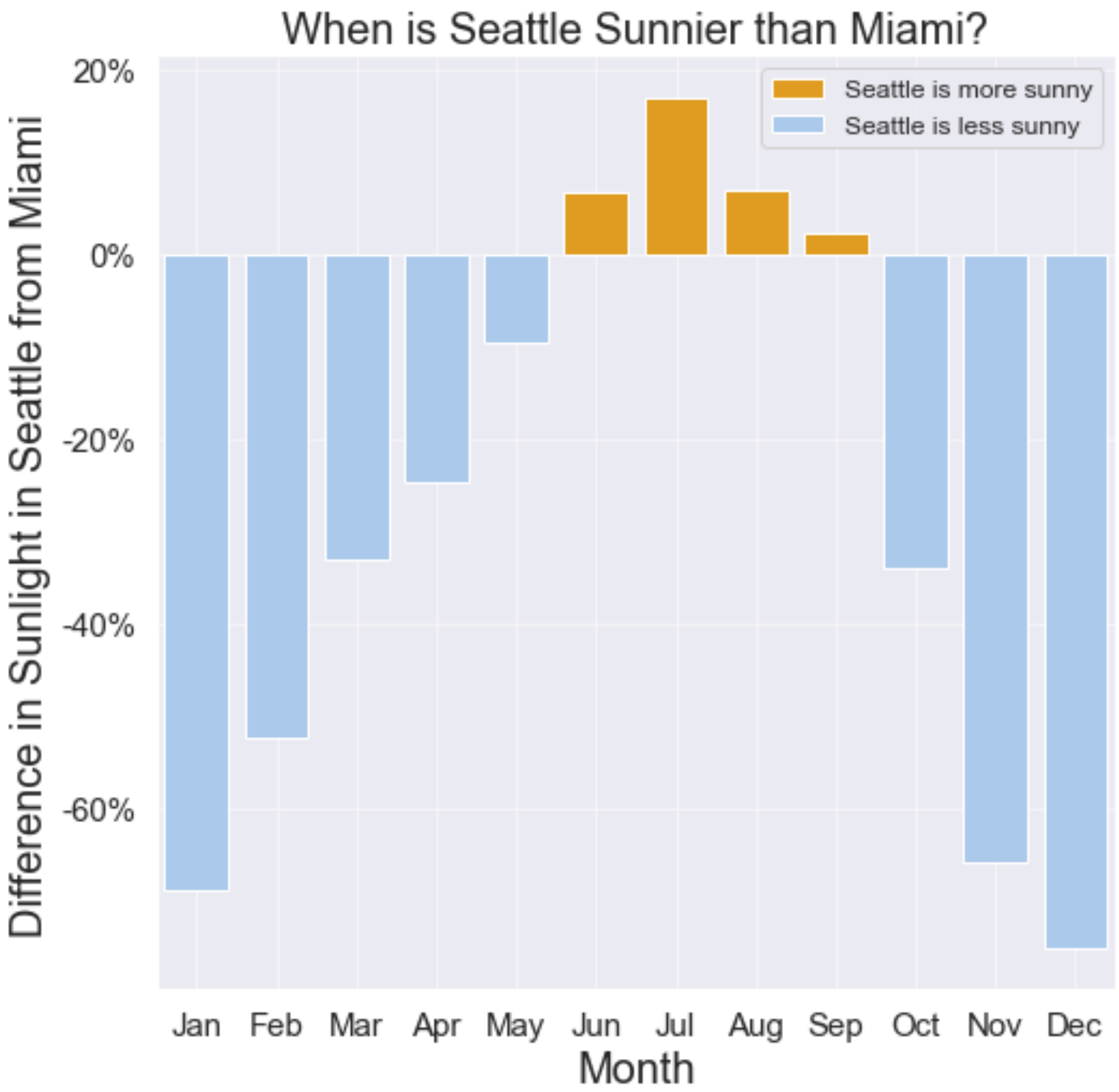

How many more days of sunshine each month, compared to Seattle, for:
Winter (December-February)
Spring (March-May)
Summer (June-August)
Autumn (September-November)
City
Miami
San Francisco
New York
Houston
Chicago
-2
-1
0
1
2
3
4
5
6
Days More Sun than in Seattle, per Month
Days More/Less Sun than in Seattle, per Month


Does Seattle have the Gloomiest Seasons?
Season
Fall
Spring
Summer
Winter
Hours of Sunshine
3,000
2,500
2,000
1,500
1,000
500
0
Seattle
Chicago
Houston
New York
Miami
San Francisco
City


Annual average hours of sunshine per city
Average sunshine (h)
250
240
230
220
210
200
190
180
170
Seattle
Chicago
Houston
New York
Miami
San Francisco
Cities


US cities compared for sunshine: San Fransico shines above all!
total hours of sunshine
0
500
1000
1500
2000
2500
3000
Seattle
Chicago
Houston
New York
Miami
San Francisco
US cities


Which city experiences the largest fluctuation in sunlight across months?
Average hours of sunshine in a month
0
50
100
150
200
250
Chicago
Houston
Miami
New York
San Francisco
Seattle
Cities

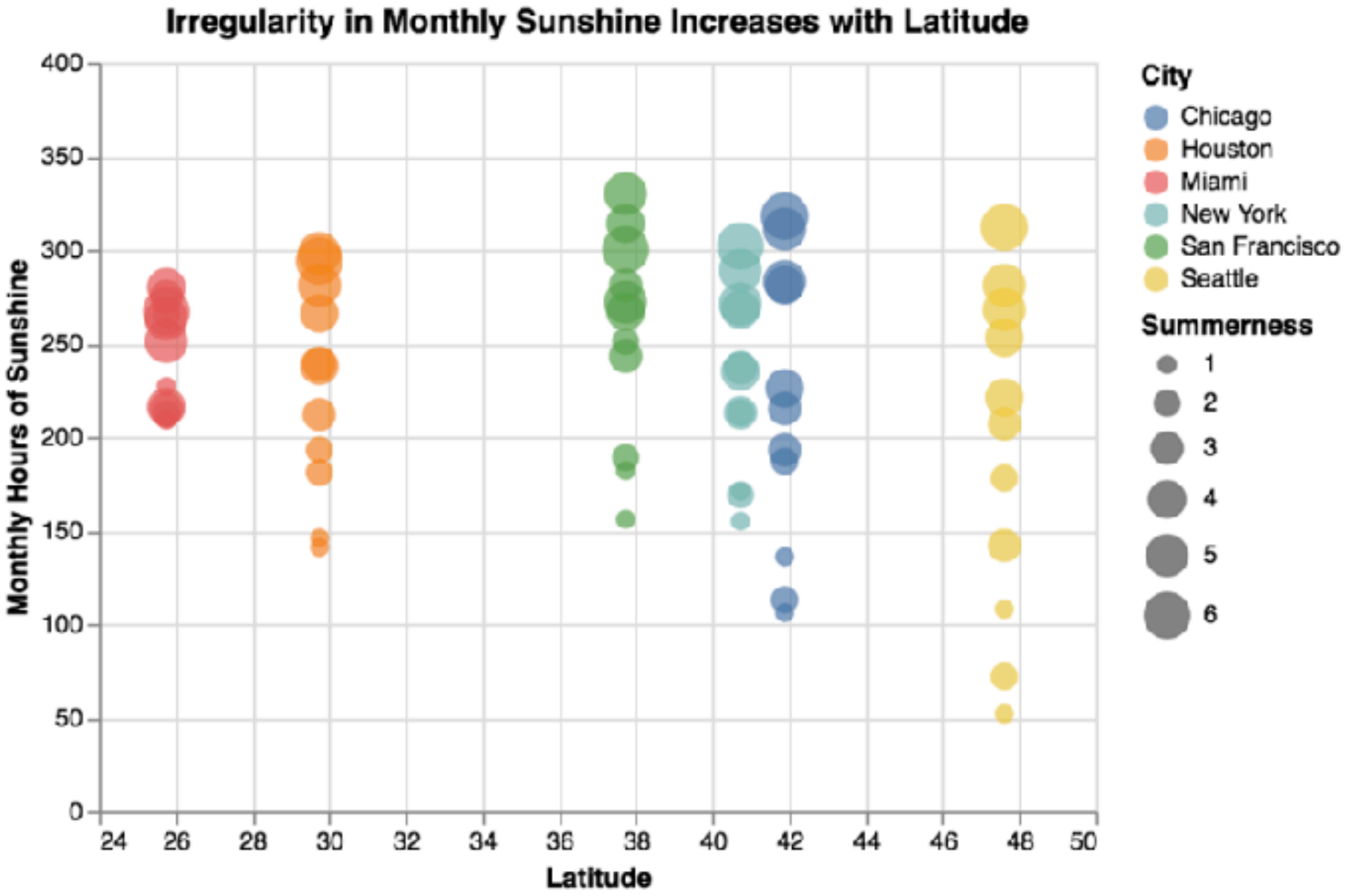

When is Seattle Sunnier than Miami?
Seattle is more sunny
Seattle is less sunny
20%
0%
-20%
-40%
-60%
Difference in Sunlight in Seattle from Miami
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

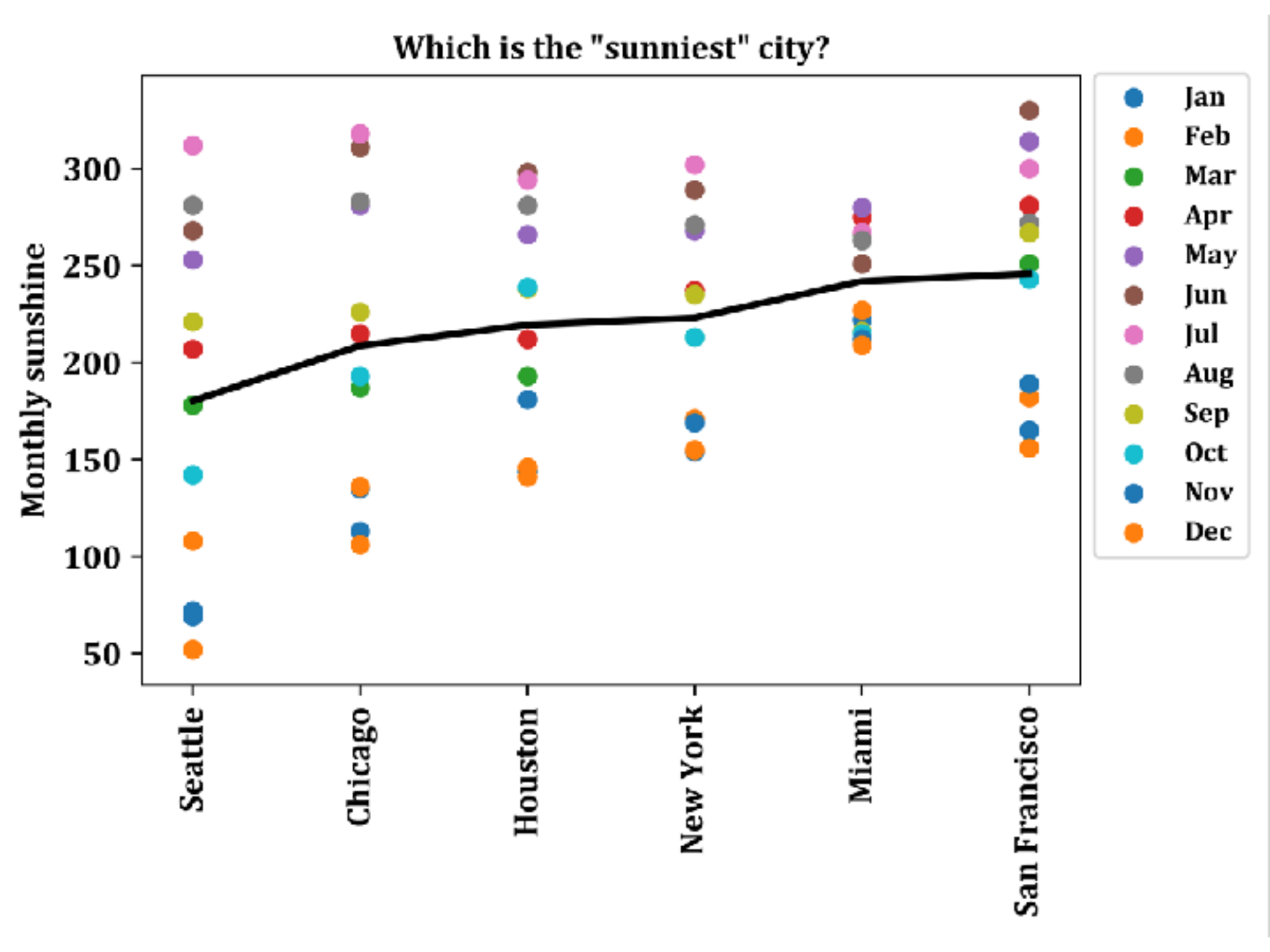
Scatter Plots

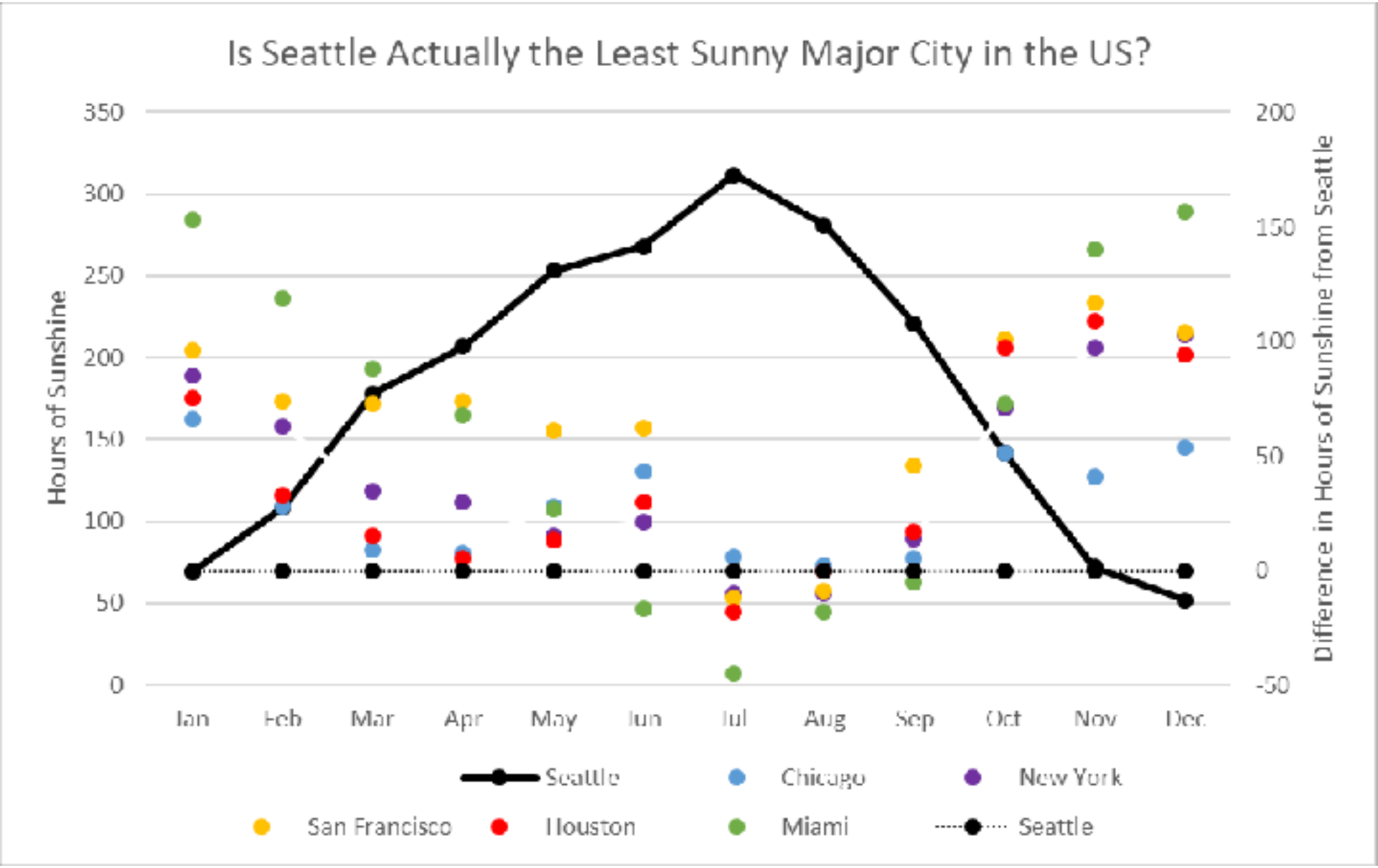
Which City Is The Sunniest?

Hours of Sunshine Per Day Across America: From Northern to Southern Latitudes

Average of HrsSunshinePerDay for each City. Color shows sum of percentOfDaySunshine. Size shows sum of percentOfDaySunshine. The marks are labeled by Month and average of percentOfDaySunshine.

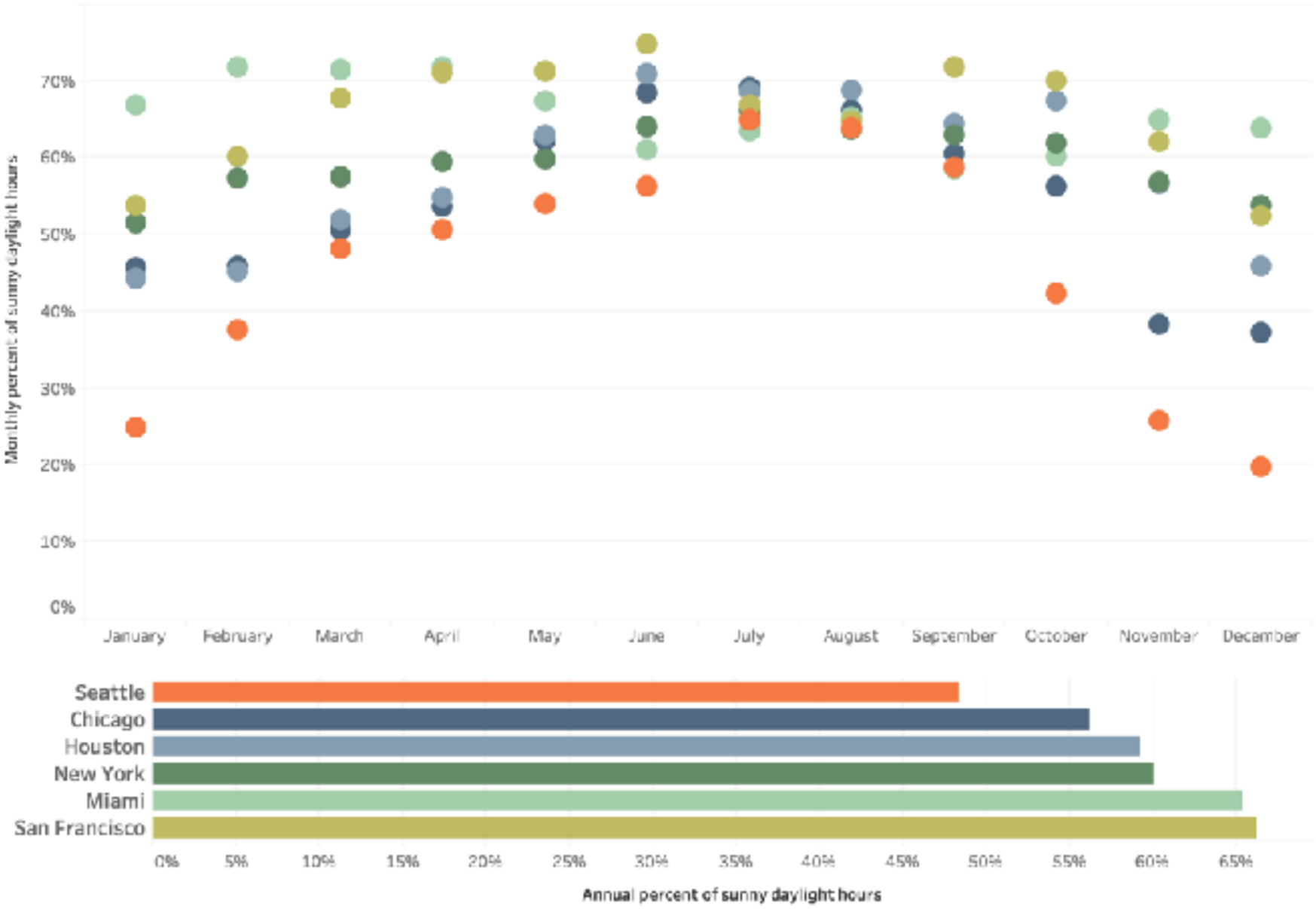

Irregularity in Monthly Sunshine Increases with Latitude
Monthly Hours of Sunshine
400
350
300
250
200
150
100
50
0
24
26
28
30
32
34
36
38
40
42
44
46
48
50
Latitude
City
Chicago
Houston
Miami
New York
San Francisco
Seattle
Summerness
1
2
3
4
5
6

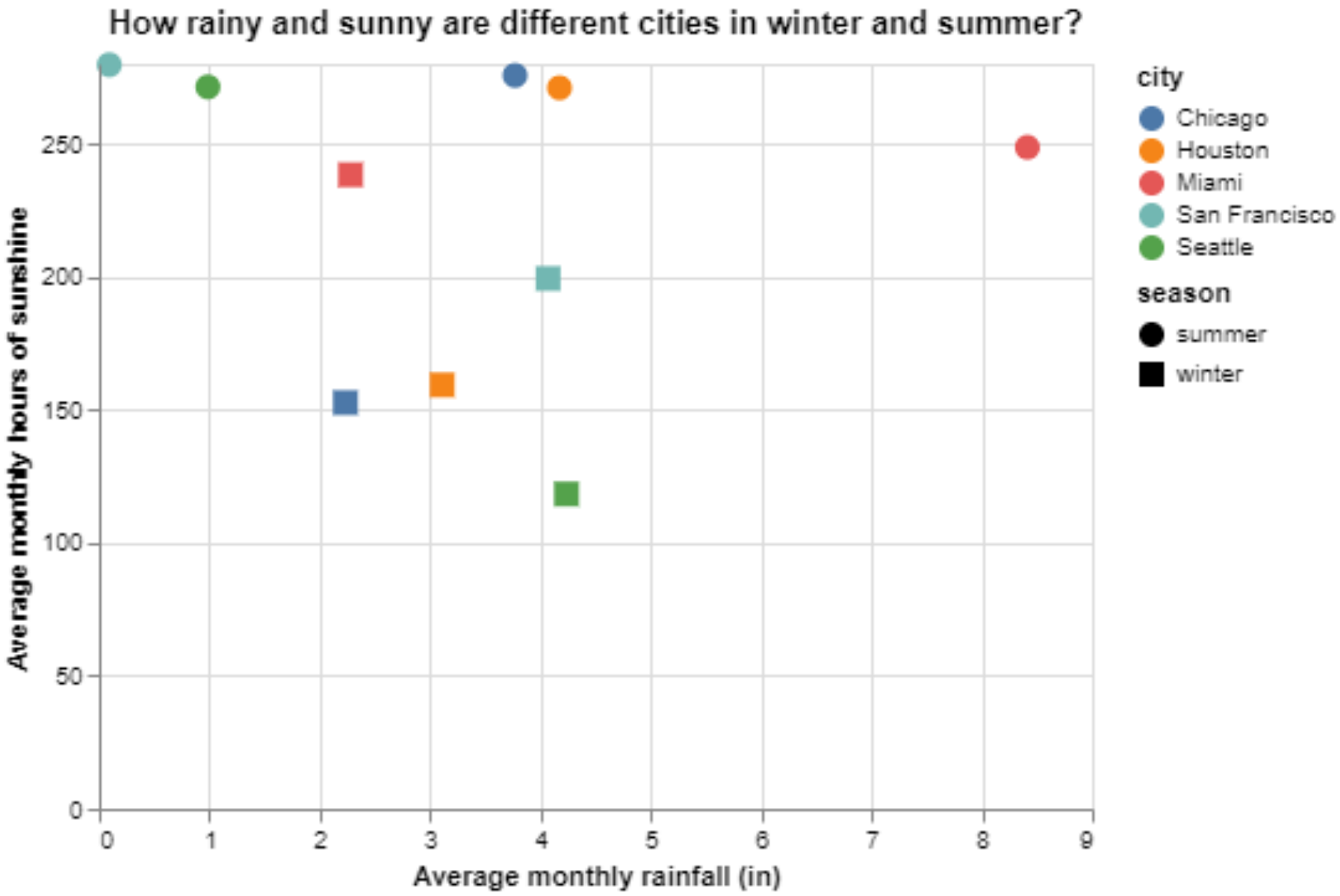

Which is the "sunniest" city?
Monthly sunshine
300
250
200
150
100
50
Seattle
Chicago
Houston
New York
Miami
San Francisco
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

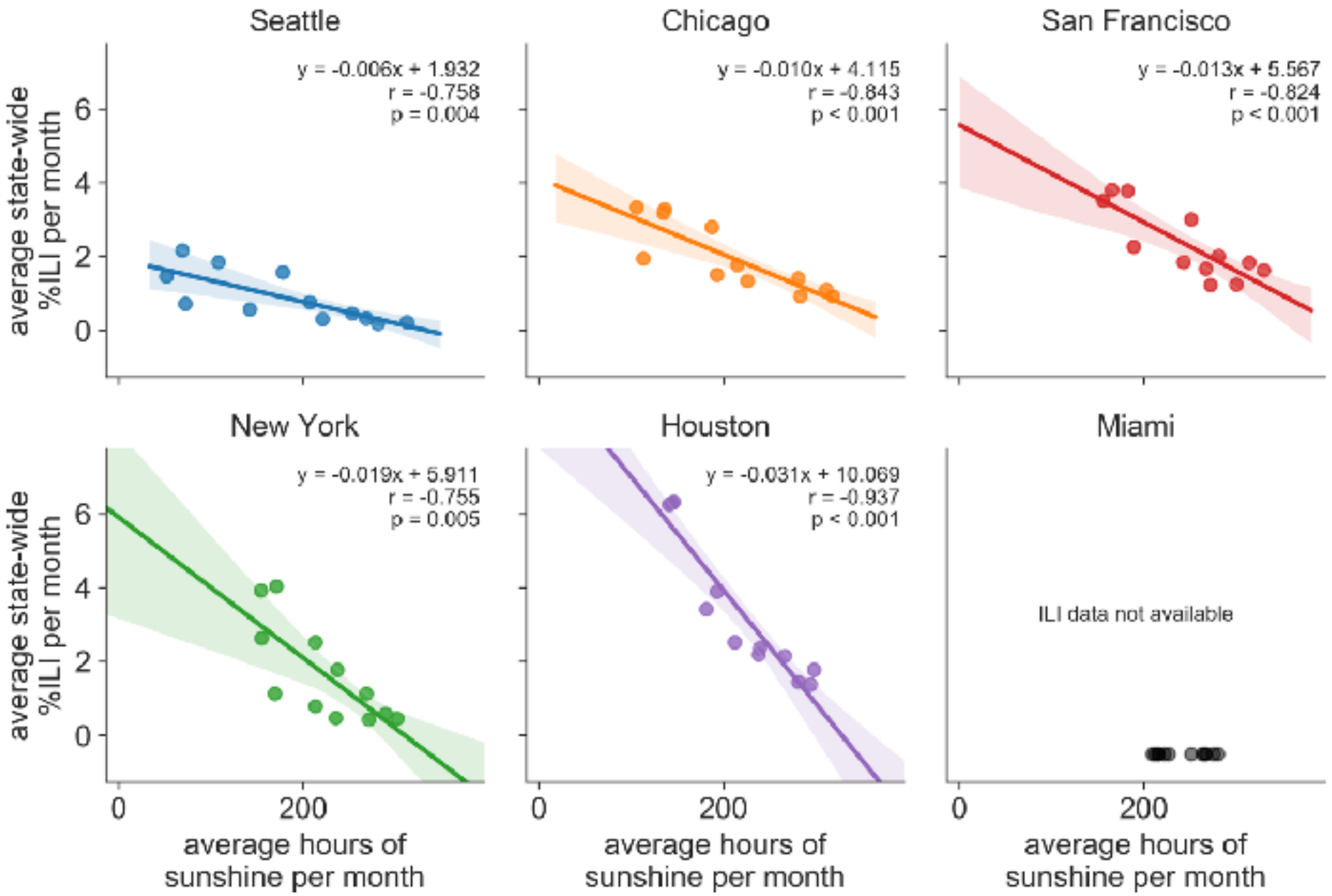

Is Seattle Actually the Least Sunny Major City in the US?
Hours of Sunshine
Difference in Hours of Sunshine from Seattle
350
300
250
200
150
100
50
0
200
150
100
50
0
-50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Seattle
Chicago
New York
San Francisco
Houston
Miami
Seattle

Is Seattle *actually* as dreary as its reputation? Yes.

Percent of daylight hours that are sunny, by month and annually, for six US cities.




How rainy and sunny are different cities in winter and summer?
Average monthly hours of sunshine
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
9
Average monthly rainfall (in)
city
Chicago
Houston
Miami
San Francisco
Seattle
season
summer
winter

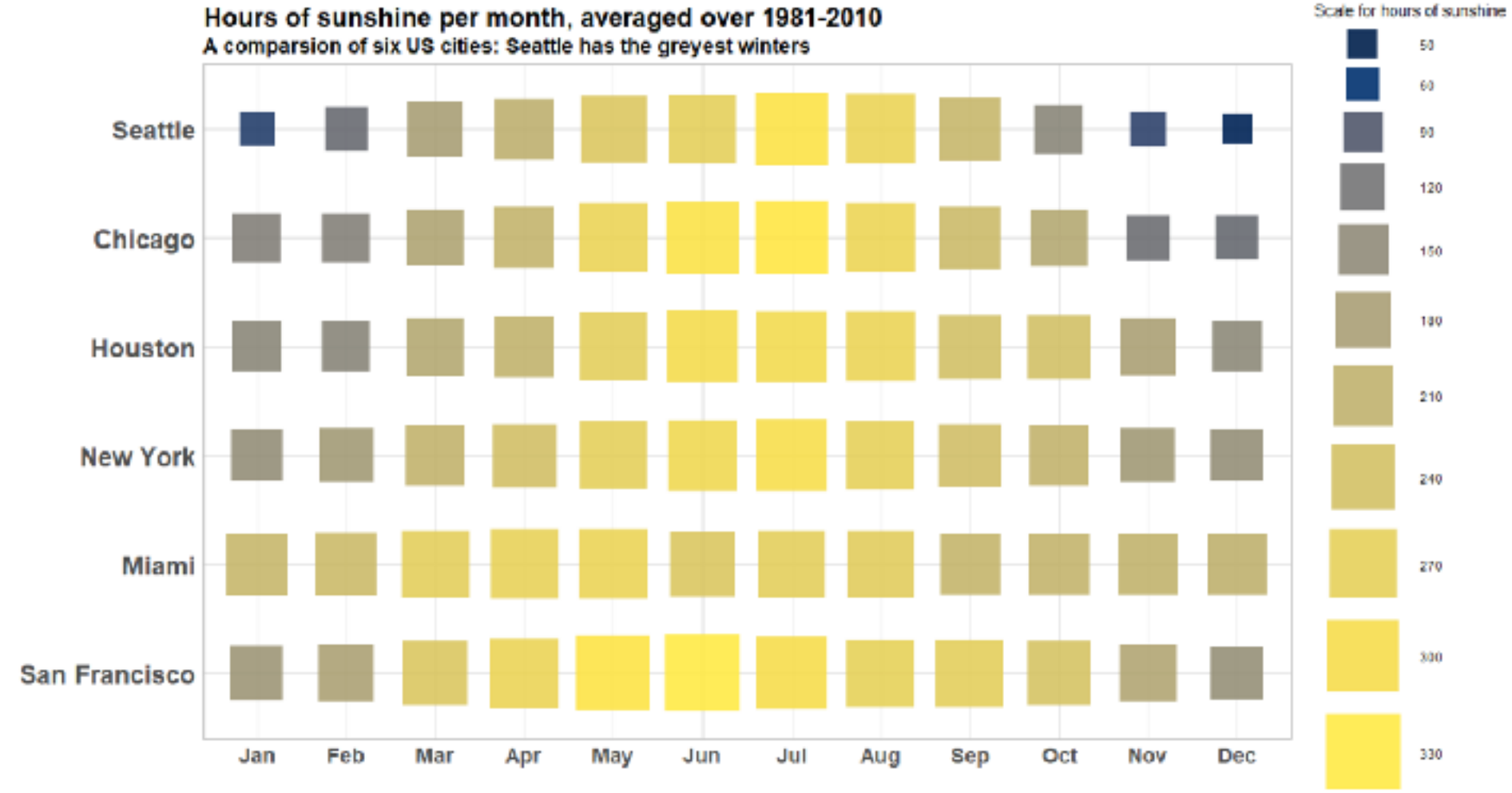

Seattle
y = -0.006x + 1.932
r = -0.758
p = 0.004
Chicago
y = -0.010x + 4.115
r = -0.843
p < 0.001
San Francisco
y = -0.013x + 5.567
r = -0.824
p < 0.001
New York
y = -0.019x + 5.911
r = -0.755
p = 0.005
Houston
y = -0.031x + 10.069
r = -0.937
p < 0.001
Miami
ILI data not available
average state-wide %ILI per month
0
2
4
6
0
200
average hours of sunshine per month

Heatmap

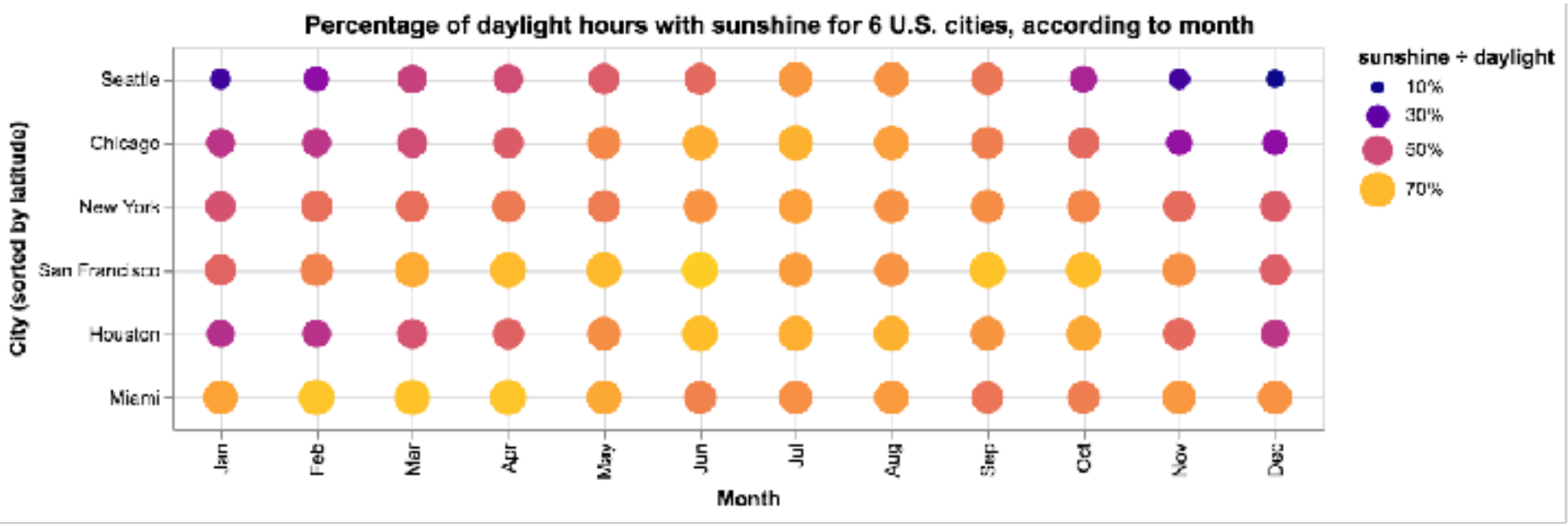
Which city in which month has more sunshine?

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Seattle	69	108	178	207	253	268	312	281	221	142	72	52
Chicago	135	136	187	215	281	311	318	283	226	193	113	106
New York	154	171	213	237	268	289	302	271	235	213	169	155
San Francisco	165	182	251	281	314	330	300	272	267	243	189	156
Houston	144	141	193	212	266	298	294	281	238	239	181	146
Miami	222	227	266	275	280	251	267	263	216	215	212	209

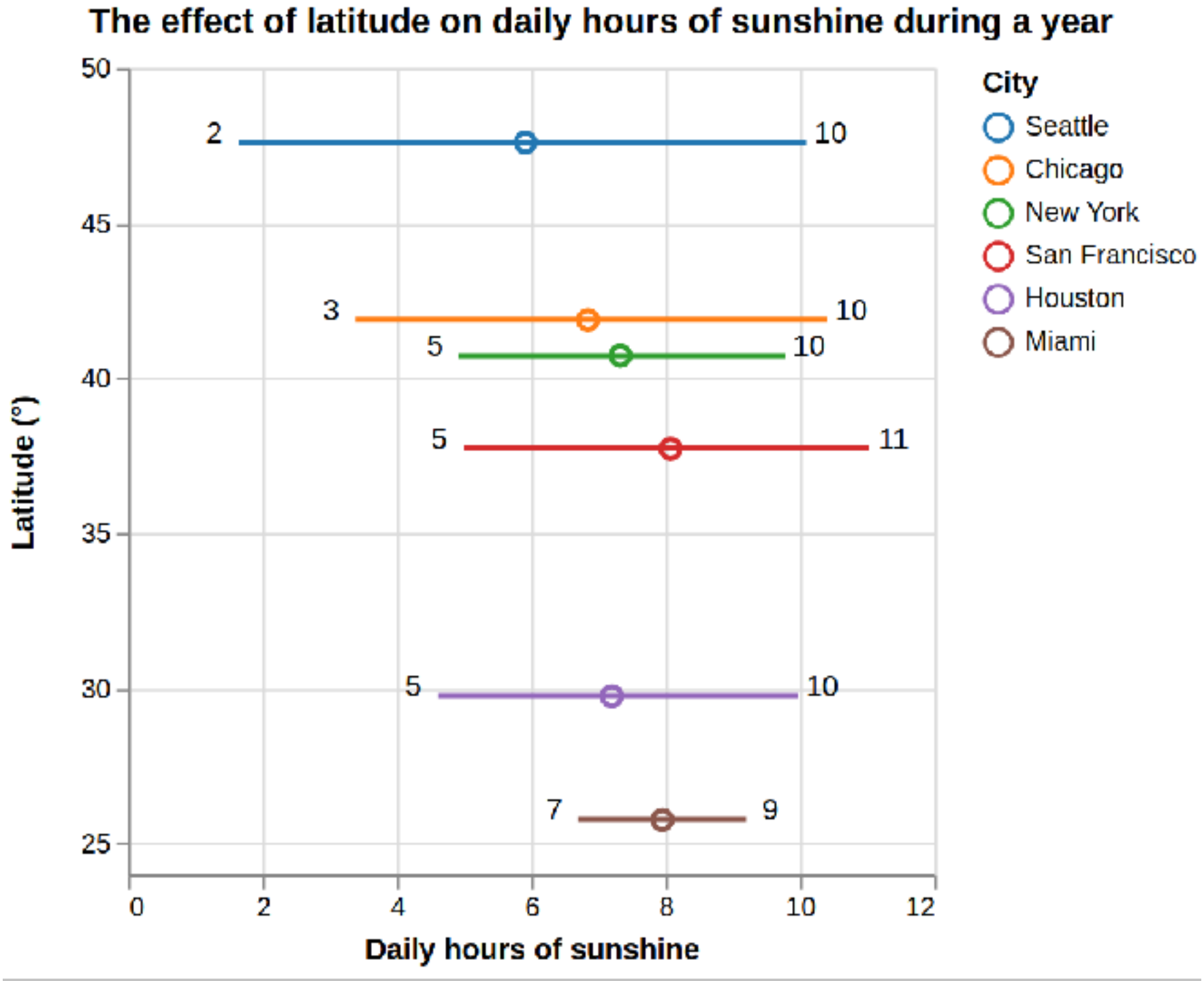
* The hours of sunshine per month, averaged over 1981-2010.

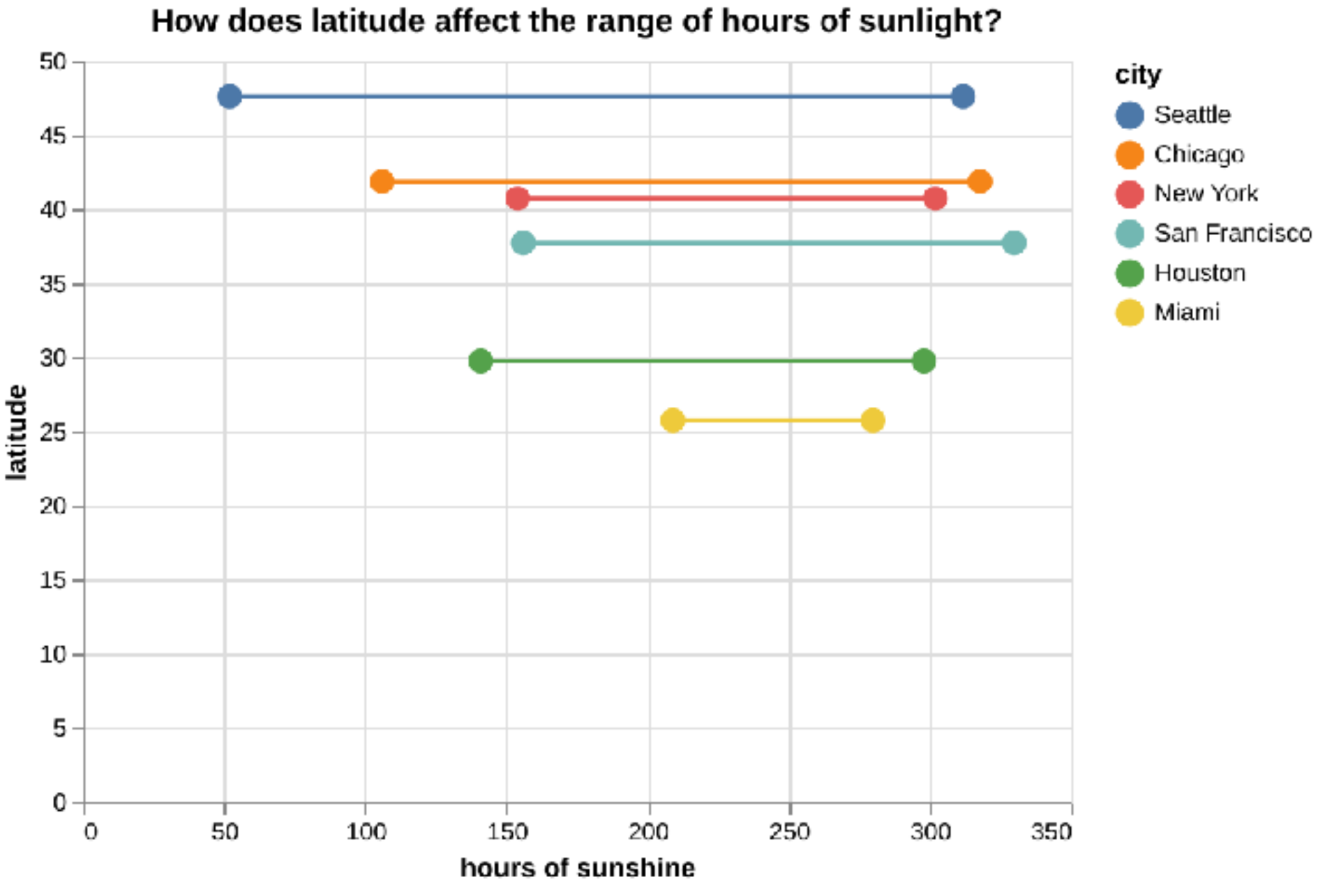

Hours of sunshine per month, averaged over 1981-2010
A comparsion of six US cities: Seattle has the greyest winters
Seattle
Chicago
Houston
New York
Miami
San Francisco
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Scale for hours of sunshine
60
90
120
150
180
210
240
270
300
330

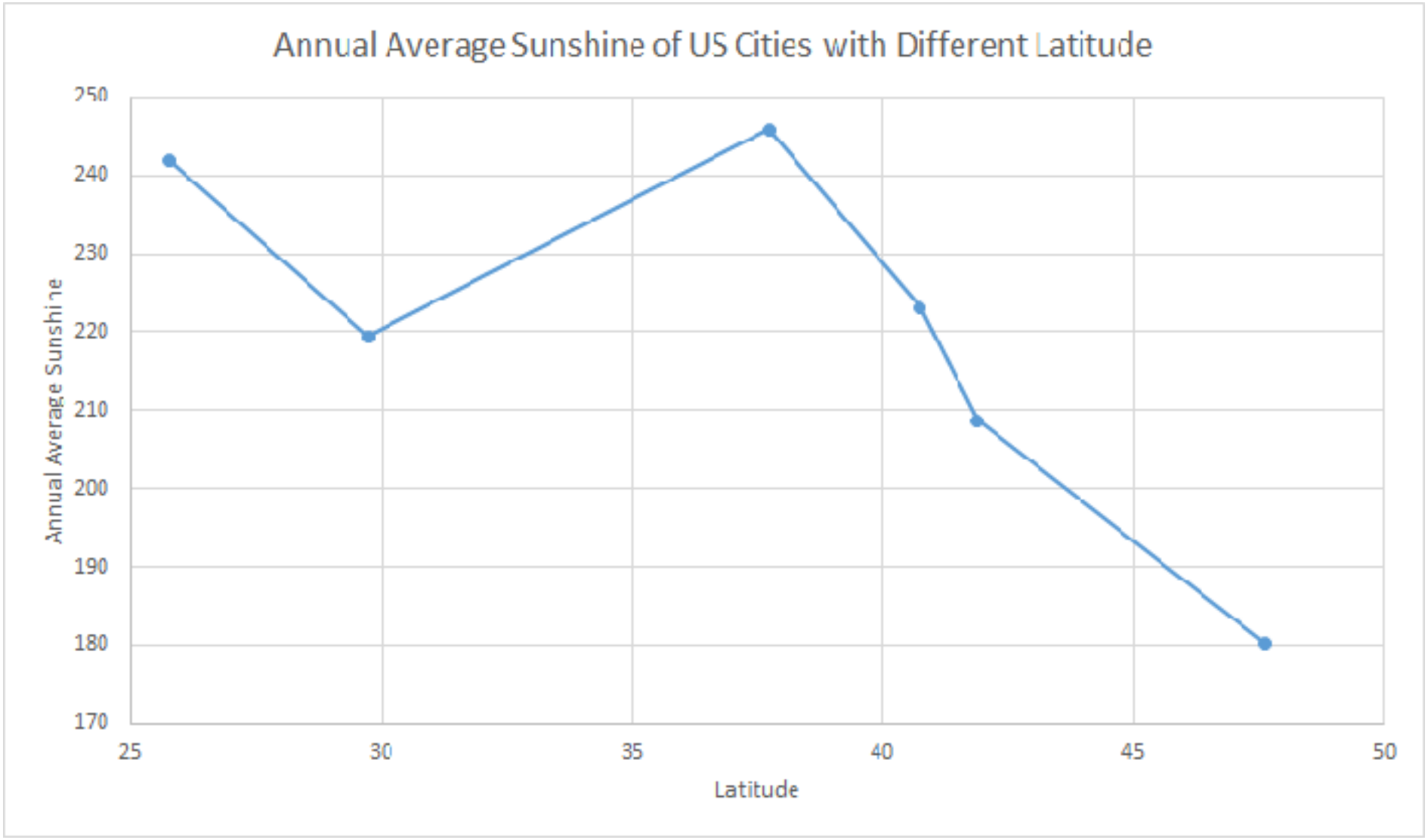

How to escape dark Seattle winters?
Latitude
Seattle
Chicago
New York
San Francisco
Houston
Miami
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Hrs of Sunshine
100
150
200
250
300

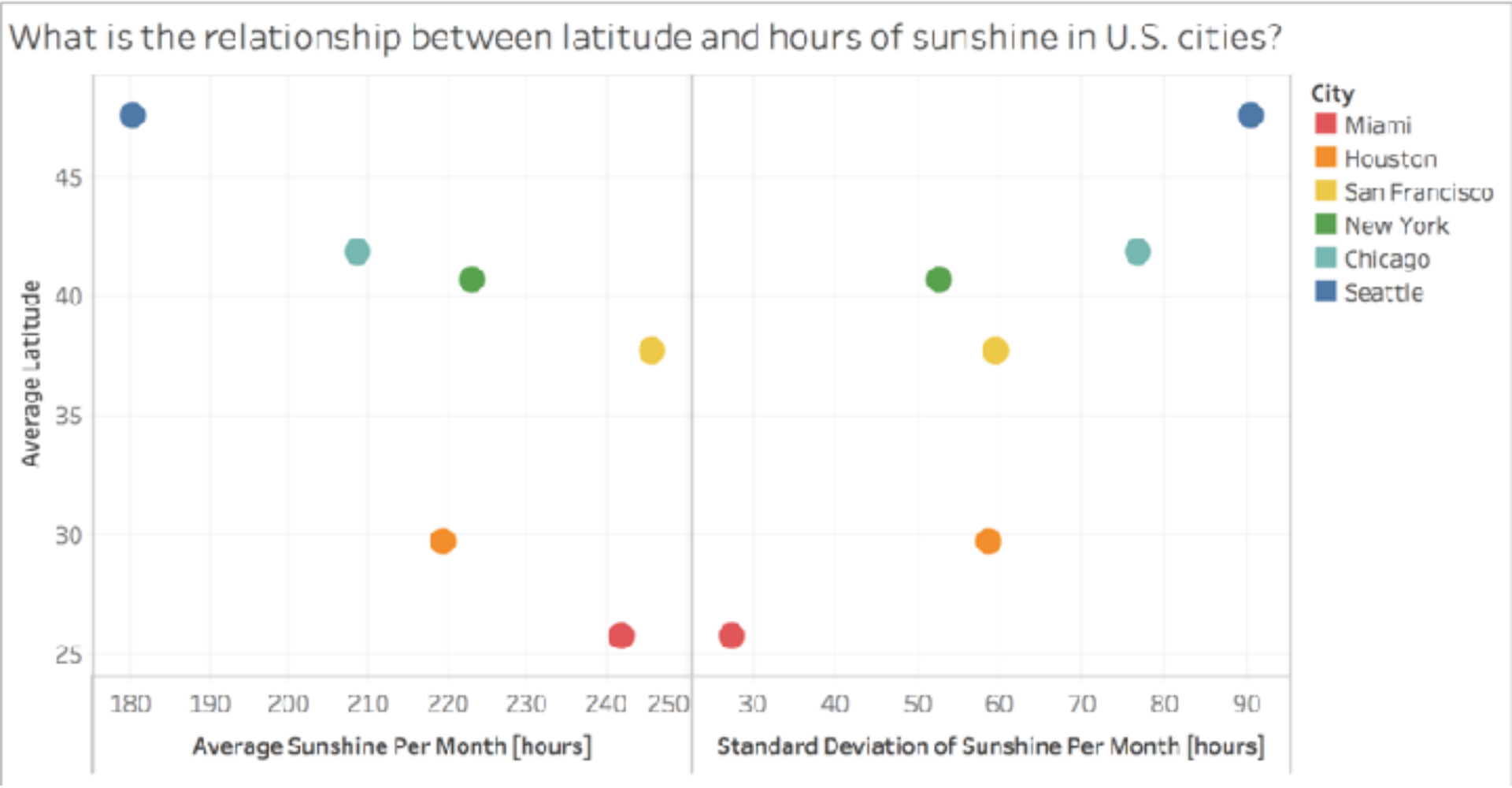

Percentage of daylight hours with sunshine for 6 U.S. cities, according to month
City (sorted by latitude)
Seattle
Chicago
New York
San Francisco
Houston
Miami
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
sunshine ÷ daylight
10%
30%
50%
70%

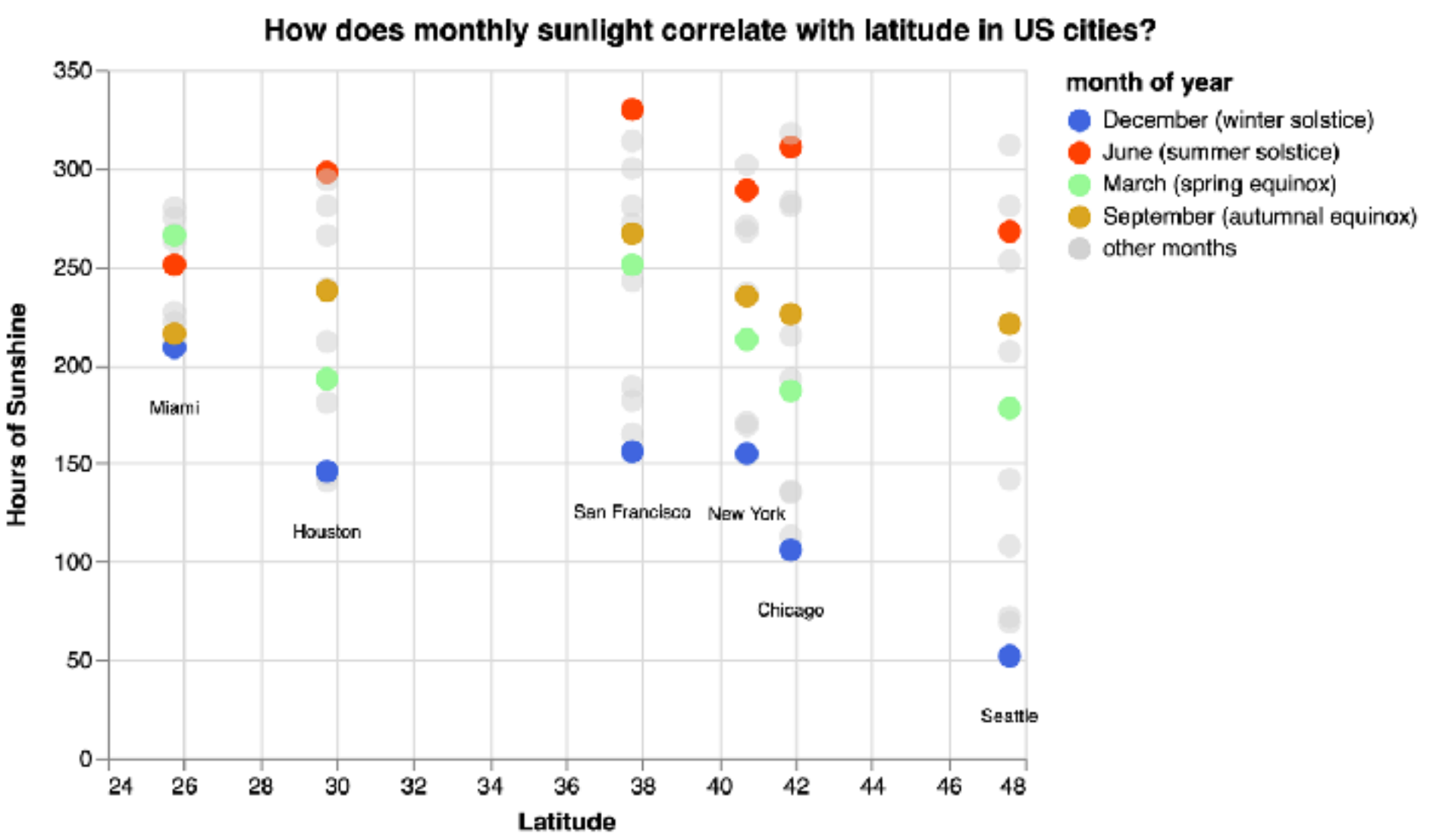
Latitude


The effect of latitude on daily hours of sunshine during a year
Latitude (°)
50
45
40
35
30
25
0
2
4
6
8
10
12
Daily hours of sunshine
2
10
3
10
5
10
5
11
5
10
7
9
City
Seattle
Chicago
New York
San Francisco
Houston
Miami

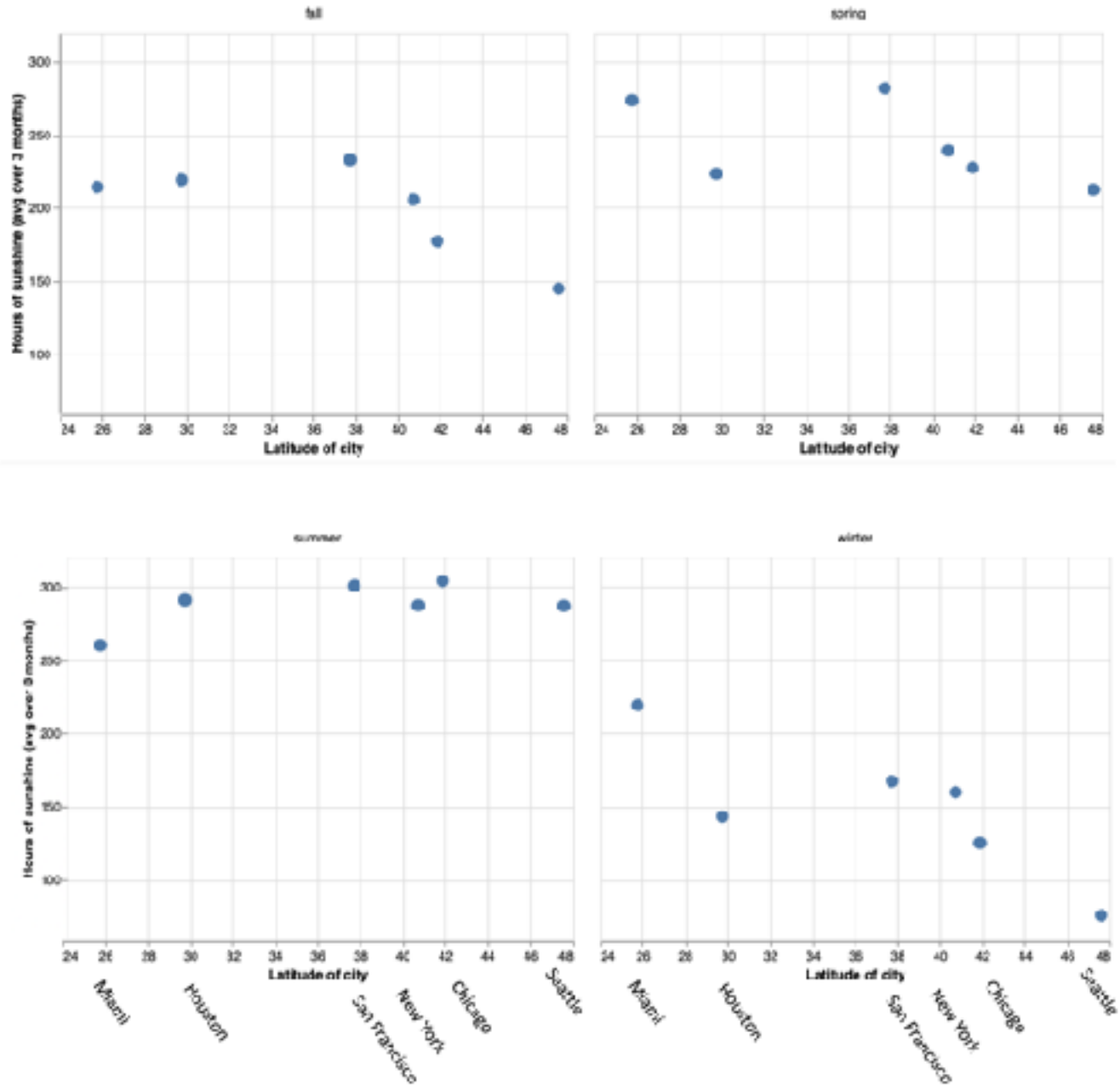

How does latitude affect the range of hours of sunlight?
latitude
50
45
40
35
30
25
20
15
10
5
0
0
50
100
150
200
250
300
350
hours of sunshine
city
Seattle
Chicago
New York
San Francisco
Houston
Miami


Annual Average Sunshine of US Cities with Different Latitude
Annual Average Sunshine
250
240
230
220
210
200
190
180
170
25
30
35
40
45
50
Latitude

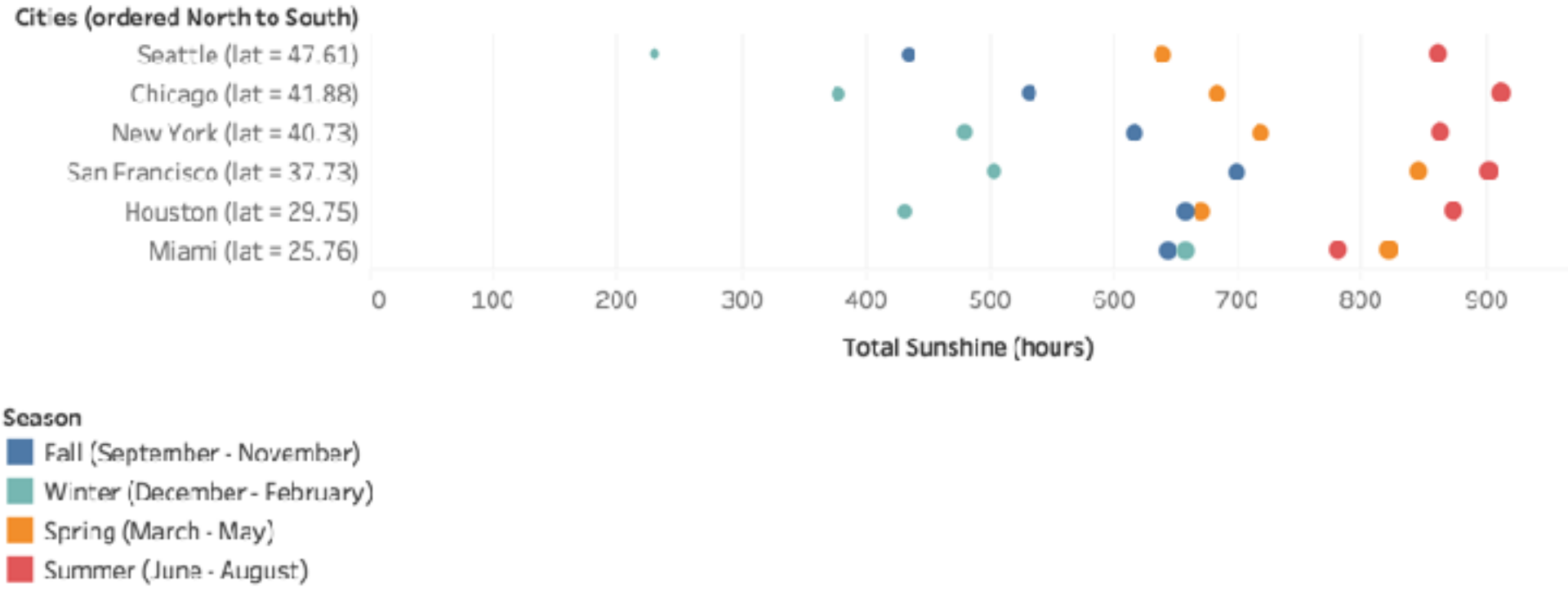

What is the relationship between latitude and hours of sunshine in U.S. cities?
Average Latitude
45
40
35
30
25
180
190
200
210
220
230
240
250
Average Sunshine Per Month [hours]
30
40
50
60
70
80
90
Standard Deviation of Sunshine Per Month [hours]
City
Miami
Houston
San Francisco
New York
Chicago
Seattle


How does monthly sunlight correlate with latitude in US cities?
Hours of Sunshine
350
300
250
200
150
100
50
0
24
26
28
30
32
34
36
38
40
42
44
46
48
Latitude
Miami
Houston
San Francisco
New York
Chicago
Seattle
month of year
December (winter solstice)
June (summer solstice)
March (spring equinox)
September (autumnal equinox)
other months

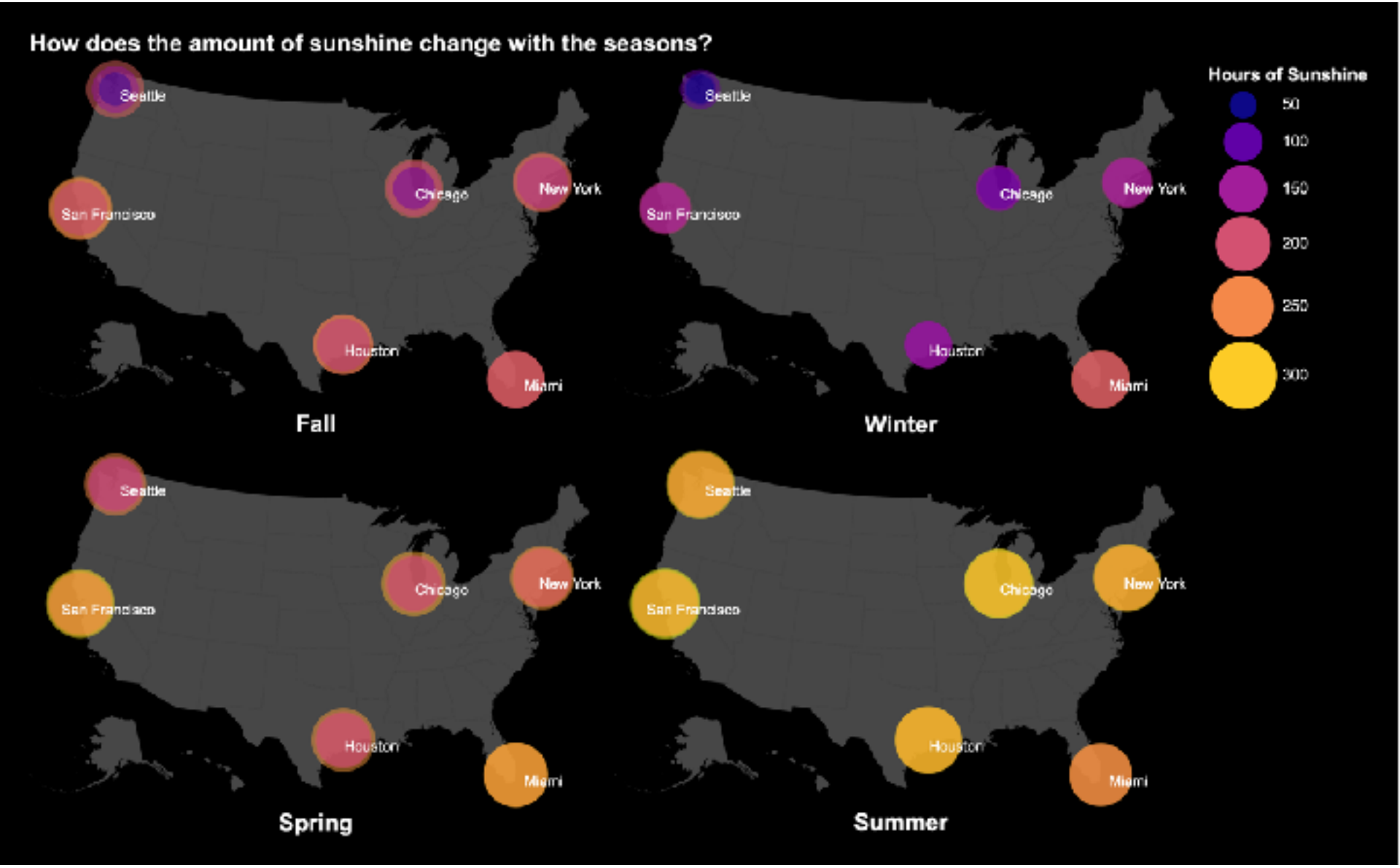
Do hours of sunshine correlate with latitude in major US cities?



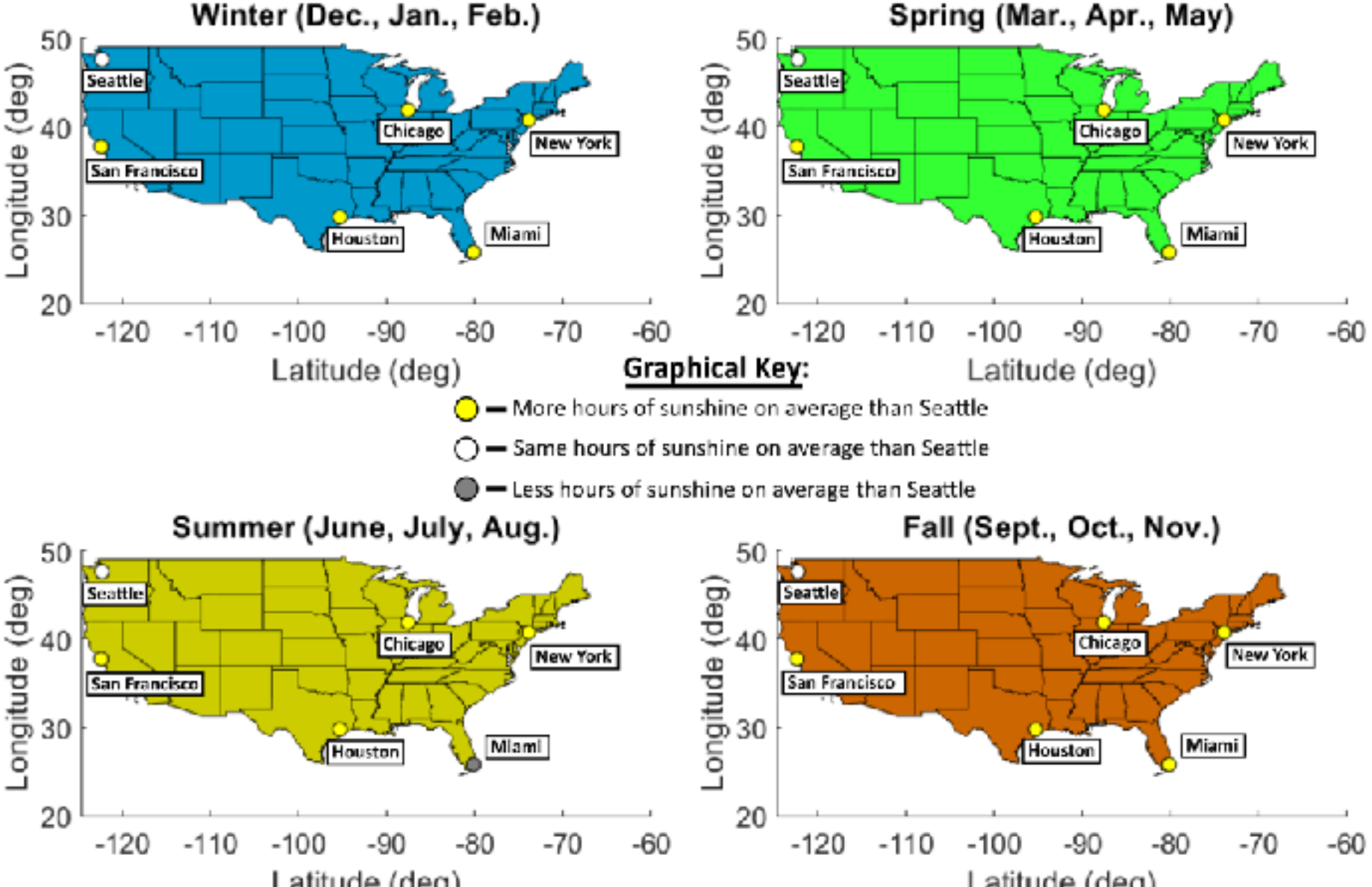
How does latitude affect the hours of sunshine per season for coastal cities in the US?



Maps


How does the amount of sunshine change with the seasons?
Hours of Sunshine
50
100
150
200
250
300
Seattle
San Francisco
Chicago
New York
Houston
Miami
Fall
Winter
Spring
Summer

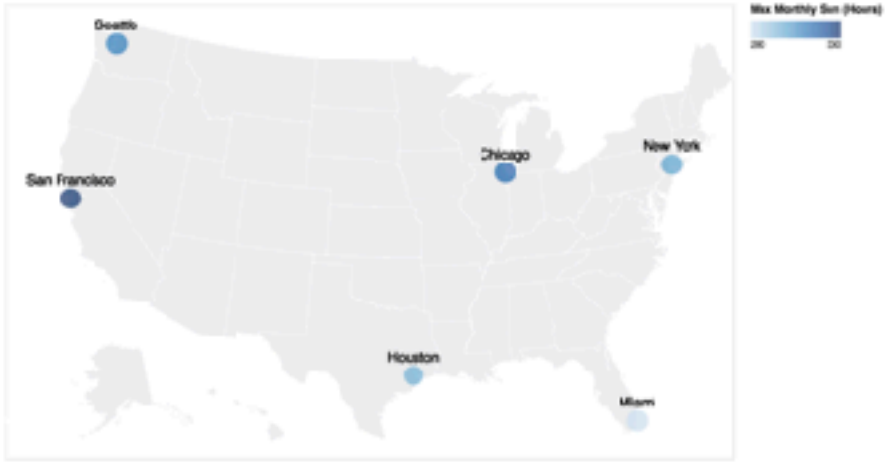
How does the average amount of sunshine (in hours) compare (greater, equal, or less than) between Seattle and other U.S. cities across seasons?



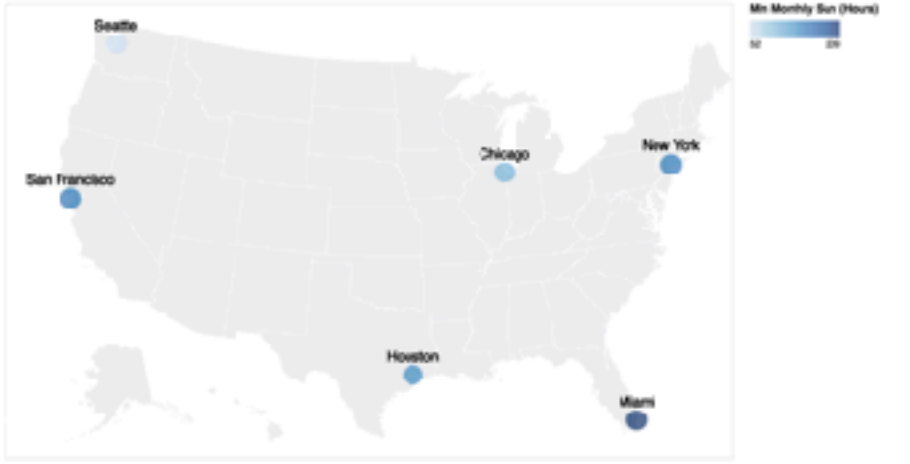
Is Seattle always the gloomiest city?

Average hours of sunshine per month

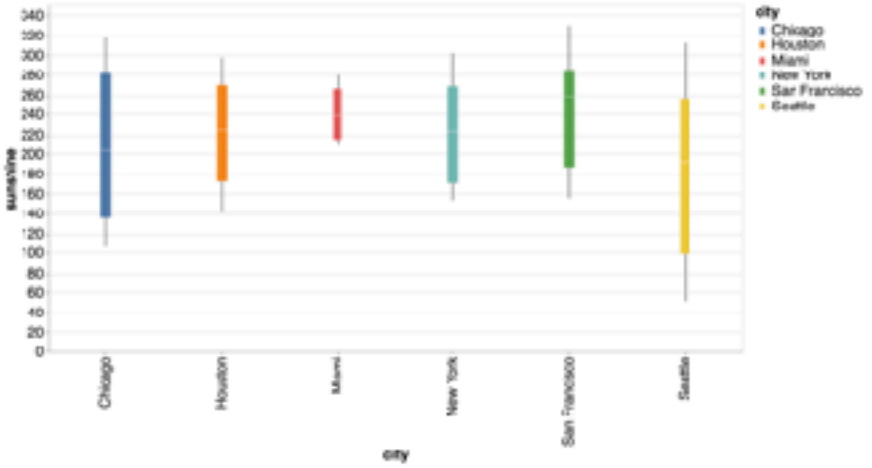
Maximum hours of sunshine per month



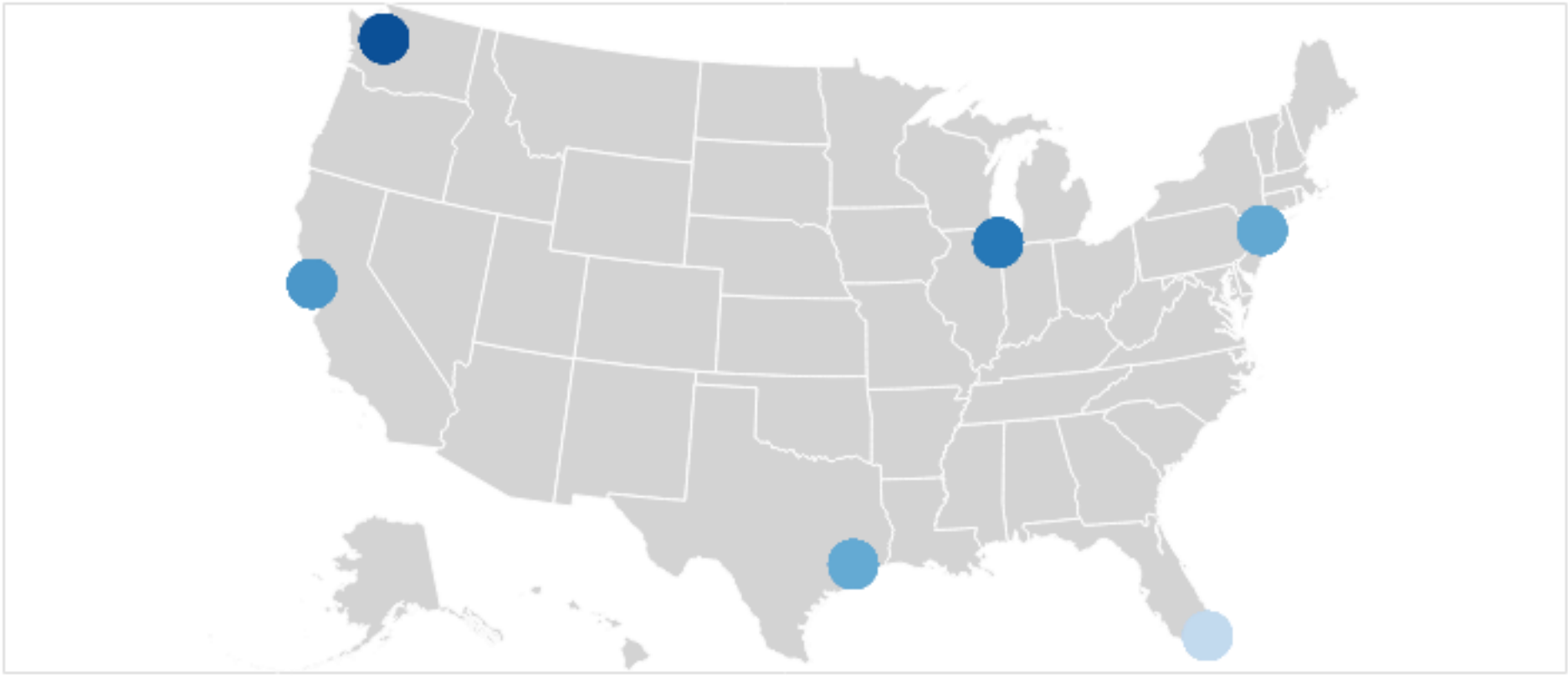
Minimum hours of sunshine per month



Distribution of monthly hours of sunshine per year

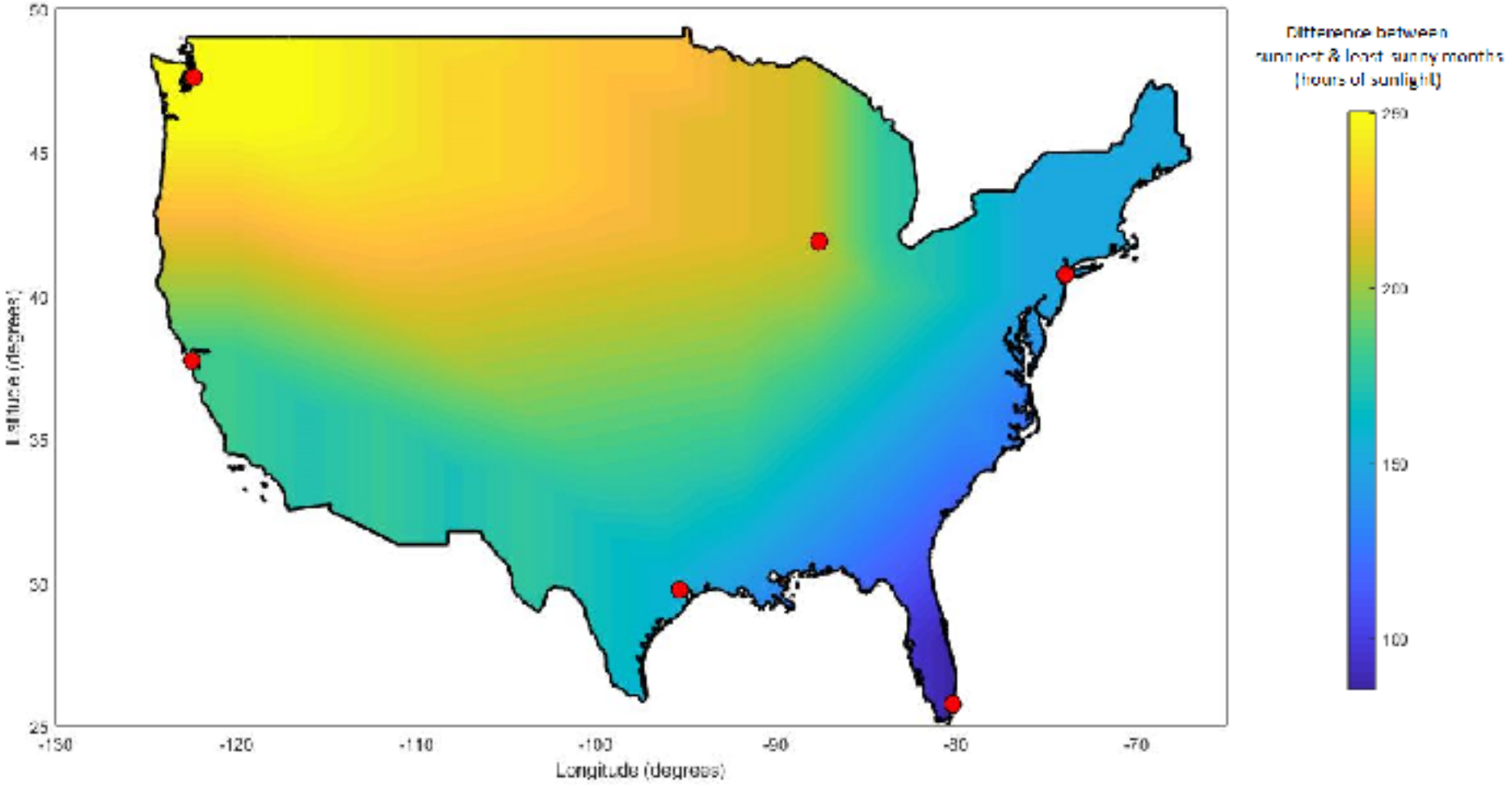


Degree of Sunshine Variability



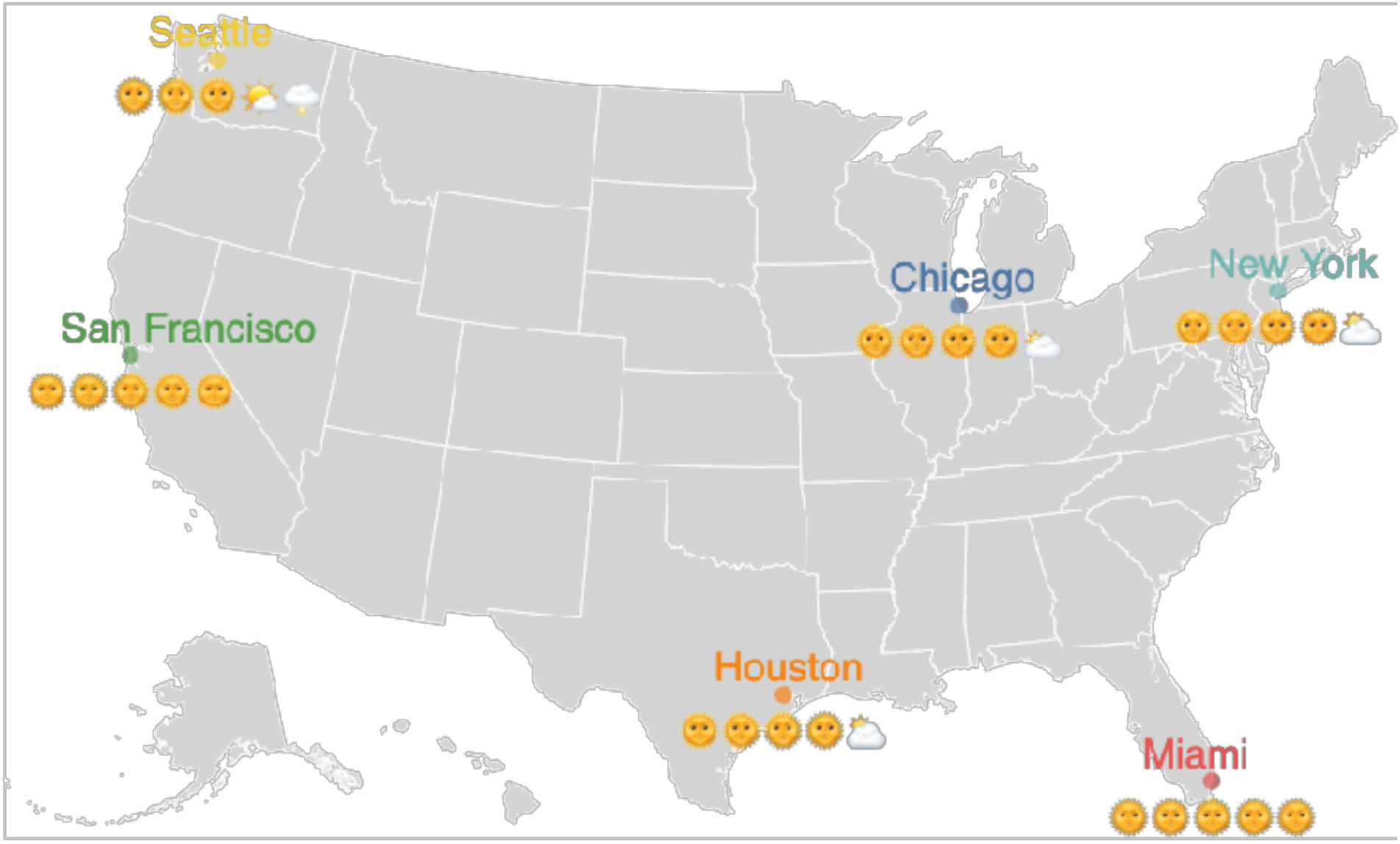
How polarized is the annual weather throughout the continental United States?

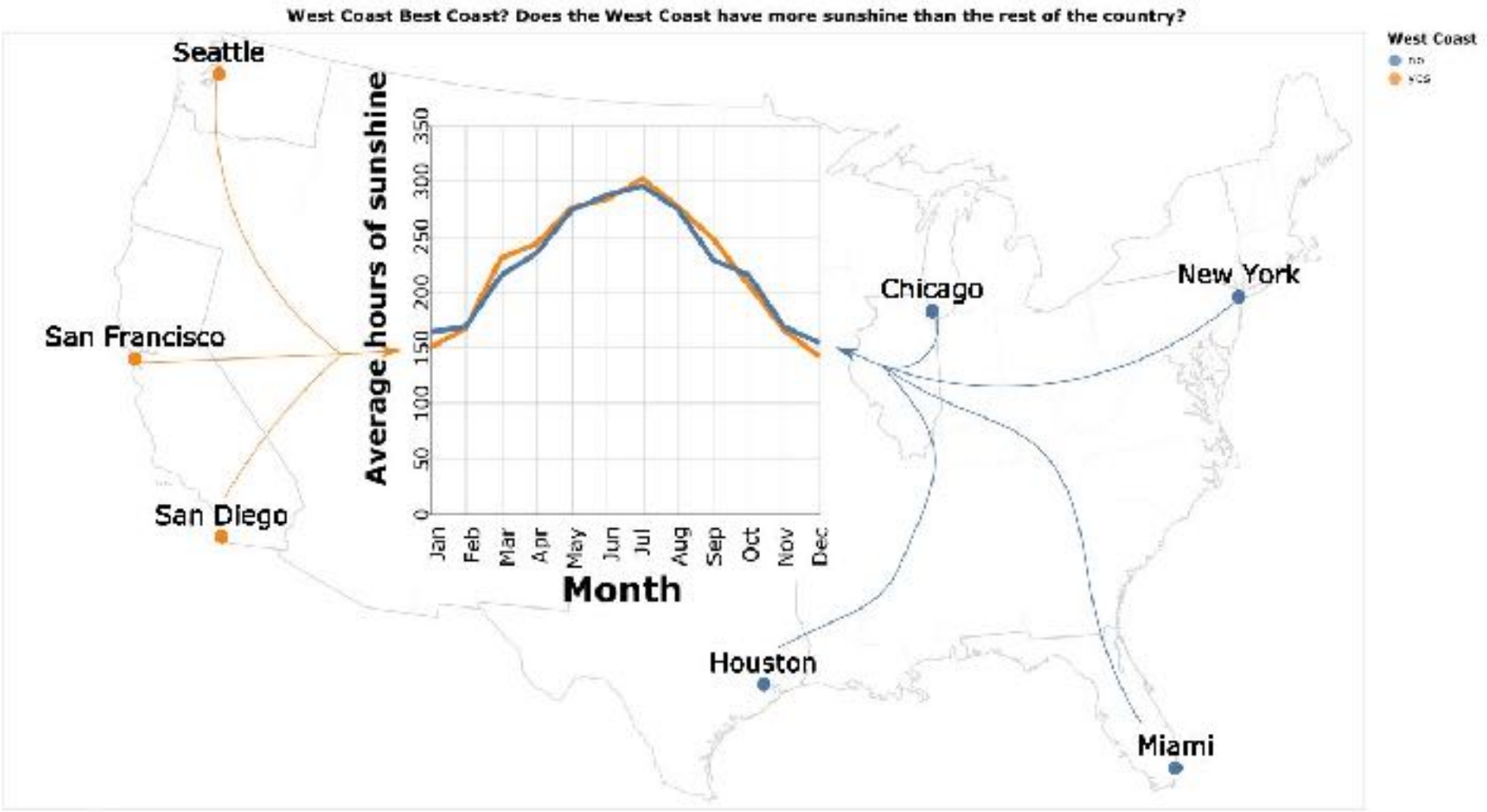
Which regions have the most consistent weather? Which are the most varied?



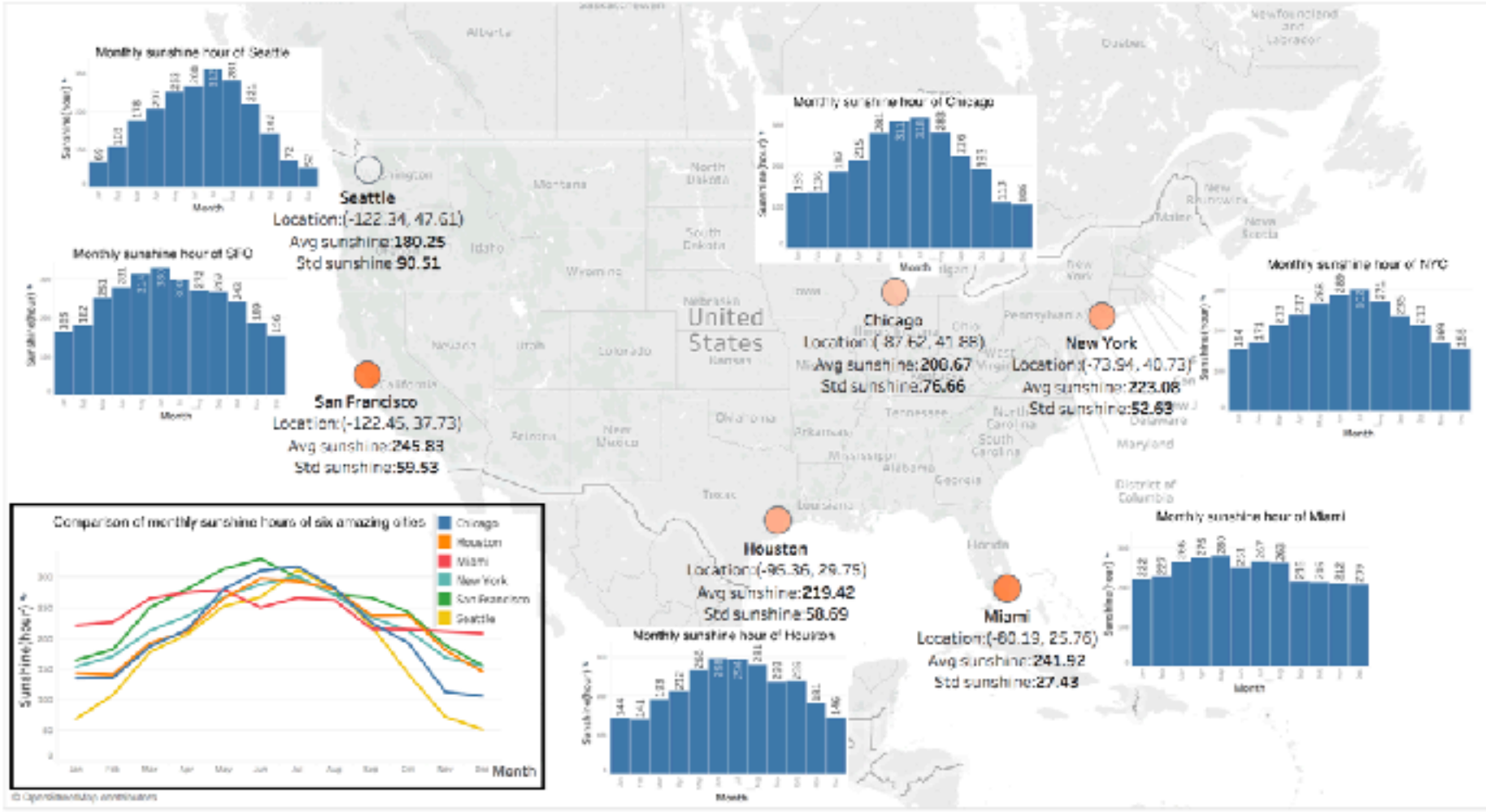
This figure depicts the difference between the months with the most and least hours of sunlight in a 12-month period, throughout the United States. The data is sampled at 6 locations, indicated with red markers, and interpolated across the rest of the country

Relative Yearly Hours of Sunshine in Major U.S. Cities



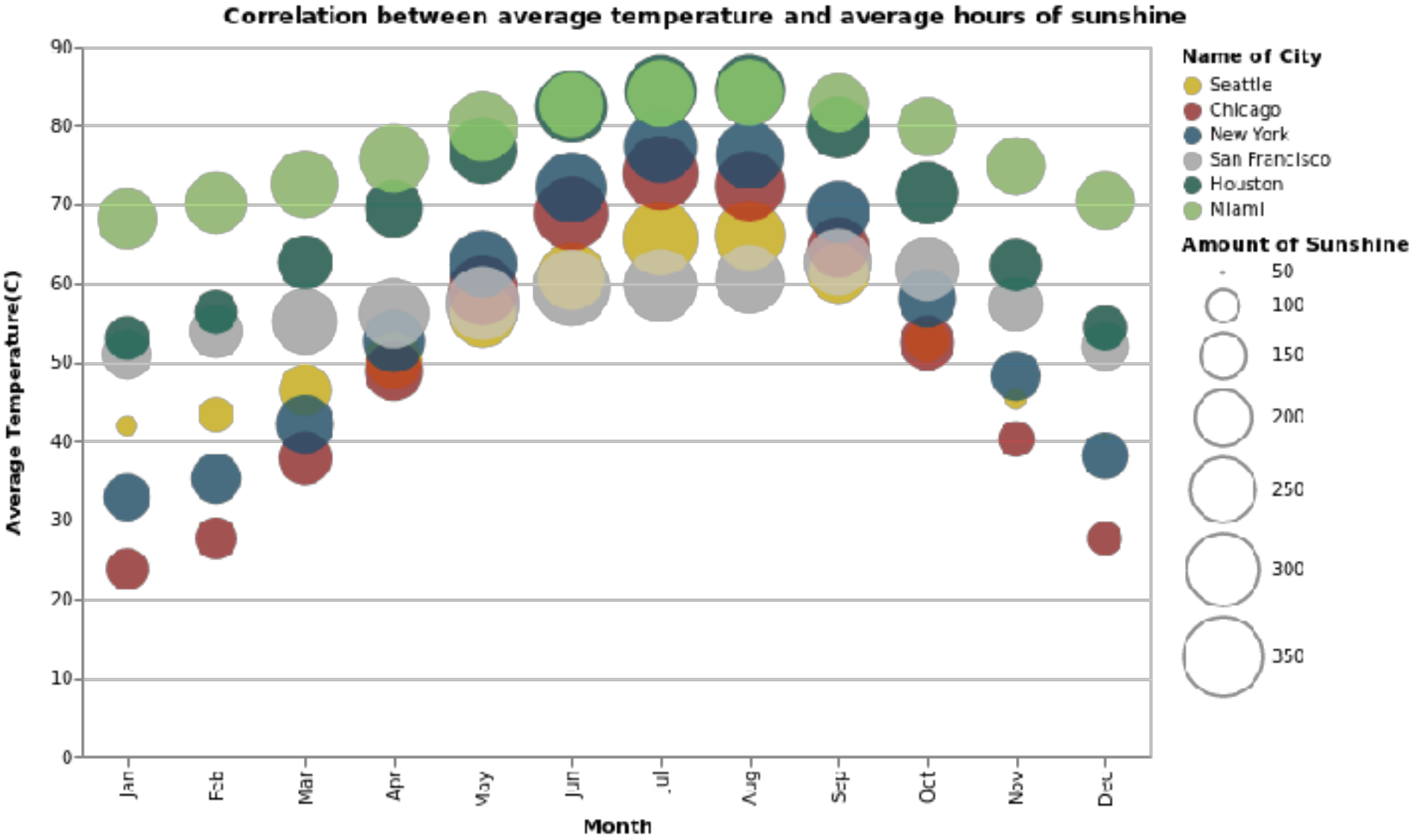

West Coast Best Coast? Does the West Coast have more sunshine than the rest of the country?
West Coast
no
yes
Seattle
San Francisco
San Diego
Chicago
New York
Houston
Miami
Average hours of sunshine
0
50
100
150
200
250
300
350
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

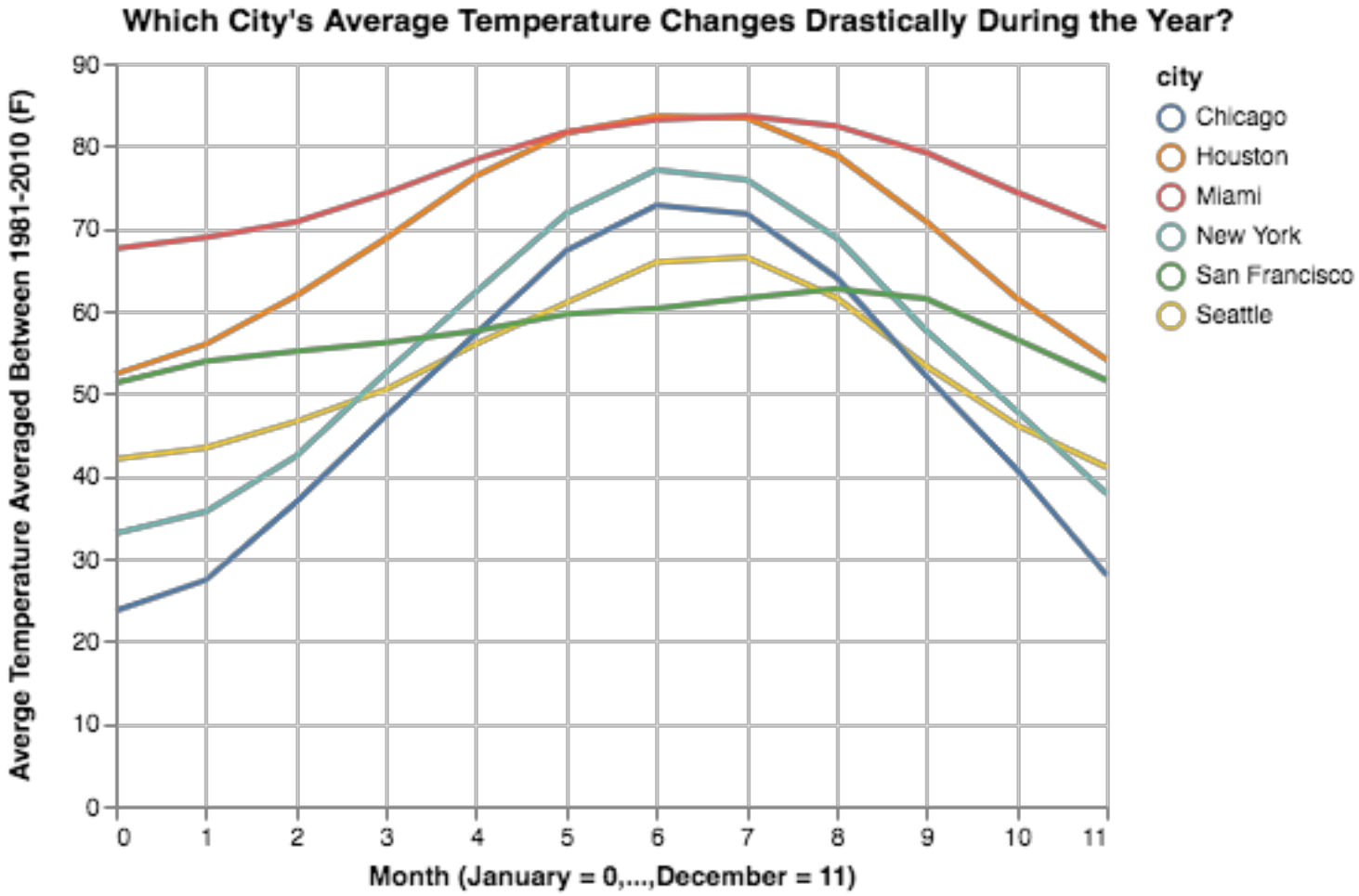
Which city shoud I (a sunshine and hiking lover) choose to live?



AVG(Sunshine) 180.25 245.83

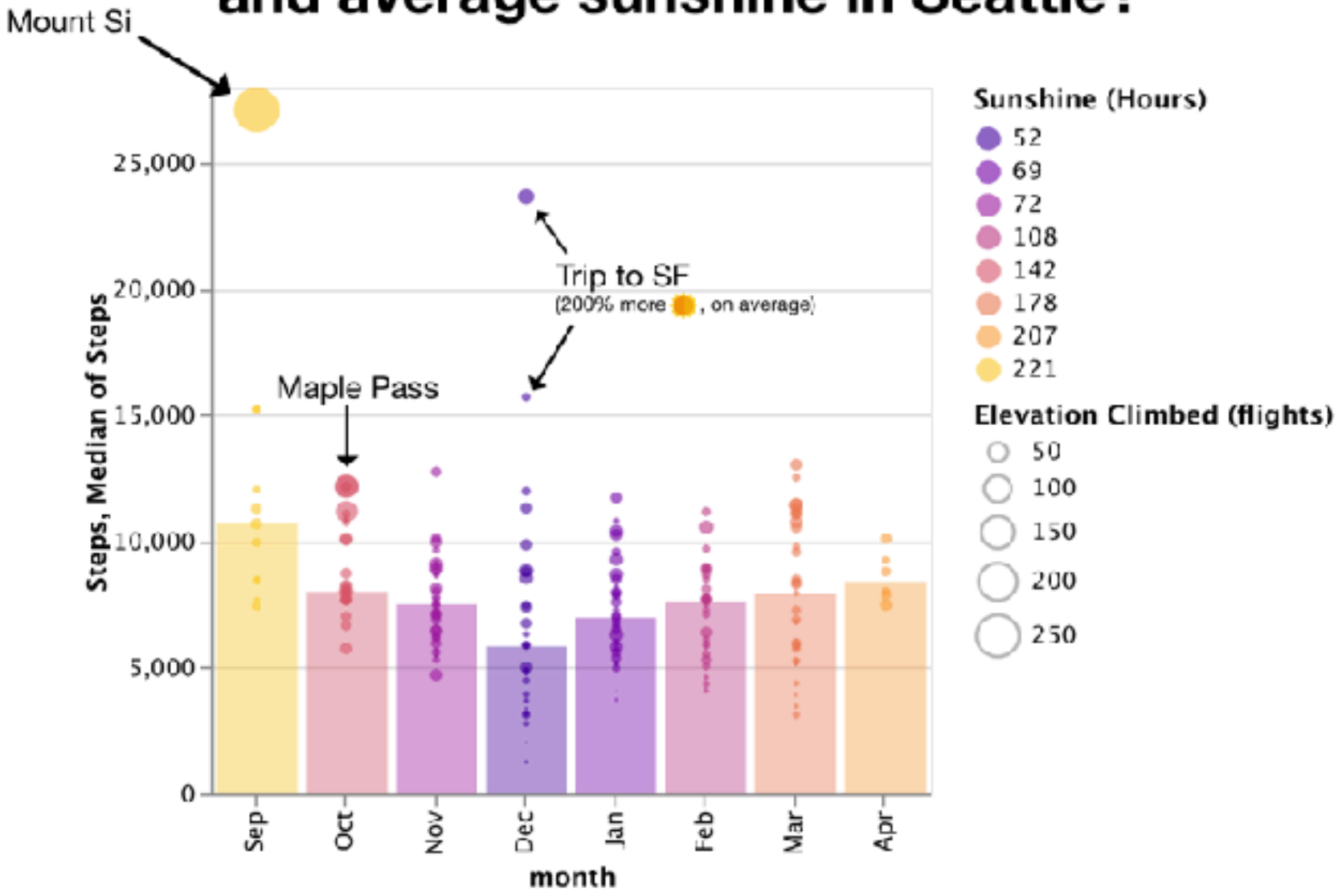
Temperature


Correlation between average temperature and average hours of sunshine
Average Temperature(C)
90
80
70
60
50
40
30
20
10
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Name of City
Seattle
Chicago
New York
San Francisco
Houston
Miami
Amount of Sunshine
50
100
150
200
250
300
350

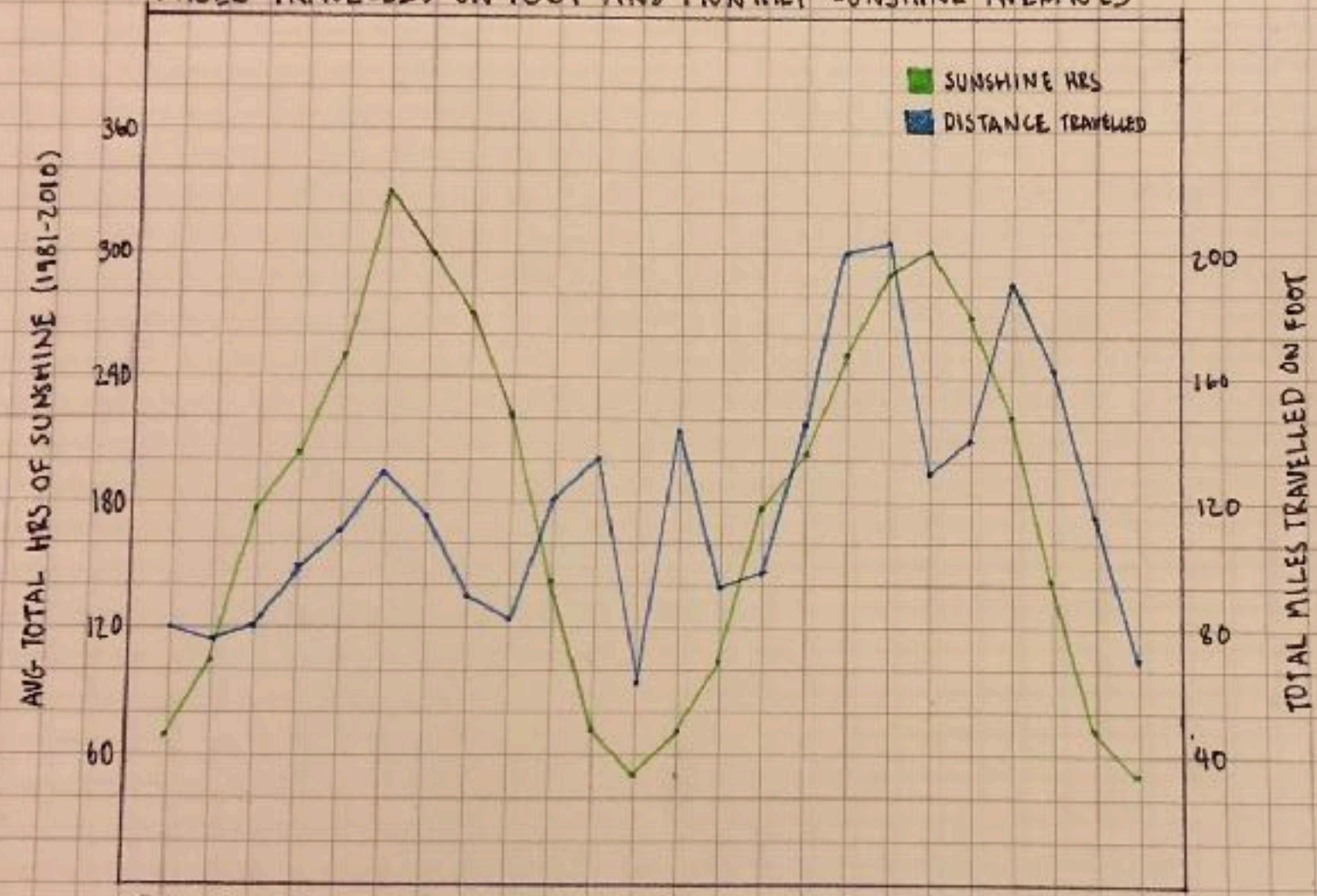

Which City's Average Temperature Changes Drastically During the Year?
Averge Temperature Averaged Between 1981-2010 (F)
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
11
Month (January = 0,...,December = 11)
city
Chicago
Houston
Miami
New York
San Francisco
Seattle

Fitness

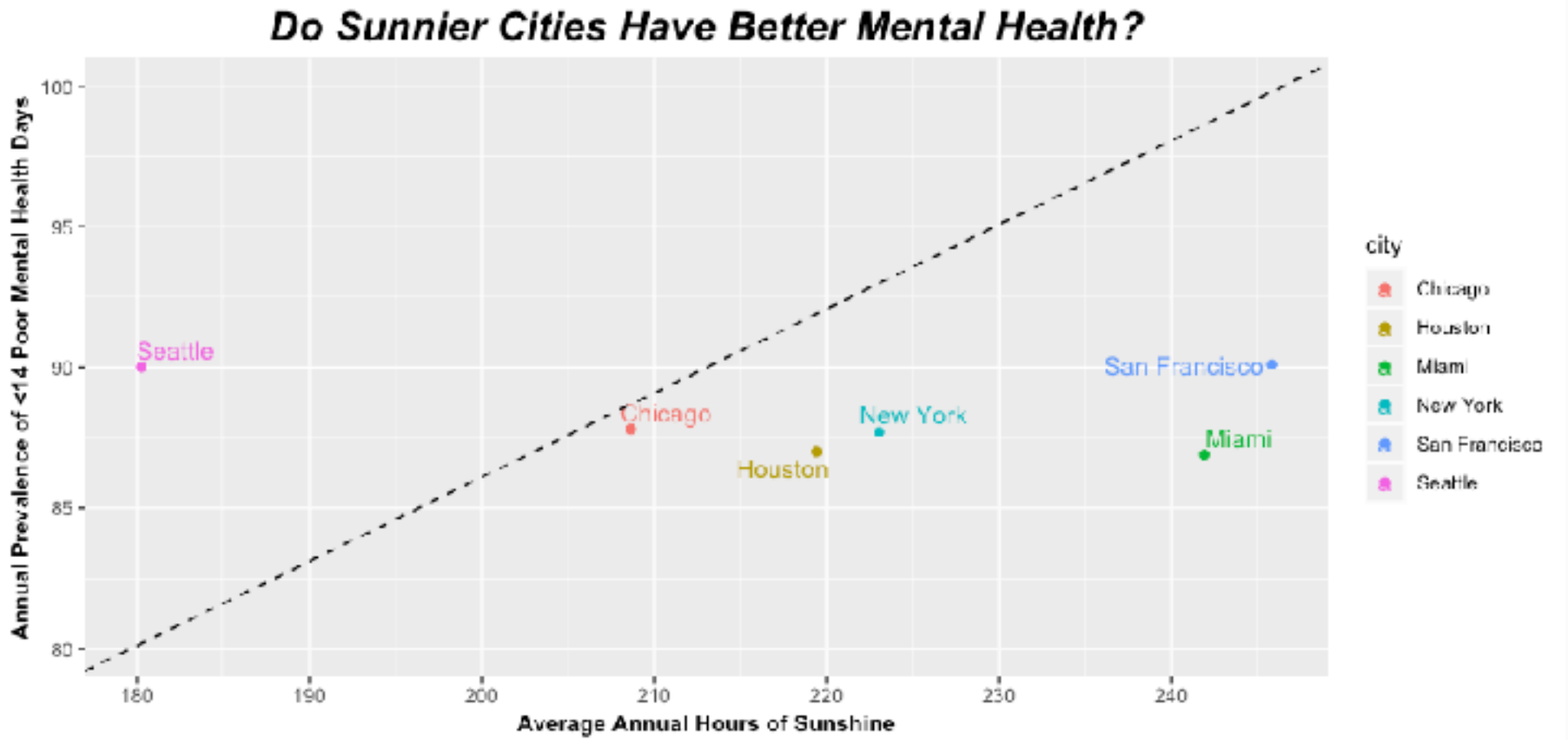
Is there a relationship between my iOS health data (steps, elevation) and average sunshine in Seattle?

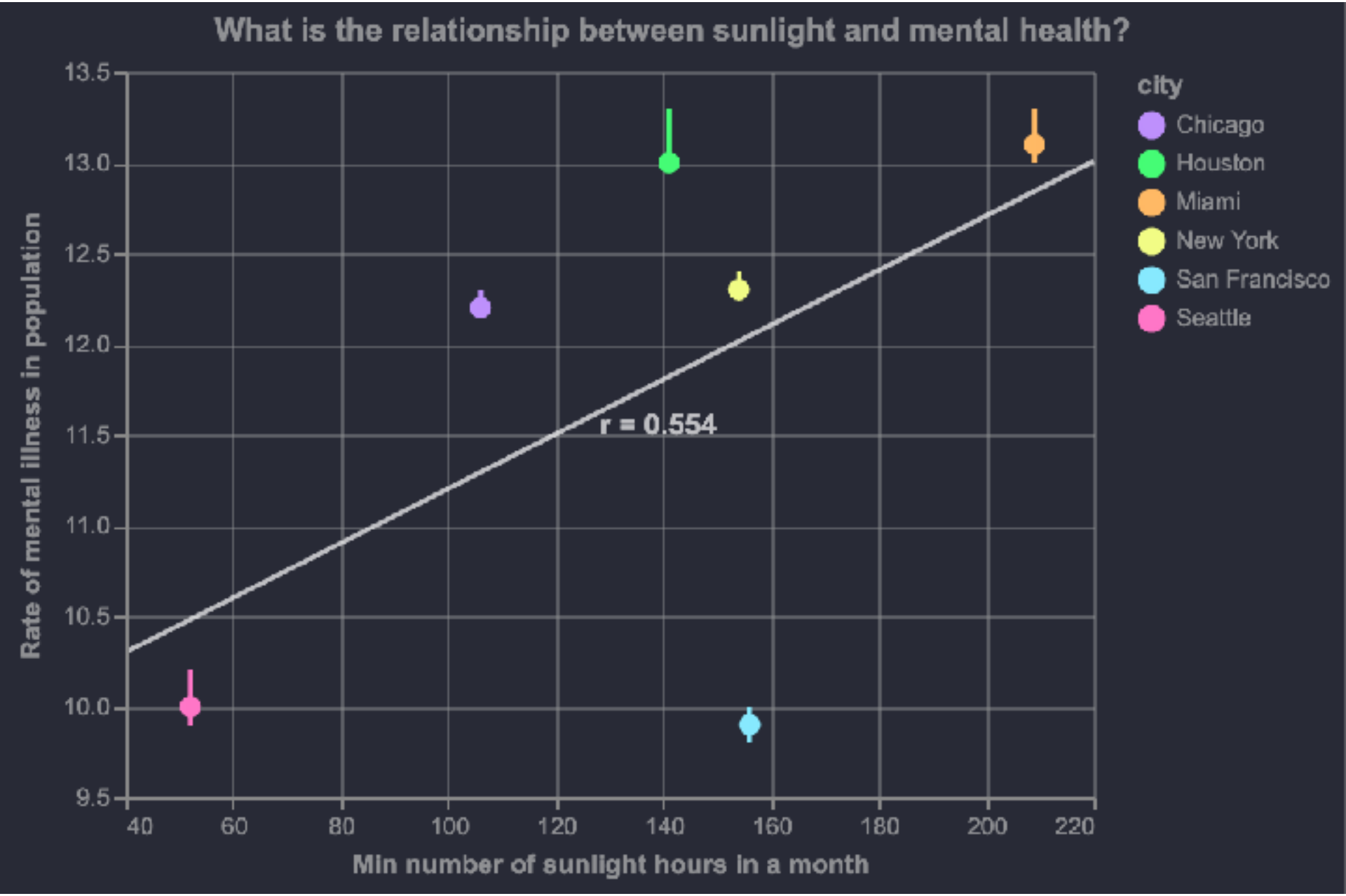


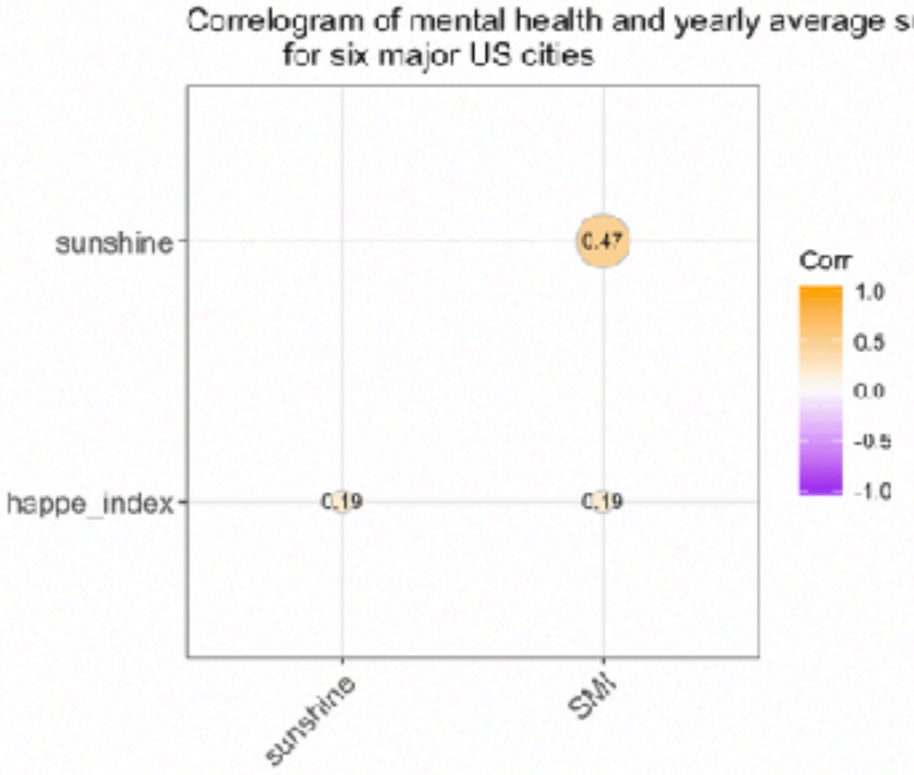
A TWO-YEAR TIMELINE OF RUNS/WALKS AS A CASE STUDY OF MILES TRAVELLED ON FOOT AND MONTHLY SUNSHINE AVERAGES

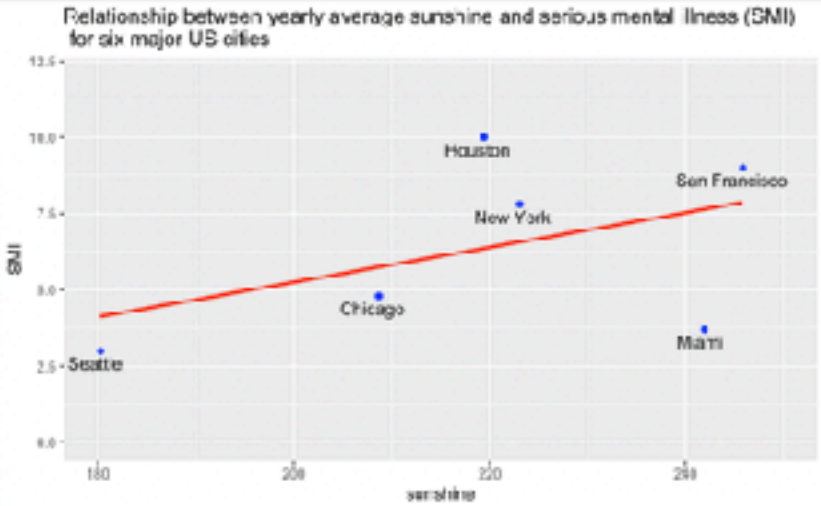


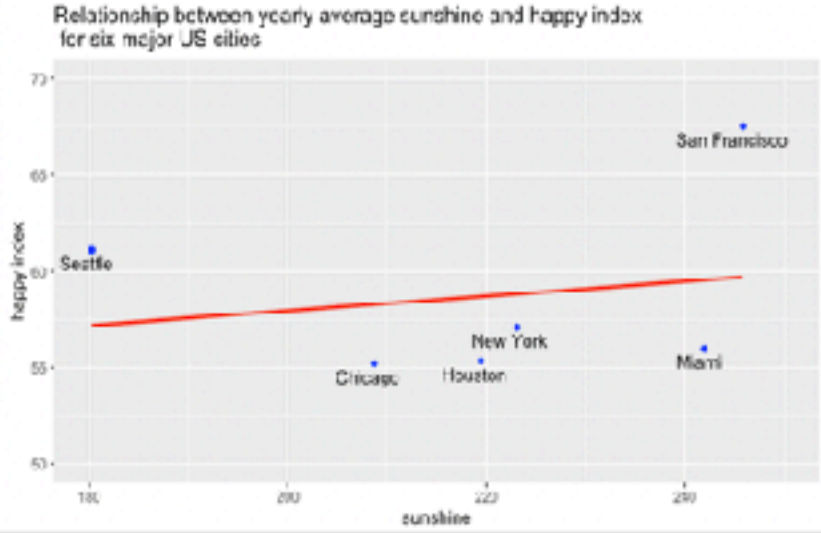
Mental Health

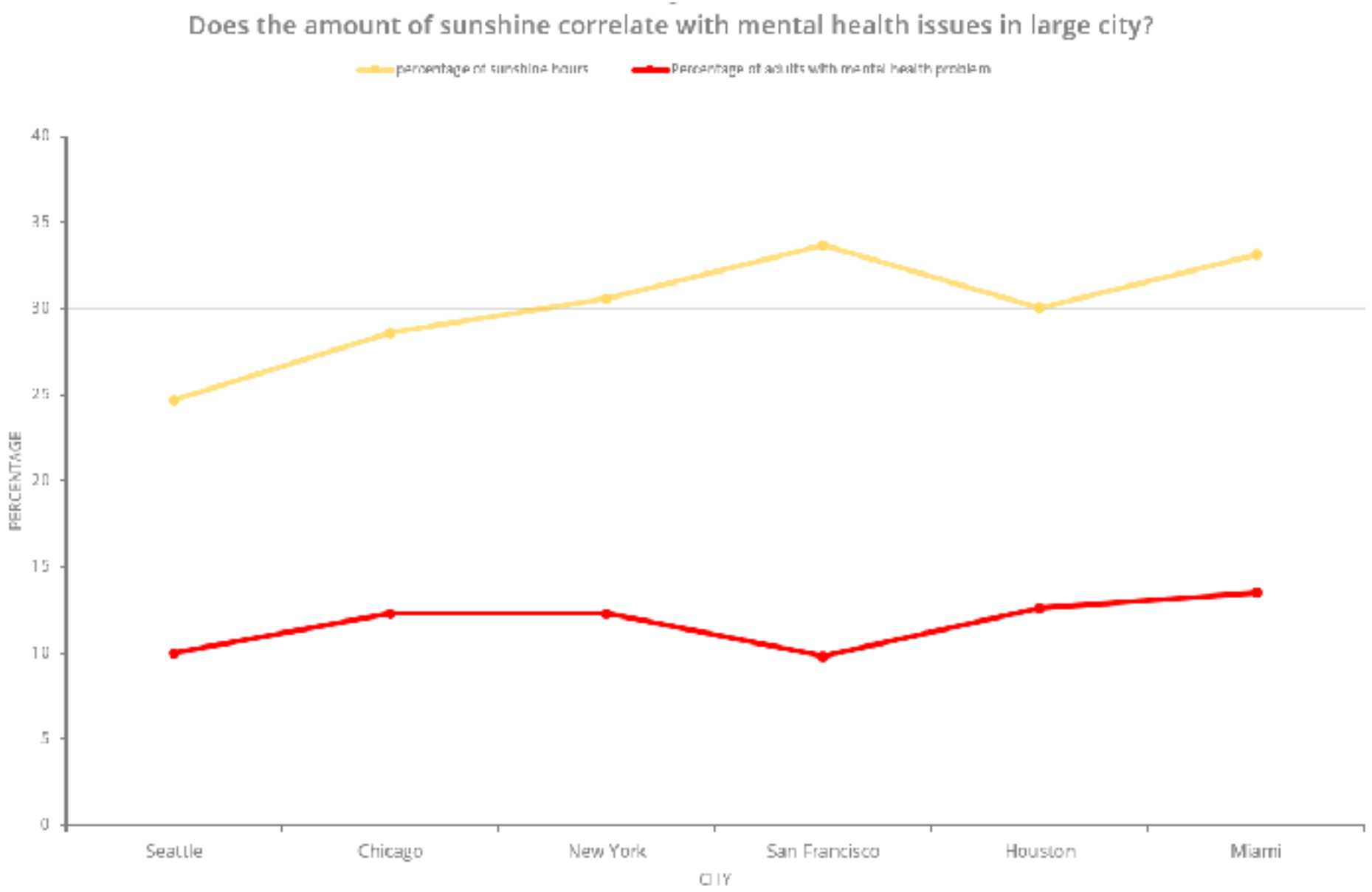

Do Sunnier Cities Have Better Mental Health?
Annual Prevalence of <14 Poor Mental Health Days
100
95
90
85
80
180
190
200
210
220
230
240
Average Annual Hours of Sunshine
Seattle
Chicago
Houston
New York
San Francisco
Miami
city
Chicago
Houston
Miami
New York
San Francisco
Seattle

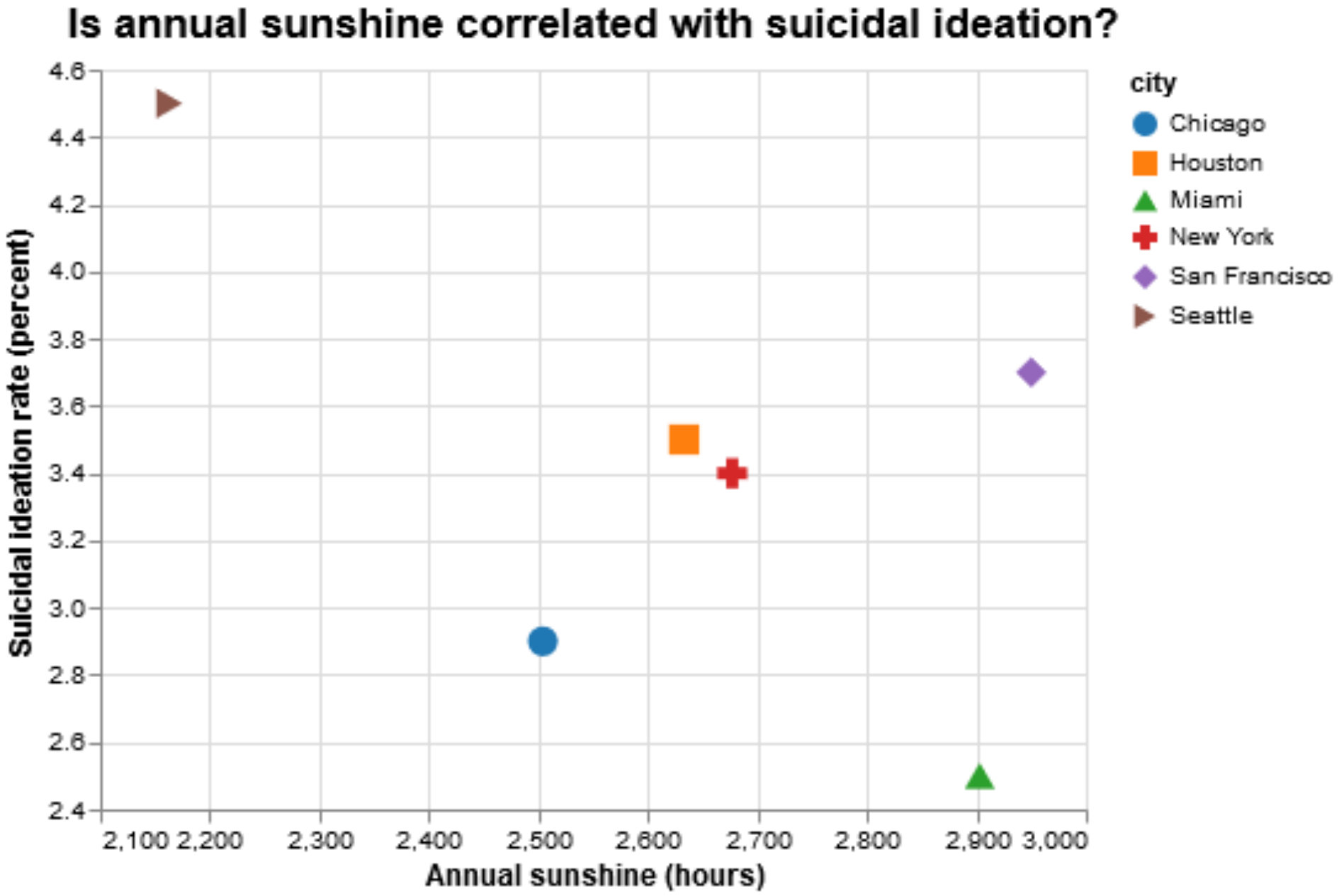

What is the relationship between sunlight and mental health?
Rate of mental illness in population
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
r = 0.554
40
60
80
100
120
140
160
180
200
220
Min number of sunlight hours in a month
city
Chicago
Houston
Miami
New York
San Francisco
Seattle


Correlogram of mental health and yearly average sunshine for six major US cities
sunshine
happe_index
0.47
0.19
0.19
Corr
1.0
0.5
0.0
-0.5
-1.0
sunshine
SMI

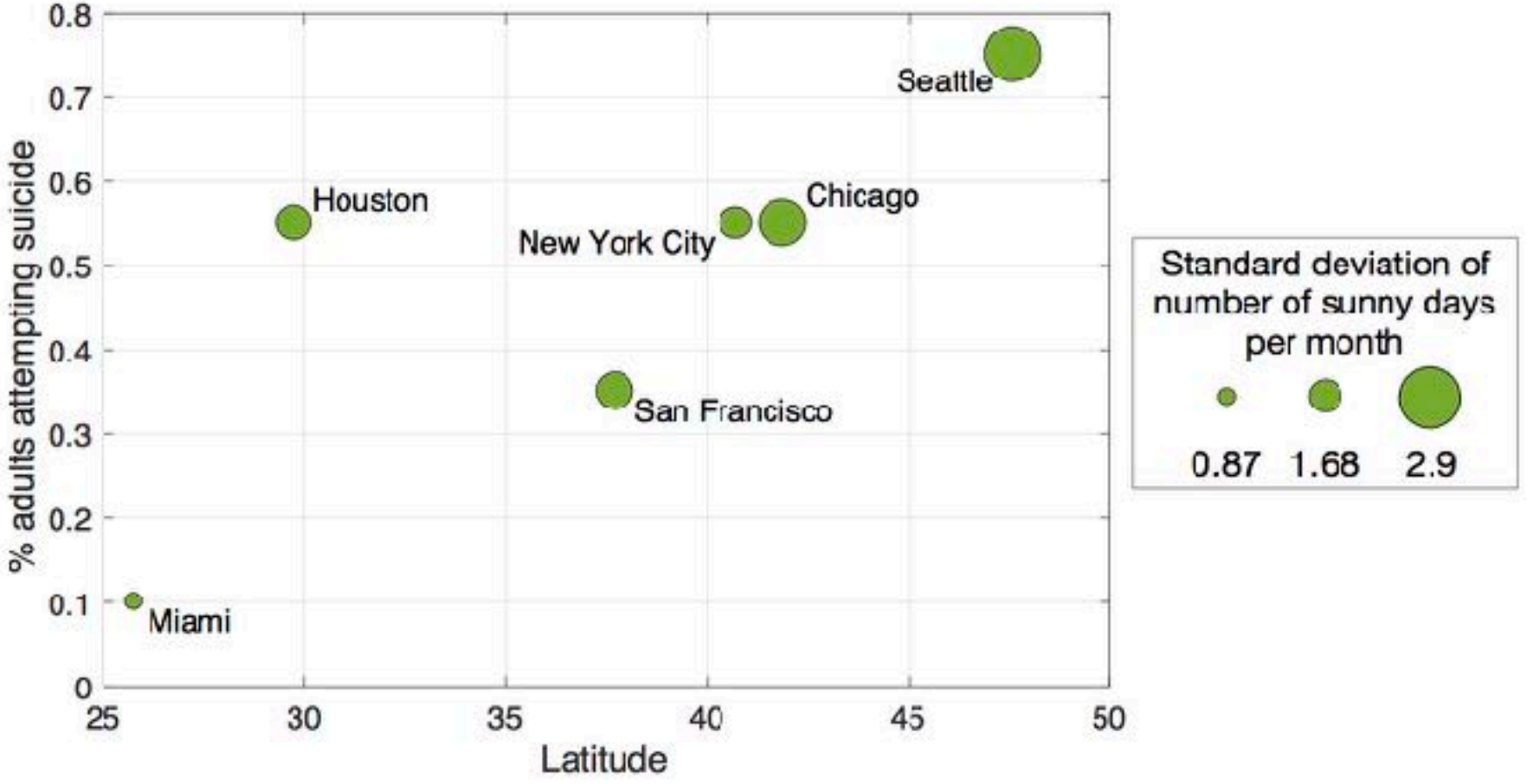

Relationship between yearly average sunshine and serious mental illness (SMI) for six major US cities
Houston
San Francisco
New York
Chicago
Miami
Seattle
SMI
sunshine


Relationship between yearly average sunshine and happy index for six major US cities
San Francisco
Seattle
New York
Miami
Chicago
Houston
happy index
sunshine

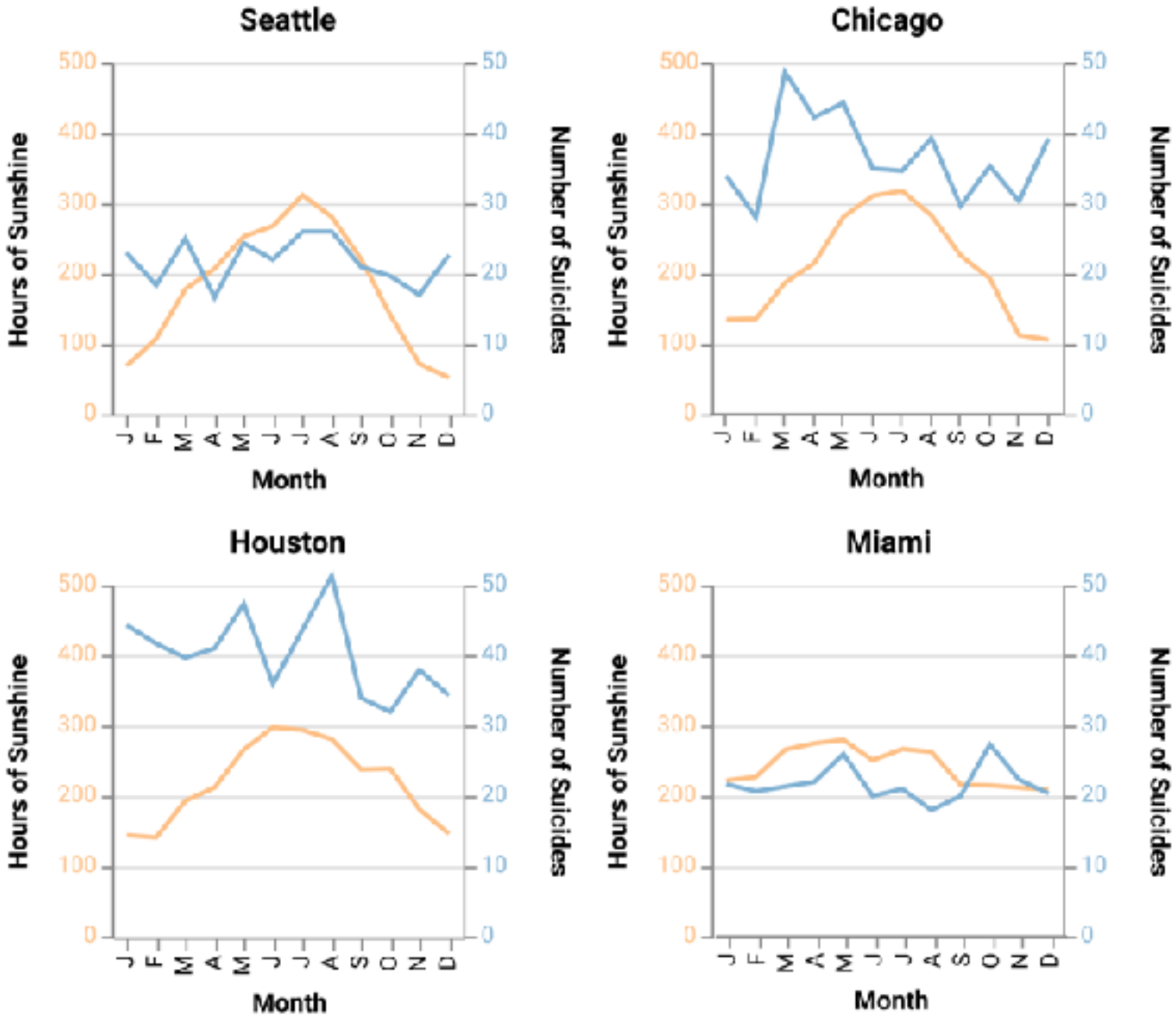

Does the amount of sunshine correlate with mental health issues in large city?
percentage of sunshine hours
Percentage of adults with mental health problem
40
35
30
25
20
15
10
5
0
PERCENTAGE
Seattle
Chicago
New York
San Francisco
Houston
Miami
CITY


Is annual sunshine correlated with suicidal ideation?
Suicidal ideation rate (percent)
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2,100
2,200
2,300
2,400
2,500
2,600
2,700
2,800
2,900
3,000
Annual sunshine (hours)
city
Chicago
Houston
Miami
New York
San Francisco
Seattle

Do correlations between variability in sunniness, latitude and rates of suicide attempt in adults exist?

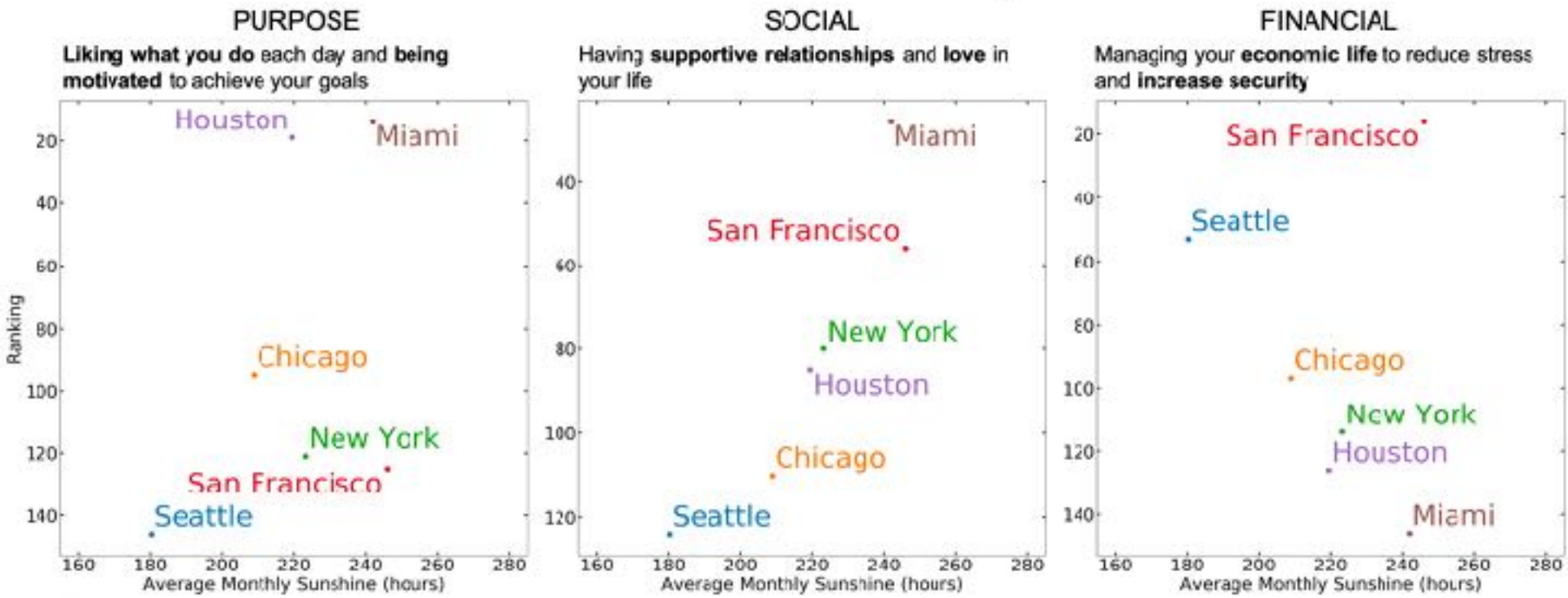


Does the number of suicides increase in sunnier months?



What is the relationship (if any) between happiness and the amount of sunshine in American cities?

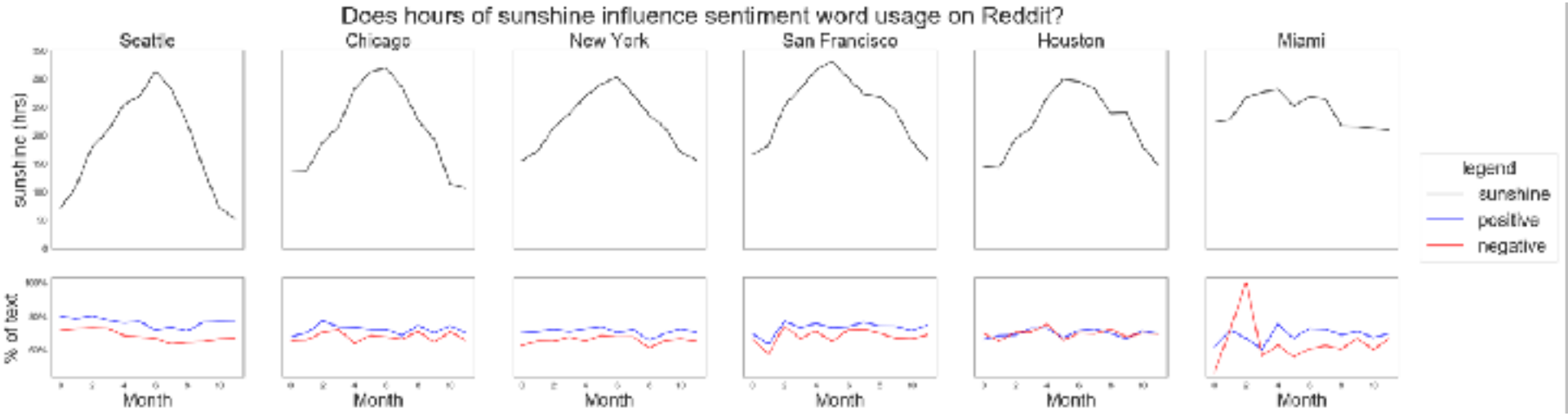
Weather and Well-Being



Notes:

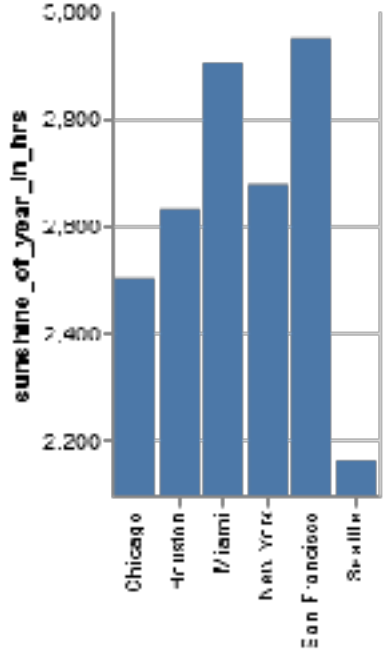
Lower rankings indicate higher quality in each category.

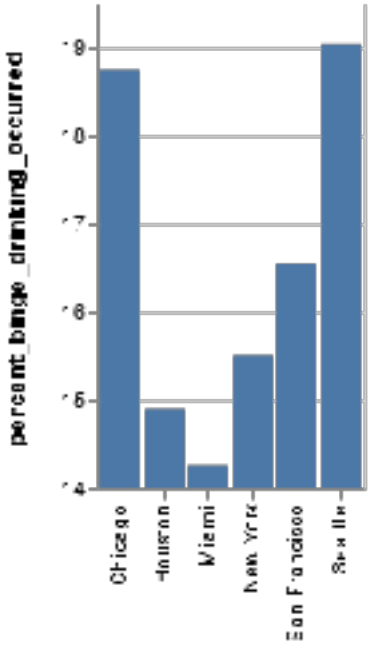
- Data on well-being along with category descriptions were gathered from the Gallup 2017 Community Well-Being Rankings.

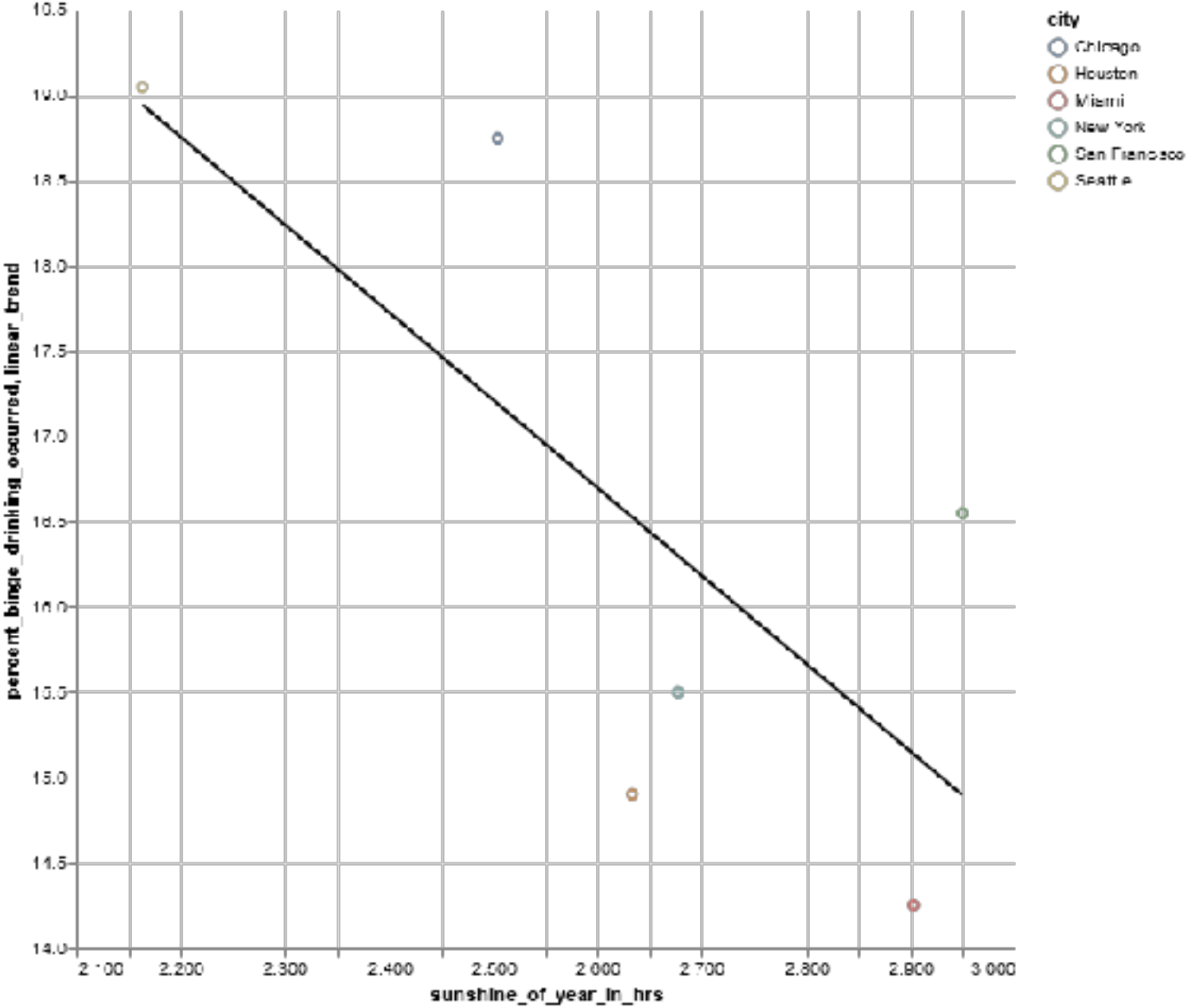

Does hours of sunshine influence sentiment word usage on Reddit?
Seattle
Chicago
New York
San Francisco
Houston
Miami
sunshine (hrs)
% of text
Month
legend
sunshine
positive
negative

Vice

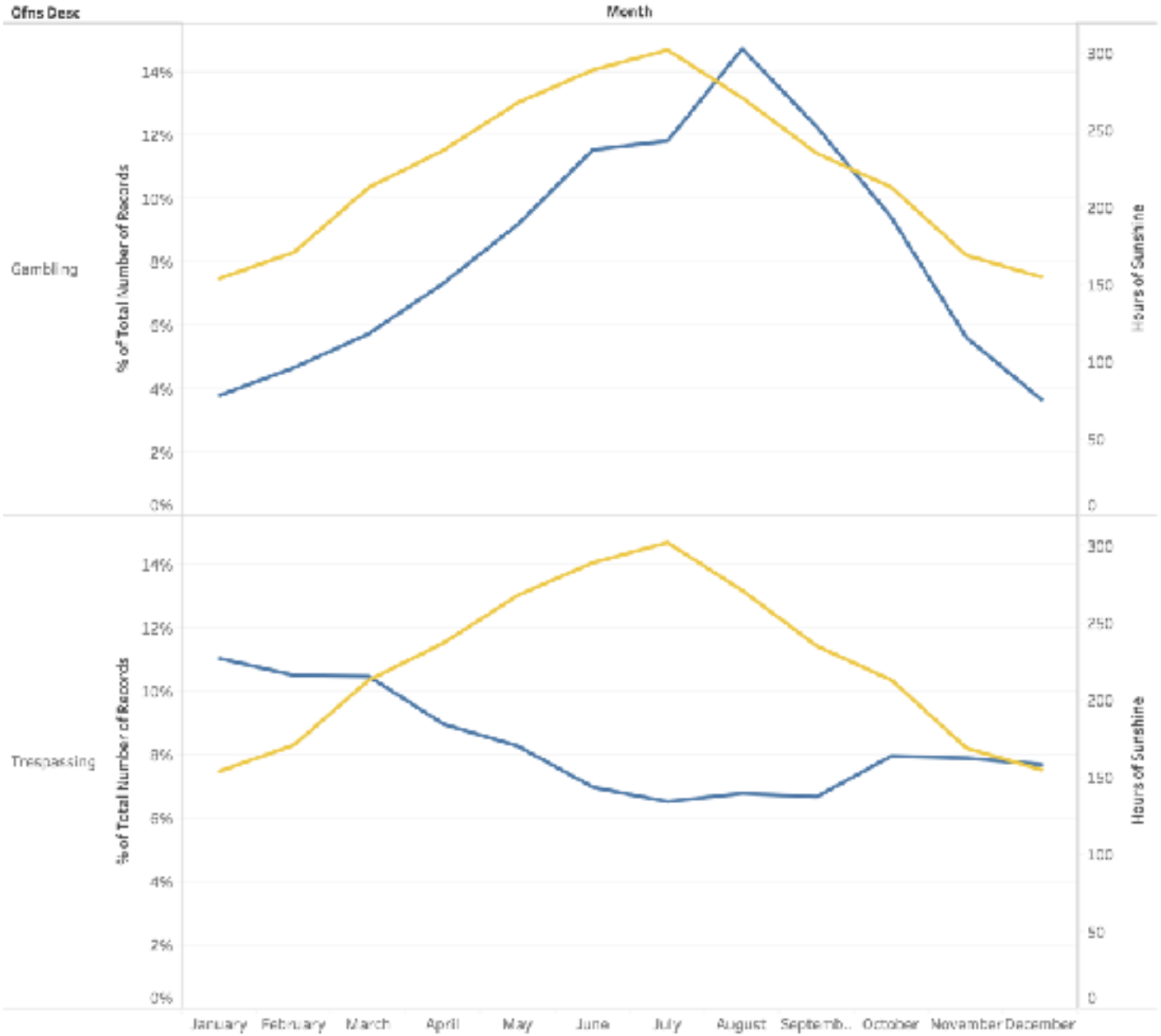
Does less sunshine encourages alcohol overconsumption in big cities?



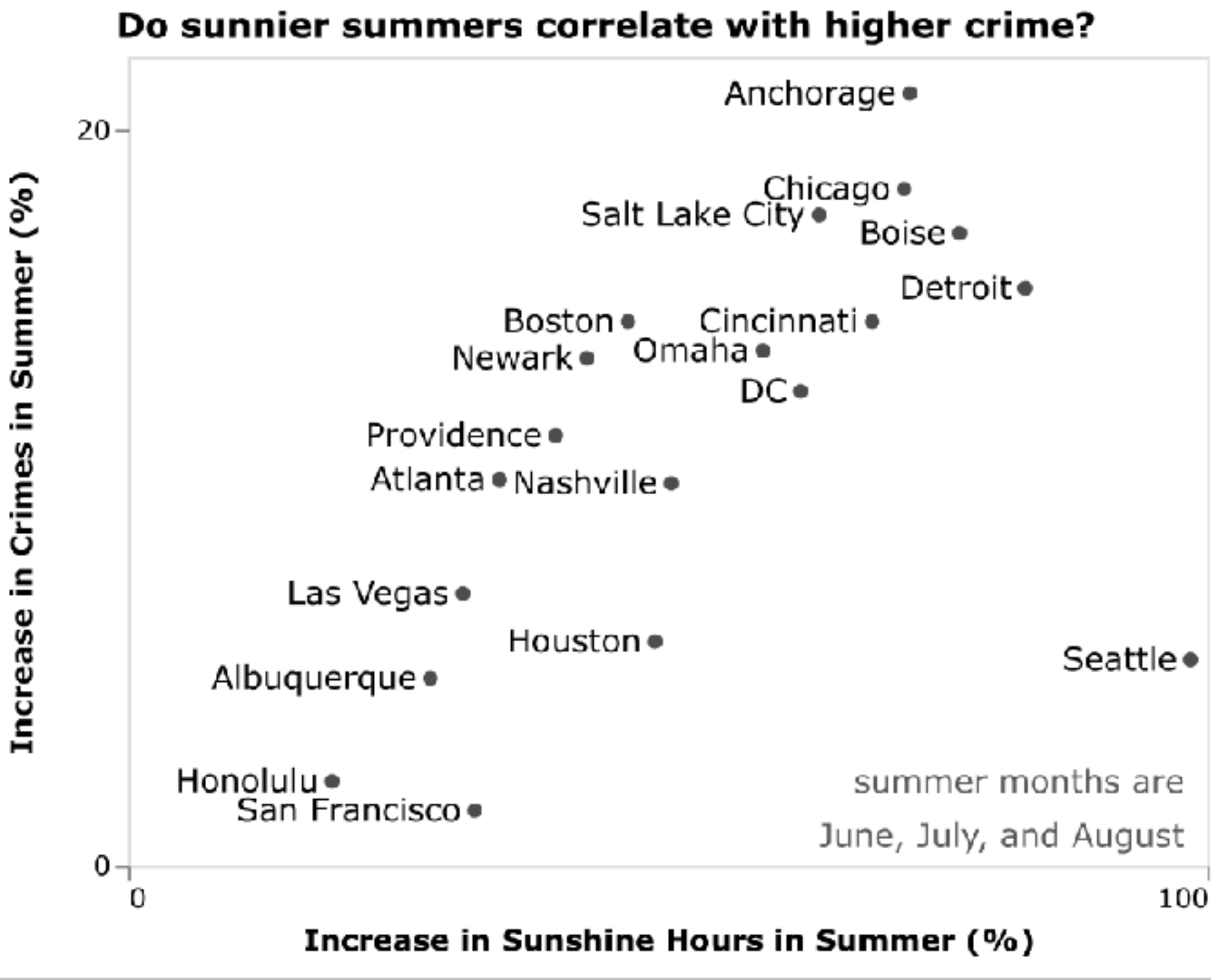




What Crimes in NYC Are More Likely on Sunny Days?

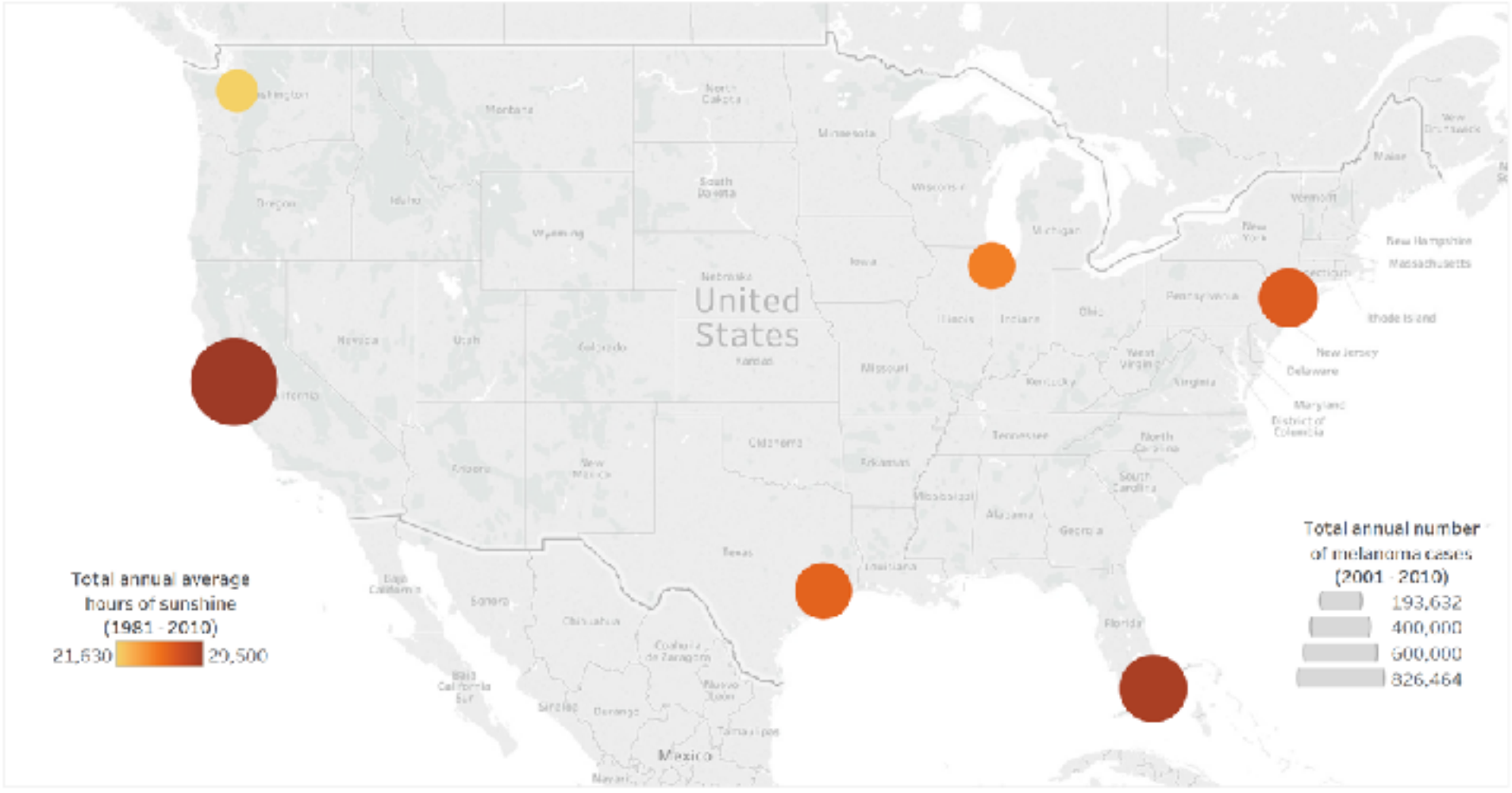


The trends of % of Total Number of Records and Hours of Sunshine for Month Month broken down by Ofns Desc. Color shows details about % of Total Number of Records and Hours of Sunshine. The view is filtered on Ofns Desc, which keeps Trespassing and Gambling.

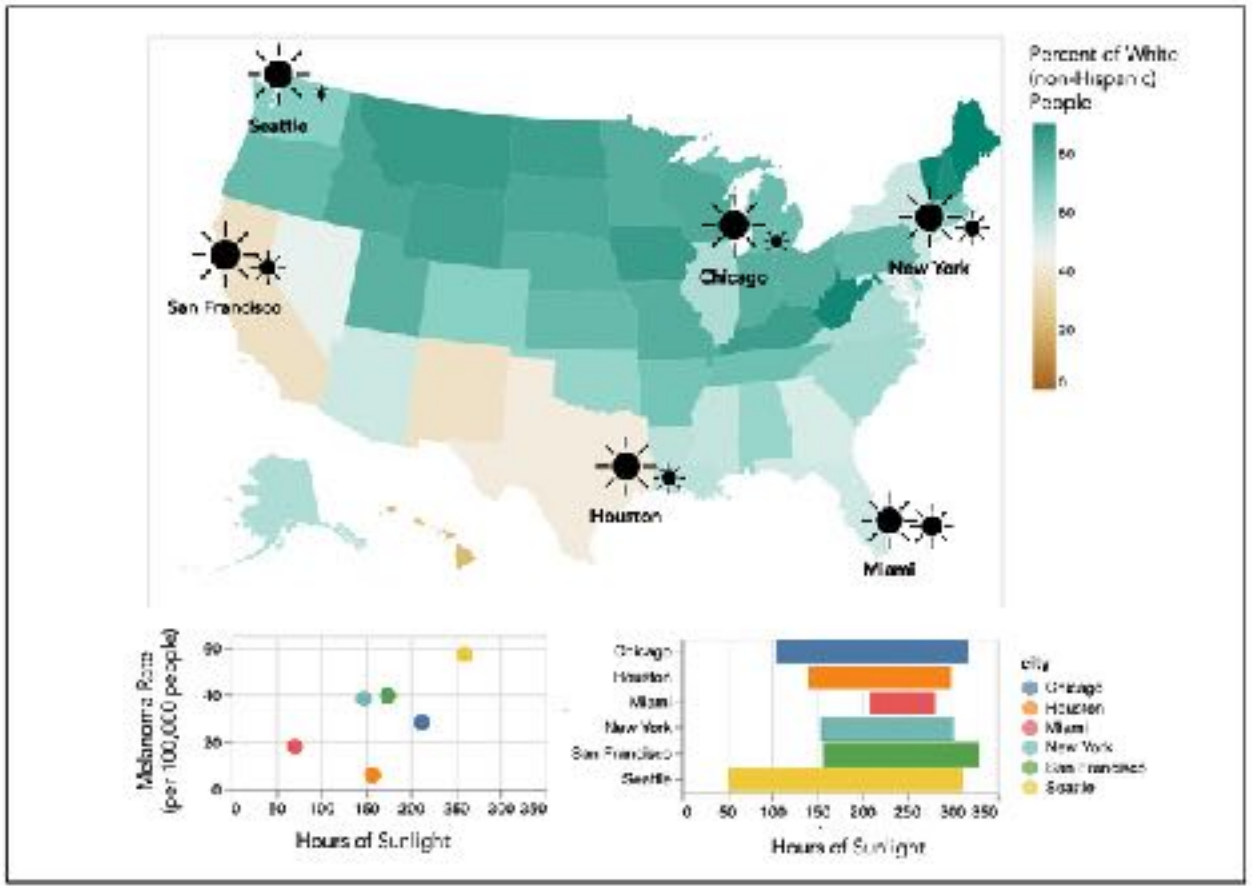

Do sunnier summers correlate with higher crime?
Anchorage
20
Chicago
Salt Lake City
Boise
Detroit
Boston
Cincinnati
Newark
Omaha
DC
Providence
Atlanta
Nashville
Las Vegas
Houston
Seattle
Albuquerque
Honolulu
San Francisco
summer months are
June, July, and August
0
0
100
Increase in Crimes in Summer (%)
Increase in Sunshine Hours in Summer (%)

Melanoma

Sunnier cities have more cases of melanoma.



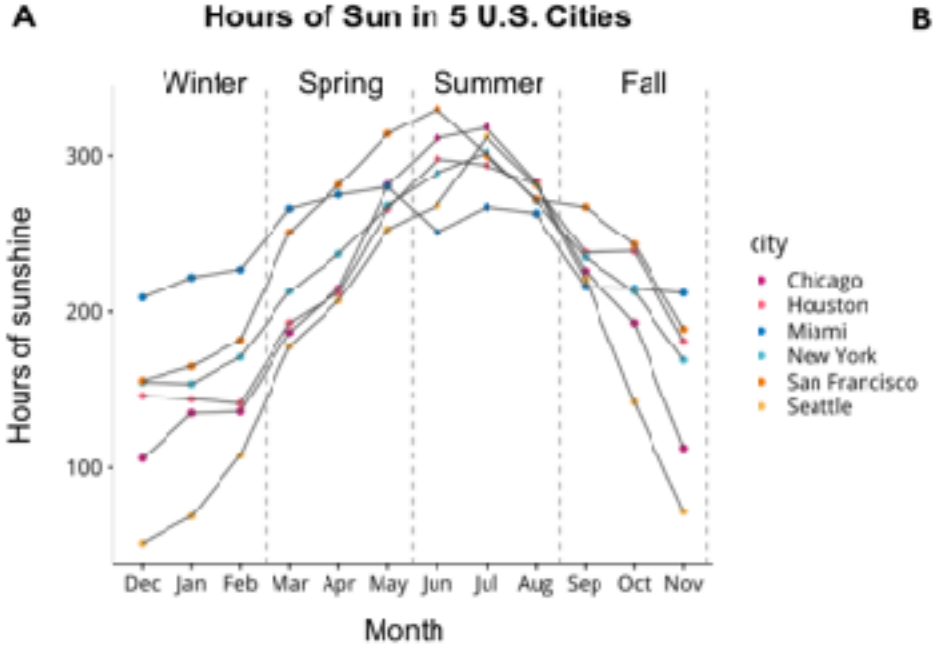
High rates of melanoma in Seattle may be attributed to a high variation in sunlight throughout the year along with a larger "at-risk" population

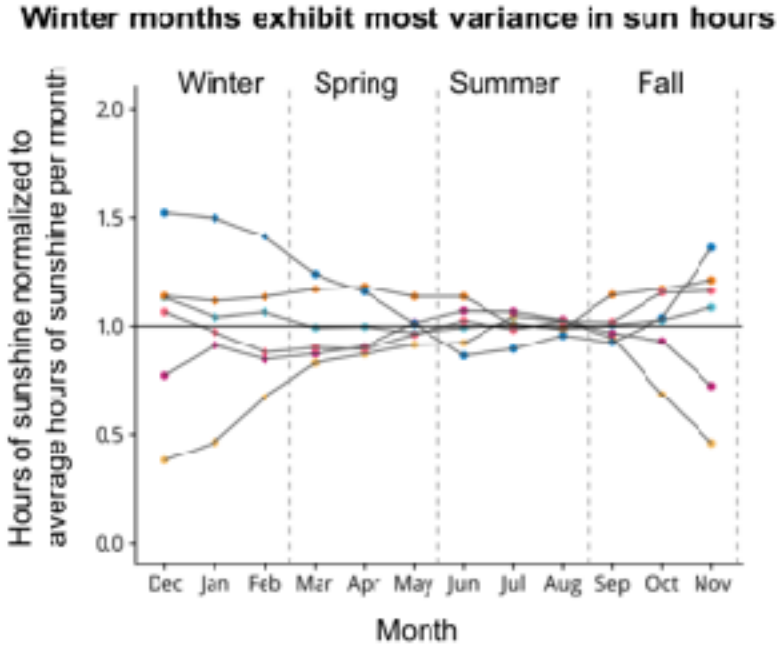


Caption. Top: Map of the United States showing percentage of each state identifying as white (non-Hispanic) along with a symbolic representation of the maximum and minimum sunlight in each marked city during the year. Bottom left: Age adjusted melanoma rate in each city plotted against the range of sunlight hours throughout the year. Bottom right: A plot of the minimum and maximum of sunlight hours for each city.

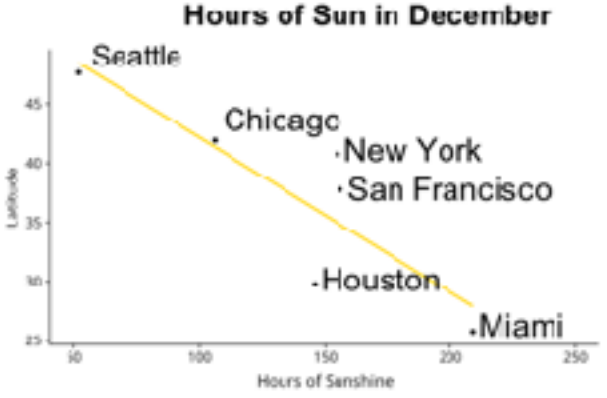
Other

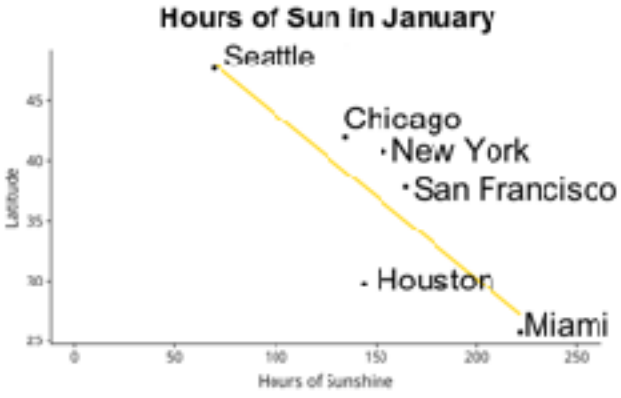
What months exhibit the most variance in hours of sun across US cities?

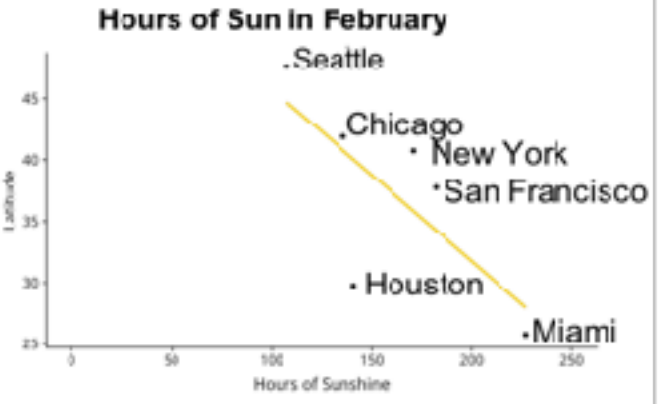


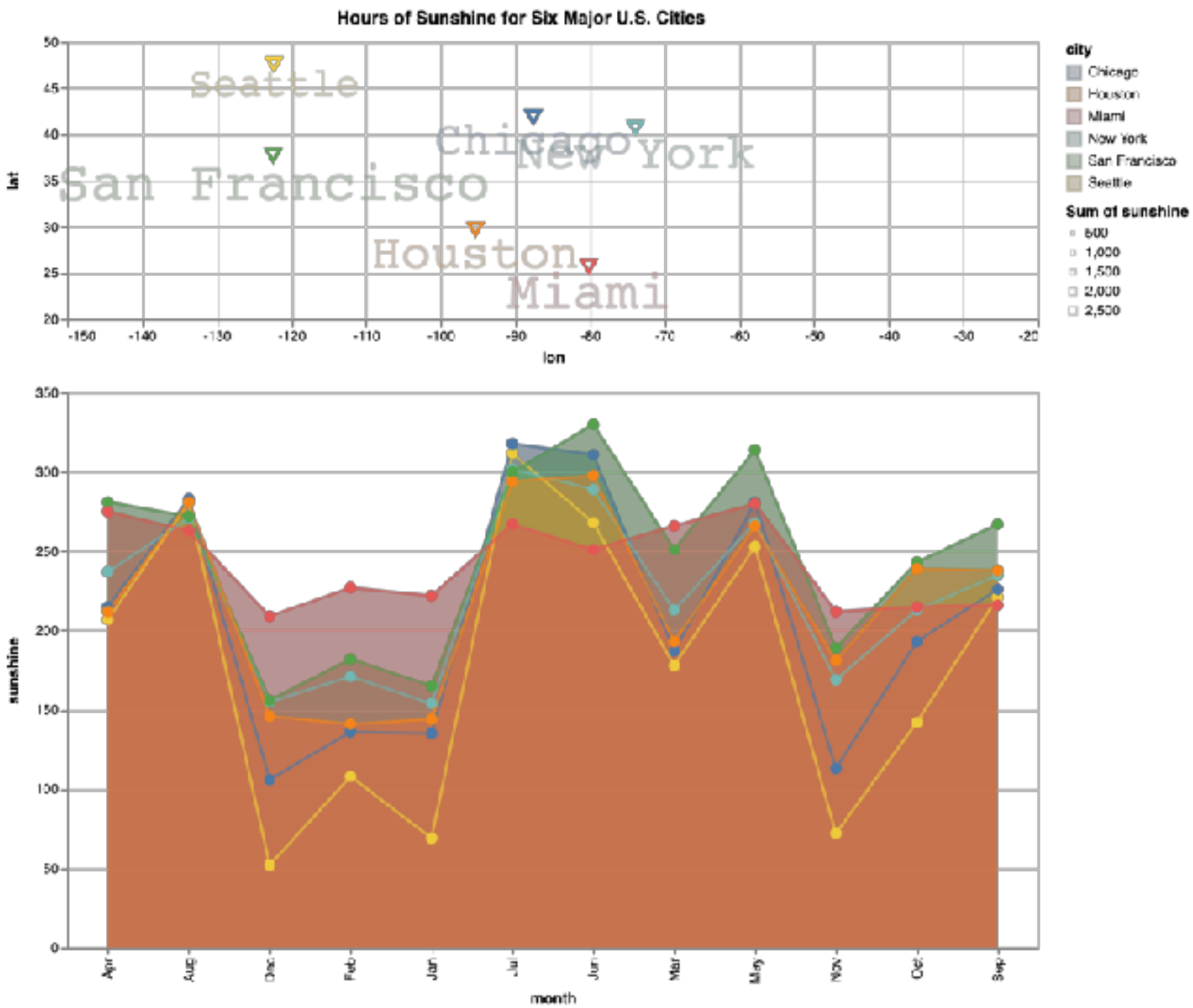


C Does latitude of each city correlate with hours of sun in the winter?

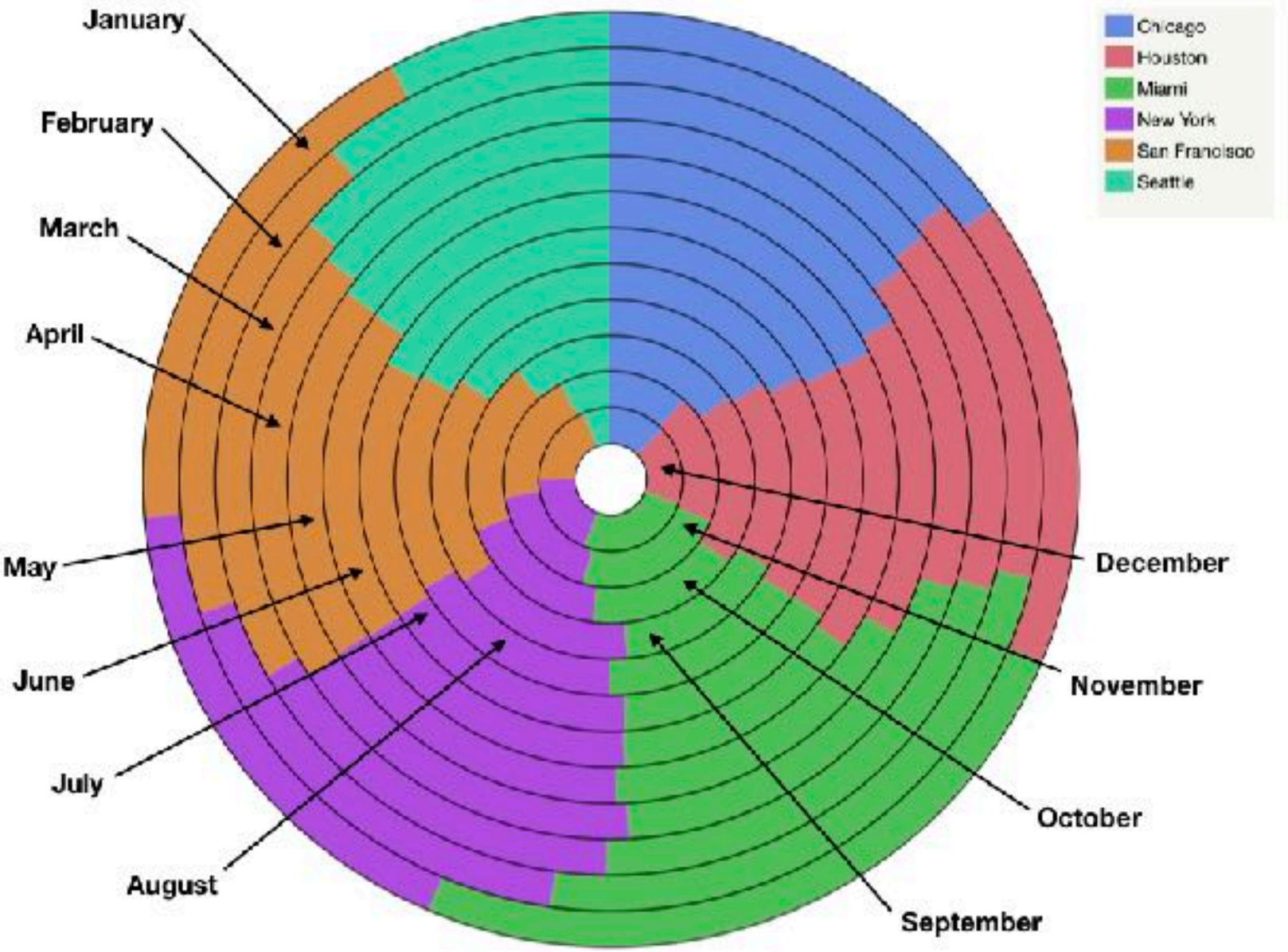




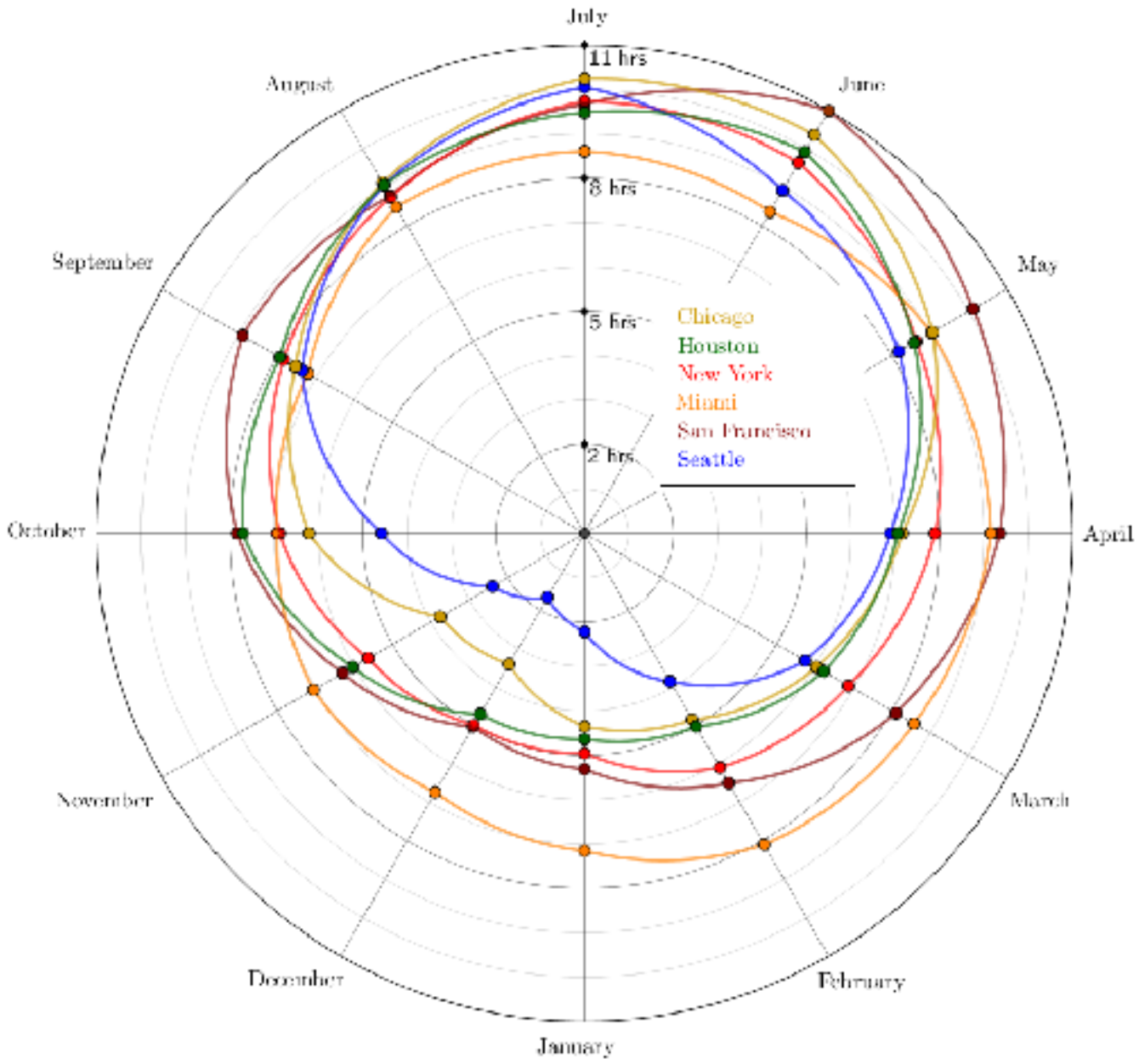



Hours of Sunshine for Six Major U.S. Cities
Seattle
San Francisco
Chicago
New York
Houston
Miami
lat
lon
city
Chicago
Houston
Miami
New York
San Francisco
Seattle
Sum of sunshine
600
1,000
1,500
2,000
2,500
sunshine
month
Apr
Aug
Dec
Feb
Jan
Jul
Jun
Mar
May
Nov
Oct
Sep

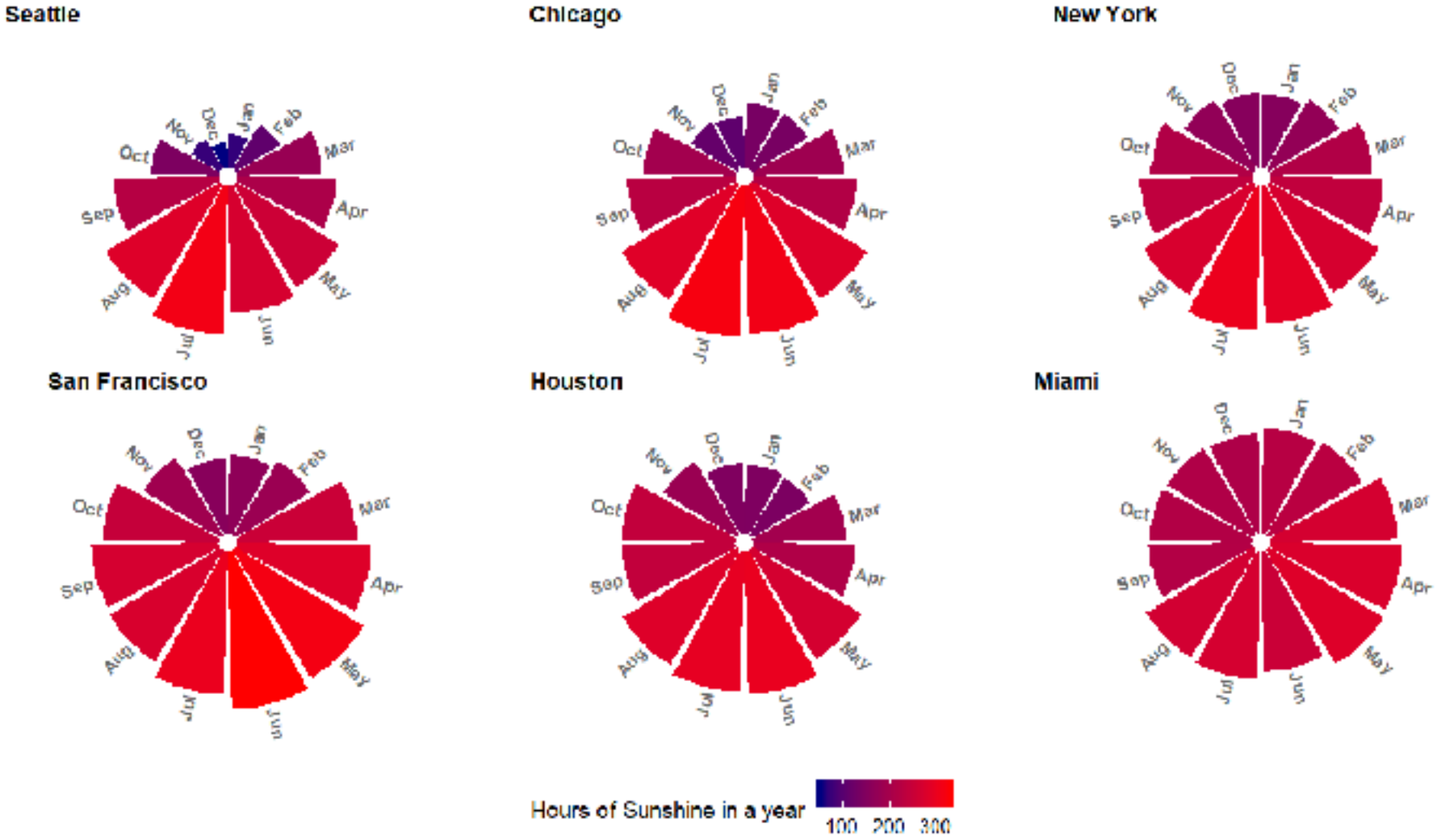
How does sunlight compare across six major US cities over the course of months?



How do major US cities compare in terms of daily sunshine hours?

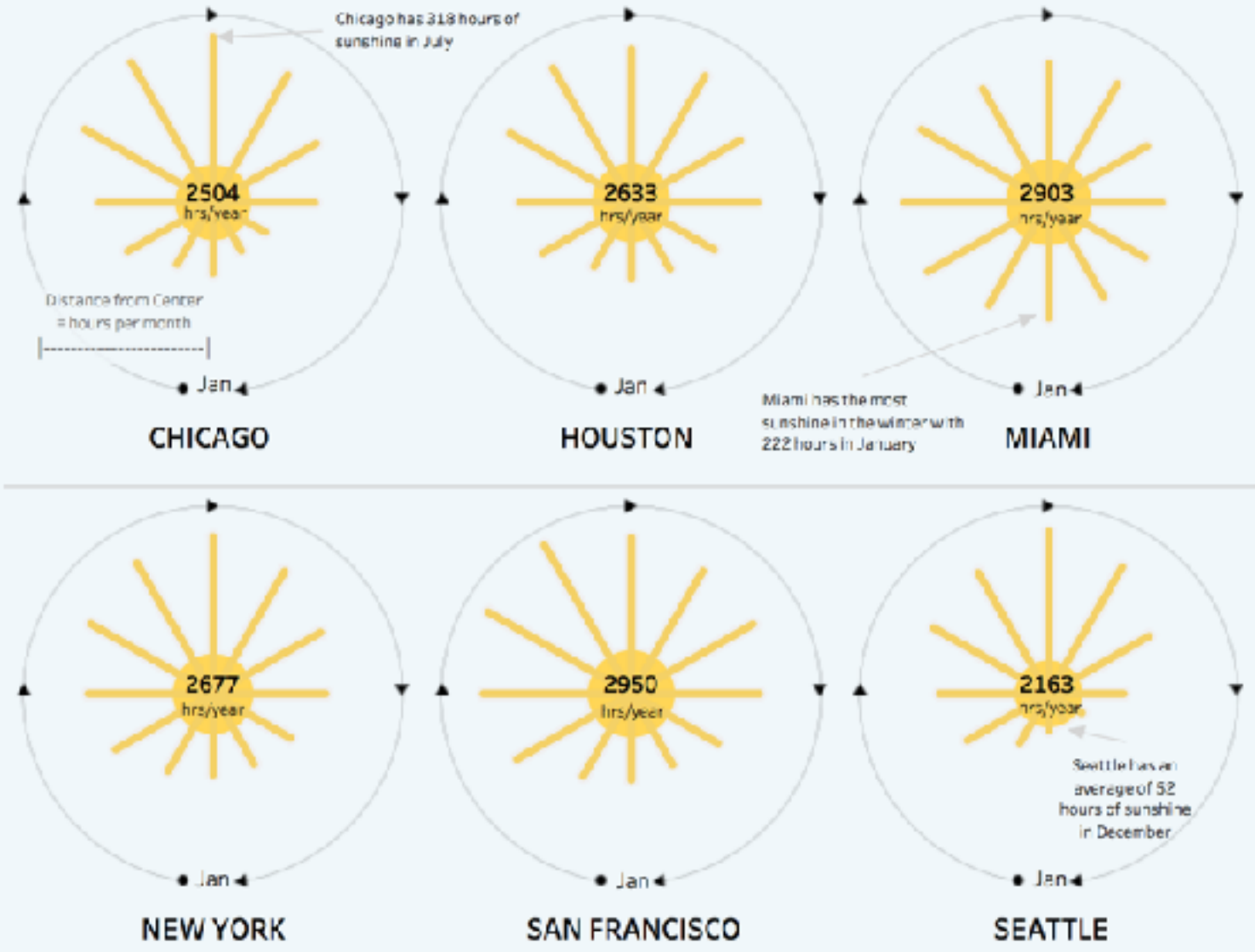


Comparison of changes in sunlight by month for 6 major cities



Color scale is shared across cities, presenting an objective representation of changes in hours of sunlight by month within the year.

Which cities have the most sunshine year-round?



Data from https://usclimatedata.com/

Created by: Melinda McClure Haughey

Re-Design Exercise

Re-Design Exercise

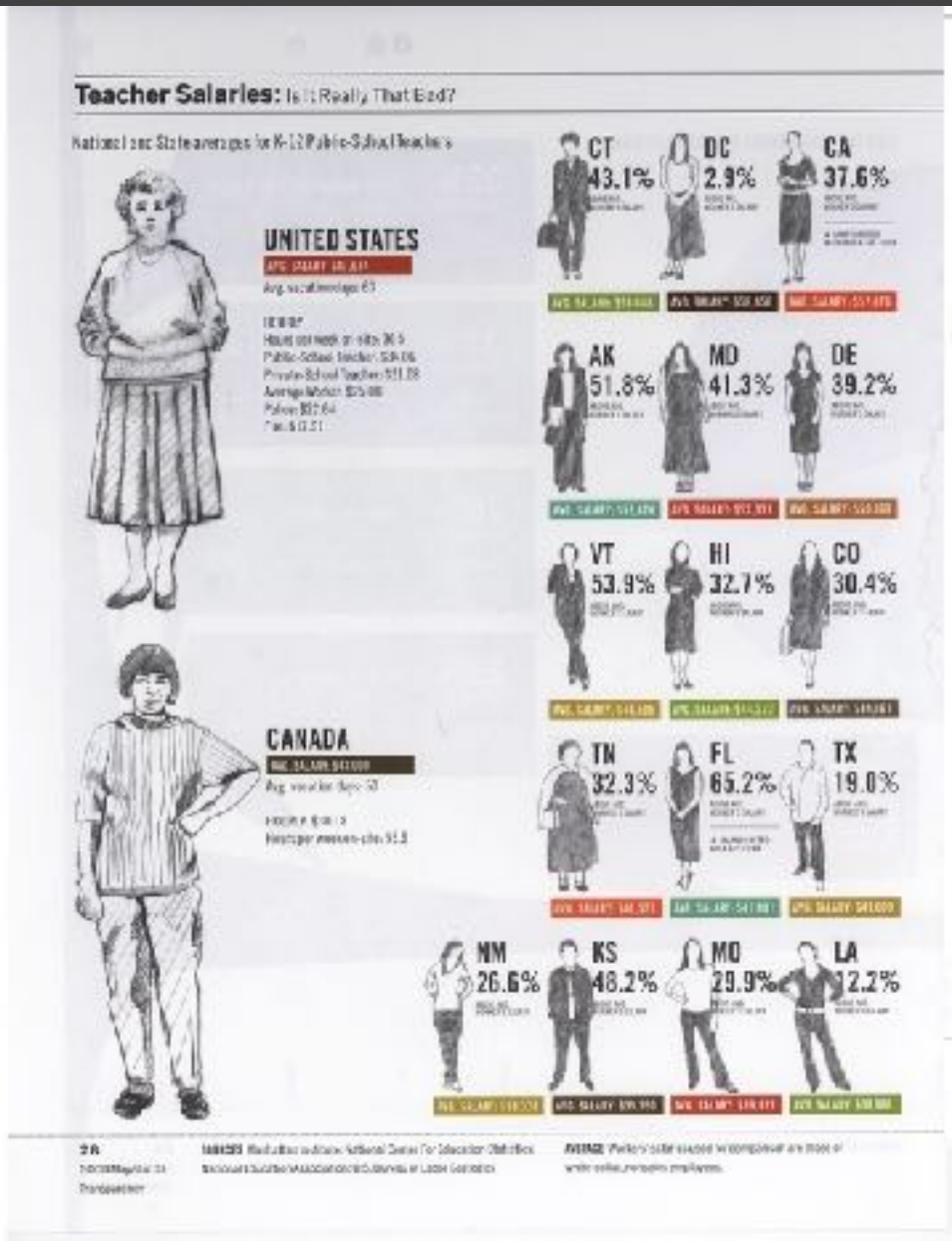
Task: Analyze and Re-design visualization

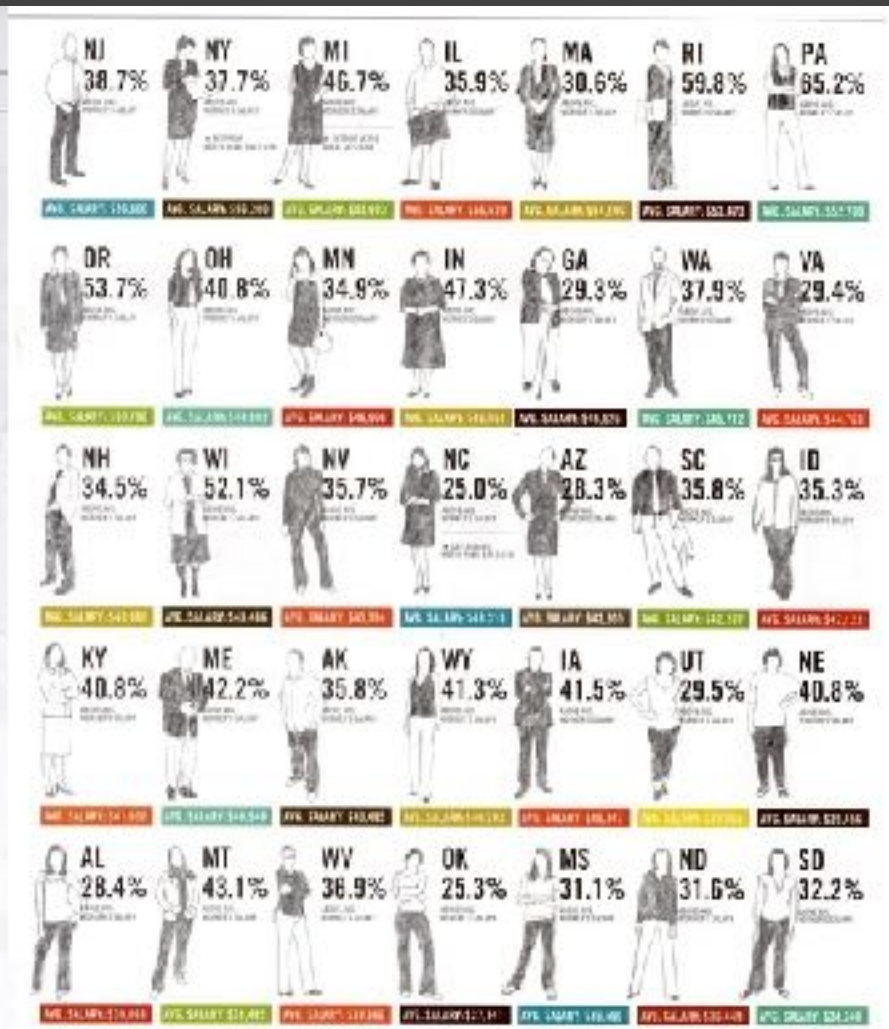
Identify data variables (N/O/Q) and encodings
Critique the design: what works, what doesn't
Sketch a re-design to improve communication
Be ready to share your thoughts with the class

Break into groups with those sitting near you
(~4 people per group)

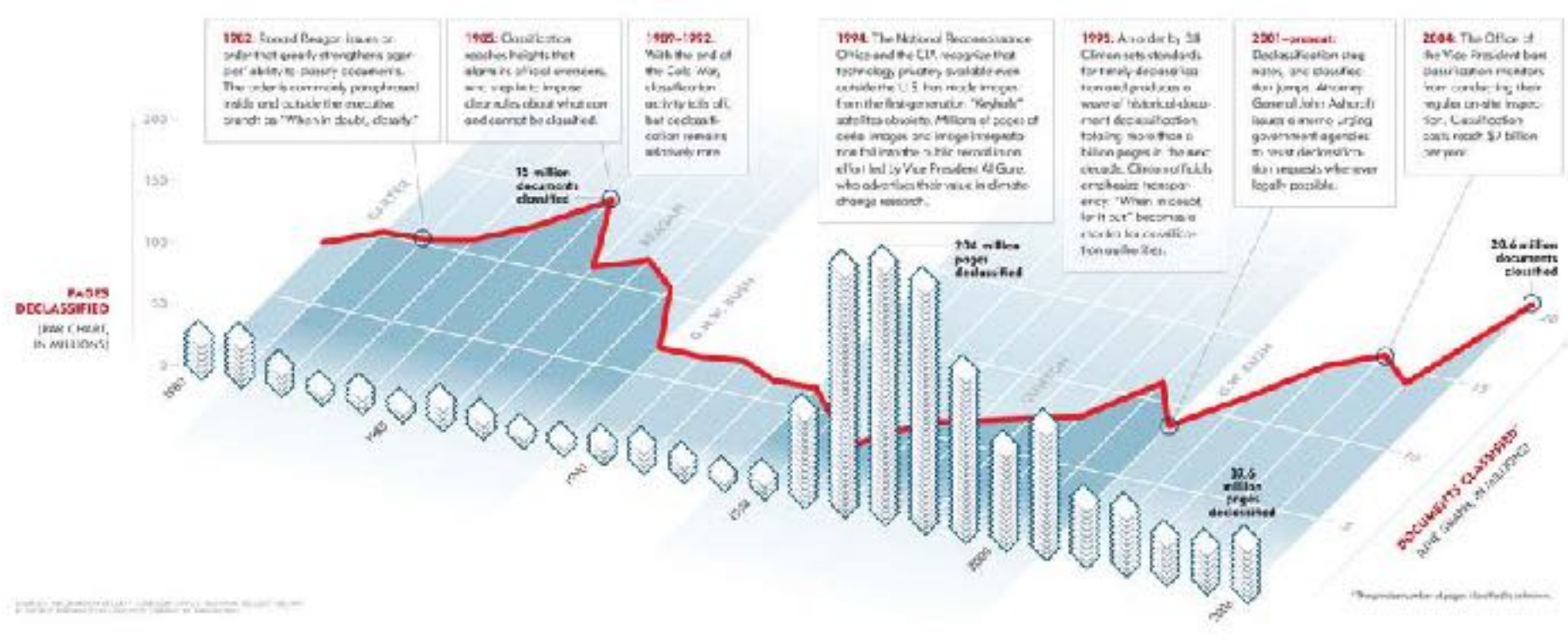
Effectiveness Rankings [Mackinlay 86]

QUANTITATIVE	ORDINAL	NOMINAL
Position	Position	Position
Length	Density (Value)	Color Hue
Angle	Color Sat	Texture
Slope	Color Hue	Connection
Area (Size)	Texture	Containment
Volume	Connection	Density (Value)
Density (Value)	Containment	Color Sat
Color Sat	Length	Shape
Color Hue	Angle	Length
Texture	Slope	Angle
Connection	Area (Size)	Slope
Containment	Volume	Area
Shape	Shape	Volume



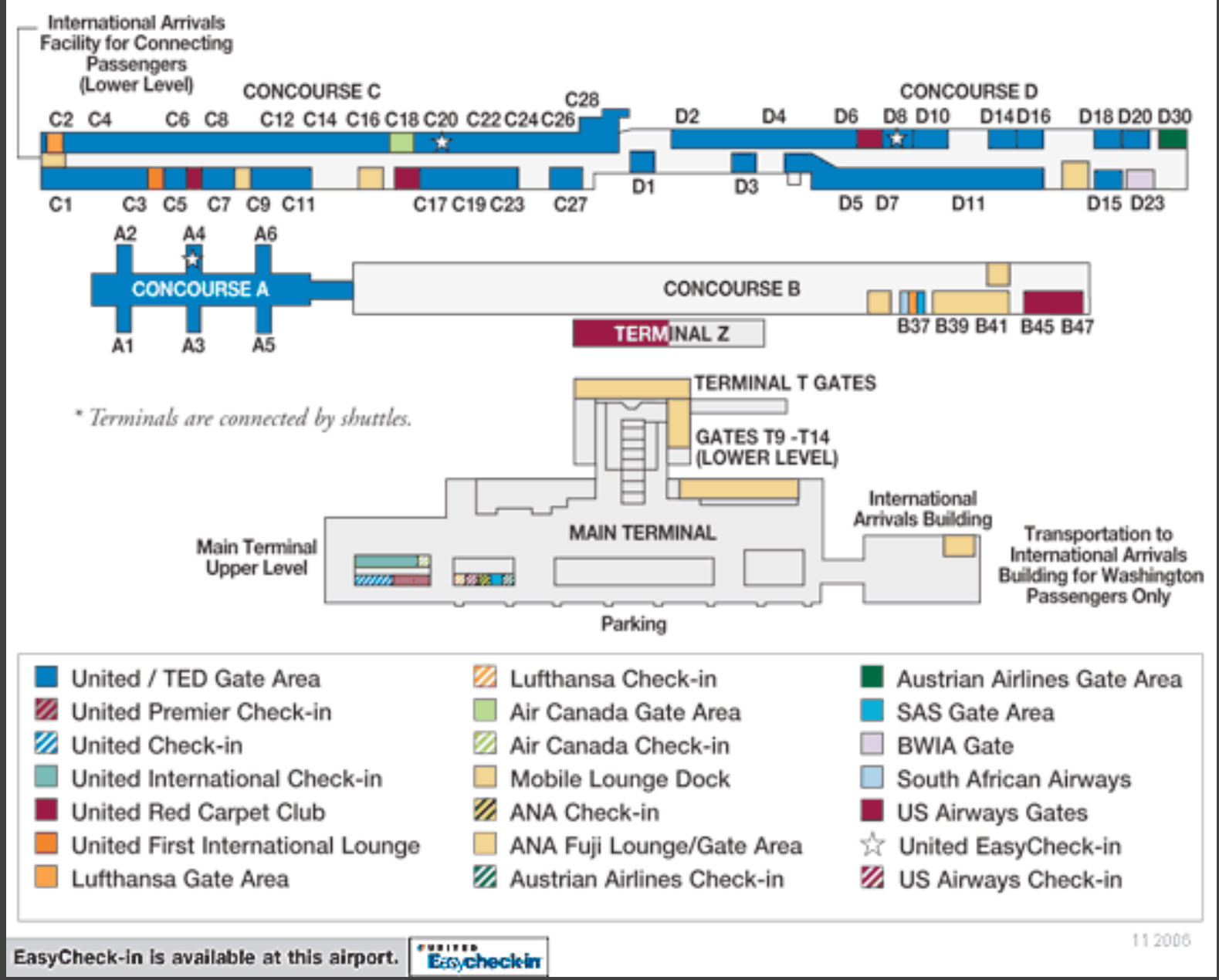


Source: *Good* Magazine



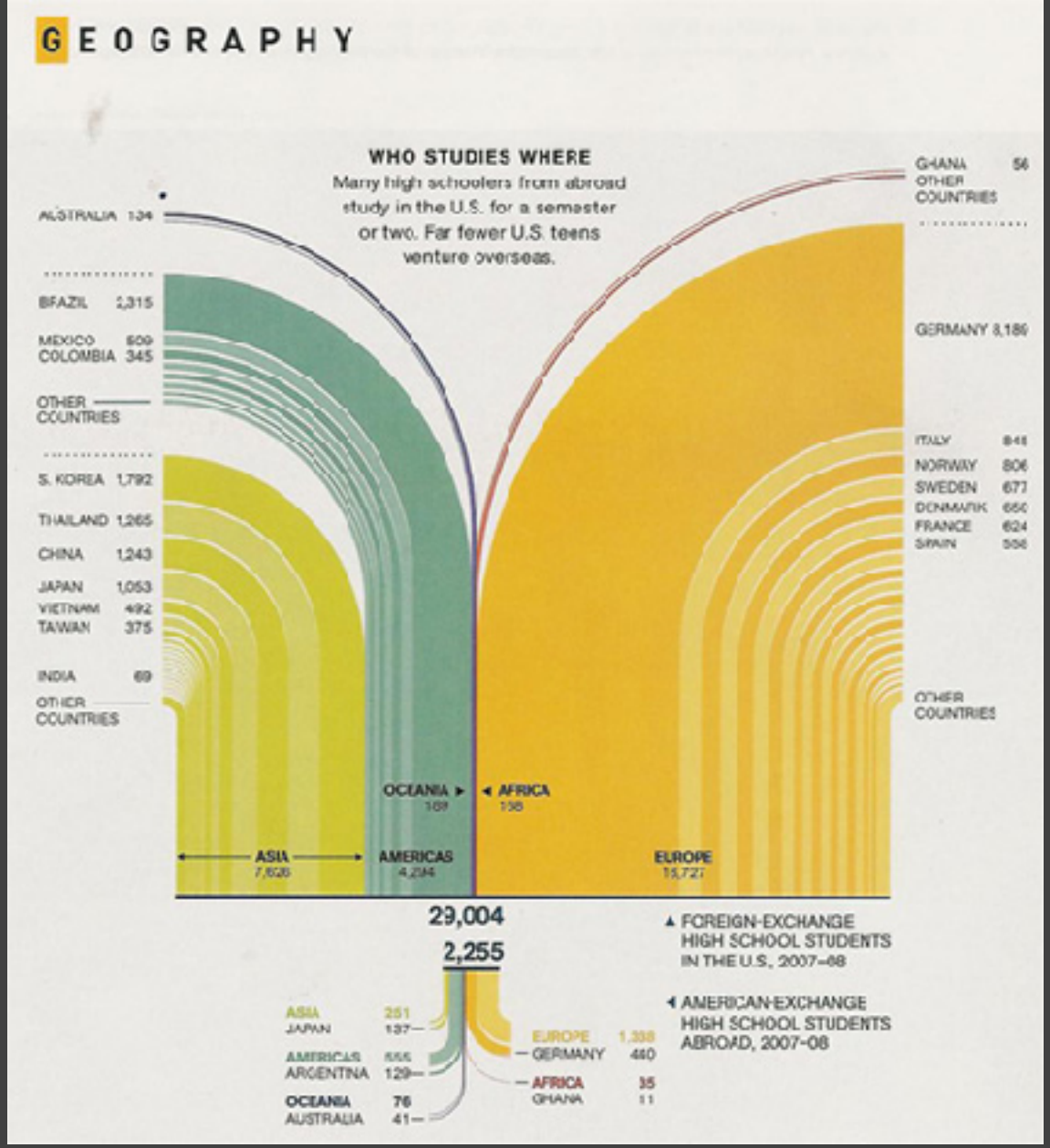
Source: *The Atlantic* 300 no. 2 (September 2007)

Number of Classified U.S. Documents



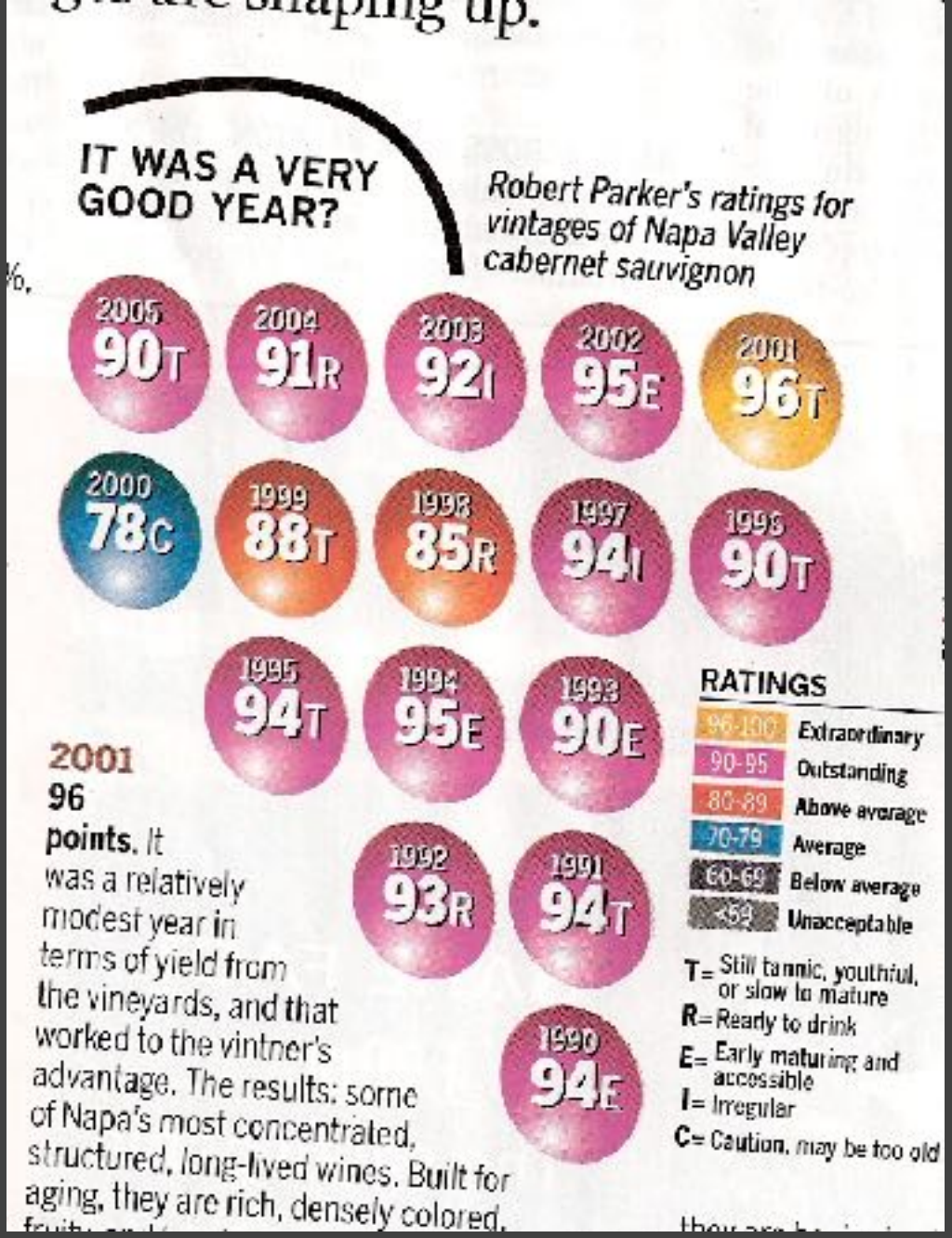
Washington Dulles Airport Map

Source: United Airlines *Hemispheres*



Source: *National Geographic*, September, 2008, p. 22.

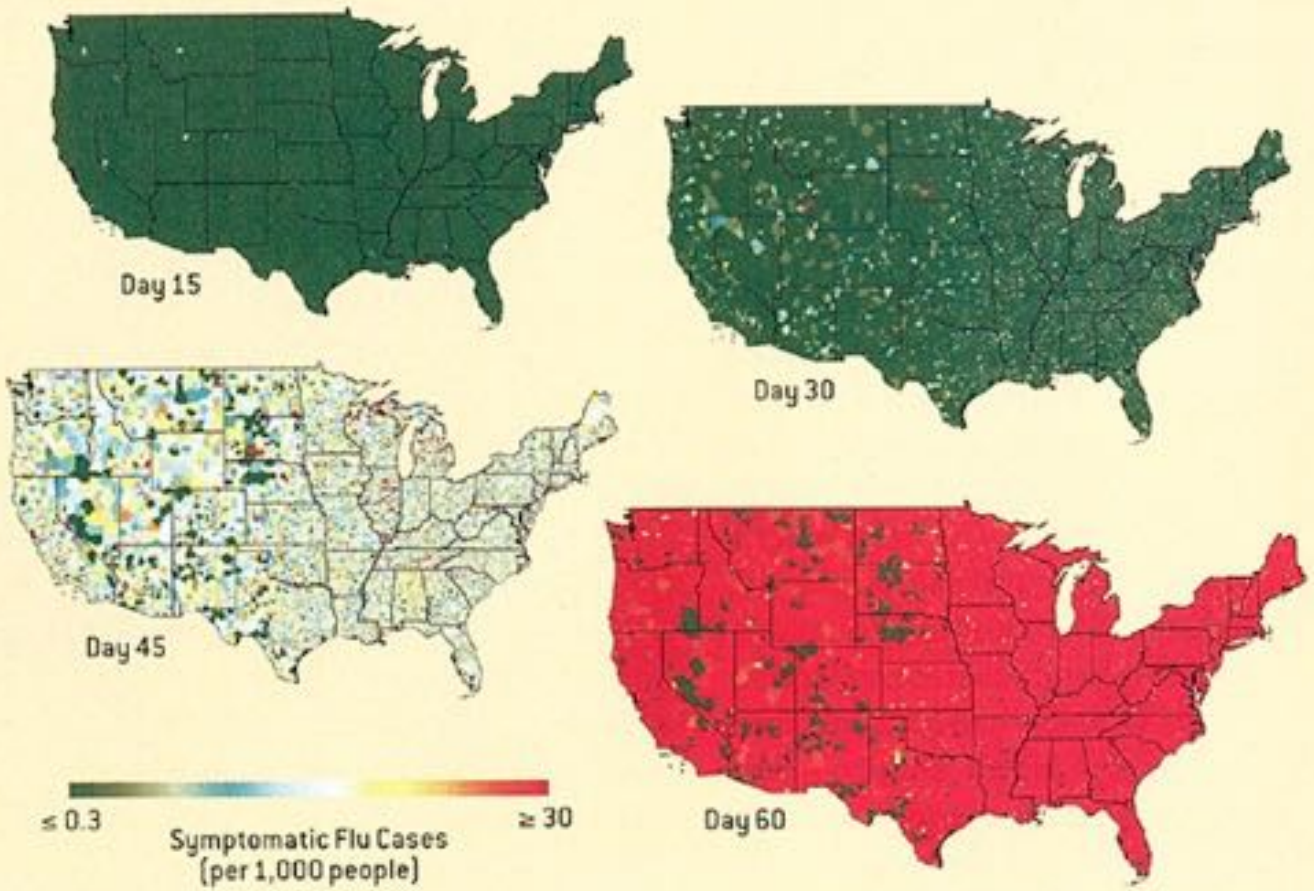
Silver, Mark. "High School Give-and-Take."



Source: *Business* Week, June 18, 2007

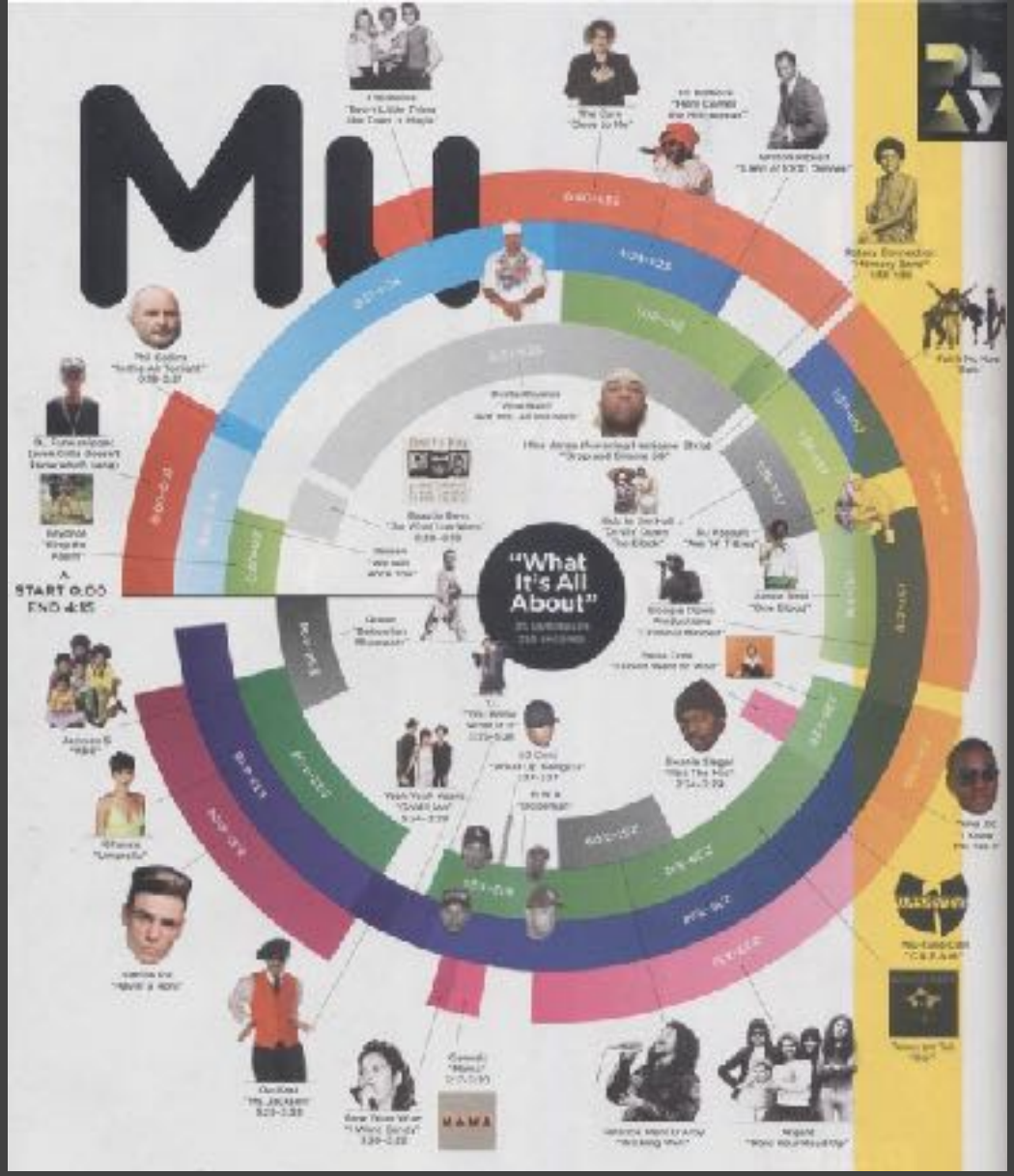
Pandemic Flu Hits the U.S.

A simulation created by researchers from Los Alamos National Laboratory and Emory University shows the first wave of a pandemic spreading rapidly with no vaccine or antiviral drugs employed to slow it down. Colors represent the number of symptomatic flu cases per 1,000 people (*see scale*). Starting with 40 infected people on the first day, nationwide cases peak around day 60, and the wave subsides after four months with 33 percent of the population having become sick. The scientists are also modeling potential interventions with drugs and vaccines to learn if travel restrictions, quarantines and other disruptive disease-control strategies could be avoided.



Preparing for a Pandemic

Source: *Scientific American*, 293(5). November, 2005, p. 50



Source: *Wired Magazine*, September 2008 Edition

Music: Super Cuts (page 92)