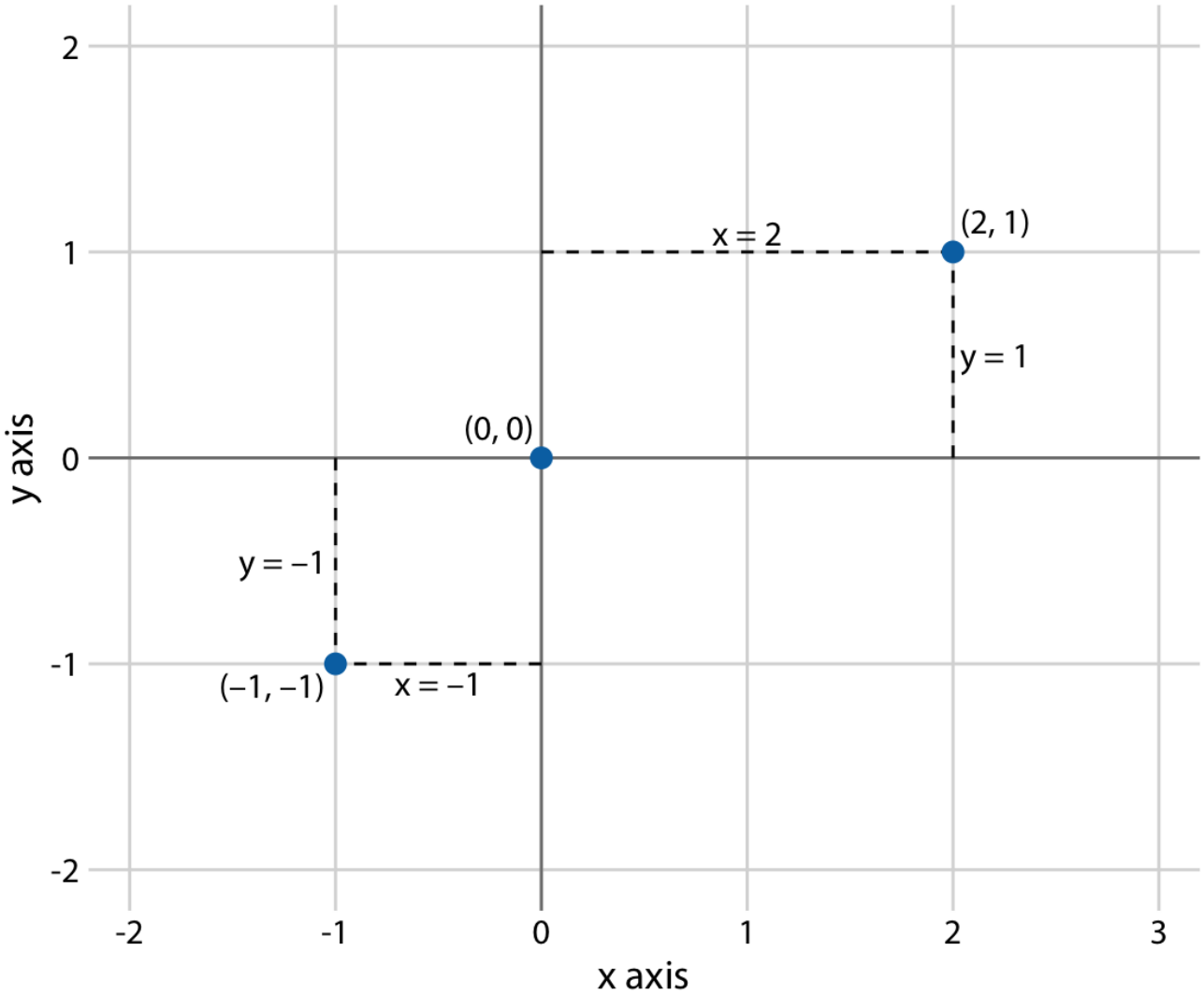
Fundamentals of Data Visualization

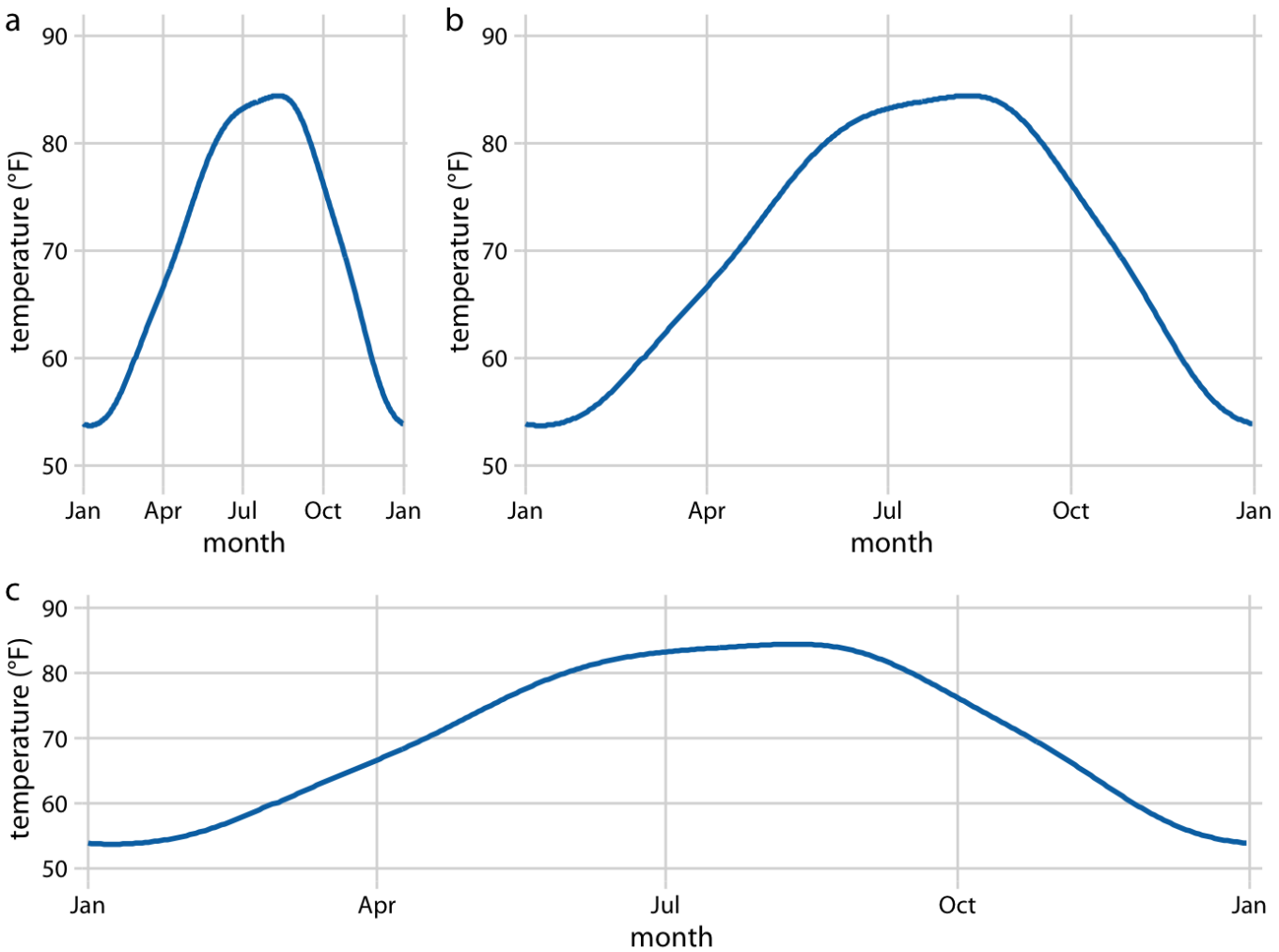
Chapter 3

April 26, 2023

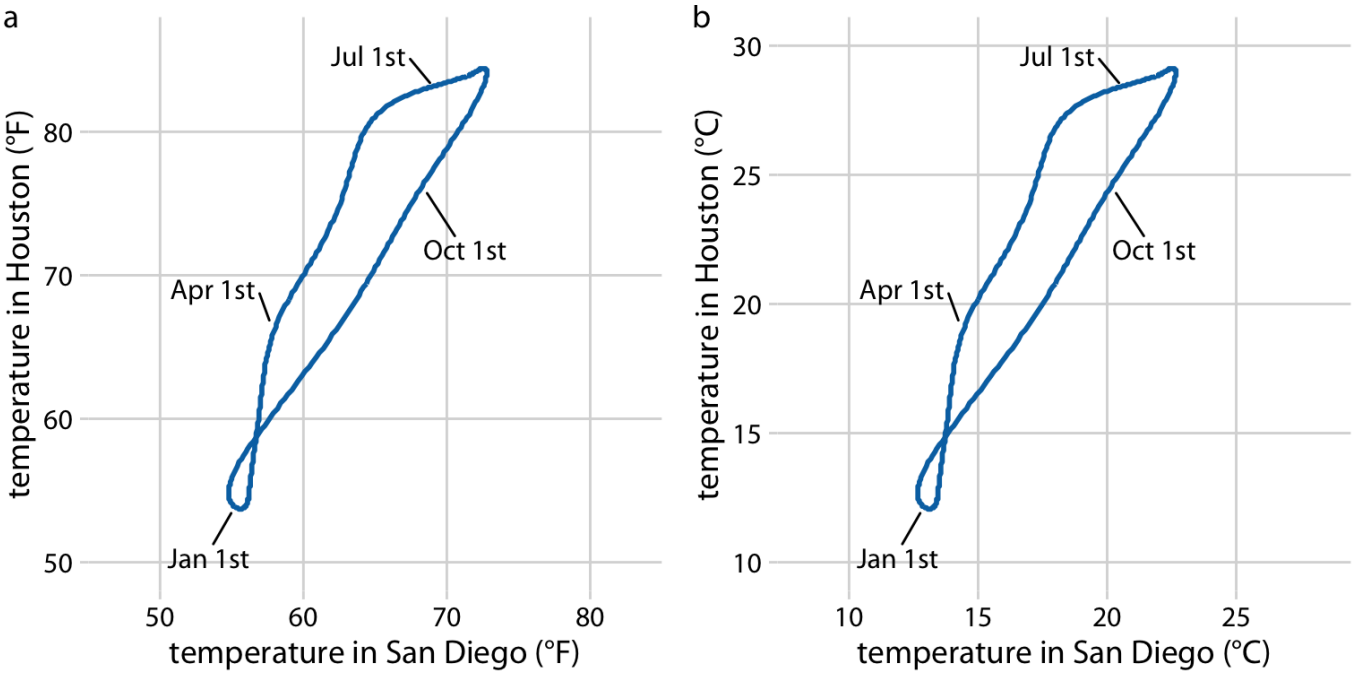
Coordinate systems and axes



Choice of axes



Choice of axes when both axes are the same quantity



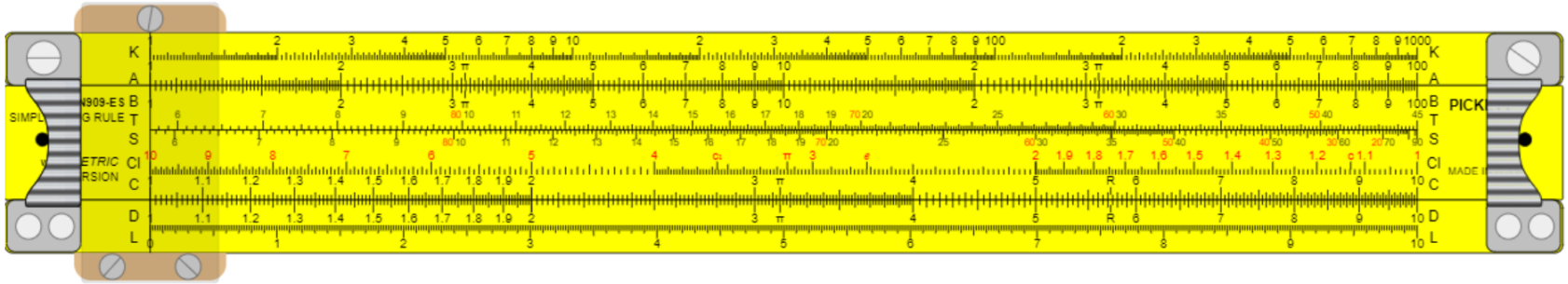
- Linear changes in axes should not change the figure.

Logarithms

> Logarithms, by shortening the labors, doubled the life of an astronomer.
>
> – *Pierre-Simon, marquis de Laplace*

$$\log_b(a) = c \Leftrightarrow b^c = a$$

$$\log_b(ac) = \log_b(a) + \log_b(c)$$



https://www.sliderules.org/

Logarithm refresher

$$\log_b(a) = c \Leftrightarrow b^c = a$$

$$b^{\log_b(a)} = a$$

$$\log_b(ac) = \log_b(a) + \log_b(c)$$

$$\log_b(a) = \frac{\log_d(a)}{\log_d(b)}$$

$$\log_d(b)\log_b(a) = \log_d(a)$$

$$\log_b(a) = \frac{1}{\log_a(b)}$$

$$\log_b(a) = k\log_d(a)$$

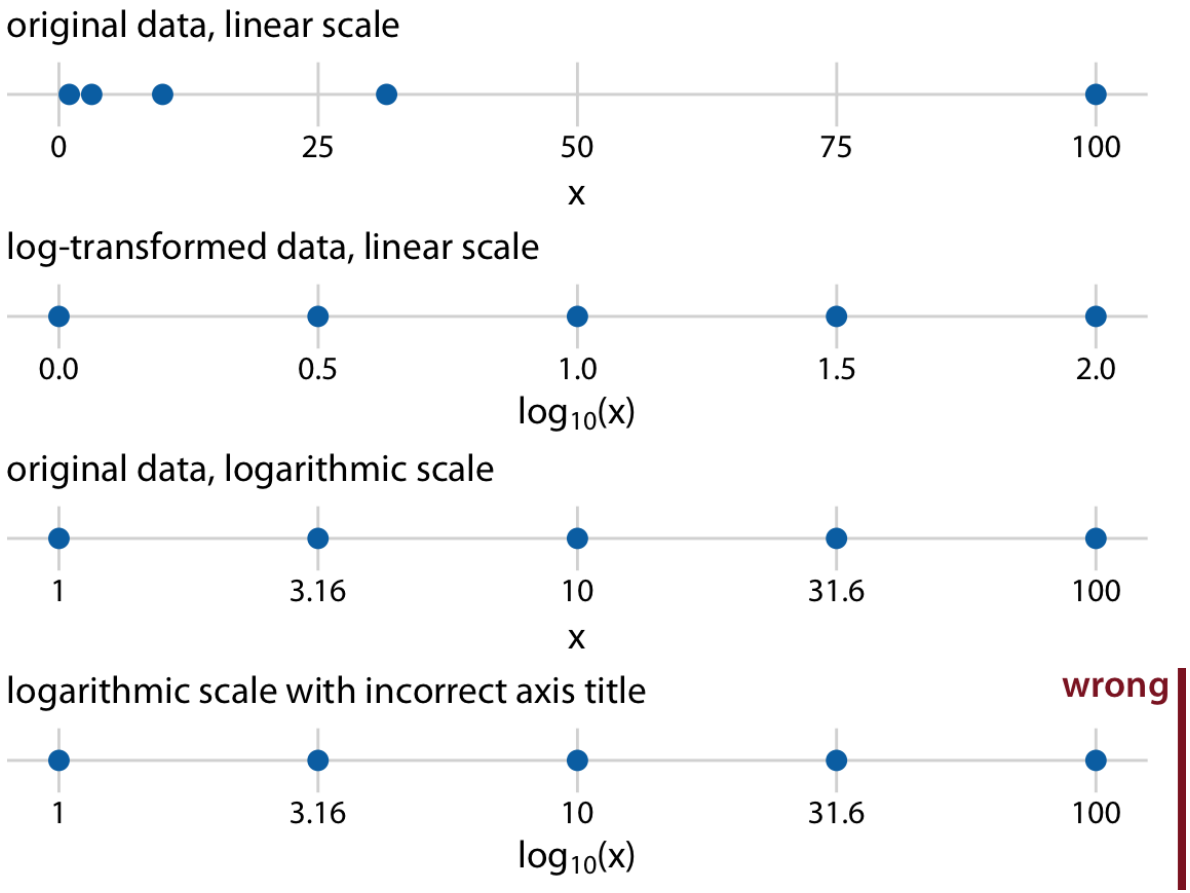
$$\frac{a}{b} = \frac{a/d}{b/d}$$

$$\frac{b}{d}\frac{a}{b} = \frac{a}{d}$$

$$\log_{10}(1203248) \approx 6$$

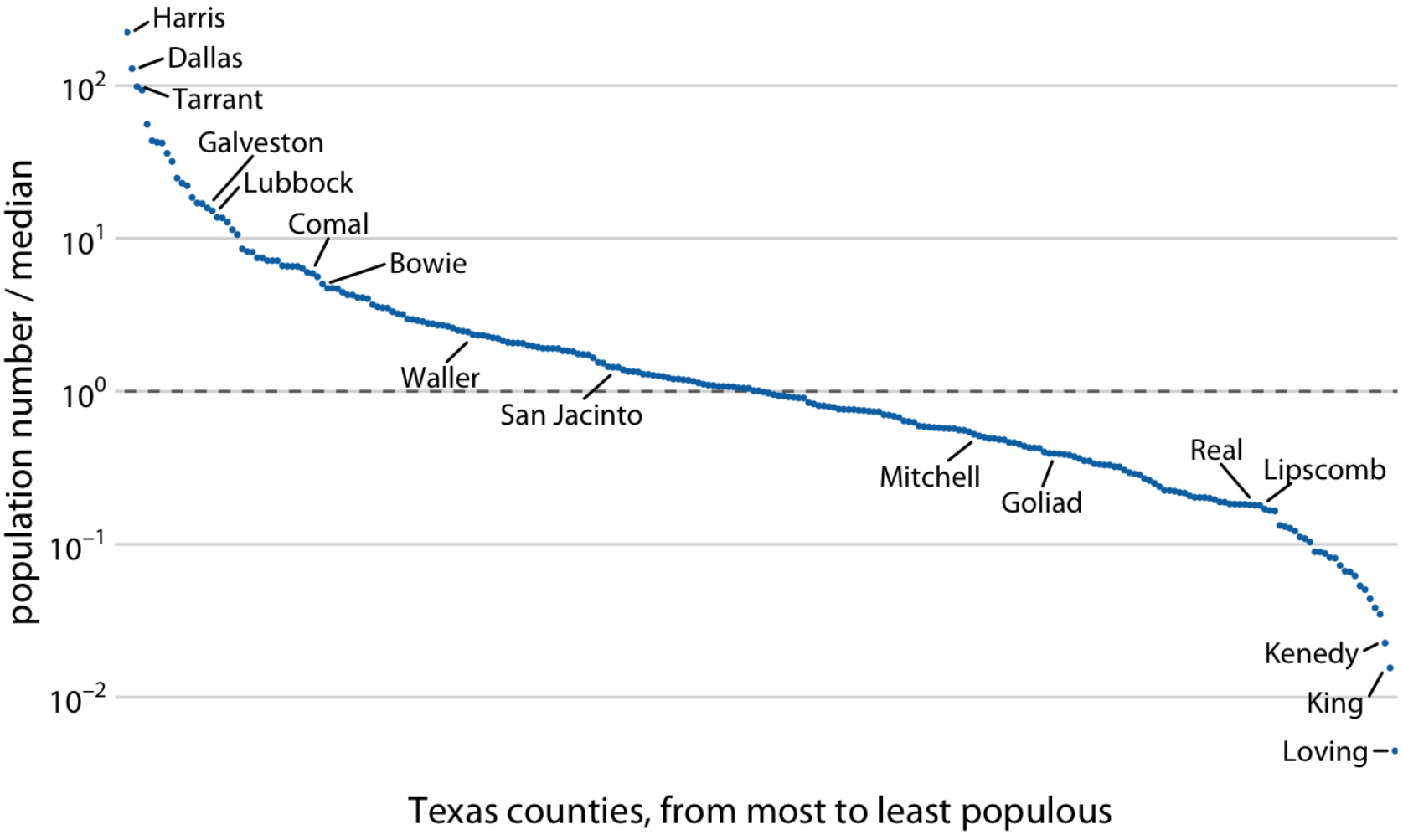
$$\log_2(1203248) \approx 20$$

Logarithmic scales

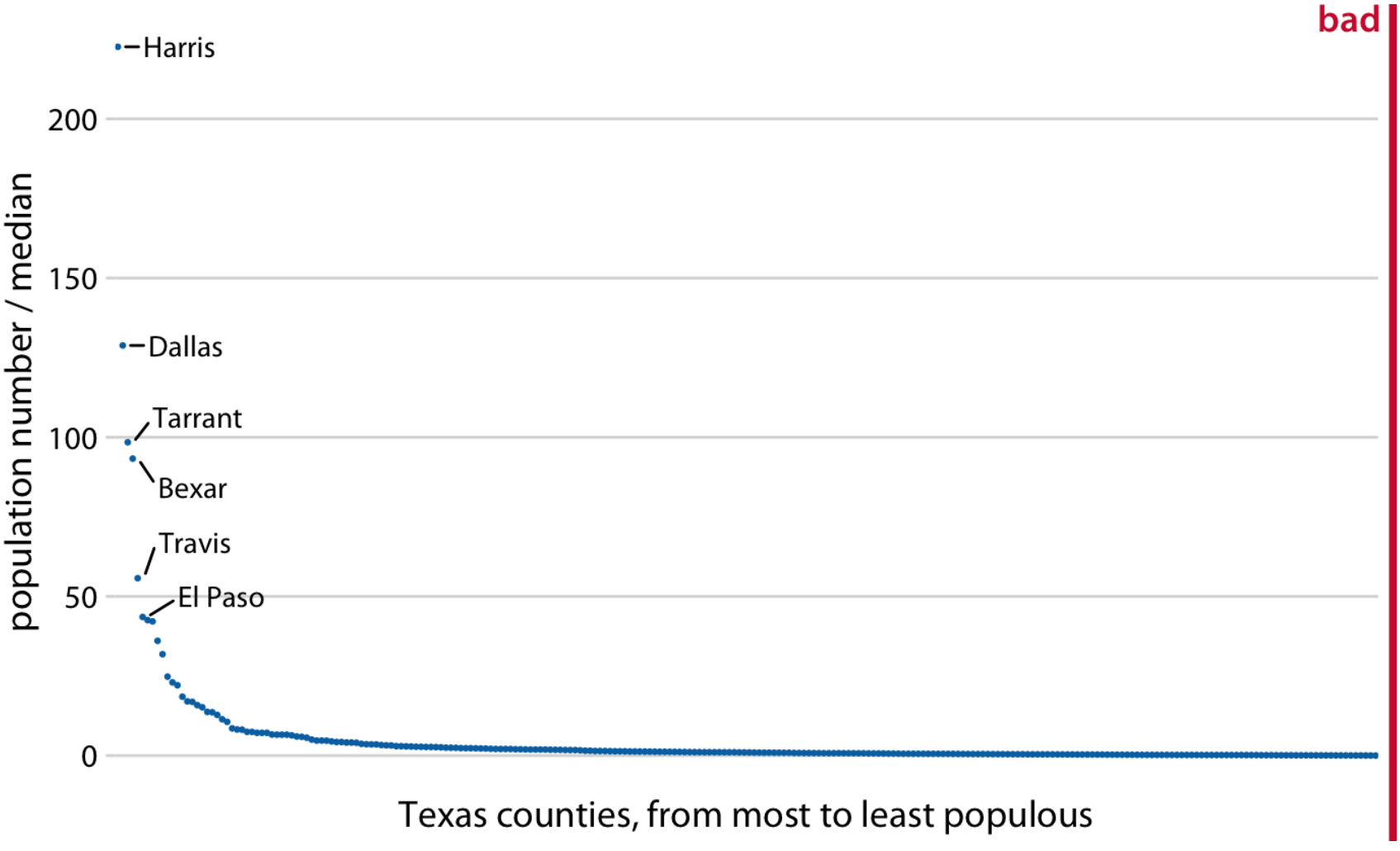


- Linear in multiplication
- Transform the data **or** the axis
- $\log(x)$ is ambiguous
- Usually preferable to label the axis
- Why 3.16?
- Ratios should be shown on log scales.

Texas counties, log scale



Texas counties, linear scale



Log scales

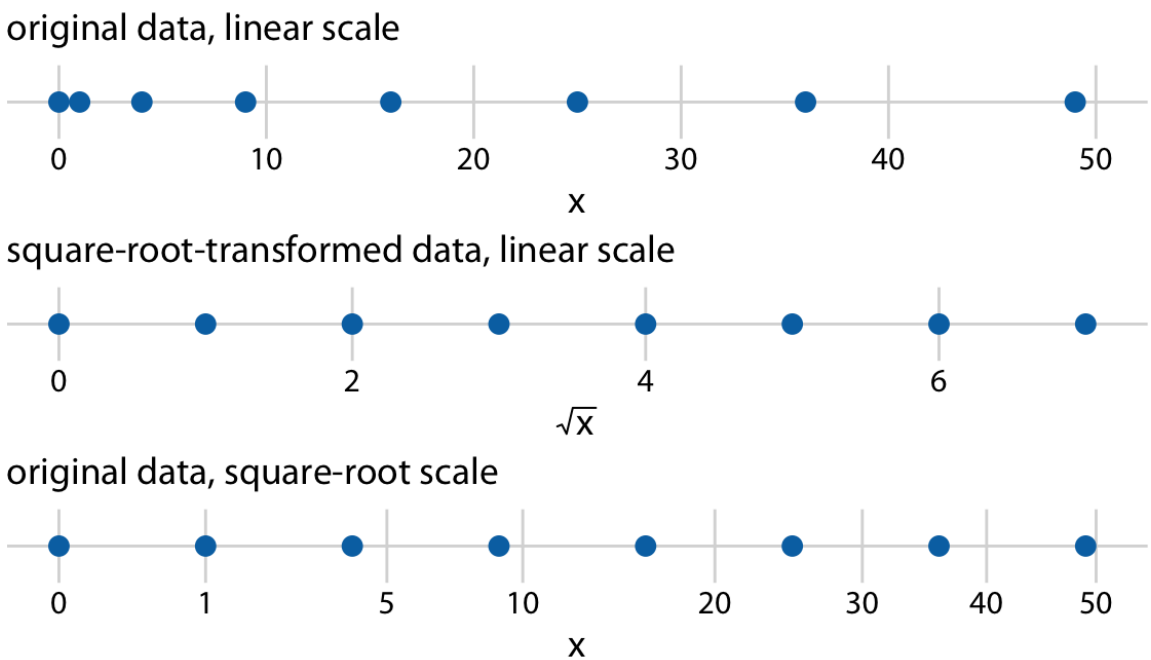
- We can think of values greater than 1 as representing multiplications and values less than 1 divisions.
- The value 0 can never appear on a log scale: $\log(0) = -\infty$
- It takes infinite divisions to reach zero: $1/10/10/10/10/10/10 \cdots = 0$
- On a log scale, the value 1 is the natural midpoint, similar to the value 0 on a linear scale.
- We can think of values greater than 1 as representing multiplications and values less than 1 divisions.

Log scales

- Frequently used when there is a large range in the data:
  - Harris: 4,092,459
  - Loving: 82
- What if there was a county with 0 inhabitants?
- This county could not be shown on a logarithmic scale.

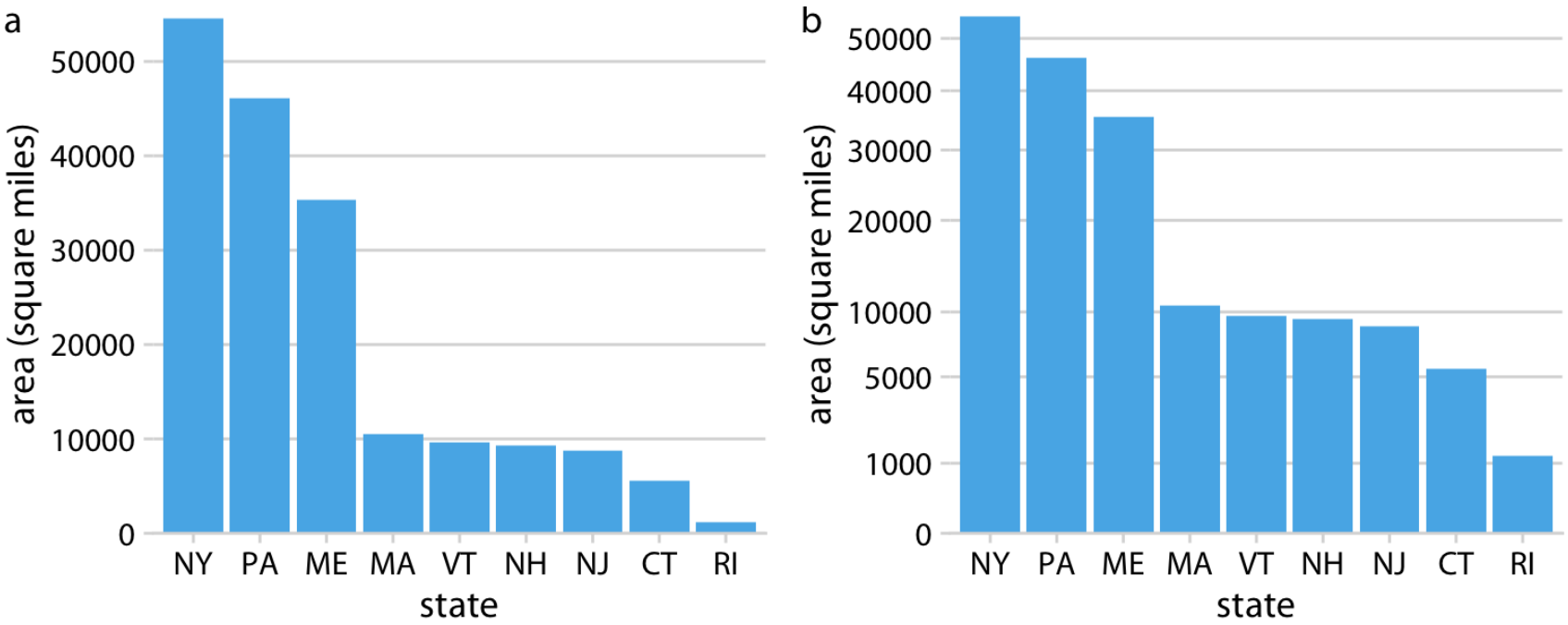
Square root scale

- Can represent zero.
- Compresses large values and expands small values.
- But:
  - One step on square root scale does not correspond to addition or multiplication.
  - Hard to place tics.

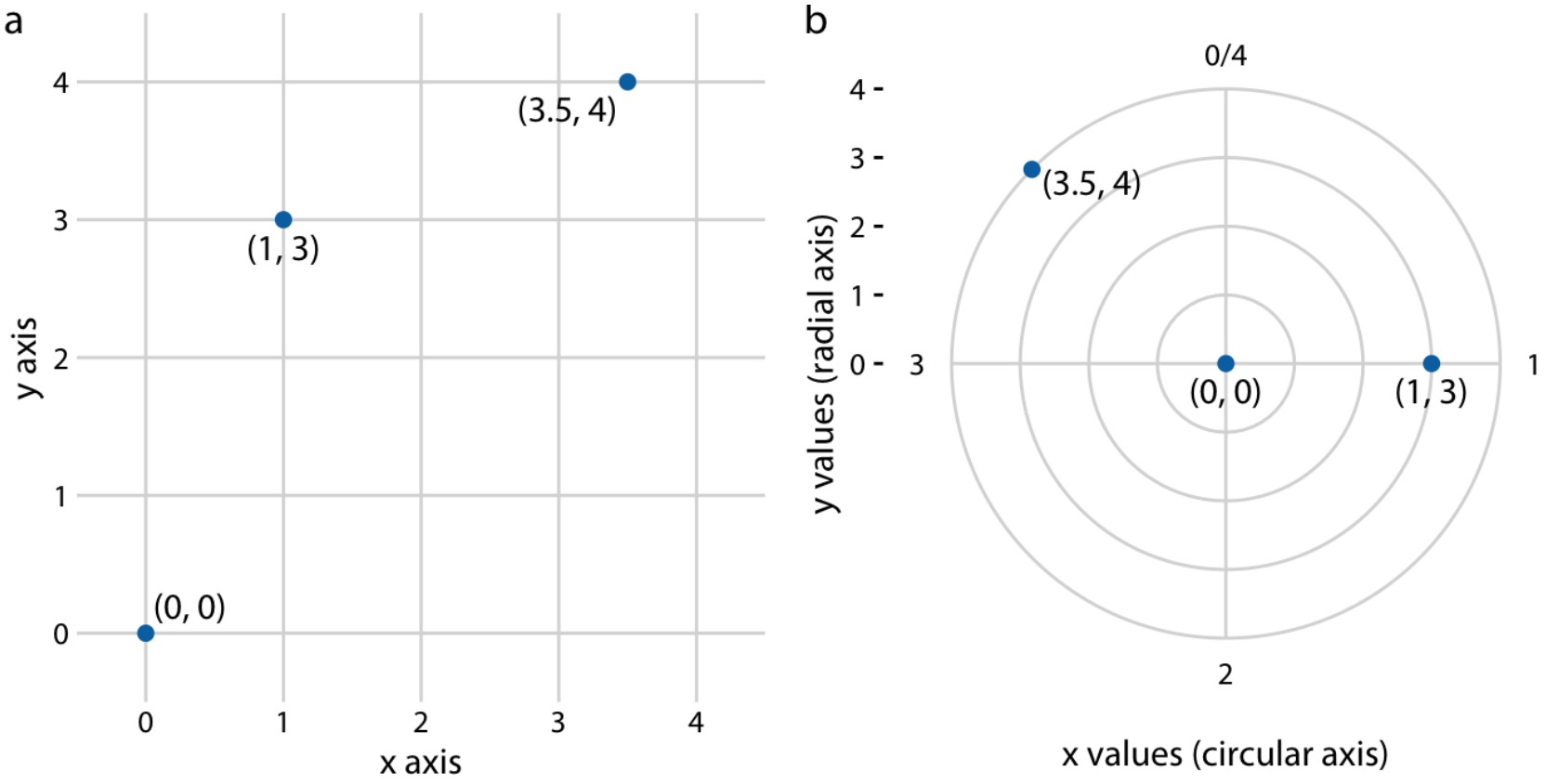


Square root scale

- Natural axis for areas.
- Intuitively, the "breadth" of an area.

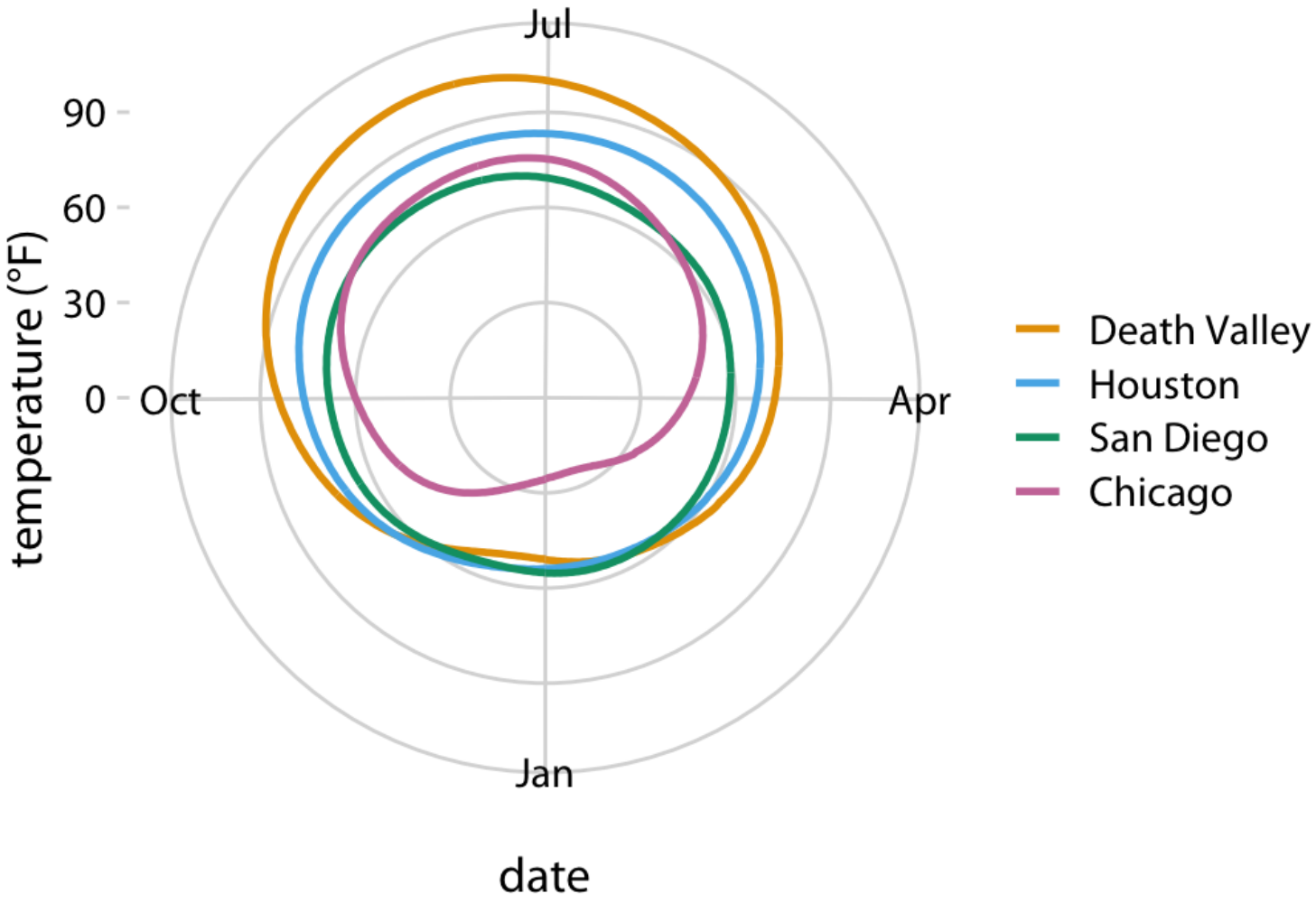


Curved axes: polar coordinate system



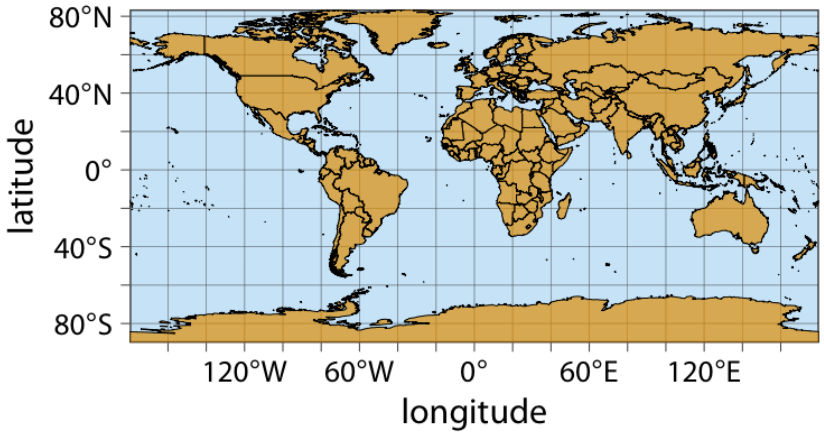
Curved axes: polar coordinate system

- Useful for periodic data.

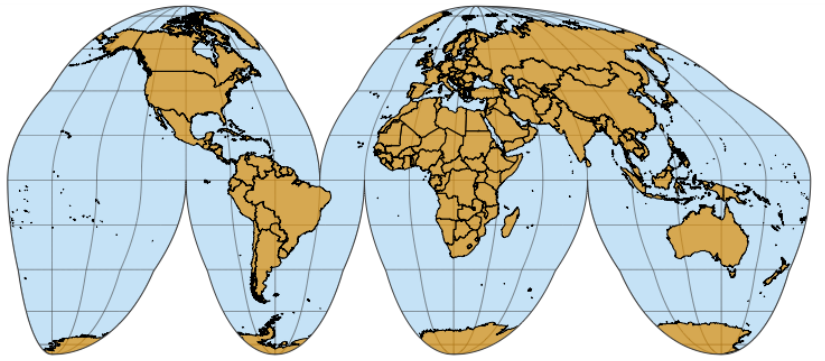


Curved axes: geospatial data

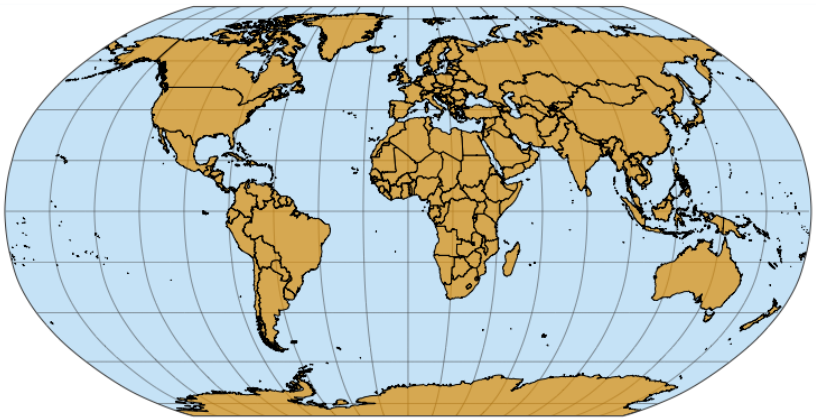
Cartesian longitude and latitude



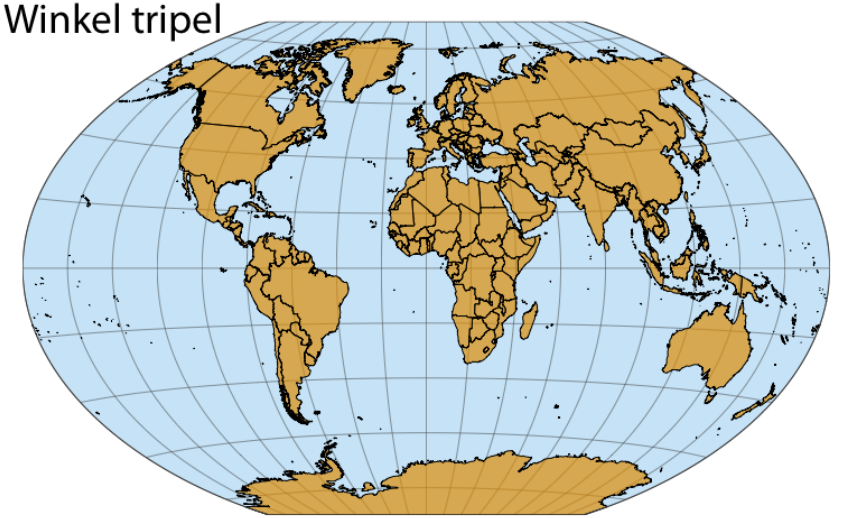
Interrupted Goode homolosine



Robinson



Winkel tripel



Axis transforms to straighten data