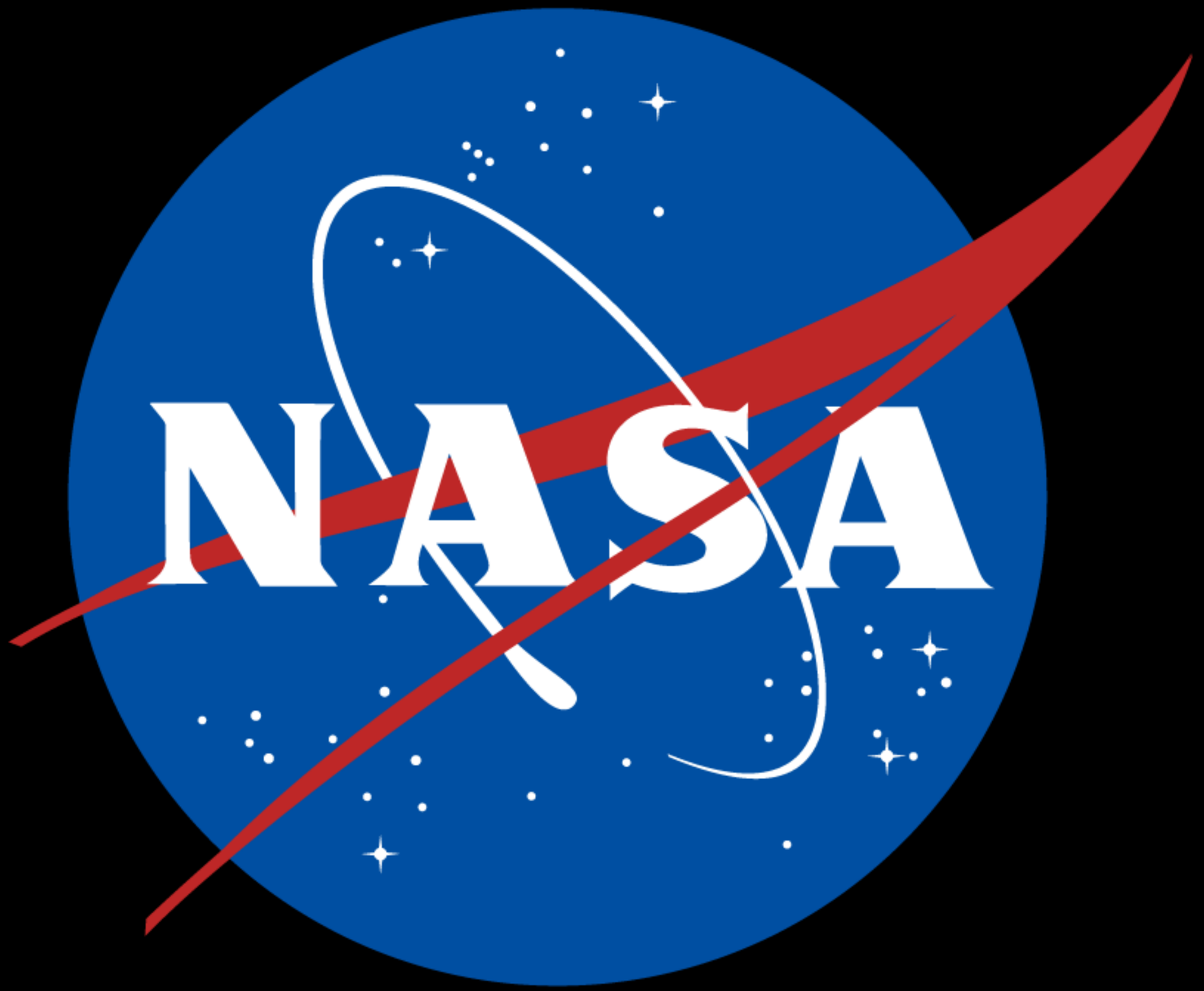
Getting Started With Data Visualization

April 6, 2016

Robert Simmon
Planet Labs
simmon@mac.com
@rsimmon


NASA

PLANET

LABS

NASA

Lake Simcoe, Ontario

Planet Labs


Yazghil Glaicer
Pakistan
Planet Labs


Itumbiara, Brazil
August 8, 2014
Planet Labs/NASA/USGS


Itumbiara, Brazil
August 9, 2014
Planet Labs

Abstraction & Representation

cc Jeanette, flickr

cc Kate Ter Haar, flickr

cc Judy Baxter, flickr

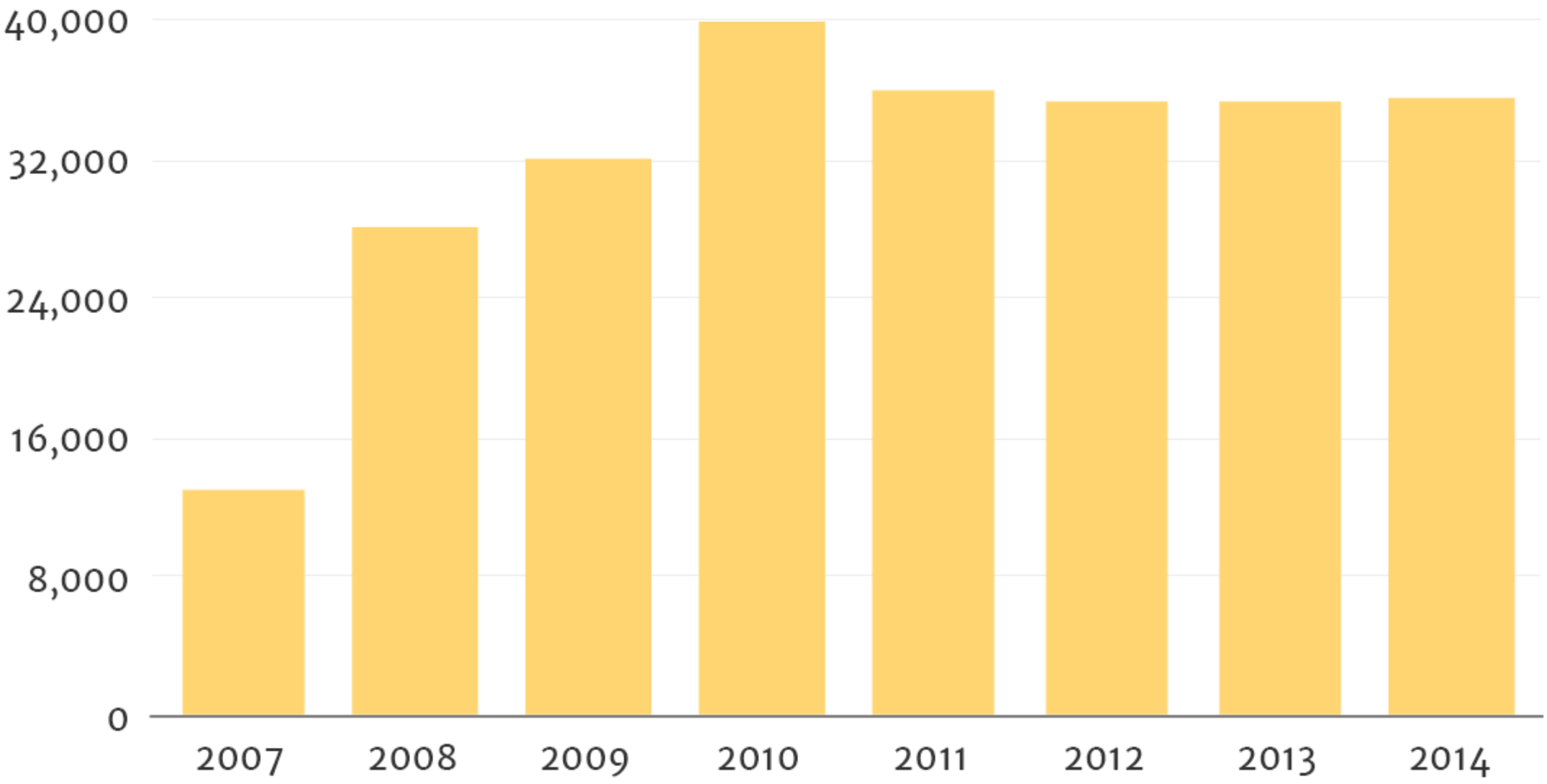
cc Brent Moore, flickr

Georgia Peaches

Year	**Production** (tons)	**Price** ($/ton)
2014	35,500	1,090
2013	35,250	826
2012	35,300	961
2011	36,000	930
2010	40,000	817
2009	32,000	930
2008	28,000	773
2007	13,000	819

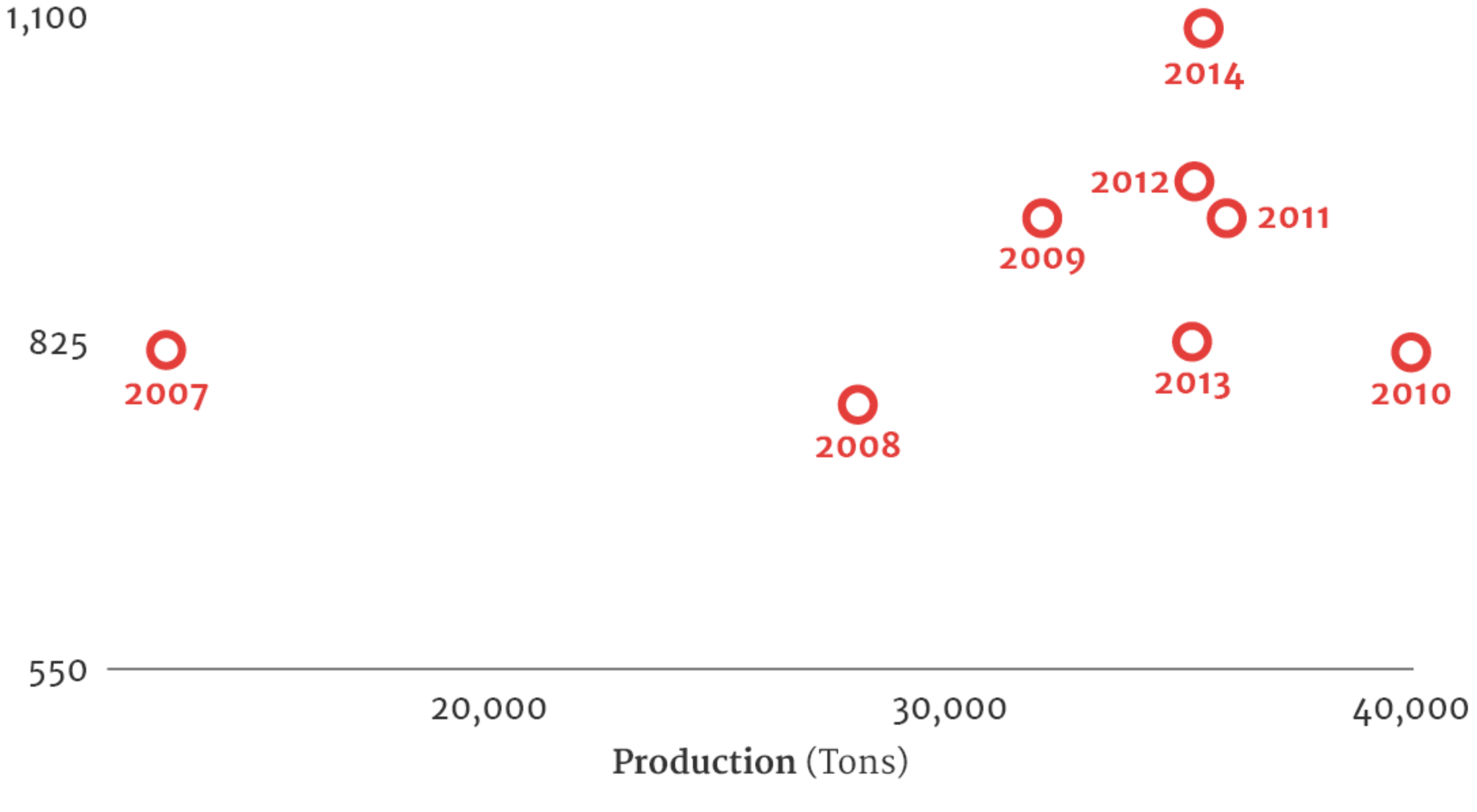
source: USDA

Georgia Peach Production (tons)



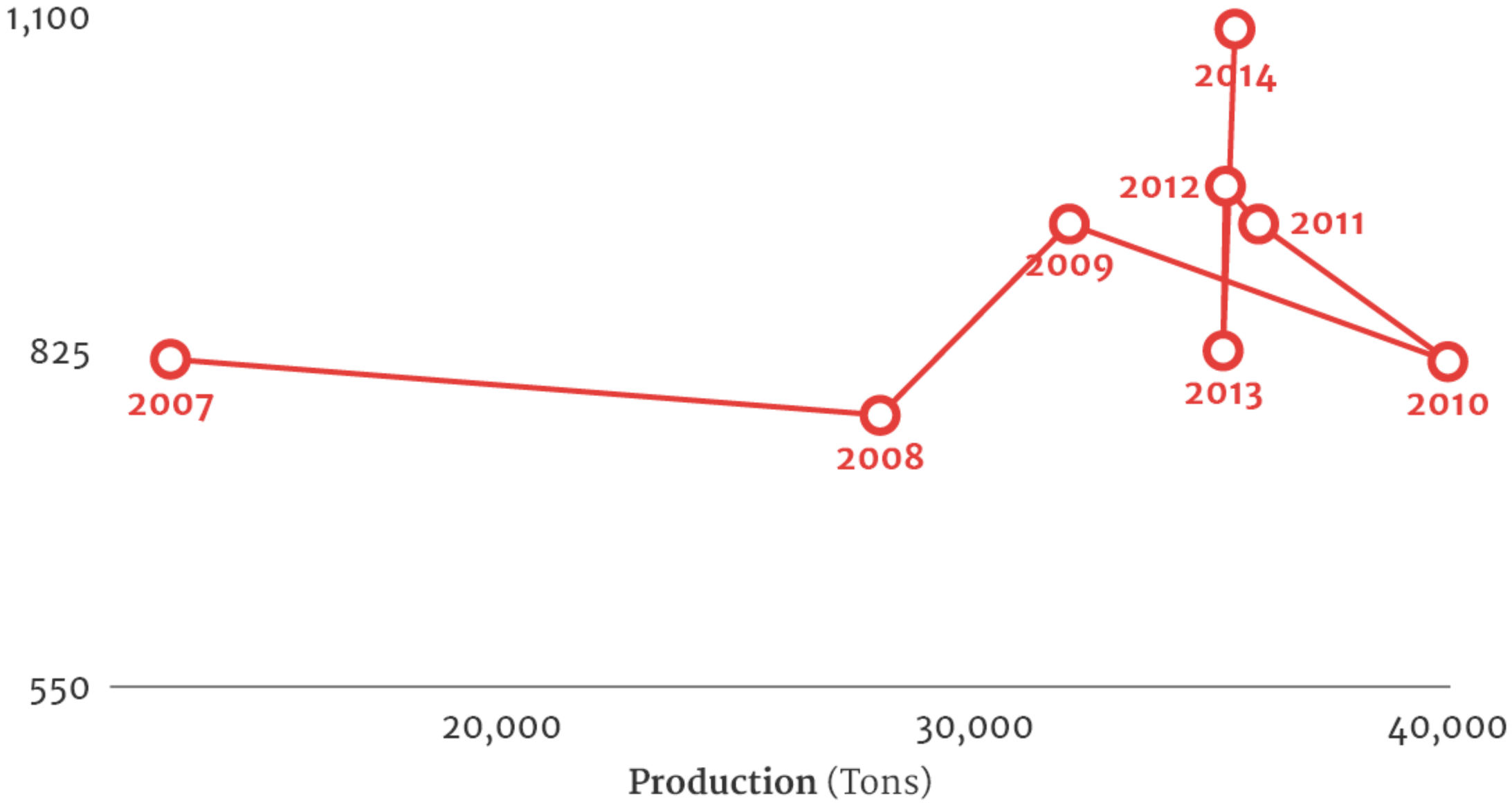
source: USDA

Price (Dollars per Ton) **vs. Production**



source: USDA

Price (Dollars per Ton) **vs. Production**



source: USDA

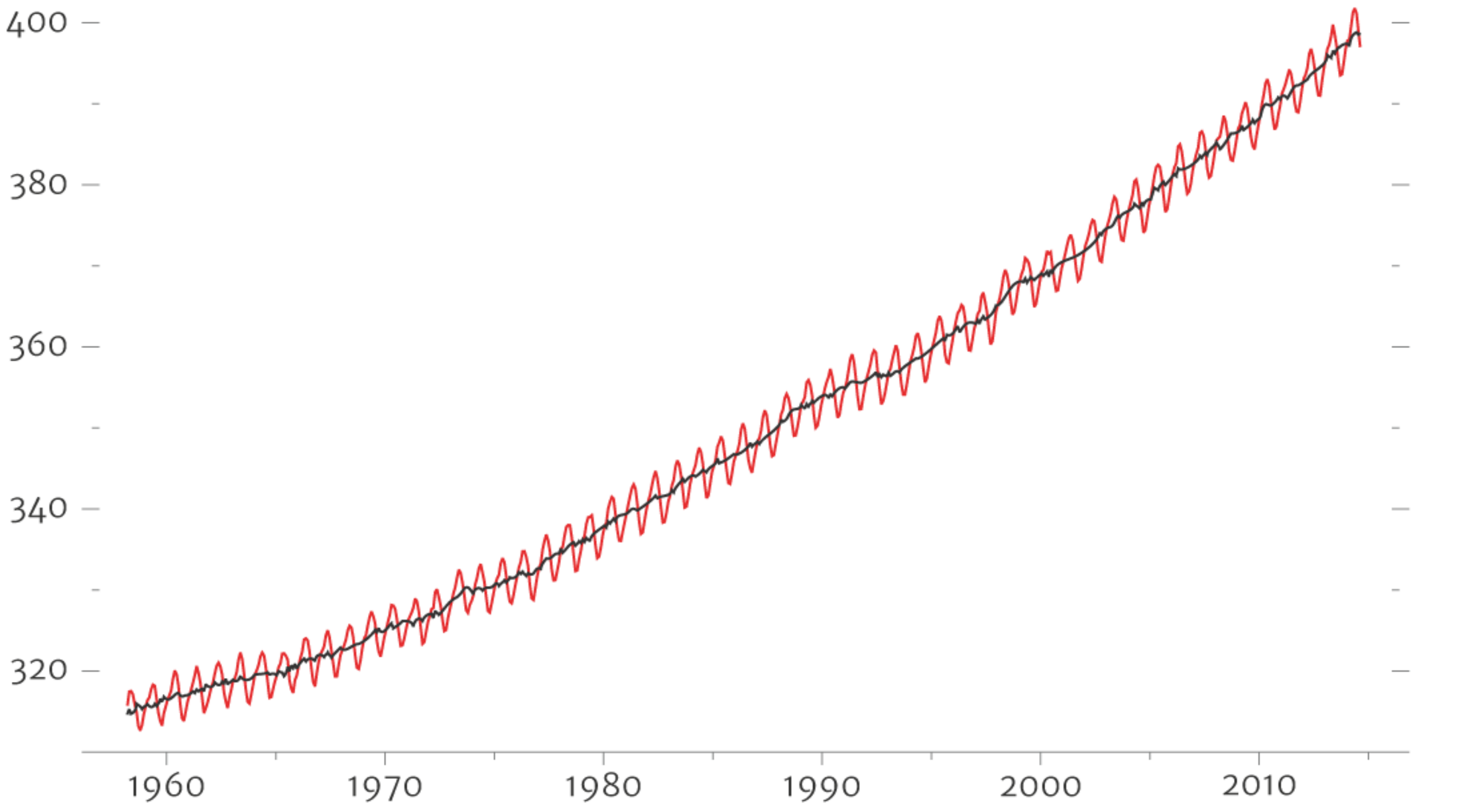
The Power of Visualization

Carbon Dioxide (parts per million)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1958			315.71	317.45	317.50	317.10	315.86	314.93	313.20	312.66	313.33	314.67
1959	315.62	316.38	316.71	317.72	318.29	318.15	316.54	314.80	313.84	313.26	314.80	315.58
1960	316.43	316.97	317.58	319.02	320.03	319.59	318.18	315.91	314.16	313.83	315.00	316.19
1961	316.93	317.70	318.54	319.48	320.58	319.77	318.57	316.79	314.80	315.38	316.10	317.01
1962	317.94	318.56	319.68	320.63	321.01	320.55	319.58	317.40	316.26	315.42	316.69	317.69
1963	318.74	319.08	319.86	321.39	322.25	321.47	319.74	317.77	316.21	315.99	317.12	318.31
1964	319.57	320.07	320.73	321.77	322.25	321.89	320.44	318.70	316.70	316.79	317.79	318.71
1965	319.44	320.44	320.89	322.13	322.16	321.87	321.39	318.81	317.81	317.30	318.87	319.42
1966	320.62	321.59	322.39	323.87	324.01	323.75	322.39	320.37	318.64	318.10	319.79	321.08
1967	322.07	322.50	323.04	324.42	325.00	324.09	322.55	320.92	319.31	319.31	320.72	321.96
1968	322.57	323.15	323.89	325.02	325.57	325.36	324.14	322.03	320.41	320.25	321.31	322.84
1969	324.00	324.42	325.64	326.66	327.34	326.76	325.88	323.67	322.38	321.78	322.85	324.11
1970	325.03	325.99	326.87	328.13	328.07	327.66	326.35	324.69	323.10	323.16	323.98	325.13
1971	326.17	326.68	327.18	327.78	328.92	328.57	327.34	325.46	323.36	323.57	324.80	326.01
1972	326.77	327.63	327.75	329.72	330.07	329.09	328.05	326.32	324.93	325.06	326.50	327.55
1973	328.54	329.56	330.30	331.50	332.48	332.07	330.87	329.31	327.51	327.18	328.16	328.64
1974	329.35	330.71	331.48	332.65	333.19	332.12	330.99	329.17	327.41	327.21	328.34	329.50
1975	330.68	331.41	331.85	333.29	333.91	333.40	331.74	329.88	328.57	328.36	329.33	330.59
1976	331.66	332.75	333.46	334.78	334.78	334.06	332.95	330.64	328.96	328.77	330.18	331.65
1977	332.69	333.23	334.97	336.03	336.82	336.10	334.79	332.53	331.19	331.21	332.35	333.47
1978	335.10	335.26	336.61	337.77	338.01	337.98	336.48	334.37	332.33	332.41	333.76	334.83
1979	336.21	336.65	338.13	338.94	339.00	339.20	337.60	335.56	333.93	334.12	335.26	336.78
1980	337.80	338.28	340.04	340.86	341.47	341.26	339.34	337.45	336.10	336.05	337.21	338.29
1981	339.36	340.51	341.57	342.56	343.01	342.49	340.68	338.49	336.92	337.12	338.59	339.90
1982	340.92	341.69	342.85	343.92	344.67	343.78	342.23	340.11	338.32	338.39	339.48	340.88
1983	341.64	342.87	343.59	345.25	345.96	345.52	344.15	342.25	340.17	340.30	341.53	343.07
1984	344.05	344.77	345.46	346.77	347.55	346.98	345.55	343.20	341.35	341.68	343.06	344.54
1985	345.25	346.06	347.66	348.20	348.92	348.40	346.66	344.85	343.20	343.08	344.40	345.82
1986	346.54	347.13	348.05	349.77	350.53	349.90	348.11	346.09	345.01	344.47	345.86	347.15
1987	348.38	348.70	349.72	351.32	352.14	351.61	349.91	347.84	346.52	346.65	347.96	349.18
1988	350.38	351.68	352.24	353.66	354.18	353.68	352.58	350.66	349.03	349.08	350.15	351.44
1989	352.89	353.24	353.80	355.59	355.89	355.30	353.98	351.53	350.02	350.29	351.44	352.84
1990	353.79	354.88	355.65	356.27	357.29	356.32	354.88	352.89	351.28	351.59	353.05	354.27
1991	354.87	355.68	357.06	358.51	359.09	358.10	356.12	353.89	352.30	352.32	353.79	355.07
1992	356.17	356.93	357.82	359.00	359.55	359.32	356.85	354.91	352.93	353.31	354.27	355.53
1993	356.86	357.27	358.36	359.27	360.19	359.52	357.42	355.46	354.10	354.12	355.40	356.84
1994	358.22	358.98	359.91	361.32	361.68	360.80	359.39	357.42	355.63	356.09	357.56	358.87
1995	359.87	360.79	361.77	363.23	363.77	363.22	361.70	359.11	358.11	357.97	359.40	360.61
1996	362.04	363.17	364.17	364.51	365.16	364.93	363.53	361.38	359.60	359.54	360.84	362.18
1997	363.04	364.09	364.47	366.25	366.69	365.59	364.34	362.20	360.31	360.71	362.44	364.33
1998	365.18	365.98	367.13	368.61	369.49	368.95	367.74	365.79	364.01	364.35	365.52	367.08
1999	368.12	368.98	369.60	370.96	370.77	370.33	369.28	366.86	364.94	365.35	366.68	368.04
2000	369.25	369.50	370.56	371.82	371.51	371.71	369.85	368.20	366.91	366.99	368.33	369.67
2001	370.52	371.49	372.53	373.37	373.82	373.18	371.57	369.63	368.16	368.42	369.69	371.18
2002	372.45	373.14	373.93	375.00	375.65	375.50	374.00	371.83	370.66	370.51	372.20	373.71
2003	374.87	375.62	376.48	377.74	378.50	378.18	376.72	374.31	373.20	373.10	374.64	375.93
2004	377.00	377.87	378.73	380.41	380.63	379.56	377.61	376.15	374.11	374.44	375.93	377.45
2005	378.47	379.76	381.14	382.20	382.47	382.20	380.78	378.73	376.66	376.98	378.29	379.92
2006	381.35	382.16	382.66	384.73	384.98	384.09	382.38	380.45	378.92	379.16	380.18	381.79
2007	382.93	383.81	384.56	386.40	386.58	386.05	384.49	382.00	380.90	381.14	382.42	383.89
2008	385.44	385.73	385.97	387.16	388.50	387.88	386.42	384.15	383.09	382.99	384.13	385.56
2009	386.94	387.42	388.77	389.44	390.19	389.45	387.78	385.92	384.79	384.39	386.00	387.31
2010	388.50	389.94	391.09	392.52	393.04	392.15	390.22	388.26	386.83	387.20	388.65	389.73
2011	391.25	391.82	392.49	393.34	394.21	393.72	392.42	390.19	389.04	388.96	390.24	391.83
2012	393.12	393.60	394.45	396.18	396.78	395.83	394.30	392.41	391.06	391.01	392.81	394.28
2013	395.54	396.80	397.31	398.35	399.76	398.58	397.20	395.15	393.51	393.66	395.11	396.81
2014	397.80	397.91	399.58	401.29	401.78	401.15	399.00	397.01				

NOAA

Carbon Dioxide (parts per million)

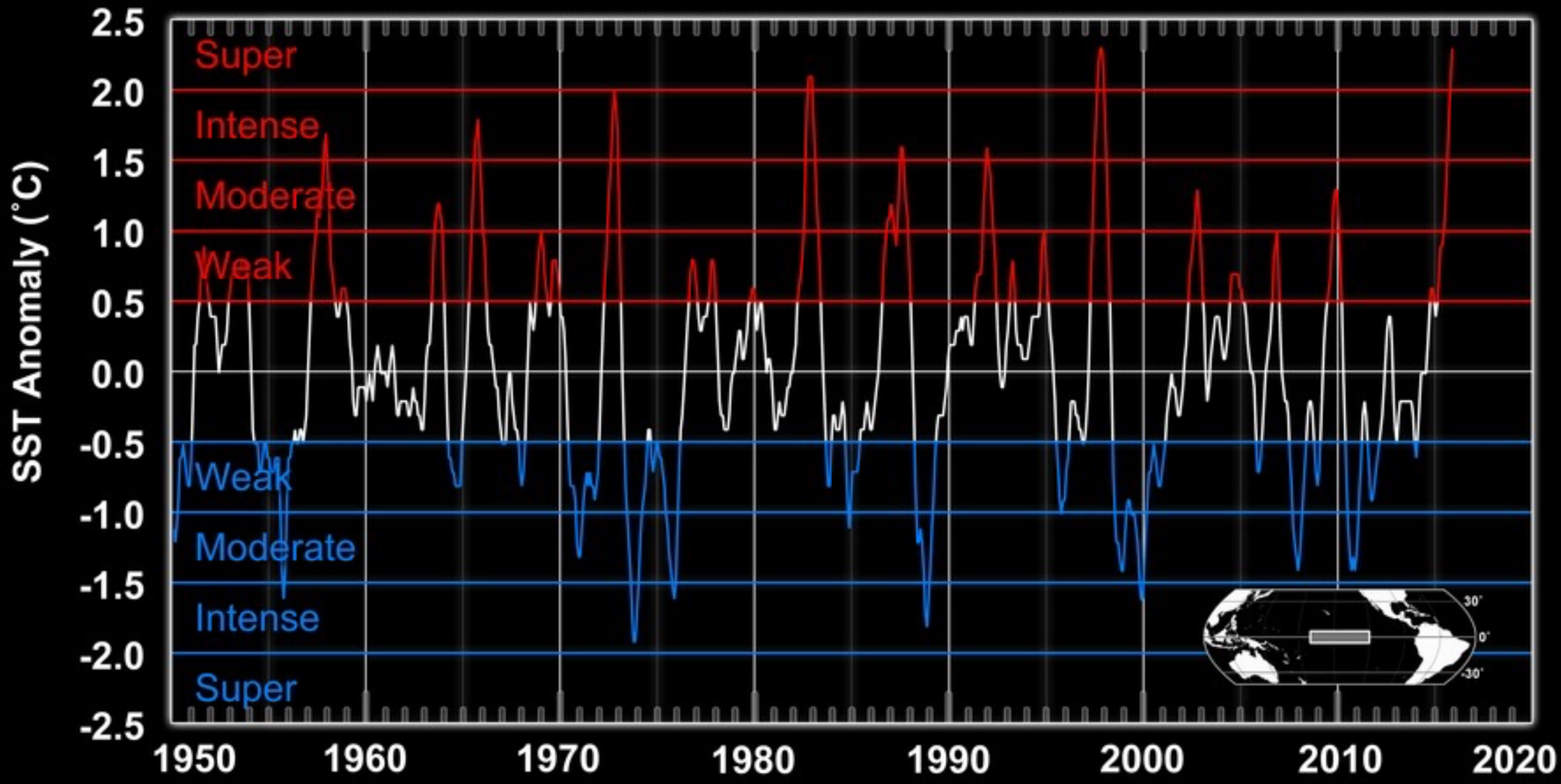


NOAA

Case Study: Design

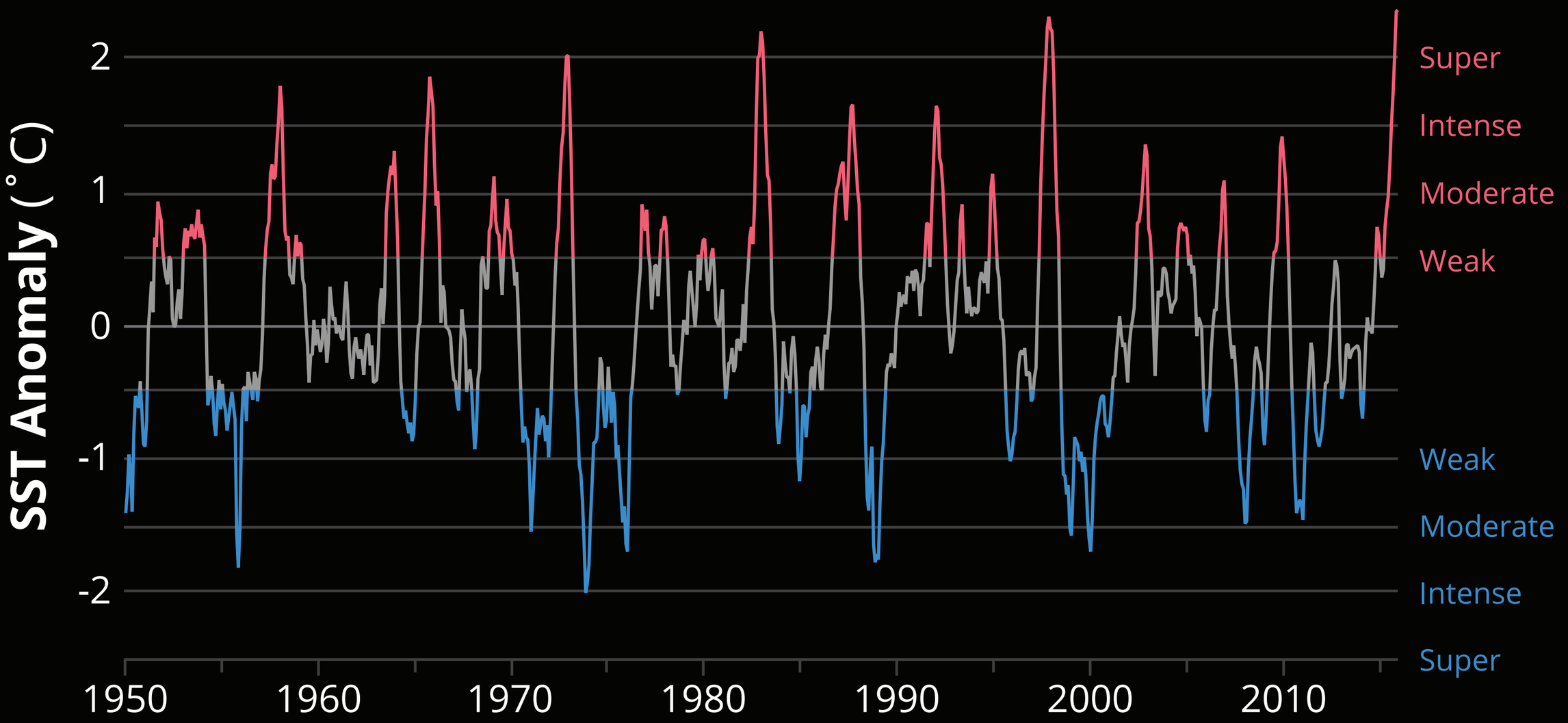
NOAA Sea Surface Temperature Anomaly (˚C)

for Oceanic Nino Index Region 3.4 (5°S - 5°N, 170°W - 120°W)



NOAA Sea Surface Temperature Anomaly (˚C)

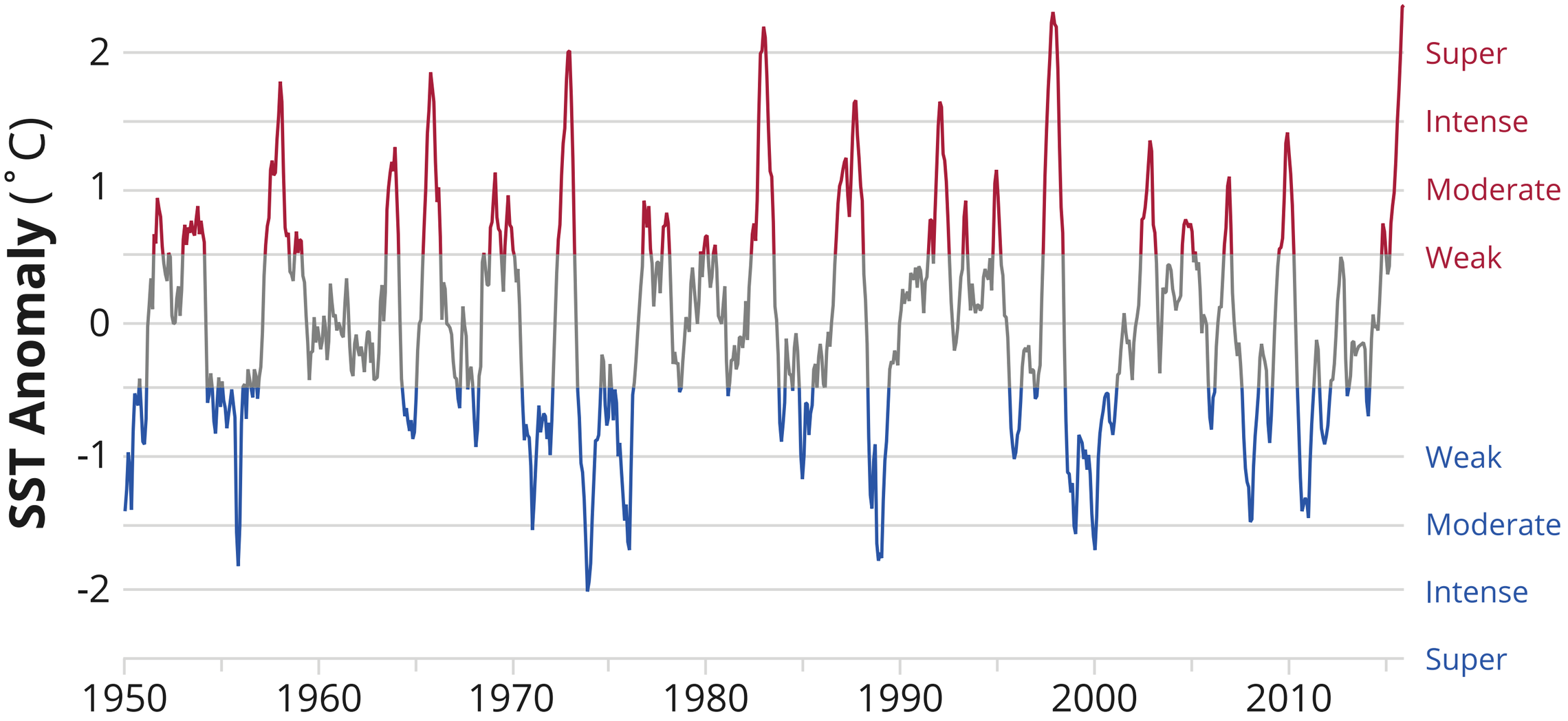
for Oceanic Niño Region 3.4 (5˚S–5˚N, 170˚W–120˚W)



source: www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_change.shtml

NOAA Sea Surface Temperature Anomaly (˚C)

for Oceanic Niño Region 3.4 (5˚S–5˚N, 170˚W–120˚W)



source: www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_change.shtml

Robert Simmon/NOAA

Color

Theory
Applications
Tools

Color has an objective reality, but the colors we see are tricks of the imagination, and there is no perfectly objective view of color.

James Gleick on Radiolab

red

green

blue

how computers calculate color

lightness

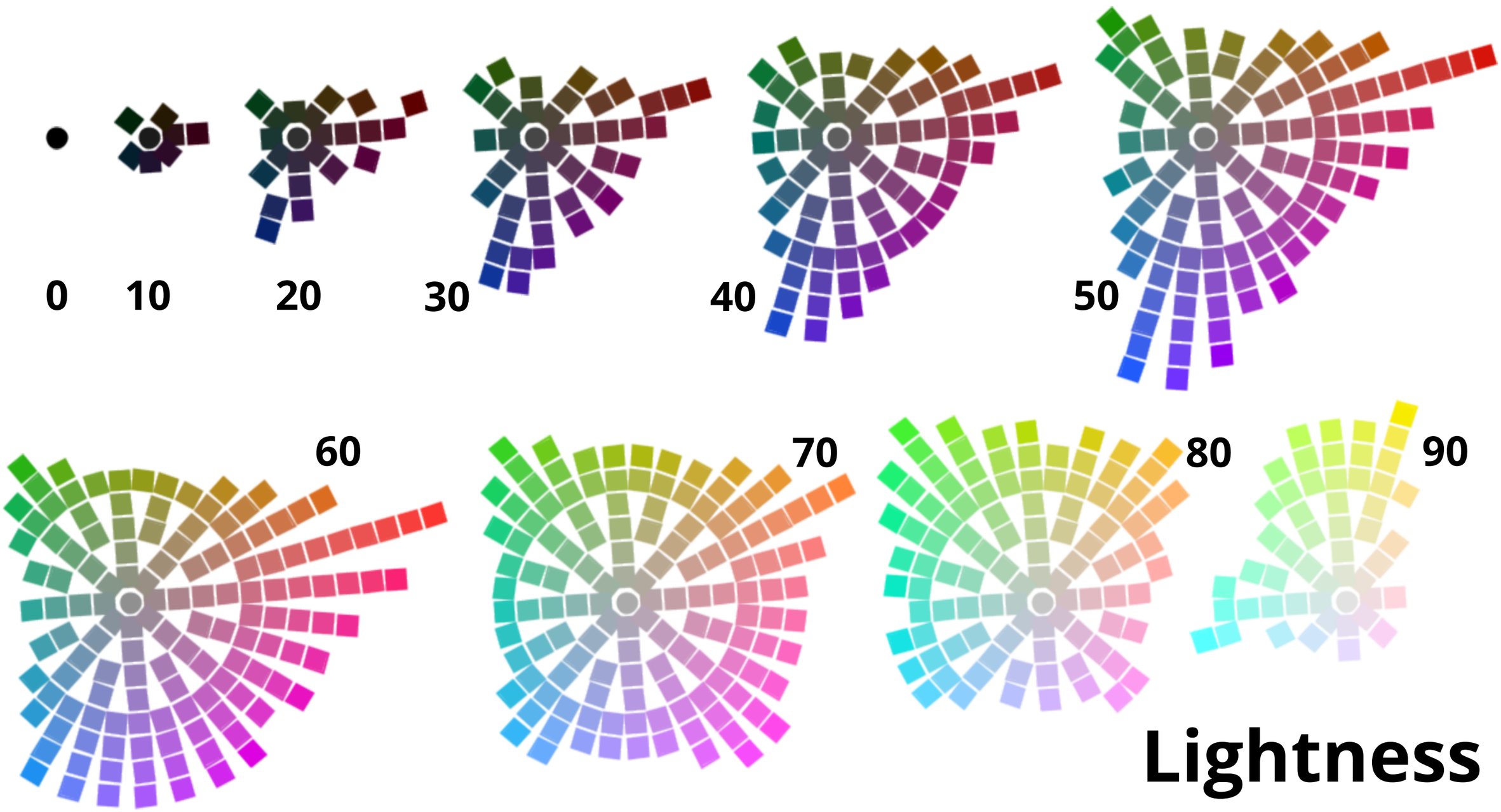
hue

saturation

how we perceive color

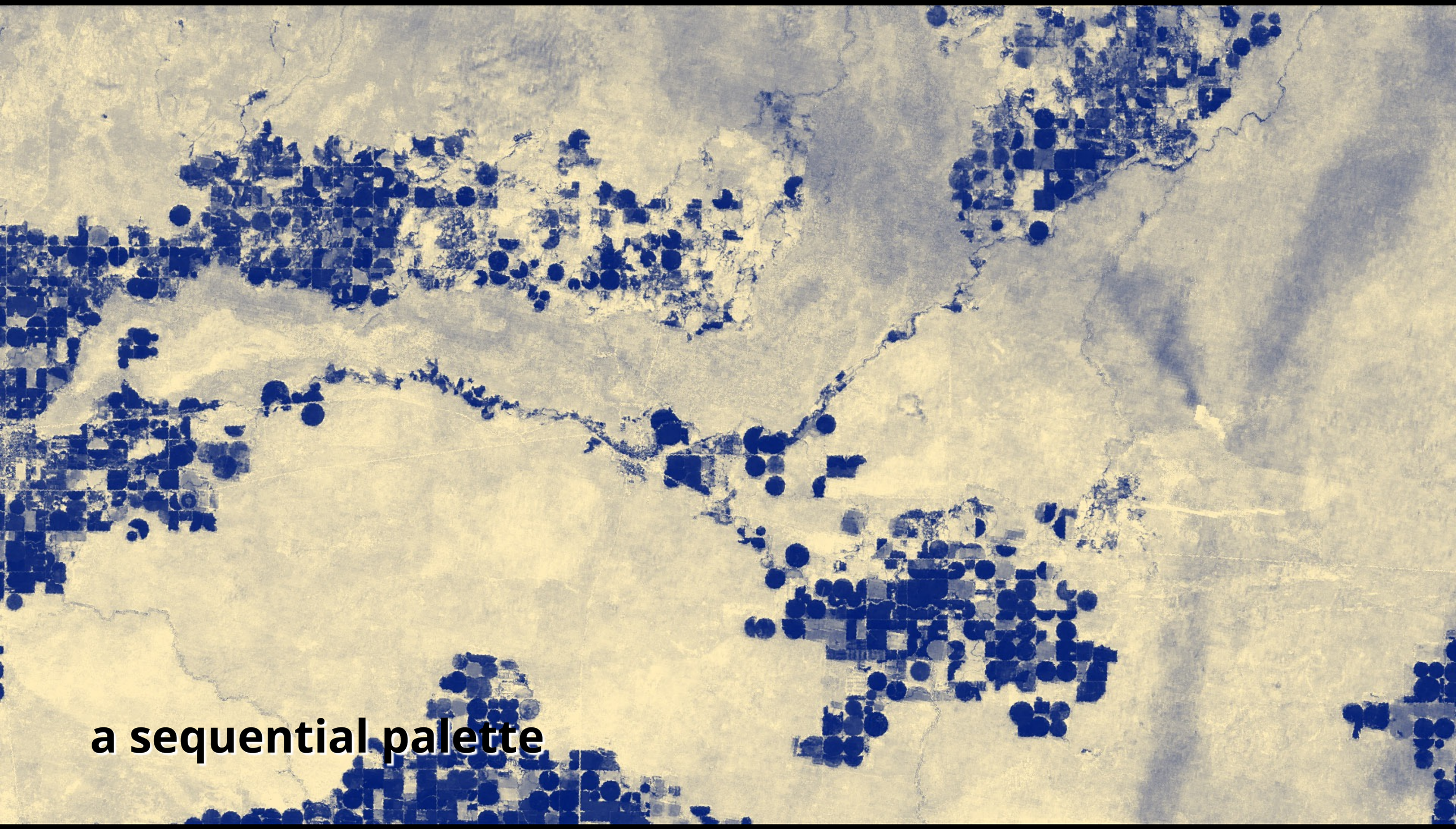
CIE L*C*h

lightness, chroma (saturation), hue


0
10
20
30
40
50
60
70
80
90
Lightness

Applications

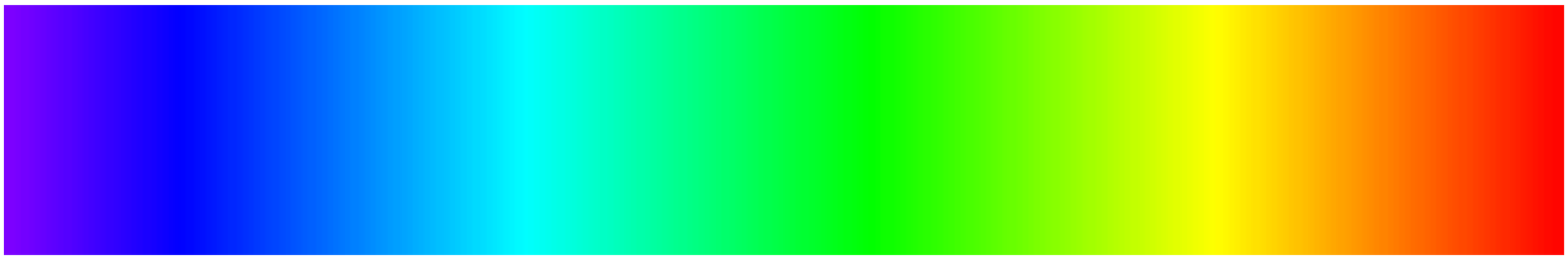
sequential, divergent, and qualitative maps


a sequential palette

grayscale

rainbow

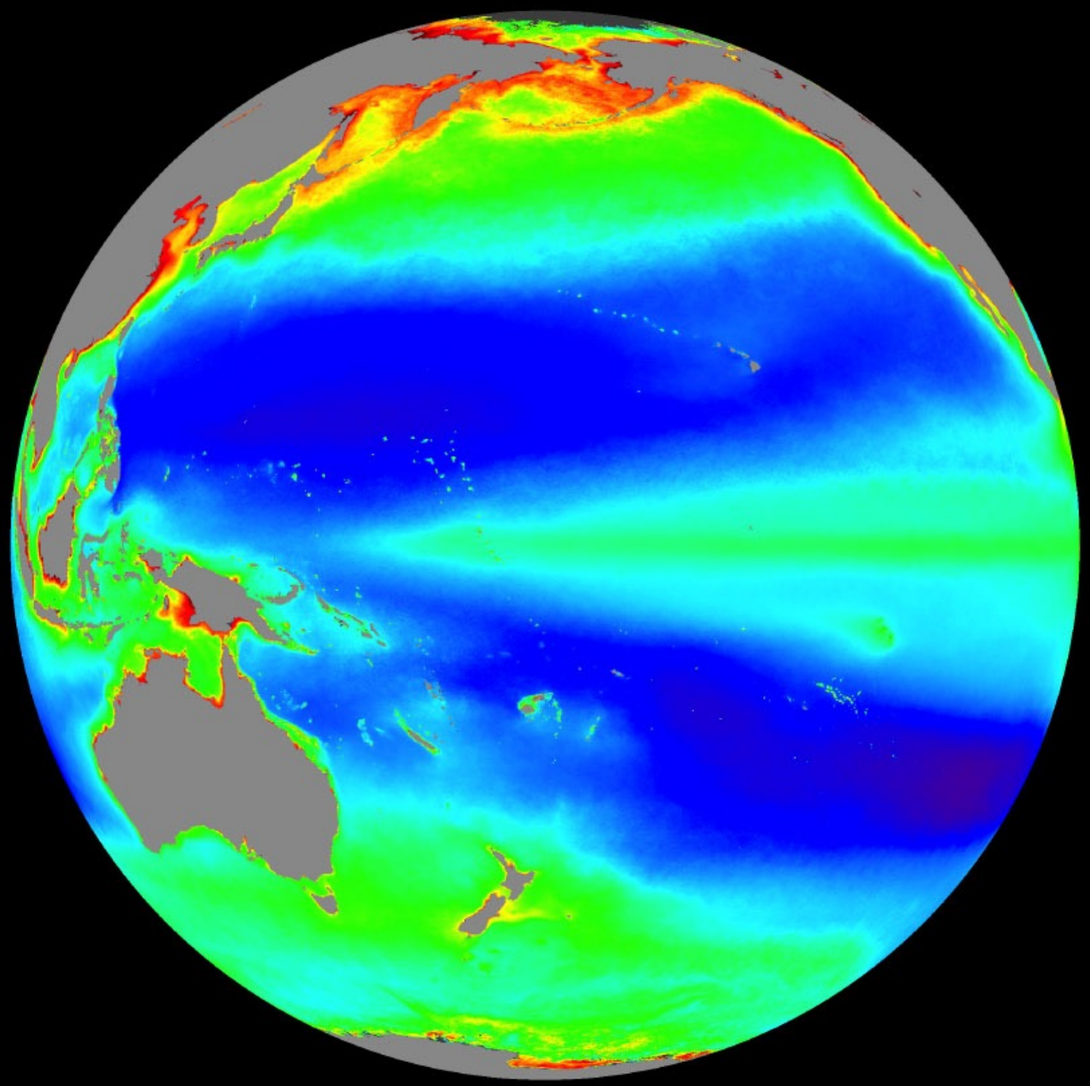
simultaneous contrast

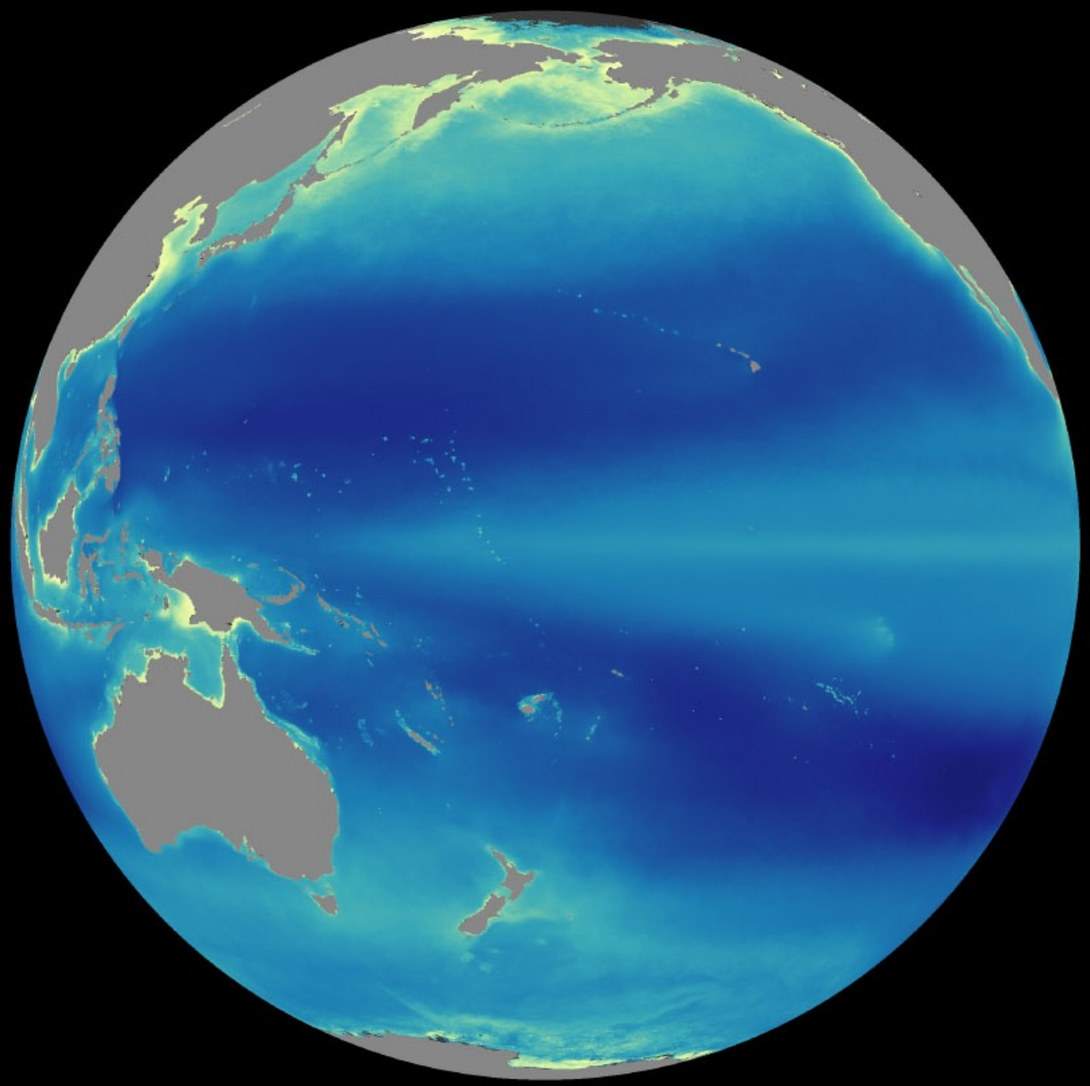


rainbow palette

“Perfect” Palettes

“a kind of spiral in color space that cycles through a variety of hues while continuously increasing in lightness” —Colin Ware

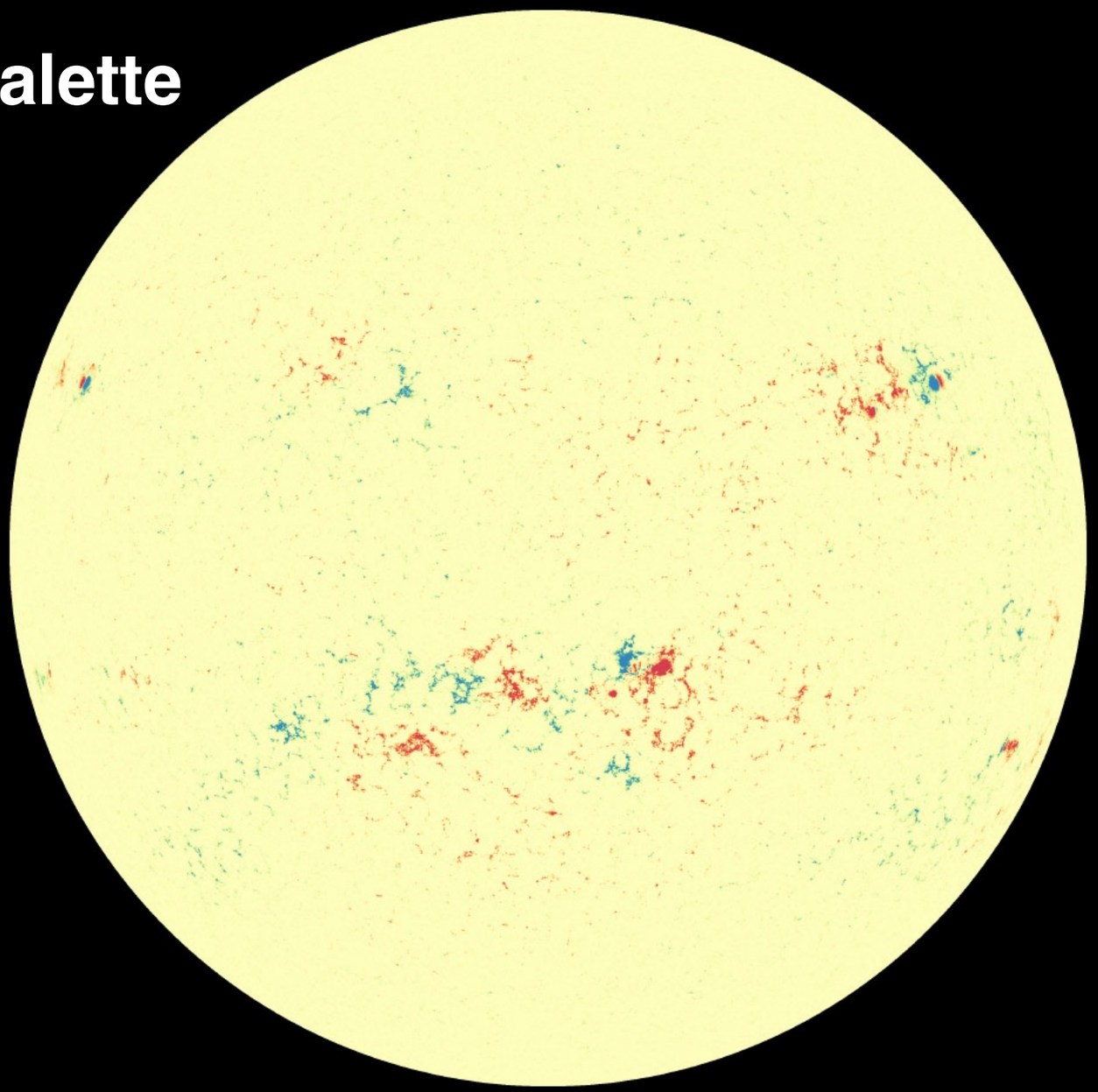




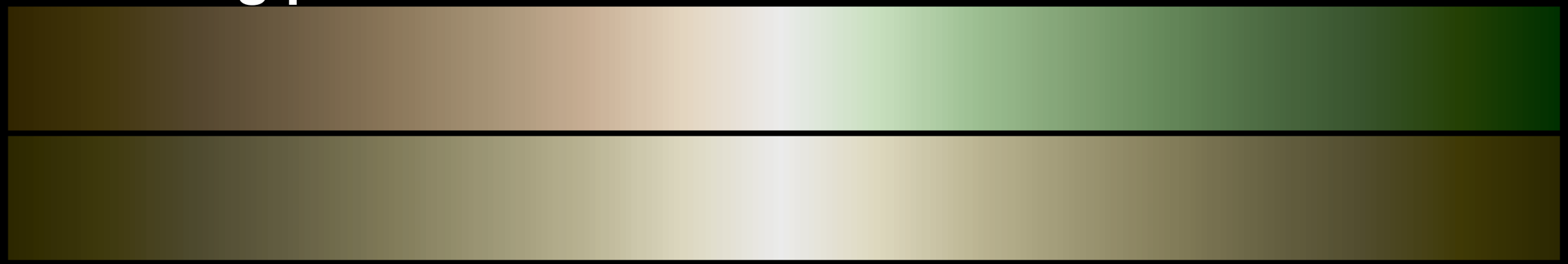
perceptually linear lightness, saturation, and hue shift (L*c*h)

nonlinear shift (HSB)

a divergent palette



confusing palette



color blind safe palette

two 12-class qualitative palettes

a qualitative palette

Land Cover Classes

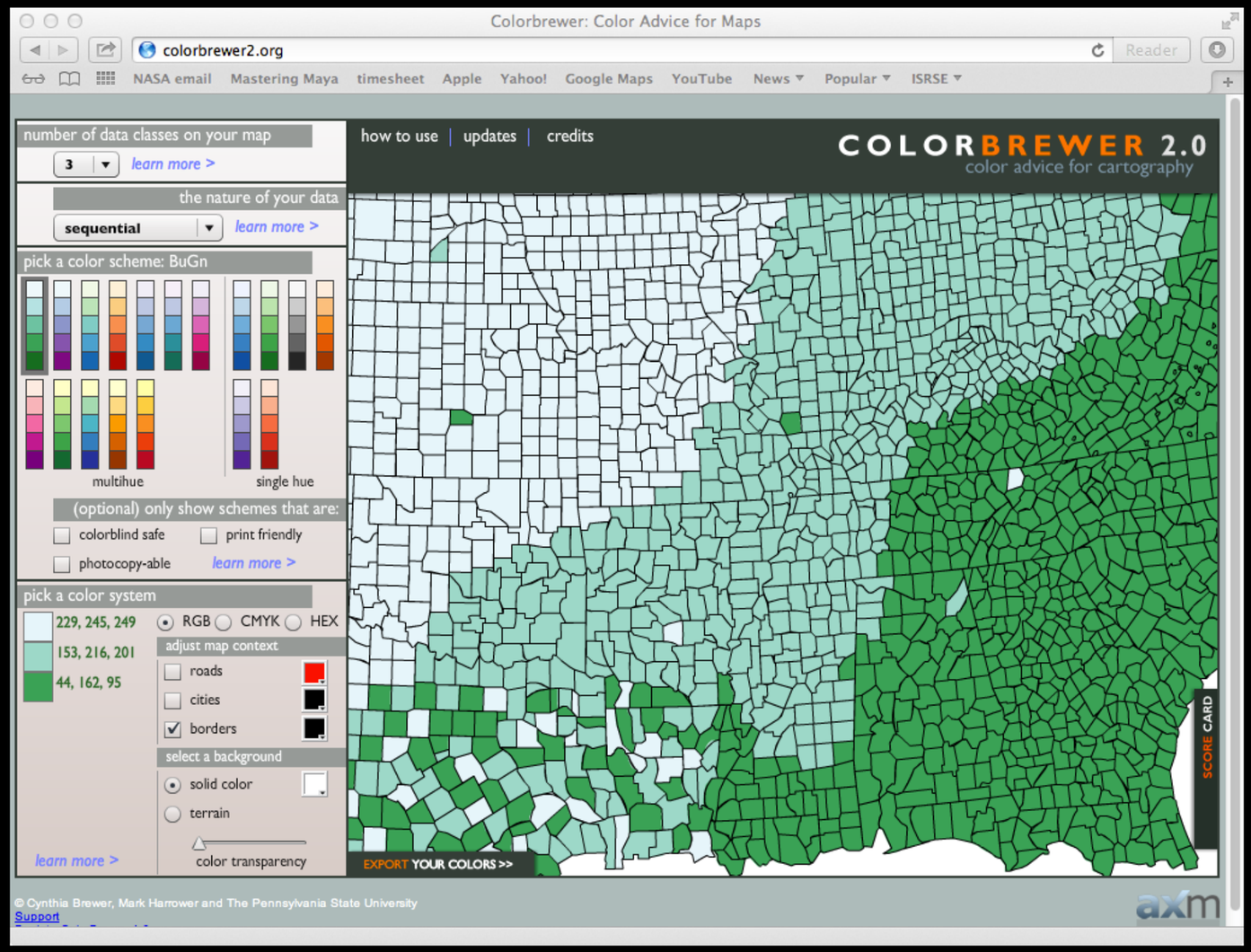
water ice urban bare forest scrub grass crops wetlands

visual hierarchy

Tools

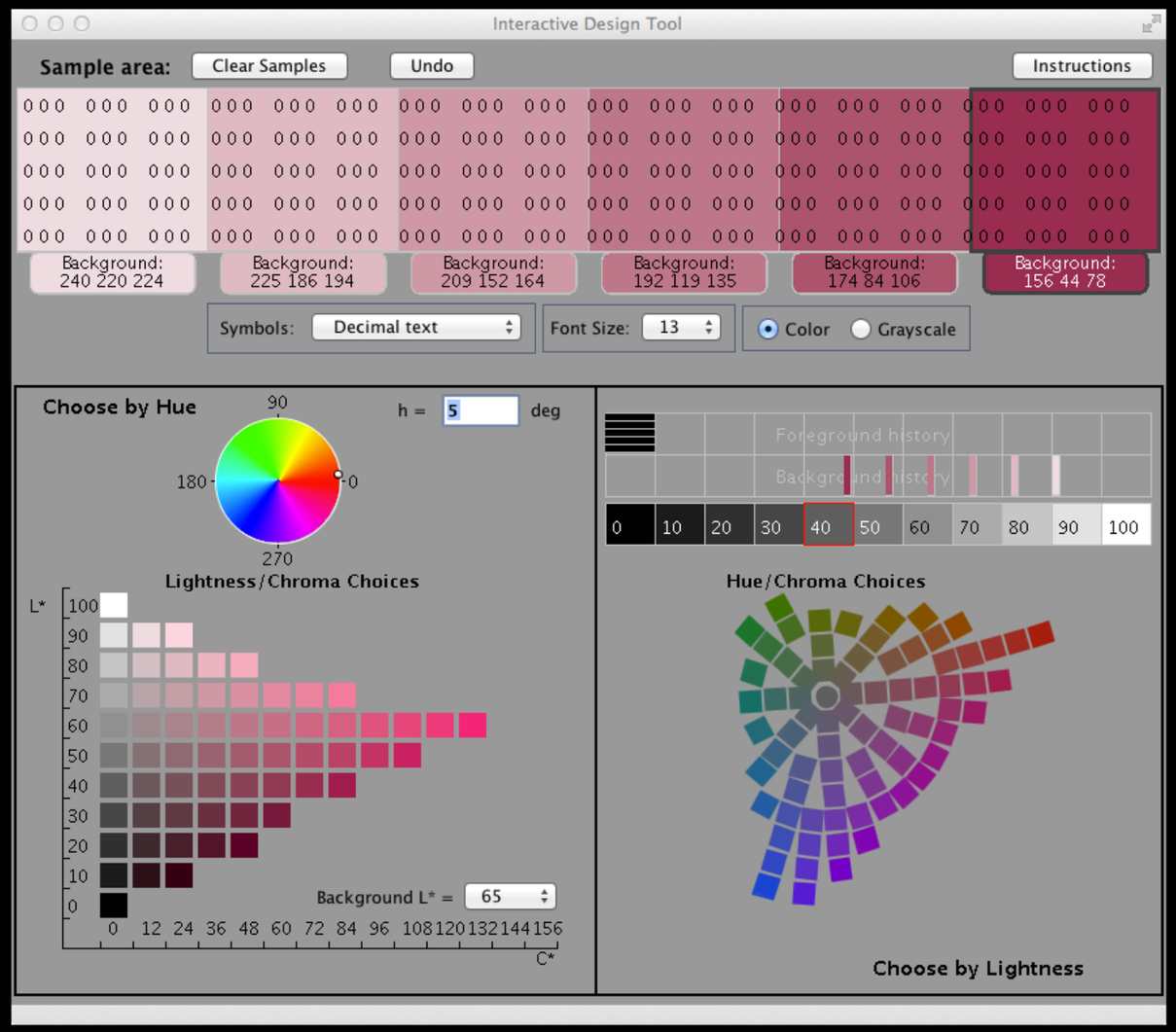
Color Brewer, NASA Color Tool, chroma.js

Color Brewer: colorbrewer2.org

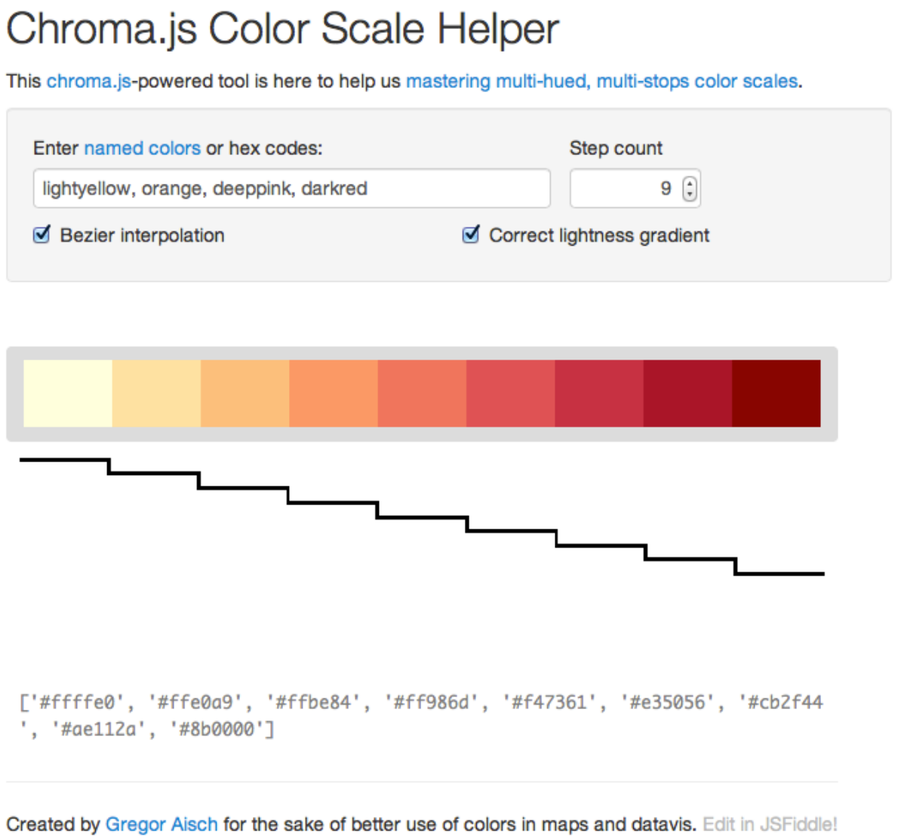


NASA Color Tool:

colorusage.arc.nasa.gov/ColorTool.php



chroma.js: https://vis4.net/labs/multihue/



Gregor Aisch

jet

parula (Matlab)

viridis (matplotlib)

https://www.youtube.com/watch?v=xAoljeRJ3lU

Export Options

R py m GrADS RAW

Examples

METEOROLOGY

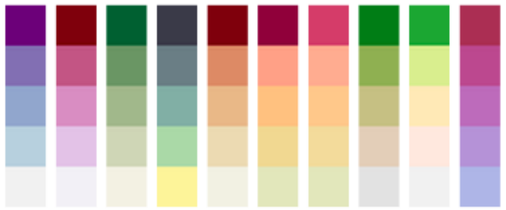
- Austria
- Equiv. Pot. Temperature
- Geopot. Temperature
- Topography
- Chlorophyll

COLORSPACE

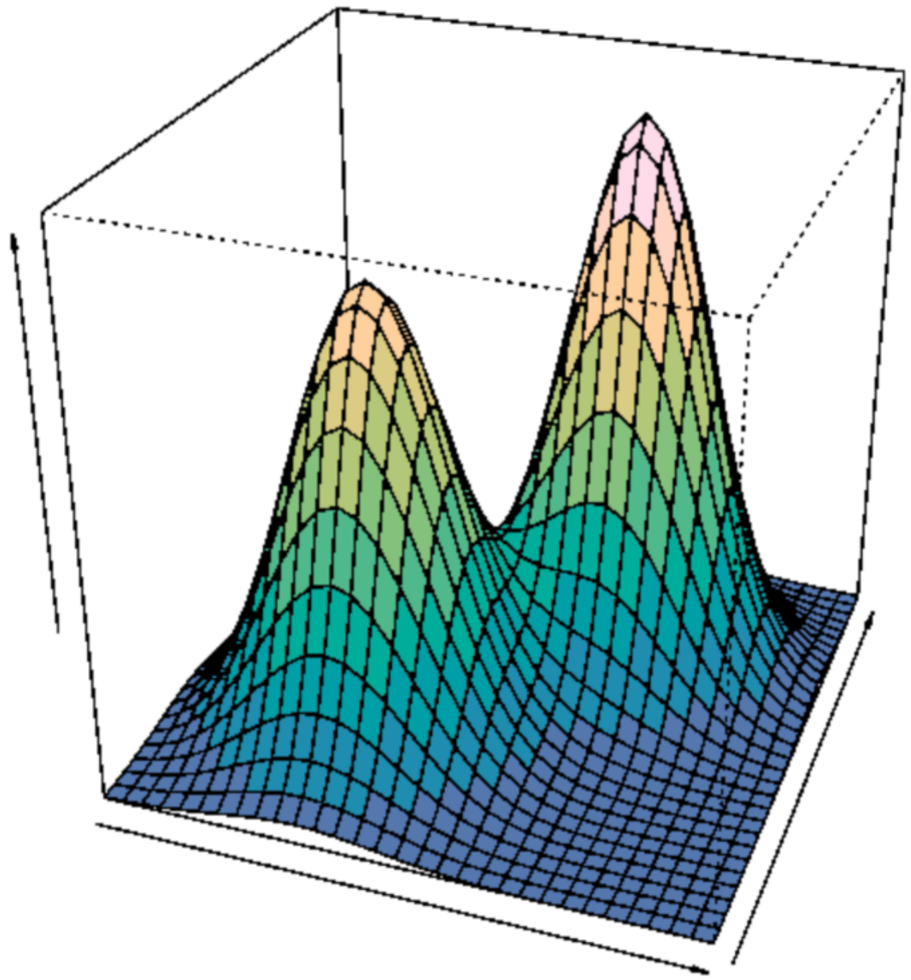
- Map
- Lineplot
- Scatterplot
- Perspective
- Pieplot
- Mosaicplot
- Barplot
- Spline
- Heatmap

Color Settings

Type Sequential multiple hue



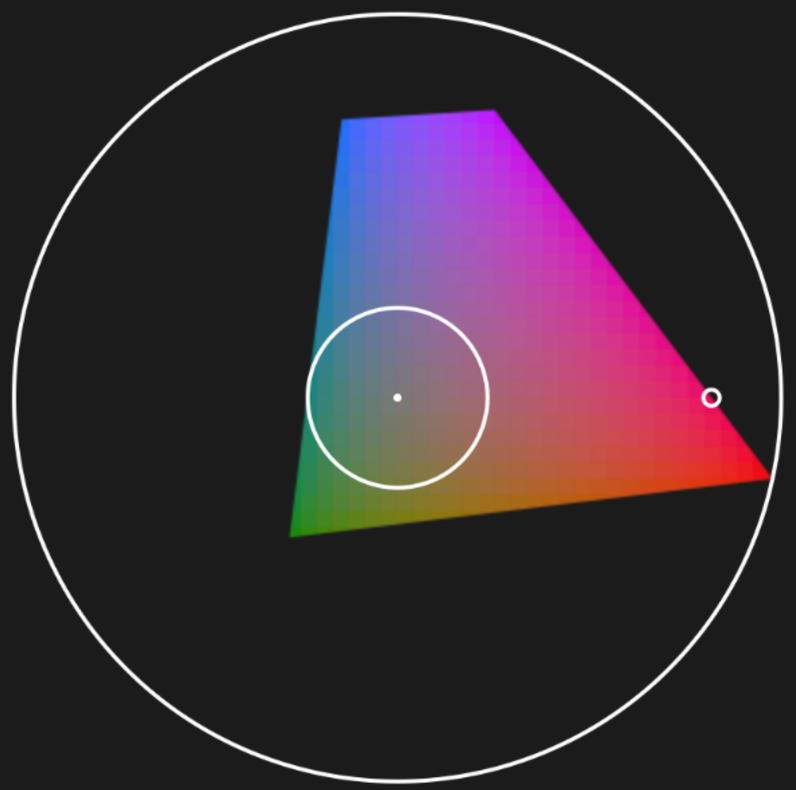
H1		250
H2		0
C1		50
C2		50
L1		50
L2		95
P1		1
P2		1
N		11



hclwizard.org

HUSL Implementations Comparison Math Demo

Star 298



HUSL is a human-friendly alternative to HSL.

To the left you can see CIELUV, a color space designed for perceptual uniformity based on human experiments. When accessed by polar coordinates, it becomes functionally similar to HSL with a single problem: its chroma component doesn't fit into a specific range.

HUSL extends CIELUV with a new saturation component that allows you to span all the available chroma as a neat percentage.

www.husl-colors.org

Selected Resources

Colin Ware. *Information Visualization: Perception for Design*

Edward Tufte. *Envisioning Information*

Cynthia Brewer. *ColorBrewer* colorbrewer2.org

Bruce MacEvoy. *Color Theory* www.handprint.com/HP/WCL/wcolor.html

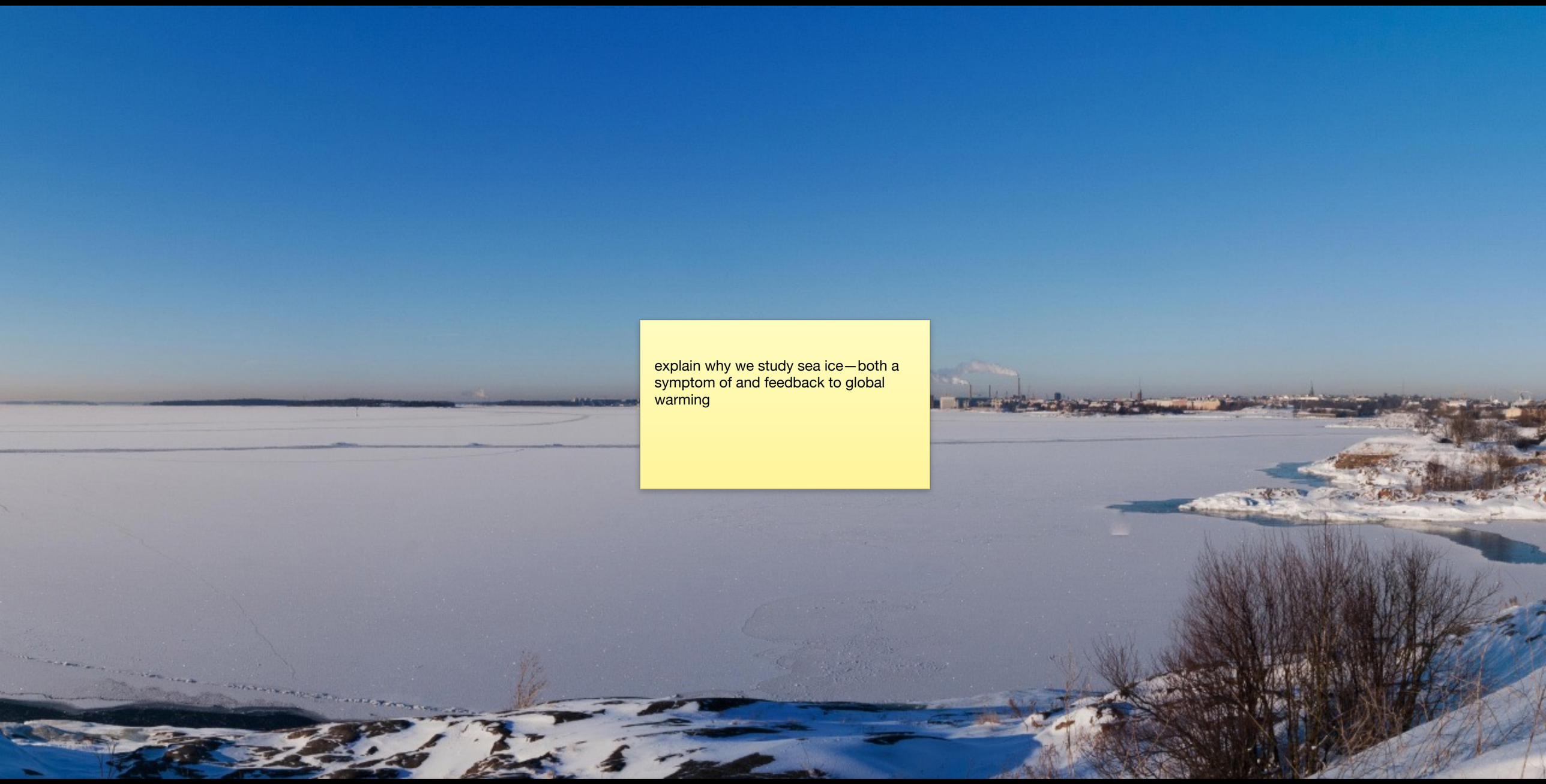
Maureen Stone. *A Field Guide to Digital Color*

Bernice Rogowitz and Lloyd Treinish. *How NOT to Lie with Visualization*

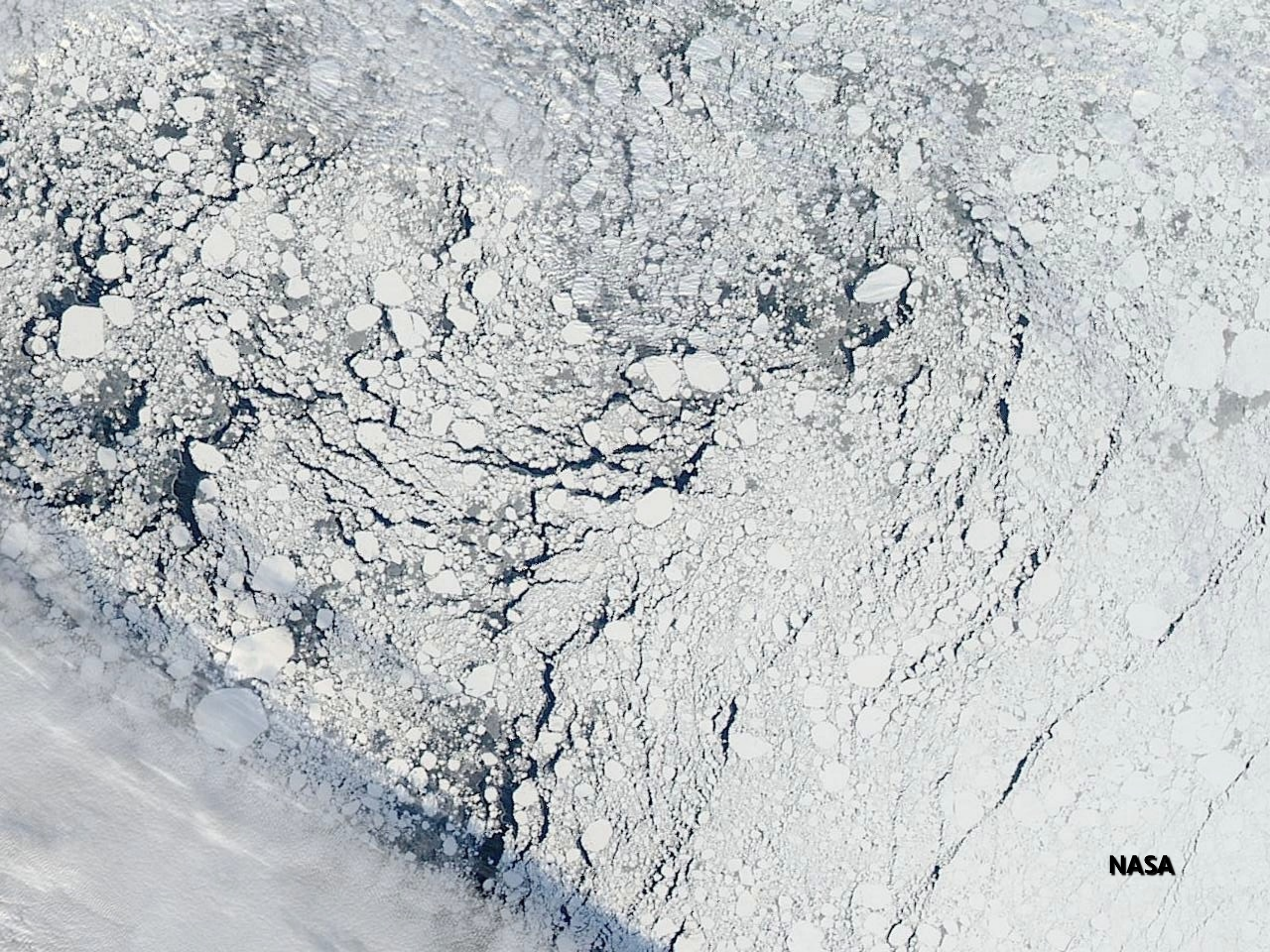
Robert Simmon *Subtleties of Color*

earthobservatory.nasa.gov/blogs/elegantfigures/2013/08/05/subtleties-of-color-part-1-of-6/

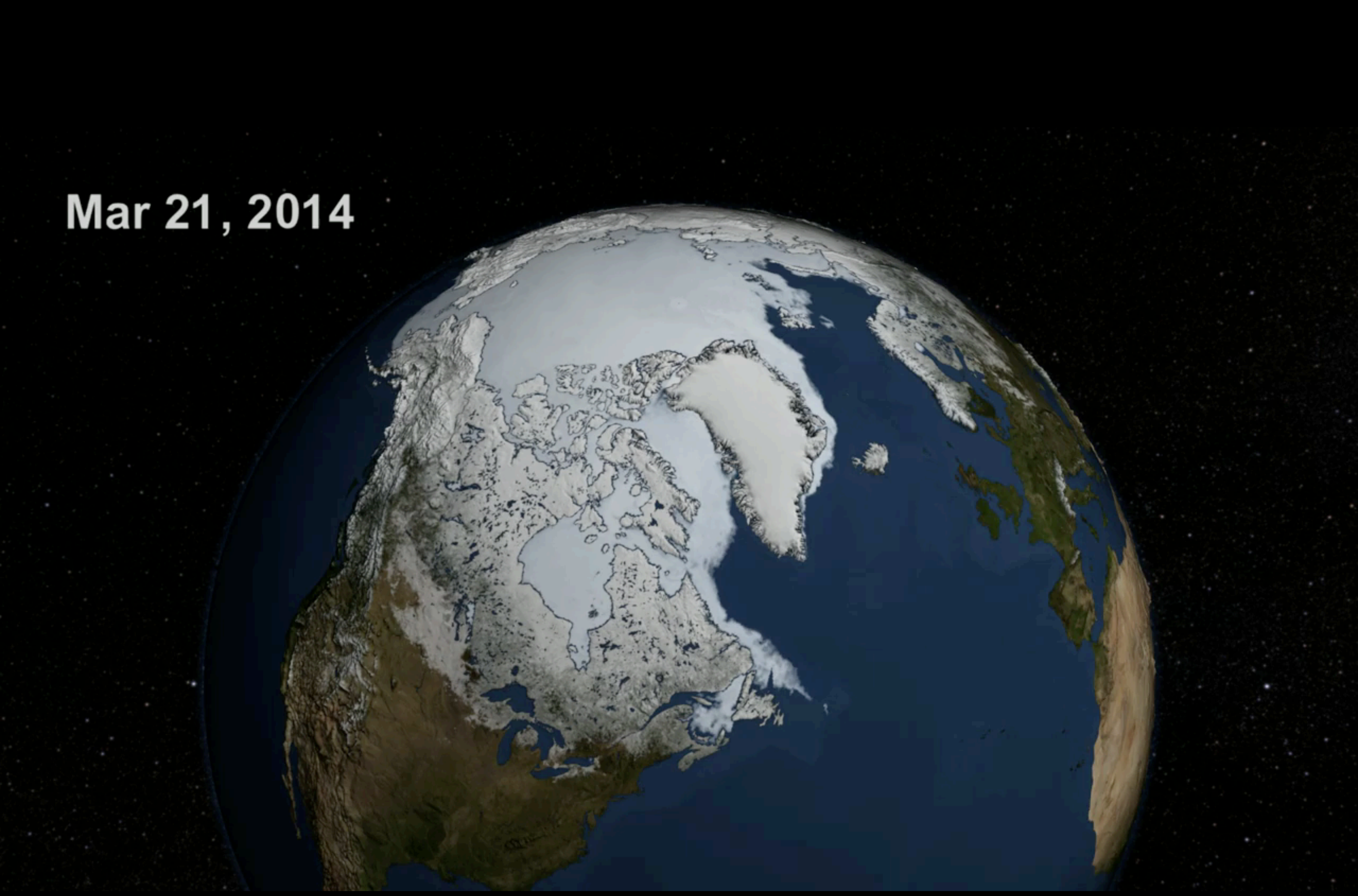
Case Study:
Sea Ice



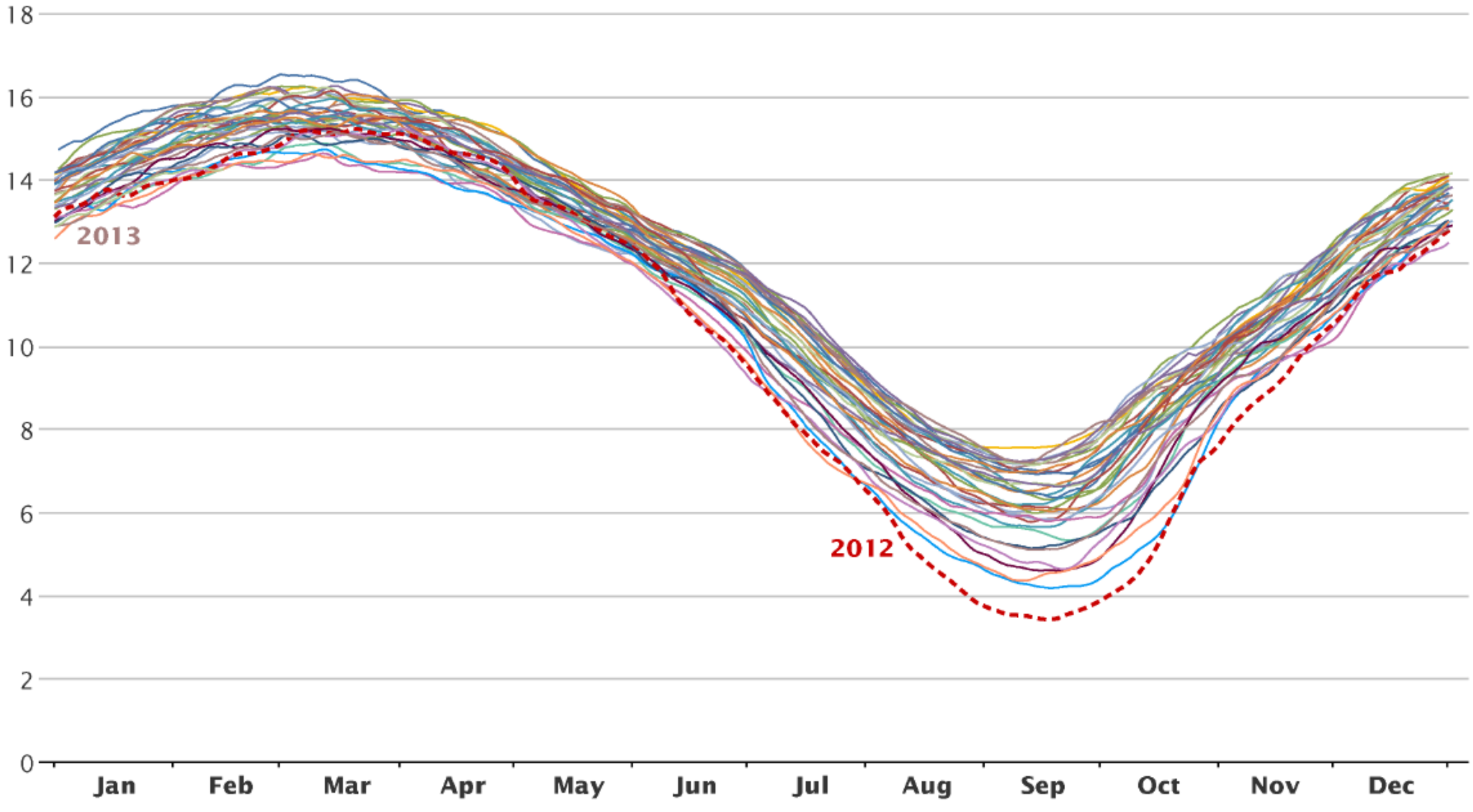
explain why we study sea ice—both a symptom of and feedback to global warming


NASA

Mar 21, 2014

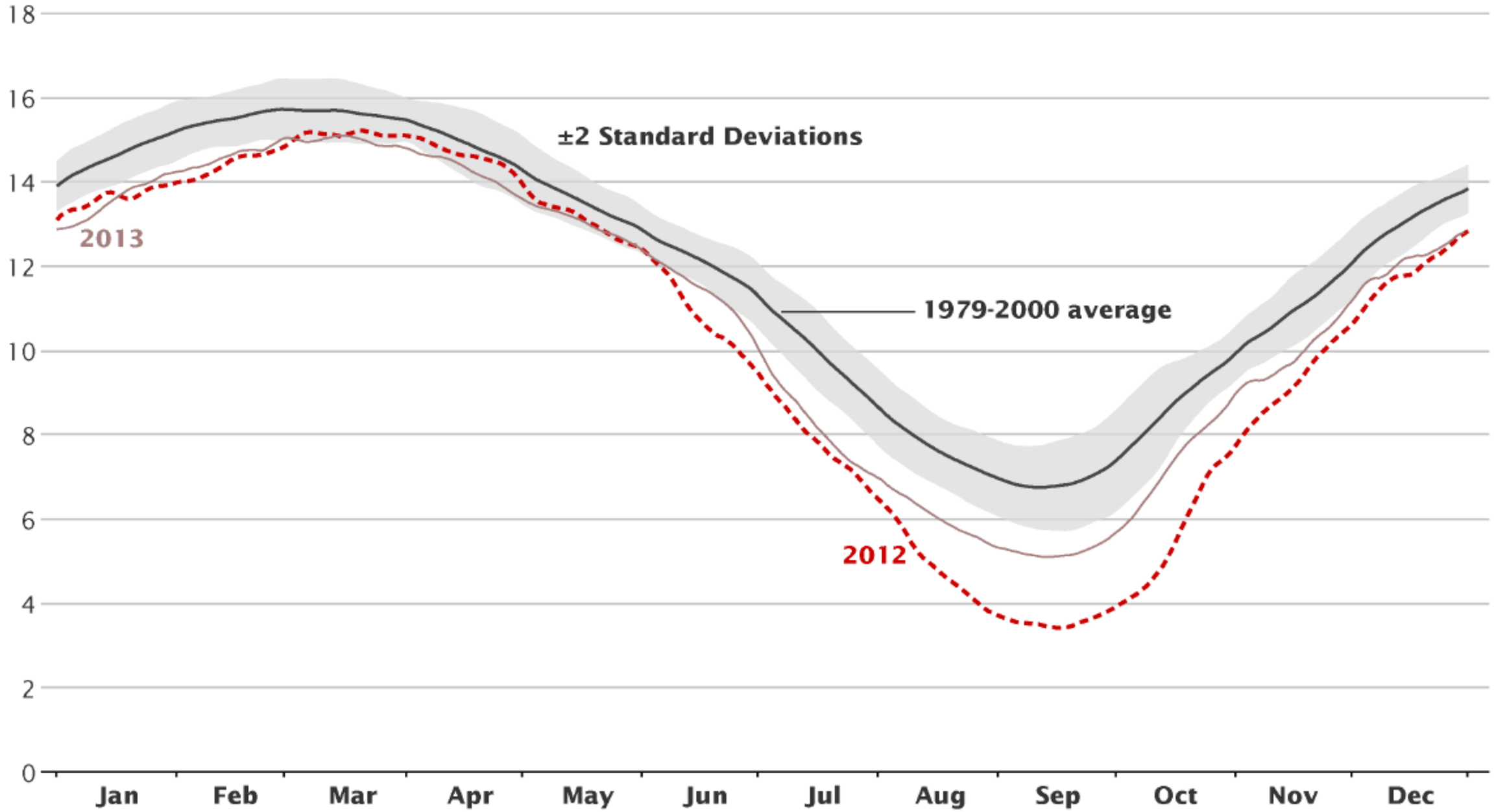


Arctic Sea Ice Extent (millions of square kilometers)
Area of Ocean with at Least 15% Sea Ice



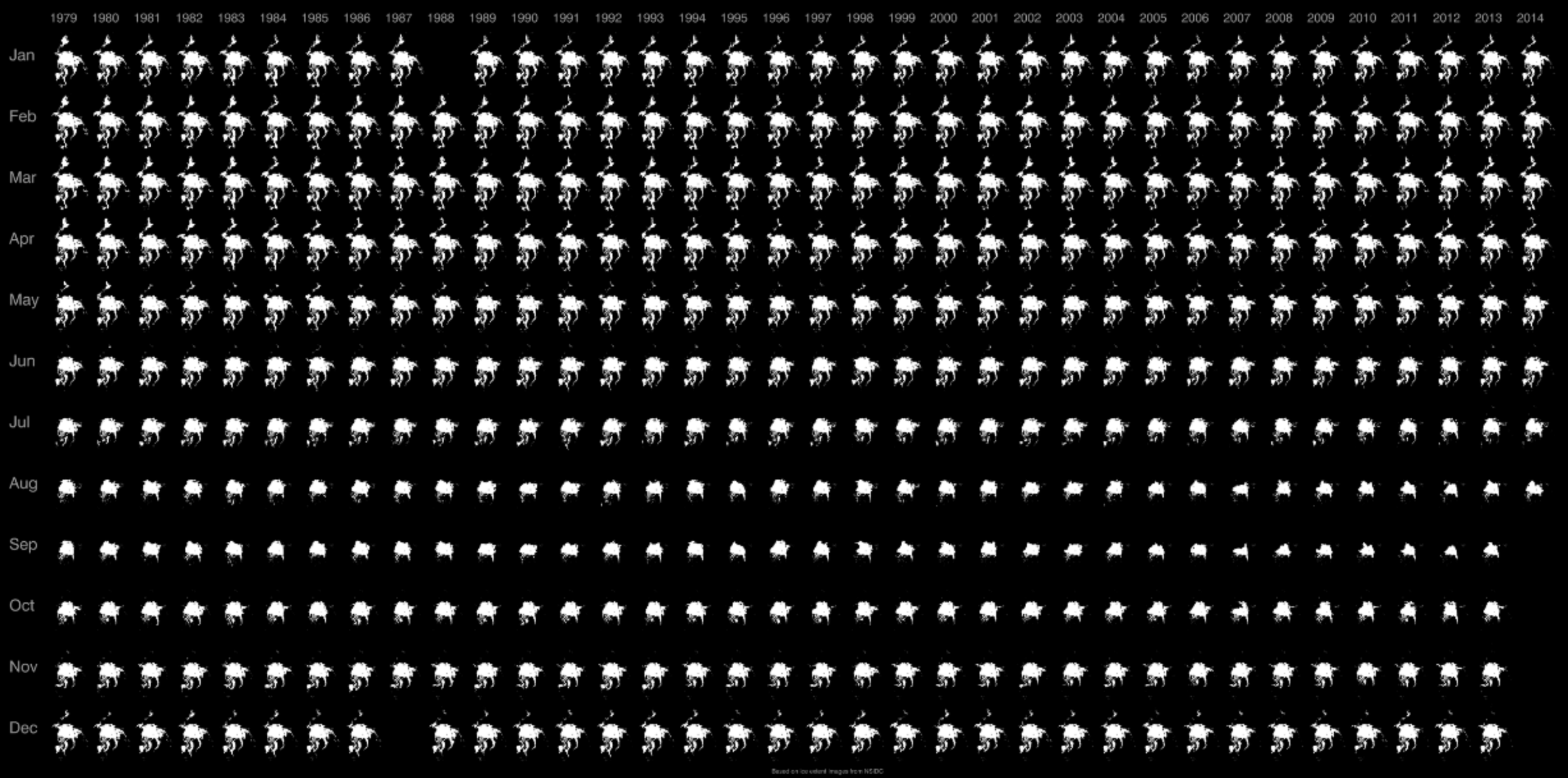
National Snow & Ice Data Center

Arctic Sea Ice Extent (millions of square kilometers)
Area of Ocean with at Least 15% Sea Ice



National Snow & Ice Data Center

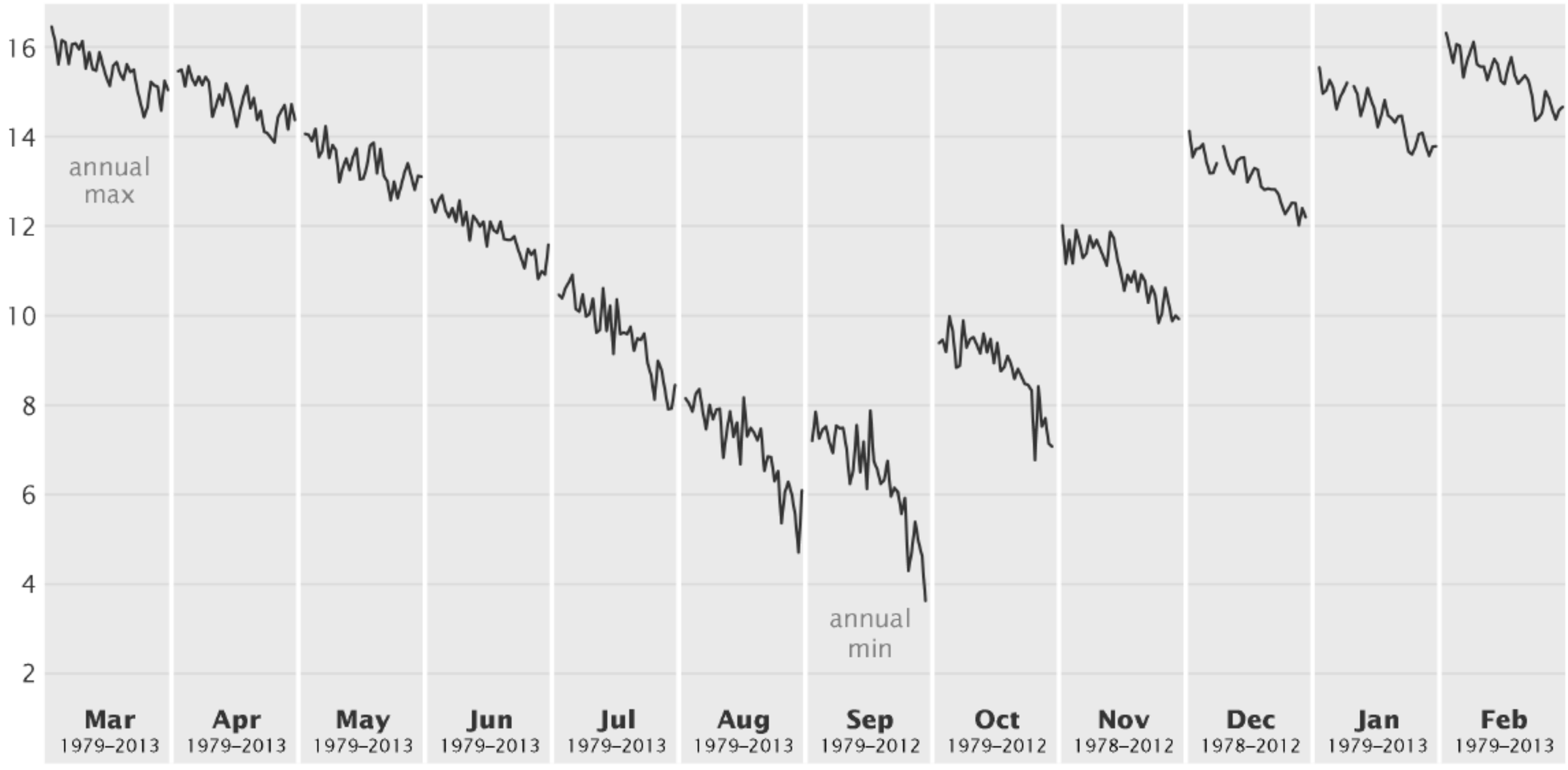
Small Multiples



Based on icevalent images from NSIDC

Cycle Plot

Monthly Mean Arctic Sea Ice Extent
November 1978–August 2013 (millions of square kilometers)

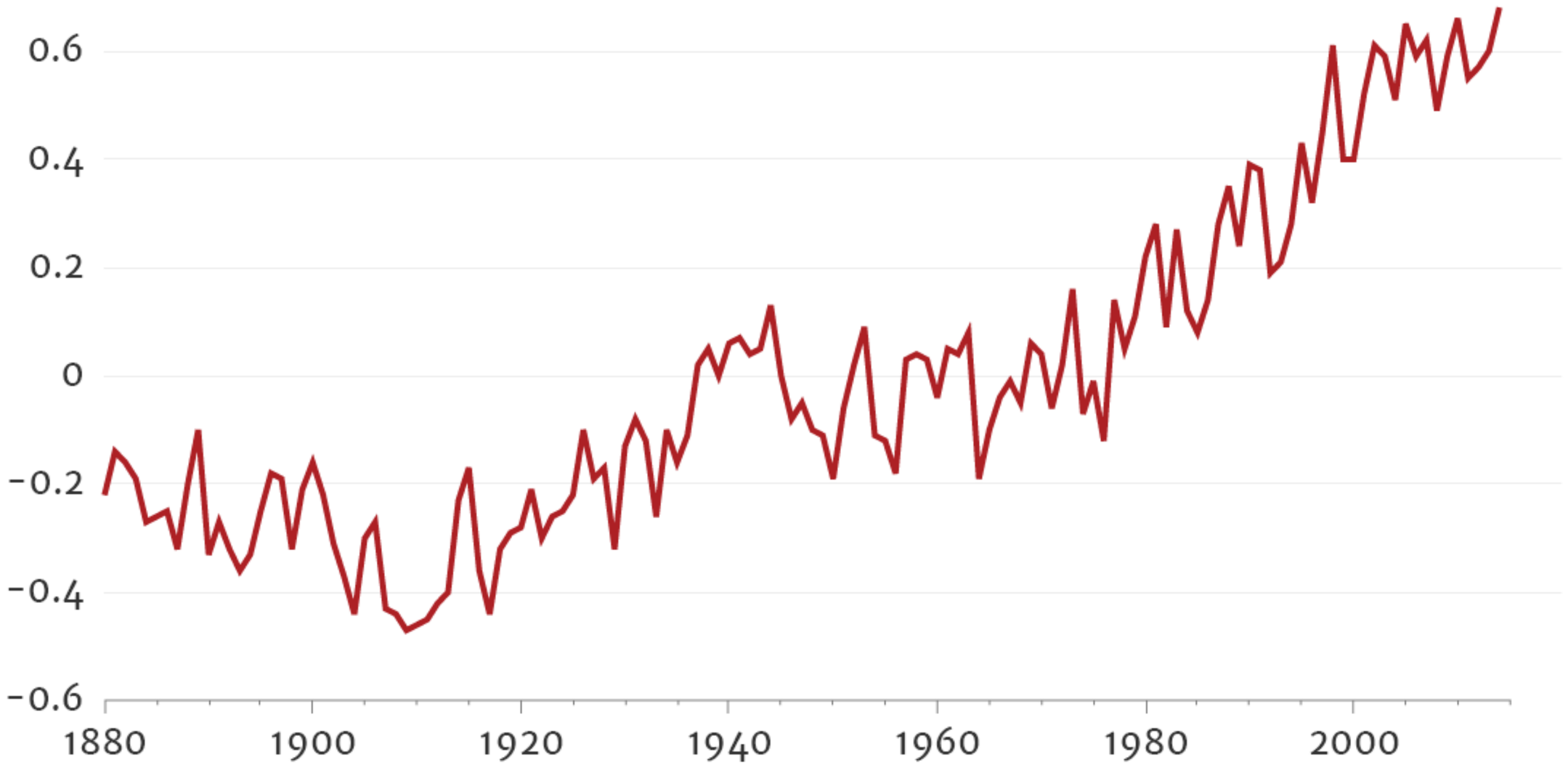


National Snow & Ice Data Center

Case Study:
Global Temperature

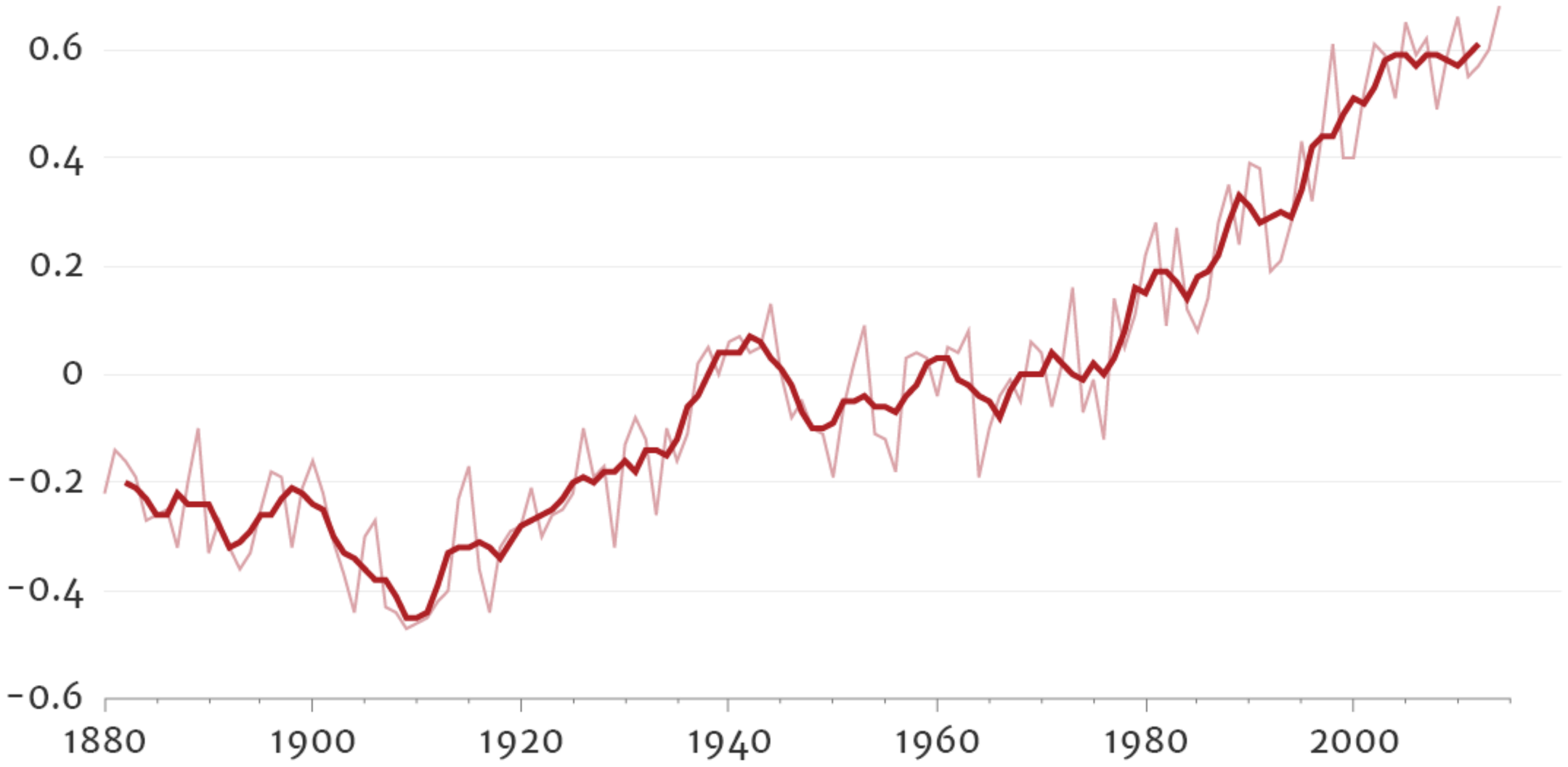
Global Temperature (°C)

Annual Difference from 1951–1980 Average



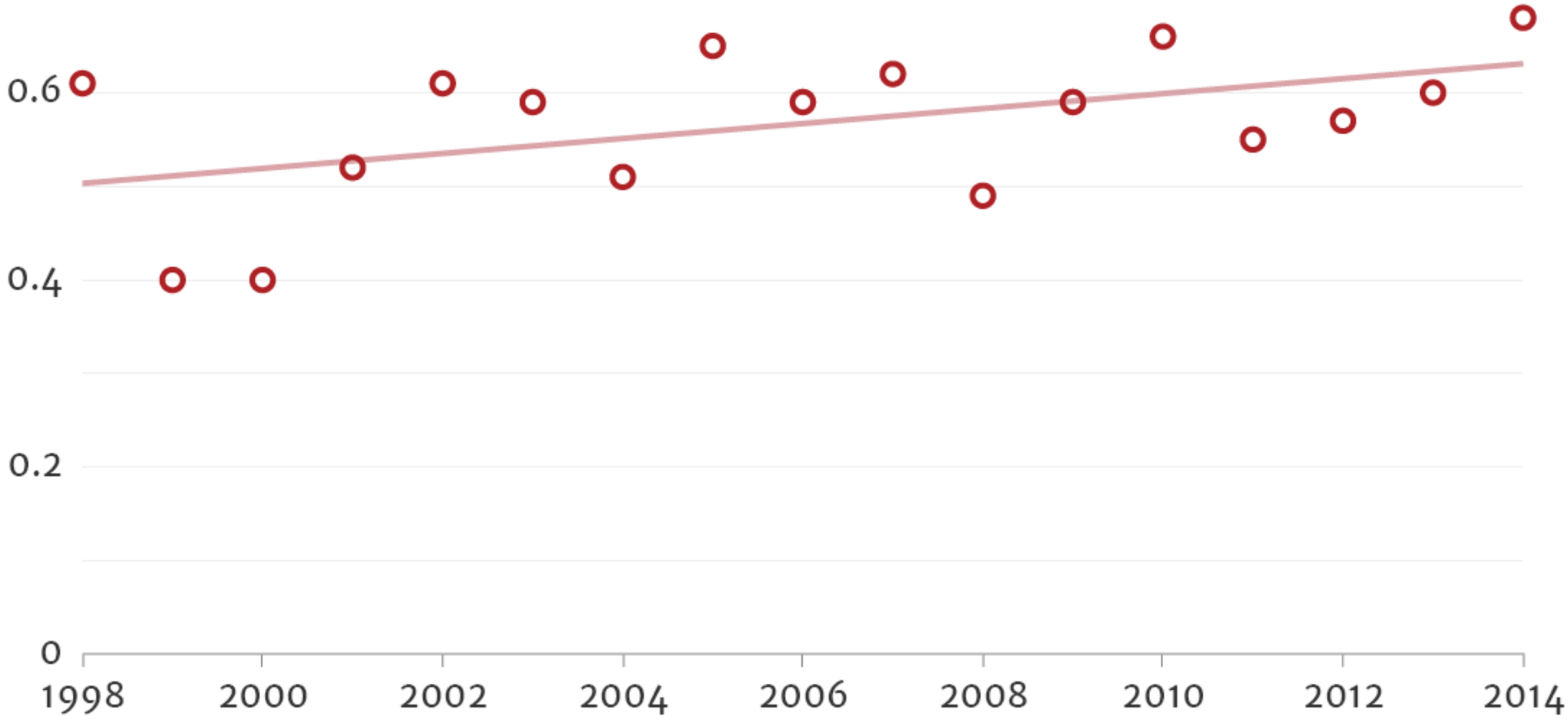
Global Temperature (°C)

5-Year Average



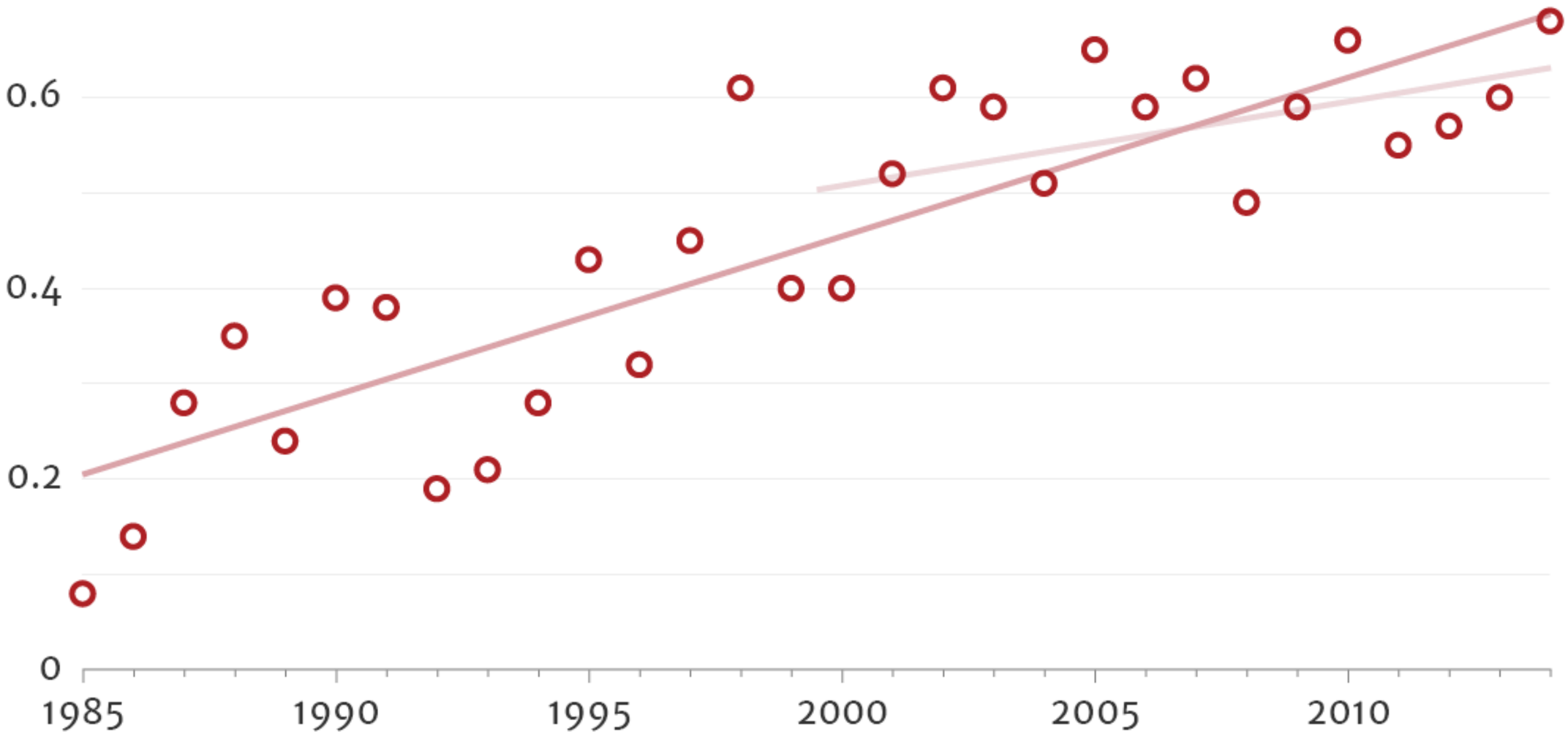
Global Temperature (°C)

15-Year Trend

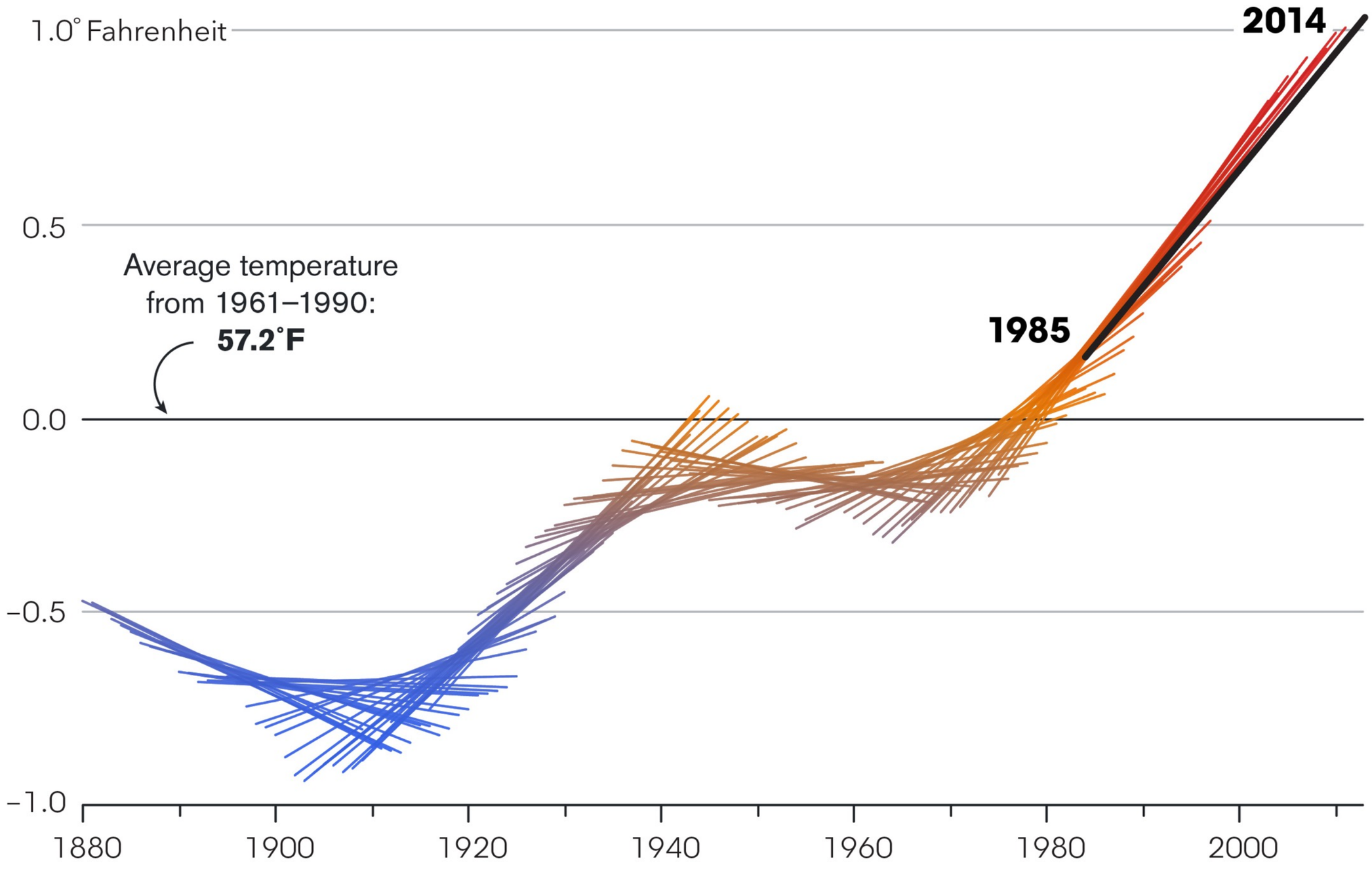


Global Temperature (°C)

30-Year Trend



Change in Global Average Air Temperature Over 30-Year Periods

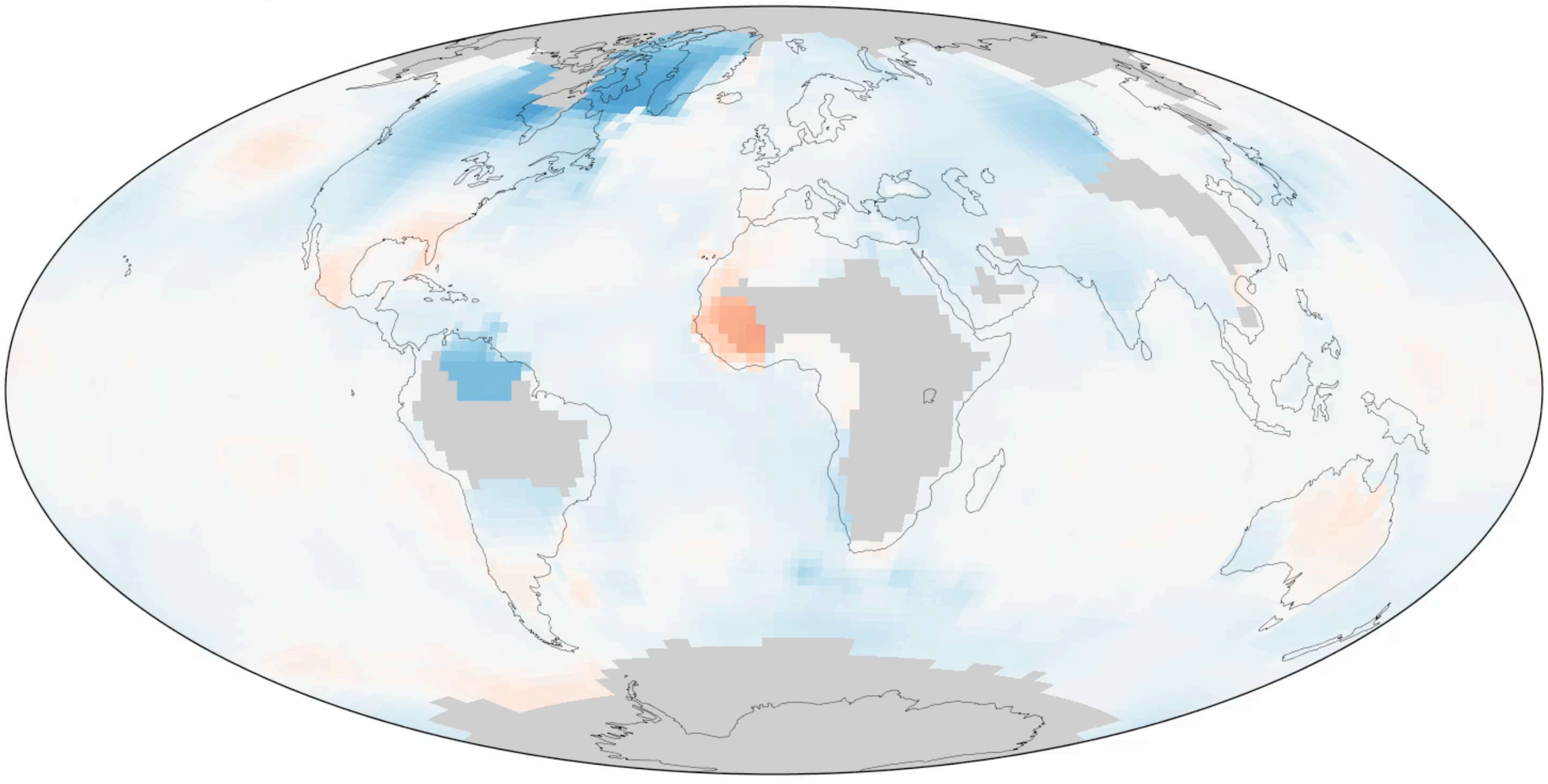


Note: Changes are measured against the planet's average temperature over the 30 years from 1961-1990, the time period the UN uses as a climate benchmark.
Sources: United Nations' World Meteorological Organization, NASA-GISS

Bloomberg Graphics

Global Temperature

Difference from 1951–1980 Average

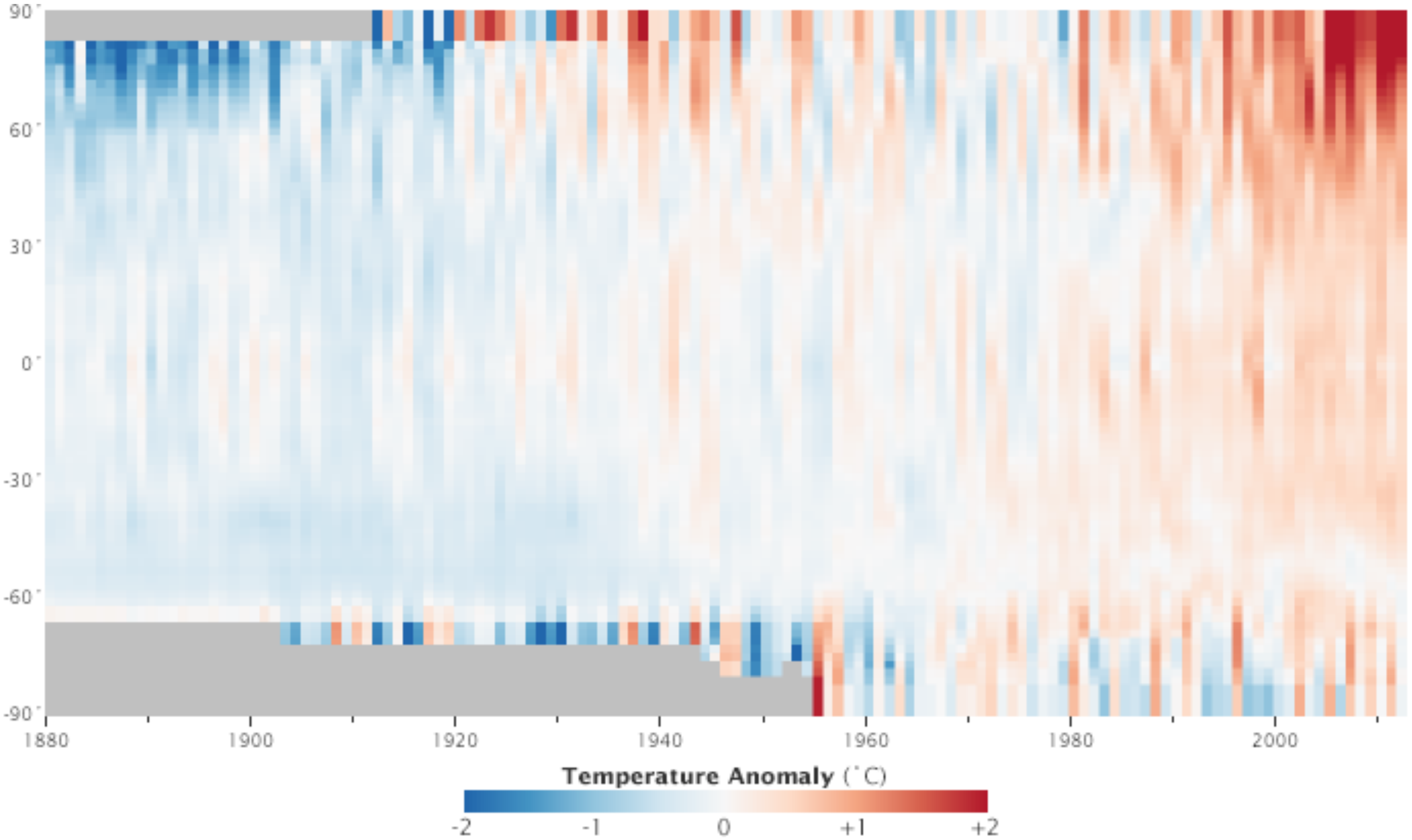


Year

1880 1900 1920 1940 1960 1980 2000

Temperature Difference (˚C)

-3 -2 -1 0 1 2 3


90˚
60˚
30˚
0˚
-30˚
-60˚
-90˚
1880
1900
1920
1940
1960
1980
2000
Temperature Anomaly (˚C)
-2
-1
0
+1
+2

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Contact

simmon@planet.com
@rsimmon

planet.com
thumbsupviz.com
earthobservatory.nasa.gov/blogs/elegantfigures