MAPPING & GEOSPATIAL ANALYSIS

UNIVERSITY OF CALGARY

RELATED ACTIVITY

DOWNLOAD THE
"Exercise - Geospatial.zip"
NOTEBOOK & DATASET

TOPICS

A History of Mapmaking and some Map Basics

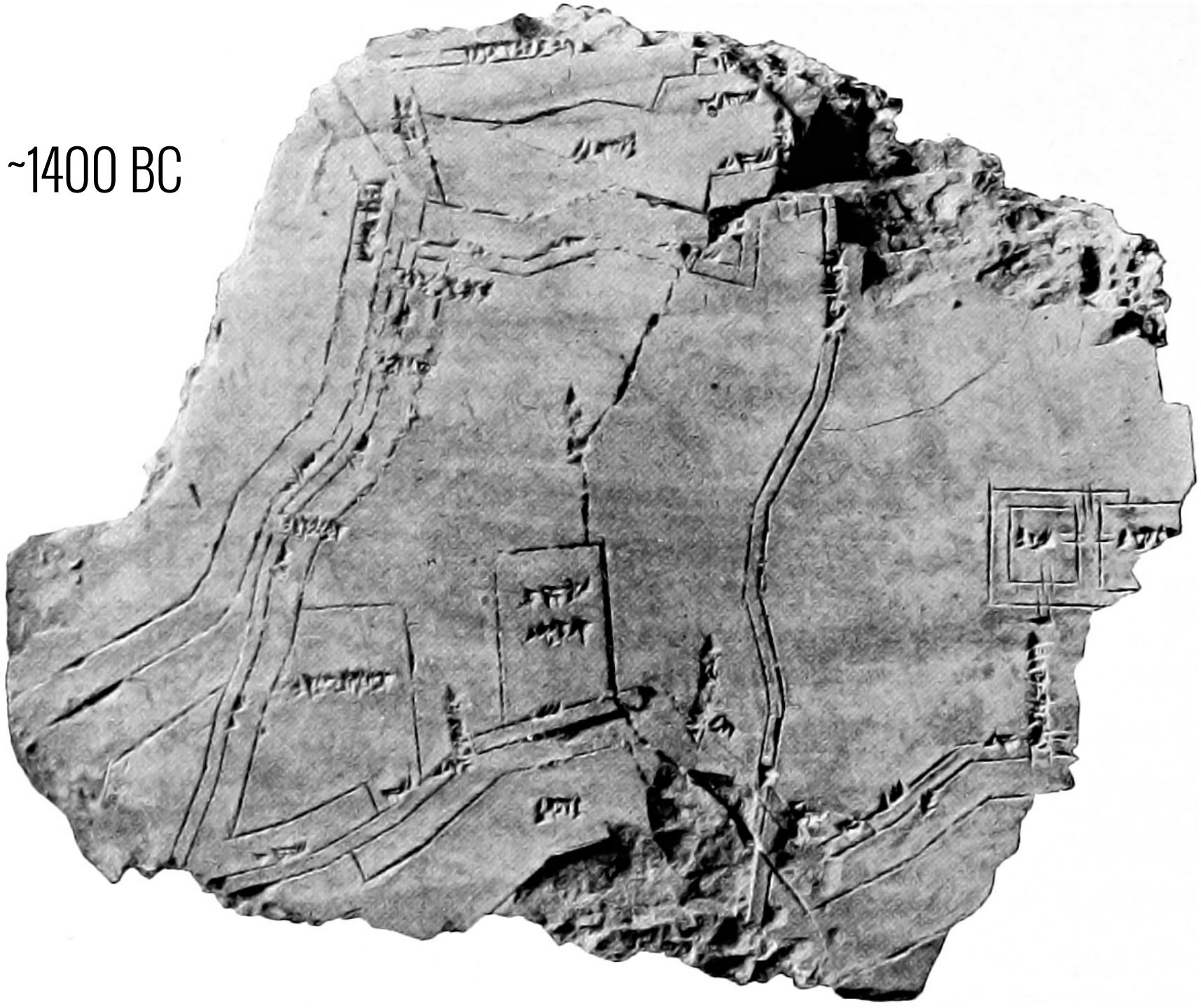
Visualization Approaches for Geospatial Data

(Some basic concepts, rules of thumb, and warnings)

Mapping and Analysis Tools

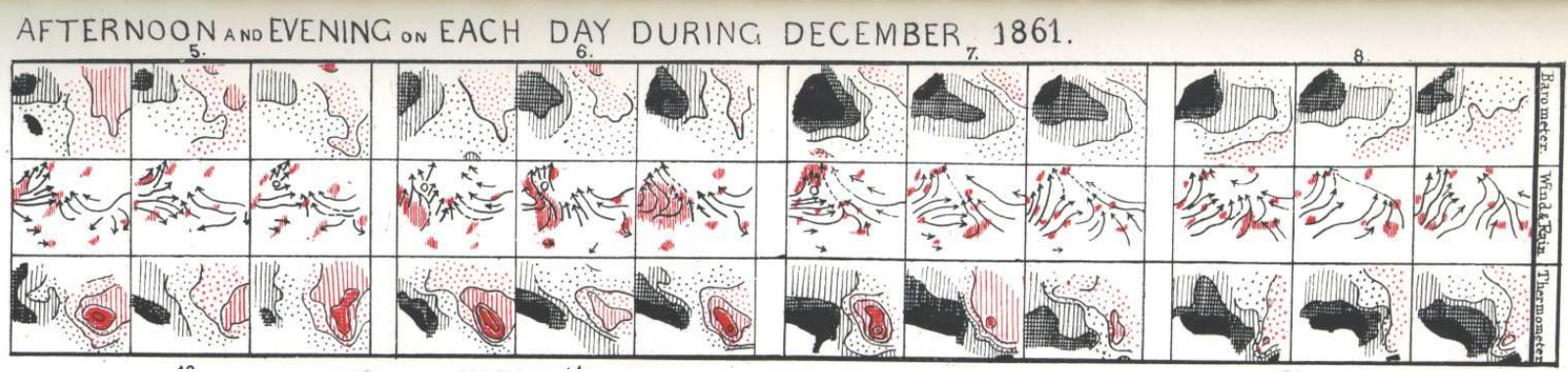
HISTORY OF MAPMAKING

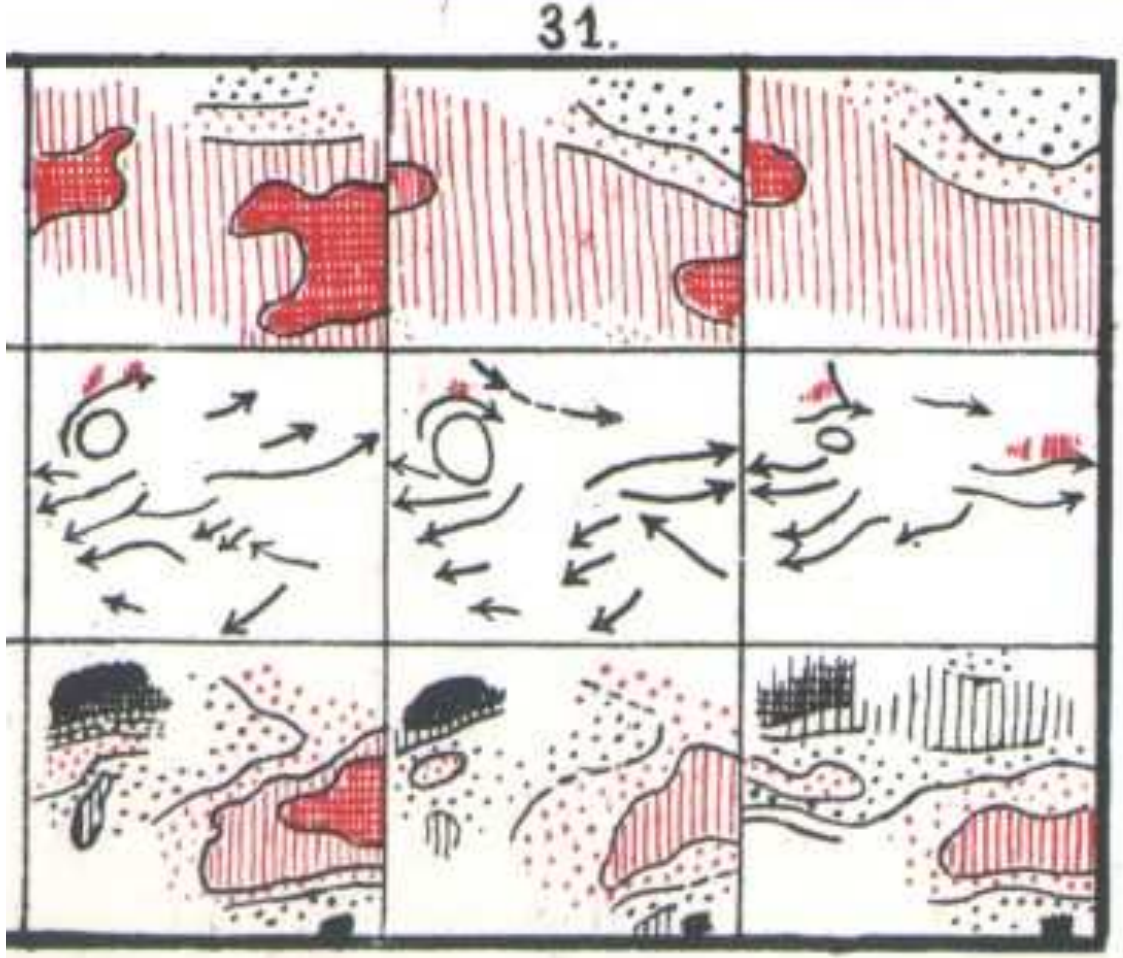
MAP OF NIPPUR ~1400 BC

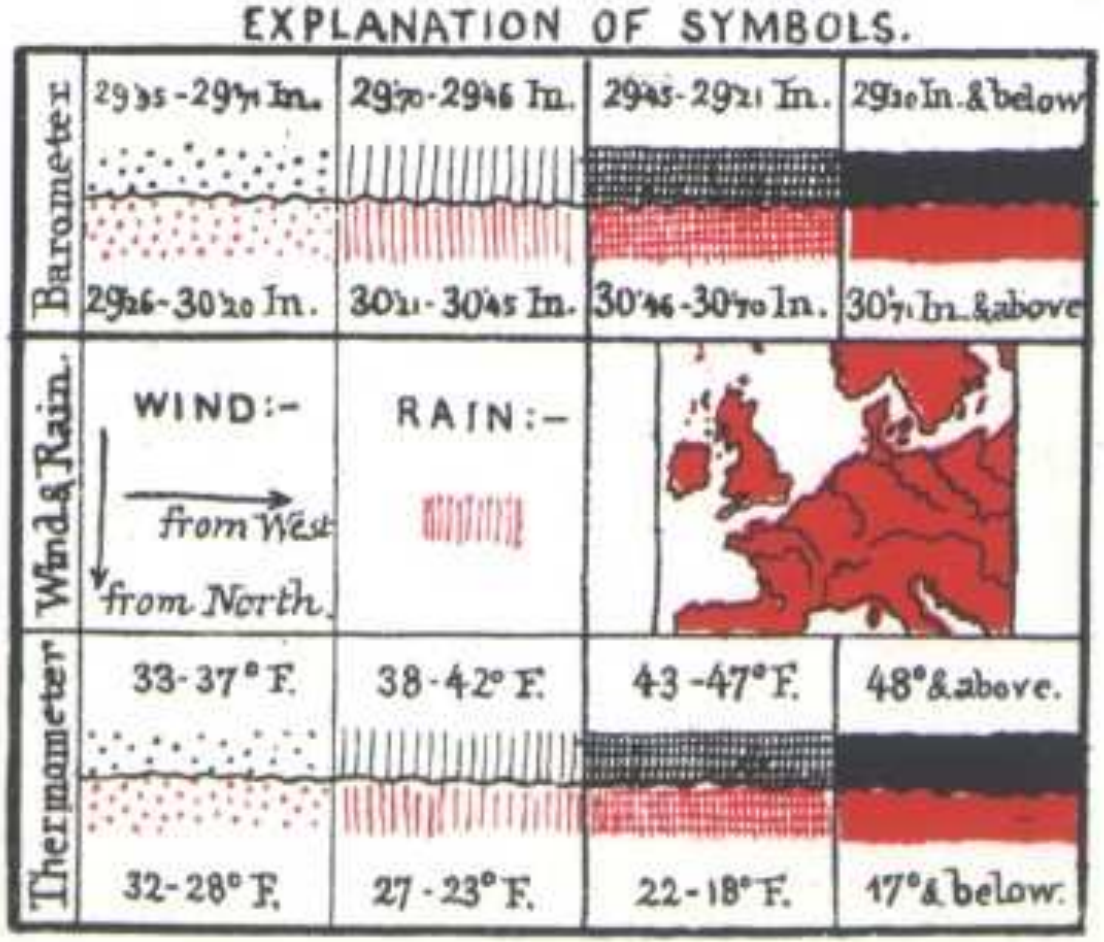


Multivariate weather chart of Europe

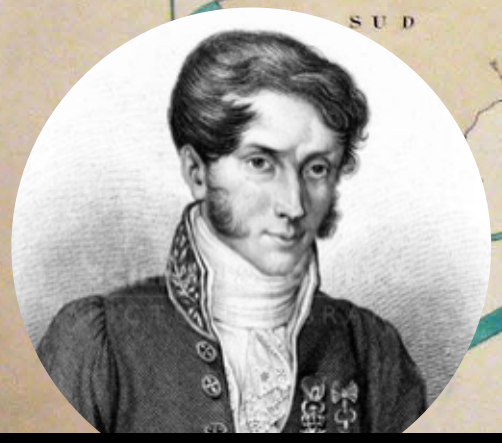
Francis Galton 1863



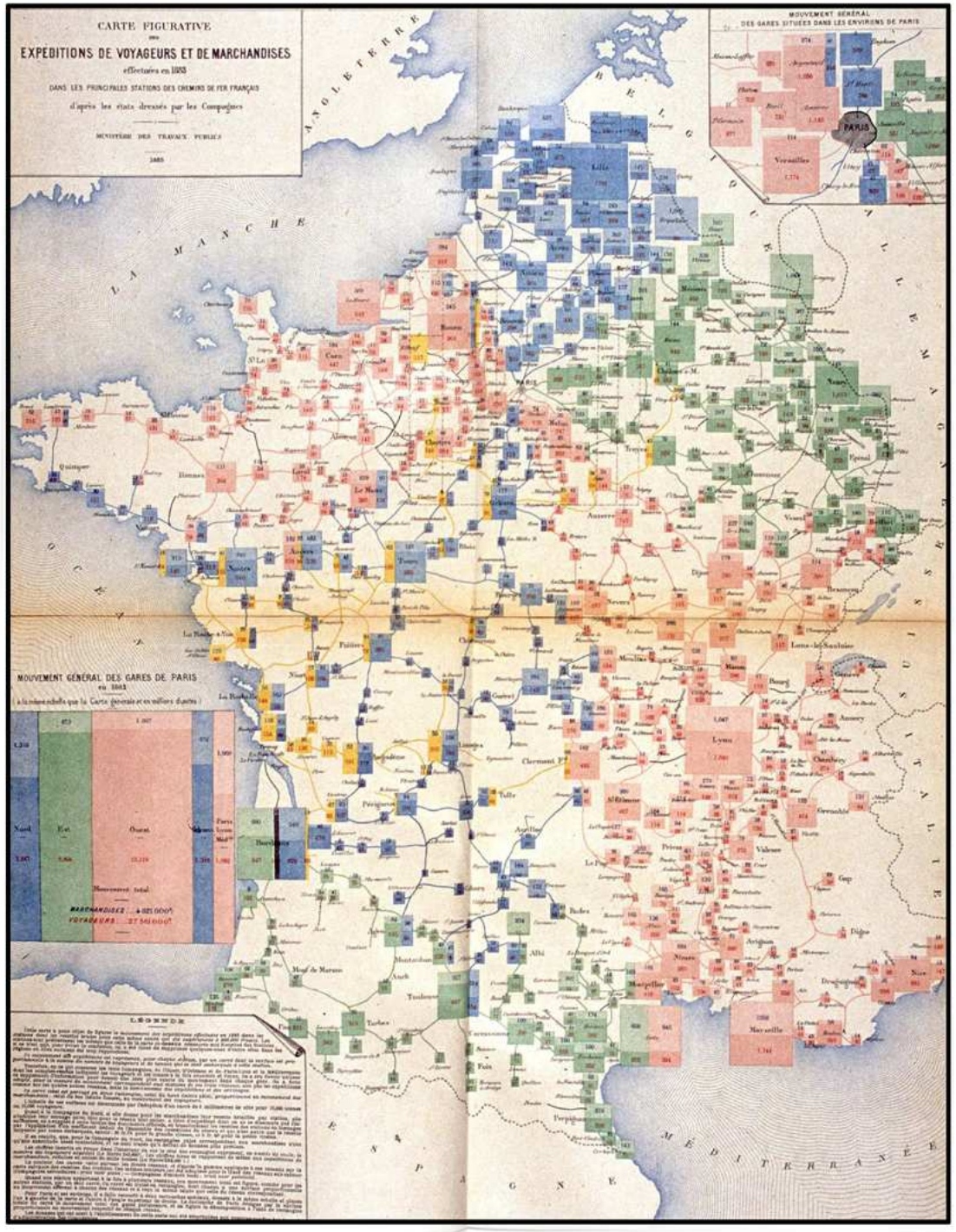




A series of weather maps from the *Meteorographica*.



CHARLES JOSEPH MINARD 1864



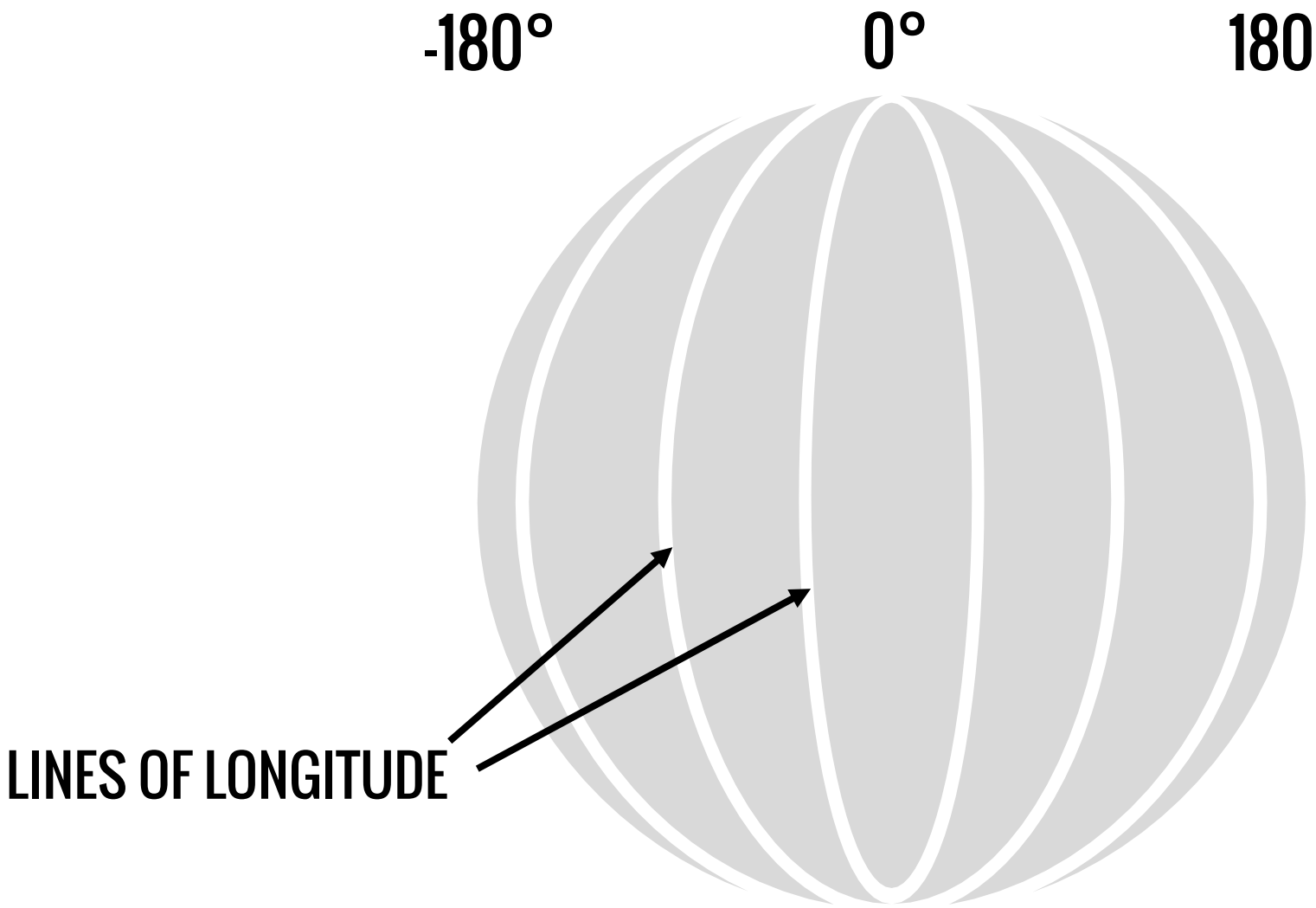
Mouvement des voyageurs et des marchandises dans les principales stations de chemins de fer en 1882

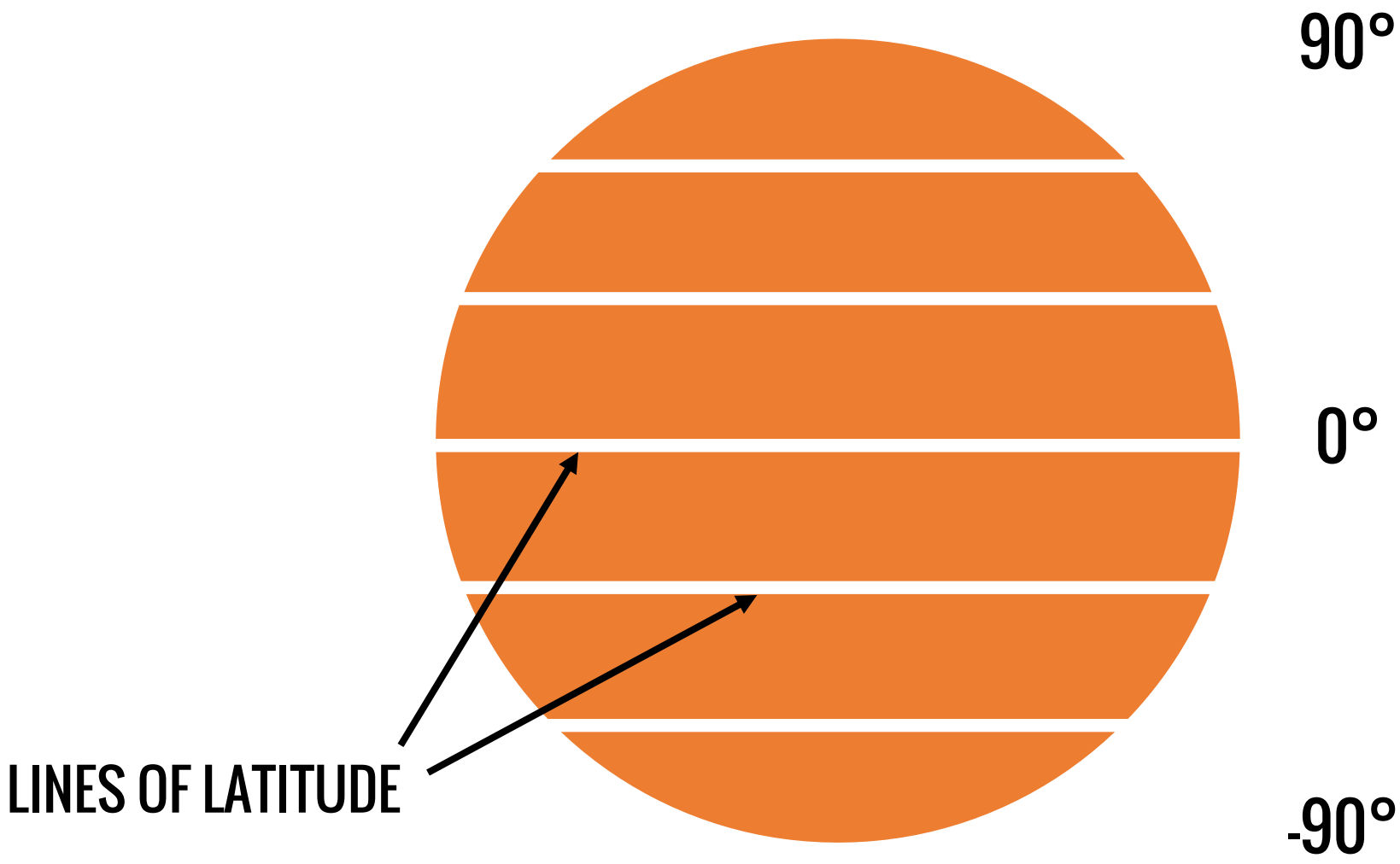
Albums de Statistique Graphique

1884

MAP BASICS

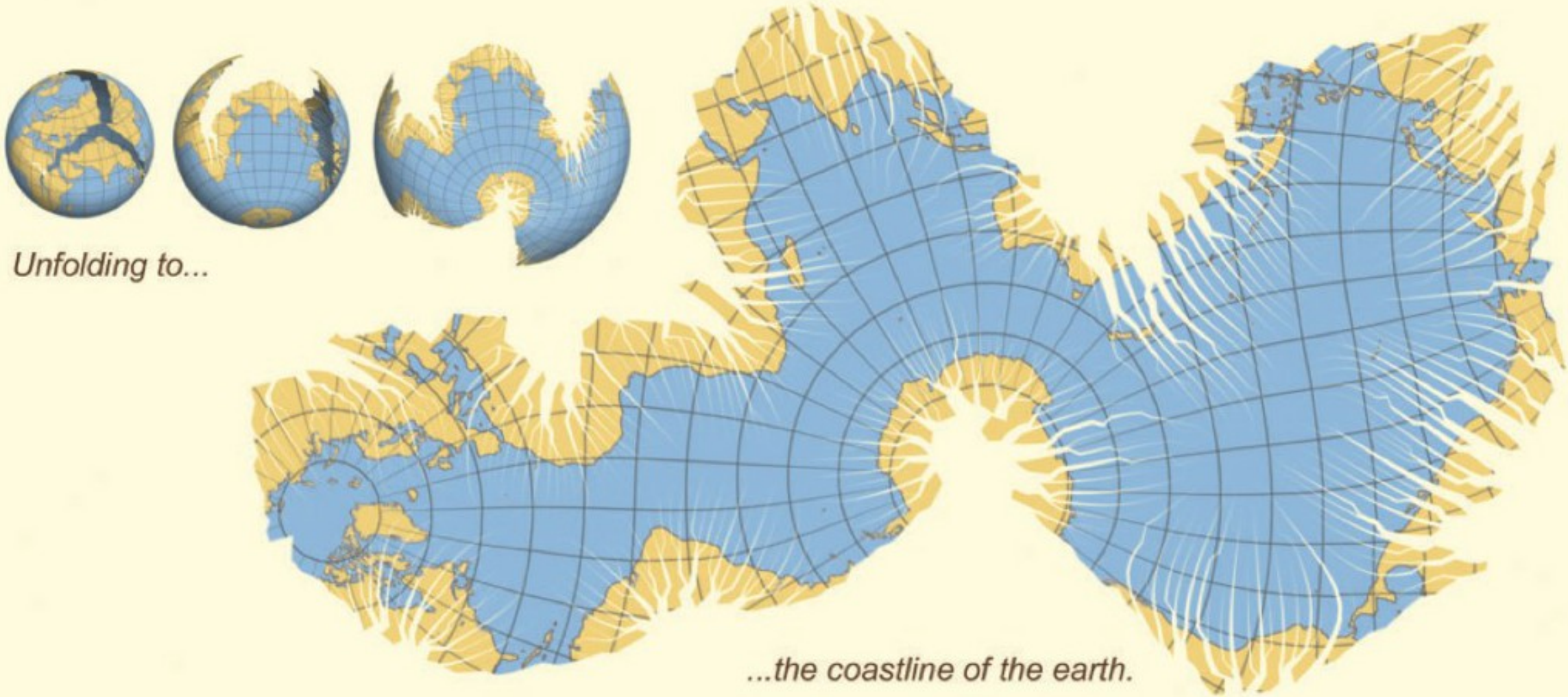
THE EARTH IS FLAT (ON MAPS)




90°
0°
-90°
LINES OF LATITUDE

A SPHERE TEARS WHEN YOU FLATTEN IT...

...BUT THERE ARE MANY WAYS TO TEAR

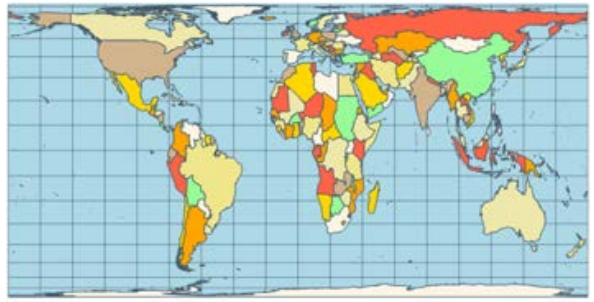


VAN WIJK 2008

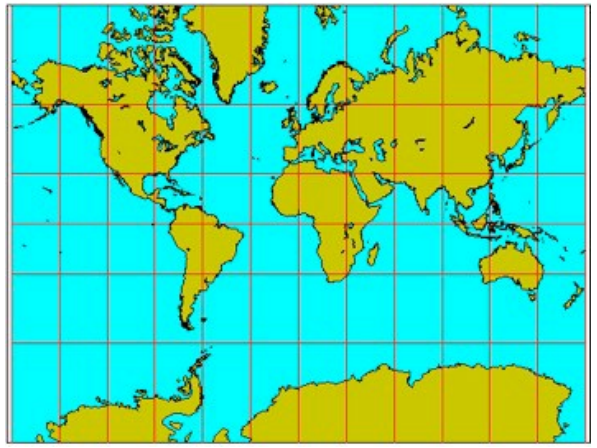
PROJECTIONS

DECIDING WHERE TO TEAR AND WHERE TO DISTORT

AZIMUTHAL
PRESERVES DIRECTION



EQUAL-AREA
PRESERVES AREA



CONFORMAL
PRESERVES LOCAL SHAPES

MERCATOR PROJEcTION

GERARDUS MERCATOR 1569

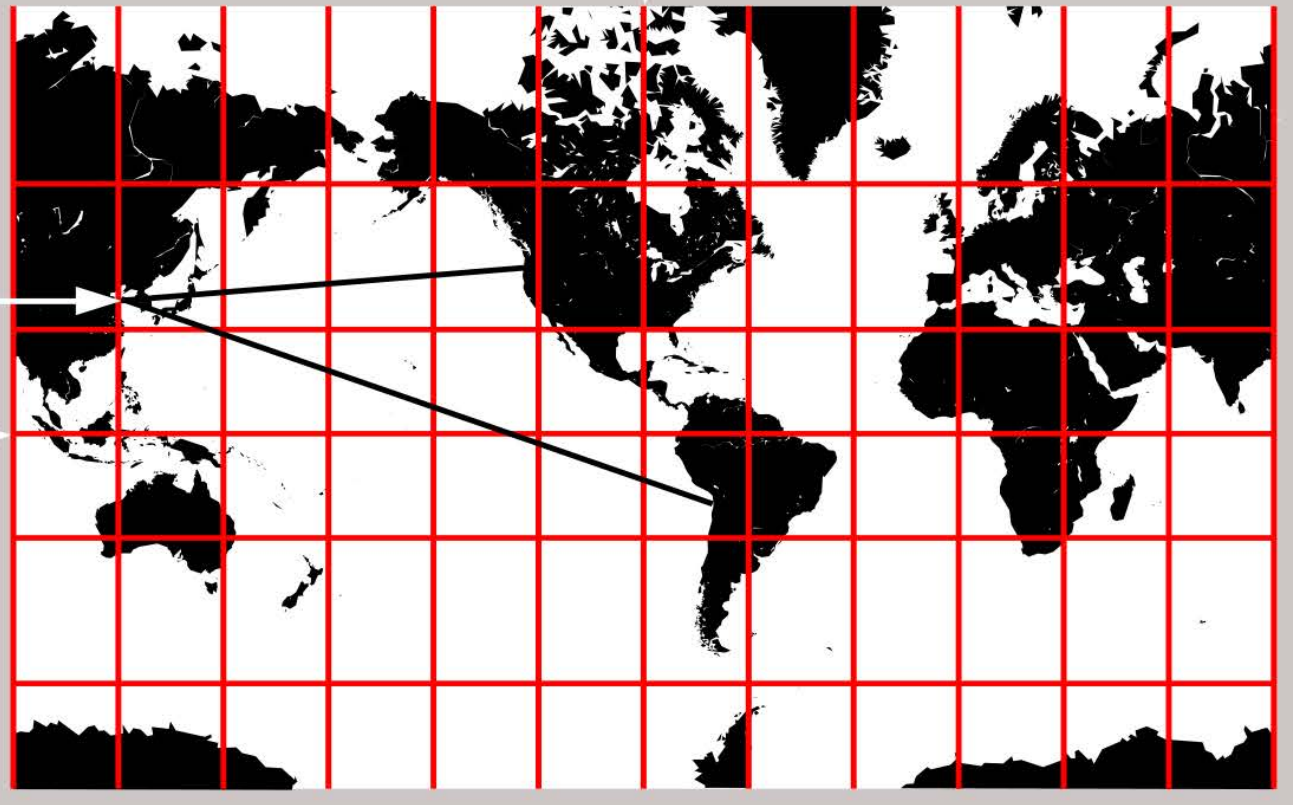
Central meridian
(selected by mapmaker)

Great distortion
in high latitudes

Examples of rhumb lines
(direction true between
any two points)

Equator touches cylinder
if cylinder is tangent

Reasonably true
shapes and distances
within 15° of Equator



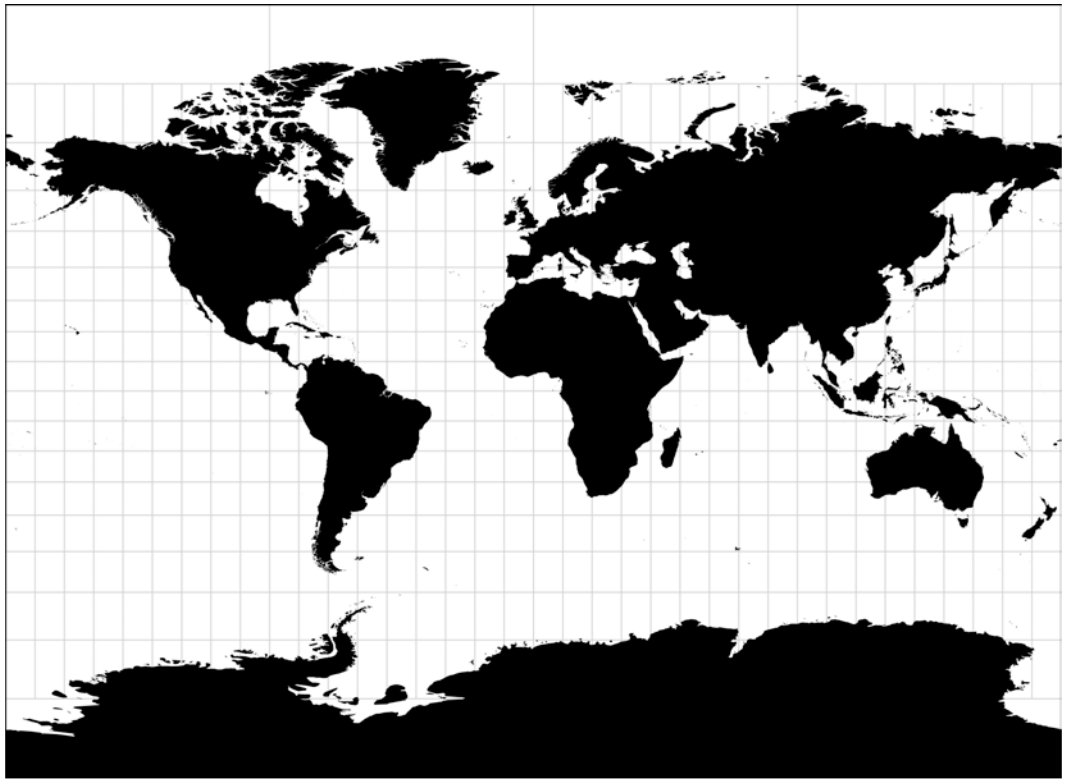
WEB MERCATOR

There are **tons** of useful projections...

But usually you'll be using

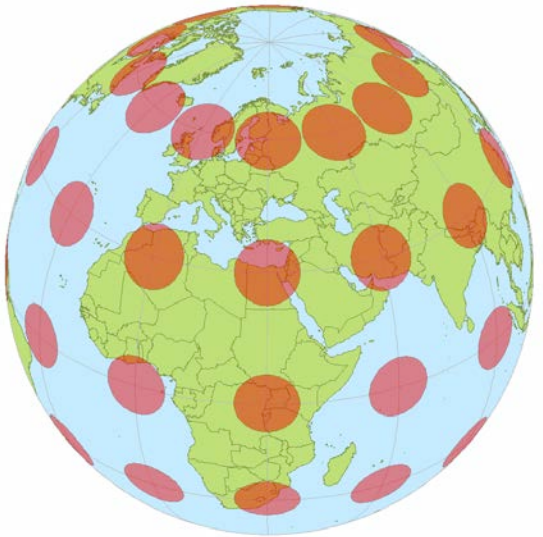
Web Mercator

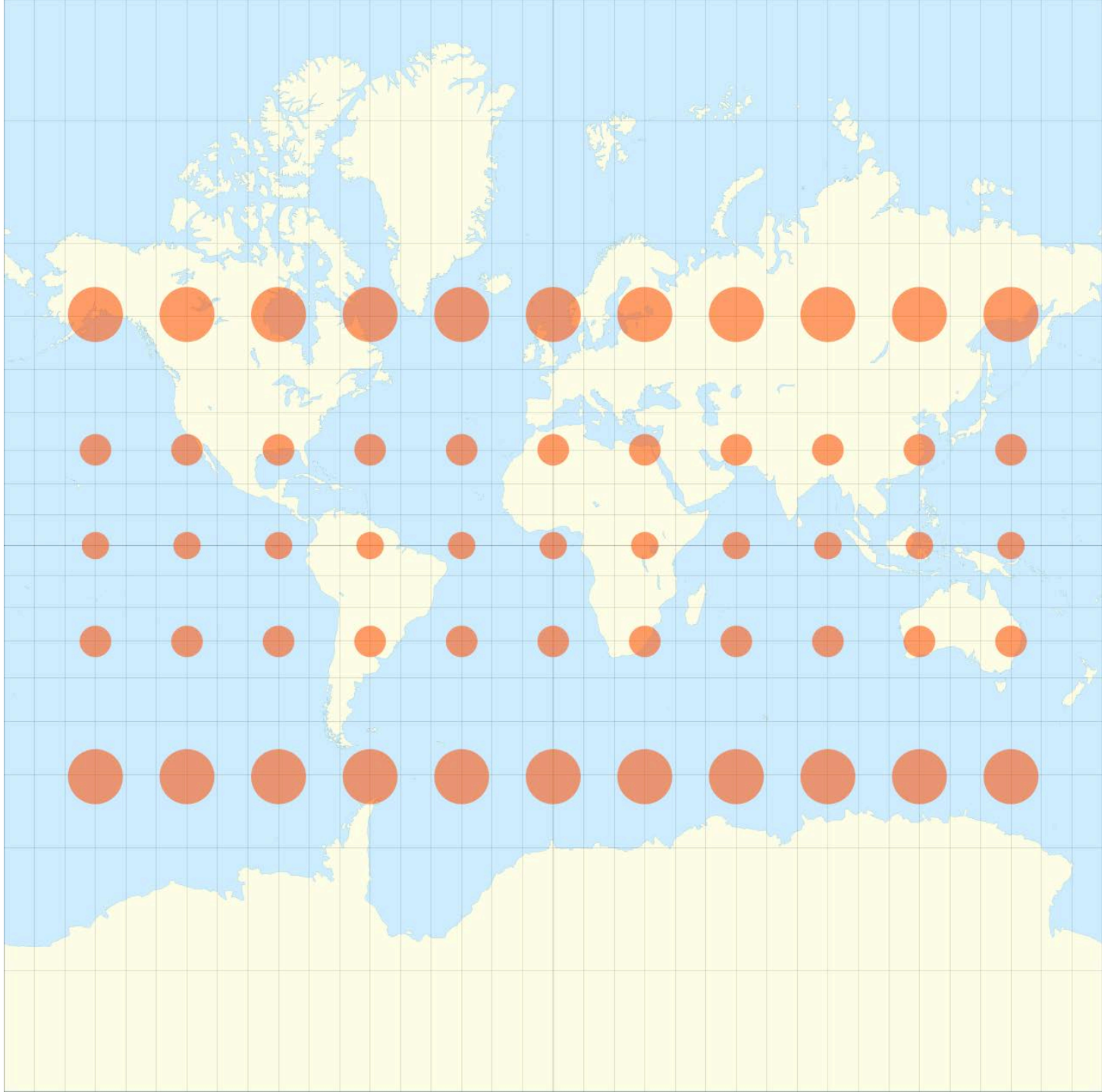
(also called Google Web Mercator,
Spherical Mercator, WGS 84 Web Mercator, etc.)



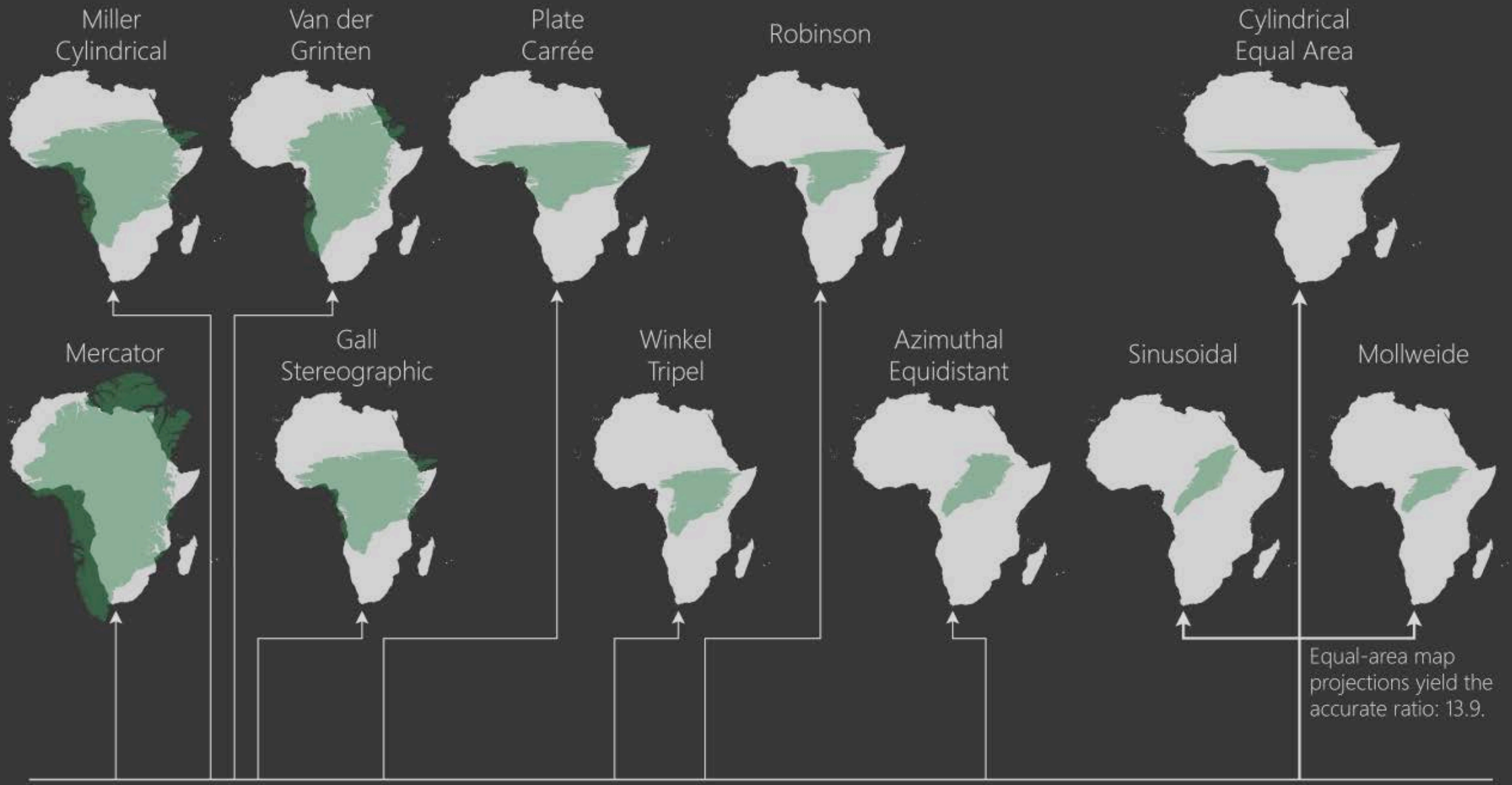
DISTORTION

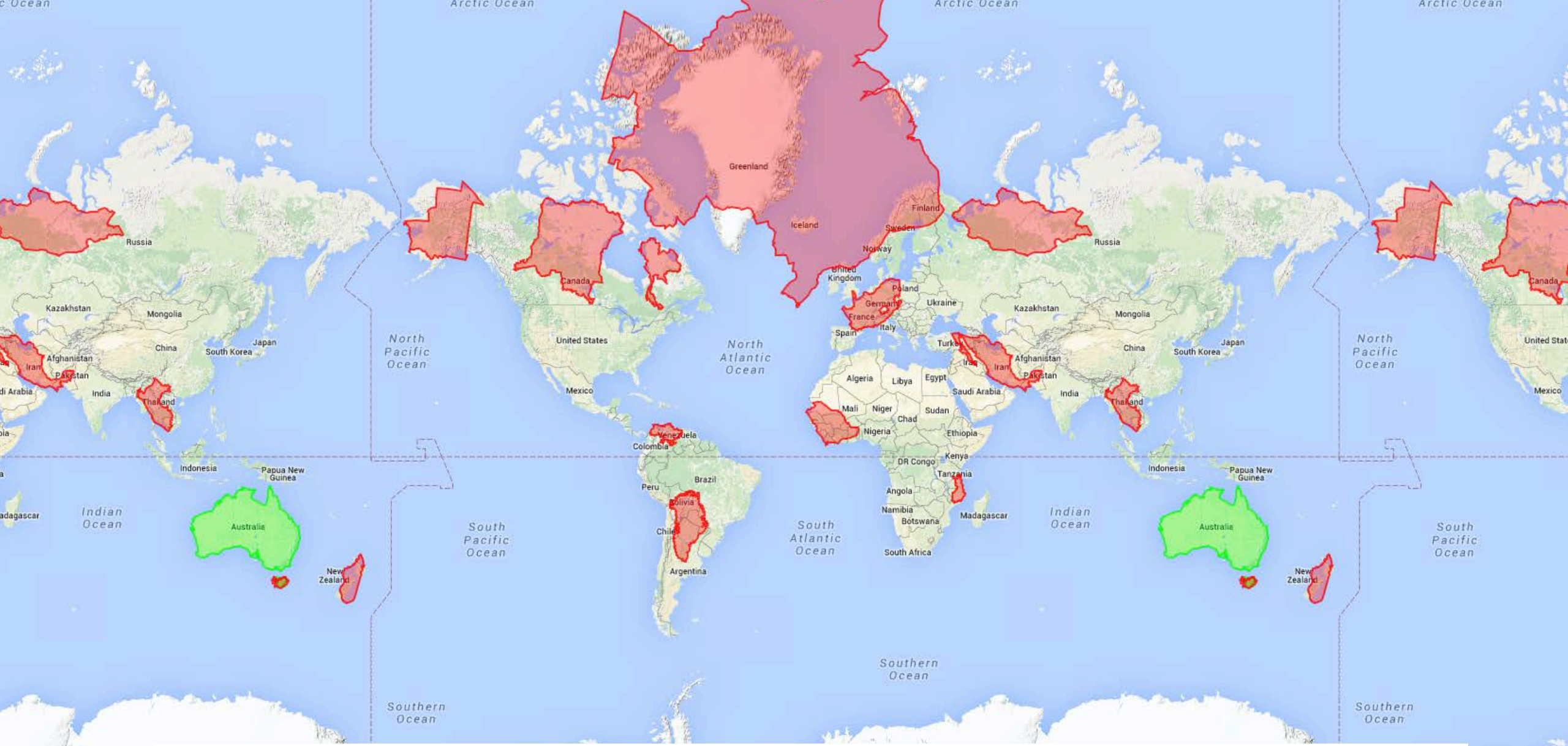
MERCATOR PROJECTION WITH TISSOT'S INDICATRIX





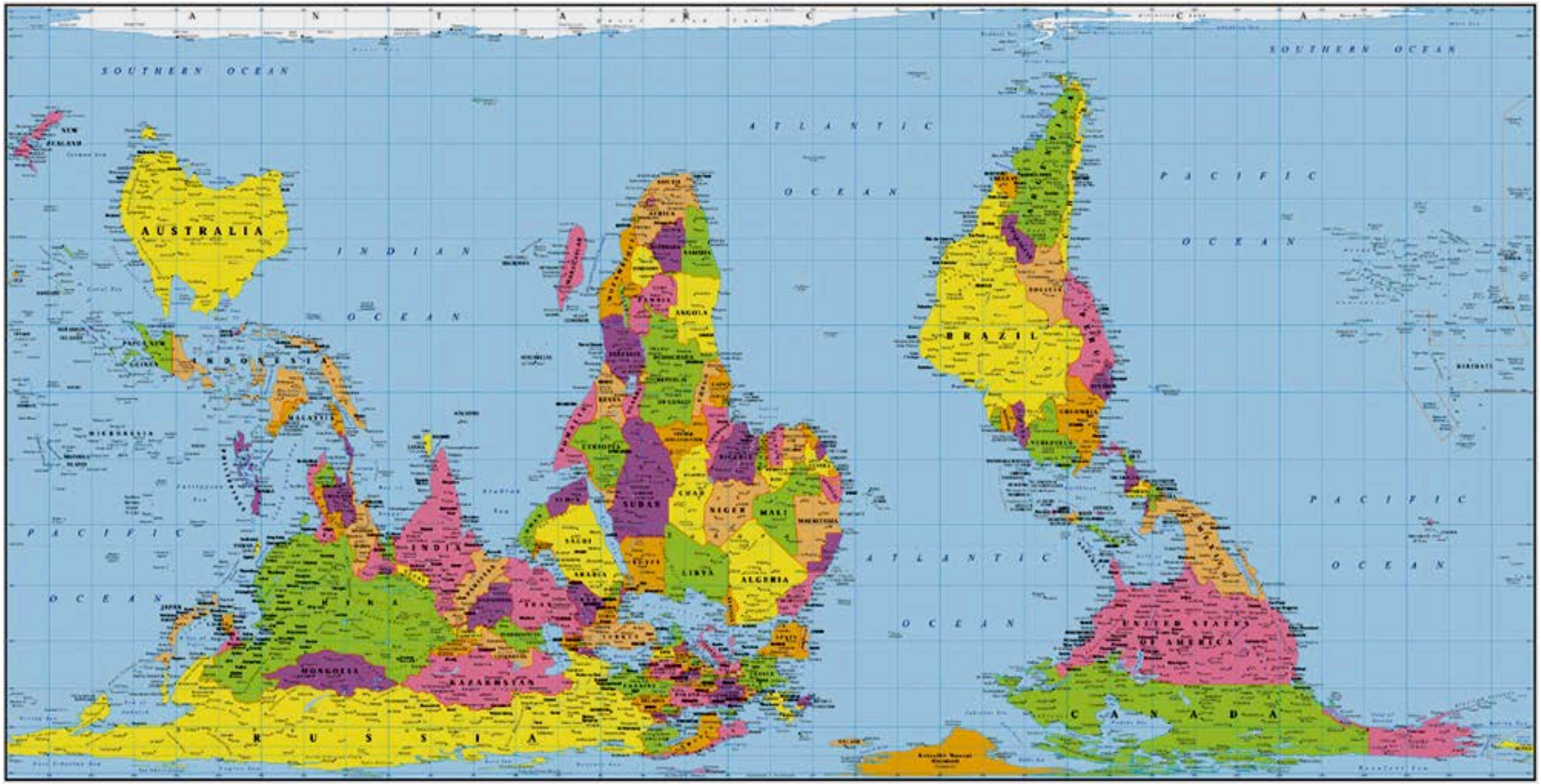
Areal Distortion of Global Map Projections





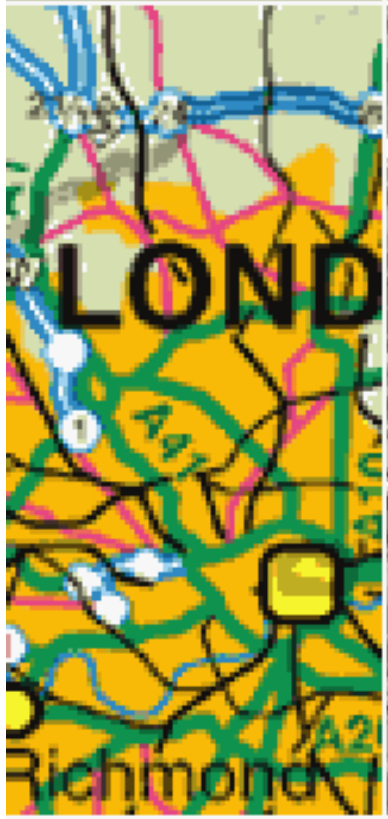
MERCATOR PUZZLE GAME

https://bramus.github.io/mercator-puzzle-redux/

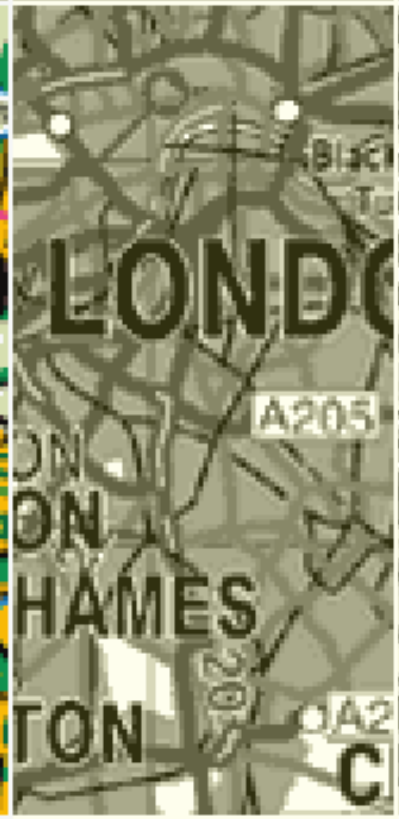


INVERTED GALL-PETERS PROJECTION

SCALE AND GENERALIZATION



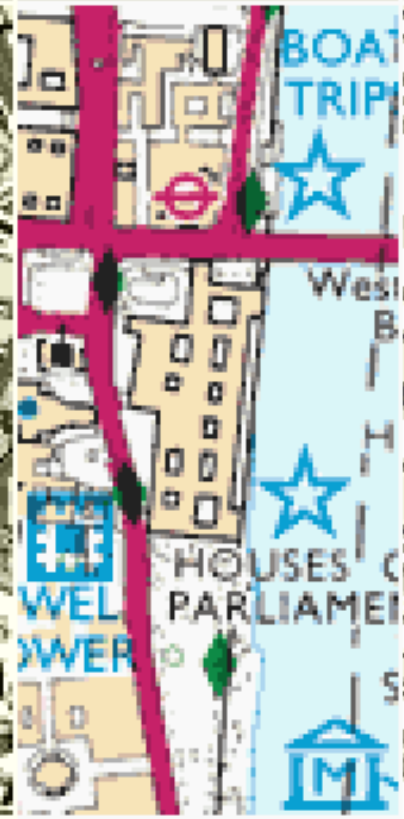
1:1,000,000 scale mapping



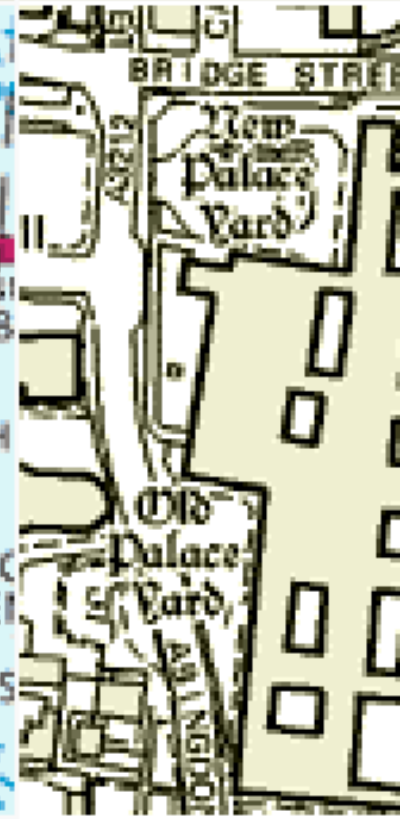
1:625,000 scale mapping

1:250,000 scale mapping

1:50,000 scale mapping



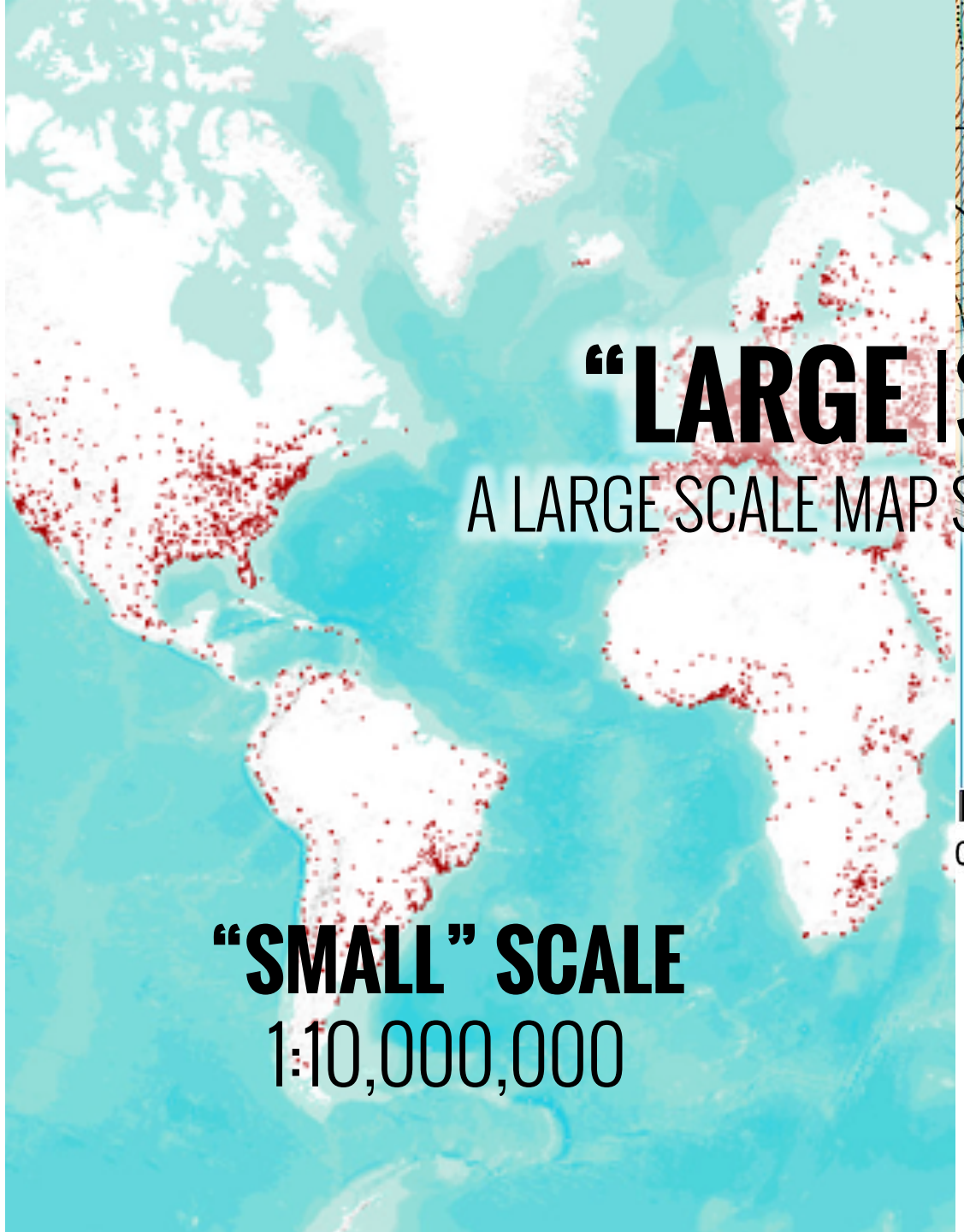
1:25,000 scale mapping



1:10,000 scale mapping

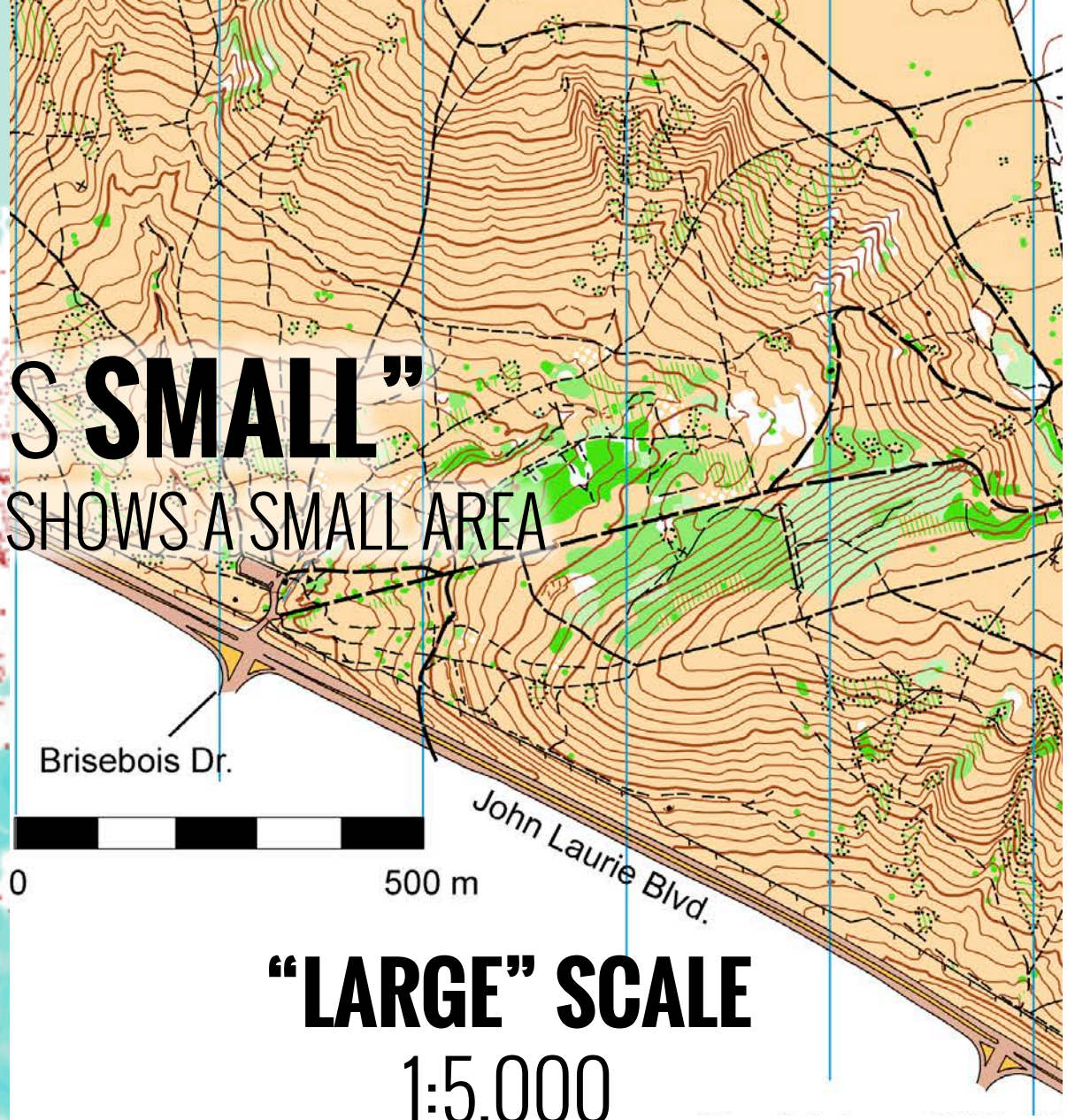
“LARGE IS SMALL”

A LARGE SCALE MAP SHOWS A SMALL AREA



“SMALL” SCALE

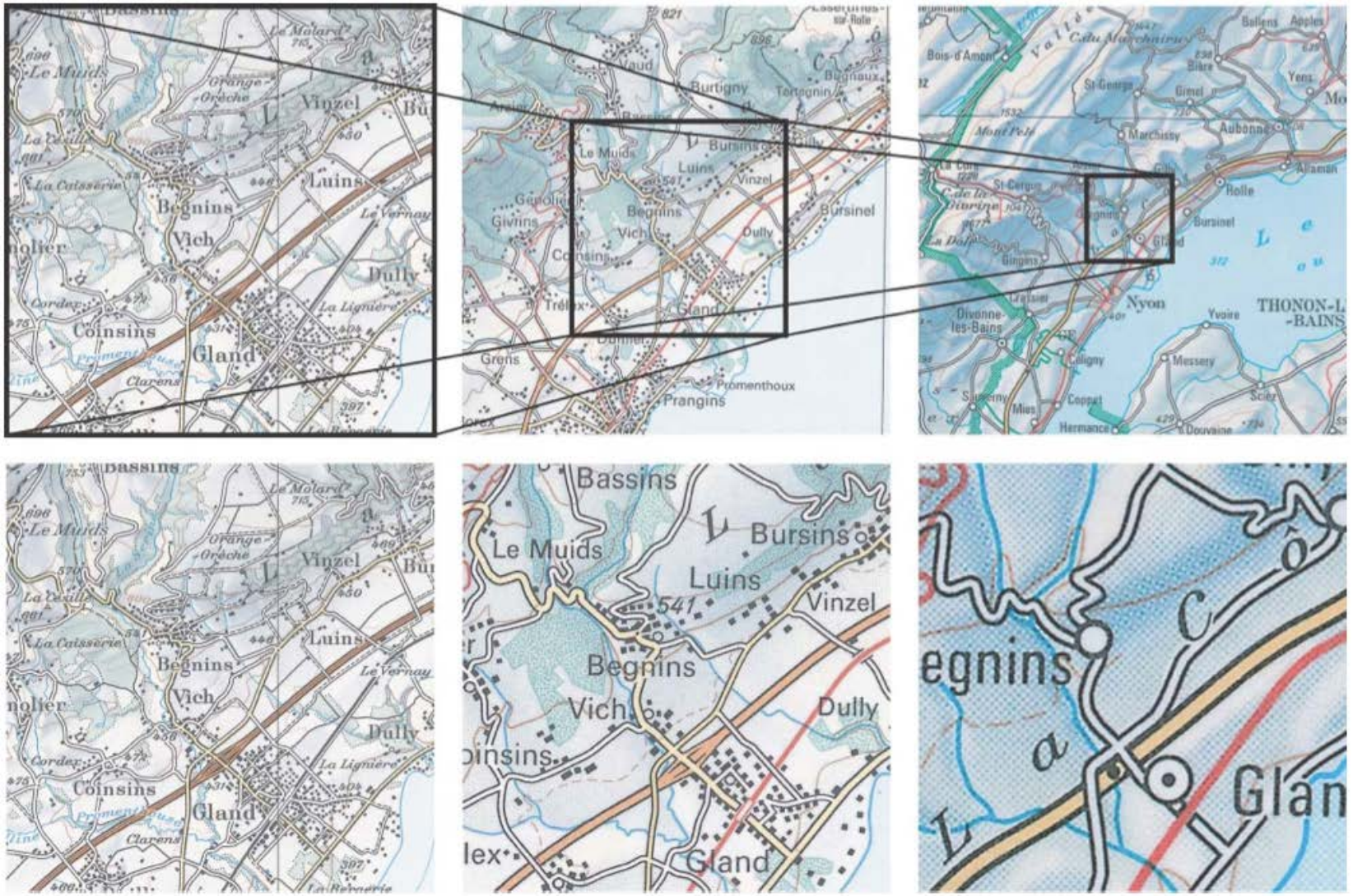
1:10,000,000



“LARGE” SCALE

1:5,000

GENERALIZATION



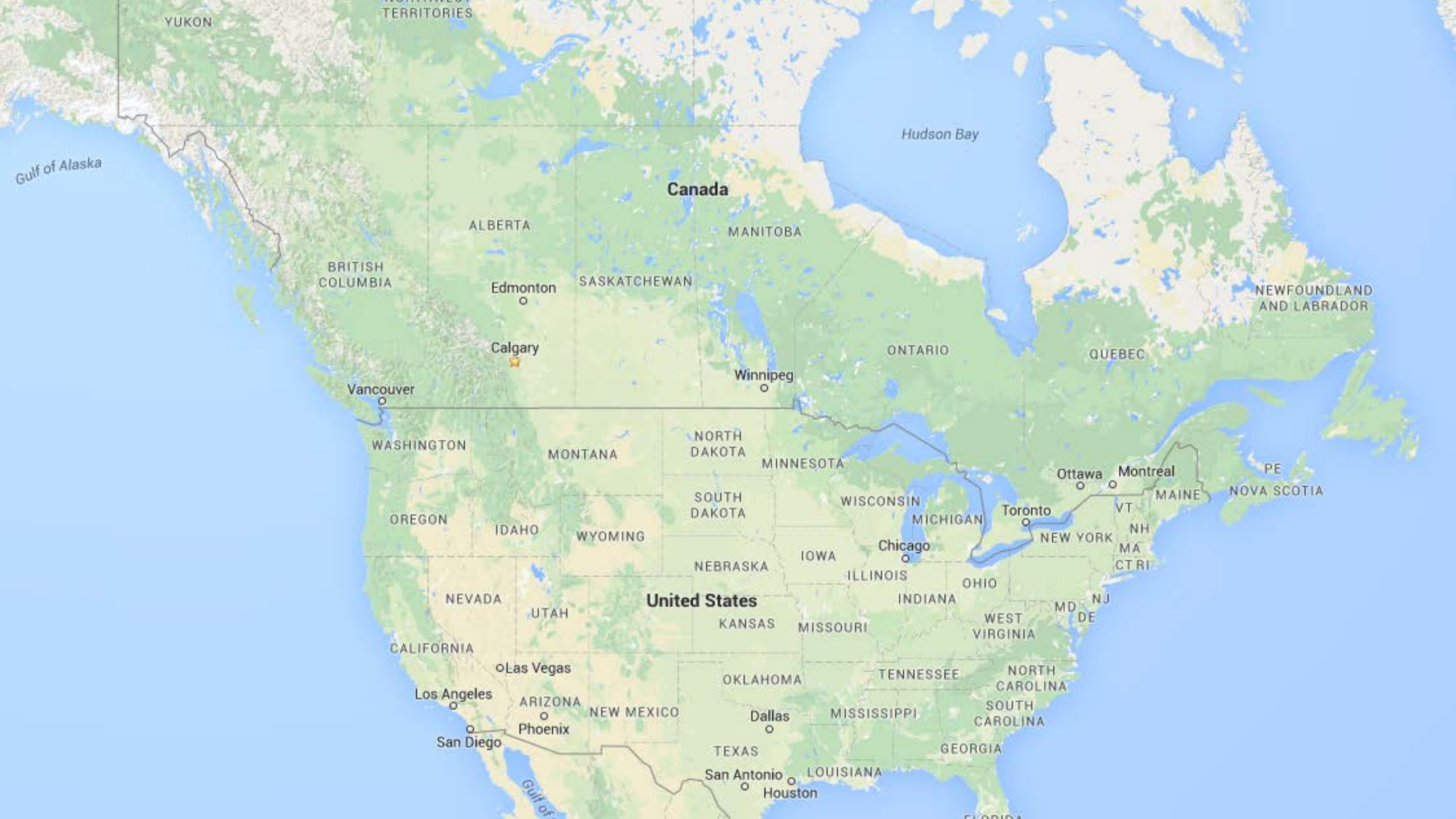

Saletes
Le Borgeaut
Le Montoly
La Lignière
Le Cottage
Les Avouillons
La Bergerie


La Lignière
Les Avouillons
Le Cottage

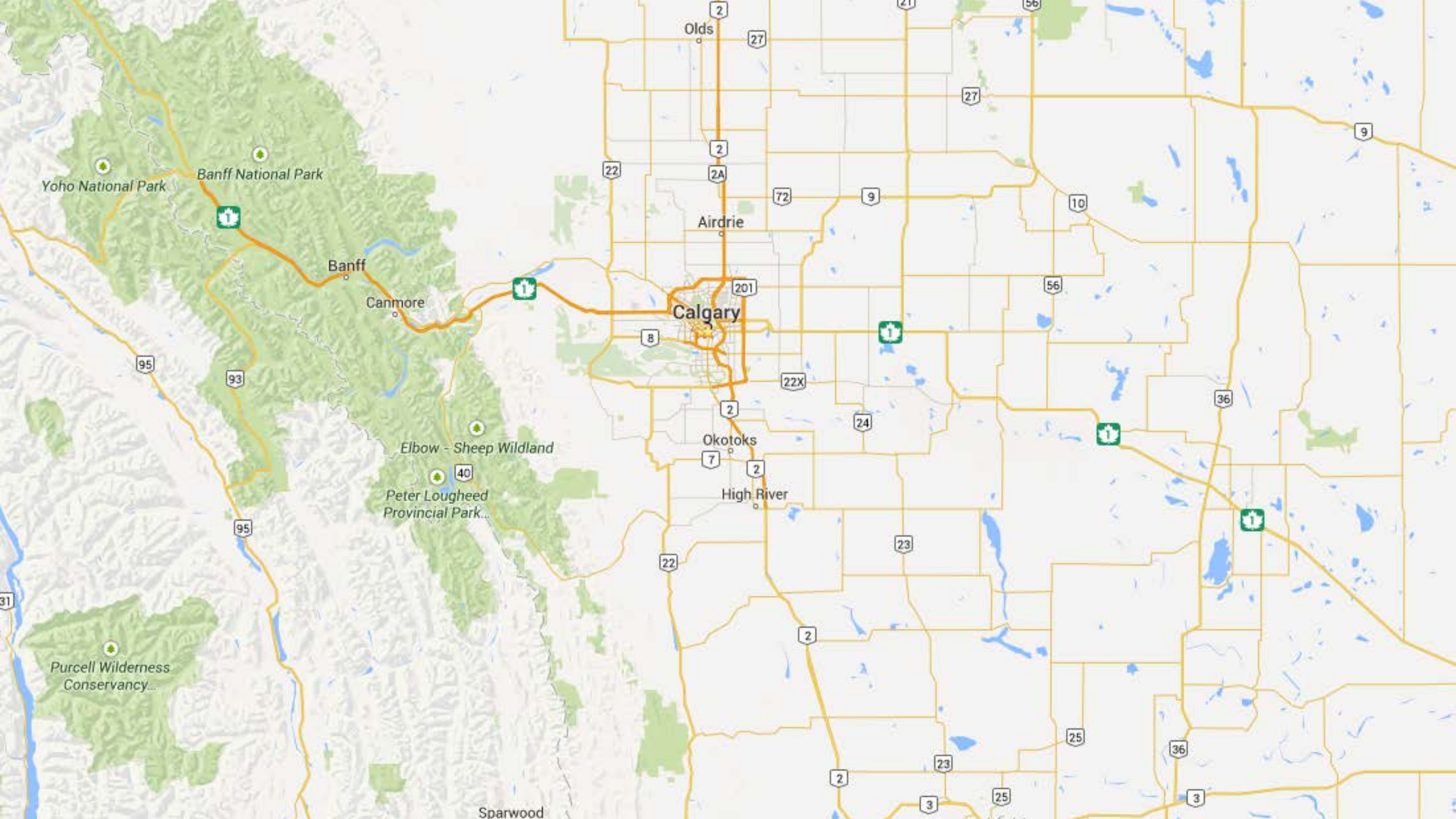

Dully
La Lignière
404
397

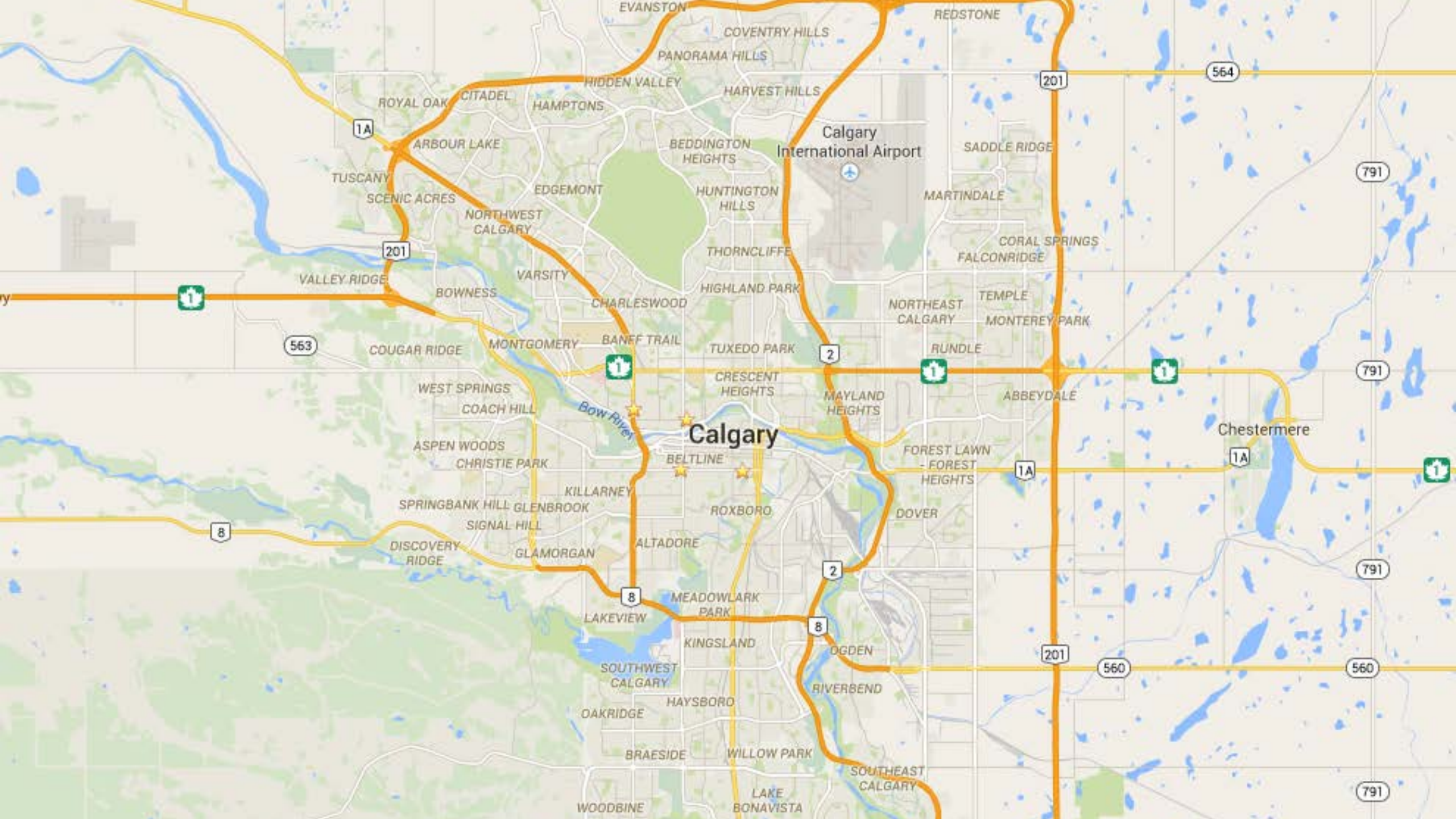

and

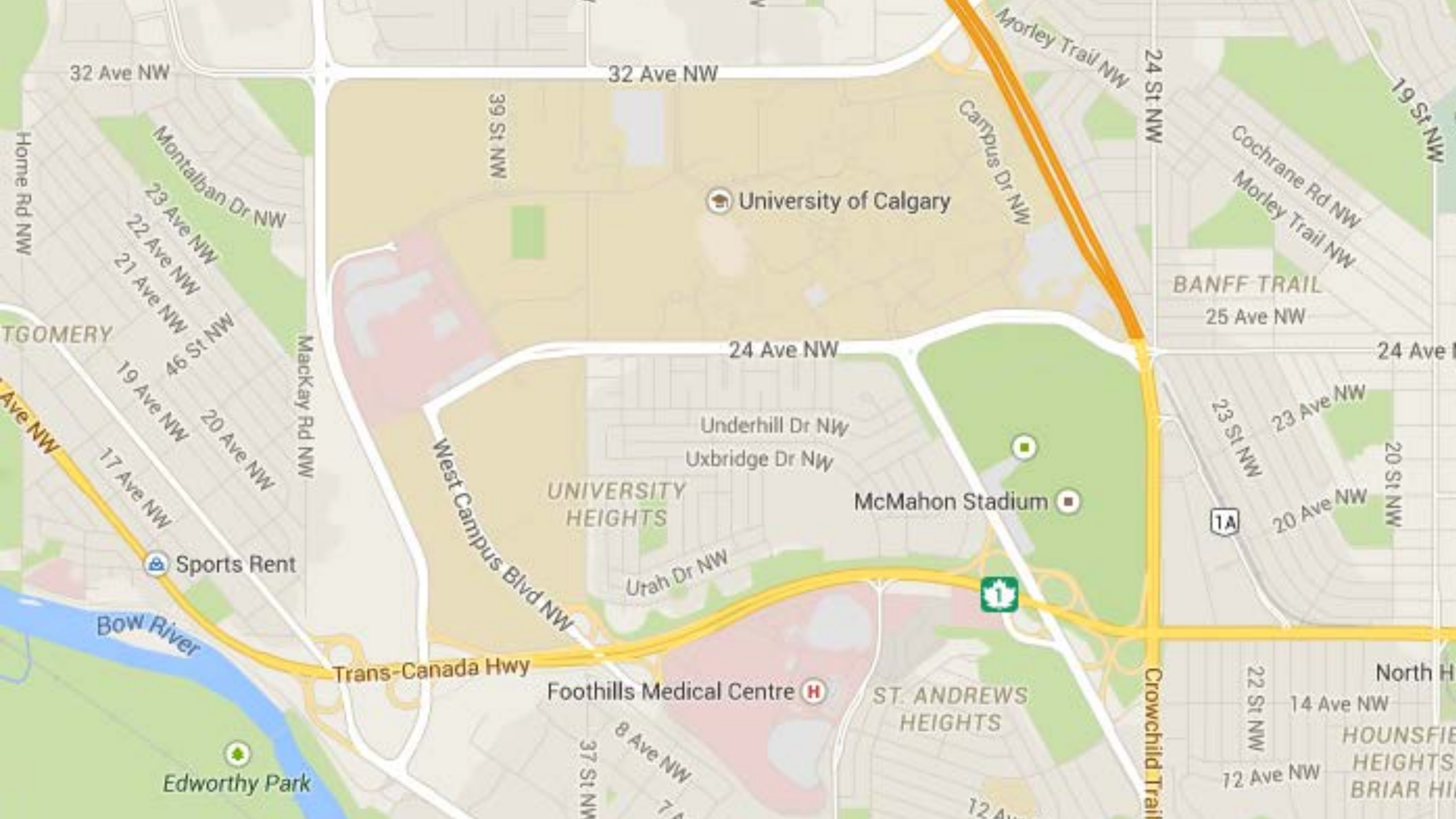

Northwestern Passages
Greenland
Iceland
AK
YT
NT
NU
Canada
Hudson Bay
AB
BC
SK
MB
NL
ON
QC
WA
MT
ND
MN
NB
PE
NS
ME
OR
ID
WY
SD
WI
MI
NH
NY
MA
NE
IA
IL
IN
OH
PA
NV
United States
UT
MO
WV
DE
KY
VA
CA
OK
AR
TN
NC
AZ
NM
MS
AL
GA
SC
TX
LA
FL
Gulf of Mexico
Mexico
Cuba
North Atlantic Ocean

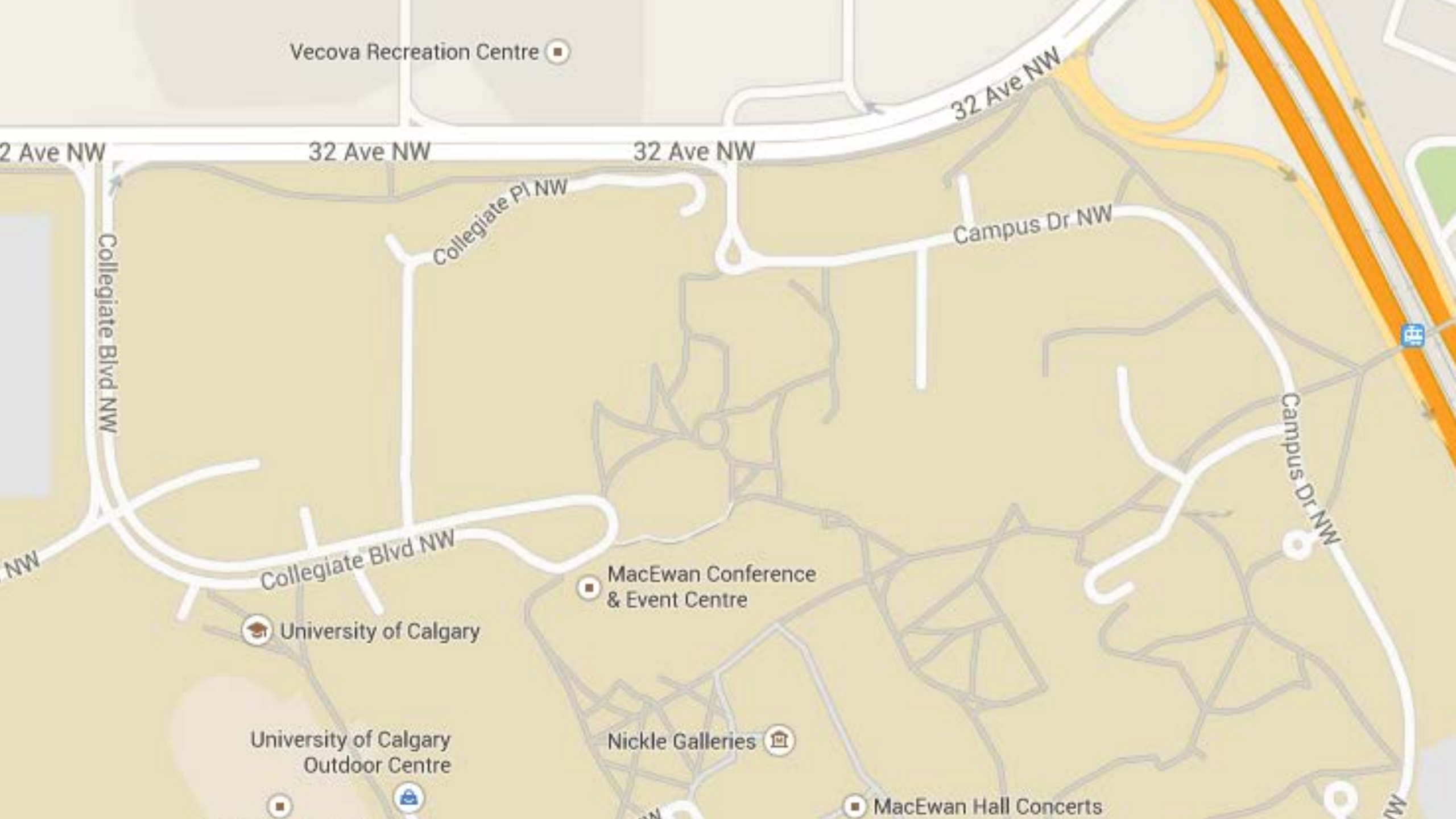

YUKON
TERRITORIES
Gulf of Alaska
Hudson Bay
Canada
ALBERTA
MANITOBA
BRITISH
COLUMBIA
Edmonton
SASKATCHEWAN
NEWFOUNDLAND
AND LABRADOR
Calgary
ONTARIO
QUEBEC
Winnipeg
Vancouver
WASHINGTON
NORTH
DAKOTA
MONTANA
MINNESOTA
Ottawa
Montreal
PE
NOVA SCOTIA
SOUTH
DAKOTA
WISCONSIN
MAINE
VT
OREGON
IDAHO
MICHIGAN
Toronto
NH
WYOMING
NEW YORK
Chicago
MA
CT RI
IOWA
NEBRASKA
ILLINOIS
OHIO
NEVADA
United States
INDIANA
NJ
UTAH
MD
DE
KANSAS
MISSOURI
WEST
VIRGINIA
CALIFORNIA
Las Vegas
OKLAHOMA
TENNESSEE
NORTH
CAROLINA
Los Angeles
ARIZONA
NEW MEXICO
Dallas
MISSISSIPPI
SOUTH
CAROLINA
Phoenix
San Diego
TEXAS
GEORGIA
San Antonio
LOUISIANA
Houston

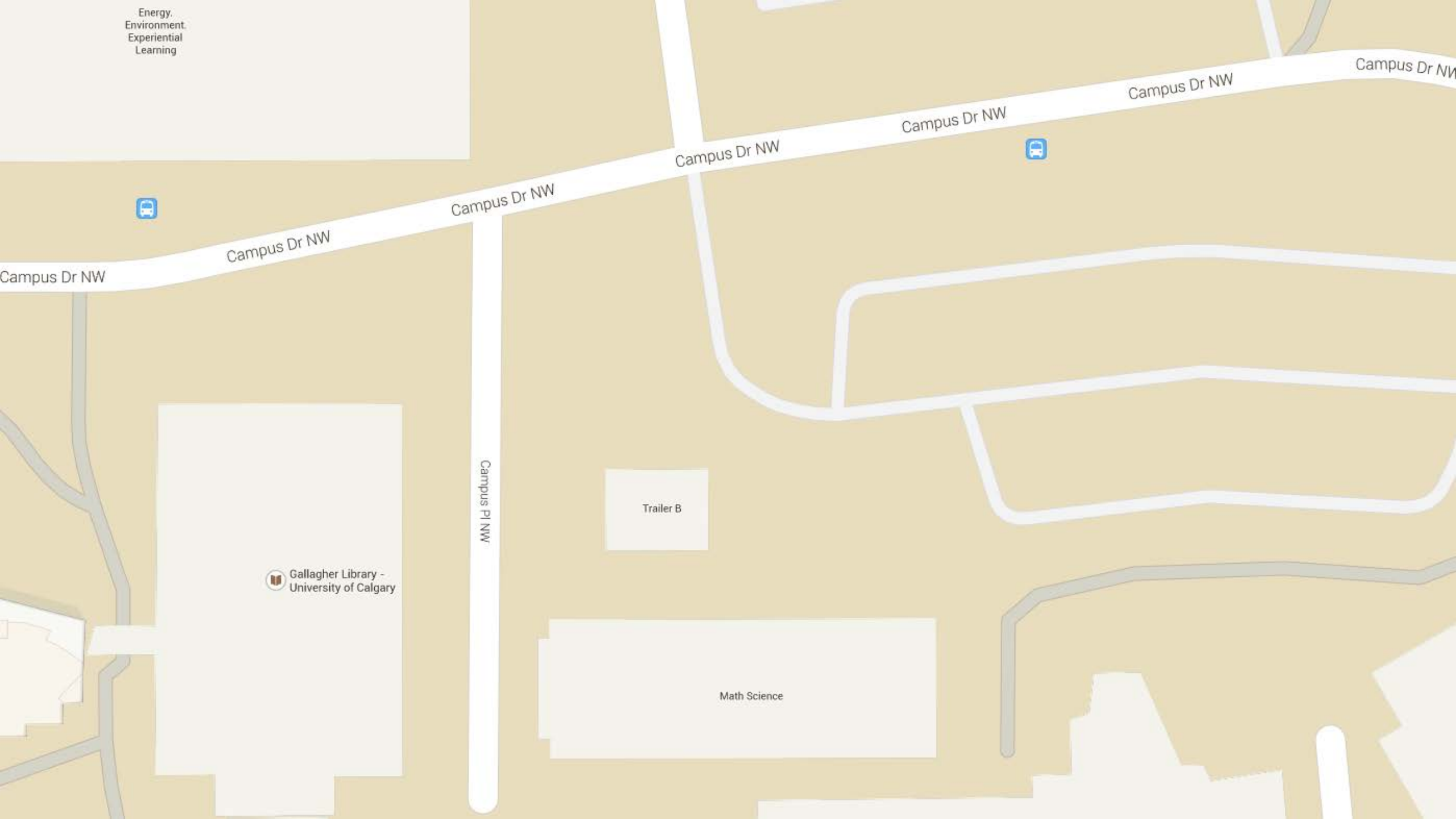

BRITISH COLUMBIA
SASKATCHEWAN
Prince George
Edmonton
Jasper National Park
Red Deer
Saskatoon
Banff National Park
Calgary
Kamloops
Regina
Medicine Hat
Kelowna
Lethbridge
Vancouver Island
Vancouver
Nanaimo
Surrey
Abbotsford
Bellingham
Victoria
Mt. Baker-Snoqualmie National Forest
Everett
Okanogan-Wenatchee National Forest
Seattle
Spokane
Flathead National Forest
Tacoma
WASHINGTON
Lewis & Clark National Forest
NORTH DAKOTA
Olympia
Missoula
MONTANA
Little Missouri National Grassland
Bismarck
Yakima
Lolo National Forest

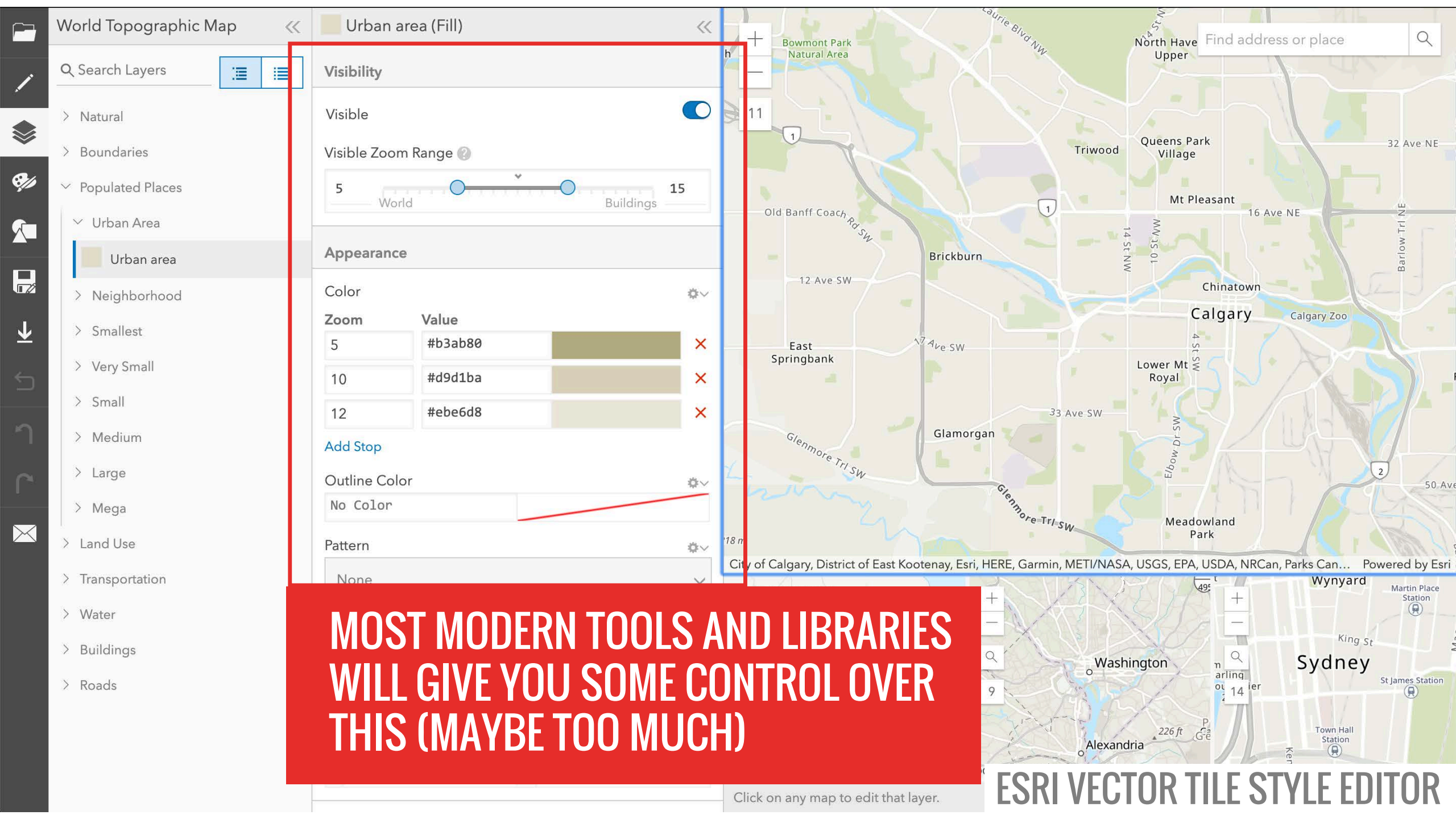

Olds
Airdrie
Calgary
Okotoks
High River
Banff
Canmore
Yoho National Park
Banff National Park
Elbow - Sheep Wildland
Peter Lougheed Provincial Park...
Purcell Wilderness Conservancy...
Sparwood


EVANSTON
REDSTONE
COVENTRY HILLS
PANORAMA HILLS
HIDDEN VALLEY
HARVEST HILLS
ROYAL OAK
CITADEL
HAMPTONS
ARBOUR LAKE
BEDDINGTON HEIGHTS
Calgary International Airport
SADDLE RIDGE
TUSCANY
SCENIC ACRES
EDGEMONT
HUNTINGTON HILLS
MARTINDALE
NORTHWEST CALGARY
THORNCLIFFE
CORAL SPRINGS
FALCONRIDGE
VALLEY RIDGE
VARSITY
BOWNESS
HIGHLAND PARK
CHARLESWOOD
NORTHEAST CALGARY
TEMPLE
MONTEREY PARK
COUGAR RIDGE
MONTGOMERY
BANFF TRAIL
TUXEDO PARK
RUNDLE
CRESCENT HEIGHTS
WEST SPRINGS
MAYLAND HEIGHTS
ABBEYDALE
COACH HILL
Bow River
Calgary
Chestermere
ASPEN WOODS
CHRISTIE PARK
BELTLINE
FOREST LAWN - FOREST HEIGHTS
KILLARNEY
SPRINGBANK HILL
GLENBROOK
ROXBORO
DOVER
SIGNAL HILL
DISCOVERY RIDGE
GLAMORGAN
ALTADORE
MEADOWLARK PARK
LAKEVIEW
KINGSLAND
OGDEN
SOUTHWEST CALGARY
RIVERBEND
HAYSBORO
OAKRIDGE
BRAESIDE
WILLOW PARK
SOUTHEAST CALGARY
LAKE BONAVISTA
WOODBINE
1A
201
564
791
563
2
1
8
560


32 Ave NW
32 Ave NW
Morley Trail NW
24 St NW
19 St NW
Home Rd NW
Montalban Dr NW
39 St NW
Campus Dr NW
University of Calgary
Cochrane Rd NW
Morley Trail NW
BANFF TRAIL
25 Ave NW
23 Ave NW
22 Ave NW
21 Ave NW
TGOMERY
St NW
46
MacKay Rd NW
24 Ave NW
24 Ave
19 Ave NW
20 Ave NW
Underhill Dr NW
Uxbridge Dr NW
West Campus Blvd NW
UNIVERSITY HEIGHTS
McMahon Stadium
23 St NW
23 Ave NW
20 Ave NW
20 St NW
1A
17 Ave NW
Sports Rent
Utah Dr NW
Bow River
Trans-Canada Hwy
Foothills Medical Centre
ST. ANDREWS HEIGHTS
Crowchild Trail
22 St NW
14 Ave NW
North H
8 Ave NW
37 St NW
12 Ave NW
HOUNSFIE
HEIGHTS
BRIAR HI
Edworthy Park


Vecova Recreation Centre
2 Ave NW
32 Ave NW
32 Ave NW
32 Ave NW
Collegiate Pl NW
Campus Dr NW
Collegiate Blvd NW
Collegiate Blvd NW
Campus Dr NW
NW
MacEwan Conference
& Event Centre
University of Calgary
University of Calgary
Outdoor Centre
Nickle Galleries
MacEwan Hall Concerts


Energy.
Environment.
Experiential
Learning
Campus Dr NW
Campus Dr NW
Campus Dr NW
Campus Dr NW
Campus Dr NW
Campus Dr NW
Campus Pl NW
Trailer B
Gallagher Library -
University of Calgary
Math Science


World Topographic Map
Search Layers
Natural
Boundaries
Populated Places
Urban Area
Urban area
Neighborhood
Smallest
Very Small
Small
Medium
Large
Mega
Land Use
Transportation
Water
Buildings
Roads
Urban area (Fill)
Visibility
Visible
Visible Zoom Range
5
15
World
Buildings
Appearance
Color
Zoom
Value
5
#b3ab80
10
#d9d1ba
12
#ebe6d8
Add Stop
Outline Color
No Color
Pattern
None
Find address or place
Bowmont Park Natural Area
North Have Upper
Triwood
Queens Park Village
Mt Pleasant
Old Banff Coach Rd SW
Brickburn
12 Ave SW
Chinatown
Calgary
Calgary Zoo
East Springbank
17 Ave SW
Lower Mt Royal
33 Ave SW
Glamorgan
Glenmore Trl SW
Meadowland Park
City of Calgary, District of East Kootenay, Esri, HERE, Garmin, METI/NASA, USGS, EPA, USDA, NRCan, Parks Can...
Powered by Esri
Wynyard
Martin Place Station
King St
Washington
Sydney
St James Station
Alexandria
Town Hall Station
Click on any map to edit that layer.
MOST MODERN TOOLS AND LIBRARIES WILL GIVE YOU SOME CONTROL OVER THIS (MAYBE TOO MUCH)
ESRI VECTOR TILE STYLE EDITOR

SHOWING DATA ON MAPS

KNOWING WHERE TO PLACE DATA

Do you have latitudes and longitudes?

...addresses?

...city or region names?

Do you have points? ...areas? ...paths?

GEOCODING AND LOCATION APIS

Simple geocoding

– Look up locations in a spreadsheet, database, of API

Geocoding tools

– More advanced tools use **big** databases of placenames

Navigation APIs

– Useful for finding paths between locations, etc.

GEOCODING RESULTS CAN'T ALWAYS BE TRUSTED

Tweets from Justin Bieber's Heart: The Dynamics of the "Location" Field in User Profiles

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Electrical Engineering and Computer Science
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Augmented Social Cognition Group
3333 Coyote Hill Road, Palo Alto, CA
{hong,suh,echi}@parc.com

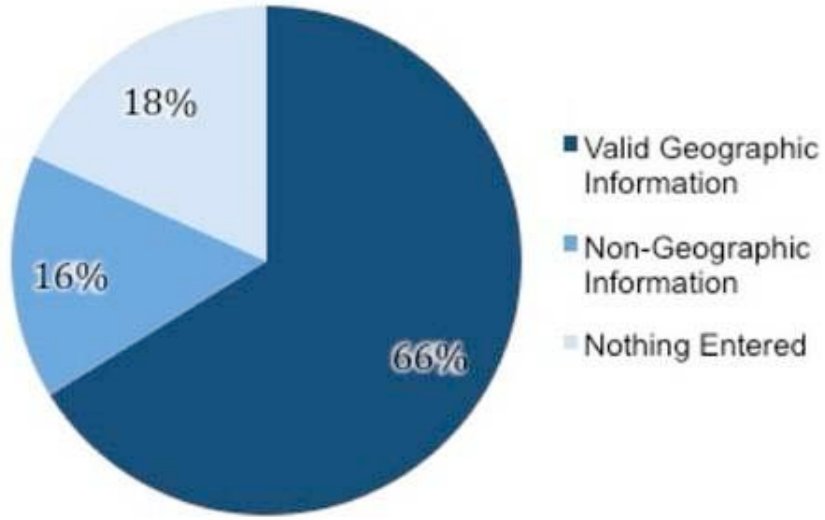
ABSTRACT
Little research exists on one of the most common, oldest, and most utilized forms of online social geographic information: the "location" field found in most virtual community user profiles. We performed the first in-depth study of user behavior with regard to the location field in Twitter user profiles. We found that 34% of users did not provide real location information, frequently incorporating fake locations or sarcastic comments that can fool traditional geographic information tools. When users did input their location, they almost never specified it at a scale any more detailed than their city. In order to determine whether or not natural user behaviors have a real effect on the "locatability" of users, we performed a simple machine learning experiment to determine whether we can identify a user's location by only looking at what that user tweets. We found that a user's country and state can in fact be

and companies like Yelp have embraced the geographic nature of their user-generated content wholeheartedly.

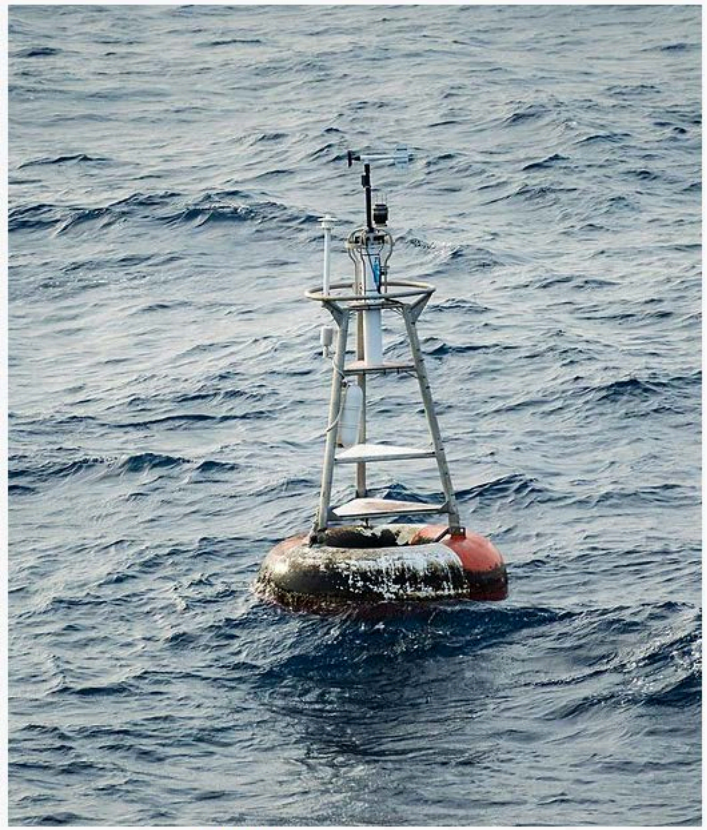
Despite this increased interest in "geo", one of the oldest, most common forms of geographic information in the Web 2.0 world has escaped detailed study. This is the information that exists in the "location" field of user profiles on dozens of immensely popular websites. Facebook has had "Current City" and "Hometown" fields for years. Flickr allows users to enter their hometown and current location in their user profile, and the recently-launched music social network Ping by Apple has "Where I Live" as one of its profile fields.

This gap in understanding has not stopped researchers and practitioners from making ample use of the data entered into location fields. In general, it has been assumed that this data is strongly typed geographic information with little

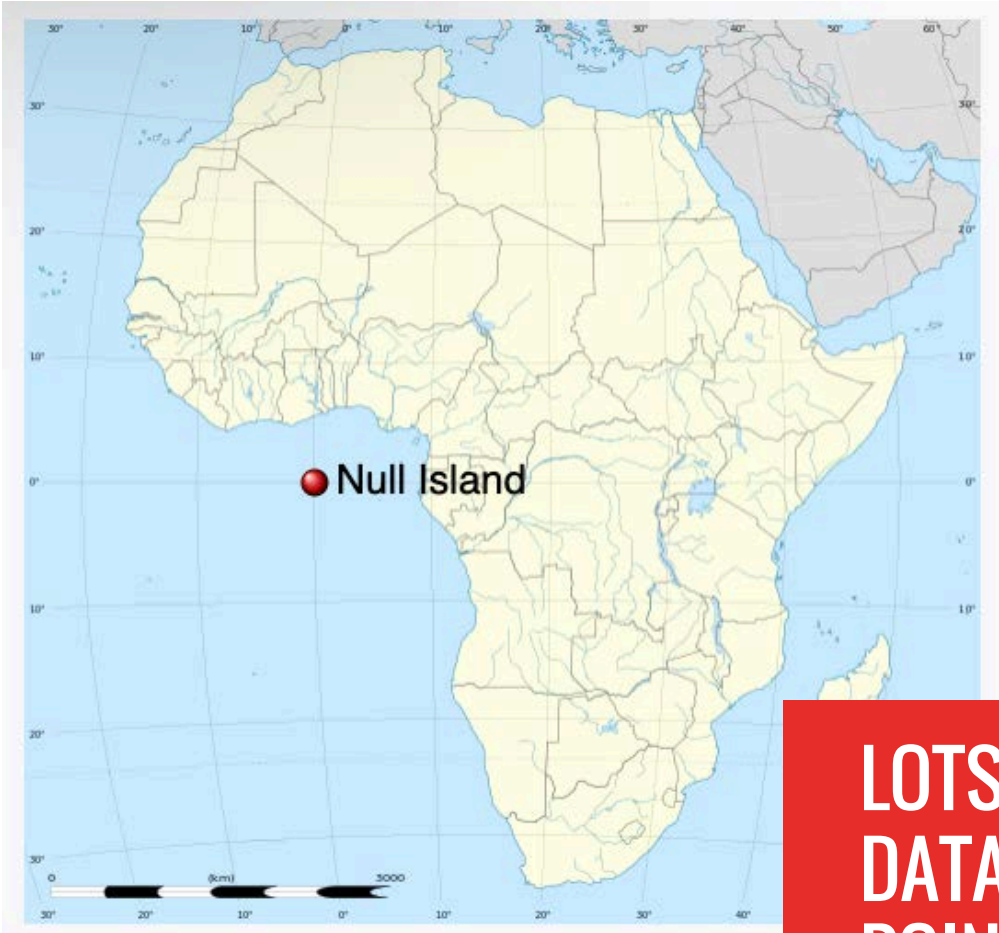
Locations **might not be real places**, or **might not be in the database**.



GEOCODING RESULTS CAN'T ALWAYS BE TRUSTED

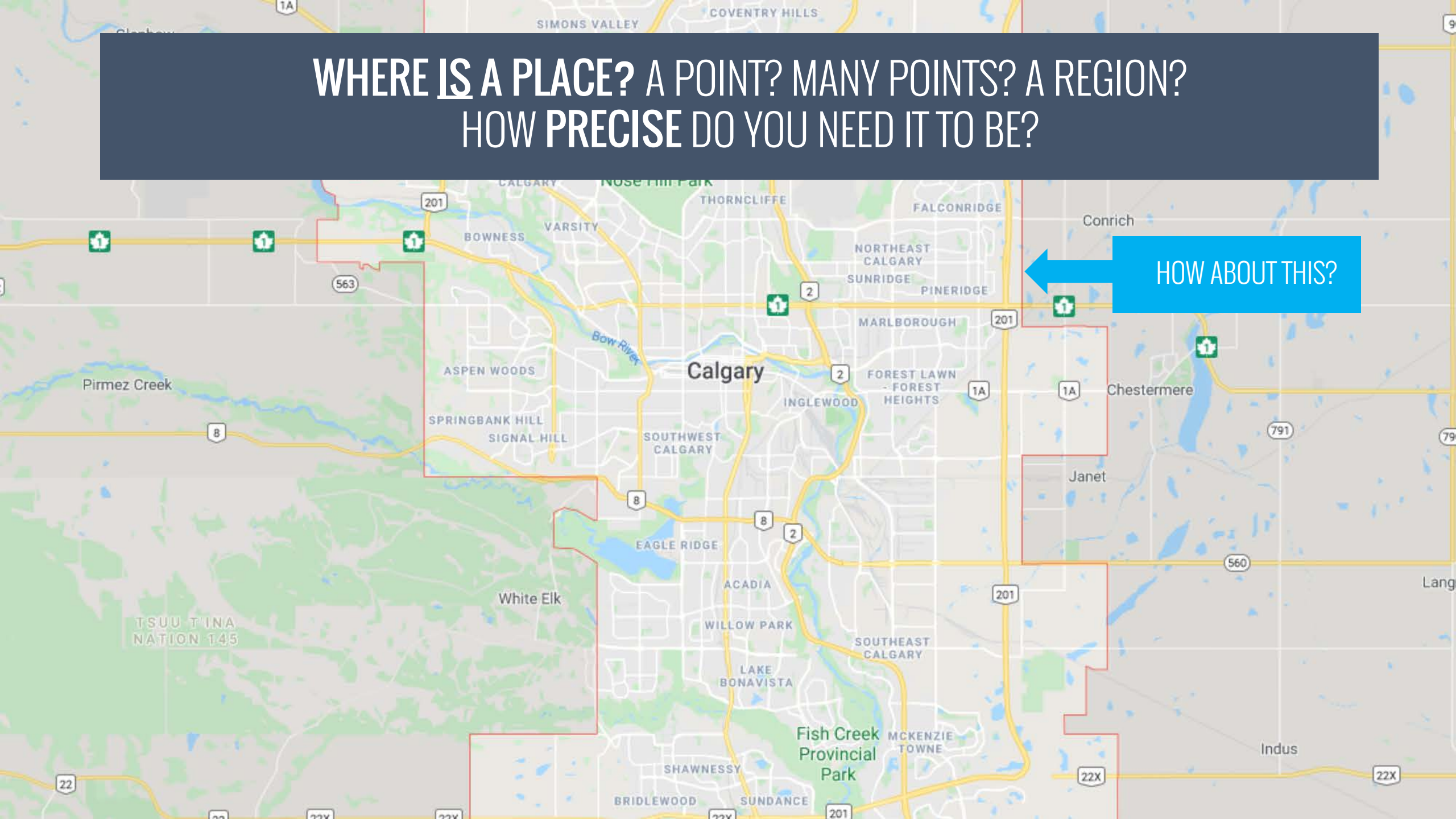


The weather buoy moored at the coordinates of Null Island, in the Gulf of Guinea at 0°N 0°E.



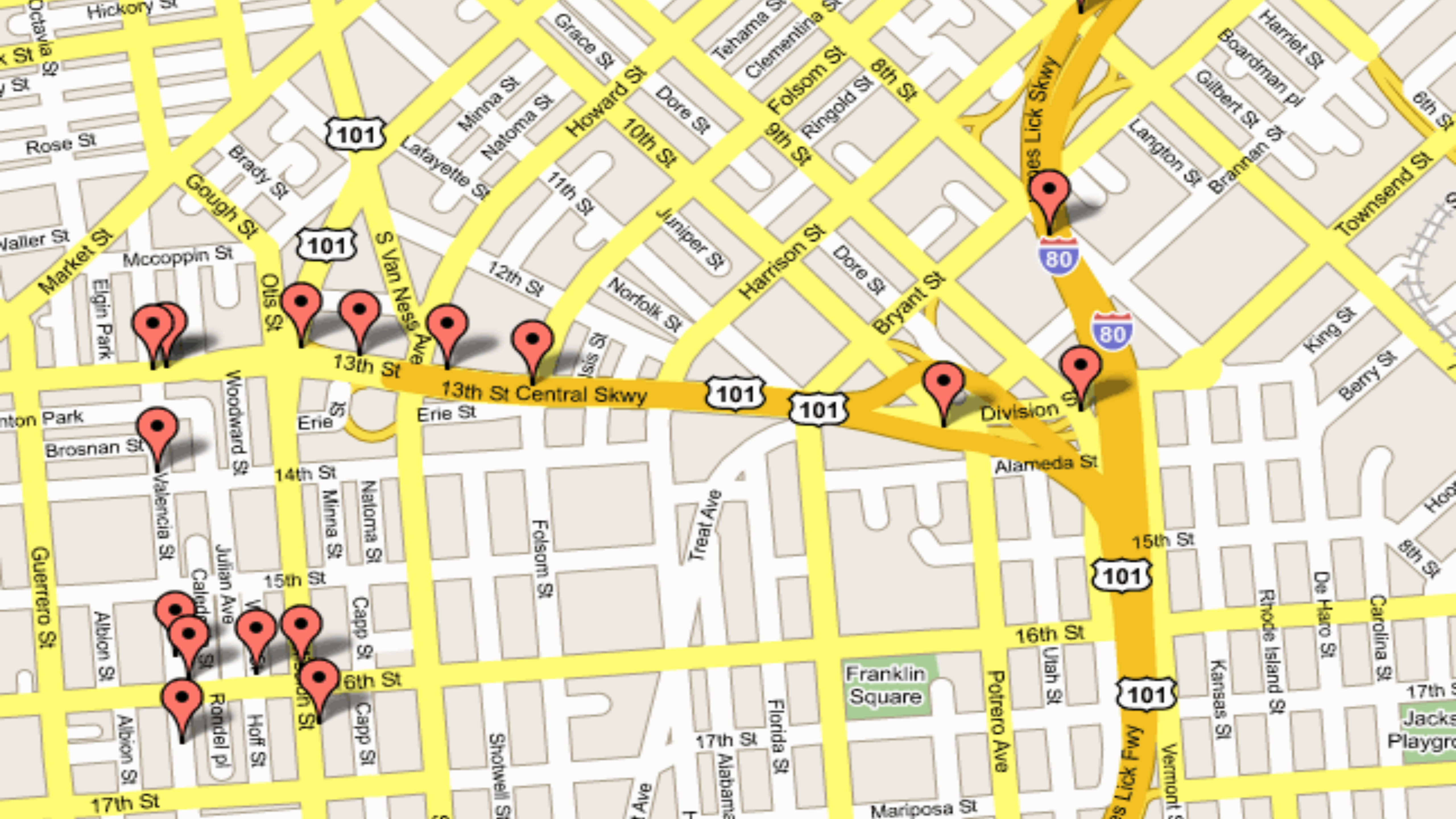
LOTS OF GEOGRAPHIC DATASETS CONTAIN POINTS HERE!

WHERE IS A PLACE? A POINT? MANY POINTS? A REGION?
HOW PRECISE DO YOU NEED IT TO BE?



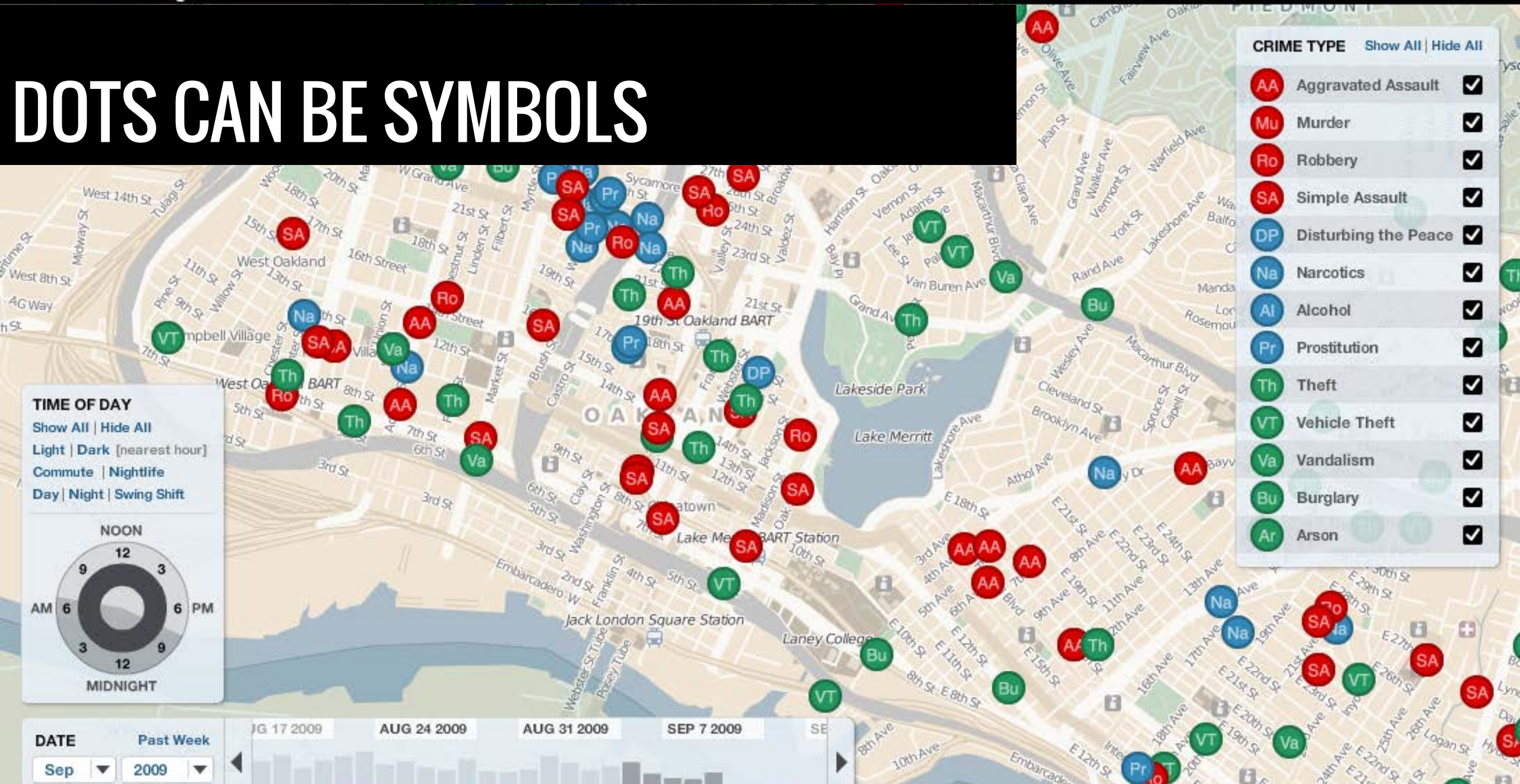
VISUALIZING DISCRETE DATA

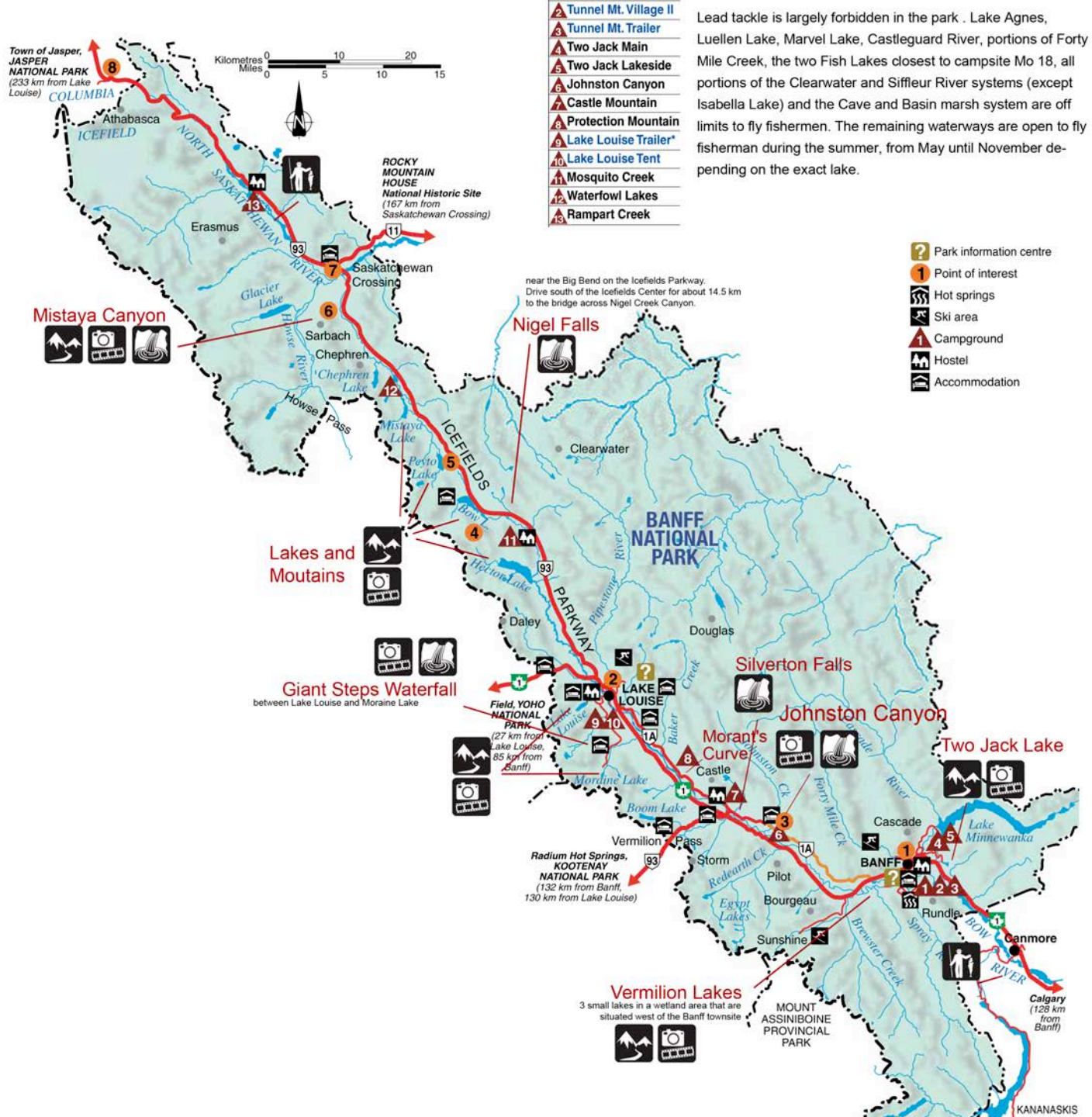
DOT MAPS
VISUALIZING SPECIFIC POINTS
ARRANGED BY LATITUDE/LONGITUDE
EACH POINT HAS A LOCATION



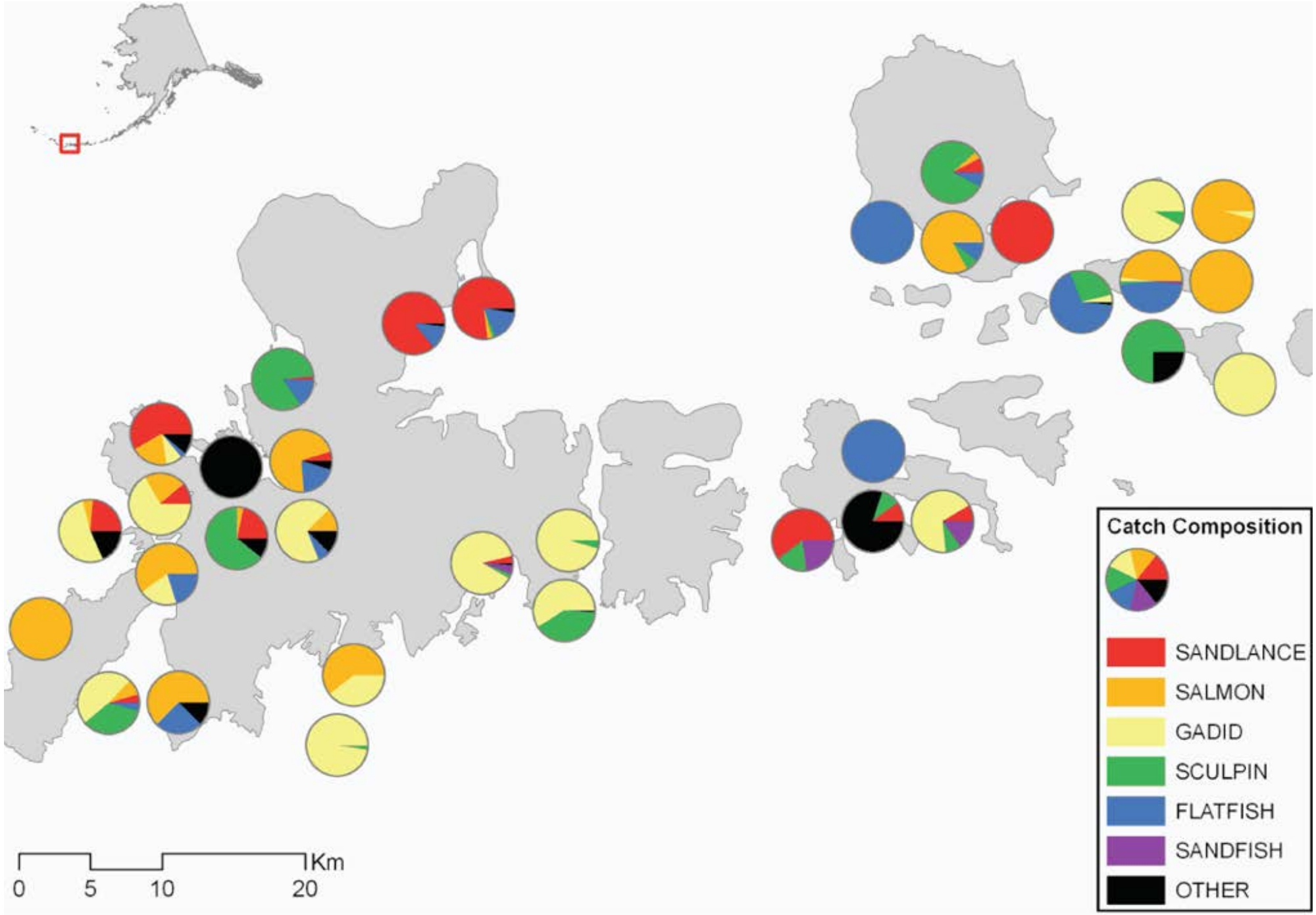
Hickory St
Octavia St
Rose St
Waller St
Market St
Gough St
Brady St
Mccoppin St
Elgin Park
Otis St
101
Lafayette St
Minna St
Natoma St
S Van Ness Ave
Howard St
Grace St
Tehama St
Clementina St
Folsom St
8th St
Dore St
10th St
9th St
Ringold St
11th St
12th St
Juniper St
Norfolk St
Harrison St
Dore St
Bryant St
Isis St
13th St
13th St Central Skwy
Erie St
Woodward St
Brosnan St
14th St
Valencia St
Minna St
Natoma St
Folsom St
Treat Ave
Division St
Alameda St
80
Boardman pl
Harriet St
Gilbert St
Langton St
Brannan St
Townsend St
King St
Berry St
15th St
8th St
6th St
Guerrero St
Albion St
Julian Ave
15th St
Capp St
16th St
Rondel pl
Hoff St
Capp St
Albion St
17th St
Shotwell St
17th St
Alabama St
Florida St
Franklin Square
Potrero Ave
Utah St
16th St
Kansas St
Rhode Island St
De Haro St
Carolina St
17th St
Vermont St
Mariposa St

DOTS CAN BE SYMBOLS




Town of Jasper, JASPER NATIONAL PARK (233 km from Lake Louise)
Kilometres 0 10 20
Miles 0 5 10 15
COLUMBIA ICEFIELD
Athabasca
NORTH SASKATCHEWAN RIVER
Erasmus
ROCKY MOUNTAIN HOUSE National Historic Site (167 km from Saskatchewan Crossing)
Saskatchewan Crossing
Glacier Lake
Howse River
Sarbach
Chephren
Chephren Lake
Howse Pass
Mistaya Canyon
Mistaya Lake
Waterfowl Lakes
Rampart Creek
Tunnel Mt. Village II
Tunnel Mt. Trailer
Two Jack Main
Two Jack Lakeside
Johnston Canyon
Castle Mountain
Protection Mountain
Lake Louise Trailer*
Lake Louise Tent
Mosquito Creek
Lead tackle is largely forbidden in the park . Lake Agnes, Luellen Lake, Marvel Lake, Castleguard River, portions of Forty Mile Creek, the two Fish Lakes closest to campsite Mo 18, all portions of the Clearwater and Siffleur River systems (except Isabella Lake) and the Cave and Basin marsh system are off limits to fly fishermen. The remaining waterways are open to fly fisherman during the summer, from May until November depending on the exact lake.
Park information centre
Point of interest
Hot springs
Ski area
Campground
Hostel
Accommodation
near the Big Bend on the Icefields Parkway. Drive south of the Icefields Center for about 14.5 km to the bridge across Nigel Creek Canyon.
Nigel Falls
Clearwater
ICEFIELDS PARKWAY
BANFF NATIONAL PARK
Lakes and Moutains
Hector Lake
Bow River
Pipestone River
Daley
Douglas
Giant Steps Waterfall
between Lake Louise and Moraine Lake
Field, YOHO NATIONAL PARK (27 km from Lake Louise, 85 km from Banff)
LAKE LOUISE
Louise Creek
Baker Creek
Silverton Falls
Johnston Canyon
Morant's Curve
Two Jack Lake
Castle
Moraine Lake
Boom Lake
Johnston Ck
Forty Mile Ck
Cascade
Lake Minnewanka
Vermilion Pass
Radium Hot Springs, KOOTENAY NATIONAL PARK (132 km from Banff, 130 km from Lake Louise)
Storm
Redearth Ck
Pilot
Bourgeau
Egypt Lakes
Sunshine
BANFF
Rundle
Spray River
Bow River
Canmore
Calgary (128 km from Banff)
Brewster Creek
Vermilion Lakes
3 small lakes in a wetland area that are situated west of the Banff townsite
MOUNT ASSINIBOINE PROVINCIAL PARK
KANANASKIS

DOTS CAN BE VISUALIZATIONS


Catch Composition
SANDLANCE
SALMON
GADID
SCULPIN
FLATFISH
SANDFISH
OTHER
0
5
10
20
Km

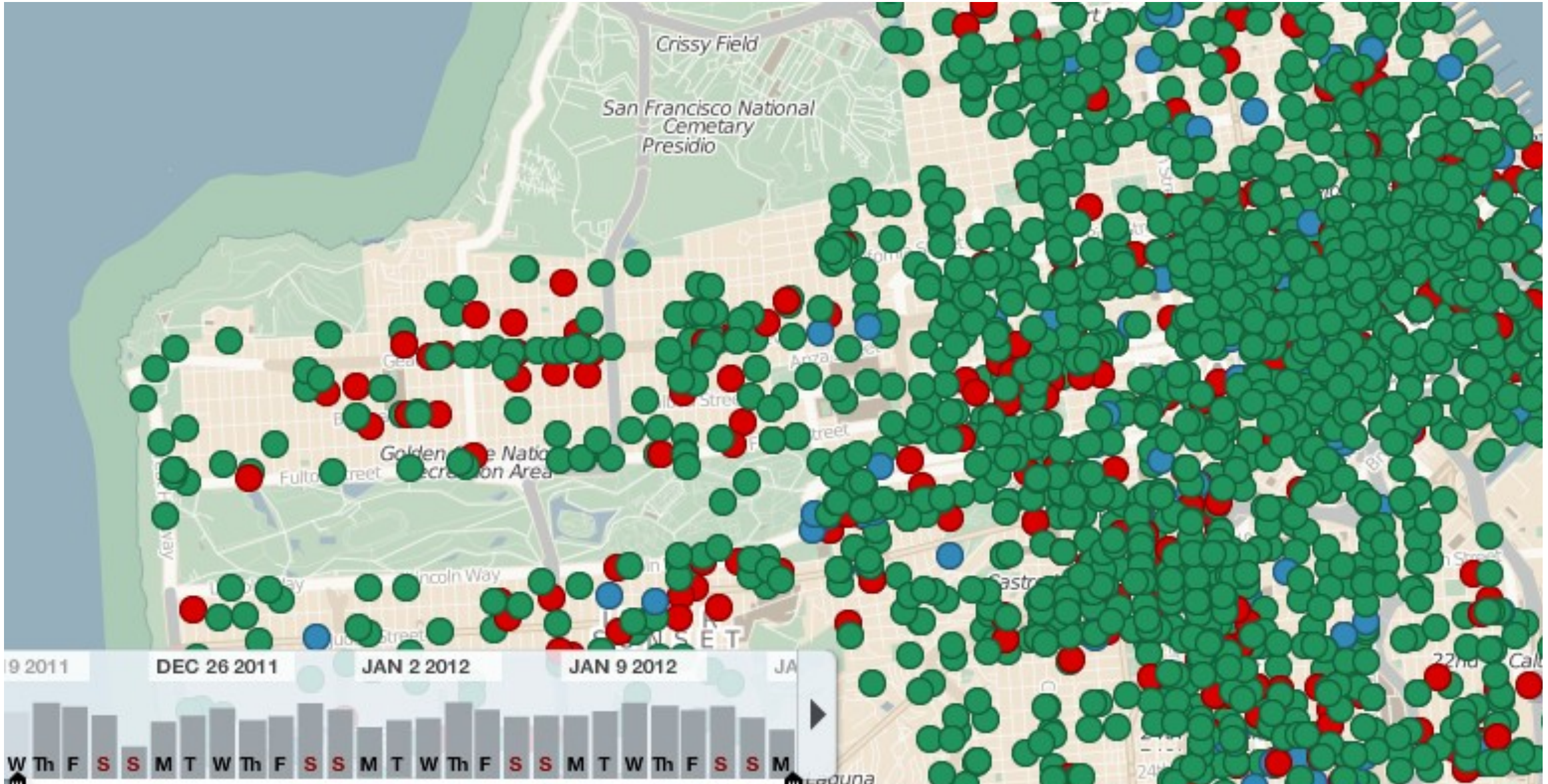
DOTS CAN BE USELESS

OVERPLOTTING

JUST POPULATION DENSITY?


DISTRIBUTION OF CANADIAN UNIVERSITIES
Hudson Bay
Canada
ALBERTA
MANITOBA
SASKATCHEWAN
ONTARIO
QUEBEC
Labrador
WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
SOUTH DAKOTA
WISCONSIN
MICHIGAN
OREGON
IDAHO
WYOMING
NEBRASKA
IOWA
ILLINOIS
INDIANA
OHIO
PENN
NEW YORK
MAINE
VT
NH
MA
CT RI
NOVA SCOTIA
Montreal
Chicago
Philadelphia
NEVADA
UTAH
COLORADO
KANSAS
MISSOURI
WEST VIRGINIA
KENTUCKY
VIRGINIA
MD
DE
NJ
NORTH CAROLINA
SOUTH CAROLINA
TENNESSEE
ARKANSAS
MISSISSIPPI
OKLAHOMA
ARIZONA
NEW MEXICO
CALIFORNIA
San Francisco
Las Vegas
Los Angeles
San Diego
Dallas
United States

OVERPLOTTING AND OCCLUSION



VISUALLY INTEGRATING POINTS

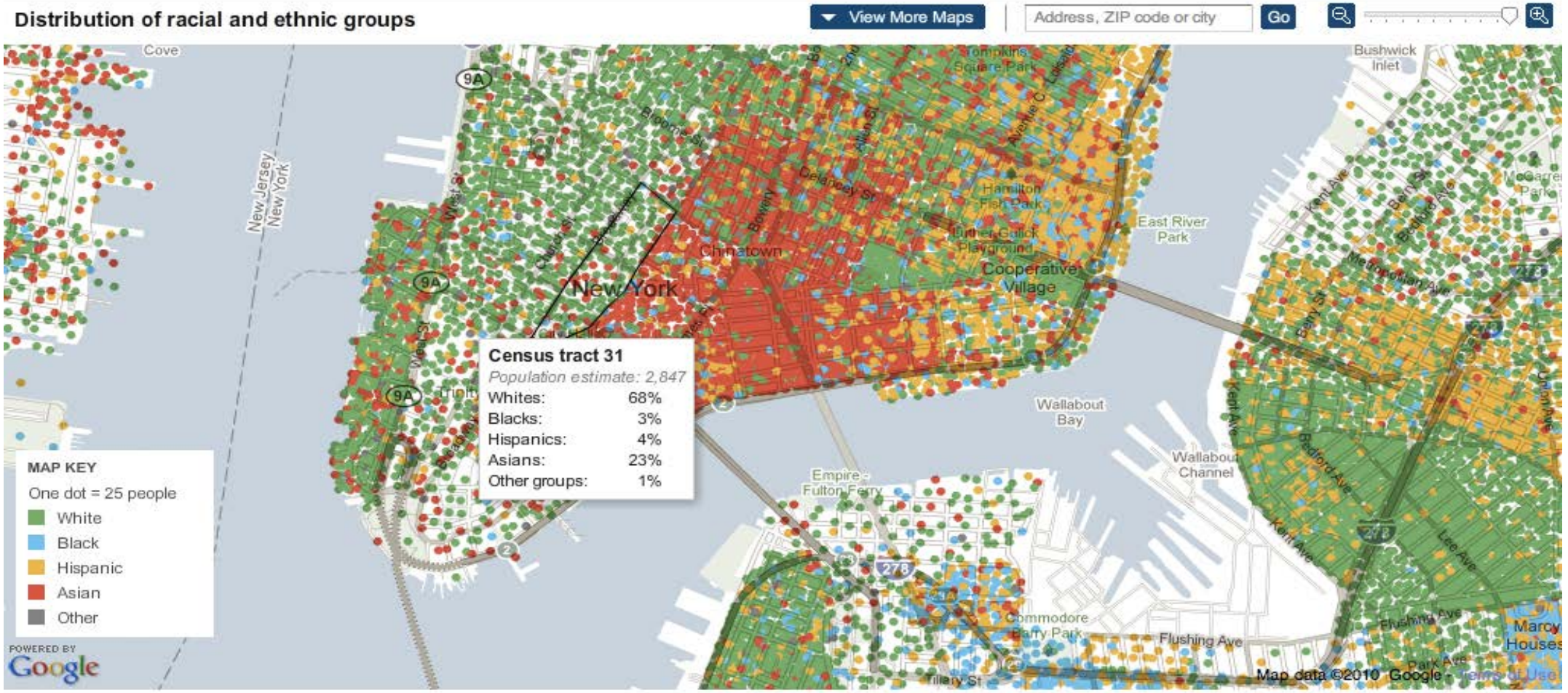
The New York Times

Mapping America: Every City, Every Block

Find something interesting? Share this view on Twitter or Facebook

Browse local data from the Census Bureau's American Community Survey, based on samples from 2005 to 2009. Because these figures are based on samples, they are subject to a margin of error, particularly in places with a low population, and are best regarded as estimates. View Readers Maps (49)

Distribution of racial and ethnic groups

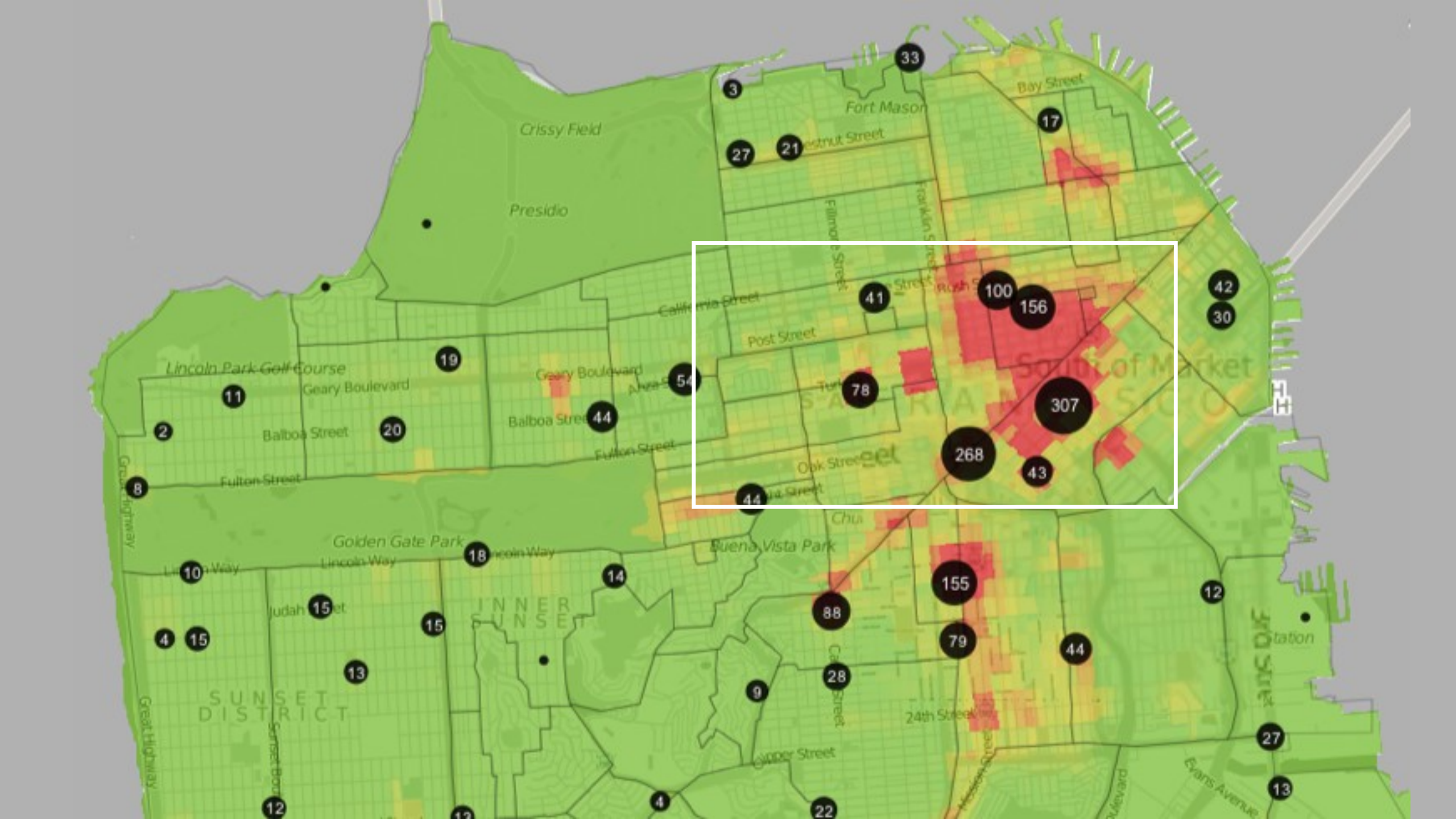


By MATTHEW BLOCH, SHAN CARTER and ALAN McLEAN | Source: 2005-9 American Community Survey, Census Bureau; socialexplorer.com

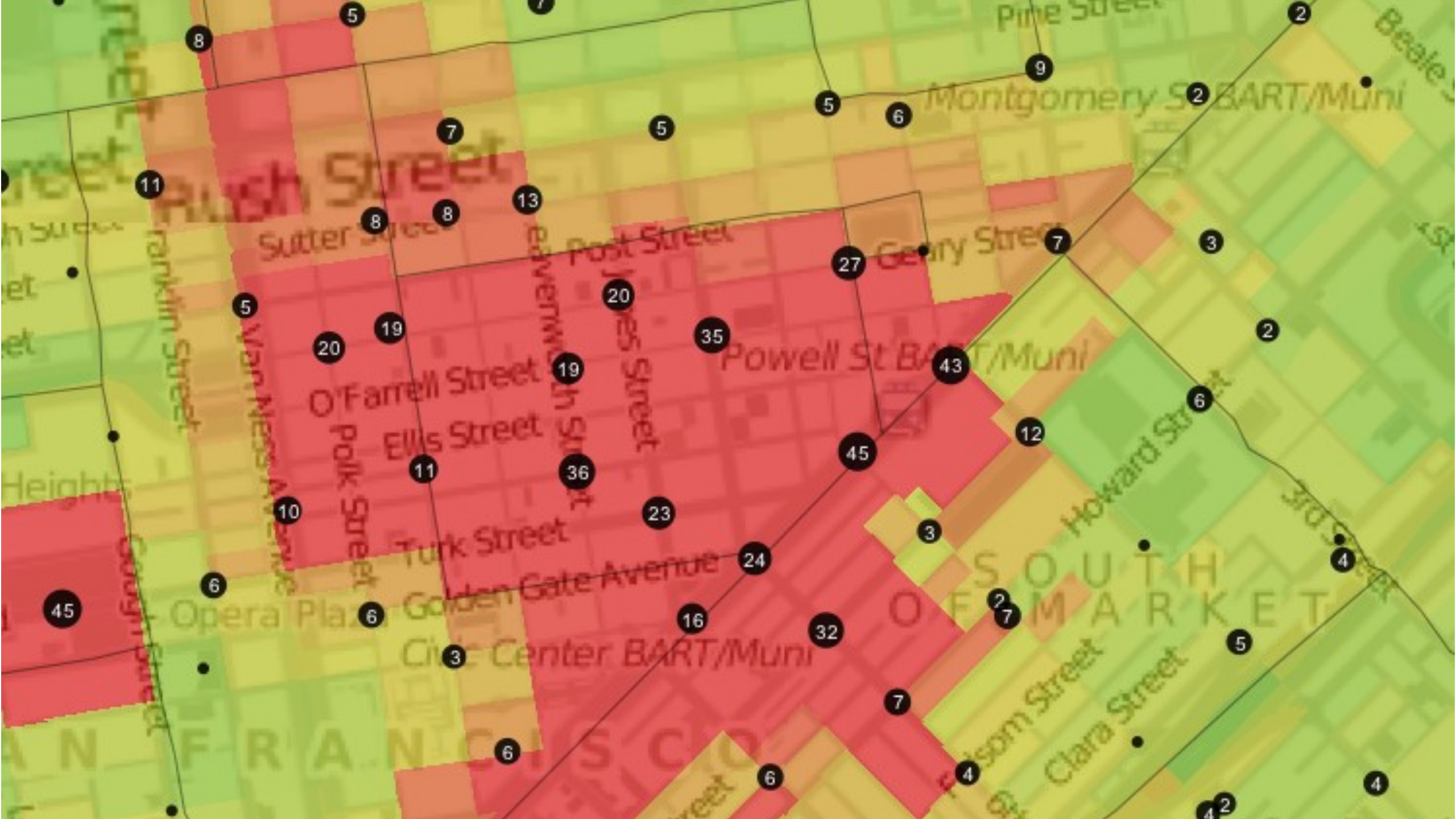
Note: Dots are evenly distributed across each Census tract or

HUE

CLUSTERING


Crissy Field
Presidio
Fort Mason
Bay Street
Lincoln Park Golf Course
Geary Boulevard
Balboa Street
Fulton Street
California Street
Post Street
Oak Street
Golden Gate Park
Lincoln Way
Buena Vista Park
INNER SUNSET
SUNSET DISTRICT
Judah Street
Great Highway
Upper Street
24th Street
Evans Avenue
South of Market
33
3
27
21
17
19
11
2
20
54
44
8
41
100
156
42
30
78
307
268
43
44
18
14
10
15
4
13
12
88
155
79
44
28
9
22
27
13

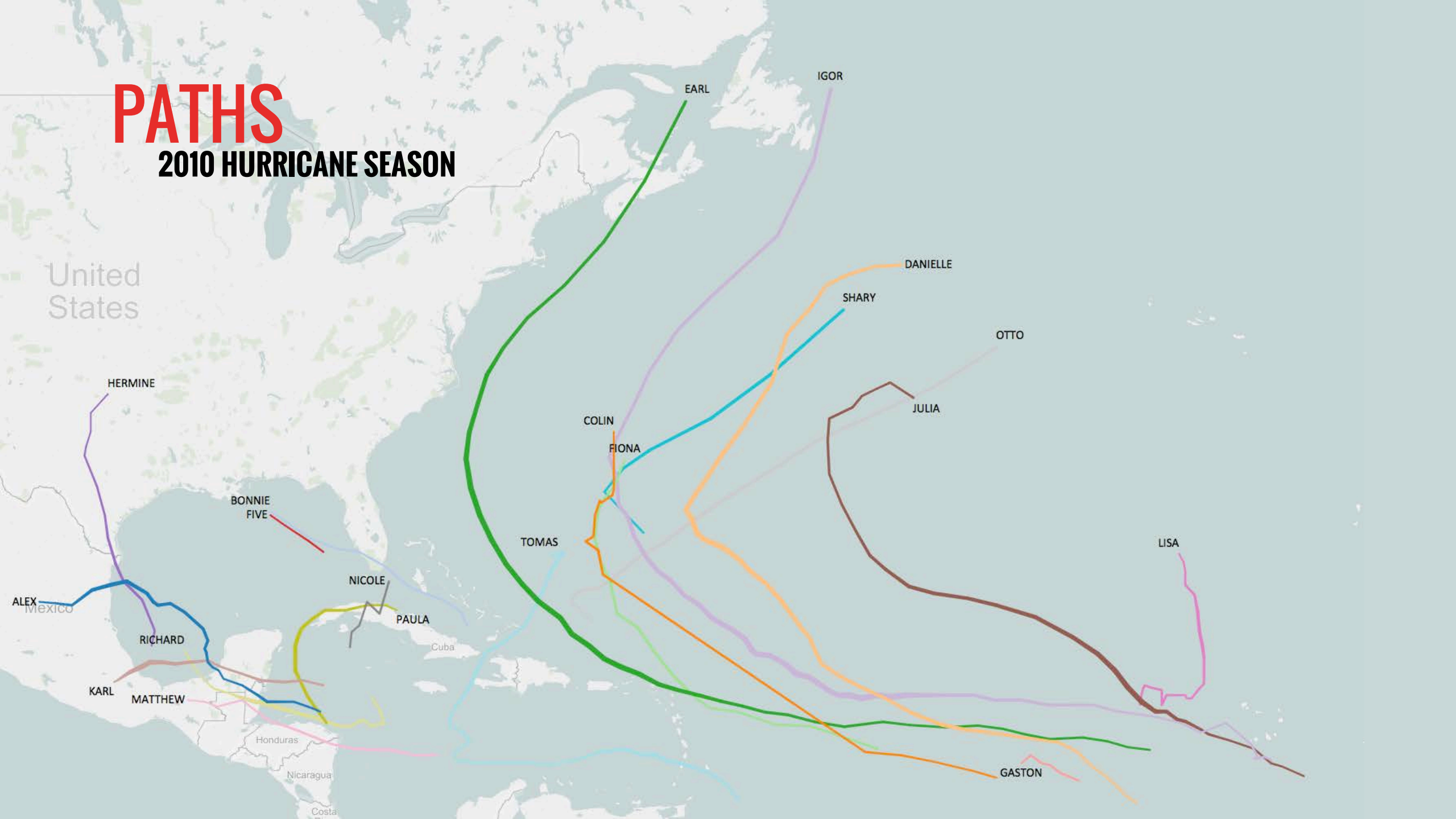

Filbert Street
Union Street
Green Street
Vallejo Street
Broadway Street
Pacific Avenue
Jackson Street
Clay Street
Sacramento Street
Pine Street
Bush Street
Post Street
Turk Boulevard
Oak Street
Franklin Street
Fillmore Street
Steiner Street
Scott Street
Pierce Street
Divisadero Street
Baker Street
Broderick Street
Walnut Street
Gough Street
Van Ness Ave
Pacific Avenue
Jackson Street
Clay Street
Pine Street
Embarcadero BART/Muni
Montgomery St BART/Muni
Powell St BART/Muni
Beale Street
Spear Street
Harrison Street
Bryant Street
Turk Street
SAN FRANCISCO
SOUTH BEACH

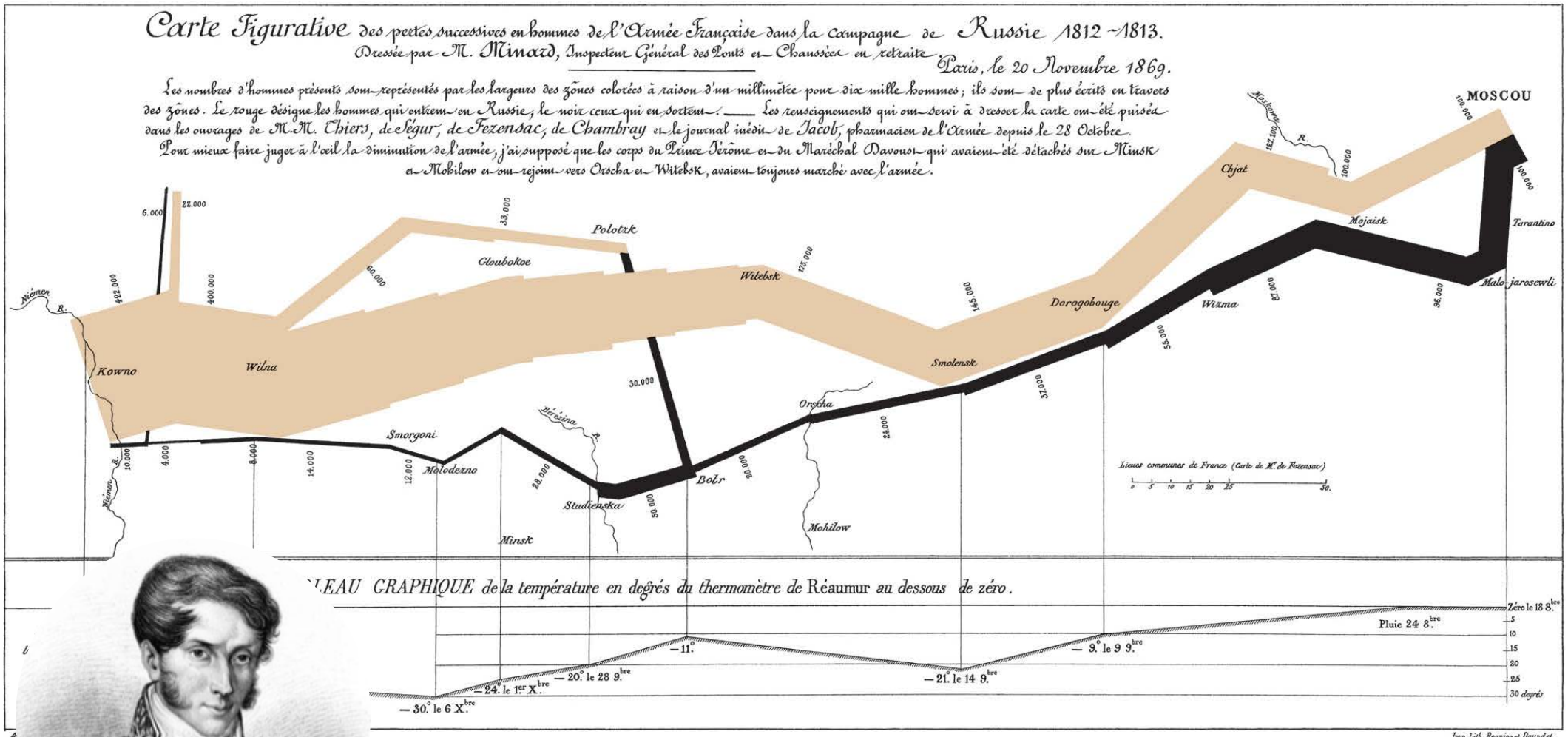

Rush Street
Sutter Street
Post Street
Geary Street
Franklin Street
Van Ness Avenue
Polk Street
Larkin Street
Jones Street
O'Farrell Street
Ellis Street
Powell St BART/Muni
Montgomery St BART/Muni
Howard Street
3rd Street
Turk Street
Golden Gate Avenue
Civic Center BART/Muni
Opera Plaza
Folsom Street
Clara Street
SOUTH OF MARKET
SAN FRANCISCO

PATHS & FLOW

PATHS

2010 HURRICANE SEASON





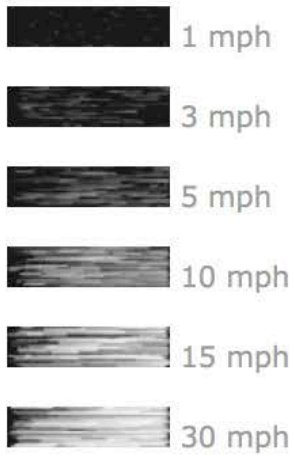
CHARLES JOSEPH MINARD 1864


Presidio of San Francisco
South Bay
Presidio Golf Course
Lincoln Park
Outer Richmond
Golden Gate Park 9th Avenue Playground
Golden Gate Park Golf Course
Outer Sunset
West Sunset Playground
Sunset Parkway
Lakeshore
Harding Park
Lake Merced Park
Olympic Golf Club
Davidson Park
Glenridge
Cayuga Terrace
Portola
Portola Place
Bayview
John McLaren Park
Crocker Amazon
Bayview Park
Candlestick Point State Recreation Area
Candlestick Park
Hunters Point
Herons Head Park
India Basin
Central Waterfront
Dogpatch
Mission Bay
Embarcadero

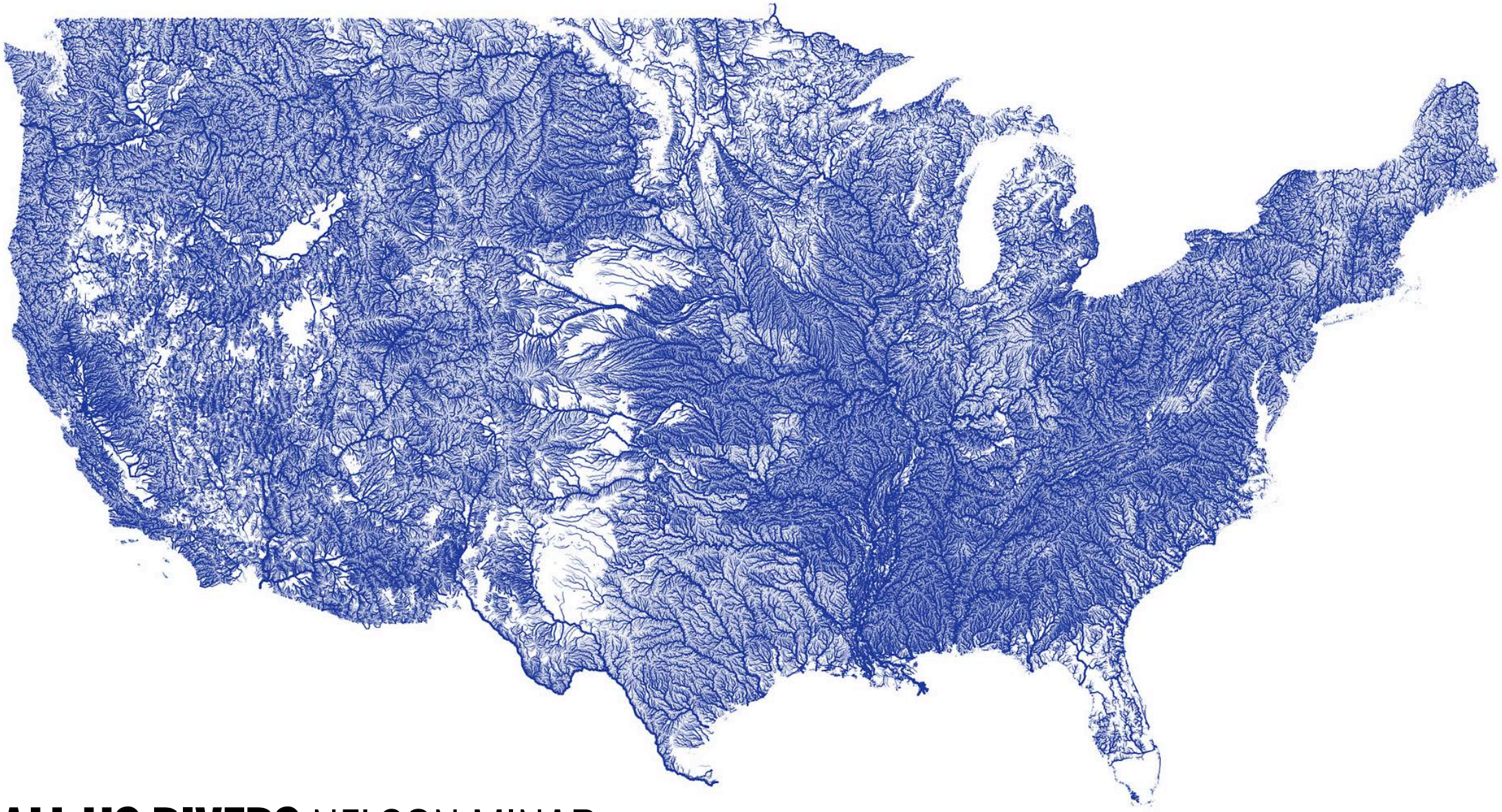
CABSPOTTING STAMEN DESIGN

Sept. 7, 2012
8:59 pm EST
(time of forecast download)

top speed: **26.2 mph**
average: **5.7 mph**



WATTENBERG & VIÉGAS 2012



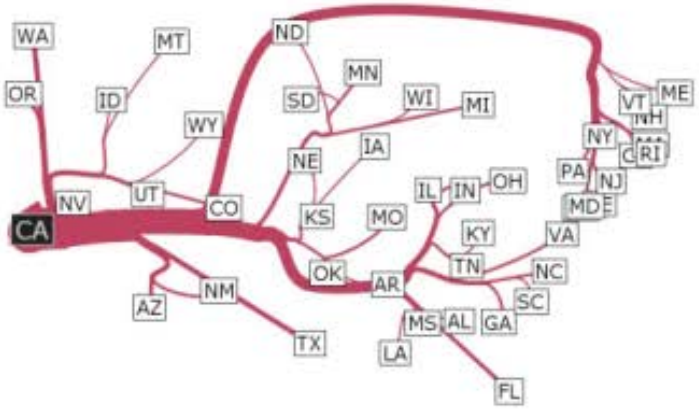
ALL US RIVERS NELSON MINAR

VISUALIZING FLOW

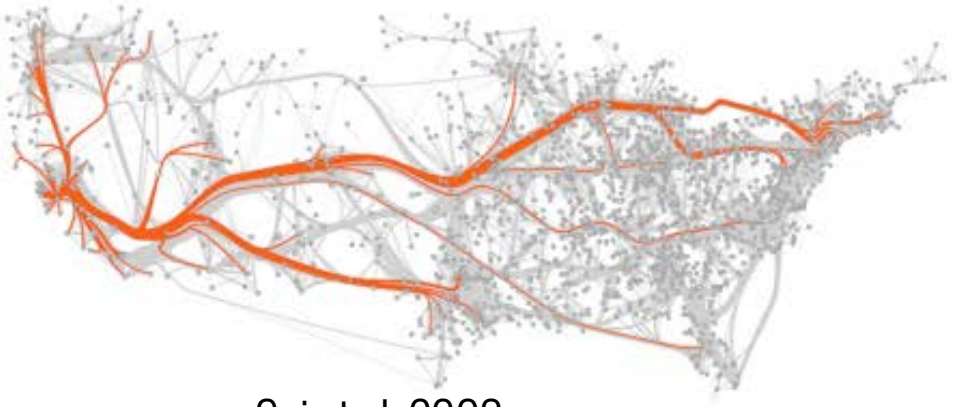
Migration from California 1995-2000

Tobler 1987

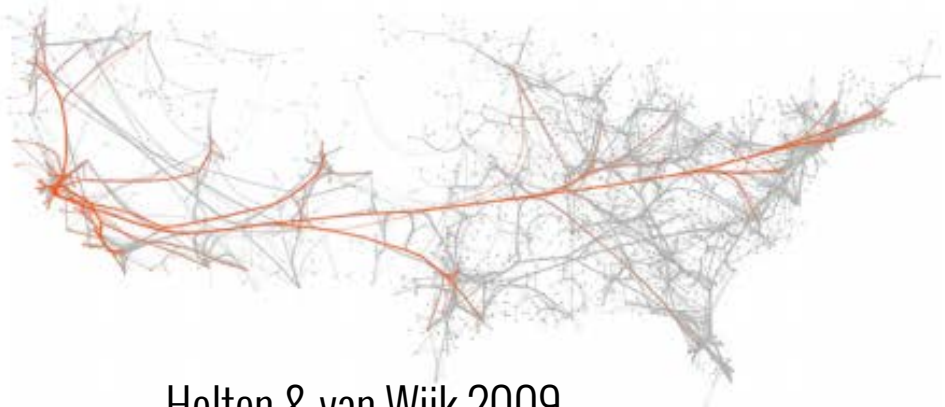
Phan et al. 2005



Verbeek et al. 2011



Cui et al. 2008



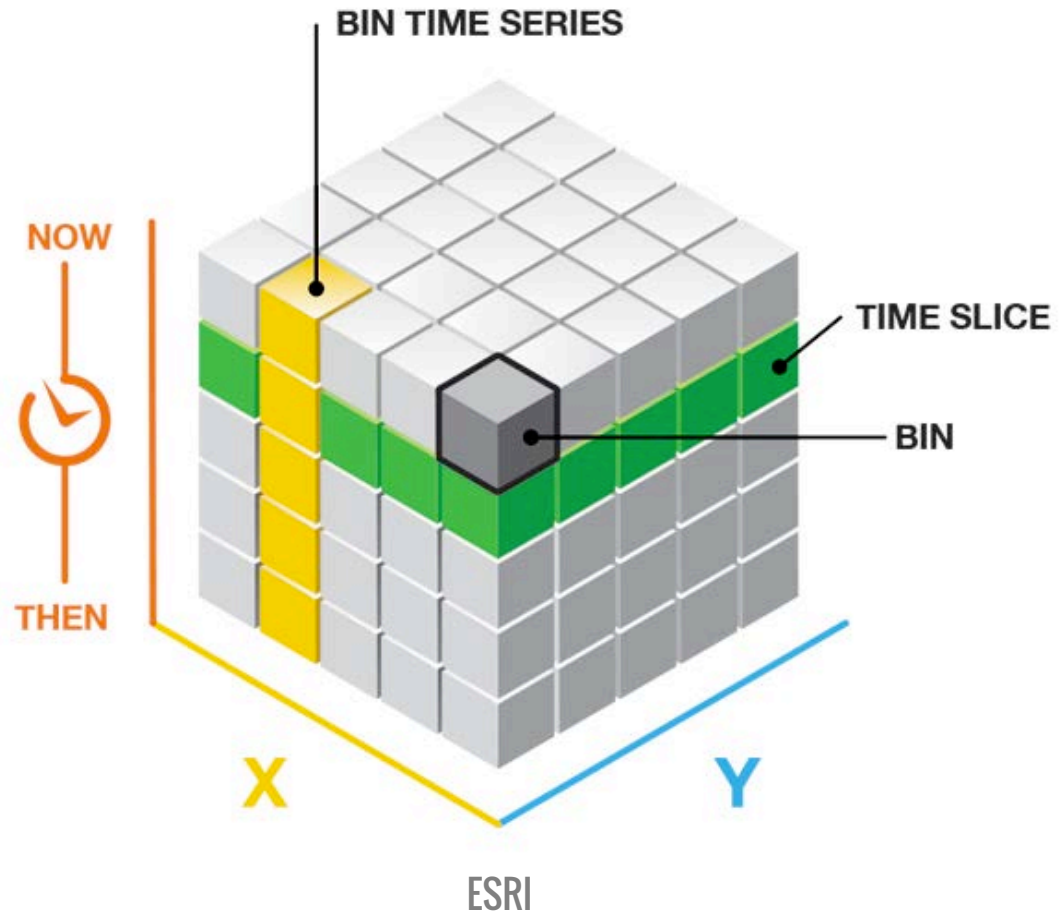
Holten & van Wijk 2009

SPACE-TIME CUBES

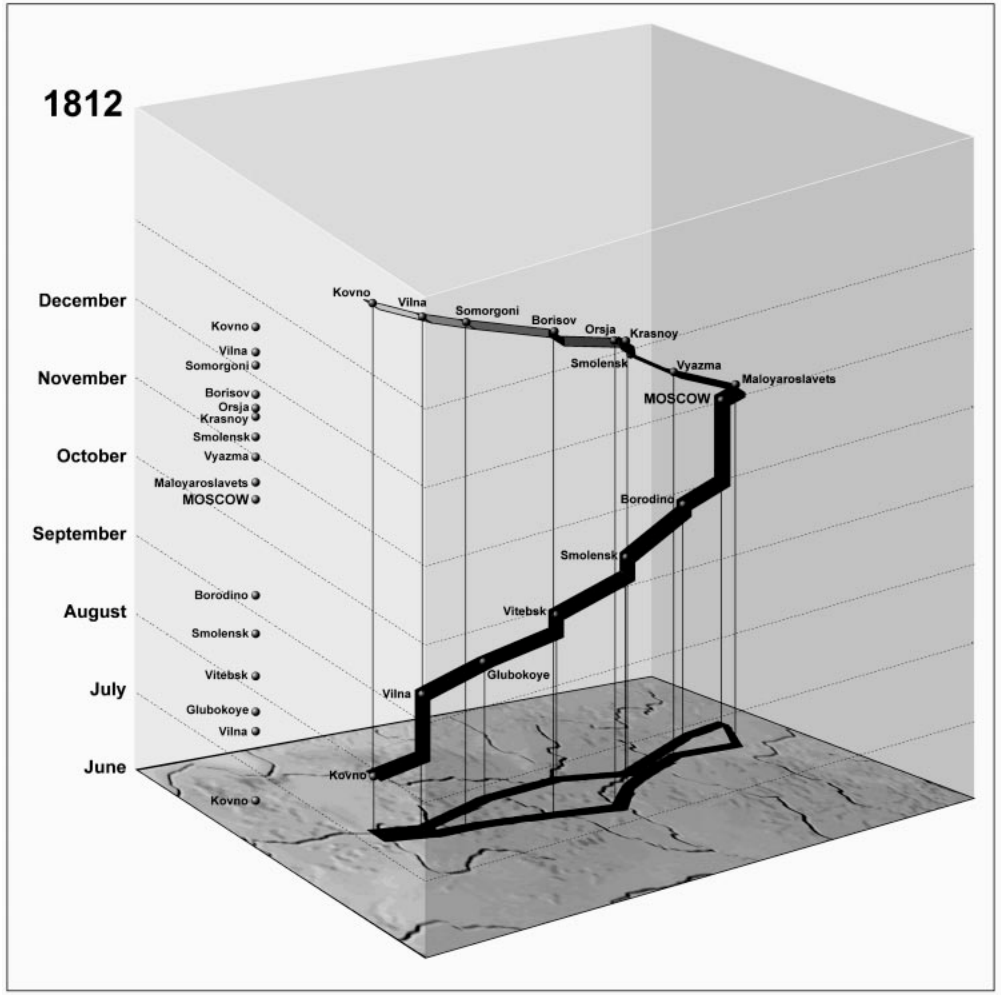
2D X-Y Dimensions
(usually spatial)

+

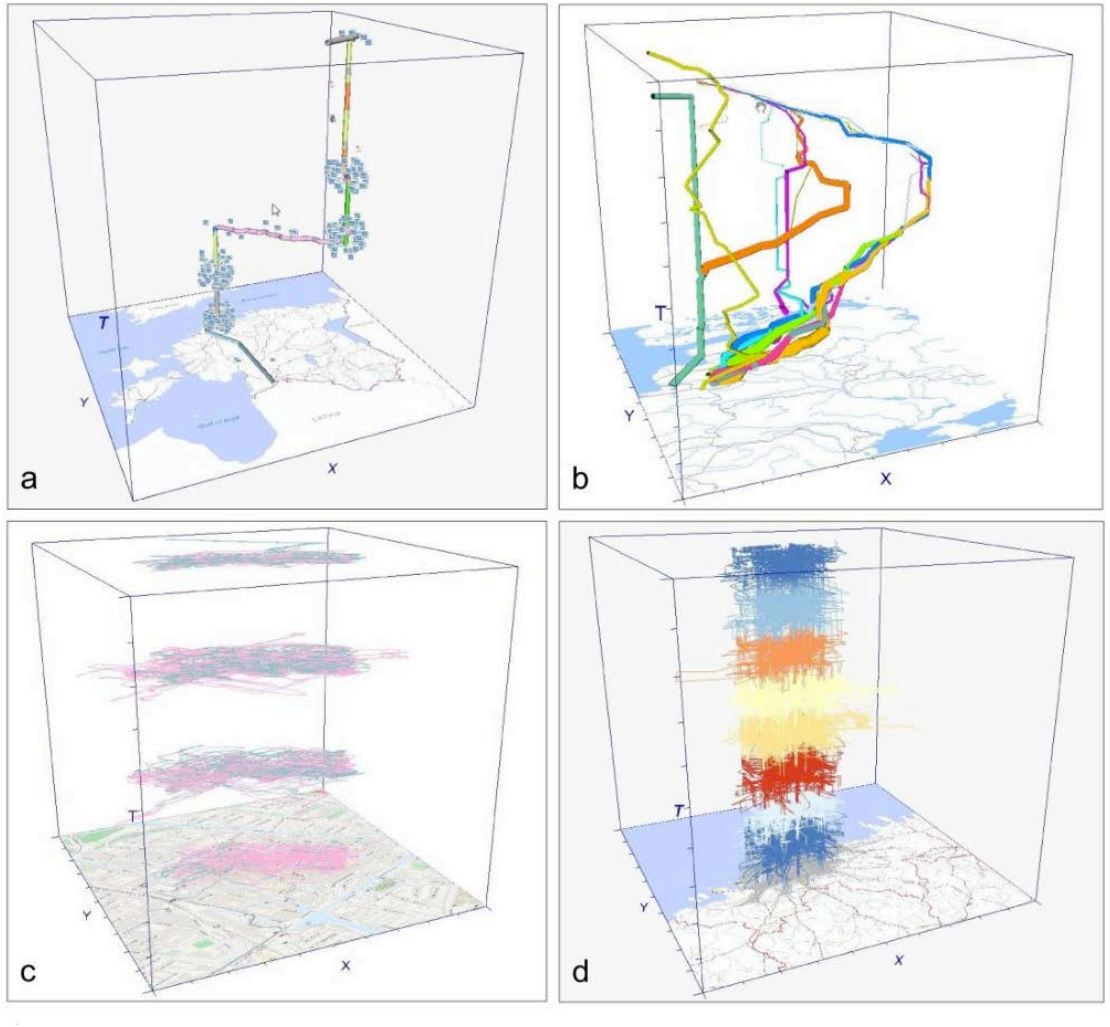
Z for Time



SPACE-TIME CUBES



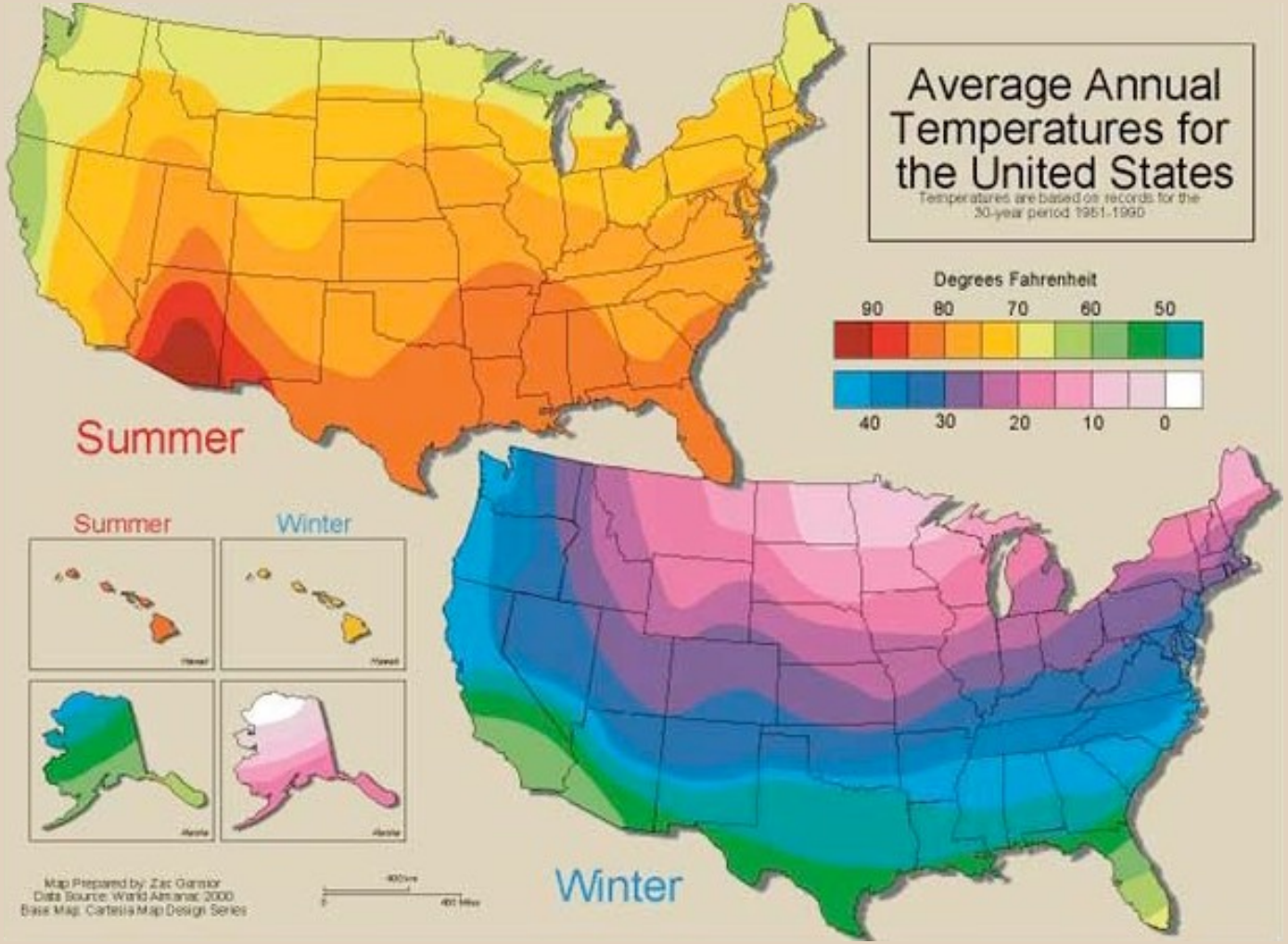
Peuquet & Kraak 2002



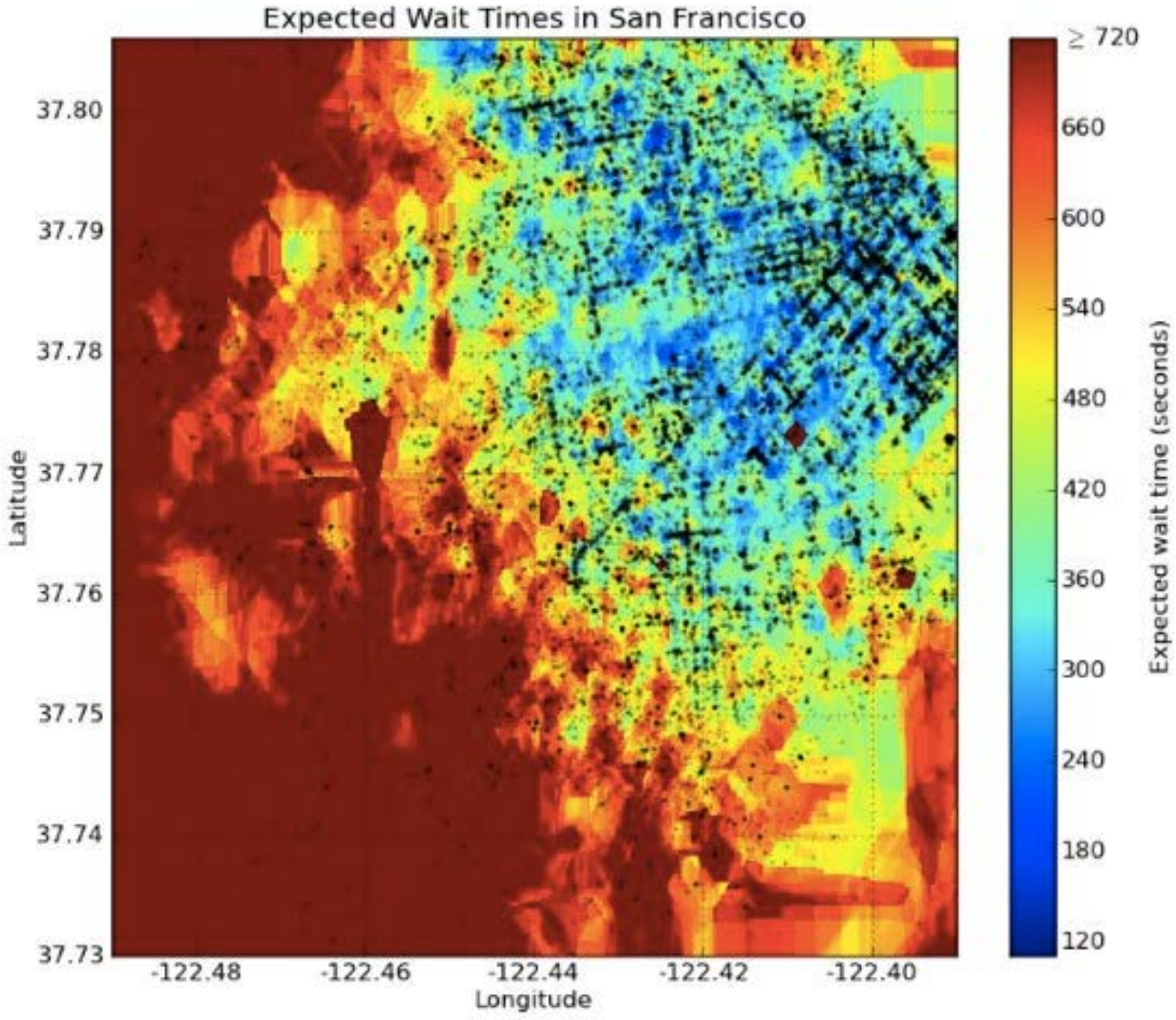
CONTINUOUS DATA

ISOPLETH MAPS

DRAWING BORDERS BETWEEN EQUAL INTERVALS

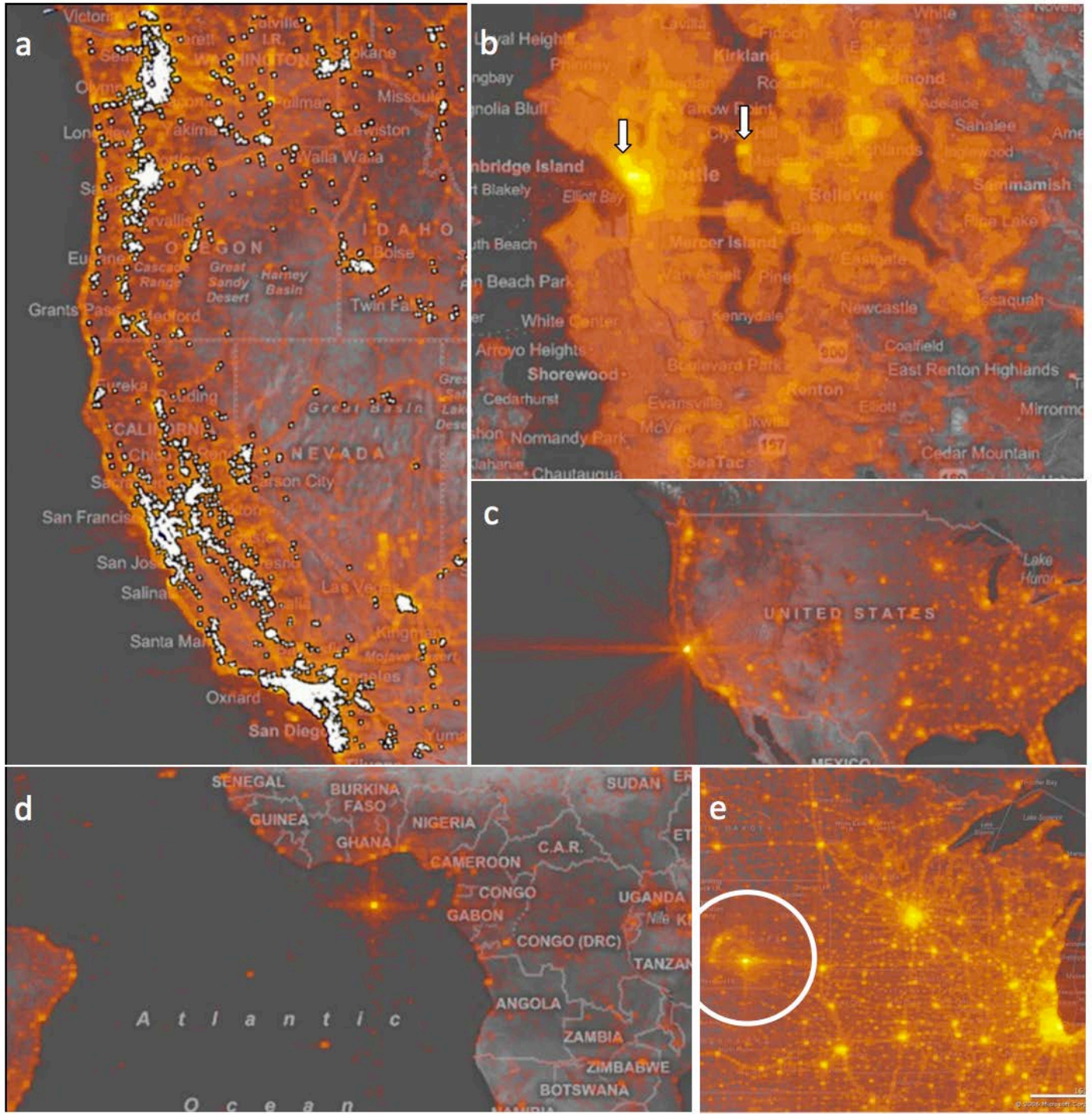


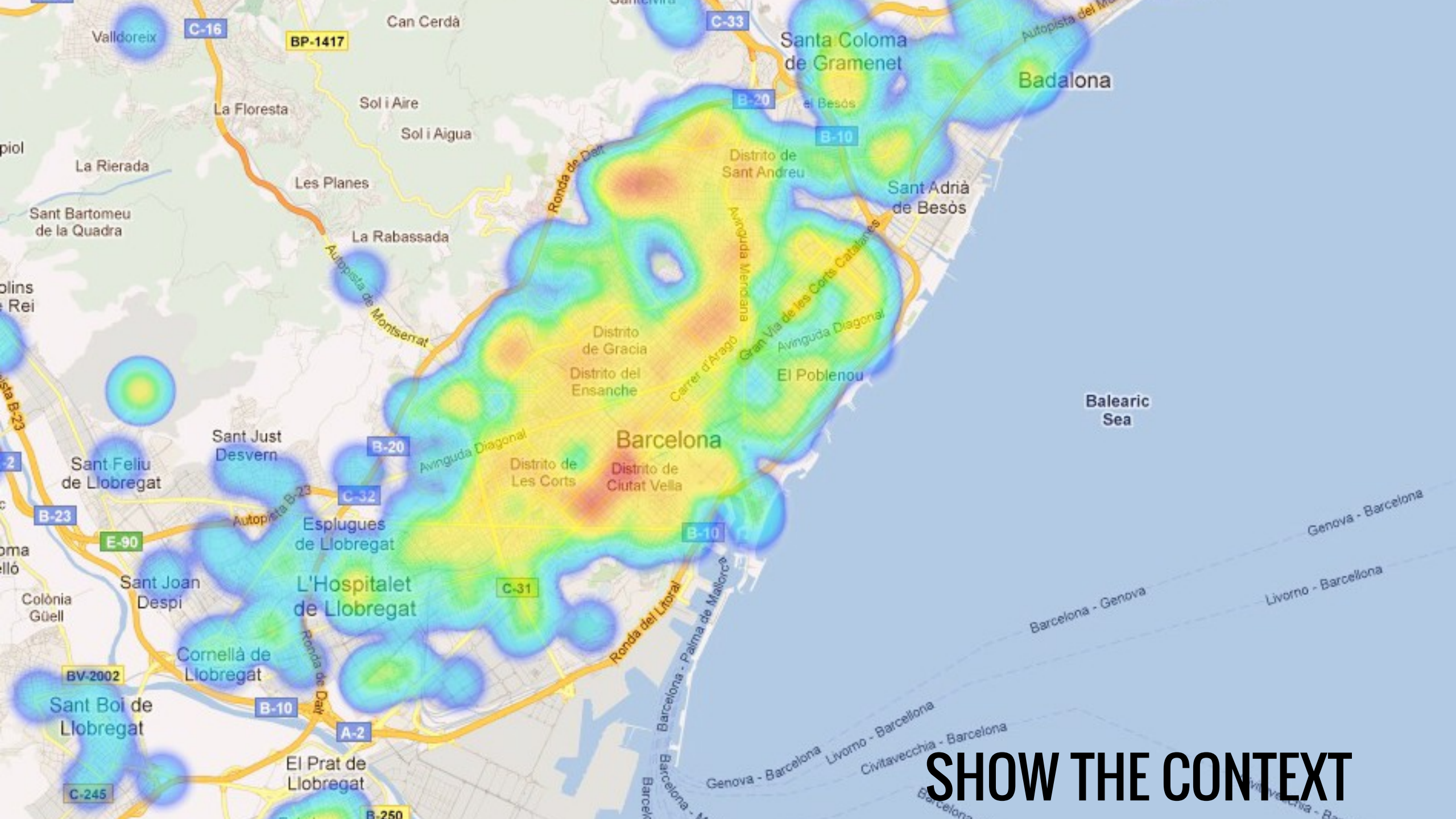
HEATMAPS


Expected Wait Times in San Francisco
37.80
37.79
37.78
37.77
37.76
37.75
37.74
37.73
Latitude
-122.48
-122.46
-122.44
-122.42
-122.40
Longitude
≥ 720
660
600
540
480
420
360
300
240
180
120
Expected wait time (seconds)

HEATMAPS

Hotmap: Looking at Geographic Attention
Danyel Fisher 2007

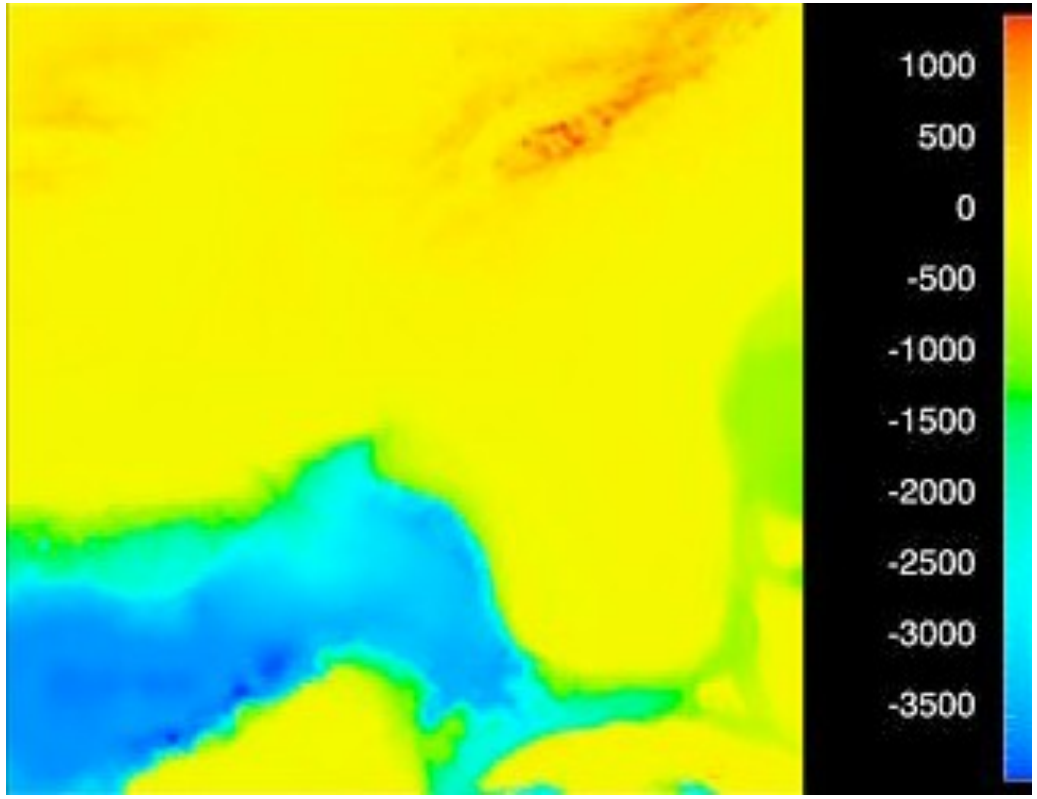




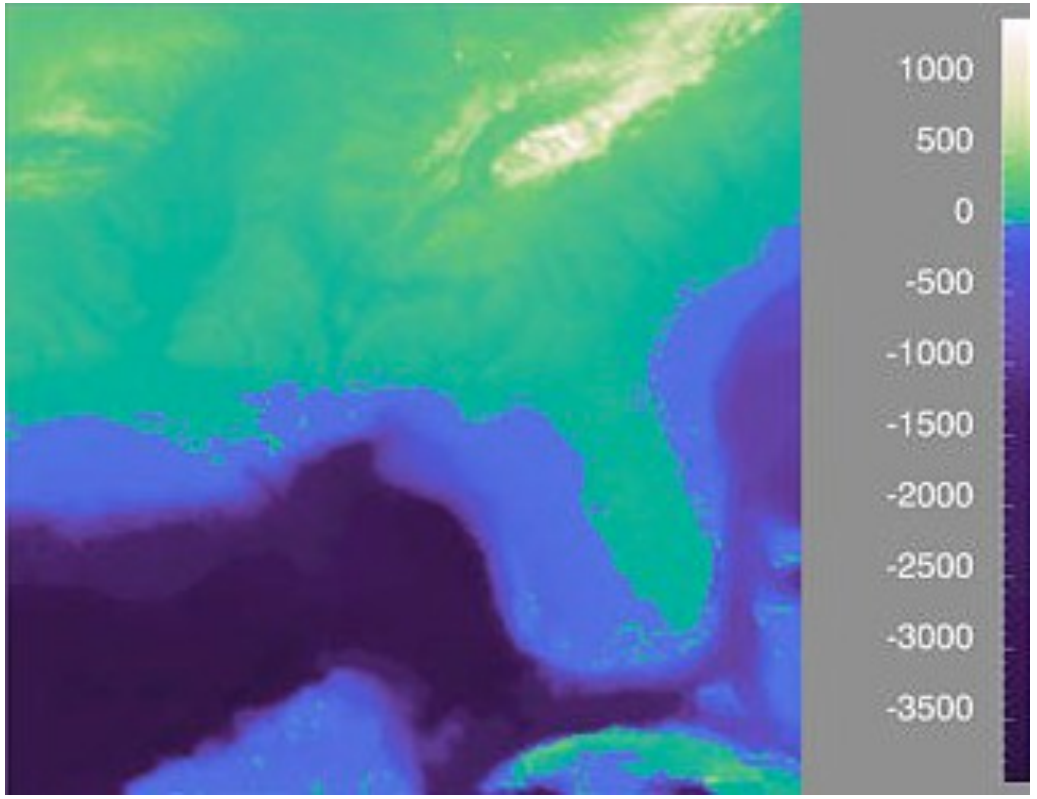
SHOW THE CONTEXT

AS ALWAYS...

BE CAREFUL WITH YOUR COLORS



(NO)



(YES!)

CONSIDER BINNING

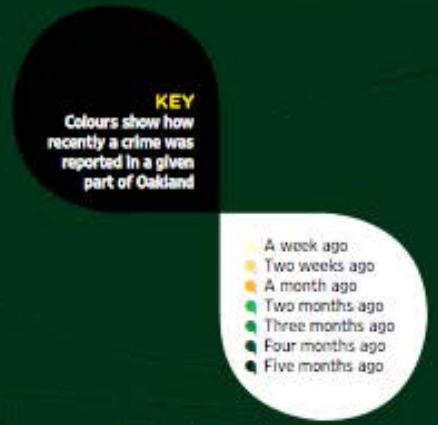
CRIMESPOTTING_

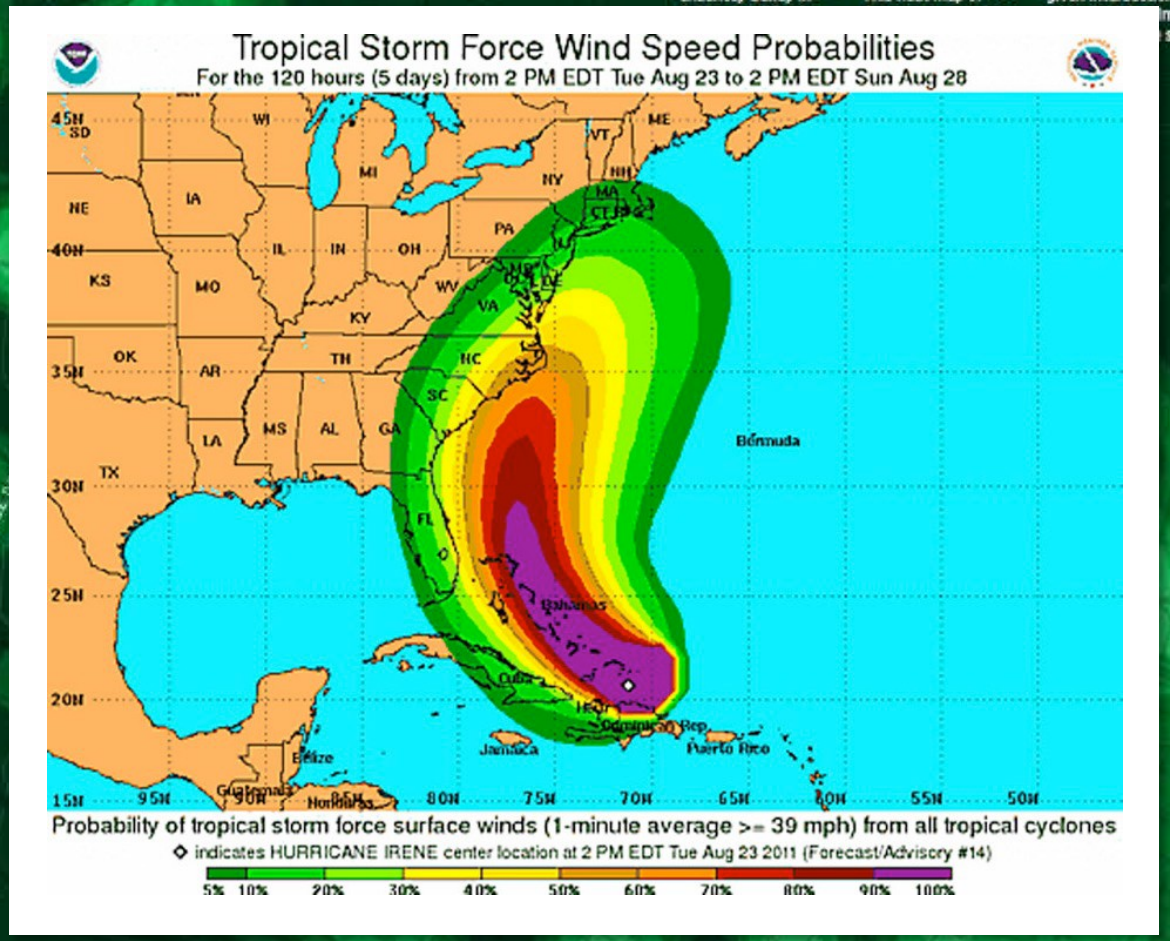
The brazen 2007 murder of journalist Chauncey Bailey in

make the city's crime data more accessible. This heat map of

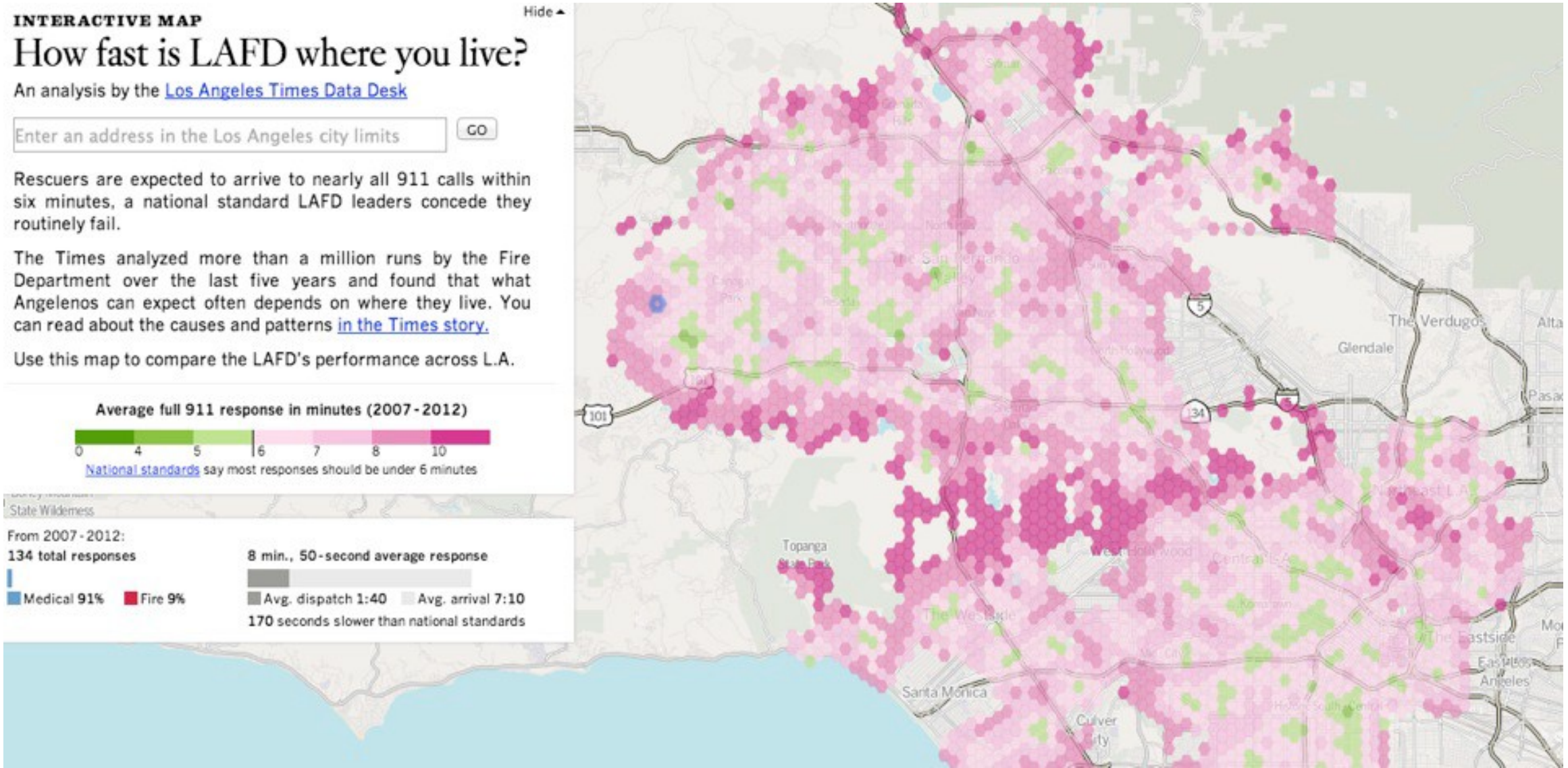
to show the gaps between crimes at a given intersection:

safe.





BREAK INTO EQUAL AREAS



CHOROPLETHS

Choropleth Map

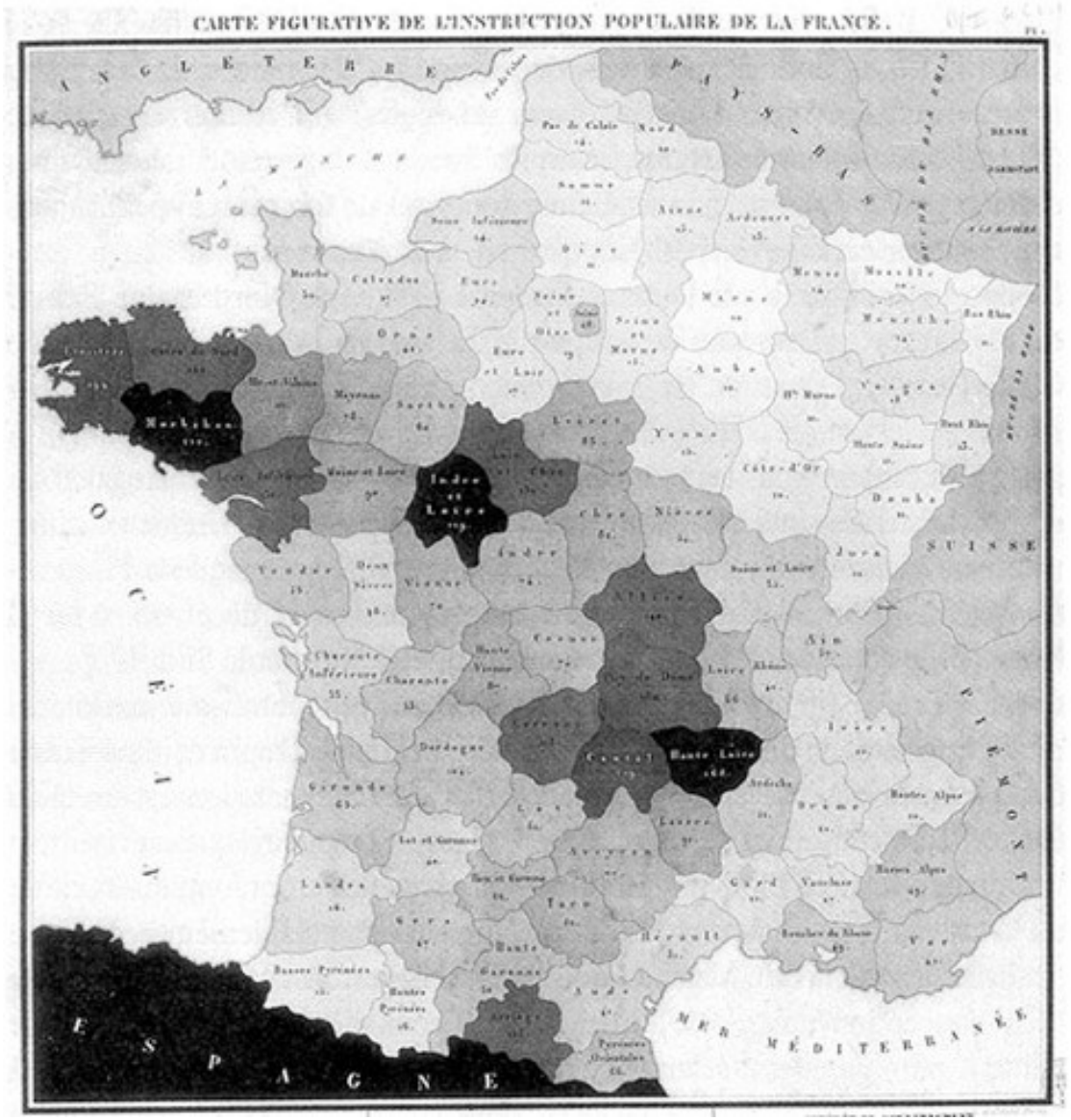
khōra (area/place) + ***plēthos*** (multitude)

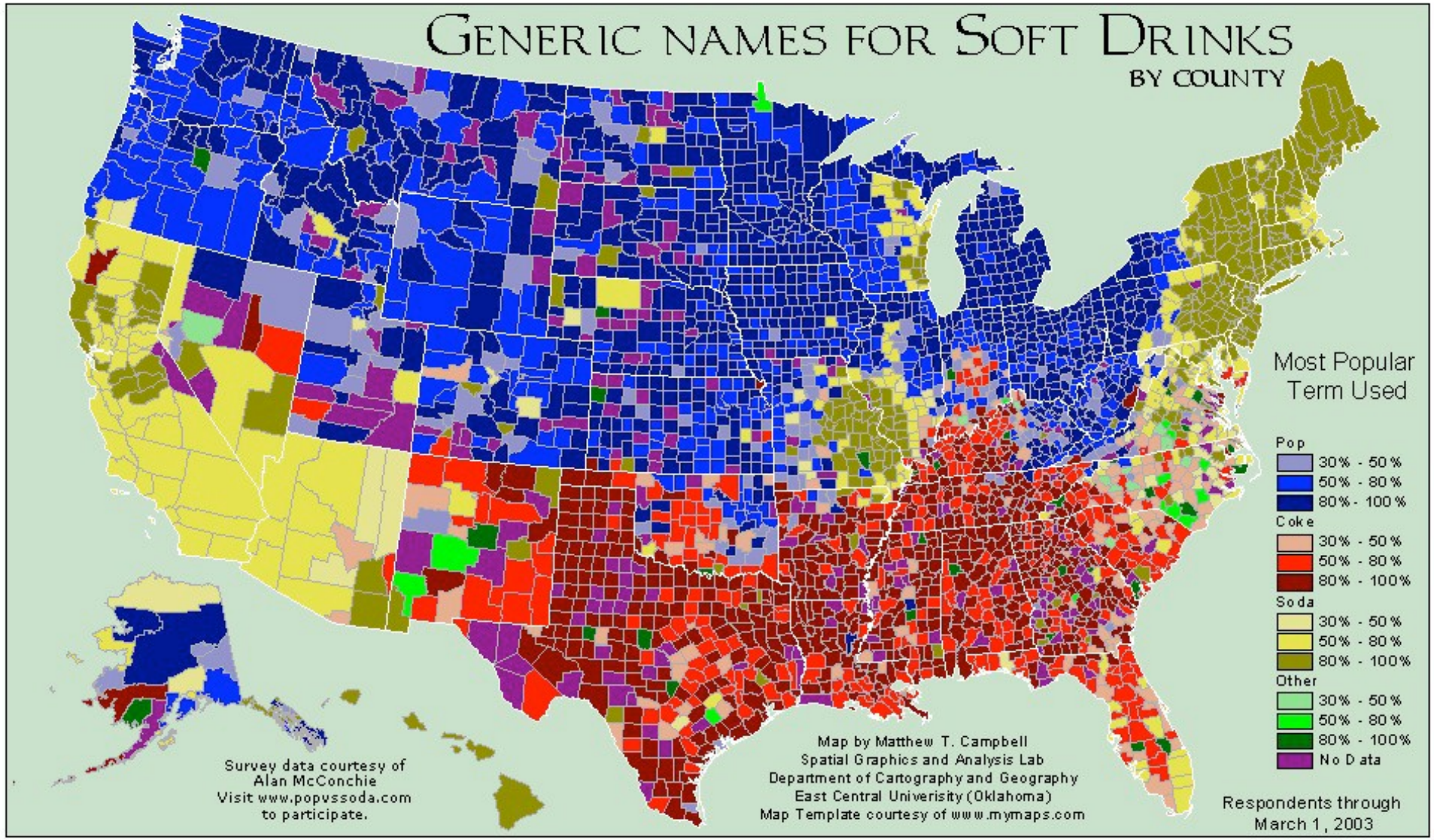
"areas are shaded or patterned in proportion to the measurement of the statistical variable being displayed on the map"

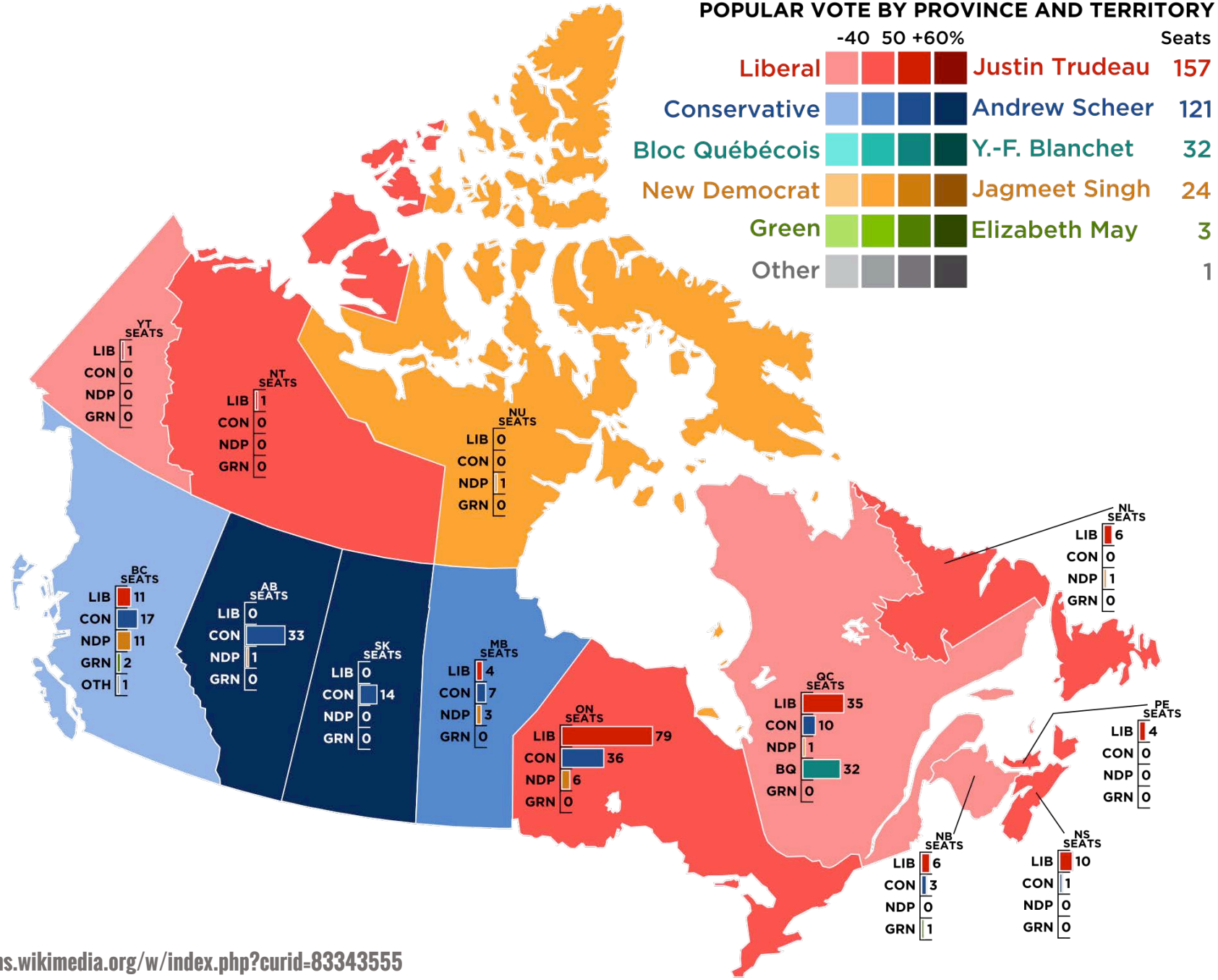
The first choropleth map

ILLITERACY IN FRANCE

CHARLES DUPIN **1826**



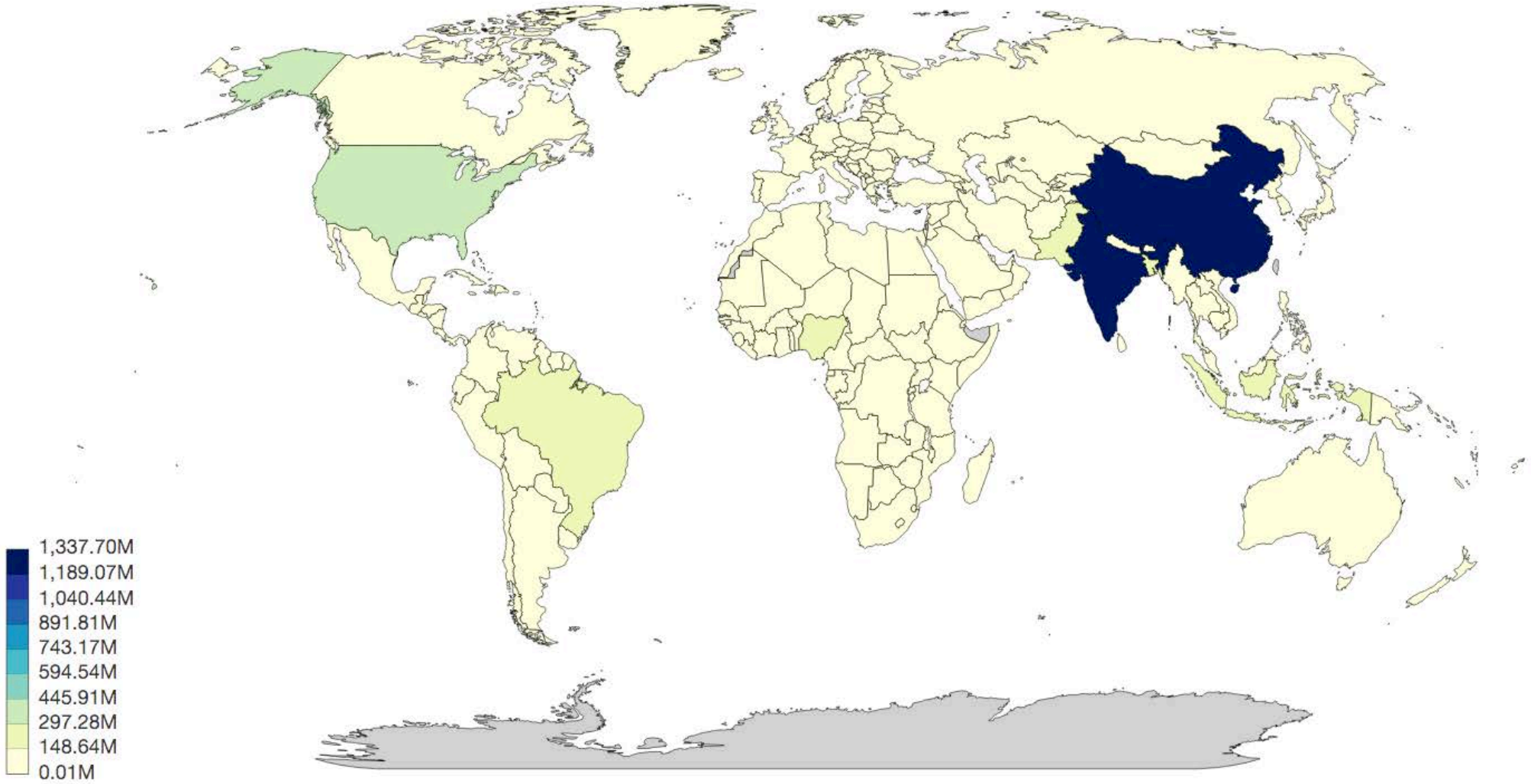

Generic names for Soft Drinks
by county
Most Popular Term Used
Pop
30% - 50%
50% - 80%
80% - 100%
Coke
30% - 50%
50% - 80%
80% - 100%
Soda
30% - 50%
50% - 80%
80% - 100%
Other
30% - 50%
50% - 80%
80% - 100%
No Data
Survey data courtesy of
Alan McConchie
Visit www.popvssoda.com
to participate.
Map by Matthew T. Campbell
Spatial Graphics and Analysis Lab
Department of Cartography and Geography
East Central University (Oklahoma)
Map Template courtesy of www.mymaps.com
Respondents through
March 1, 2003



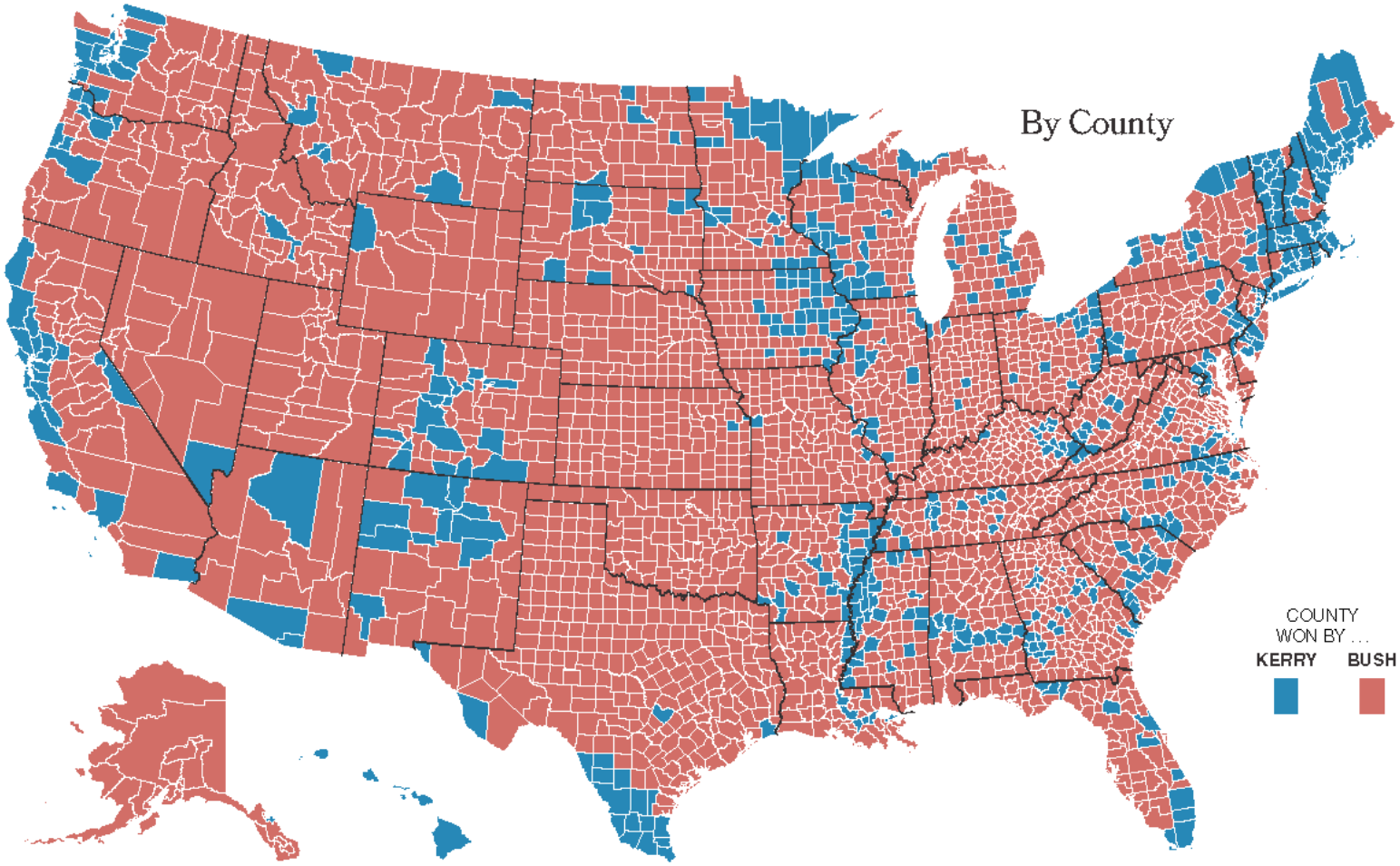
PROBLEMS

DENSITY

WHITE SPACE / DIFFERENT SIZES

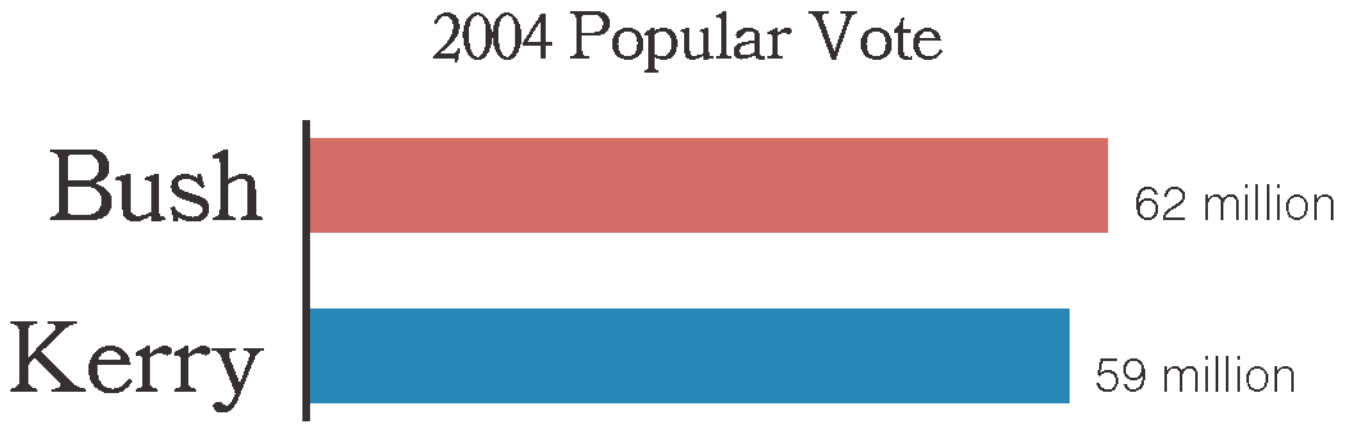


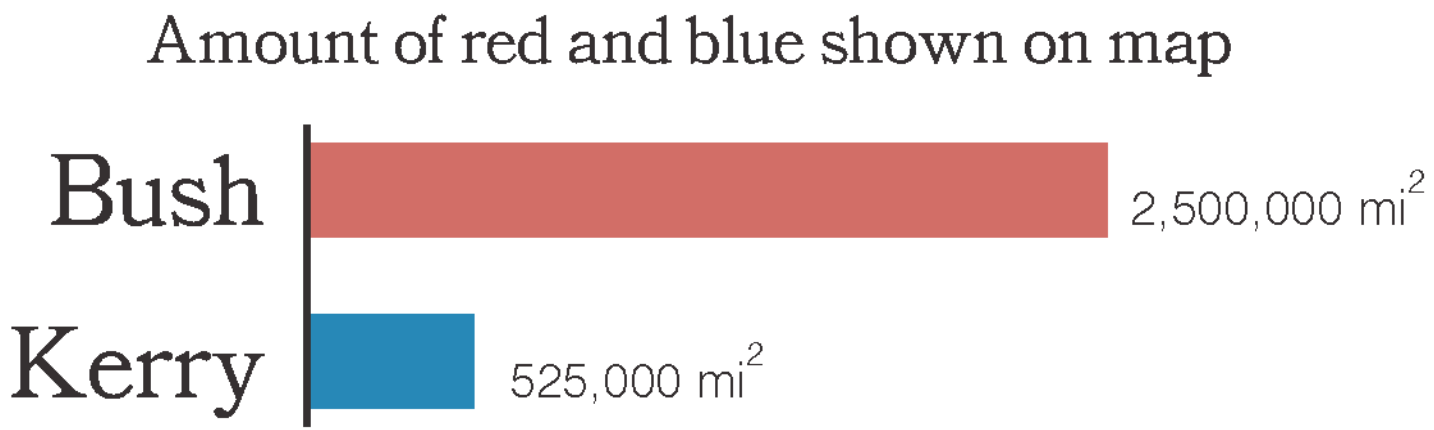
KERRY VS. BUSH 2004



MATTHEW ERICSON, NY TIMES

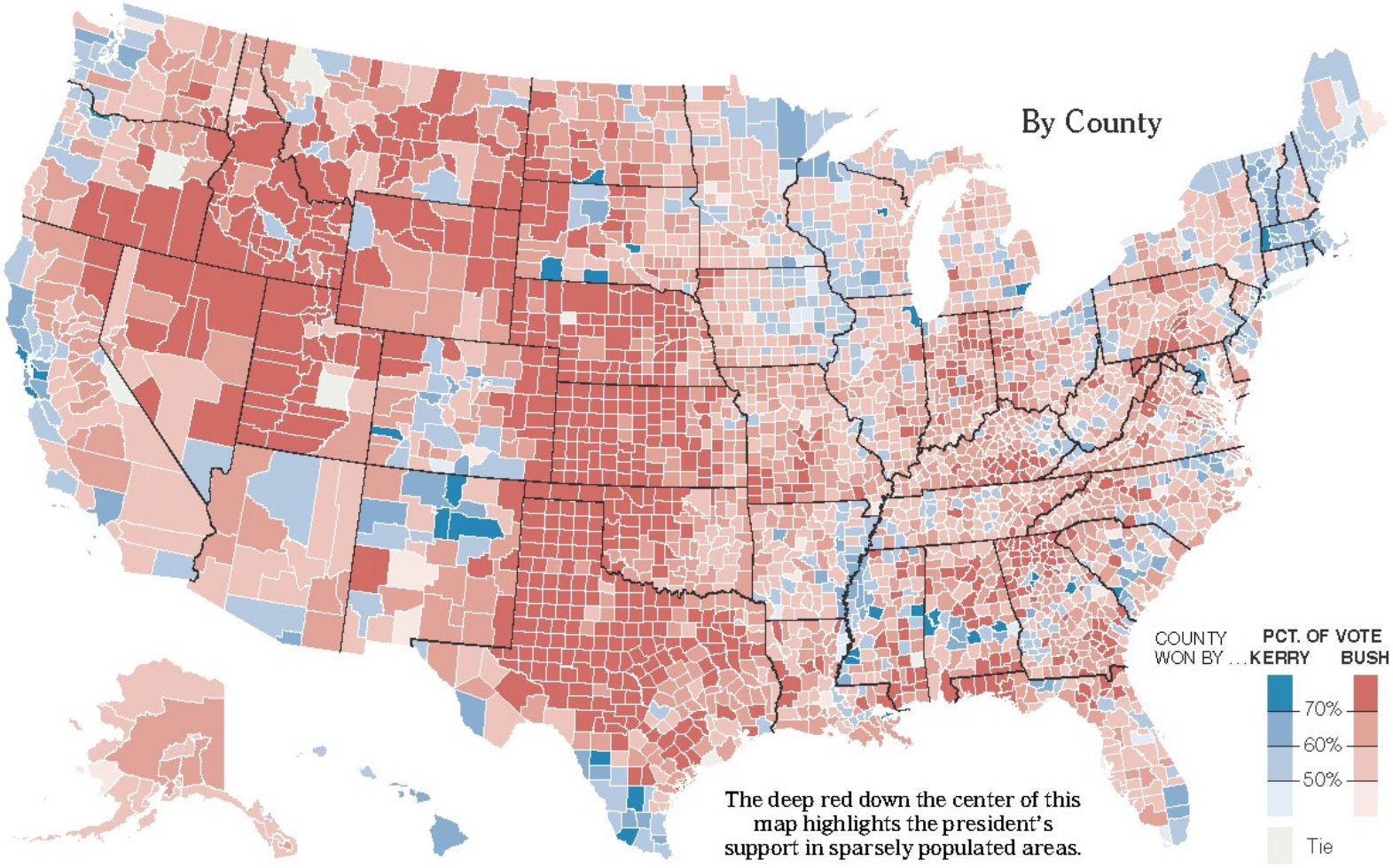
KERRY VS. BUSH 2004





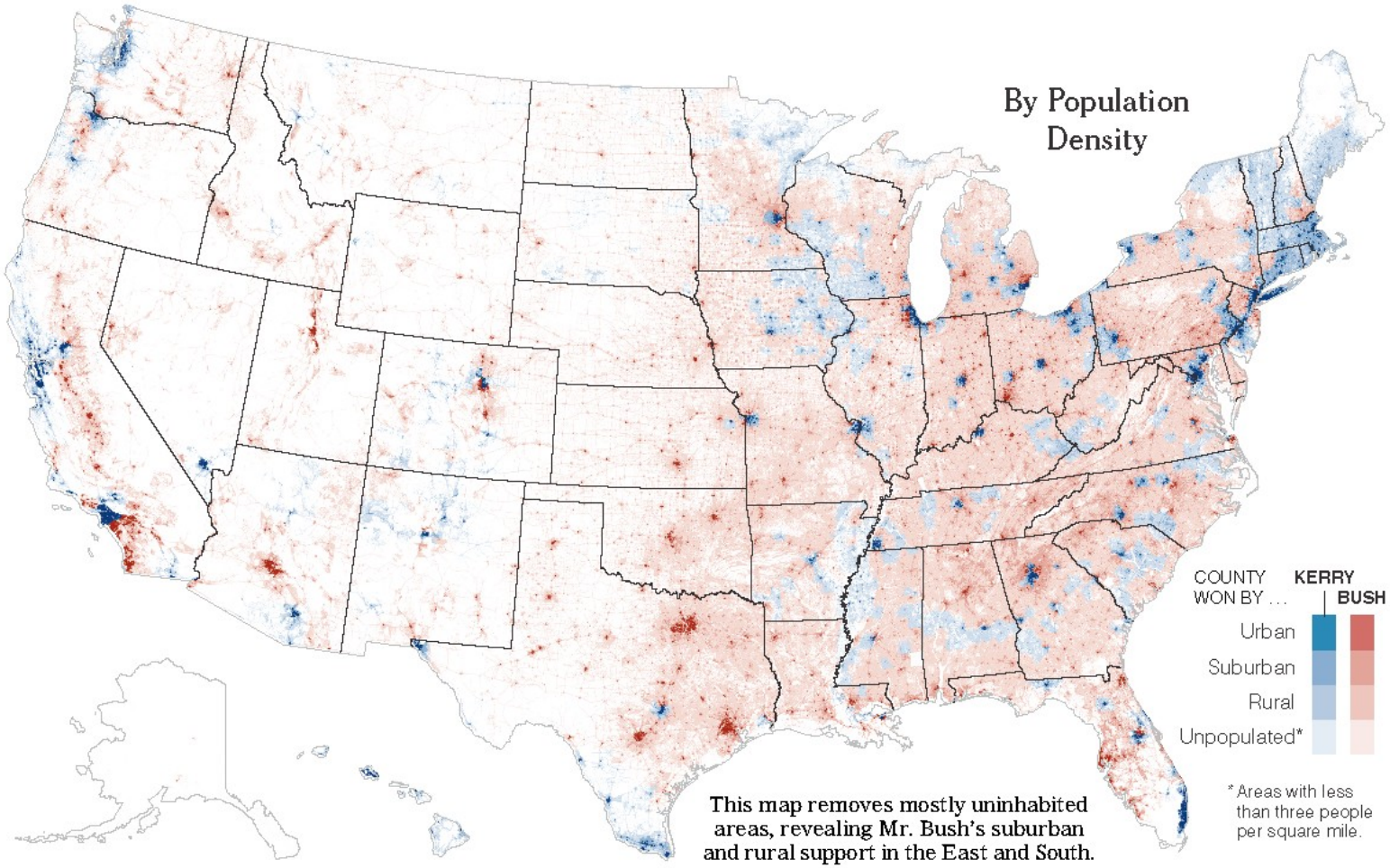
MATTHEW ERICSON, NY TIMES

KERRY VS. BUSH 2004



MATTHEW ERICSON, NY TIMES

KERRY VS. BUSH 2004



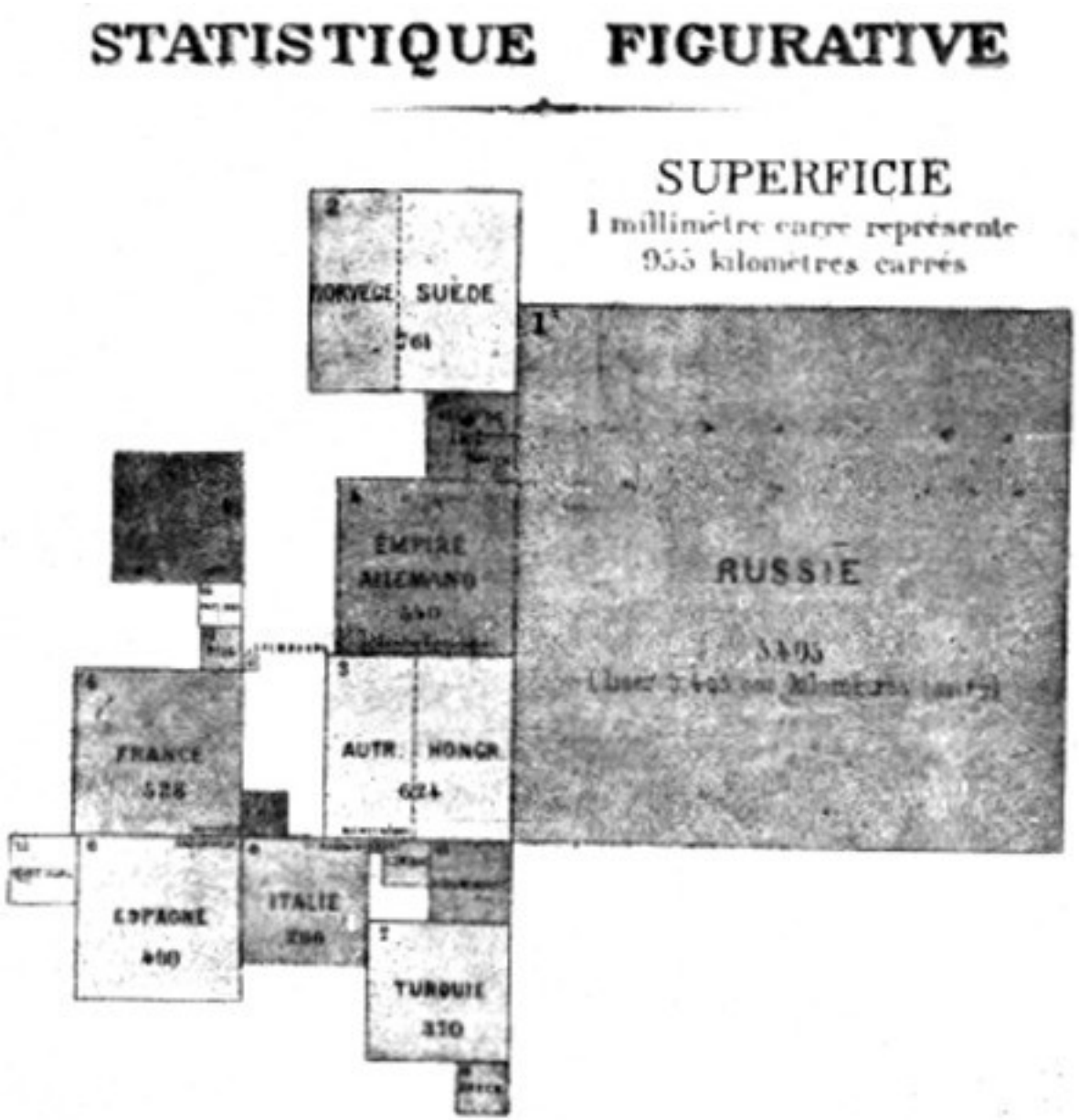
MATTHEW ERICSON, NY TIMES

MATTHEW ERICSON, NY TIMES

CARTOGRAMS

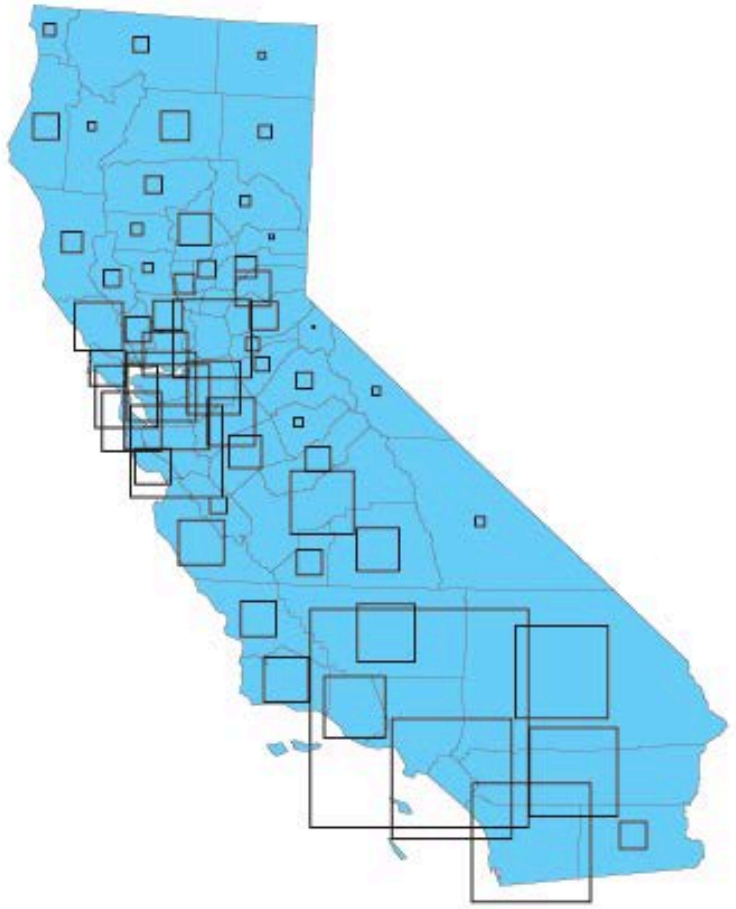
CARTOGRAMS

Maps in which **areas are scaled and distorted** relative to a data attribute (population, GDP, etc.)



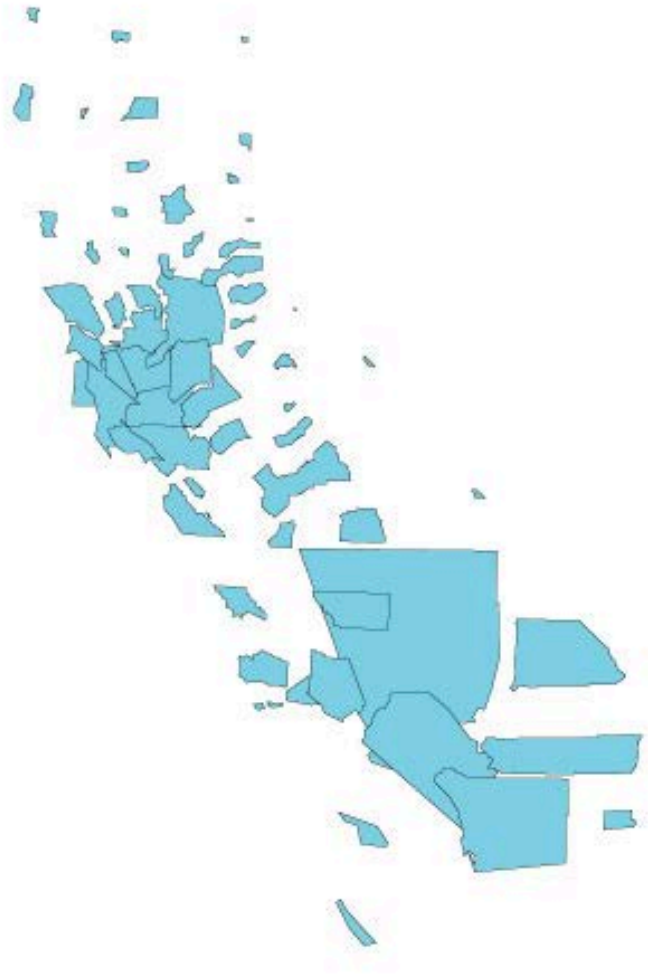
EMILE LEVASSEUR 1868

AREAS+MAP



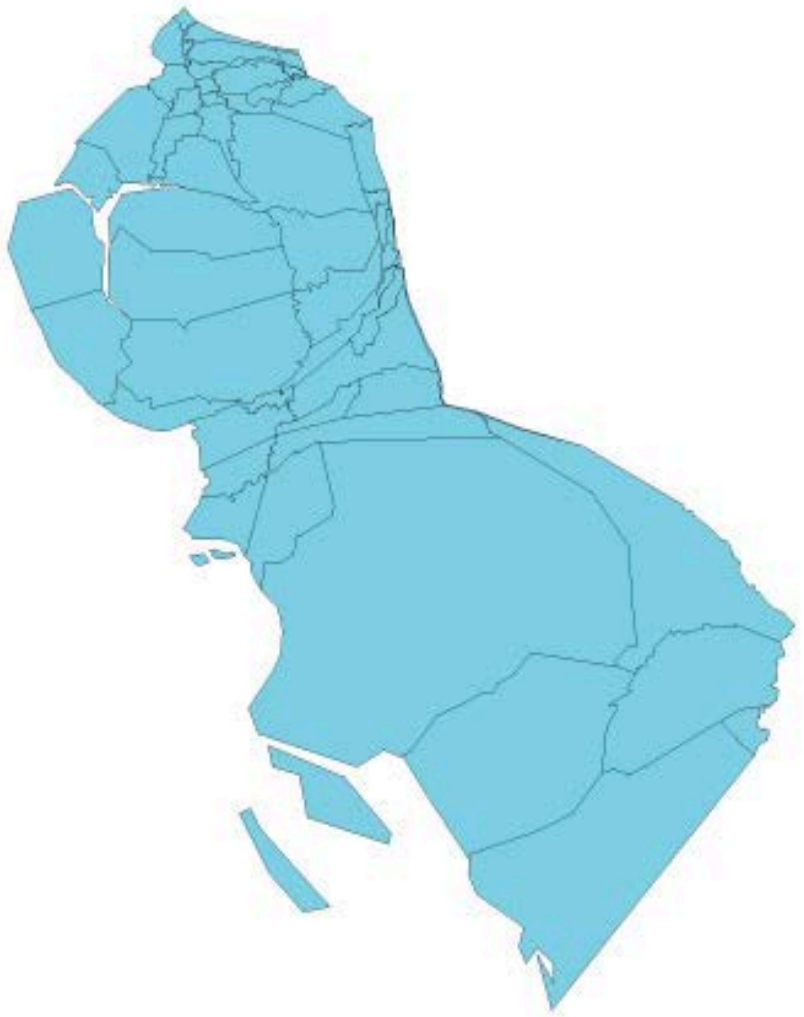
NON-CONTIGUOUS CARTOGRAMS

Overlapping



Non-Overlapping

CONTINUOUS CARTOGRAMS

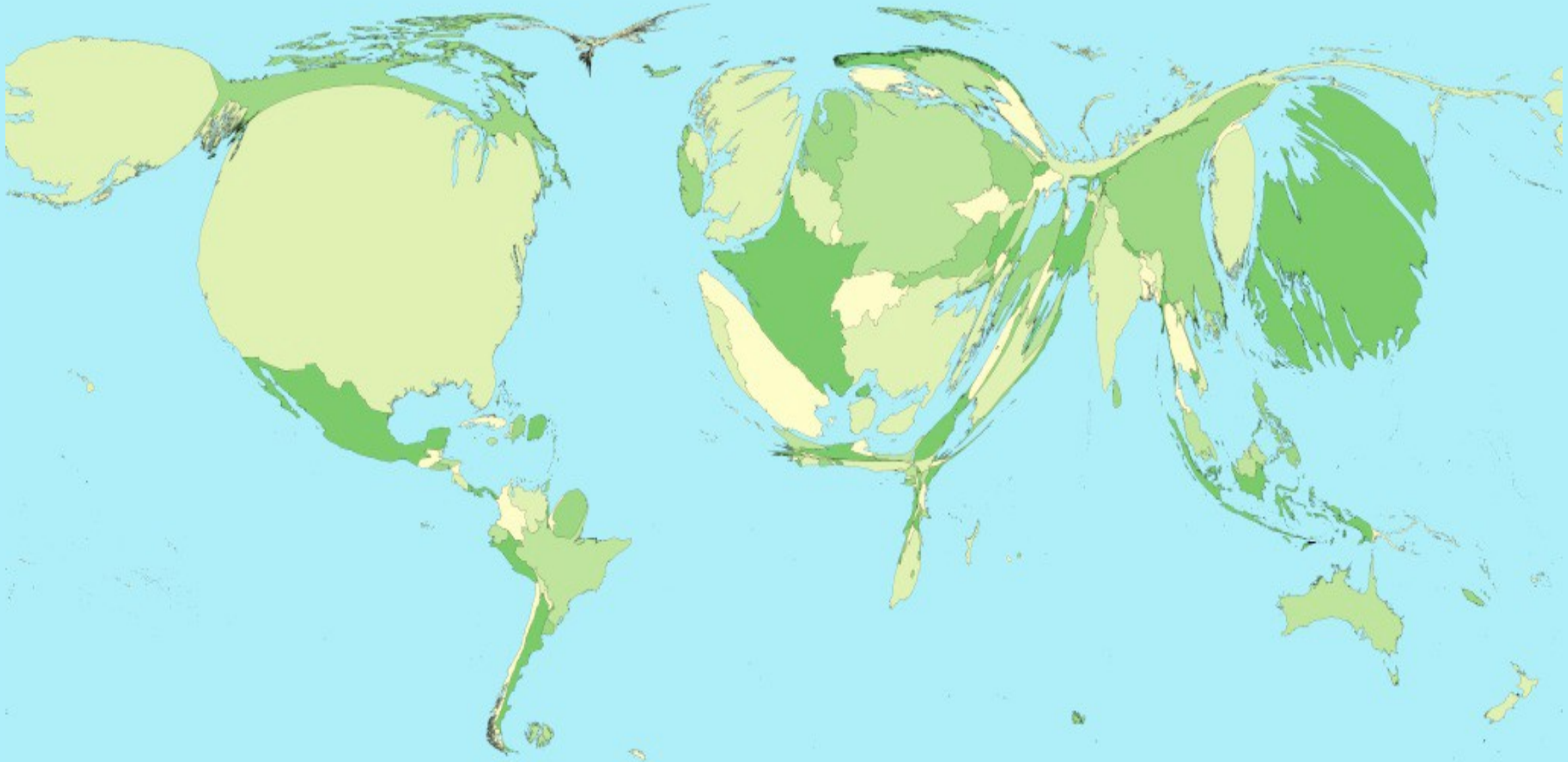


THE WORLD

http://www-personal.umich.edu/~mejn/cartograms/

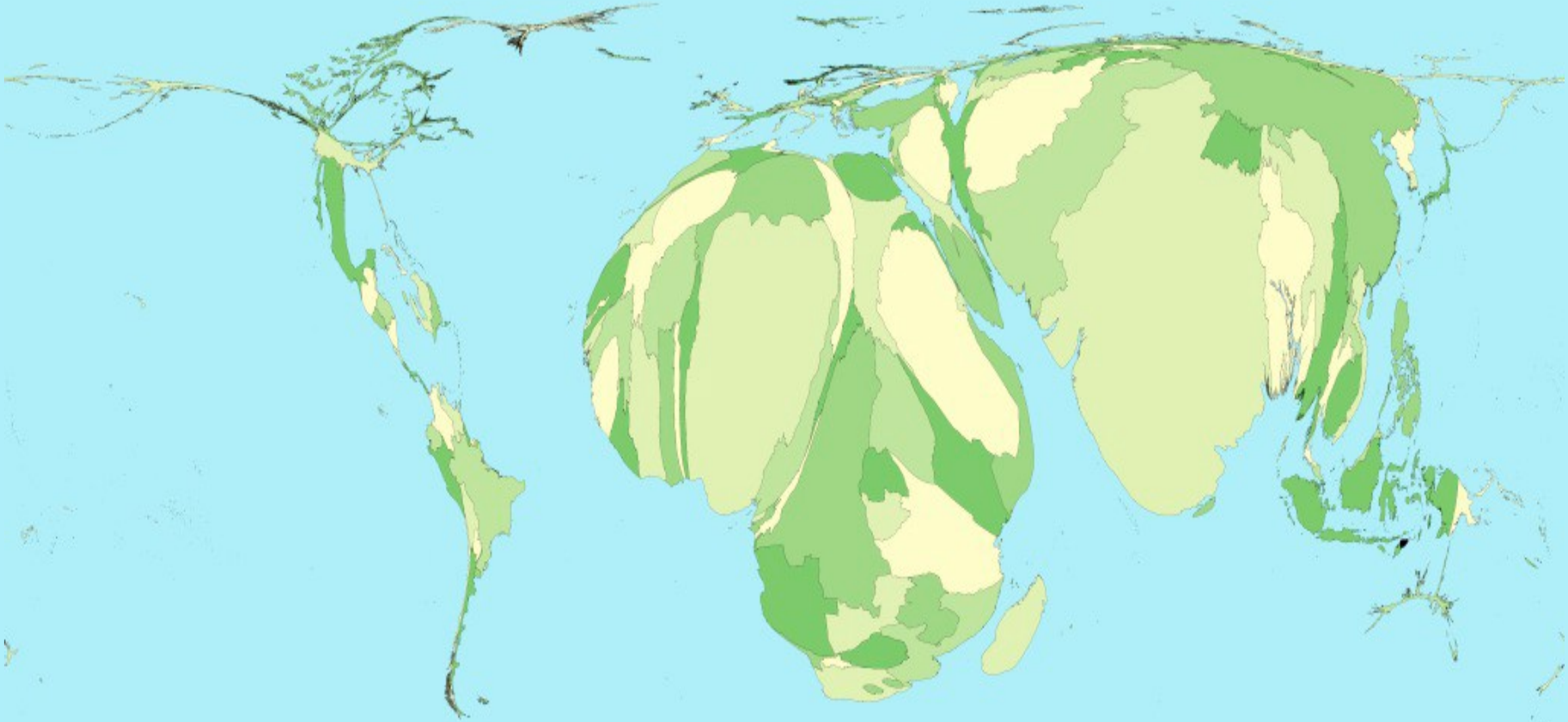
POPULATION

http://www-personal.umich.edu/~mejn/cartograms/



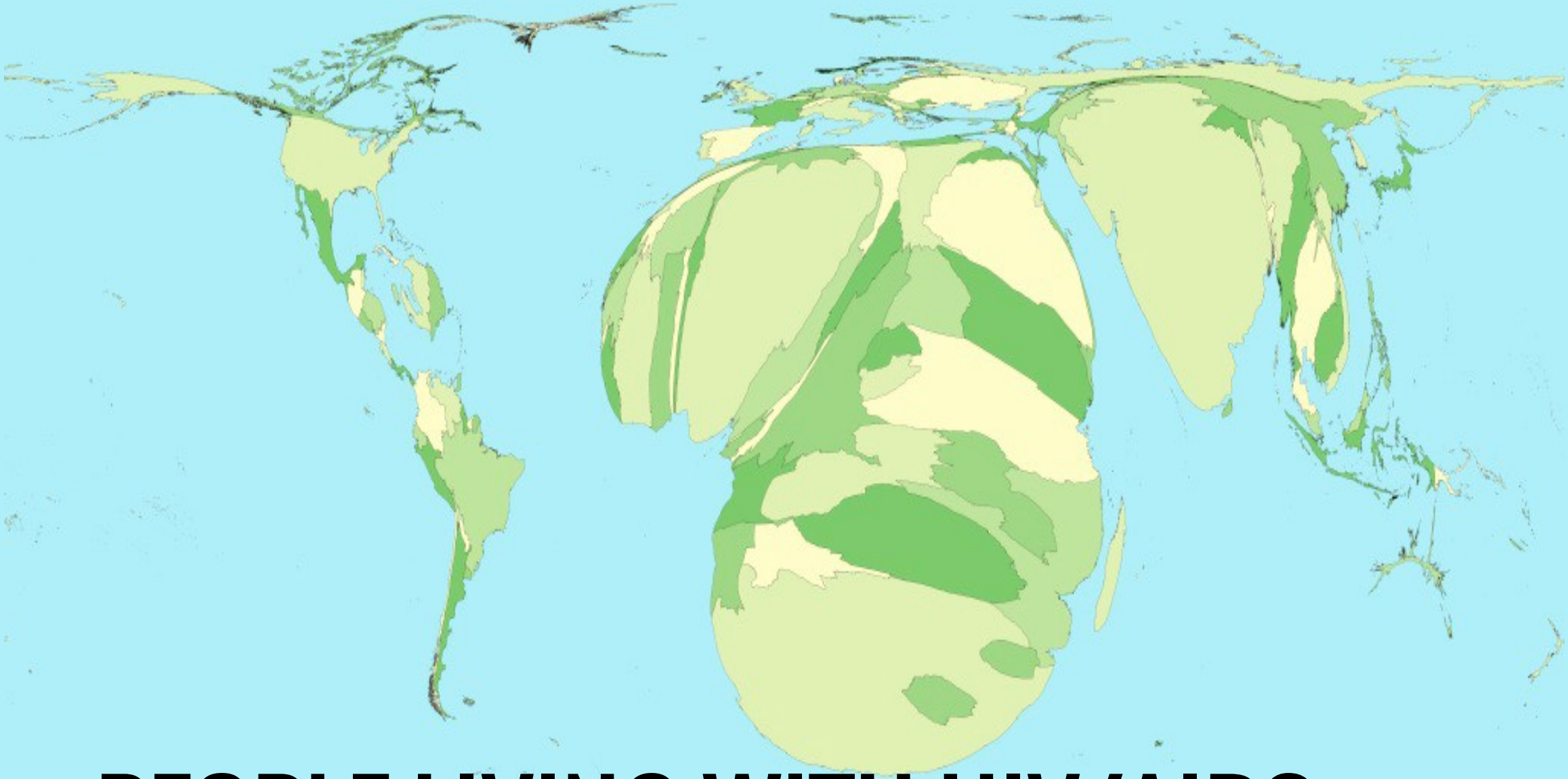
GROSS DOMESTIC PRODUCT

http://www-personal.umich.edu/~mejn/cartograms/



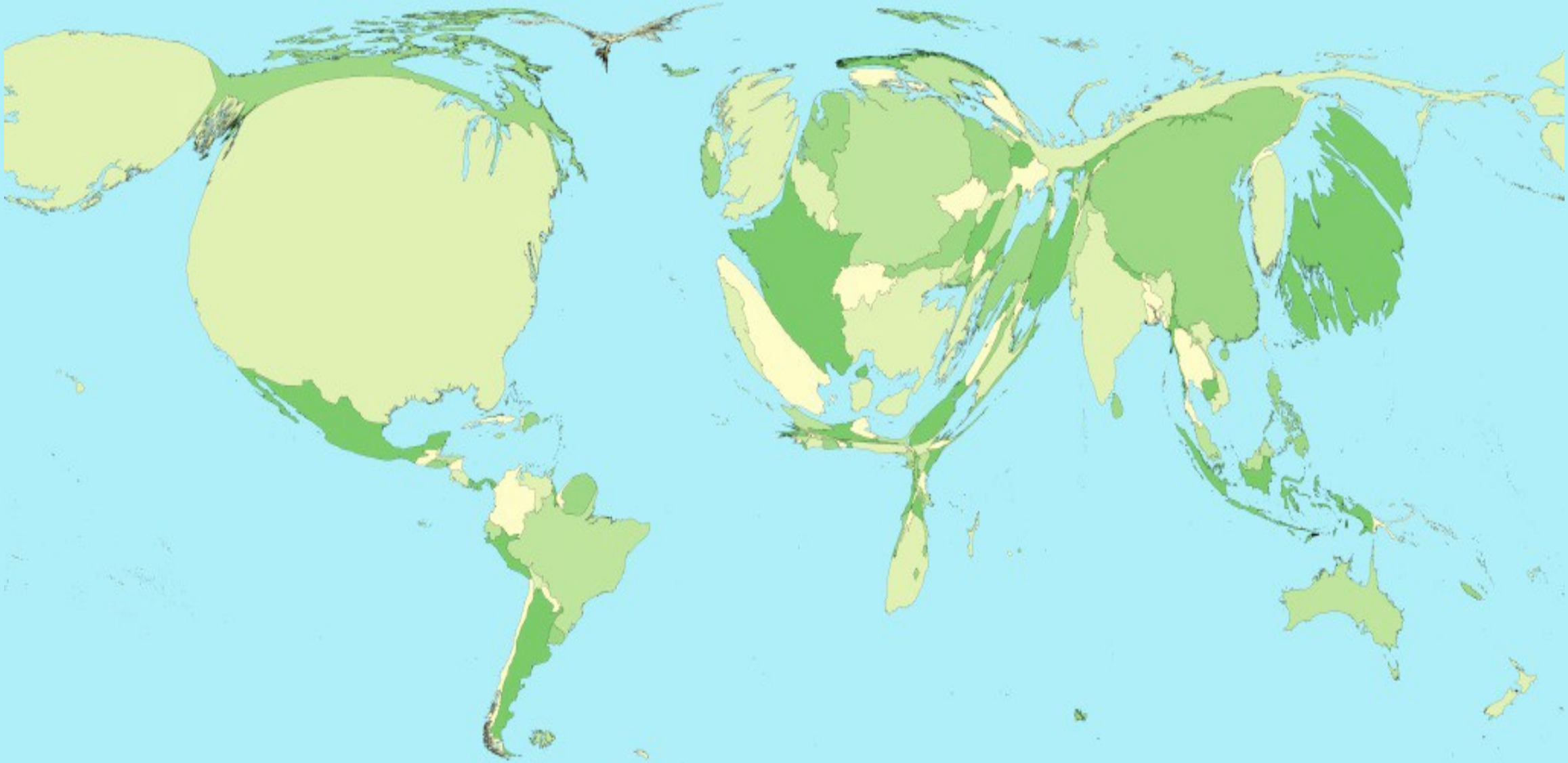
CHILD MORTALITY

http://www-personal.umich.edu/~mejn/cartograms/



PEOPLE LIVING WITH HIV/AIDS

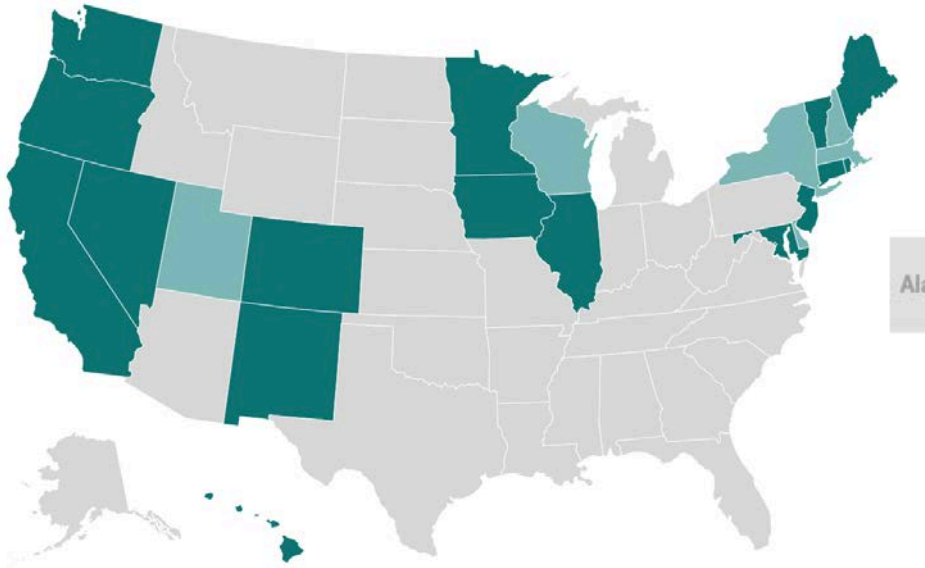
http://www-personal.umich.edu/~mejn/cartograms/

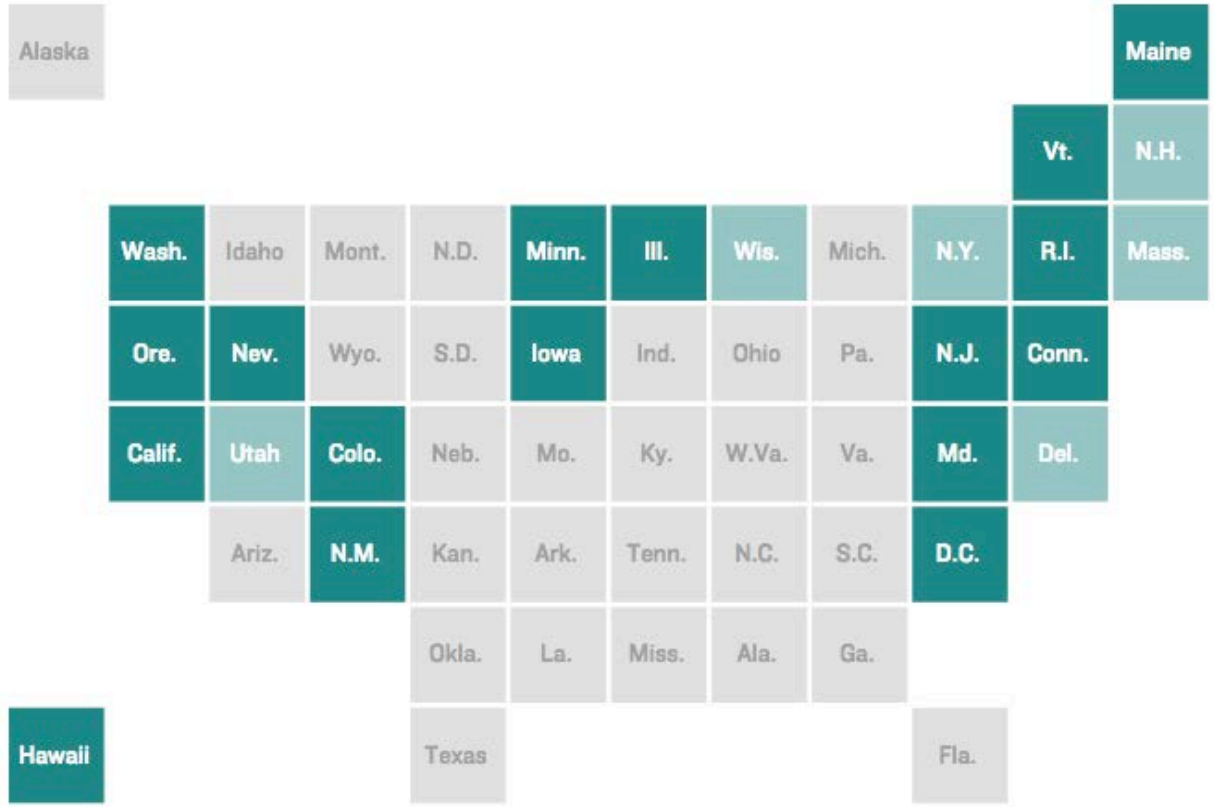


TOTAL SPENDING ON HEALTH CARE

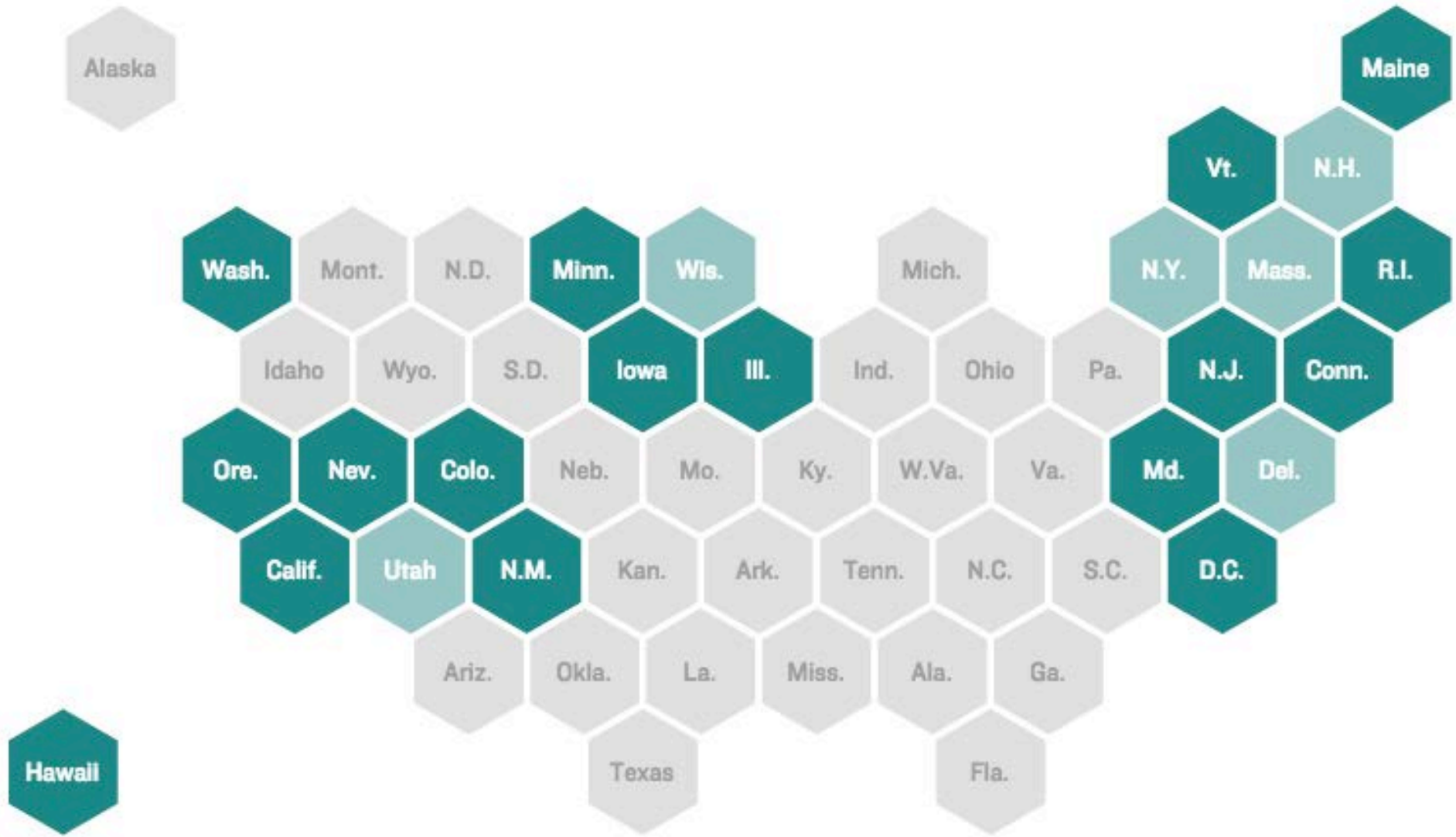
http://www-personal.umich.edu/~mejn/cartograms/

TILE GRID MAPS





NPR **2015**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S.D.
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Conn.
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Ky.
W.Va.
Va.
Md.
Del.
Calif.
Utah
N.M.
Kan.
Ark.
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Ariz.
Okla.
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Ala.
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Hawaii
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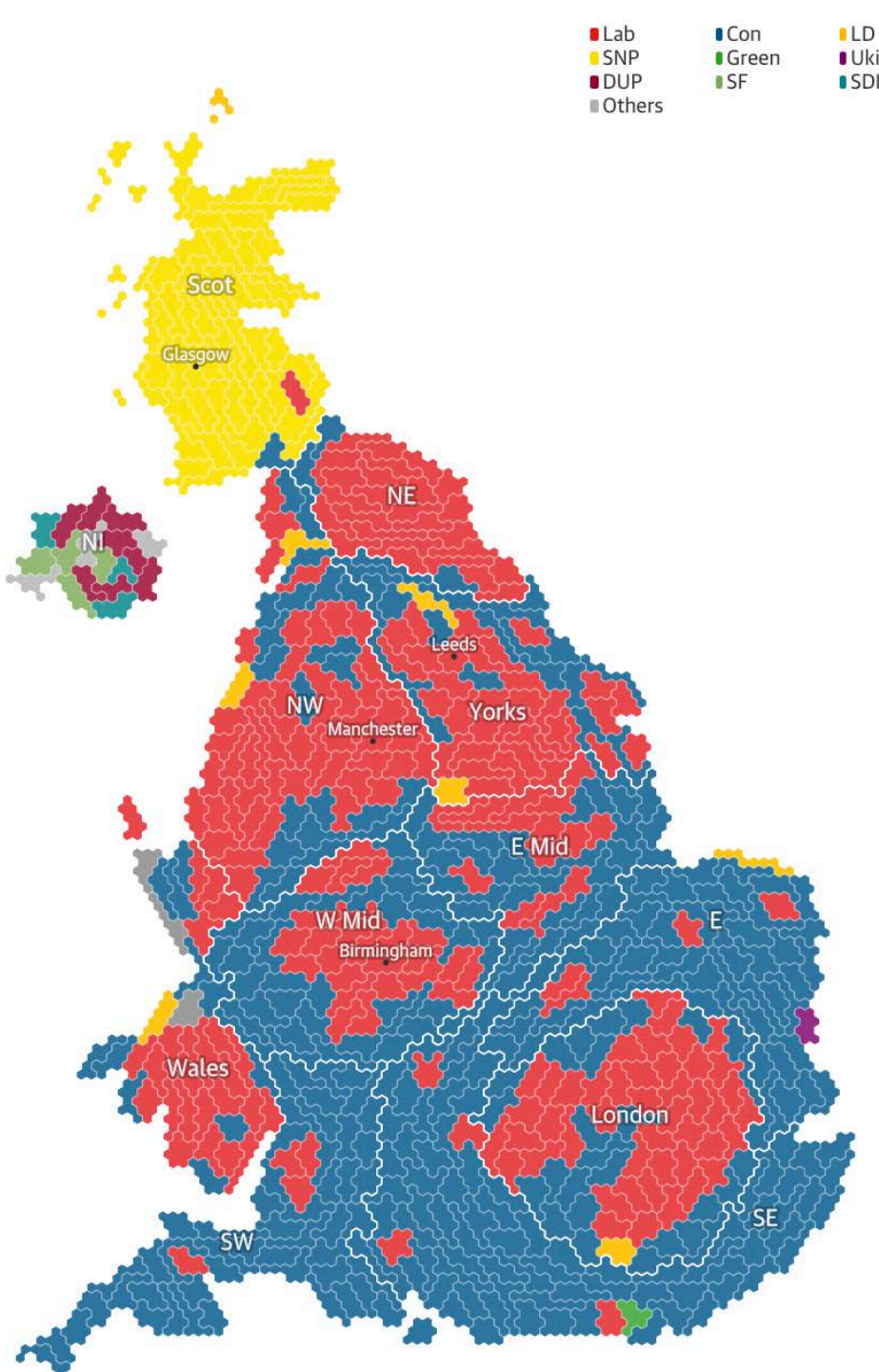

THE GUARDIAN **2015**

London Squared Map

Making the city easier to read

AFTER THE FLOOD 2015
http://aftertheflood.co/projects/london-


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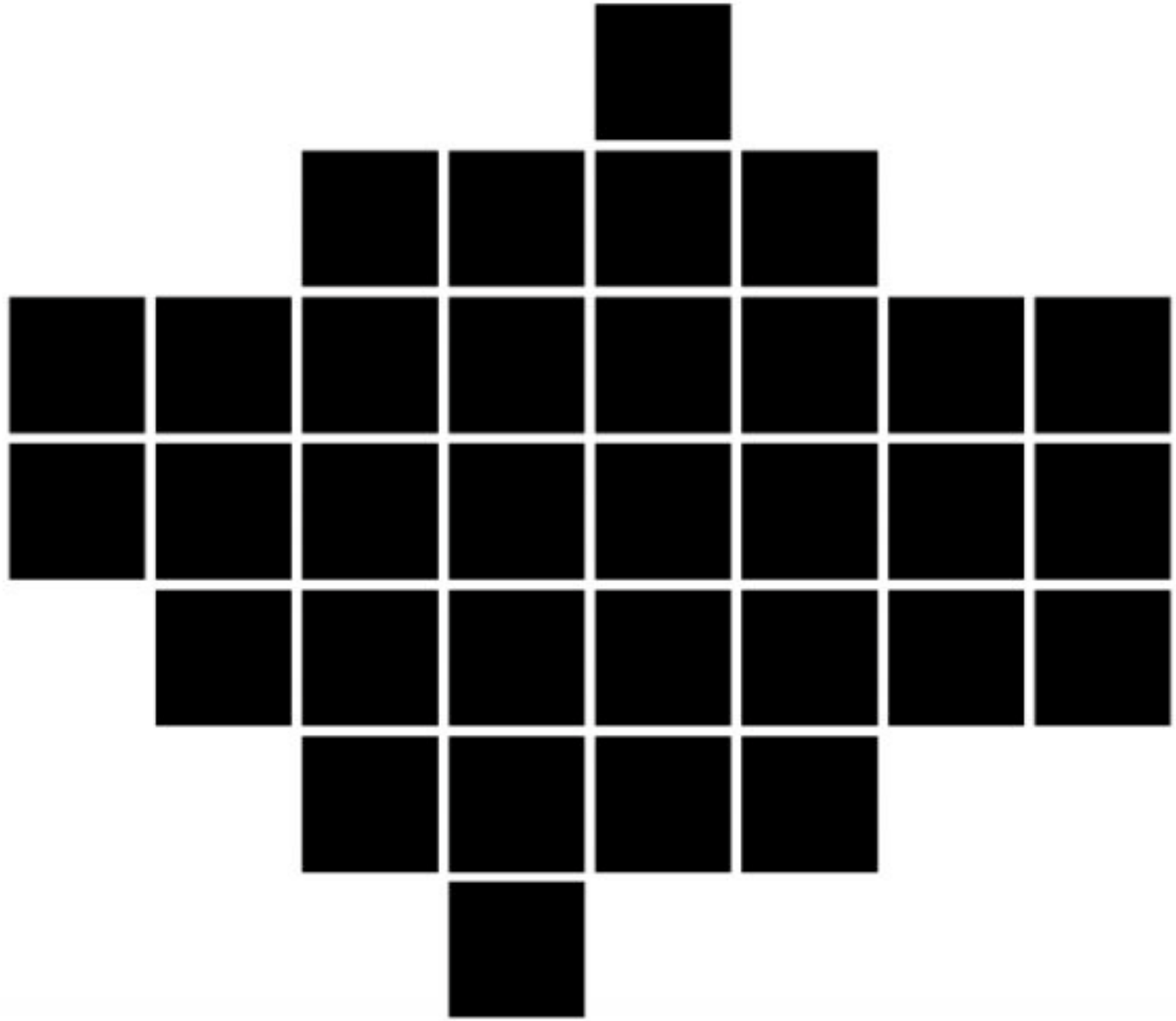

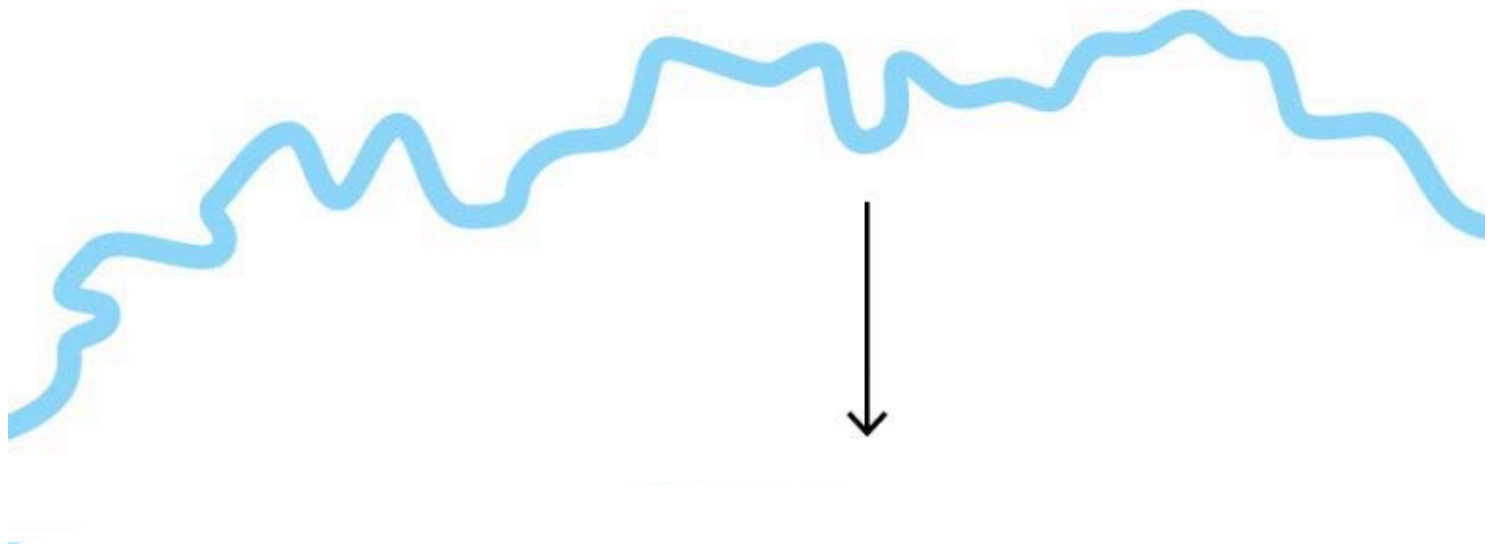

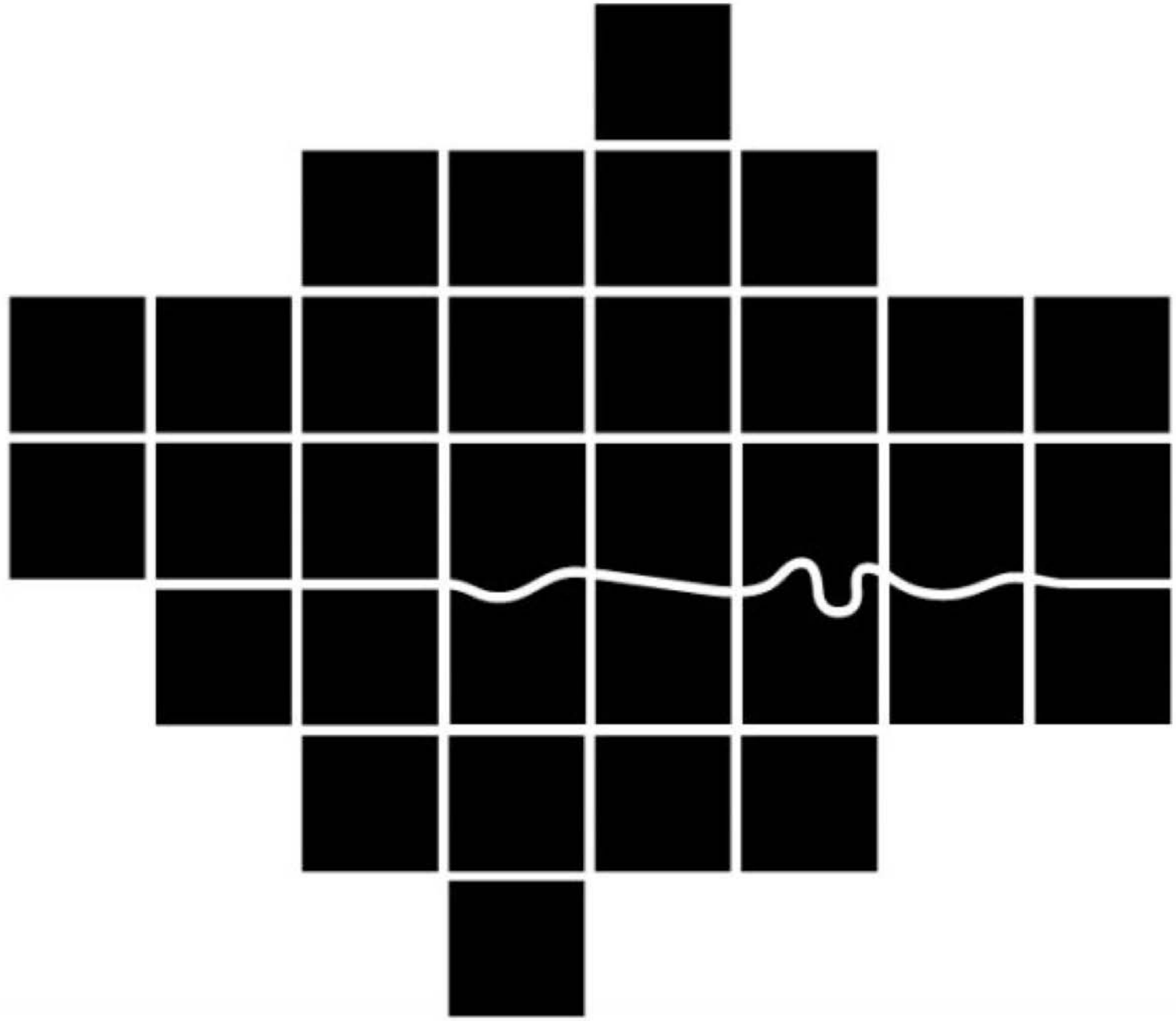

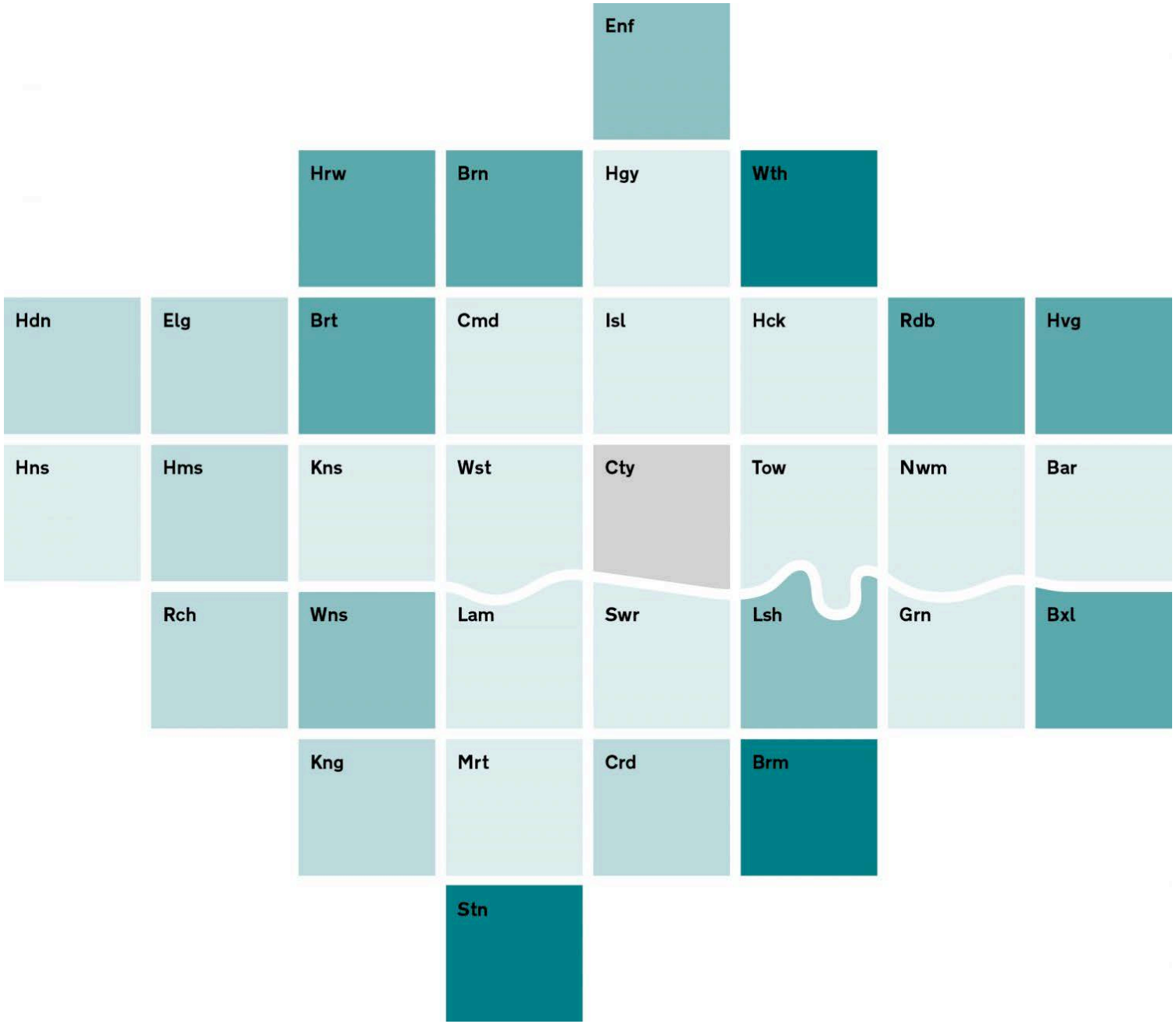
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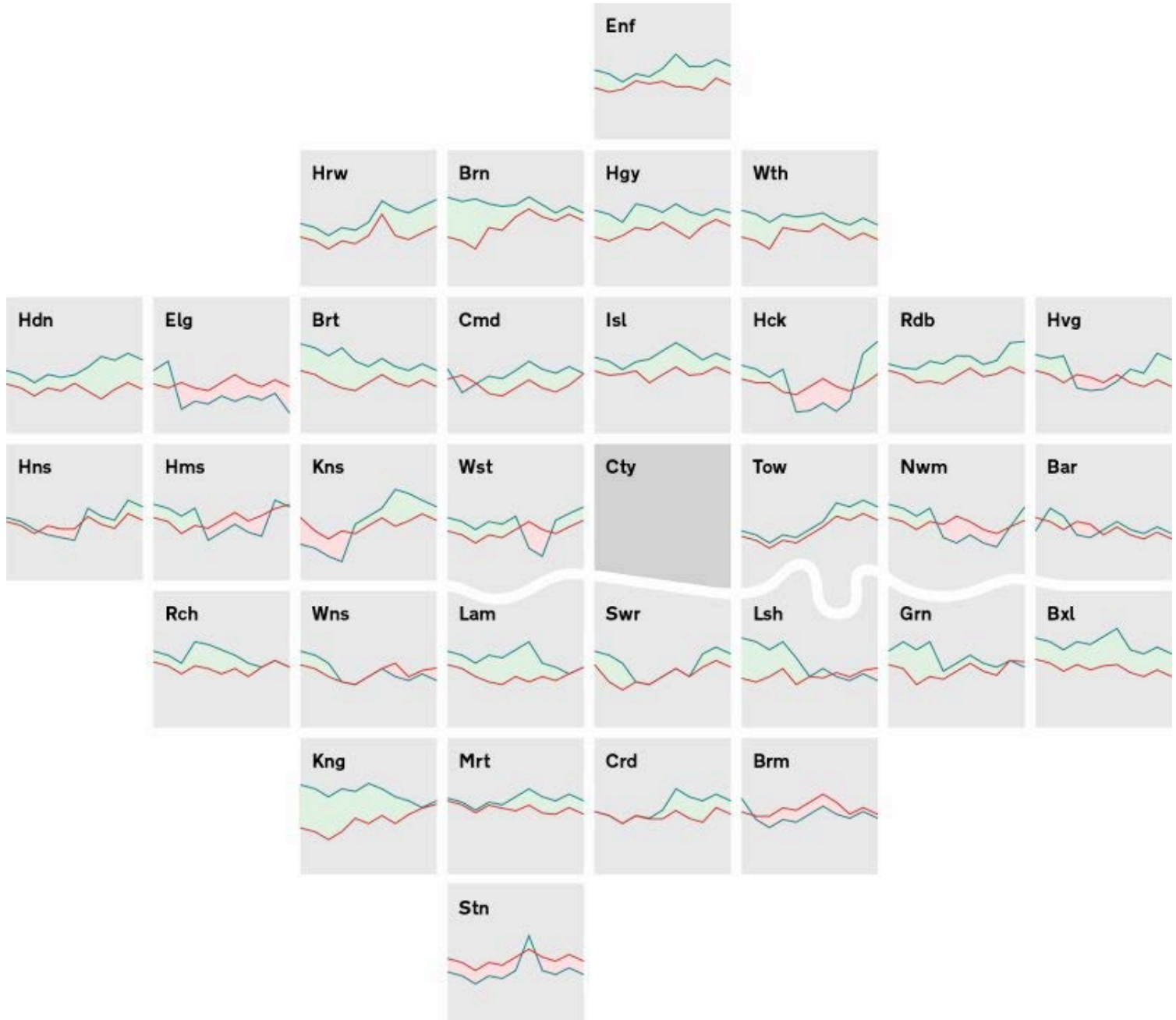
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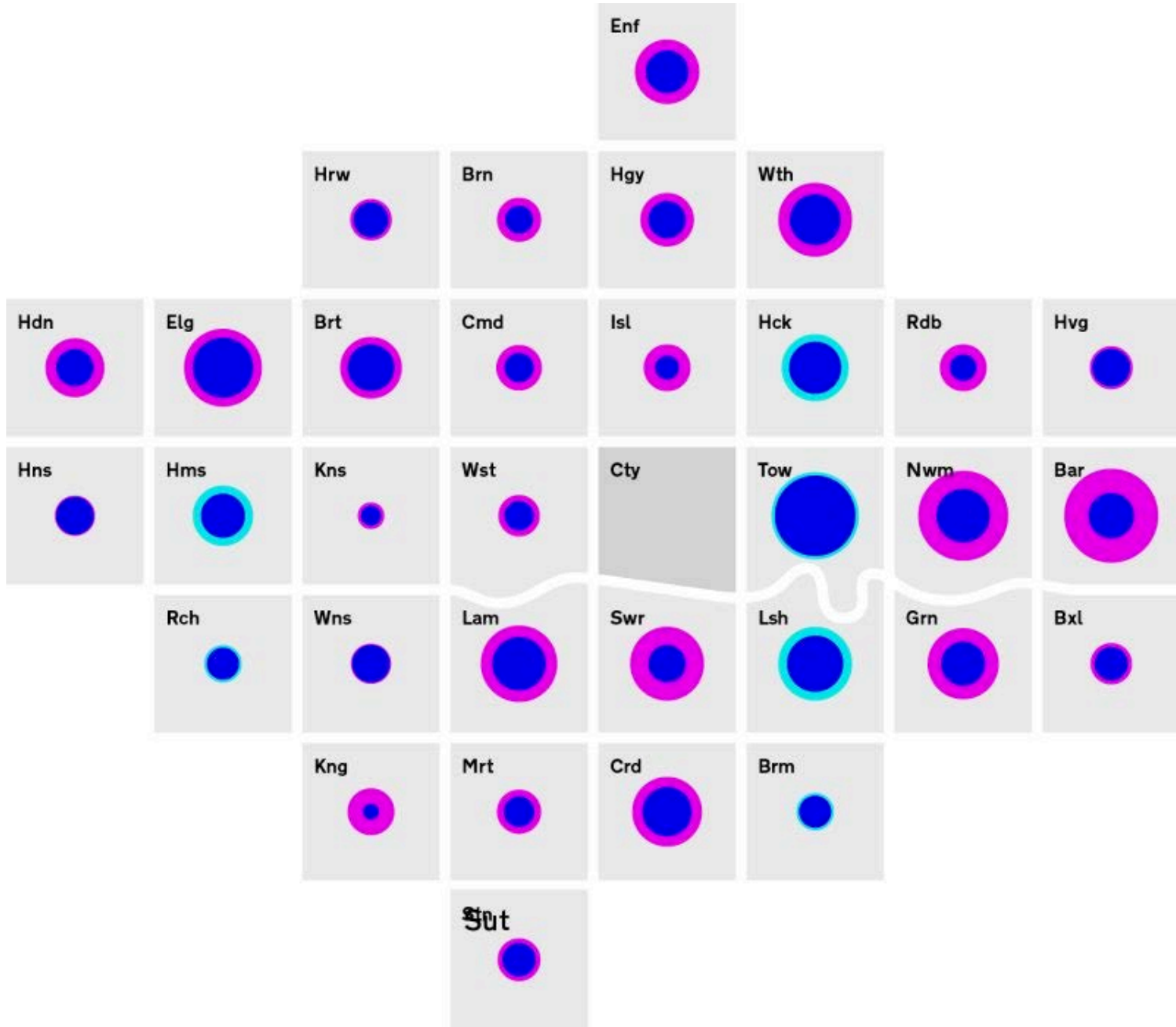
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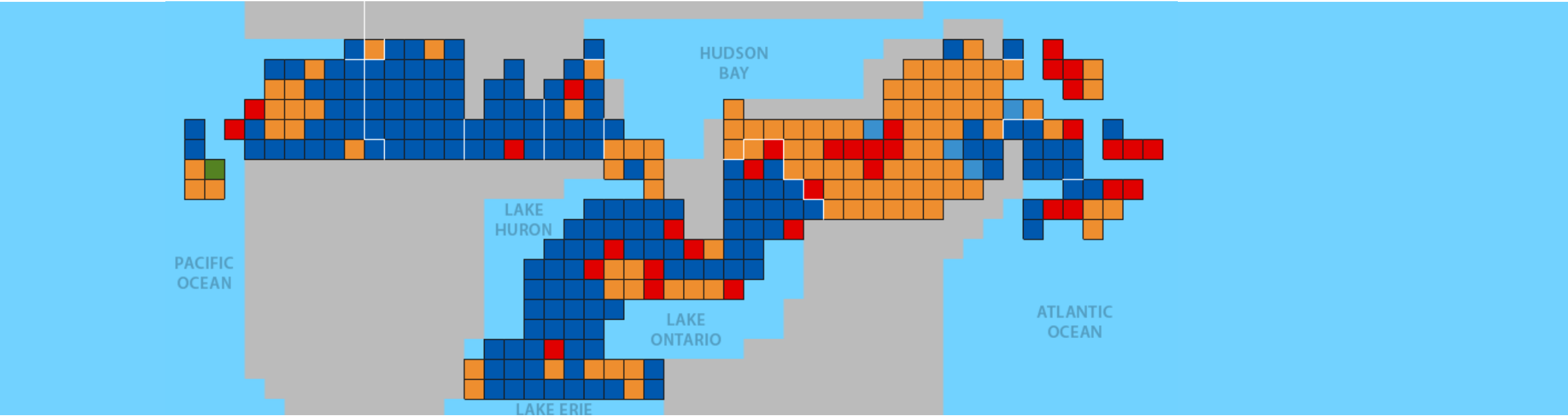
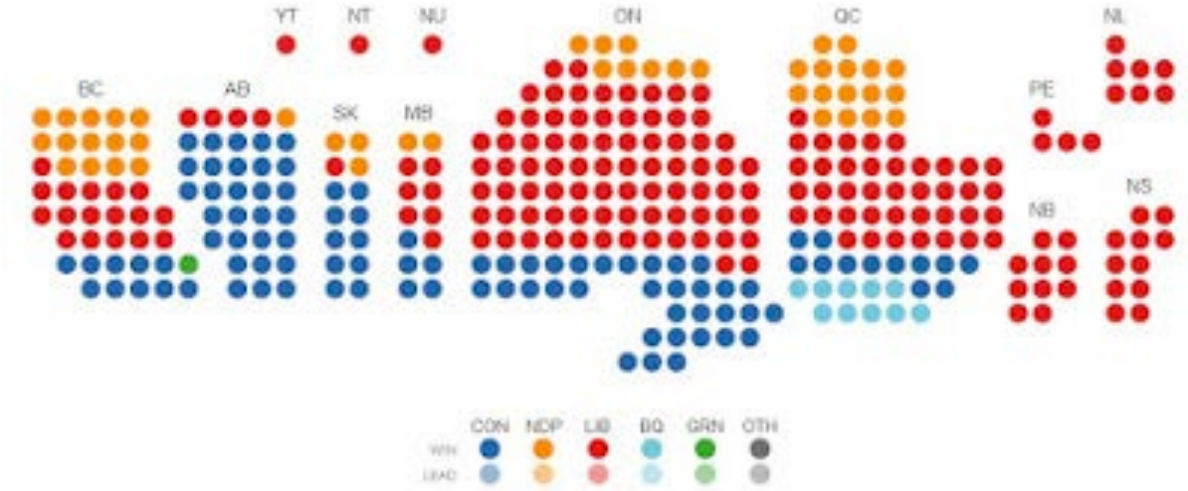
WHAT ABOUT CANADA?

THREEHUNDREDEIGHT.COM **2011**

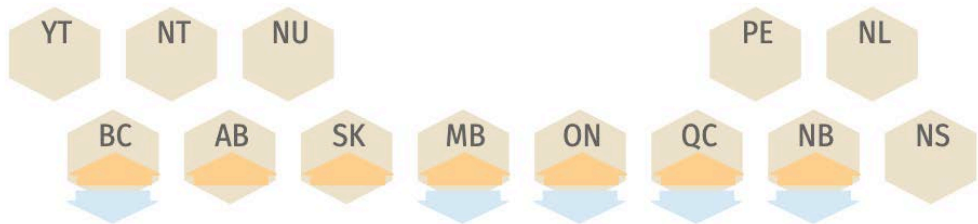




THREEHUNDREDEIGHT.COM **2011**

Imports & Exports of Energy Products to and from Canada

This visualization shows the quarterly energy trade data between Canada and the U.S. for various energy sources.

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TOOLS & PLATFORMS

CHALLENGES

Geocoding
What spatial location should I use for this data?

Basemap selection
What base information to include?

Legibility
How to overlay complex data with existing geography?
How to avoid over/under emphasizing effects?

GIS TOOLS

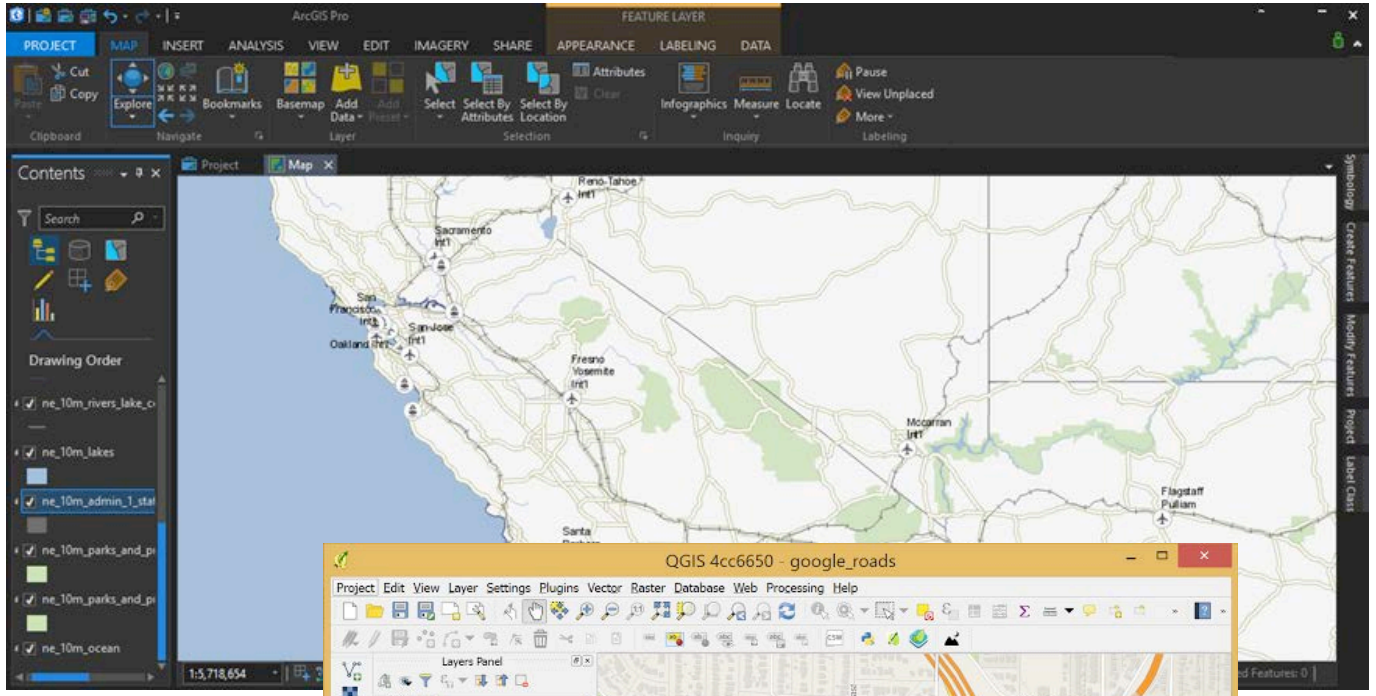
(Geographic Information Systems)

ESRI ArcGIS

QGIS

GRASS

...

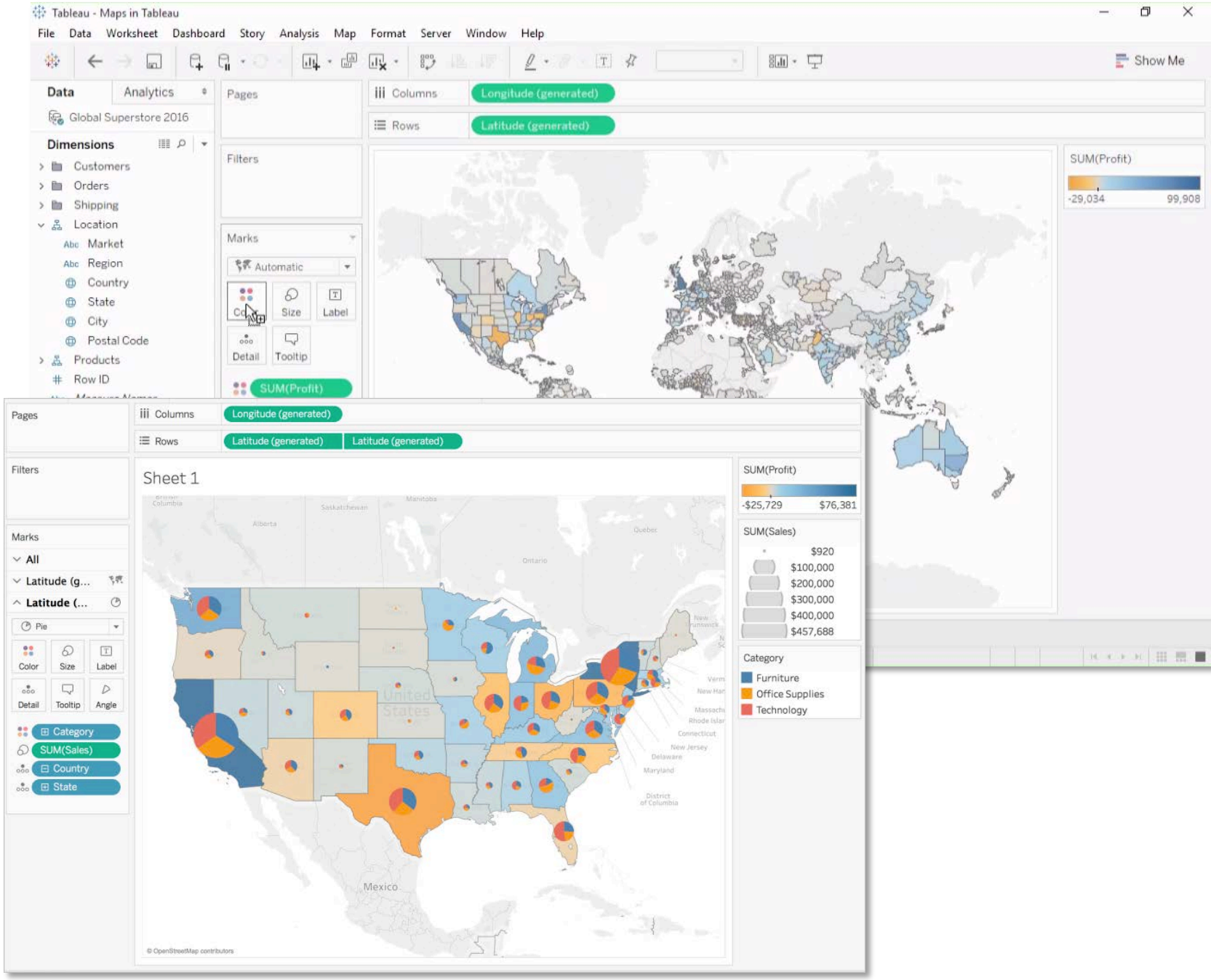


ArcGIS

QGIS

TABLEAU

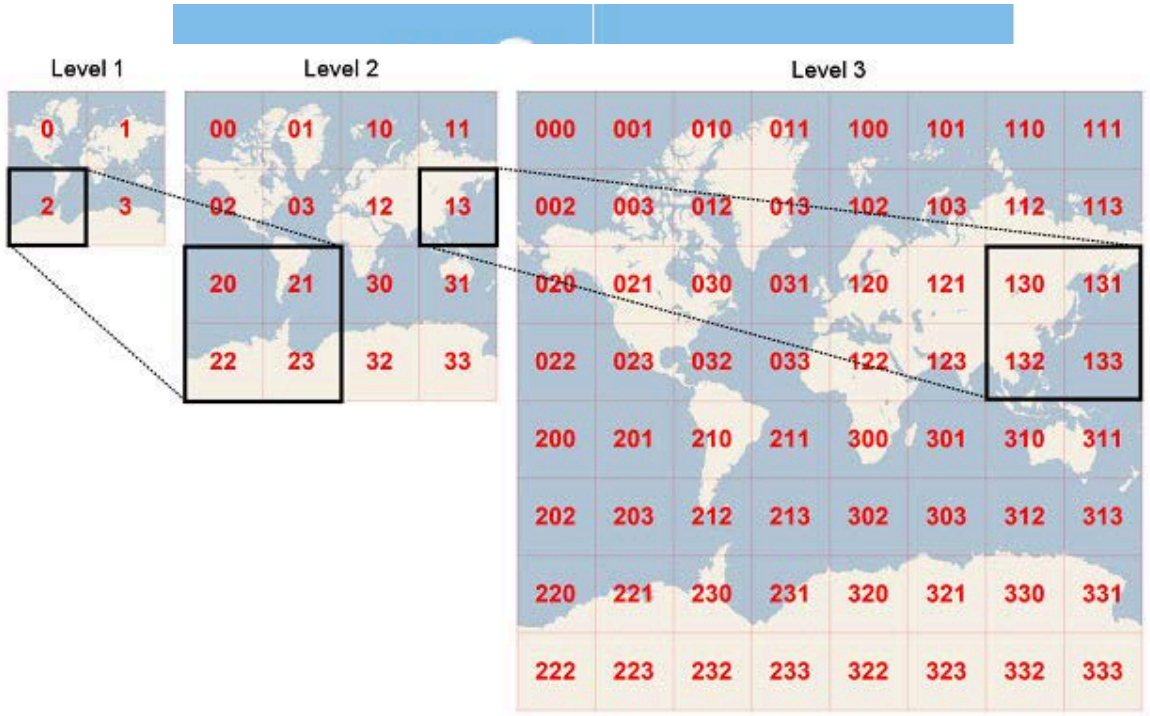
Choropleths
Dot maps
Basic geocoding
Etc.



WEB-BASED MAPPING TOOLS

REMEMBER MAPQUEST?

BITMAP TILES




```
http://.../Z/X/Y.png
```

CACHE EFFICIENTLY
LOAD PROGRESSIVELY
SIMPLE TO COORDINATE

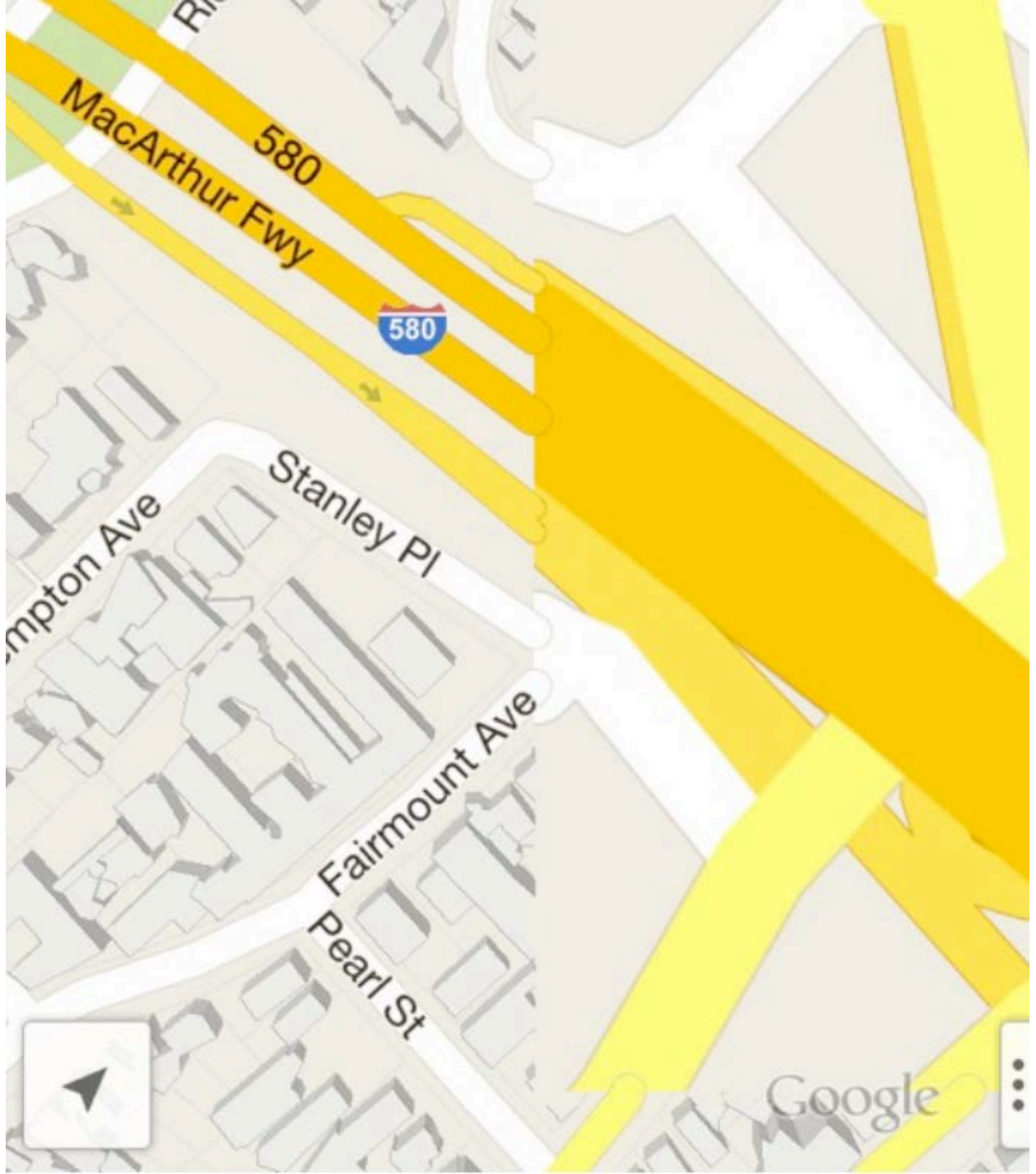
VECTORS

INFINITE SCALING
(SOMETIMES) SMALLER
DYNAMIC RENDERING

GOOGLE MAPS

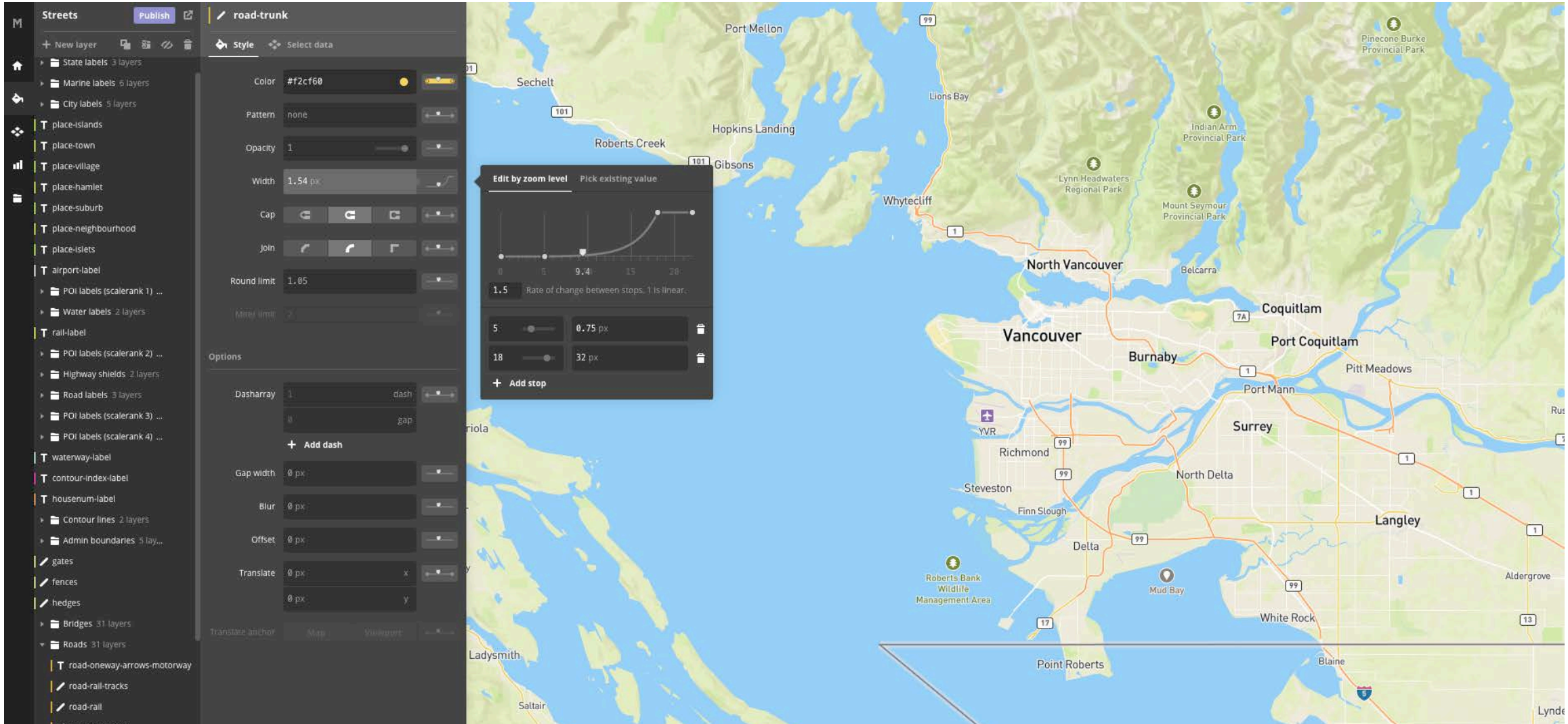
FIRST MAJOR SITE TO USE TILES AS AN INTERACTIVE "SLIPPY MAP"

NEW VERSIONS ARE VECTOR-BASED



MAPBOX

LOTS OF LIBRARIES AND INTERACTIVE/CSS-STYLE GENERALIZATION

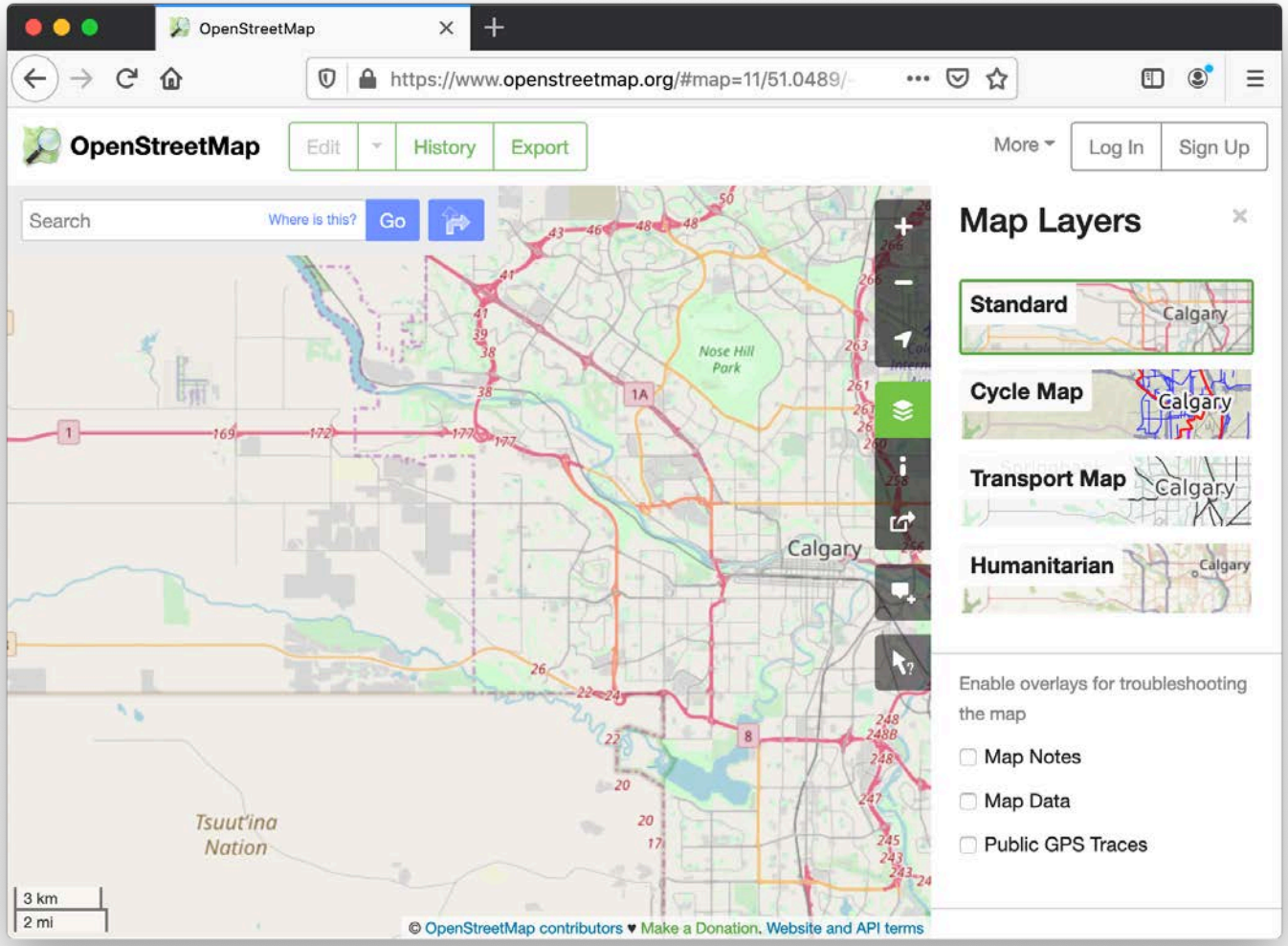


OPEN STREETMAP

Huge open-source repository of map data

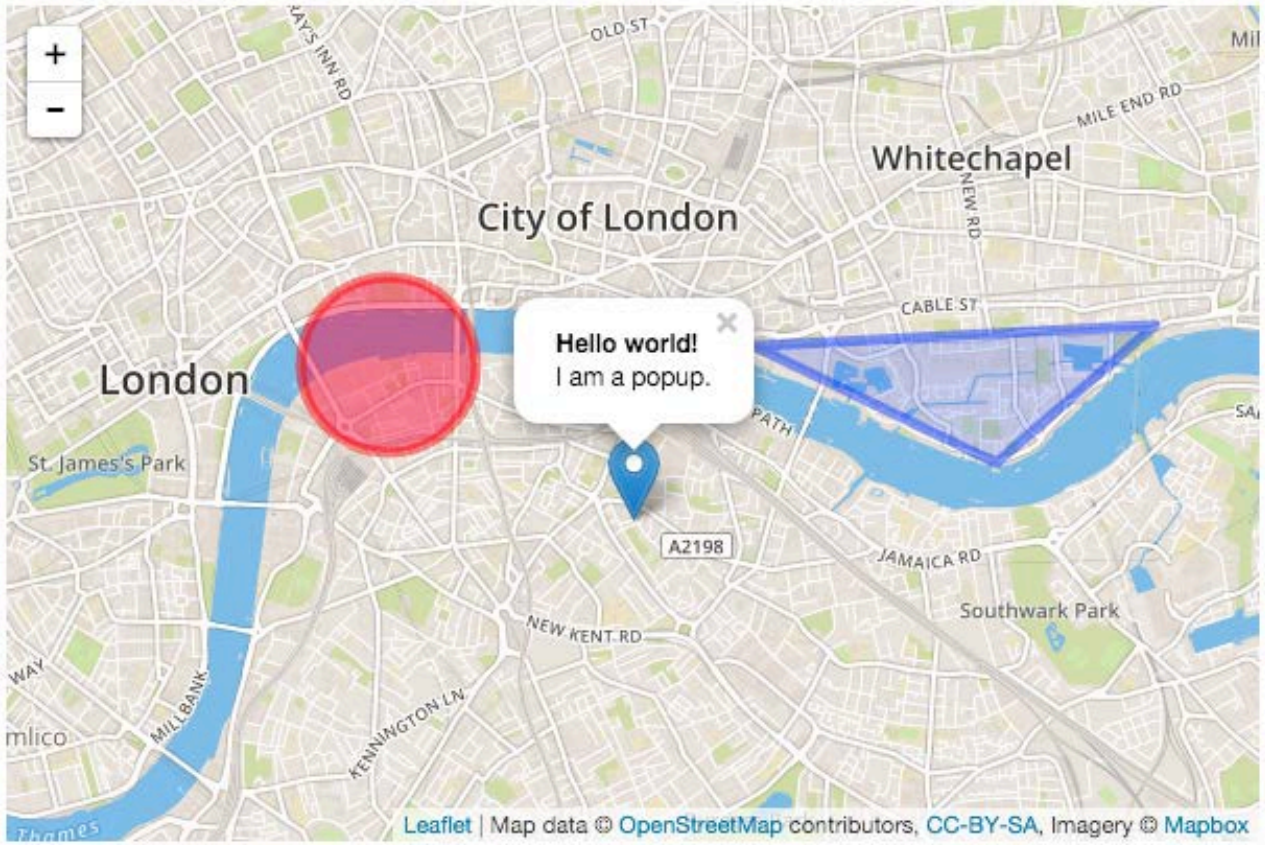
Used by many other tools

Map layers, geocoding APIs, etc.



LEAFLET

A SIMPLE JS LIBRARY FOR DRAWING ON MAPS




```
var map = L.map('map').setView([51.505, -0.09], 13);

L.tileLayer('https://api.tiles.mapbox.com/v4/{id}/{z}/{x}/{y}.png?access_token=pk.eyJ1Ij
    maxZoom: 18,
    attribution: 'Map data &copy; <a href="http://openstreetmap.org">OpenStreetMap</a> c
        '<a href="http://creativecommons.org/licenses/by-sa/2.0/">CC-BY-SA</a>, ' +
        'Imagery © <a href="http://mapbox.com">Mapbox</a>',
    id: 'mapbox.streets'
}).addTo(map);


L.marker([51.5, -0.09]).addTo(map)
    .bindPopup("<b>Hello world!</b><br />I am a popup.").openPopup();

L.circle([51.508, -0.11], 500, {
    color: 'red',
    fillColor: '#f03',
    fillOpacity: 0.5
}).addTo(map).bindPopup("I am a circle.");

L.polygon([
    [51.509, -0.08],
    [51.503, -0.06],
    [51.51, -0.047]
]).addTo(map).bindPopup("I am a polygon.");


var popup = L.popup();

function onMapClick(e) {
    popup
        .setLatLng(e.latlng)
        .setContent("You clicked the map at " + e.latlng.toString())
        .openOn(map);
}

map.on('click', onMapClick);
```

maps.stamen.com

TILE SETS AND BASE MAPS

D3.JS

Elements Console Sources Network Timeline Profiles Resources Security Audits

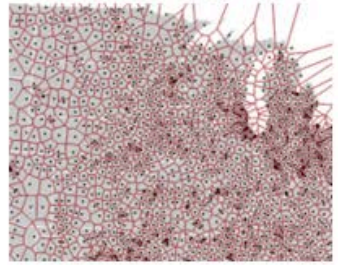
step-7.html ×

```
.subunit-boundary {
  fill: none;
  stroke: #777;
  stroke-dasharray: 2,2;
  stroke-linejoin: round;
}

.subunit-boundary.IRL {
  stroke: #aaa;
}

.subunit-label {
  fill: #777;
  fill-opacity: .5;
  font-size: 20px;
  font-weight: 300;
  text-anchor: middle;
}

.place,
.place-label {
  fill: #444;
}

text {
  font-family: "Helvetica Neue", Helvetica, Arial, sans-serif;
  font-size: 10px;
  pointer-events: none;
}

</style>
<body>
<script src="//d3js.org/d3.v3.min.js" charset="utf-8"></script></script>
<script src="//d3js.org/topojson.v1.min.js"></script>
<script>

var width = 960,
    height = 1160;

var projection = d3.geo.albers()
    .center([0, 55.4])
    .rotate([4.4, 0])
    .parallels([50, 60])
    .scale(1200 * 5)
    .translate([width / 2, height / 2]);

var path = d3.geo.path()
    .projection(projection)
    .pointRadius(2);

var svg = d3.select("body").append("svg")
    .attr("width", width)
    .attr("height", height);

d3.json("uk.json", function(error, uk) {
  var subunits = topojson.feature(uk, uk.objects.subunits),
      places = topojson.feature(uk, uk.objects.places);

  svg.selectAll(".subunit")
      .data(subunits.features)
    .enter().append("path")
      .attr("class", function(d) { return "subunit " + d.id; })
      .attr("d", path);

  svg.append("path")
      .datum(topojson.mesh(uk, uk.objects.subunits, function(a, b) { return a !== b && a.id !== "IRL"; }))
      .attr("d", path)
      .attr("class", "subunit-boundary");

  svg.append("path")
      .datum(topojson.mesh(uk, uk.objects.subunits, function(a, b) { return a === b && a.id === "IRL"; }))
      .attr("d", path)
      .attr("class", "subunit-boundary IRL");

  svg.selectAll(".subunit-label")
      .data(subunits.features)
    .enter().append("text")
      .attr("class", function(d) { return "subunit-label " + d.id; })
      .attr("transform", function(d) { return "translate(" + path.centroid(d) + ")"; })
      .attr("dy", ".35em")
      .text(function(d) { return d.properties.name; });

  svg.append("path")
      .datum(places)
      .attr("d", path)
```

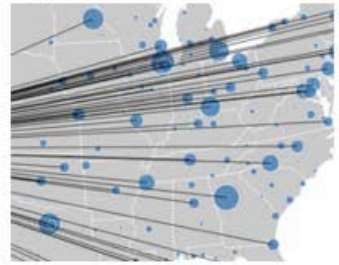
{} Line 33, Column 1

PROJECTIONS
INTERACTION
MAPS + VIS

Voronoi Diagram



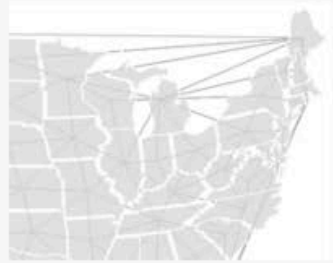
Symbol Map



Animated wind chart

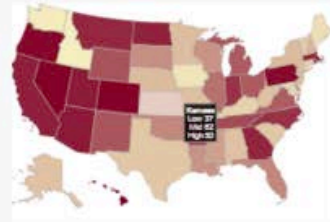
Choropleth with svg filter

Force-Directed States



Hip Replacement by State

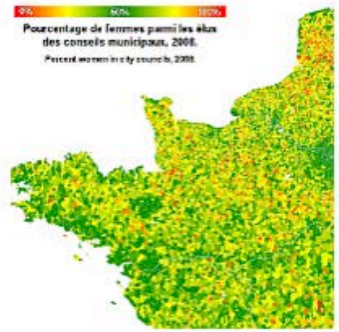
US State Map



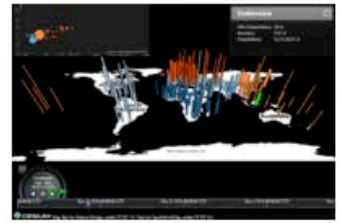
Azimuthal Projections

Geographical hexbins

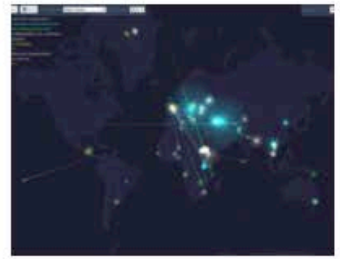
Choropleth on canvas



D3 Cesium - Health and Wealth of Nations



WorldBank Contract Awards

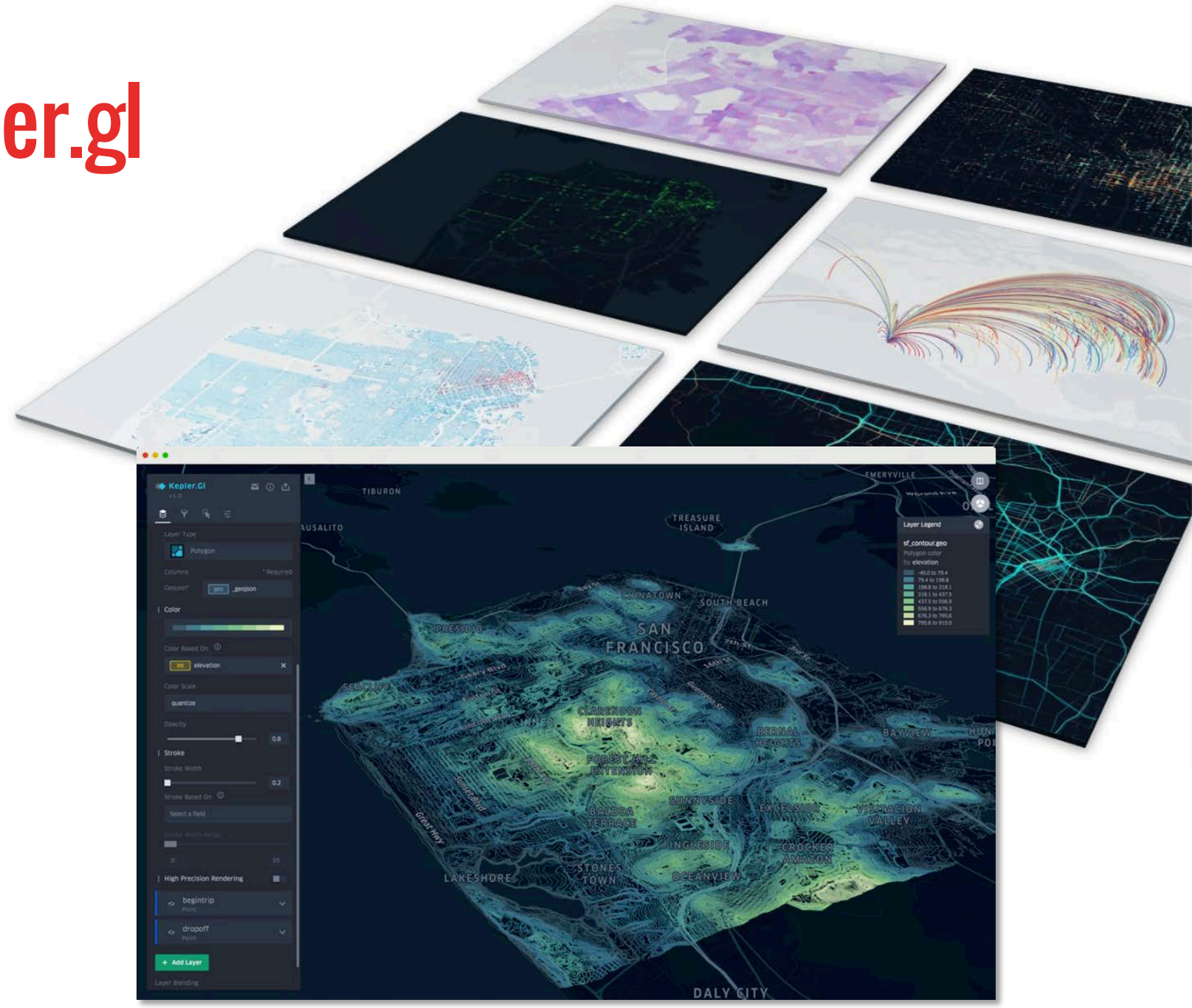


Deck.gl and Kepler.gl

WebGL-optimized mapping tools developed at Uber

Deck.gl – lower-level visualization frameworks

Kepler.gl – Geospatial Analysis Platform



Geospatial Analysis in Python

Geopandas – Pandas extensions for handling geospatial datatypes.

OSMnx – retrieving, analyzing, and visualizing street networks and other data from OpenStreetMap.

Geopy – helpers for third-party geocoding packages.

Nominatim – OpenStreetMap's geocoding tool. Good for small-scale jobs / doesn't require an API key

Pysal – functions and tools for spatial data analysis, including Choropleth map classifiers

Geospatial Analysis in Python

See the workbook.

Demo if we have time.

Based on Henrikki Tenkanen's online course (includes lots of other good resources).