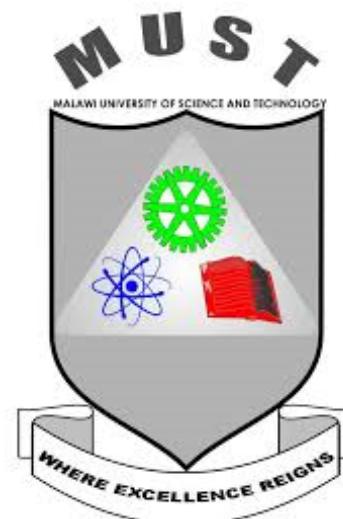


# African Drone and Data Academy (ADDA)

## Data Visualization and Cartography

### Day 1



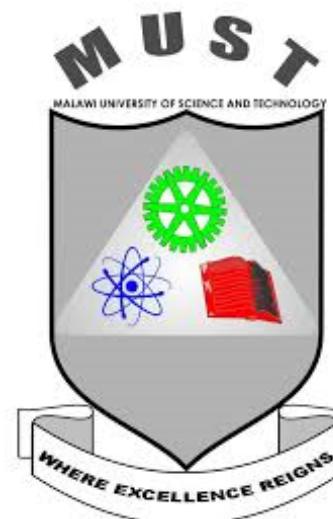
FURMAN  
U N I V E R S I T Y



# DATA VISUALIZATION AND CARTOGRAPHY

---

## Introduction



FURMAN  
U N I V E R S I T Y





# About the Instructor

## Dr. Suresh Muthukrishnan

2017-18, Fulbright US Scholar in Malawi

ADDA GIS Curriculum Lead

Professor and Chair,  
Dept. of Earth, Environmental, and Sustainability Sciences  
Director, GIS and Remote Sensing Center



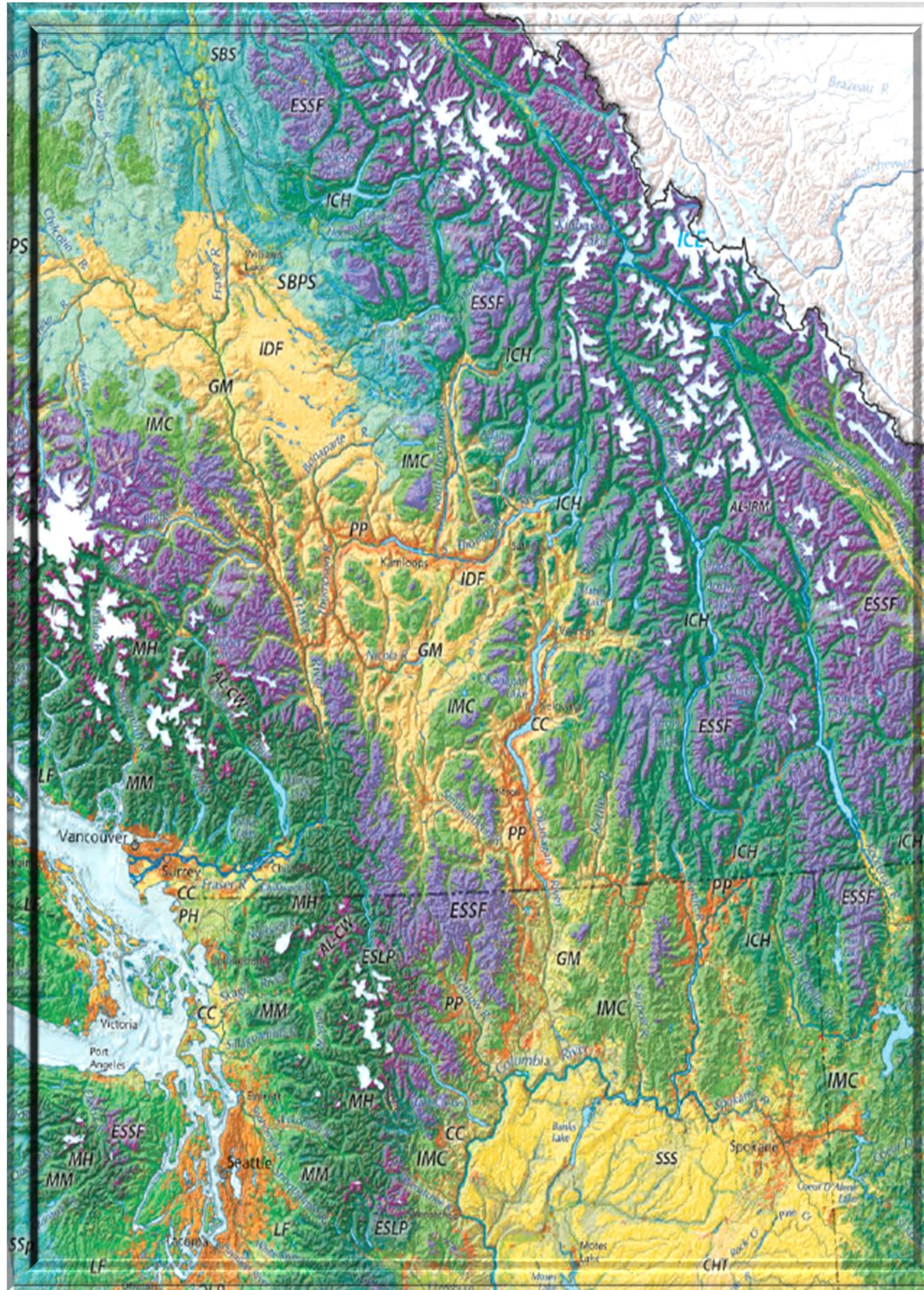
**Areas of Expertise:** Geomorphology, Geographical Information System (GIS),  
Remote Sensing and Image Analysis, Natural Hazards, Decision Support System

**Research Focus:** GIS applications to campus and community sustainability, Urban  
Geomorphology, Landscapes and Rivers, Landslides, Health GIS, WebGIS

**Hobbies:** Hiking, Photography, Travel, GIS ;)



# Outline



Learning Outcomes

Course Materials

Software / Tools Needed

Course Format

Why Visualize Data?

- Power of data
- Effective communication
- Connecting science and policy

What is Cartography? Basic Steps in Cartography.

Certificate Requirements

Plan for the Rest of the Week



# Expected Learning Outcomes

- At the successful completion of this course, you will
  - Have an appreciation for maps and other forms of data visualization
  - Understand what cartography is and how GIS provides a way to create cartographic representations of data
  - Have the basic skills necessary to create and evaluate professional cartographic map representations
  - Be able to create custom maps and 3D visuals to meet specific needs
  - Have the skills to communicate project outcomes more effectively with interactive maps using StoryMaps



# Course Materials

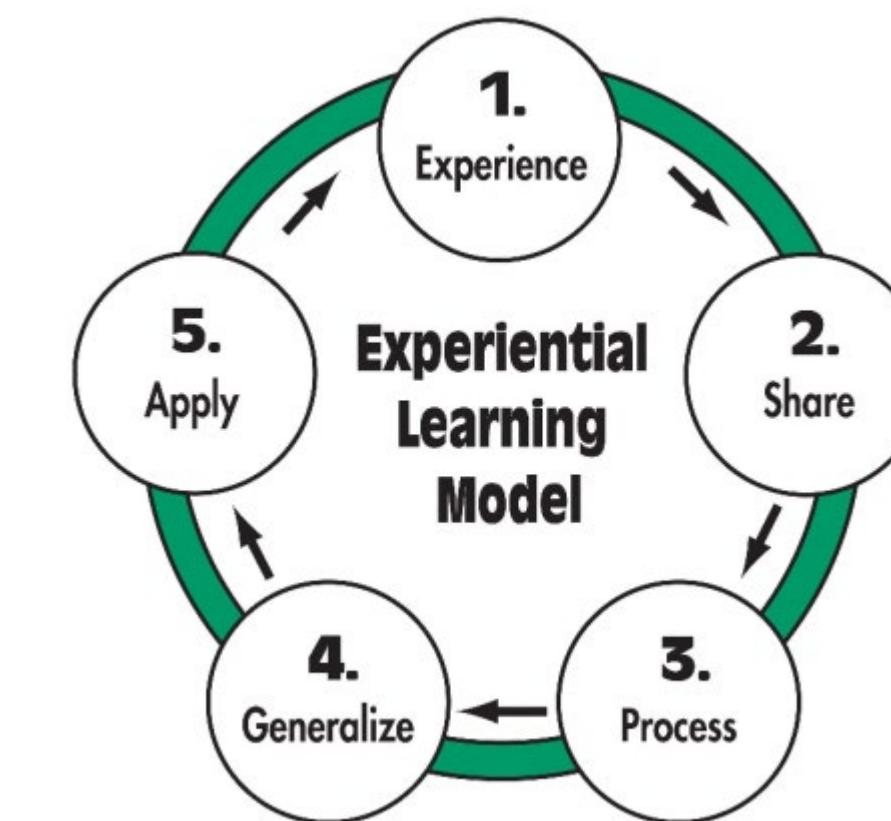
- Course materials are provided through Moodle, which is our course management system. It will contain:
  - Course lectures and laboratory materials developed for this course
  - Various published materials
- QGIS Online Documentation (links are for stable version, other versions can be found online)
  - Introduction to GIS [https://docs.qgis.org/3.10/en/docs/gentle\\_gis\\_introduction/index.html](https://docs.qgis.org/3.10/en/docs/gentle_gis_introduction/index.html)
  - Training Manual [https://docs.qgis.org/3.10/en/docs/training\\_manual/index.html](https://docs.qgis.org/3.10/en/docs/training_manual/index.html)
  - QGIS User Guide [https://docs.qgis.org/3.10/en/docs/user\\_manual/index.html](https://docs.qgis.org/3.10/en/docs/user_manual/index.html)



# Tools and Software Needs

- Q-GIS – recommended version is 3.16
  - Latest version is 3.16 but the latest stable version is 3.10
  - Link to download is provided to you on course Moodle page
- Google Earth Pro Desktop Version
  - Latest version is 7.3.3
  - Link to download is provided to you on course Moodle page
- ArcGIS StoryMaps – Online platform
  - You will need to create your own account by signing up online
  - Instructions provided on course Moodle page
  - You need to be connected to Internet while working on this platform

# Course Format



- Lecture and Reading Materials
  - Are designed to be self sufficient and provide you background on topics
  - You are expected to complete any assignments or quiz provided
  - Sharing reflections with each other and peer-review are part of the course requirements
- Assignments and Exercises
  - These provide detailed instructions to gain knowledge and skills
  - Pay close attention to details
  - Your ability to apply knowledge gained through additional practices on your own is advised
  - Any submission requirements should be met to get certificate



# DVAC Certificate

- In order to receive the certificate, one must
  - Complete learning materials
  - Submit assignments
    - Take part in providing peer-responses or evaluations
  - Complete any quiz or polls provided
  - Submit lab exercises

# Why Maps and Why Visualize Data?

Let Us Look @ Some Examples



# Maps Are Good Interface Between Humans & Data

Whistler village, Canada,  
by James Niehues.

One of the most prolific  
ski-trail mapmakers at  
work, Niehues is known  
for extreme attention to  
detail



Source: <https://www.theguardian.com/travel/gallery/2015/sep/10/cool-cartography-the-art-of-mapmaking>

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# Maps Break Language Barrier



## Community Outreach Using Maps Created with Drone Photos, Lilongwe - Malawi

Photos show UNICEF team interacting with community leaders and general public to highlight environmental issues associated with Cholera. Local community members identifying trash sites and open pit latrines within their communities using the map. Most of them have never seen their town from a birds-eye perspective.



# Maps Break Visual Barrier

3D printed tactile map made from OSM data





# Maps Can Provide a Sense of Smell 😊





# Maps Can Tell A Long Story Short

A Guide to the  
Discovery of  
Machu Picchu  
by Kevin Cannon





# Maps Can Make Travel Fun

Rome by Libby VanderPloeg

In New York-based illustrator VanderPloeg's playful maps, lines tracing major streets become decorative flourishes, while text bubbles call out her favorite shops, parks, restaurants and boutiques.



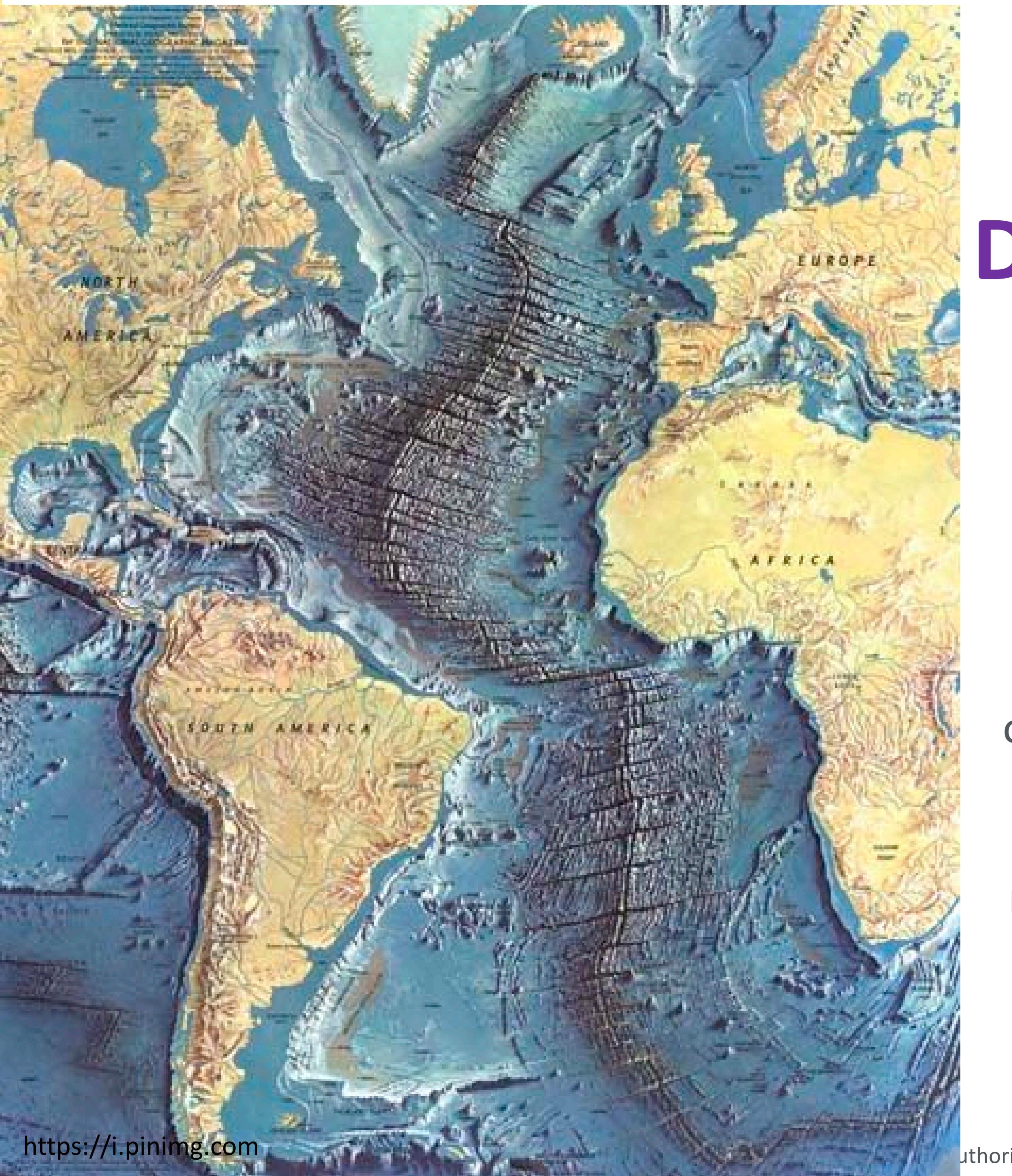
# Even Cheesy Maps Are Nice



Le Tour de Fromage by Elly Walton

A fun map of regional cheeses by English illustrator who combines hand-drawn work with digital techniques

# Present Day Map



# Maps & Discoveries

The art of map making is very old and people have always been obsessed with their desire to show everything in one map for navigation and enforcing land ownership claims.

# 1570 Map of the World

by Abraham Ortelius

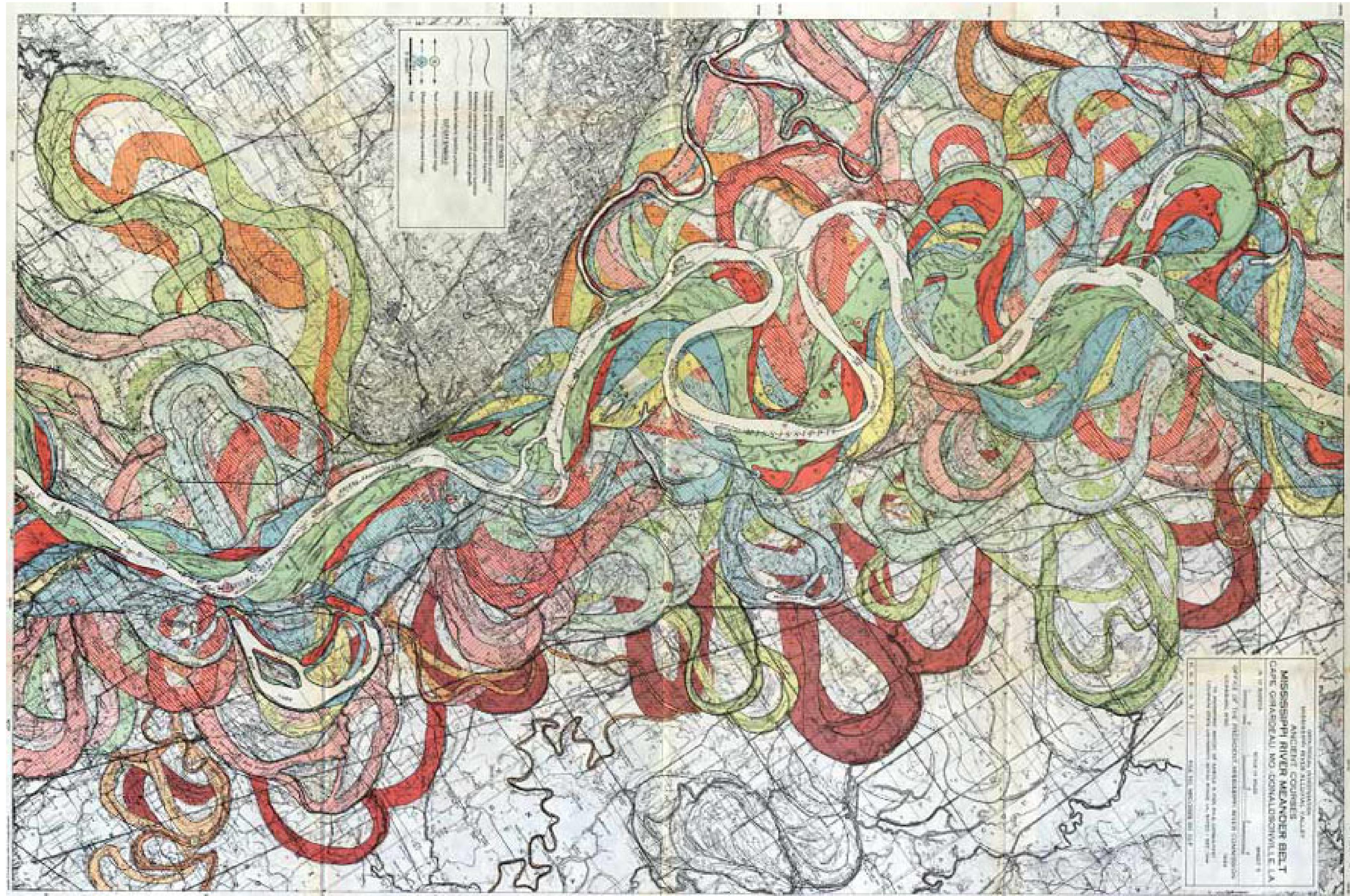




# Vintage Maps of the Mississippi River's Path Over Time

Rivers naturally change their course over decades to centuries due to flood, erosion, and river meandering.

This map shows the history of this fertile landscape

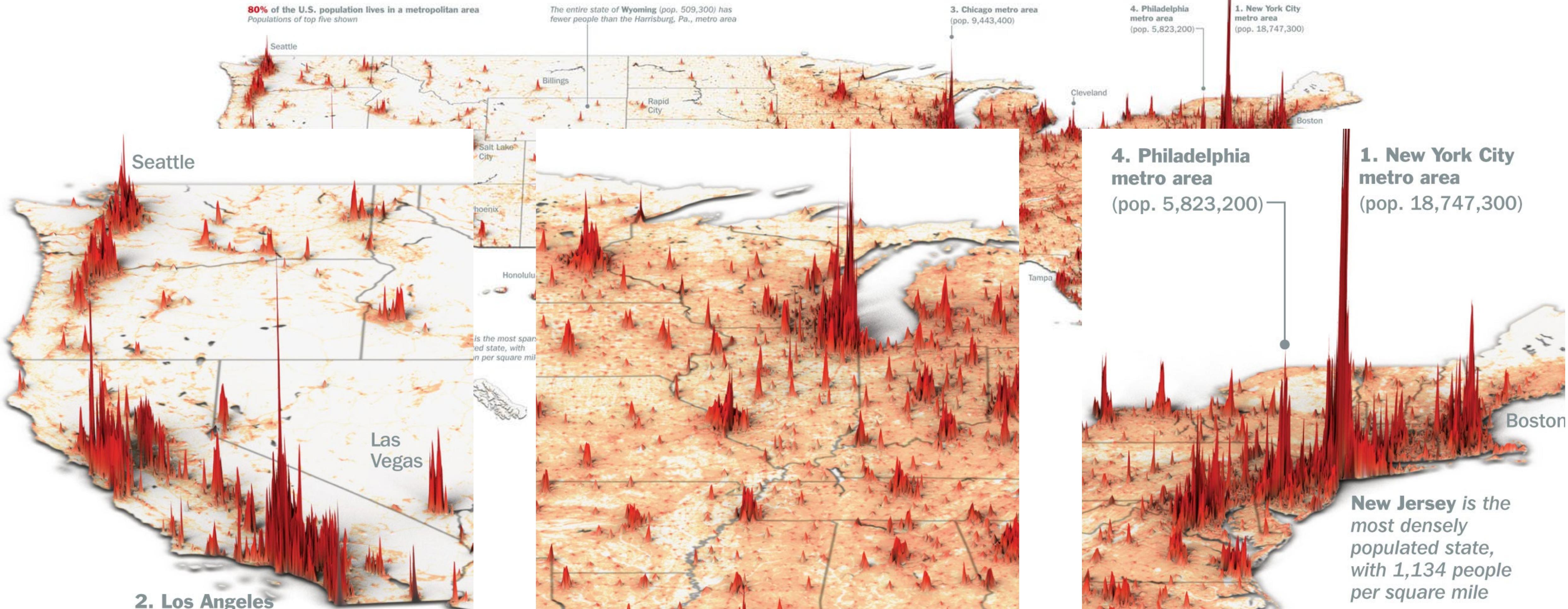




# A Different Perspective Alters Our Viewpoint

## Where We Live...

Unlike many developed countries, the U.S. keeps growing. We are also moving south and west. But compared with China or India, the nation is a vast prairie



Our families are getting smaller—with one vital exception. Compared with those of Europe and Japan, the U.S. population is younger and more colorful because of the continued arrival of immigrants and their higher-than-average birthrates. Of the 100 million Americans who will join us in the next 37 years, half will be immigrants or their children. In the next few decades, 97% of the world's population growth will occur in the developing world; the U.S. is the largest developed country in the world that is still growing at a healthy clip. That matters, strategically, economical-

Ala.; Possum Trot, Ky.; or Lonelyville, N.Y. But they are all probably close to someone's idea of paradise. —By Nancy Gibbs

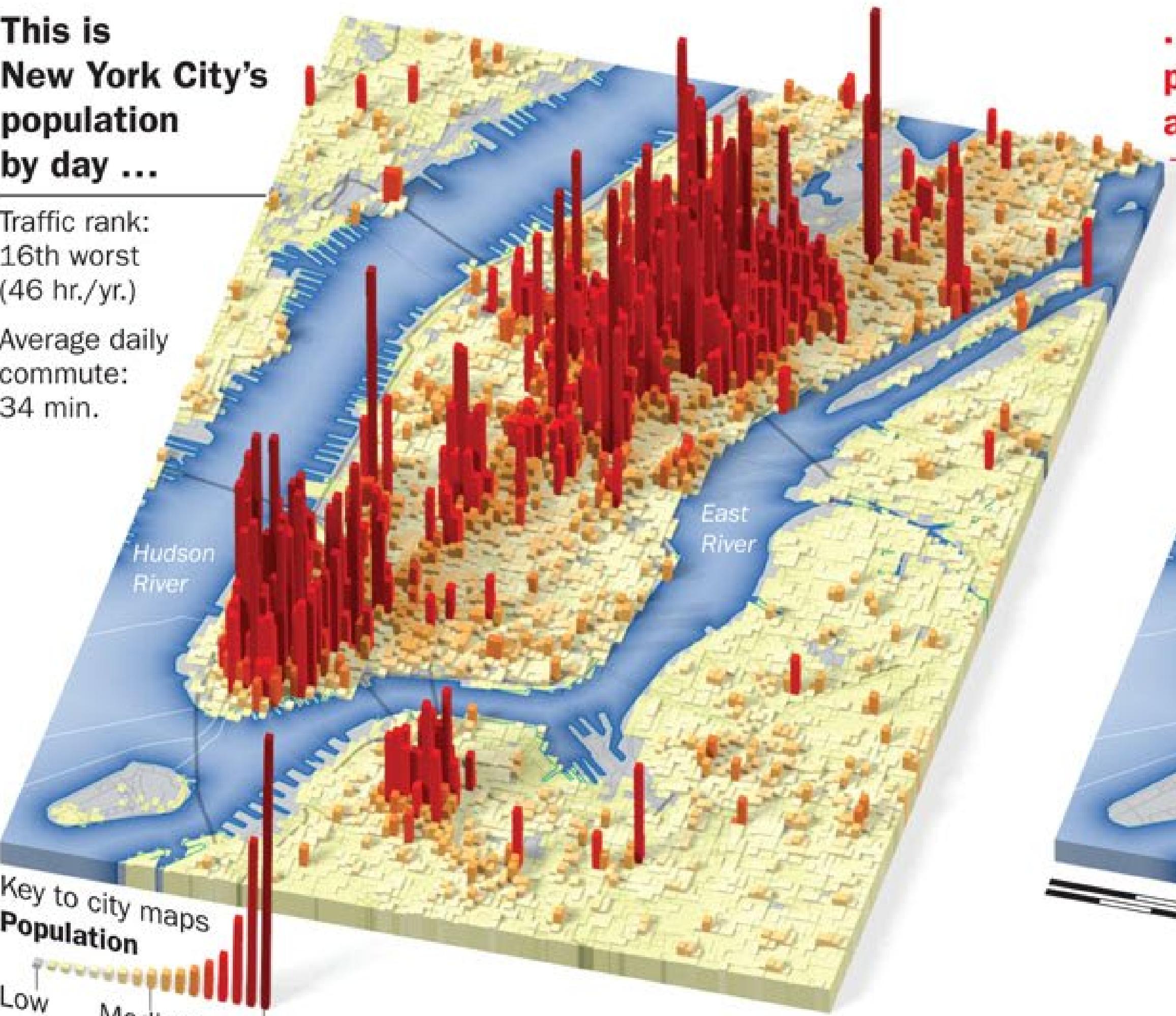
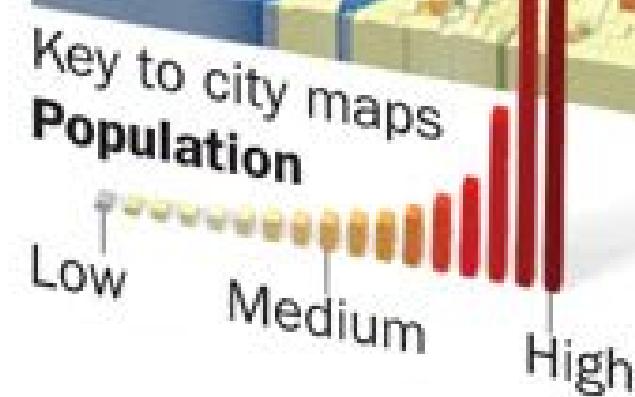


# A Different Perspective Alters Our Viewpoint

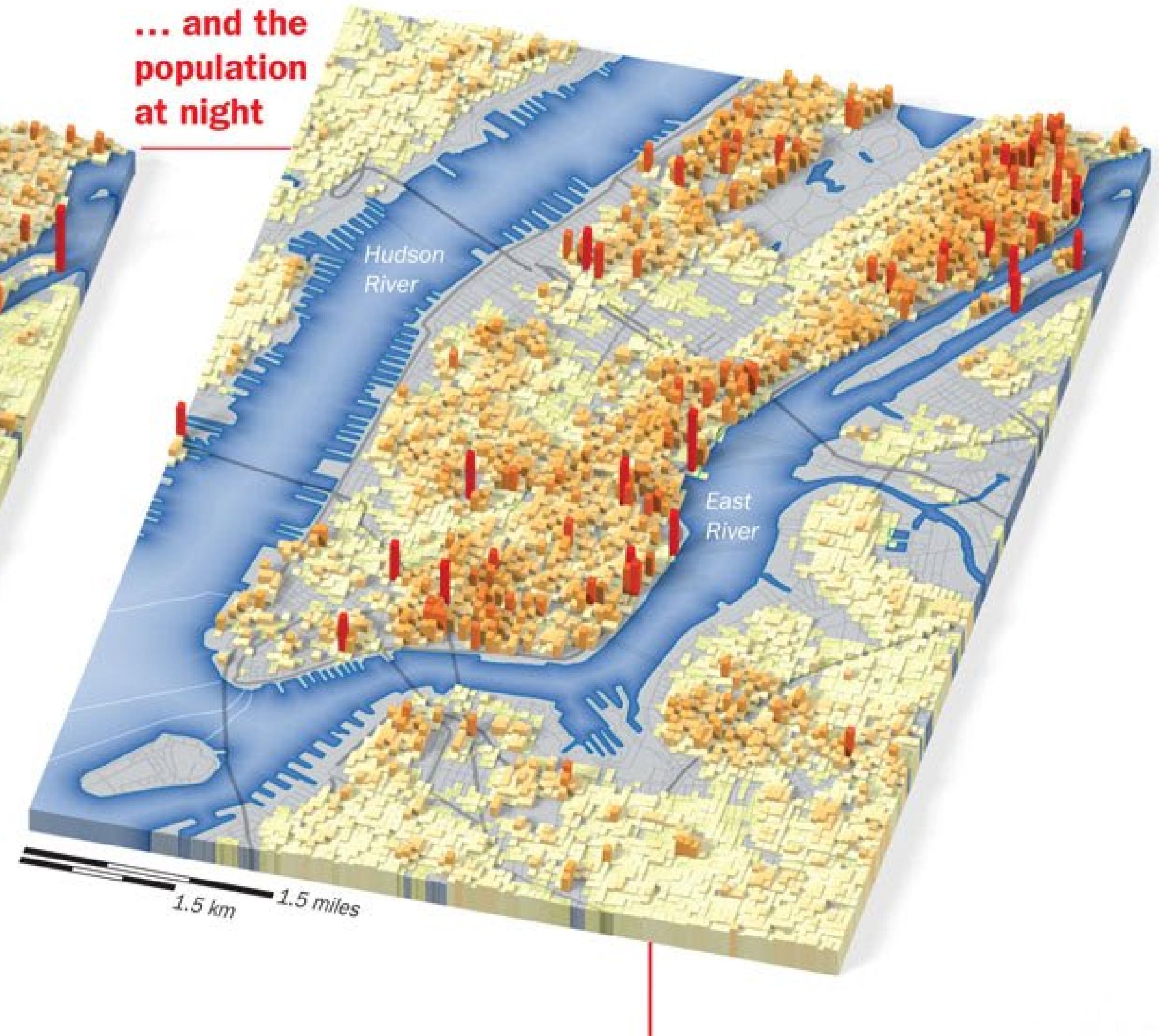
This is  
New York City's  
population  
by day ...

Traffic rank:  
16th worst  
(46 hr./yr.)

Average daily  
commute:  
34 min.



... and the  
population  
at night





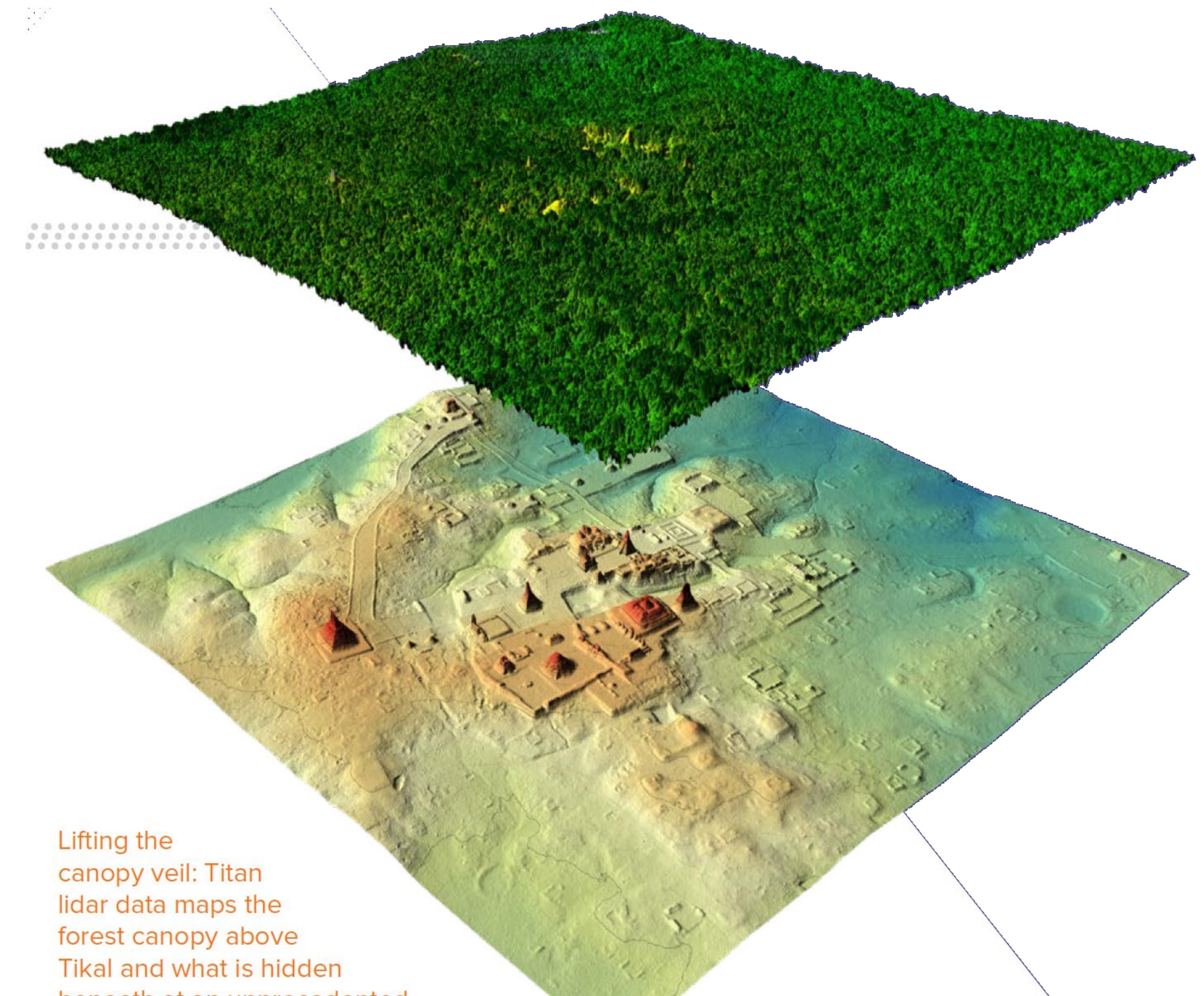
# Maps Can Reveal Hidden Treasures

## Airborne LiDAR for Archaeology in Central and South America

Light Detection and Ranging (LiDAR) method uses a similar approach to how traffic police check speed of a moving car. In this case, the derivative information provides intricate details of the terrain even if the area is covered by dense vegetation.

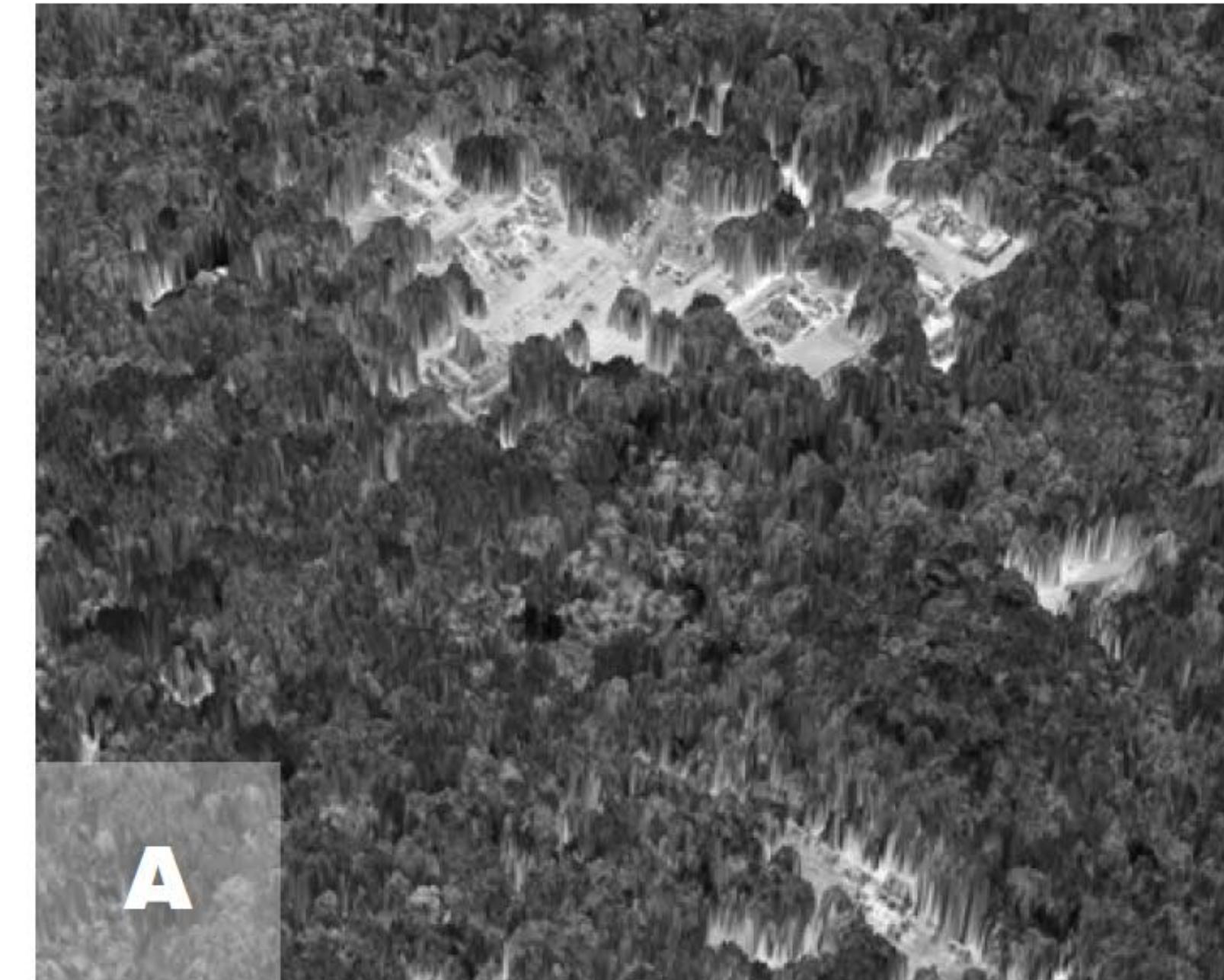
It helps lift the veil of canopy to reveal the hidden history underneath.

Now we can do this using images taken with a drone using appropriate software and image processing.





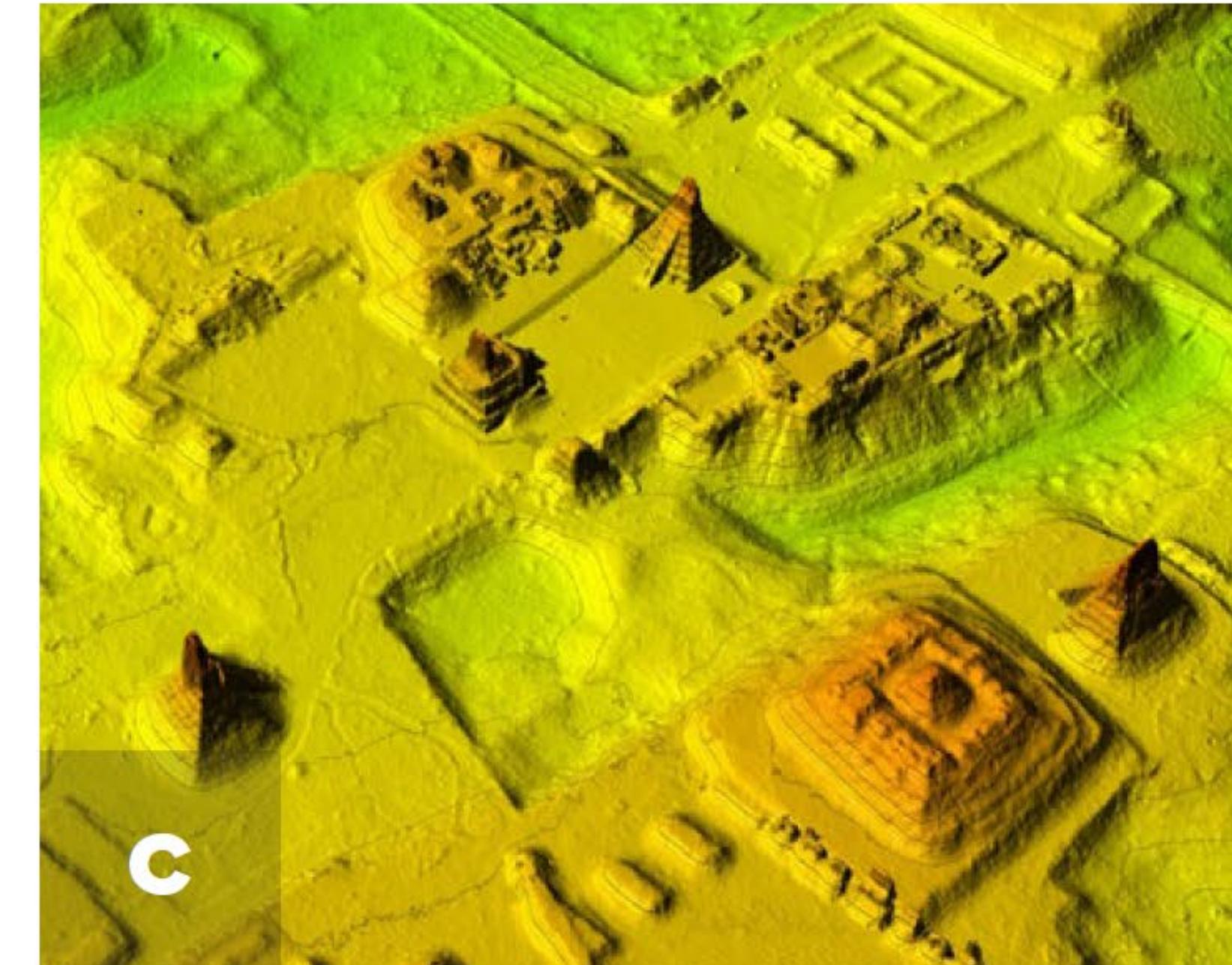
# Maps Can Reveal Hidden Treasures



**A**



**B**



**C**

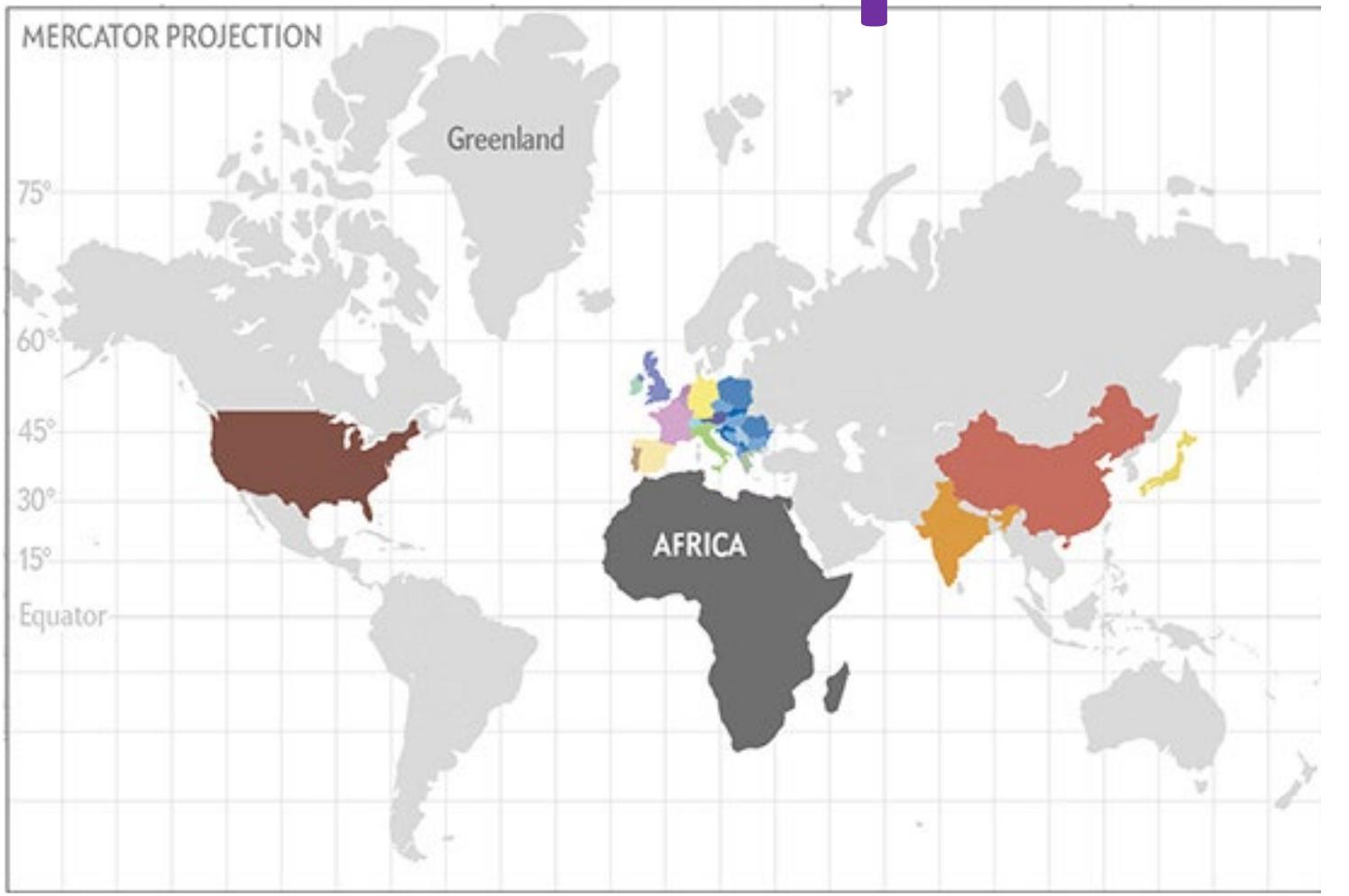
The core of Tikal seen in Optech Titan multispectral lidar data: A) First-surface DSM colored with 1064-nm lidar intensities; B) First-surface DSM colored with multispectral intensities (R: 1550 nm, G: 1064 nm, B 532 nm); C) Bare-earth DEM colored by elevation.

Airborne LiDAR for Archaeology in  
Central and South America



# Maps Can Lie (if you want them to)

Graphic Science



The traditional world maps were made using projection system that was useful for navigating the world using magnetic compass. However, it resulted in significant distortion of the countries represented.

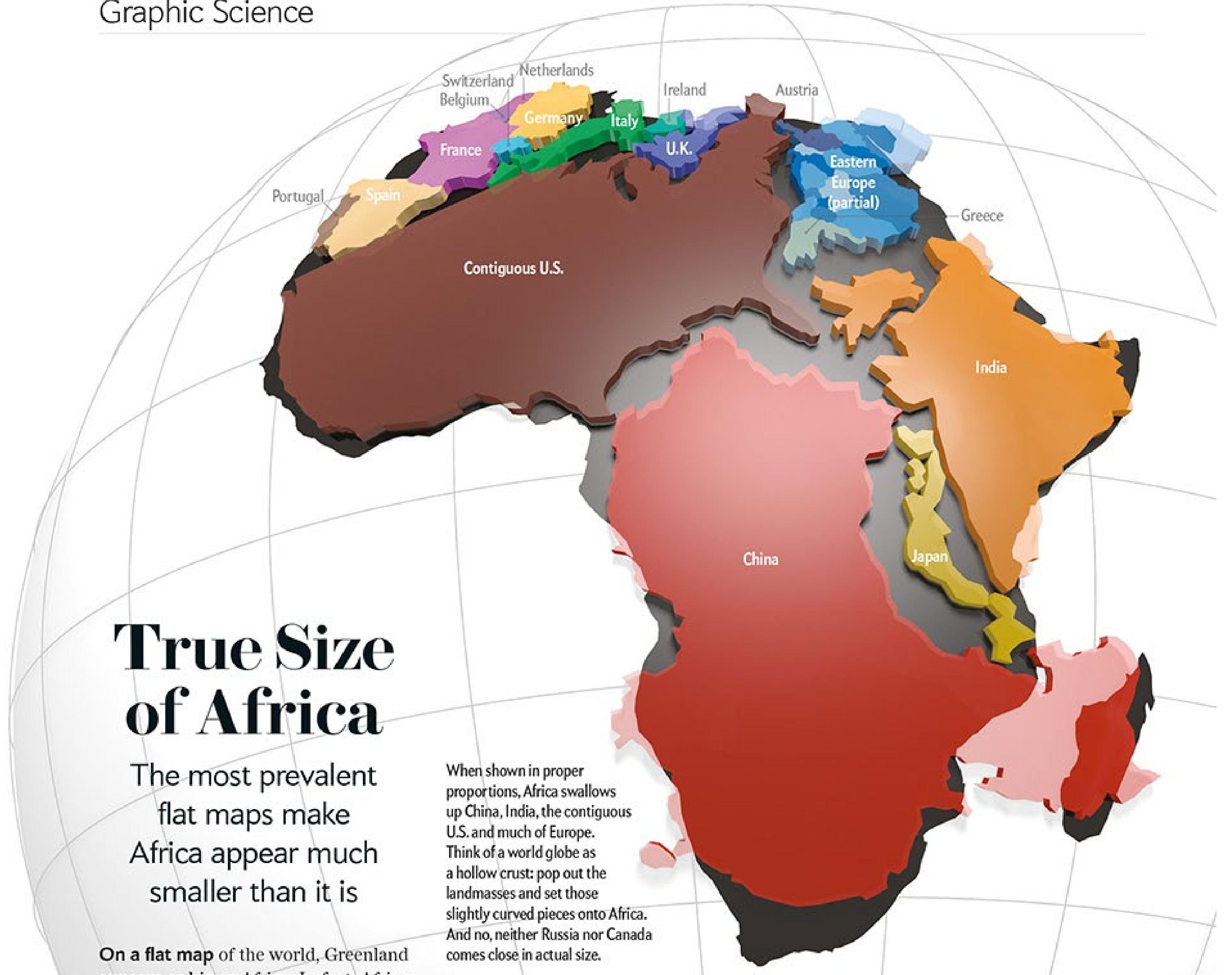
People in most part of the world grew up believing Africa is smaller than Greenland! Africa is ~15 times the size of Greenland.

## True Size of Africa

The most prevalent flat maps make Africa appear much smaller than it is

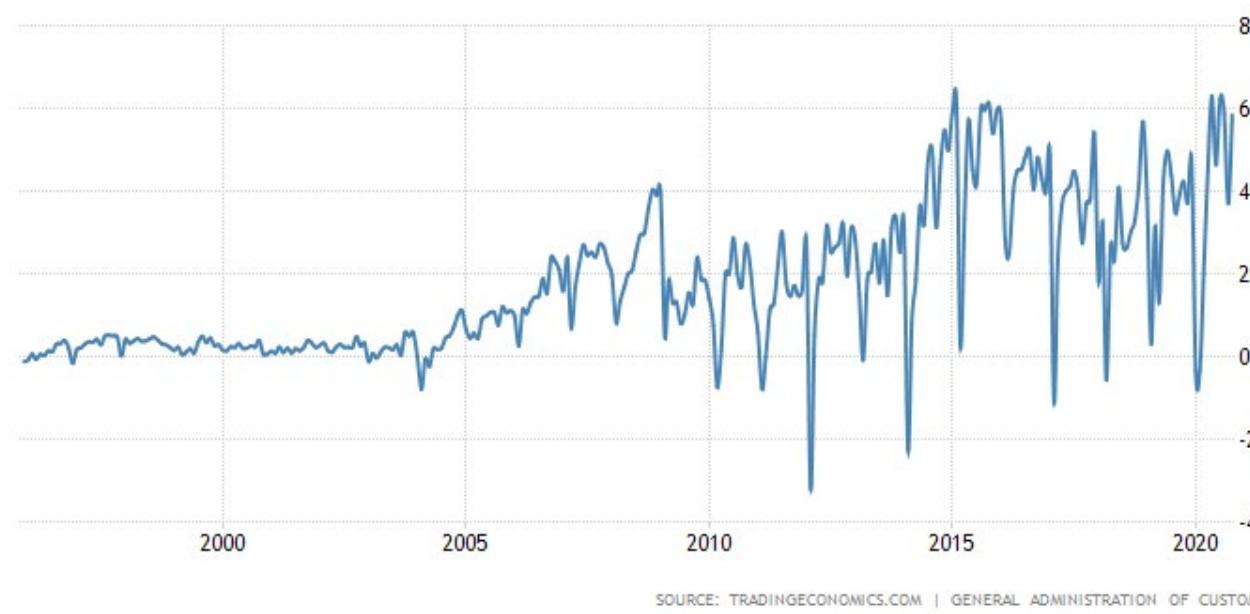
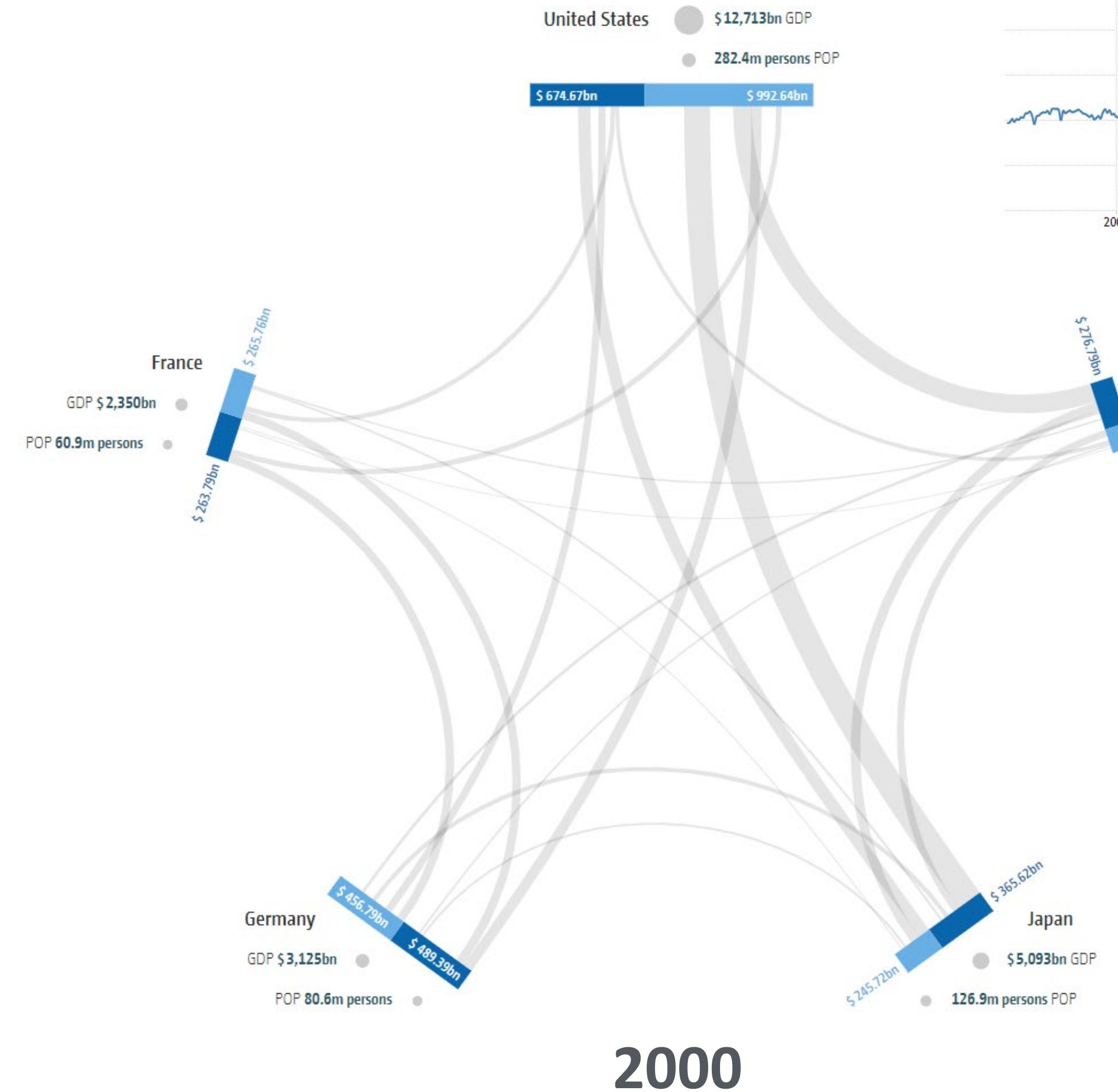
On a flat map of the world, Greenland

When shown in proper proportions, Africa swallows up China, India, the contiguous U.S. and much of Europe. Think of a world globe as a hollow crust: pop out the landmasses and set those slightly curved pieces onto Africa. And no, neither Russia nor Canada comes close in actual size.





# Visuals Can Show Complex Relations



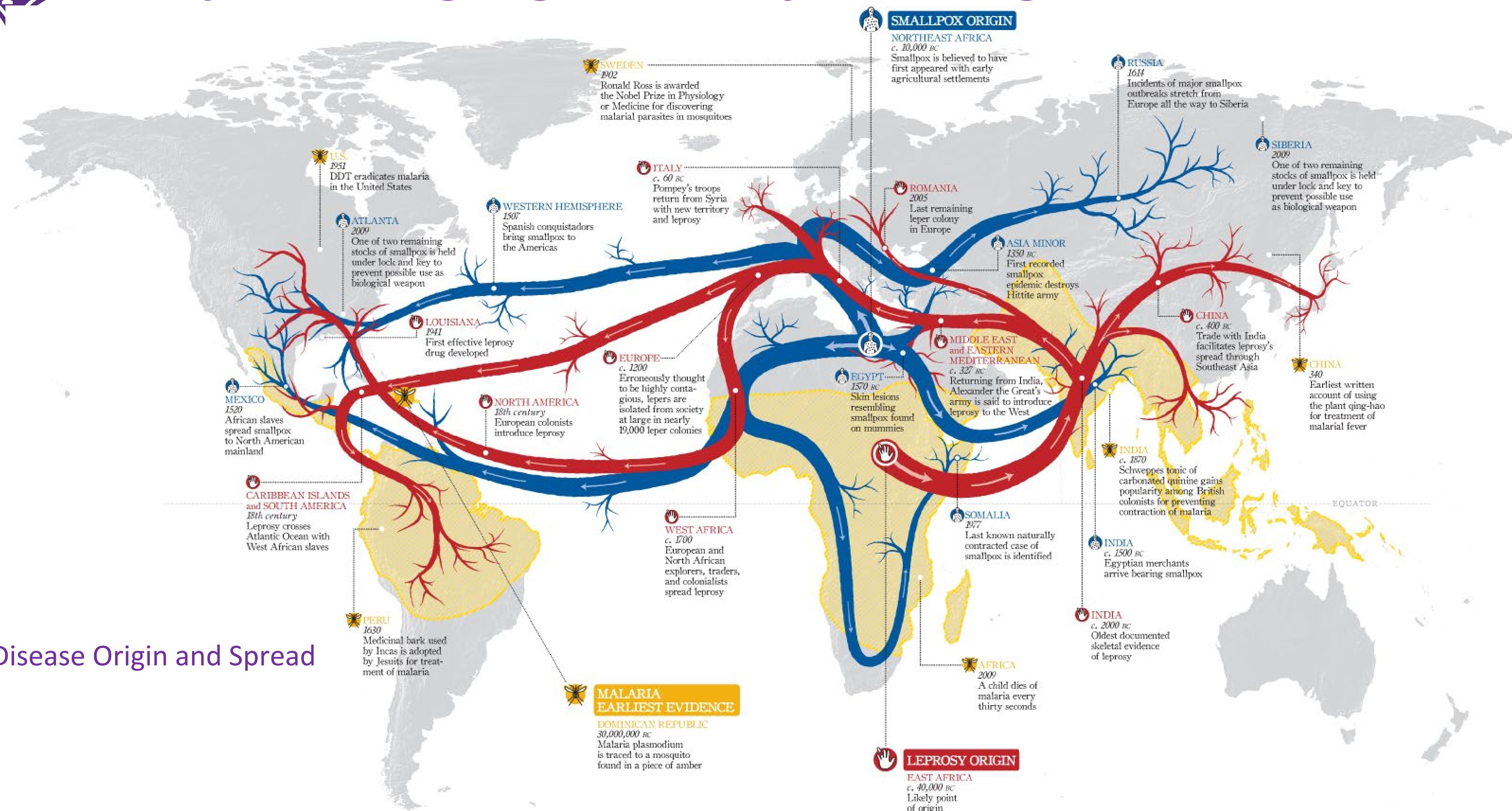
The U.S. goods trade deficit with China was \$345.2 billion in 2019

**LEGEND**

- 2013 Merchandise exports/imports to/from all available countries in billion US-\$ (current prices) as reported by import countries' statistics. Bar lengths relative to largest sum of imports and exports (among displayed countries for all years).
- Merchandise exports/imports in billion US-\$ (current prices)
- Bubble size relative to largest indicator value. GDP: Gross Domestic Product, in billion US-\$ (constant prices, base 2010) max. size \$ 15,902bn POP: Population, in million persons max. size 1,385m
- Tendency arrows indicate change to previous year's value (i) for absolute values: relative change; (ii) for percentage values: difference in percent points.

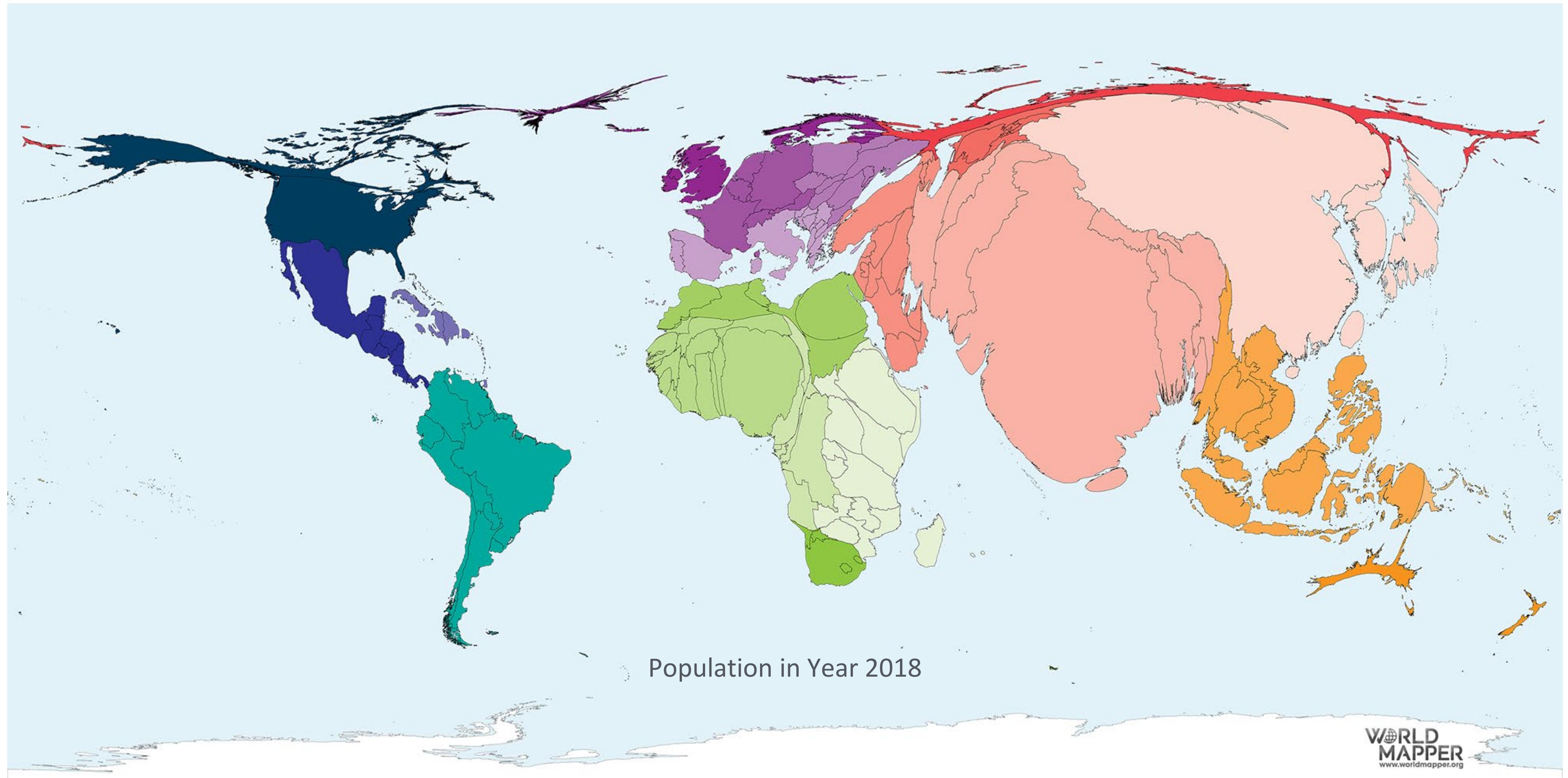


# Maps Can Highlight History and Magnitude of Problems





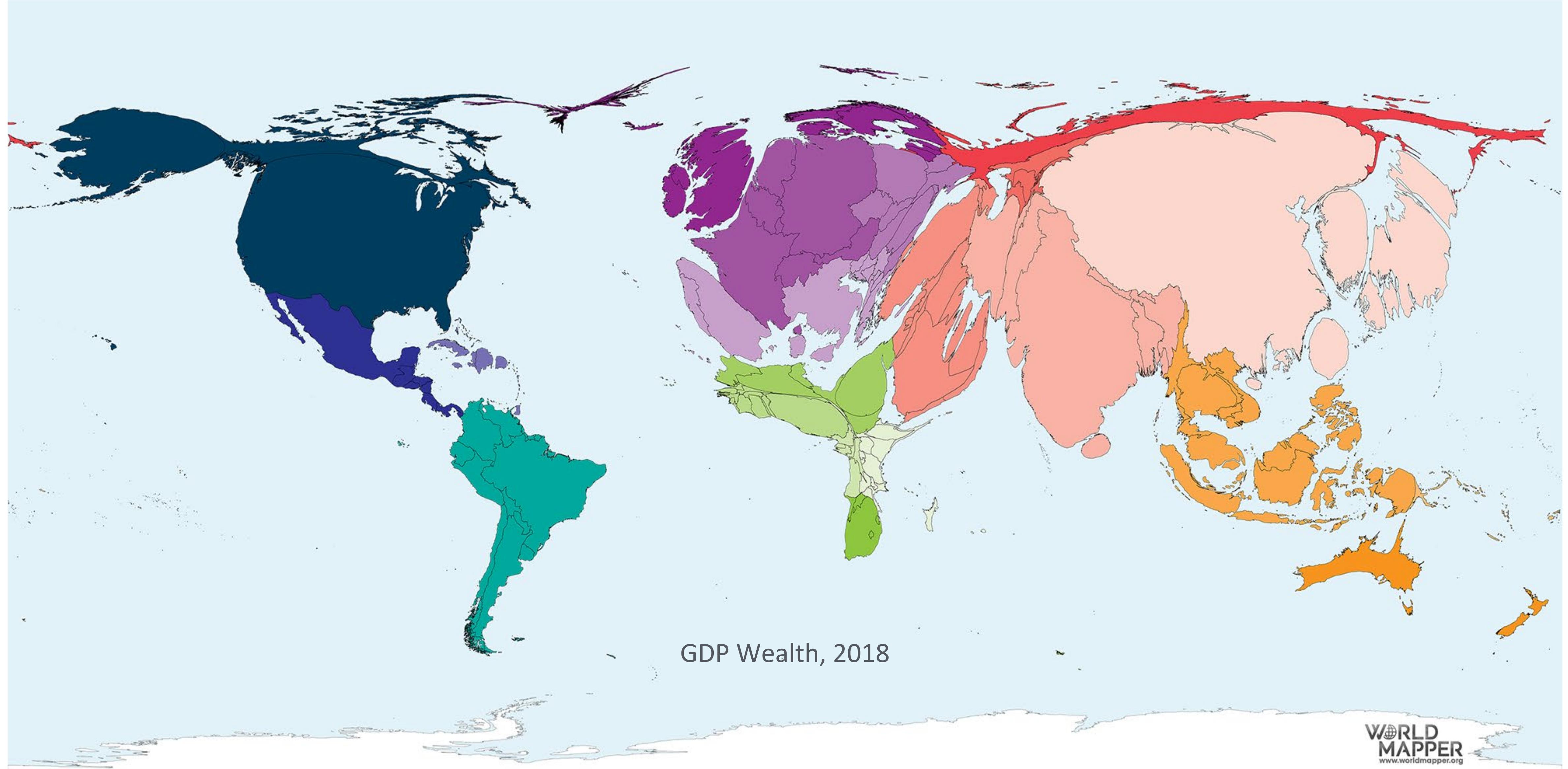
# Distorted Maps Can Enhance Our Worldview



WORLD  
MAPPER  
www.worldmapper.org

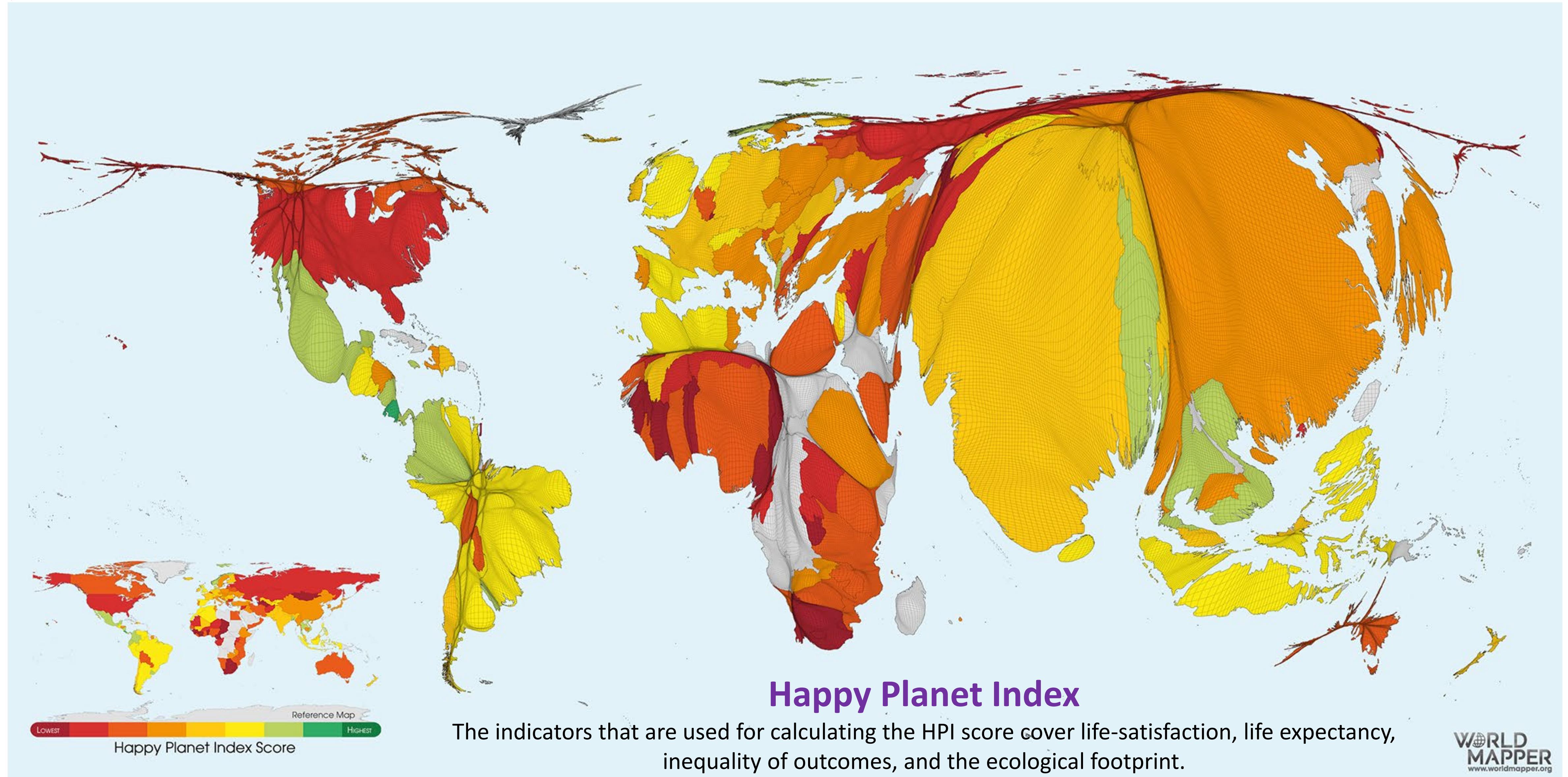


# Distorted Maps Can Enhance Our Worldview





# Distorted Maps Can Enhance Our Worldview

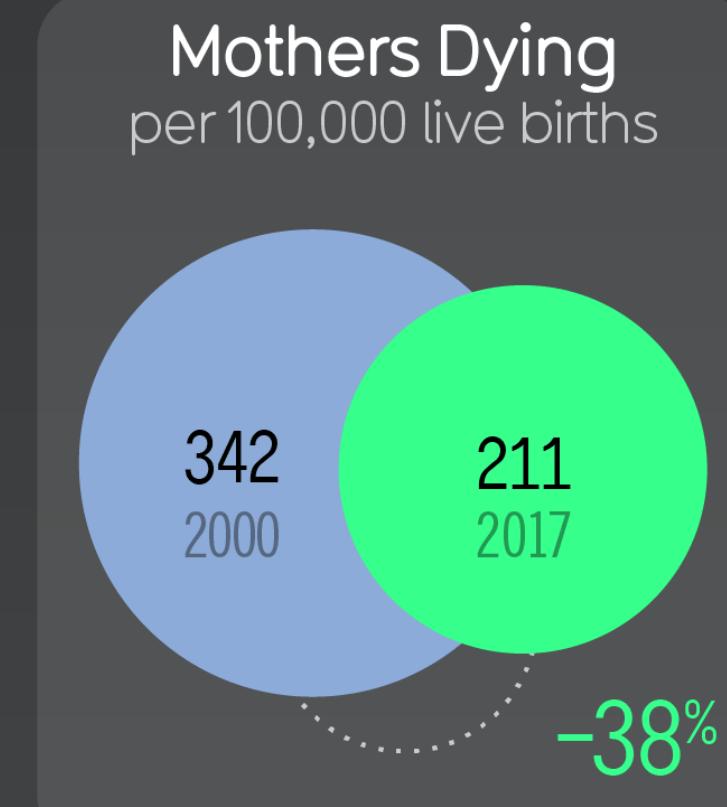
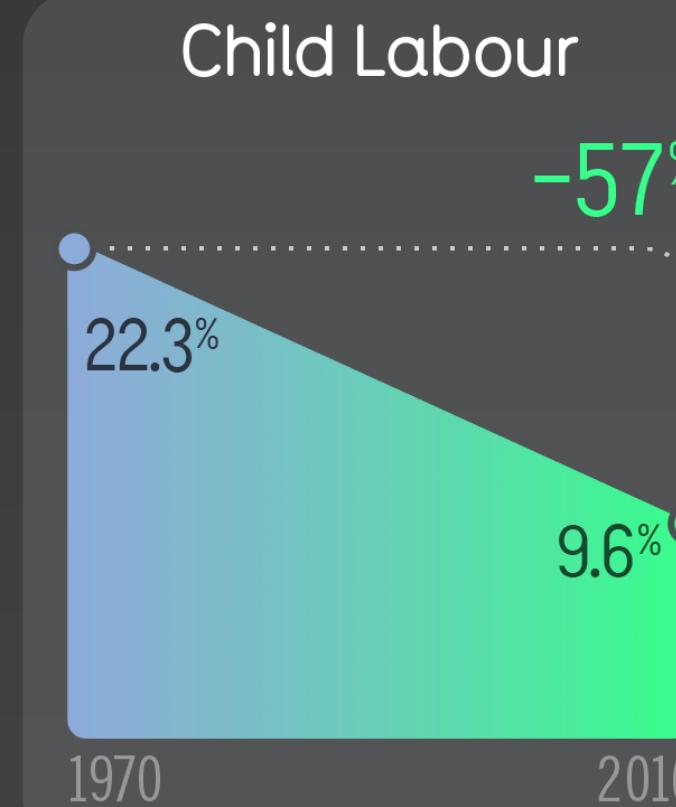
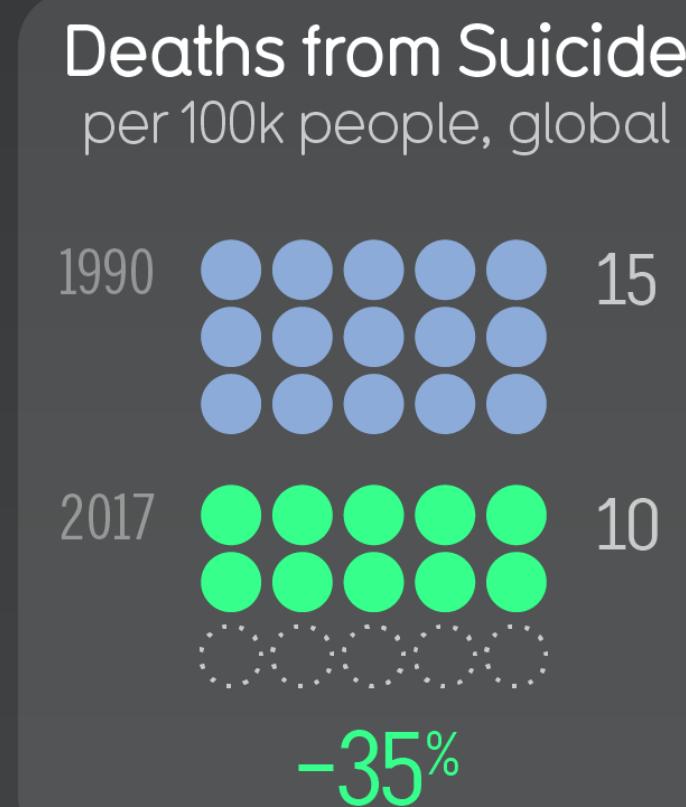
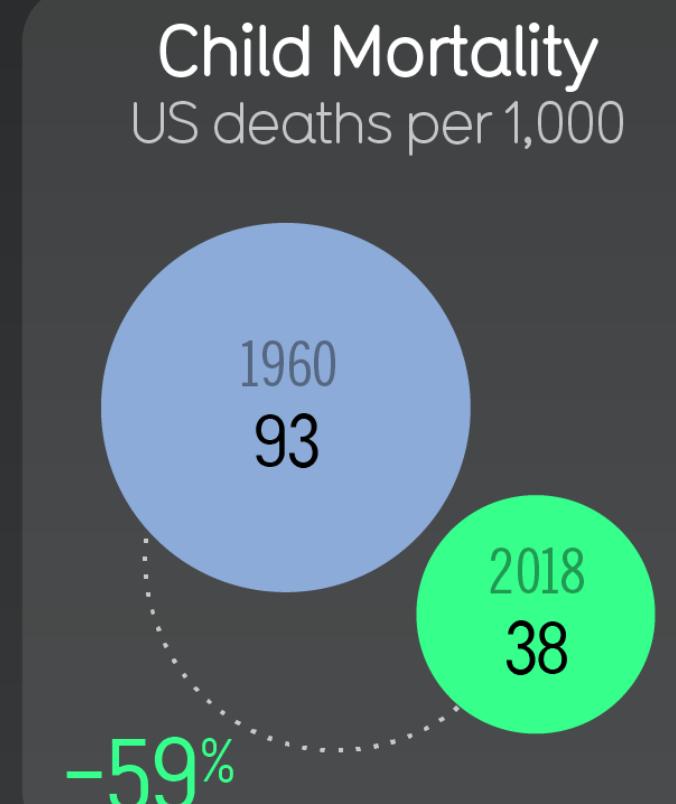
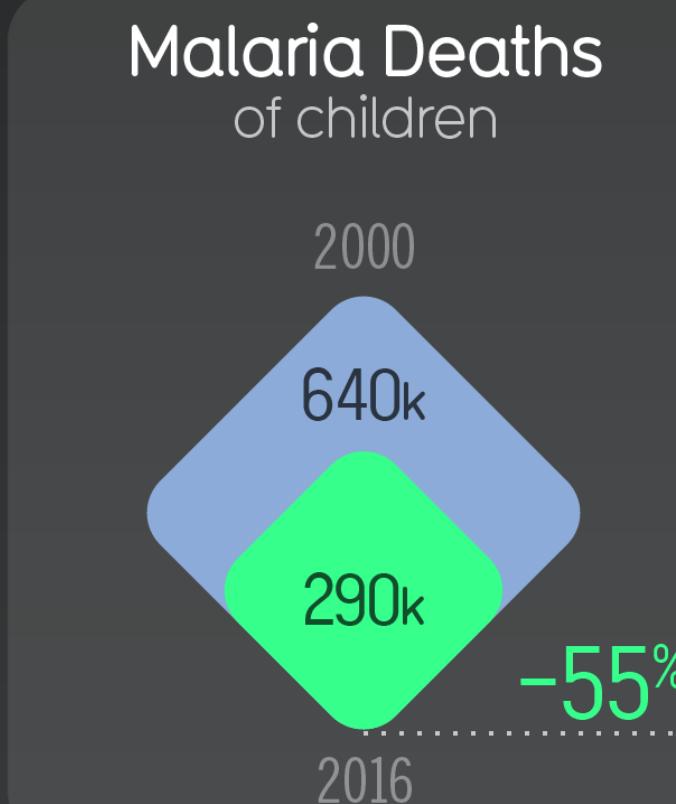
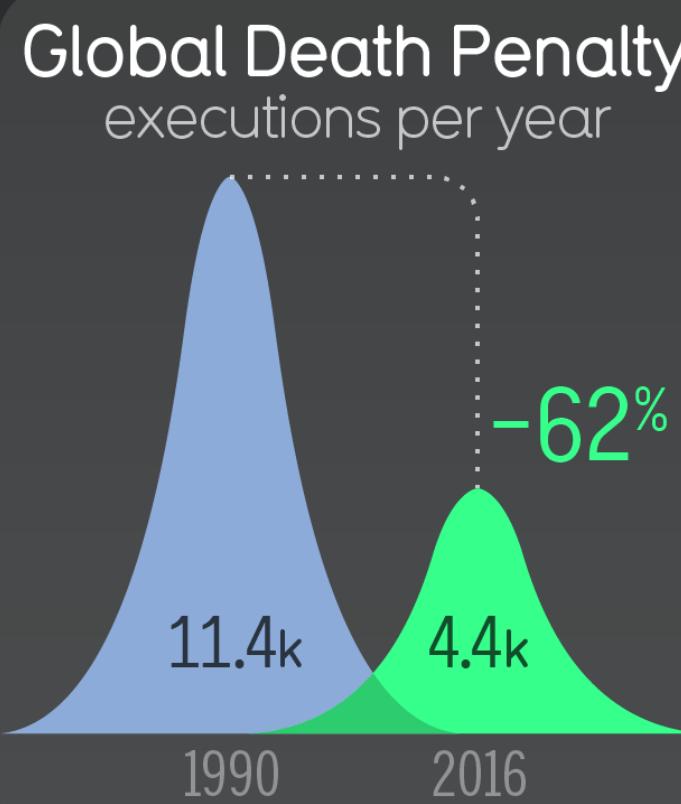




# Colors and Symbols Can Make Data Readable

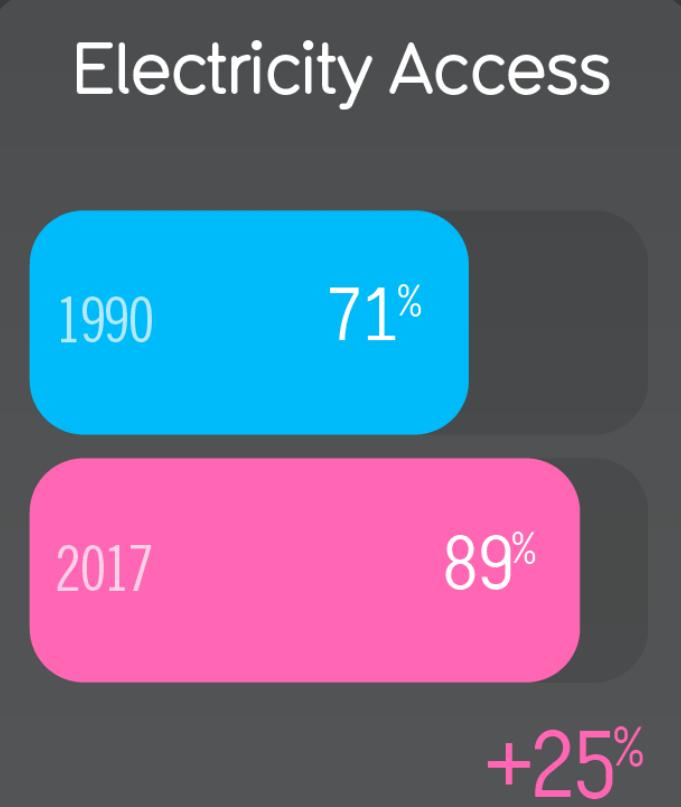
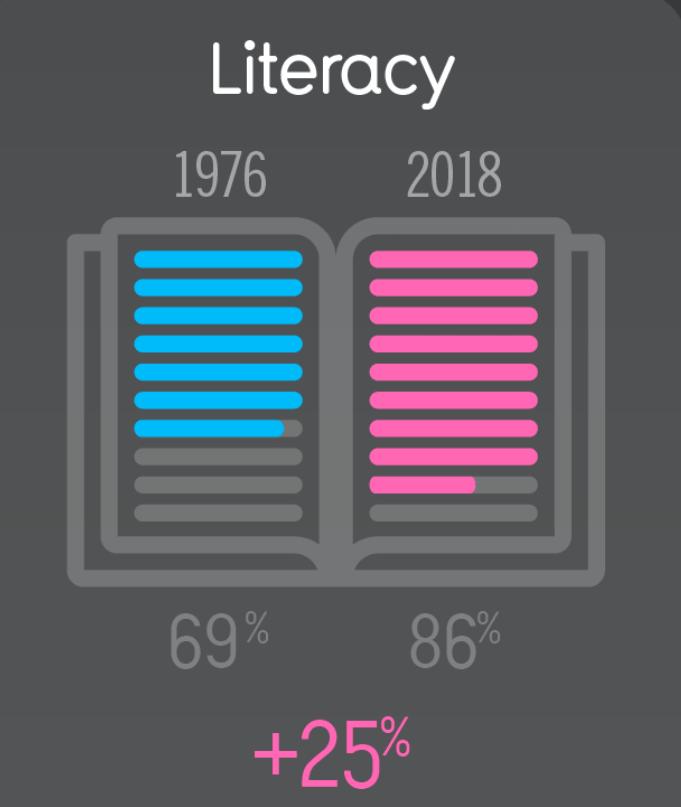
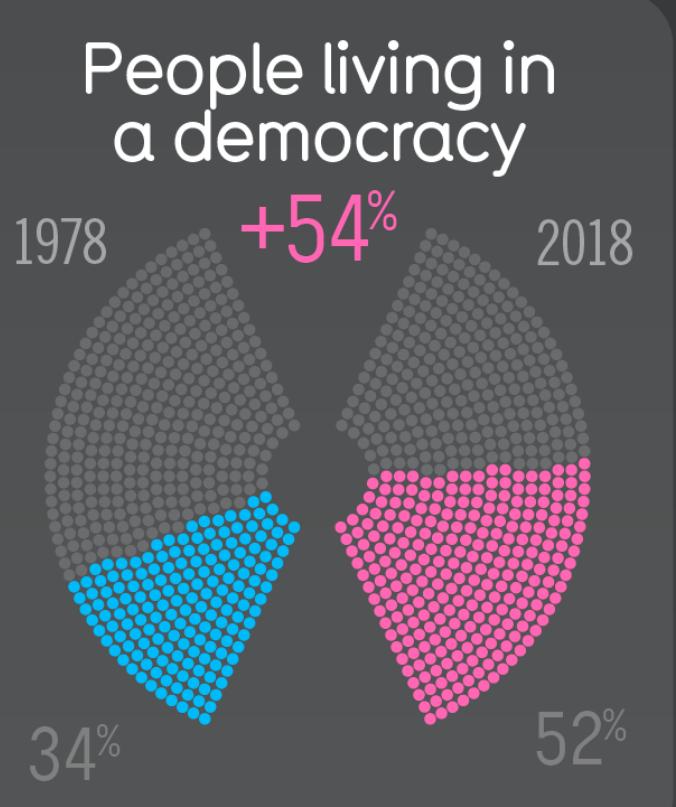
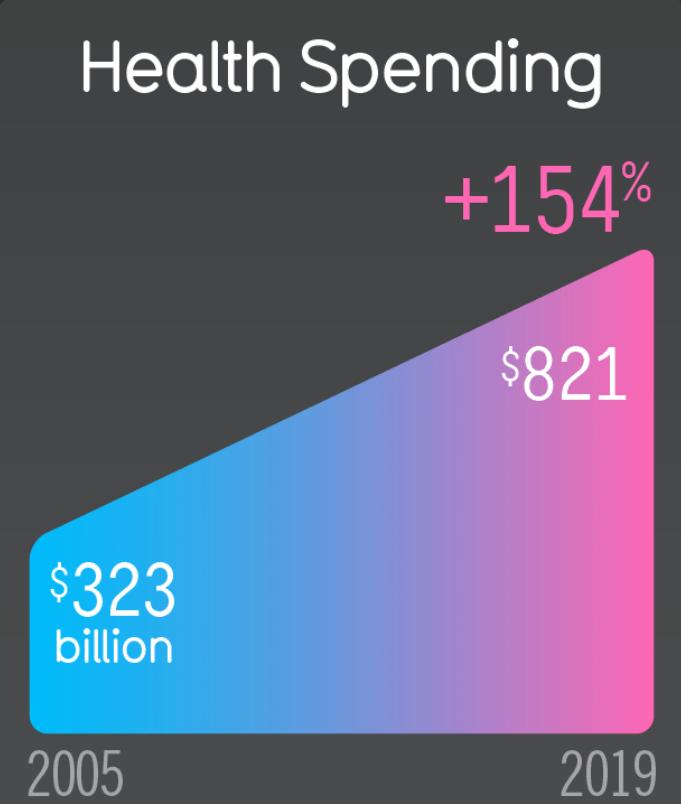
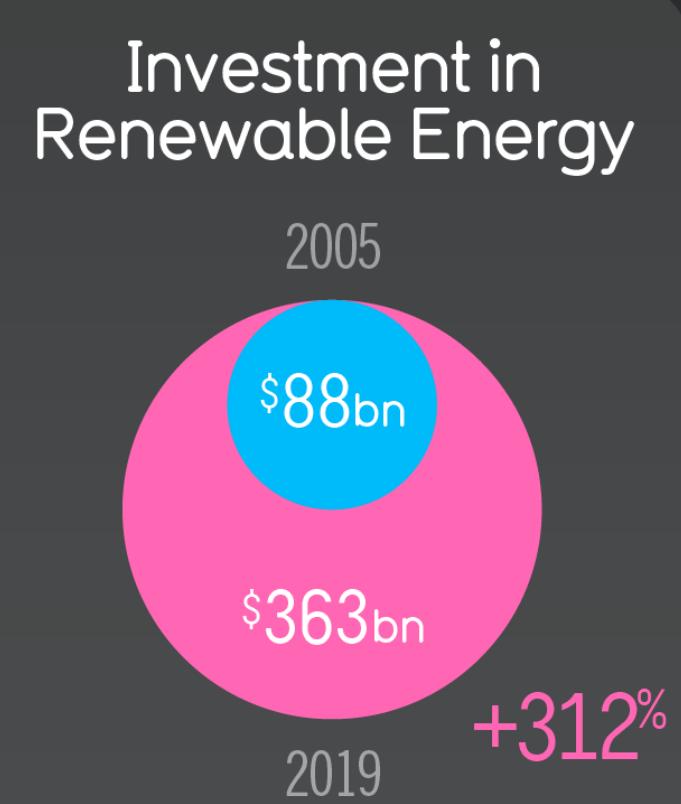
Things Going **Down!** Down! Down!

in a good way



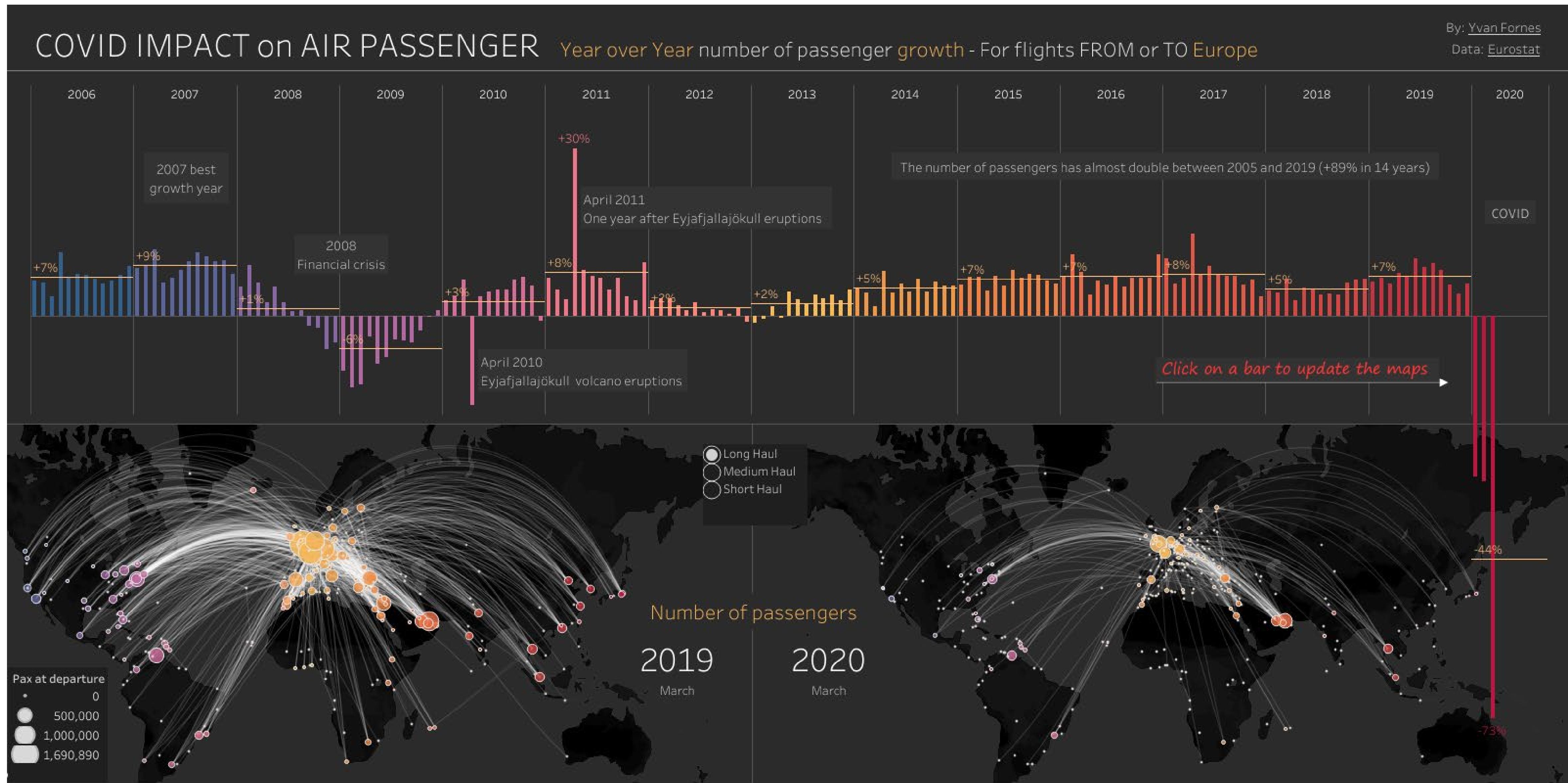
Things Going **Up!** Up! Up!

improving substantially, globally





# Maps and Visuals Can Show Problems and Give Hope



# Maps and Visuals Transcend Many Barriers!





# What is Cartography?

“the art, science and technology of making maps, together with their study as scientific documents and works of art. In this context, maps may be regarded as including all types of maps, plans, charts and sections, three-dimensional models and globes representing the earth or any celestial body at any scale” (Meynen 1973)

“the discipline dealing with the conception, production, dissemination and study of maps” (International Cartographic Association (I.C.A) 1992)

“the science of preparing all types of maps and charts and includes every operation from original survey to final printing of maps”  
(United Nations 1949, cited in Freitag 1993).

*“cartography is map using or making by processing various approaches including postmodern deconstruction, hypermedia, cognitive psychology, semiotics, GIScience, and visualization”*



# Basic Steps in Cartography



## APPLICABILITY

Consider what the real-world distribution of the phenomenon might look like

Objective vs.  
Correct



## AUDIENCE

Determine the purpose of the map and its intended audience

Generalizations,  
Scale, Scope



## DATA

Collect data appropriate for the map's purpose

Quality and  
Reliability Matters!



## DESIGN

Design and construct the map

Ask Lots of  
Questions!



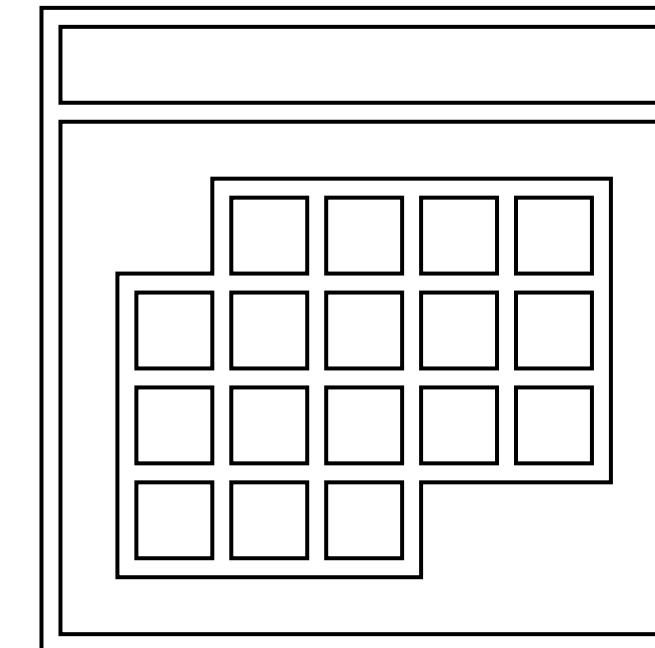
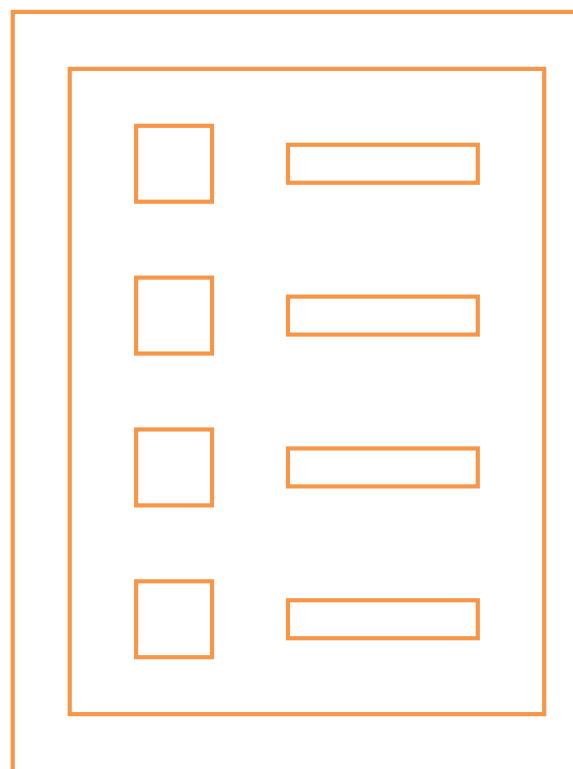
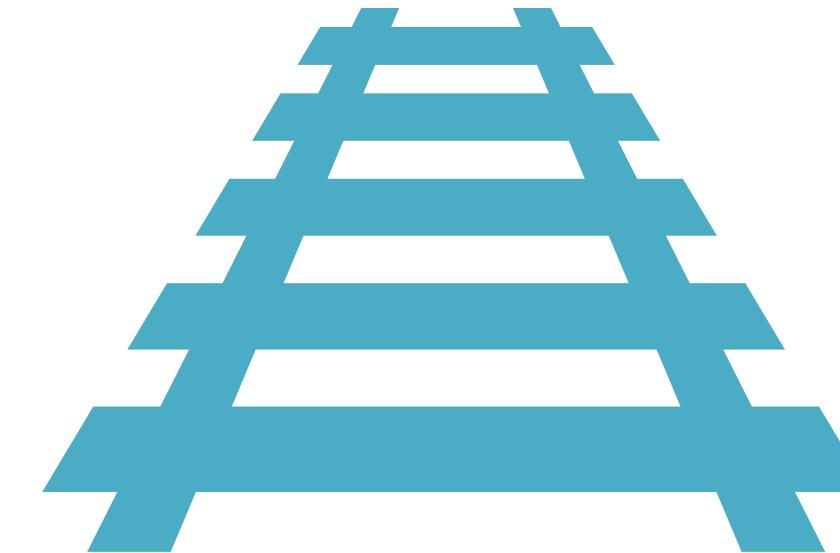
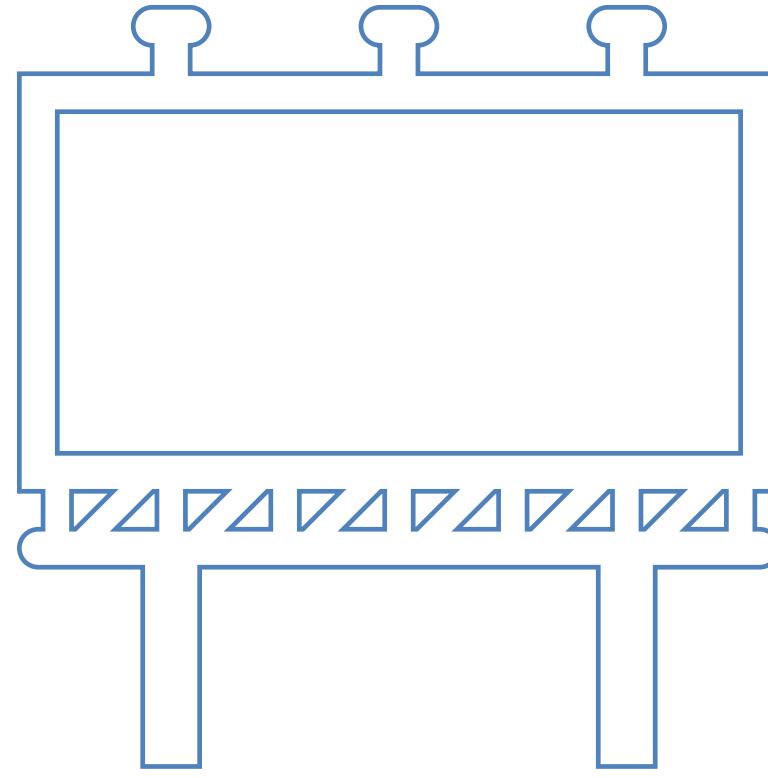
## FEEDBACK

Determine whether users find the map useful and informative

Map is for “them”,  
not “you”!



# Topics for this Week



## Day 1: Why Cartography?

- a. Basics of Cartography & Cartographic Representations
- b. Download software and get basic settings completed
- c. Basic overview of QGIS

## Day 2: Map Design and Layout

- a. Basic map elements & customizing map elements
- b. Layout size and shape
- c. Labels, Legend, colors and symbols
- d. Hands-on with QGIS Map Template

## Day 3: Turning Data into Maps

- a. Ease of making and sharing
- b. Data to Map
- c. Hand-on Map Making and Enhancing

## Day 4: Data Classification and Visualization Using QGIS

- a. Choropleth Maps
- b. Cartograms
- c. 3D visualization

## Day 5: Effective Communication using maps

- a. ArcGIS StoryMaps and Google Earth Pro for Data Visualization & Communication
- b. Maps as part of your story!

# End of Session