

African Drone and Data Academy (ADDA)

Data Visualization and Cartography

Day 1



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DATA VISUALIZATION AND CARTOGRAPHY

Introduction



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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

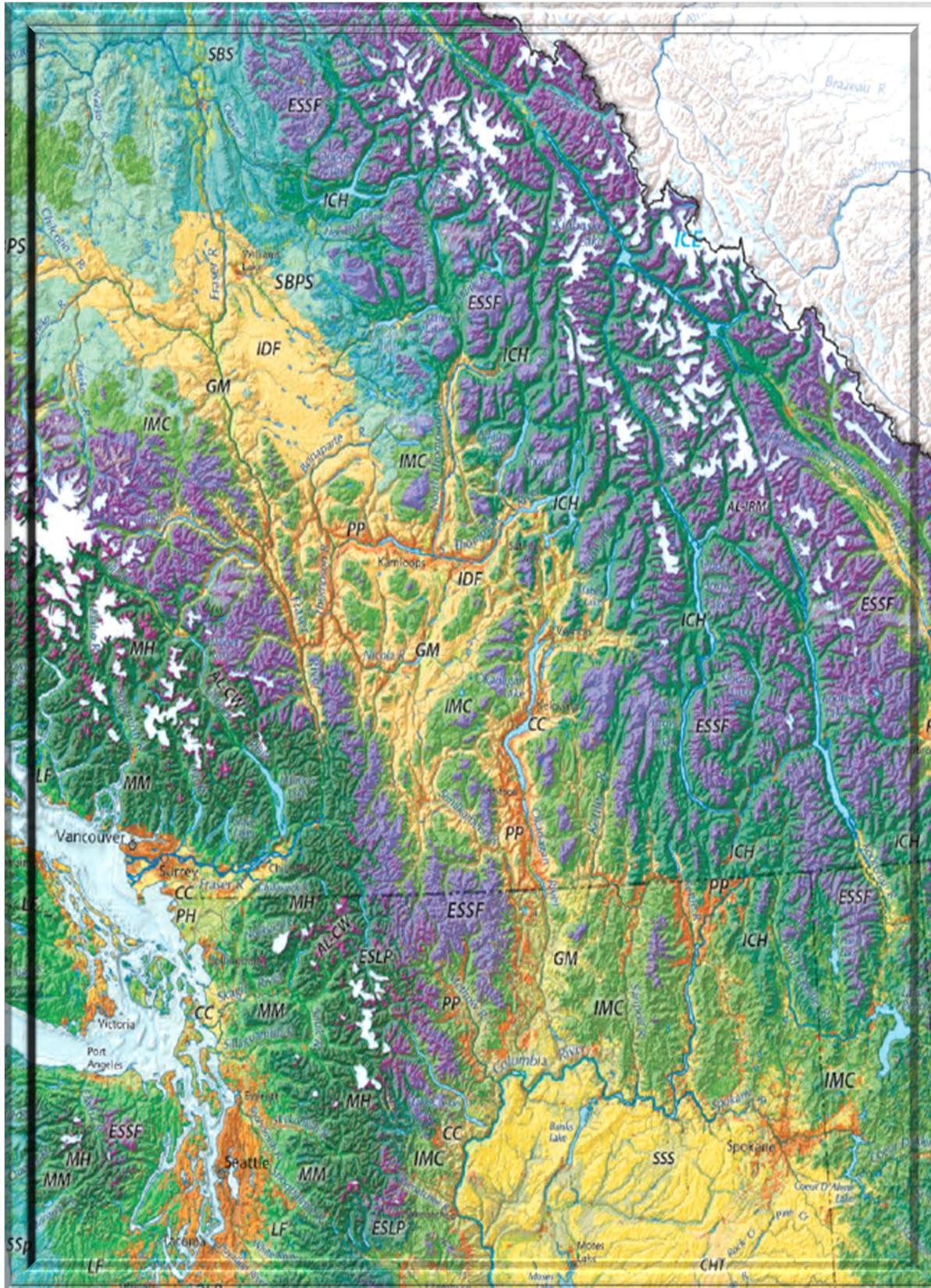
Why Visualize Data?

- 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

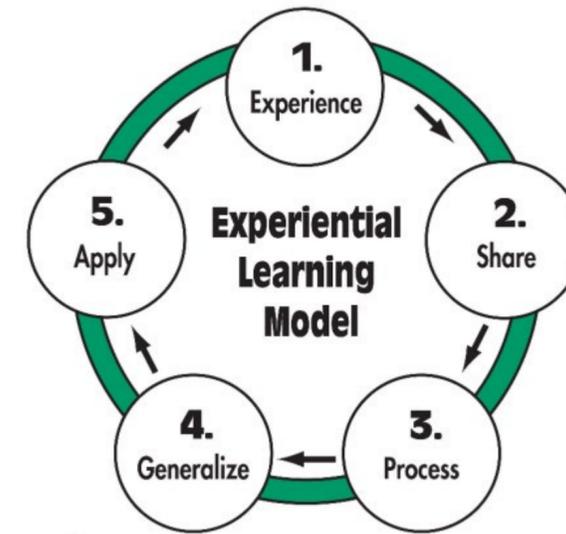
- Course materials are provided through Moodle, which is our course management system. It will contain:
 - Course lectures and laboratory materials developed for this course
 - Various published materials
- QGIS Online Documentation (links are for stable version, other versions can be found online)
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



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>

Copyright: CC-BY 2.5 UNICEF



Maps Break Language Barrier



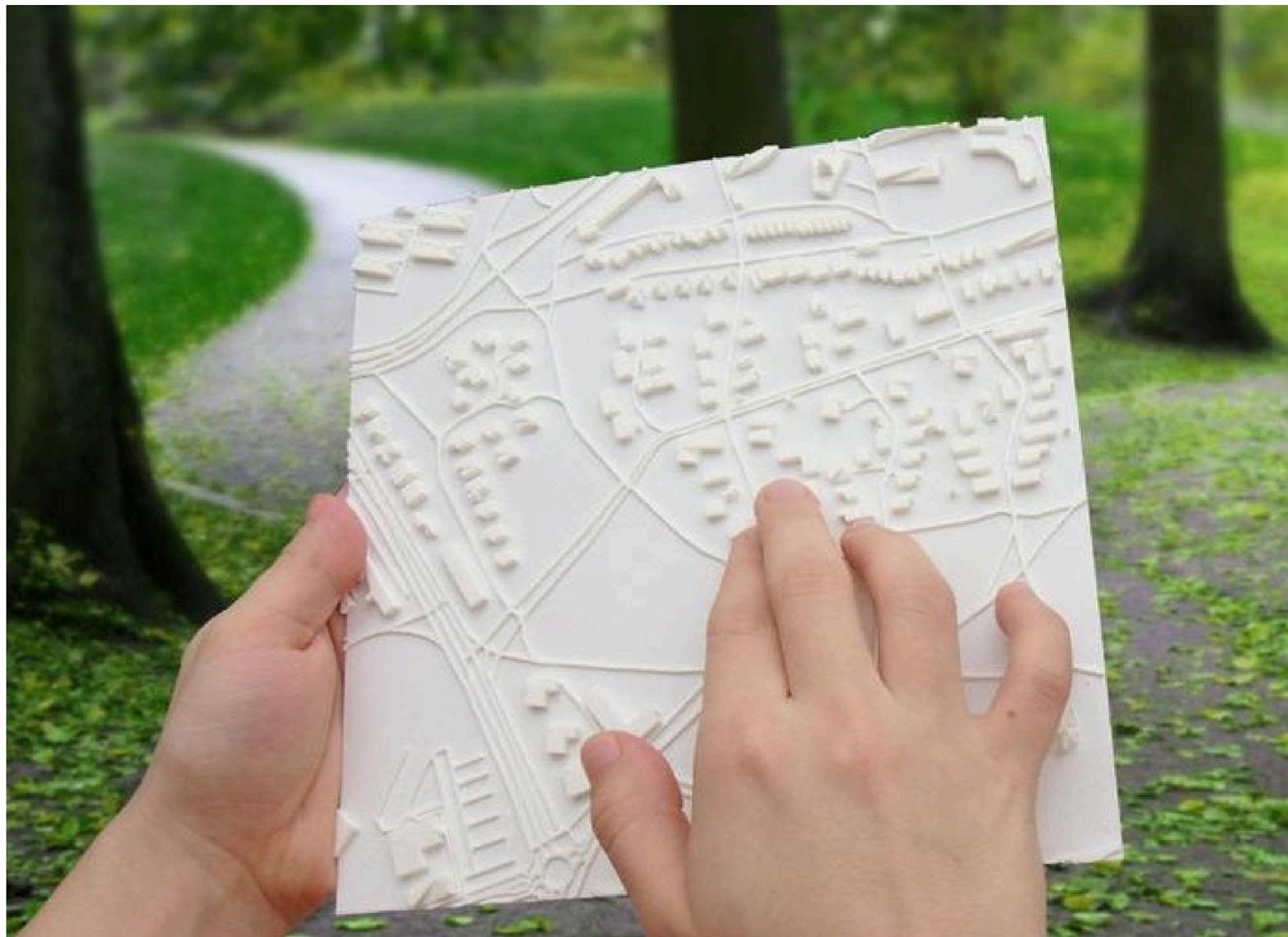
Community Outreach Using Maps Created with Drone Photos, Lilongwe - Malawi

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.

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1570 Map of the World

by Abraham Ortelius



<https://www.etsy.com>



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

80% of the U.S. population lives in a metropolitan area
Populations of top five shown

The entire state of Wyoming (pop. 509,300) has fewer people than the Harrisburg, Pa., metro area

3. Chicago metro area (pop. 9,443,400)

4. Philadelphia metro area (pop. 5,823,200)

1. New York City metro area (pop. 18,747,300)



Seattle

Salt Lake City

Phoenix

Honolulu

is the most sparsely populated state, with only 1 person per square mile

Las Vegas

2. Los Angeles

4. Philadelphia metro area (pop. 5,823,200)

1. New York City metro area (pop. 18,747,300)

Tampa

Boston

New Jersey is the most densely populated state, with 1,134 people per square mile

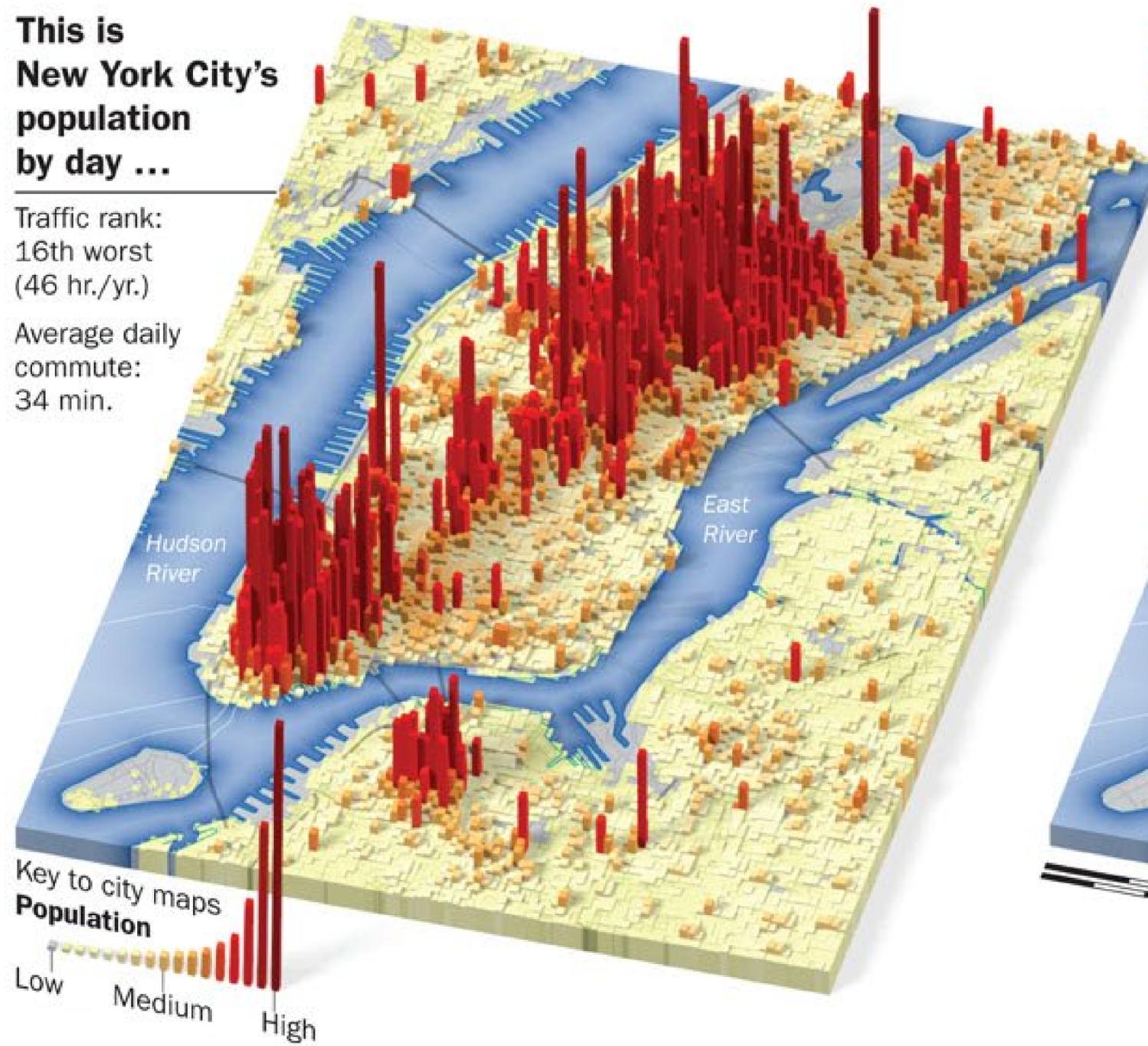


A Different Perspective Alters Our Viewpoint

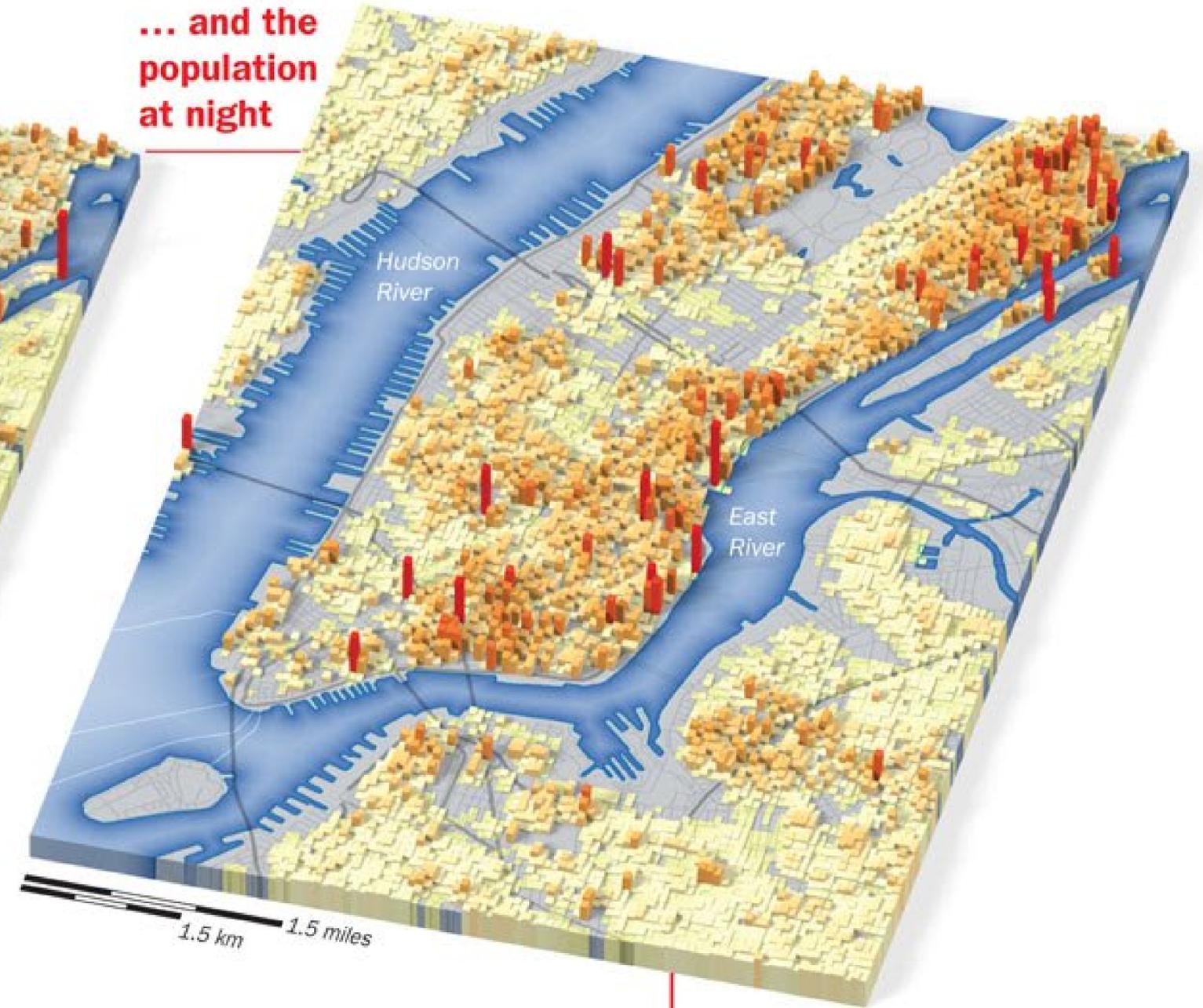
**This is
New York City's
population
by day ...**

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

Average daily
commute:
34 min.



**... and the
population
at night**





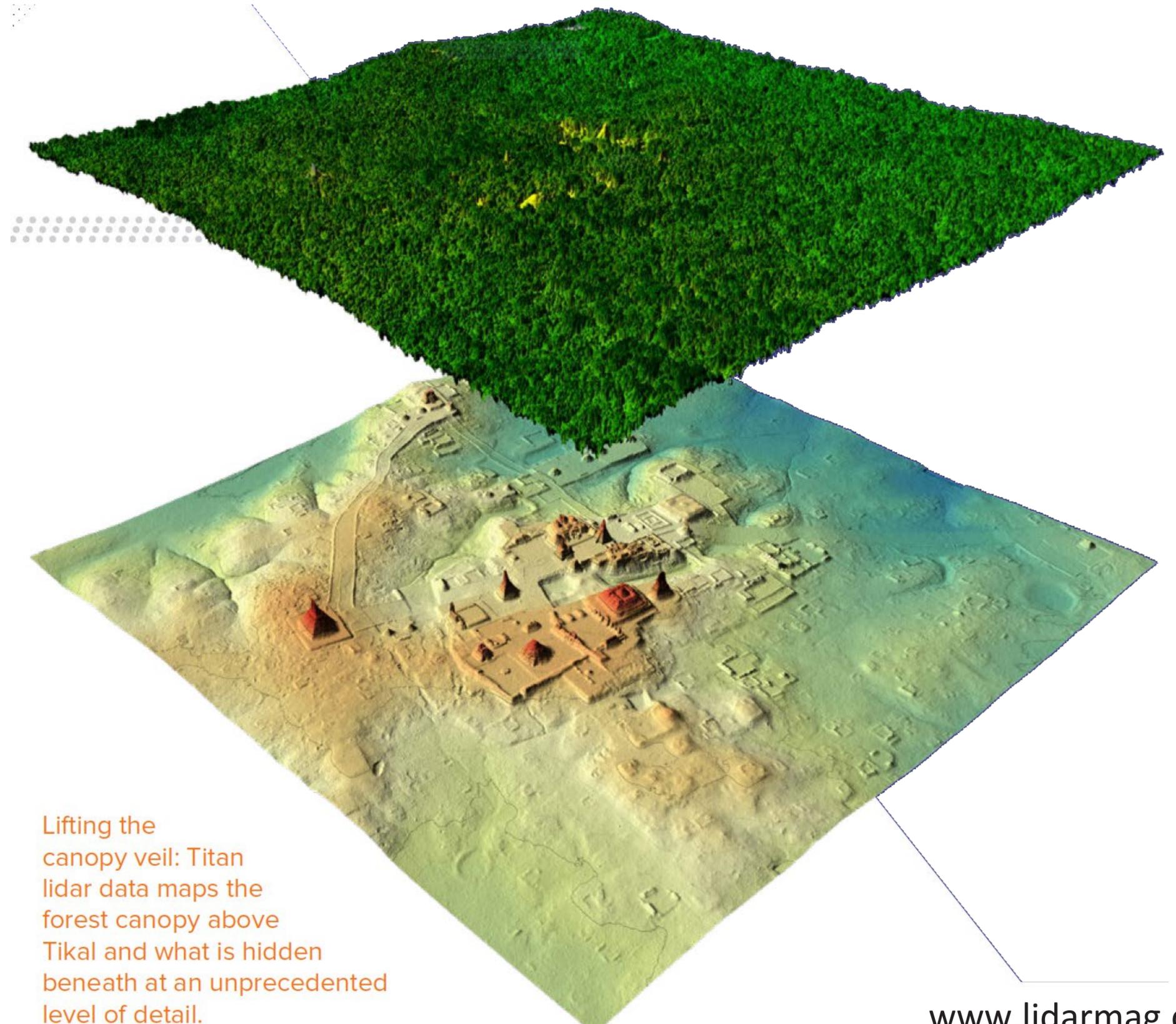
Maps Can Reveal Hidden Treasures

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.

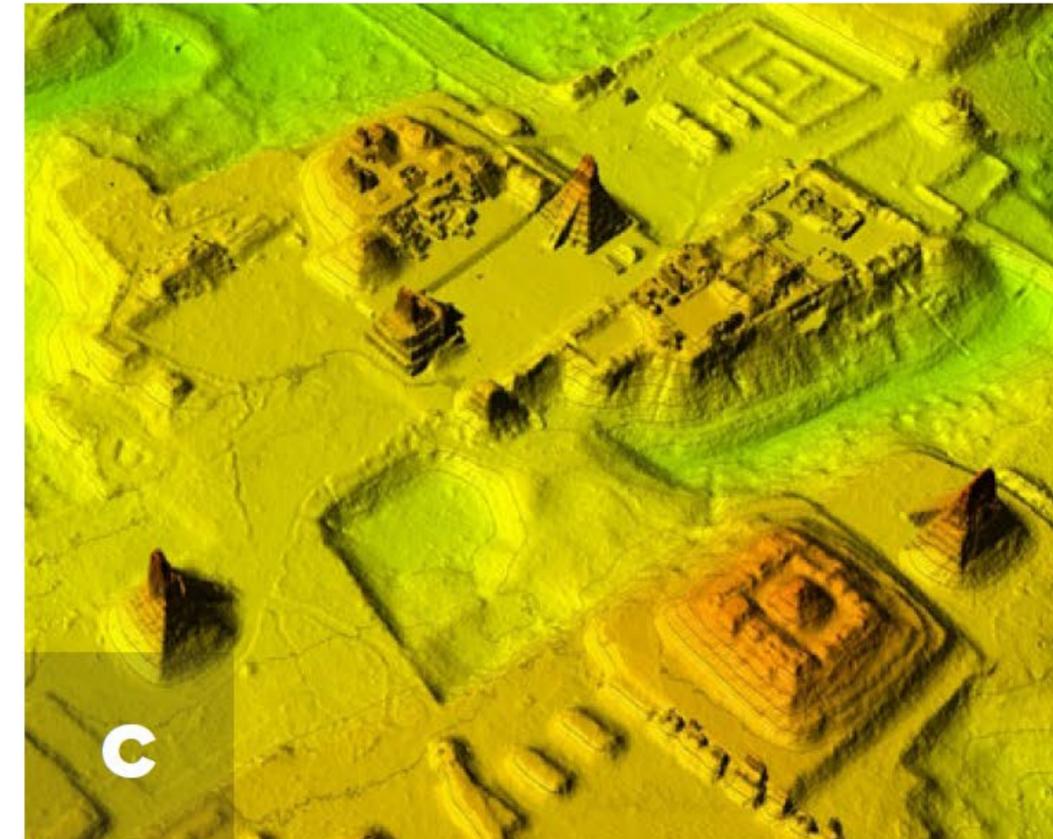
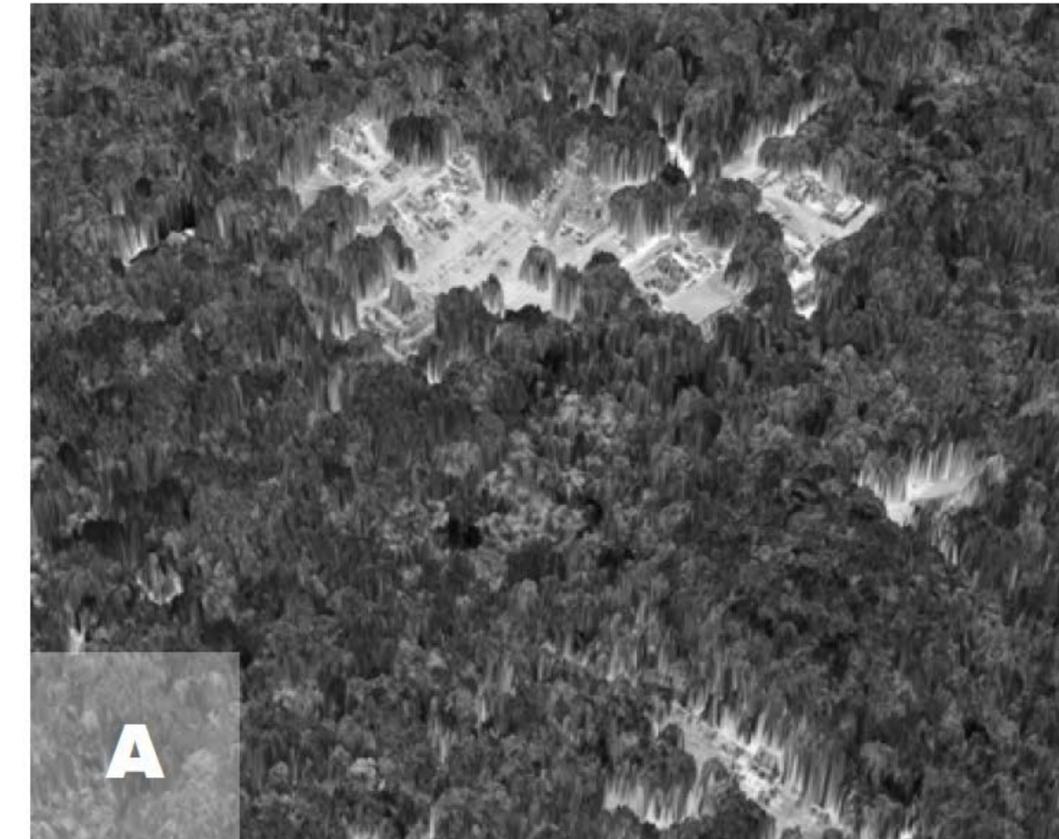


Lifting the canopy veil: Titan lidar data maps the forest canopy above Tikal and what is hidden beneath at an unprecedented level of detail.

Copyright: CC-BY 2.5 UNICEF



Maps Can Reveal Hidden Treasures



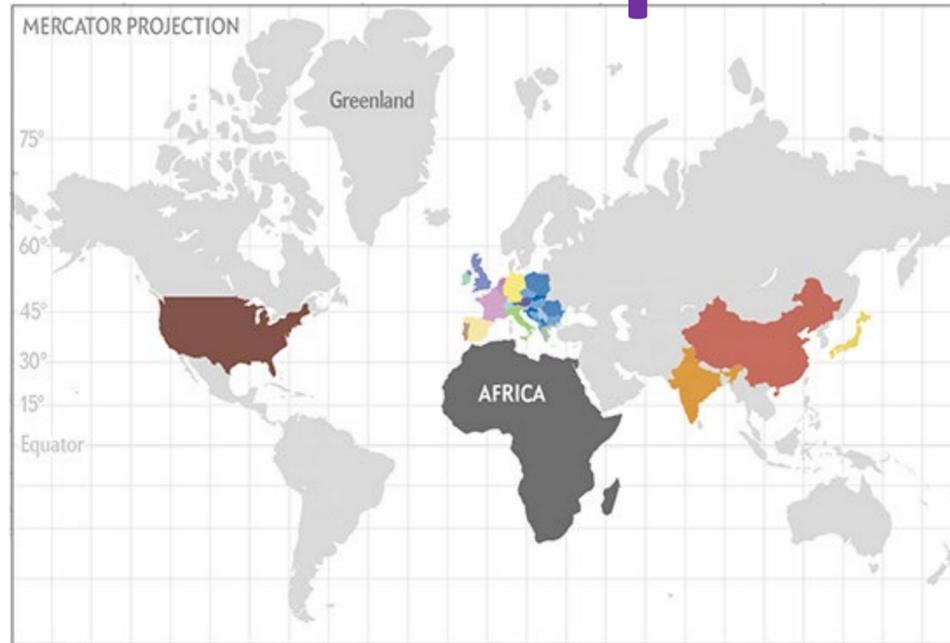
The core of Tikal seen in Optech Titan multispectral lidar data: A) First-surface DSM colored with 1064-nm lidar intensities; B) First-surface DSM colored with multispectral intensities (R: 1550 nm, G: 1064 nm, B 532 nm); C) Bare-earth DEM colored by elevation.

Airborne LiDAR for Archaeology in
Central and South America



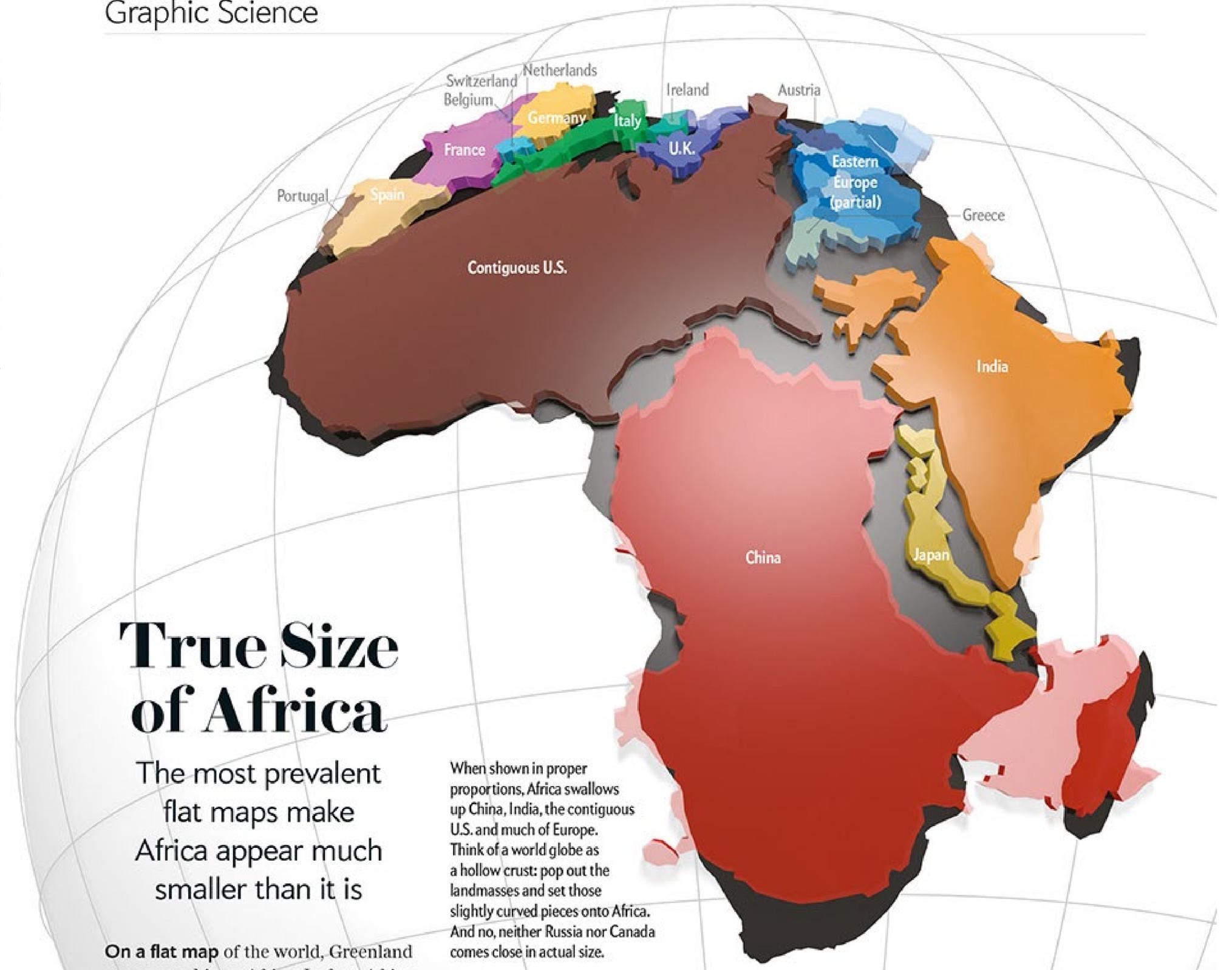
Maps Can Lie (if you want them to)

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

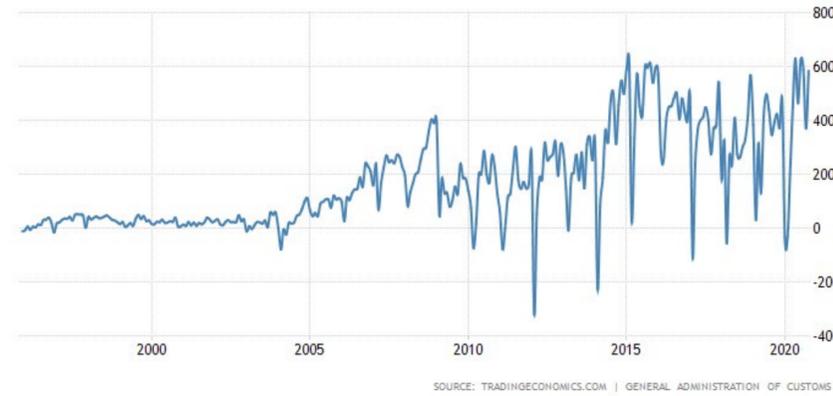
The most prevalent flat maps make Africa appear much smaller than it is

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.

On a flat map of the world, Greenland



Visuals Can Show Complex Relations



United States ● \$12,713bn GDP
● 282.4m persons POP

United States ● \$15,902bn → GDP
● 316.5m persons → POP

\$ 674.67bn \$ 992.64bn

\$ 1,169bn \$ 1,836bn

China ● \$2,195bn GDP
● 1,280m persons POP

France ● GDP → \$2,723bn
● POP → 65.9m persons

China ● \$7,539bn ↗ GDP
● 1,385m persons → POP

France ● GDP \$2,350bn
● POP 60.9m persons

GDP \$2,350bn
POP 60.9m persons

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.

2000

2013

Germany

GDP \$3,125bn
POP 80.6m persons

Japan

\$ 5,093bn GDP
● 126.9m persons POP

Germany

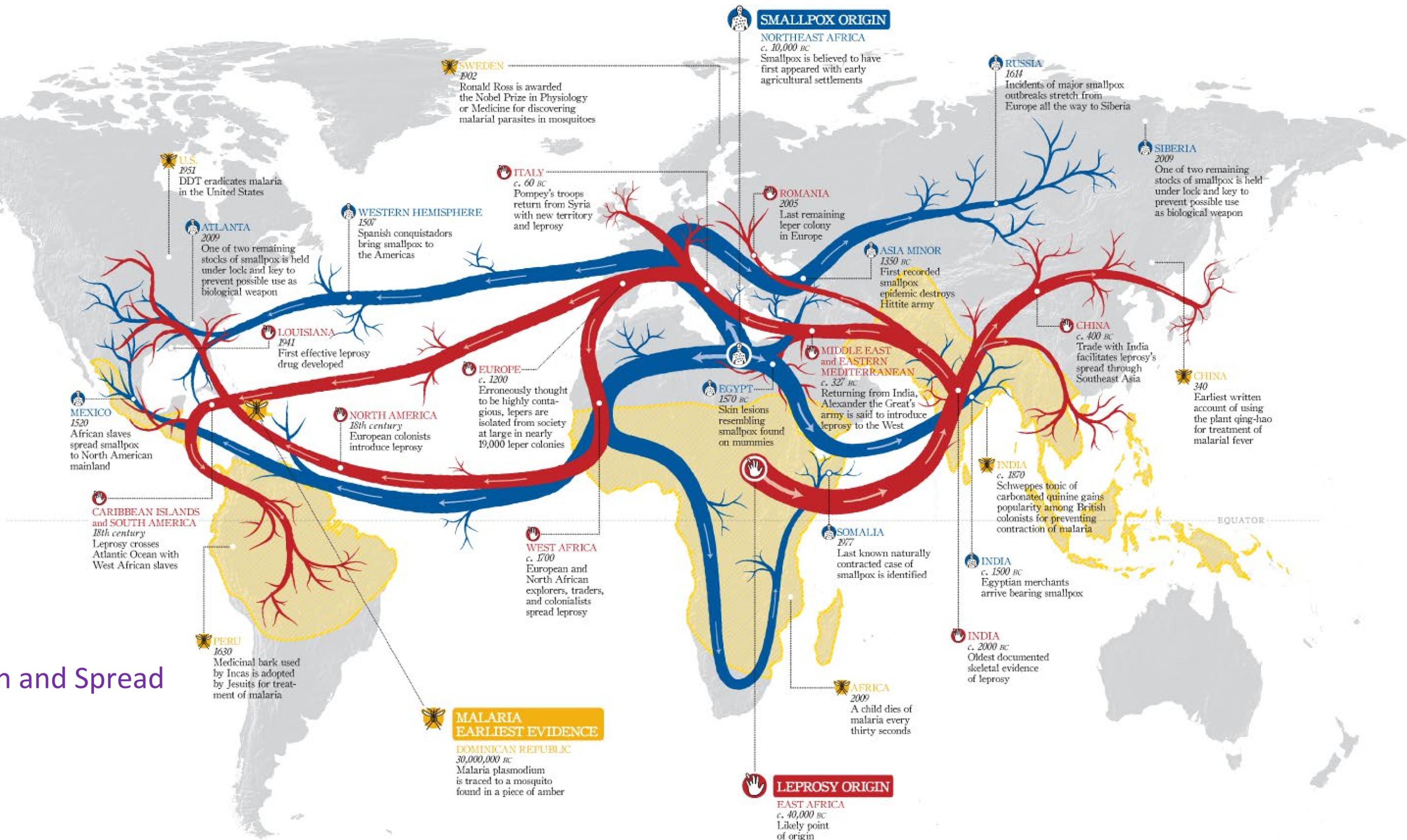
GDP → \$3,558bn
● POP → 80.4m persons

Japan

\$ 5,634bn → GDP
● 127.3m persons → POP



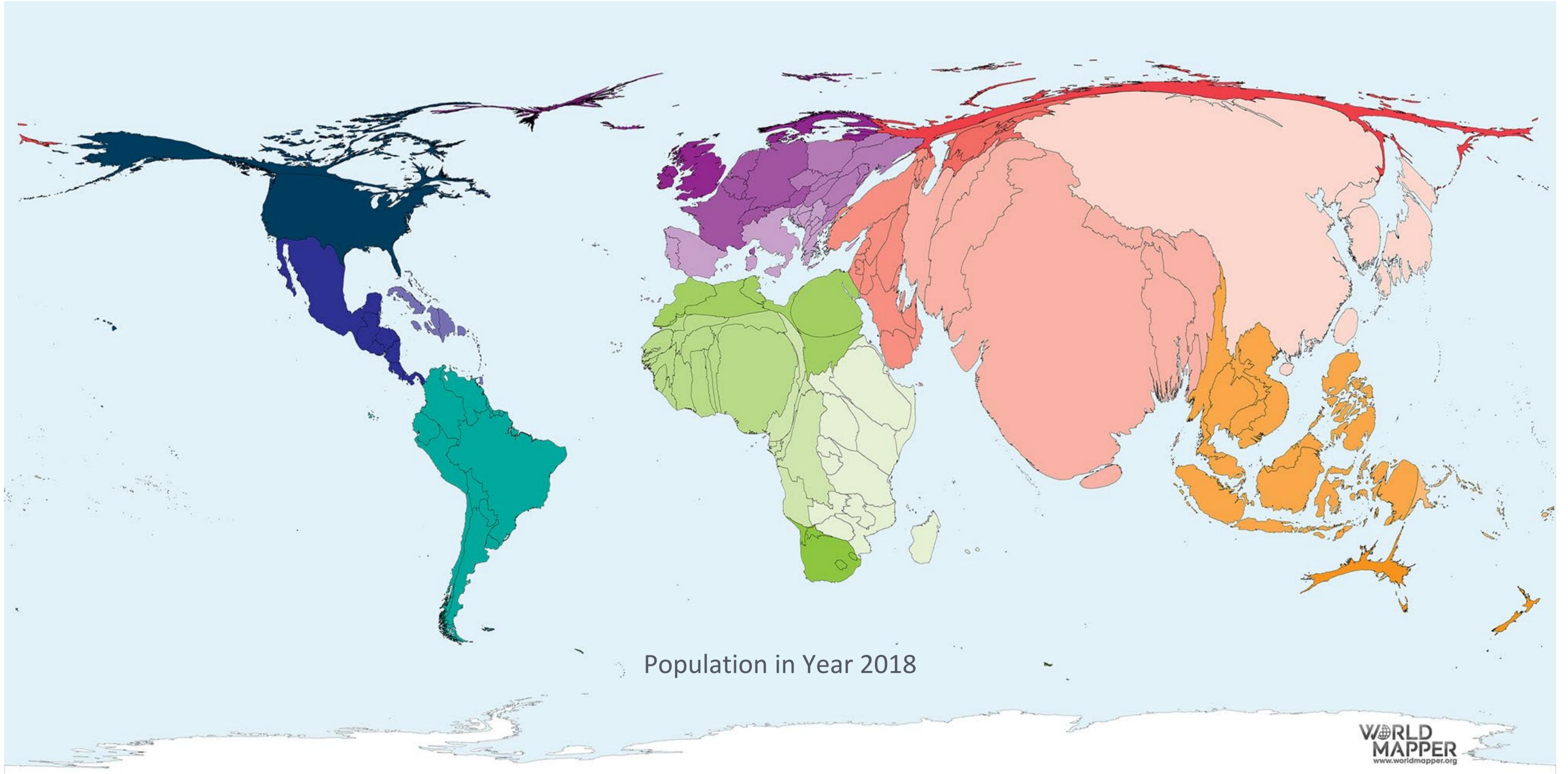
Maps Can Highlight History and Magnitude of Problems



Disease Origin and Spread

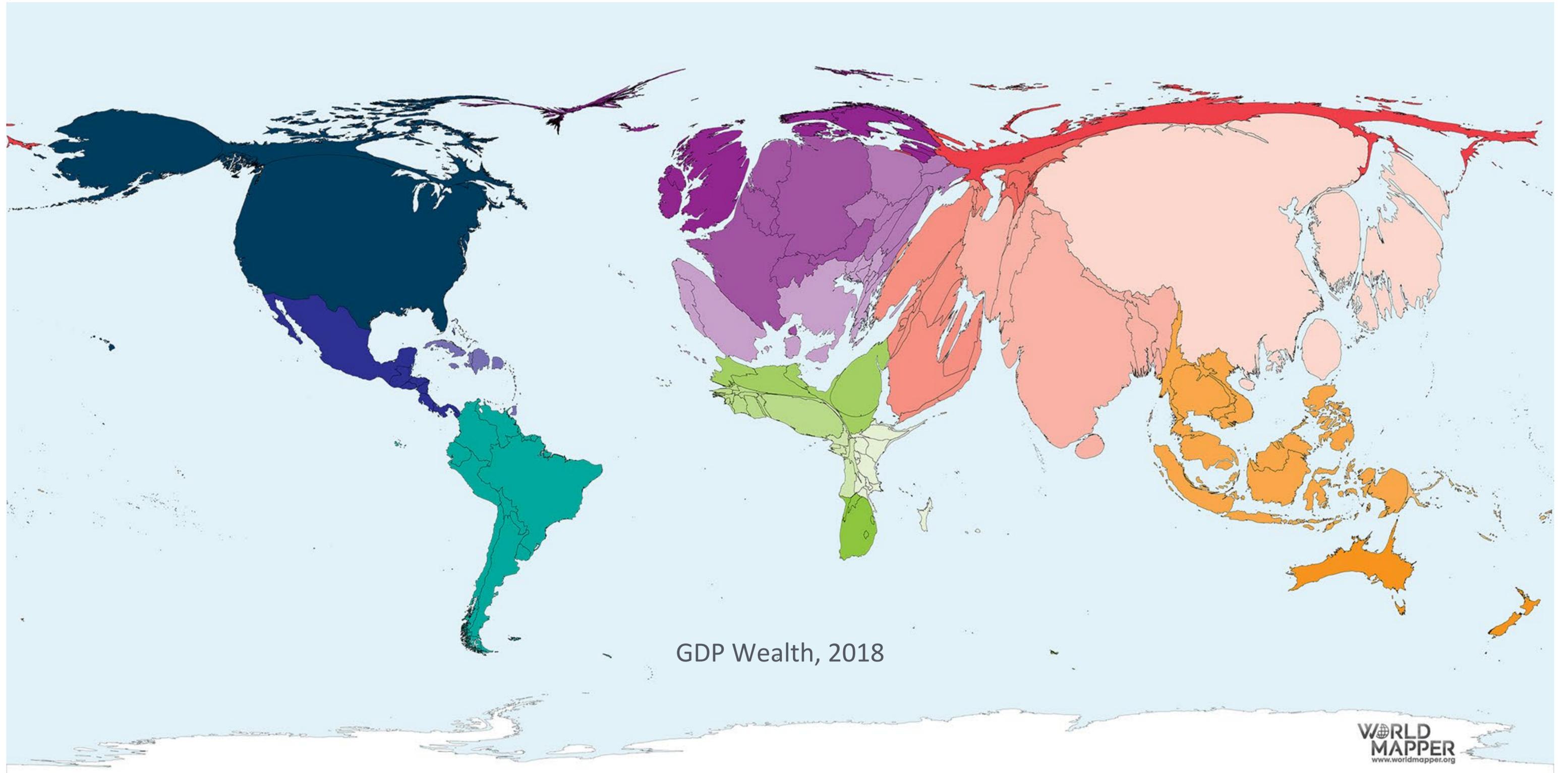


Distorted Maps Can Enhance Our Worldview



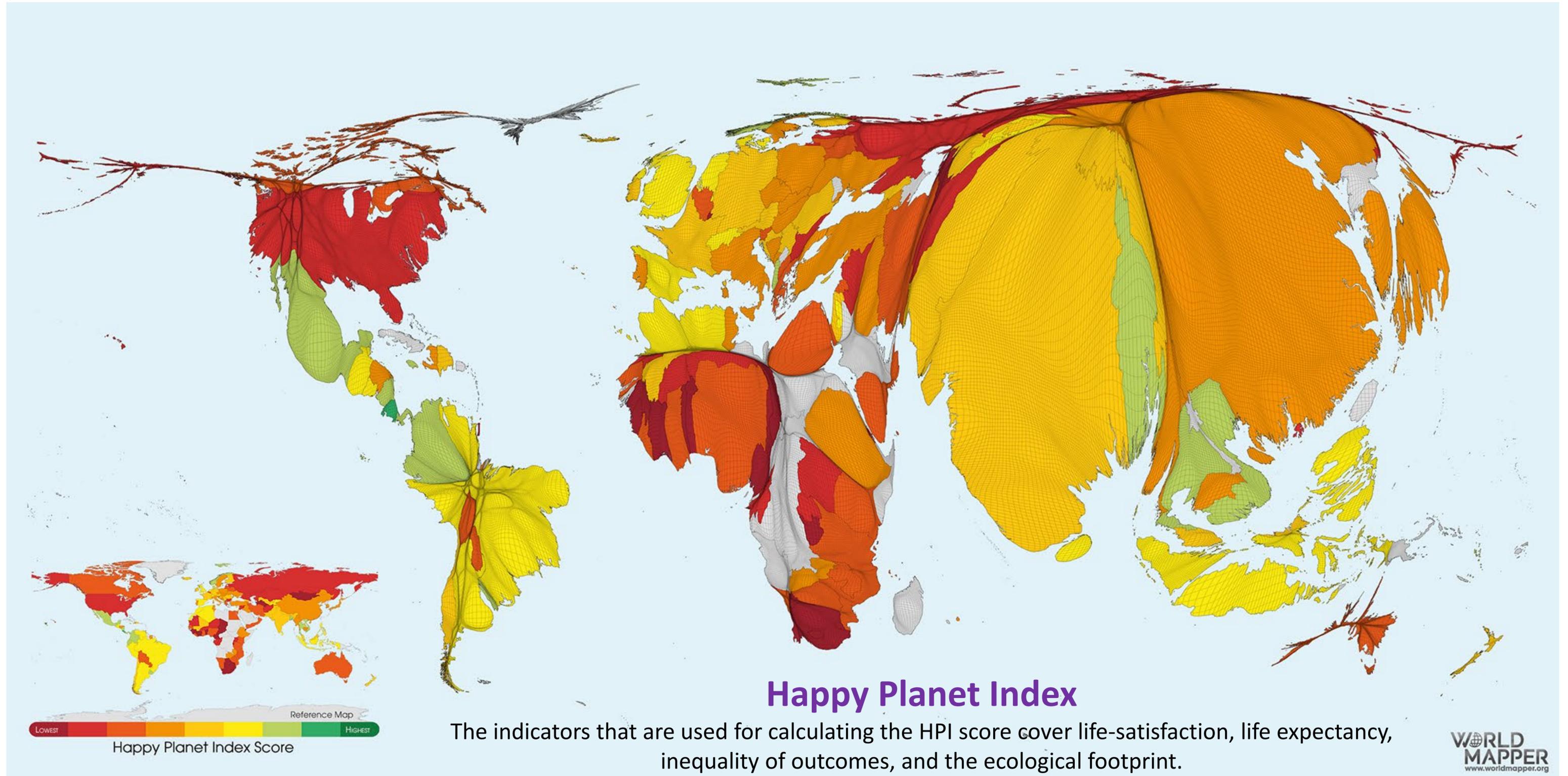


Distorted Maps Can Enhance Our Worldview





Distorted Maps Can Enhance Our Worldview

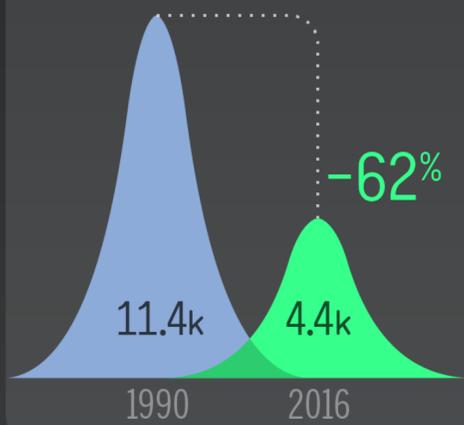




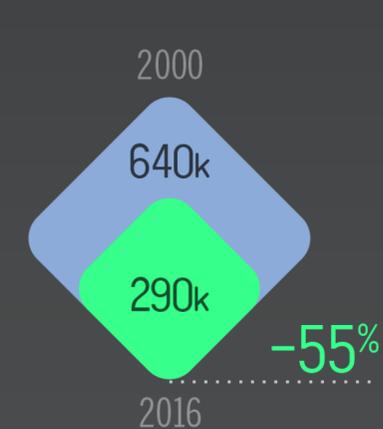
Colors and Symbols Can Make Data Readable

Things Going **Down! Down! Down!** in a good way

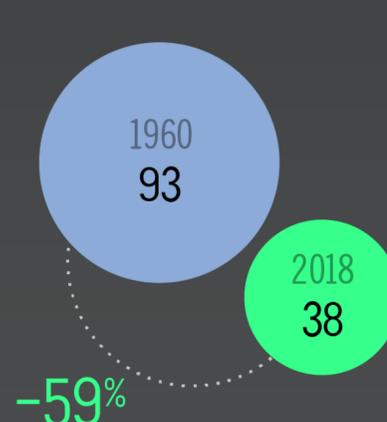
Global Death Penalty
executions per year



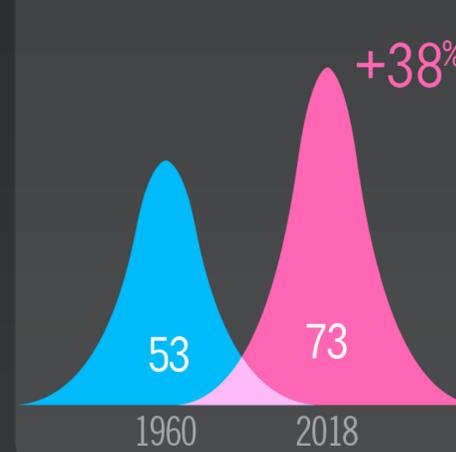
Malaria Deaths
of children



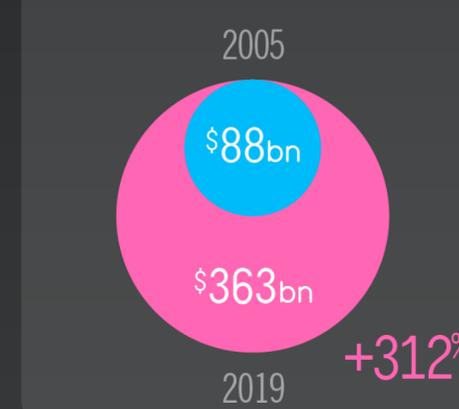
Child Mortality
US deaths per 1,000



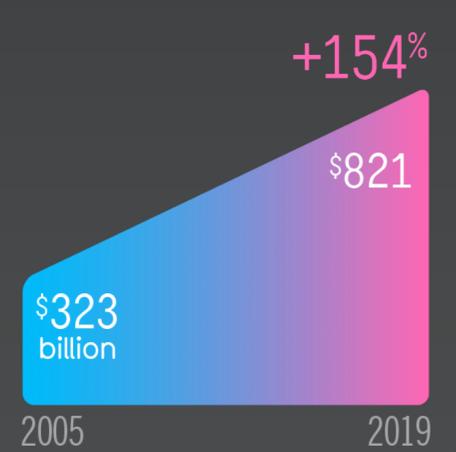
Life Expectancy



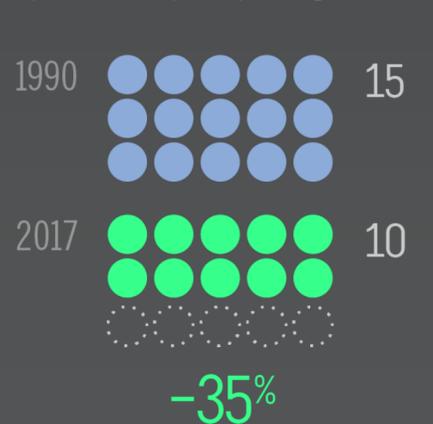
Investment in
Renewable Energy



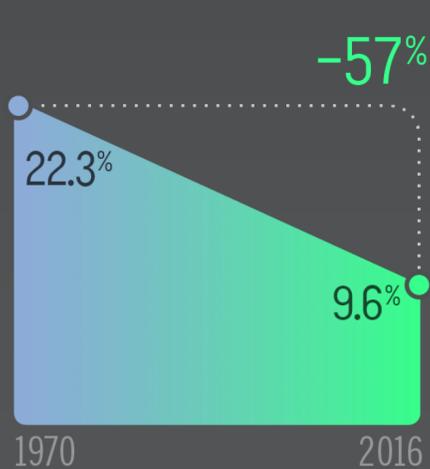
Health Spending



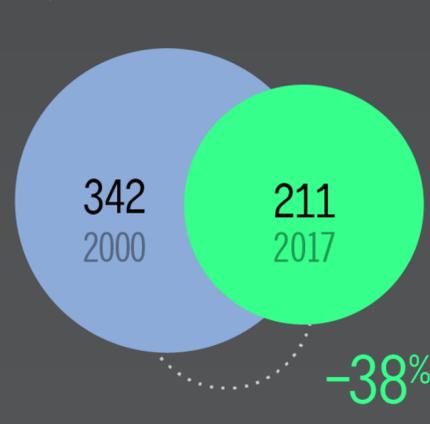
Deaths from Suicide
per 100k people, global



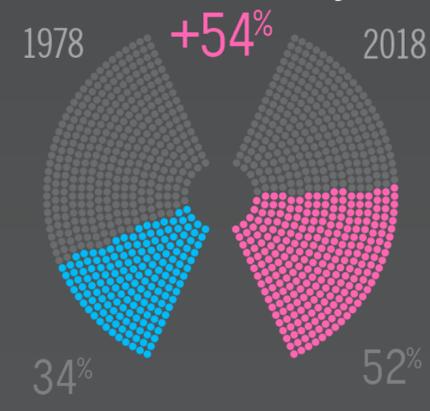
Child Labour



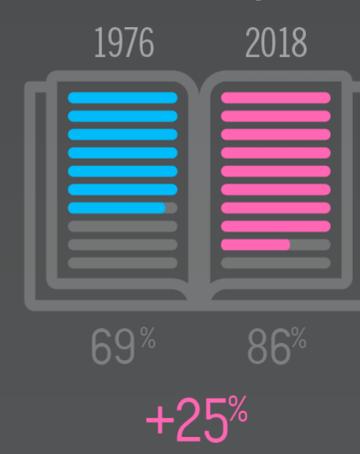
Mothers Dying
per 100,000 live births



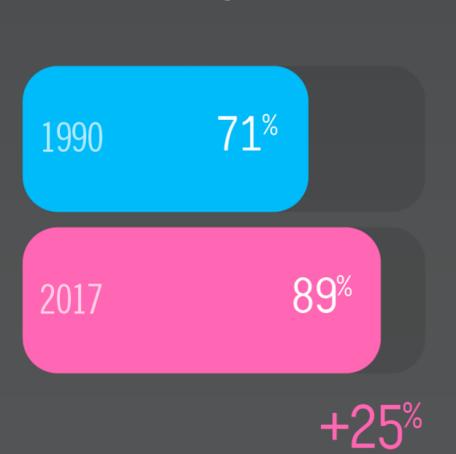
People living in
a democracy



Literacy



Electricity Access





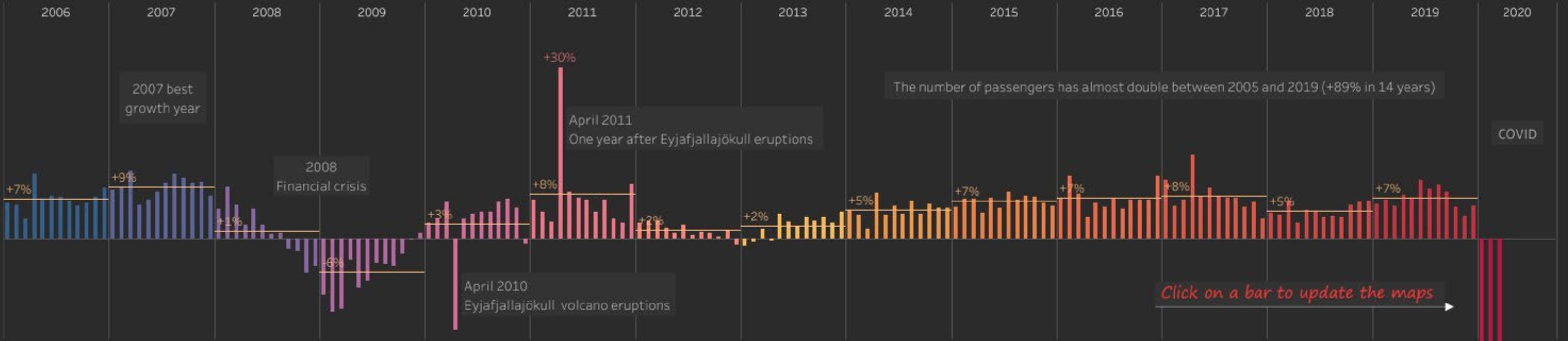
Maps and Visuals Can Show Problems and Give Hope

COVID IMPACT on AIR PASSENGER

Year over Year number of passenger growth - For flights FROM or TO Europe

By: Yvan Fornes

Data: Eurostat



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

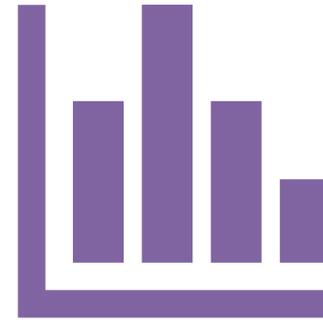
Objective vs. Correct



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!



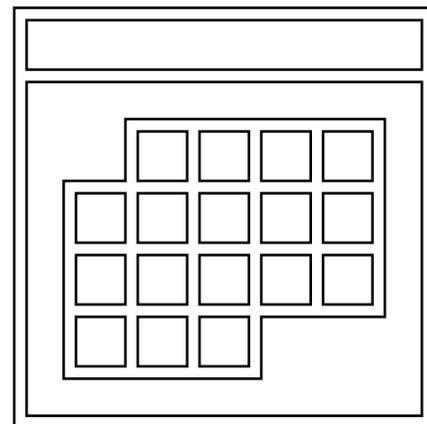
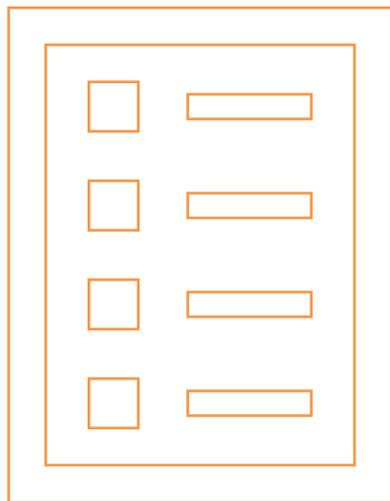
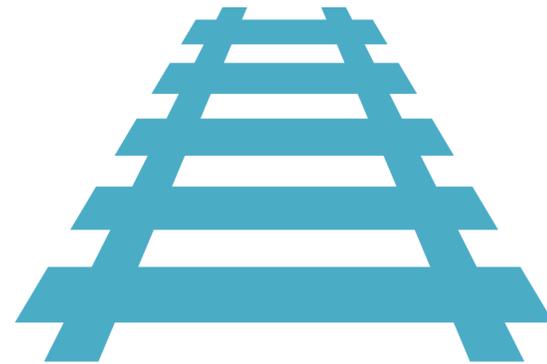
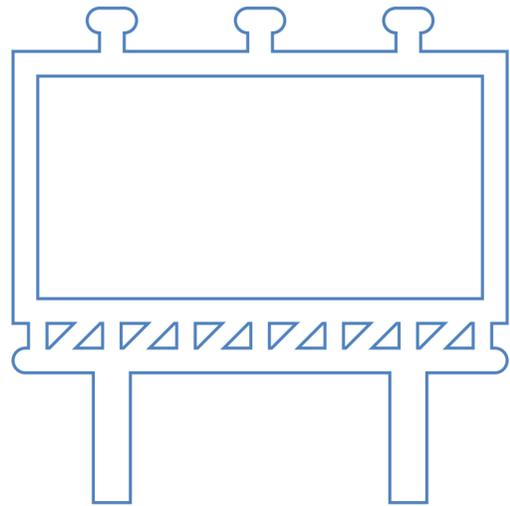
FEEDBACK

Determine whether users find the map useful and informative

Map is for "them", not "you"!



Topics for this Week



Day 1: Why Cartography?

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

Day 2: Map Design and Layout

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

Day 3: Turning Data into Maps

- Ease of making and sharing
- Data to Map
- Hand-on Map Making and Enhancing

Day 4: Data Classification and Visualization Using QGIS

- Choropleth Maps
- Cartograms
- 3D visualization

Day 5: Effective Communication using maps

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

End of Session