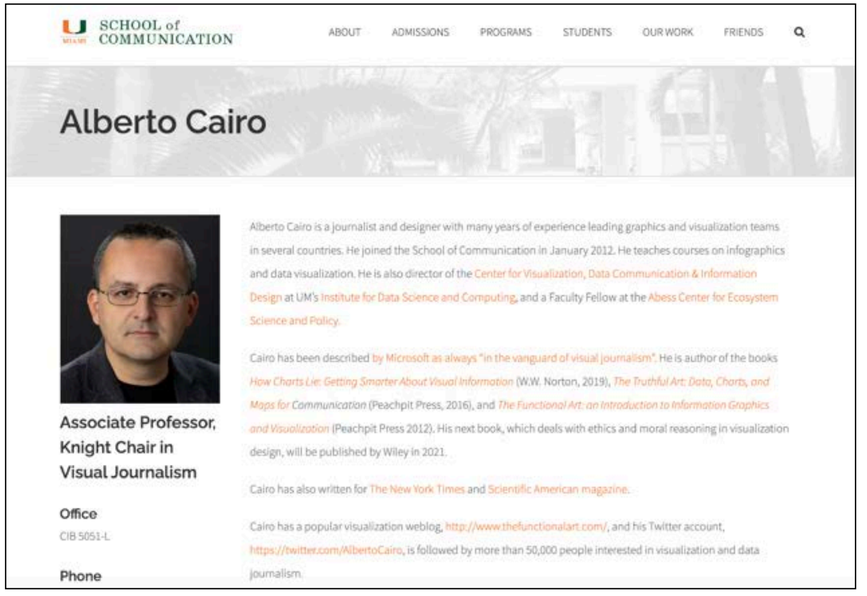
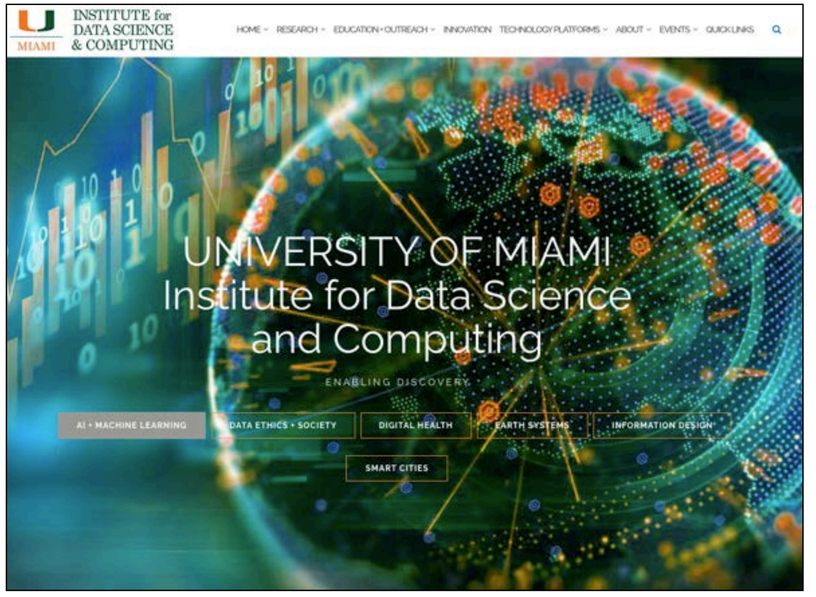
Decisions in Visualization Design

Alberto Cairo

Generative art by Nadieh Bremer



https://com.miami.edu/profile/alberto-cairo/



https://idsc.miami.edu/

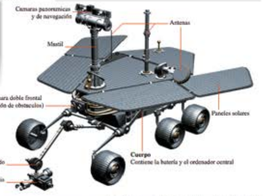
https://openvisualizationacademy.org/

Mars Exploration Rover: Misión a Marte

Portada | Lanzamiento | El viaje | Llegada | Operaciones | Descubrimientos

Estructura

El vehículo, de **155 kg** de peso, tiene una **vida útil** de 90 días marcianos (un poco más largos que los de la Tierra). Puede avanzar **100 metros** en un día. Punto que no baterías se alimenta de luz solar, sólo está operativo durante el día.



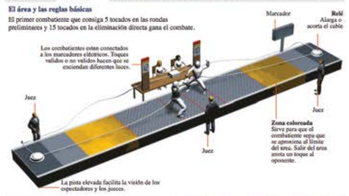
Fuente: NASA / Agencias • Gráficos: Pelio Gutiérrez / Alberto Cairo • e-mail

Esgrima

Portada | Introducción | Modalidades | Equipamiento | Maniobras | Historia

El área y las reglas básicas

El primer combatiente que consiga 5 tocados en las rondas preliminares y 15 tocados en la eliminación directa gana el combate.



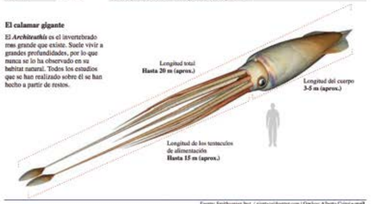
Fuente: Esgrima (AAC Black London) / Esgrima (Brian Pitman) • Gráficos: Alberto Cairo • e-mail

El calamar gigante

Portada | El animal | Hábitat y distribución | Comparativa de longitudes

El calamar gigante

El *Architeuthis* es el invertebrado más grande que existe. Suele vivir a grandes profundidades, por lo que nunca se lo ha observado en su hábitat natural. Todos los estudios que se han realizado sobre él se han hecho a partir de restos.



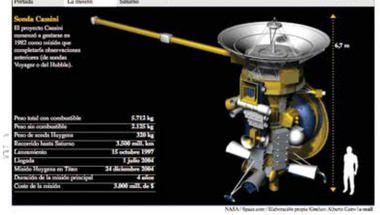
Fuente: Smithsonian Inst. / pantsquidcenter.com • Gráficos: Alberto Cairo • e-mail

Cassini-Huygens: cita con Saturno

Portada | La misión | Saturno

Sonda Cassini

El proyecto Cassini nació en 1982 como misión que completaría observaciones anteriores (de sondas Voyager e del Hubble).



Peso total con combustible	5.712 kg
Peso sin combustible	2.125 kg
Peso de sonda Huygens	320 kg
Recorrido hasta Saturno	3.500 mill. km
Lanzamiento	15 octubre 1997
Llegada	1 julio 2004
Misión Huygens en Titan	24 diciembre 2004
Duración de la misión principal	4 años
Coste de la misión	3.000 mill. de €

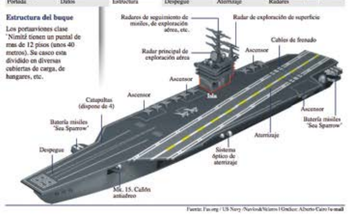
NASA / Space.com / Elaboración propia • Gráficos: Alberto Cairo • e-mail

Los portaaviones clase `Nimitz´

Portada | Datos | Estructura | Despegue | Aterrizaje | Radares

Estructura del buque

Los portaviones clase 'Nimitz tienen un puntal de más de 12 pisos (unos 40 metros). Su casco está dividido en diversas cubiertas de carga, de hangares, etc.



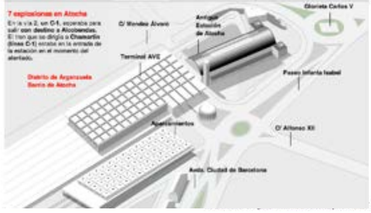
Fuente: Fas.org / US Navy / Nuevloo&Vicens • Gráficos: Alberto Cairo • e-mail

Masacre en Madrid

Portada | Introducción | Atocha | El Pozo | Santa Eugenia

7 explosiones en Atocha

En la vía 2, un tren de cercanías para salir con destino a Alcobendas. El tren que se dirigía a Chamartín (línea C-1) estaba en la entrada de la estación en el momento del atentado.



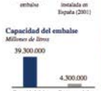
Fuente: Elaboración propia • Gráficos: Alberto Cairo • e-mail

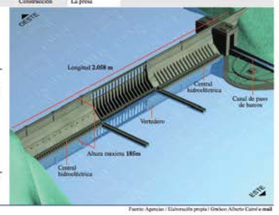
La presa de las Tres Gargantas

Portada | El río | Construcción | La presa

Potencia instalada
En MW

Capacidad del embalse
Millones de litros





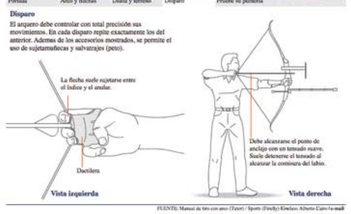
Fuentes: Agencias / Elaboración propia / Gráficos: Alberto Cairo • e-mail

Tiro con arco

Portada | Ahora y hechos | Diana y tamaño | Disparo | Prueba su puntería

Disparo

El arquero debe controlar con total precisión sus movimientos. En cada disparo repite exactamente los del anterior. Además de los accesorios mostrados, se permite el uso de sujetamuñecas y salvavigas (peto).



FUENTE: Manual de tiro con arco (Tizer) / Sports (Feedy) • Gráficos: Alberto Cairo • e-mail

Tiroteo en Ciudad Lineal

Portada | Los hechos

El tiroteo

El primer sicario se sitúa tras las víctimas y los dispara tres ráfagas con su Kalashnikov (la policía ha recogido más de 50 casquillos de bala). Uno de los hombres sobrevive a los primeros disparos, pero el asesino **lo remata en el suelo.** Según algunos testigos, una de las víctimas intentó repeler la agresión con una pistola, pero no pudo disparar.

Fuente: Elaboración propia • Gráficos: Alberto Cairo / Mariano Zafra • e-mail

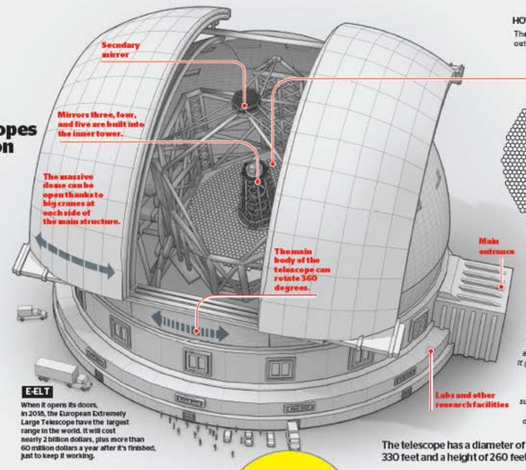
Diagram
NEWS IN PERSPECTIVE

400 years after Galileo, mega-telescopes rule space exploration

A new generation of observatories is under construction. Brazil needs to decide if it's going to be part of this new revolution in astronomy.

Peter Moon, Alberto Cairo, Gerson Mora

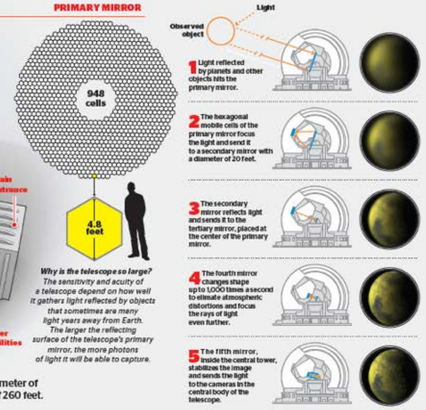
In 1609, Galileo Galilei perfected the telescope, created in 1608 by Hans Lippershey. Galileo's telescope had a lens of 6 inches. Today, the largest telescopes are in Hawaii and northern Chile. Equiped with mirrors 24 to 35 feet in diameter, they allow the observation of galaxies billions of light years away from us, but with little clarity. So a new generation of mega-telescopes is being built. The largest is the European Extremely Large Telescope (E-ELT), an initiative of the European Space Agency that is under construction in the Atacama Desert in Chile, and will open in 2018. The Ministry of Science and Technology of Brazil defends participation in the project, but the huge investment has unleashed concerns in other areas of the government. The total cost for Brazil would be $650 million over 20 years.



Sources: Southern European Observatory (ESO), TMT, Gemini, Soar

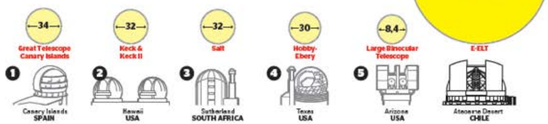
HOW THE E-ELT GATHERS HIGH-RESOLUTION IMAGES

The E-ELT will be the first telescope able to shoot pictures of planets outside the solar system, which will be useful for analyzing their atmospheres.



THE SUPER TELESCOPE RANKING

The E-ELT is a giant compared to the existing mega-telescopes. Its primary mirror is four times the size of the one in the largest telescope, in the Canary Islands, Spain.
Mirror diameter in feet



TELESCOPES WITH BRAZILIAN INVOLVEMENT

Brazil participates on jest two of the largest telescopes.

Gemini

Built in Cerro Pachón, Chile, and the Neaxe Kee volcano, Hawaii, these twin telescopes have mirrors with a diameter of 26.5 feet. Brazil participates by receiving 2.4% of the total cost in exchange for the right of using them for observations.

Soar

Built in Cerro Pachón, Chile, the Southern Astro Physical Research Telescope has a mirror with a diameter of 13.5 feet. The Brazilian Relocal Scientific Development Council covers a great portion of its costs.

OTHER LARGE TELESCOPES UNDER CONSTRUCTION

Besides the E-ELT, there are other projects in development.

Thirty Meters Telescope (TMT)

Opening: 2018
Cost: $1 billion
Mirror: 98 feet
Place: Hawaii
Built by: USA, Canada China, India

Telescópio Gigante Magalhães (GMT)

Opening: 2018
Cost: $900 million
Mirror: 80.4 feet
Place: Chilean Andes
Built by: USA, Australia South Korea

Atacama Large Milimeter Array (Alma)

Opening: 2012
Cost: $ 1.3 billion
Place: Atacama, Chile
Built by: European Unice USA, Canada, Japan Taiwan, Chile

Radio telescope 66 antennas

OTHER LARGE TELESCOPES UNDER CONSTRUCTION

Besides the E-ELT, there are other projects in development.

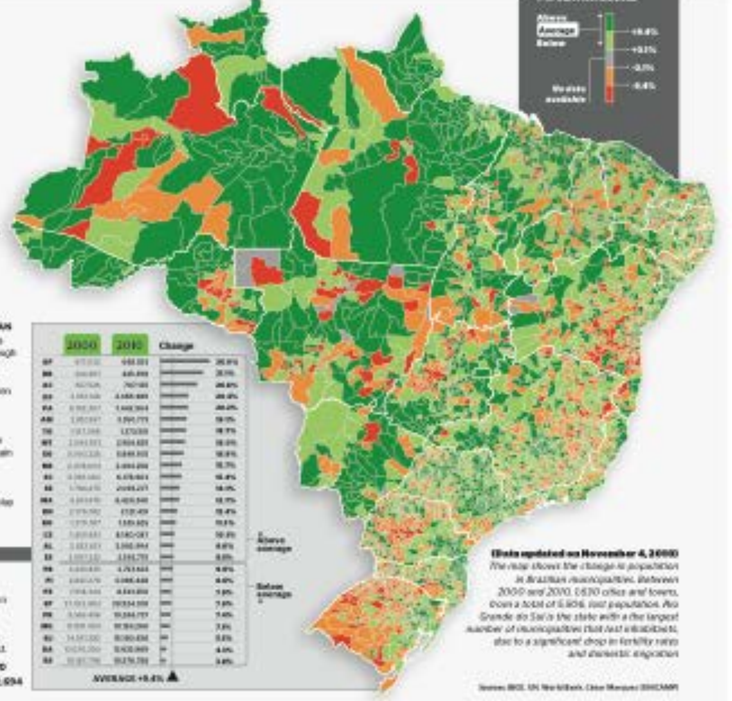
DIAGRAM
NEWS IN PERSPECTIVE

Brazil's Demographic Opportunity

How Brazil can take advantage of a future with fewer children per couple

Alberto Cairo, Francine Lima, Marco Vergotti

PRELIMINARY DATA FROM THE 2010 CENSUS create an interesting picture of the changes that the Brazilian population has gone through in the past ten years. Brazil's population grew, on average, 12% between 2000 and 2010, but the fertility rate is below 2.1 children per woman, the minimum to keep a population from shrinking. According to Cesar Marques, a demographer from the University of Campinas, the main challenge Brazil will face in the future is how to maintain a healthy social security system if the number of older and retired people will likely be much larger than it is today. Read on to learn about all the variables at play in this story.



	2000	2010	Change
RR	317,755	450,551	41.8%
AP	477,032	669,526	40.3%
AM	2,812,557	3,480,937	23.8%
RO	1,379,787	1,562,409	13.2%
AC	557,526	733,559	31.6%
PA	6,192,307	7,581,051	22.4%
TO	1,157,098	1,383,445	19.6%
MA	5,651,475	6,574,789	16.3%
PI	2,843,278	3,119,015	9.7%
CE	7,430,661	8,452,381	13.8%
RN	2,776,782	3,168,027	14.1%
PB	3,443,825	3,766,528	9.4%
PE	7,918,344	8,796,448	11.1%
AL	2,822,621	3,120,494	10.5%
SE	1,784,475	2,068,017	15.9%
BA	13,070,250	14,016,906	7.2%
MG	17,891,494	19,597,330	9.5%
ES	3,094,932	3,514,952	13.6%
RJ	14,391,282	15,989,929	11.1%
SP	37,032,403	41,262,199	11.4%
PR	9,563,458	10,439,601	9.2%
SC	5,356,360	6,248,436	16.7%
RS	10,187,798	10,693,929	5.0%
MS	2,078,001	2,449,024	17.9%
MT	2,504,353	3,035,122	21.2%
GO	5,003,228	6,003,788	20.0%
DF	2,051,146	2,570,160	25.3%

AVERAGE +9.4%

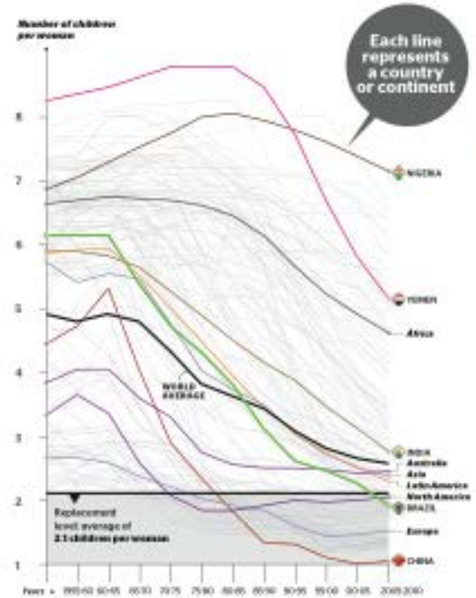
1 BRAZIL'S POPULATION IS BIGGER

The 2010 Census has revealed a 9.4% population increase between 2000 and 2010. The differences between states, as you can see on the chart on the right, are substantial. Most rich states, such as São Paulo and Rio, didn't grow as fast as the ones in the north east.

2000 169,799,170
2010 190,732,694

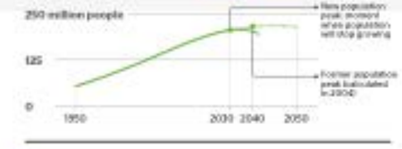
2 —BUT THE FERTILITY RATE IS MUCH LOWER THAN EXPECTED

A study in 2004 estimated that in 2010, the fertility rate would be 2.4 children per woman, on average. But new data collected by the IBGE prove that the fertility rate is already 1.9, below the threshold called "replacement rate". When the fertility rate drops below this number, the population of a country will eventually start to shrink and grow older.



3 —AS A CONSEQUENCE, POPULATION WILL STOP GROWING—

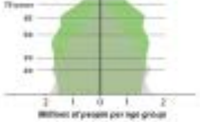
Forecasts made in 2004 anticipated that Brazil's population would stop growing in 2040. But the most recent data from the IBGE suggests that this could happen much earlier, in 2030.



4 —AND IT WILL BECOME OLDER

Comparing the current population pyramid with the one predicted for 2050

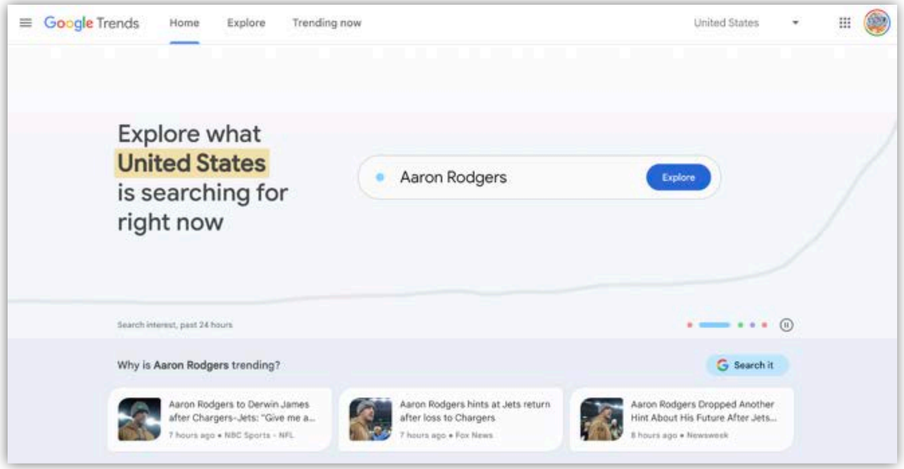
2005
Forecast for 2050

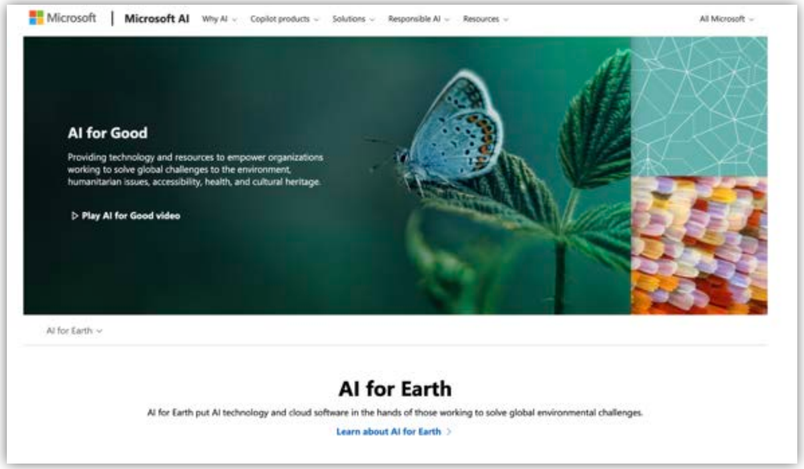


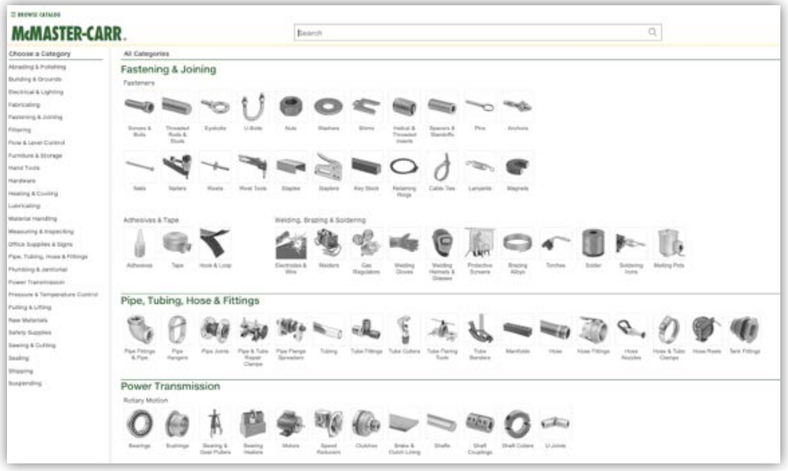
How Brazil can transform the population challenge into an opportunity

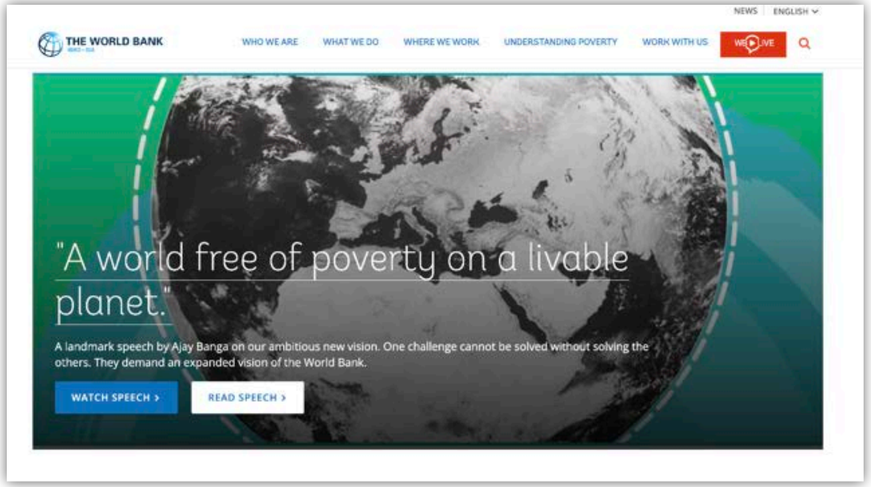
- As the population ages, the proportion of people of working age increases. The country will therefore have more people producing wealth (if the labor market can absorb them) and fewer children to consume investments. It is a window of opportunity, because in some cases the number of people of working age to fall back when older people are leaving the market.
- The population under 15 years of age is falling today. A smaller number of student in public schools will facilitate the quality of teaching, if the amount invested in education stays the same.
- Educational policy focused on low income youth favors the formation of more skilled workforce and greater social mobility.
- In the future, Brazil will reach the stage of Europe and Japan, which struggle to support their elders. This is why it's so important to prepare a more balanced retirement system, which will include retirement at a later age.

Consulting, freelancing, art direction









A core idea in my classes is that **anyone** can learn to design well

NAVIGATING INDONESIA'S EARTHQUAKES

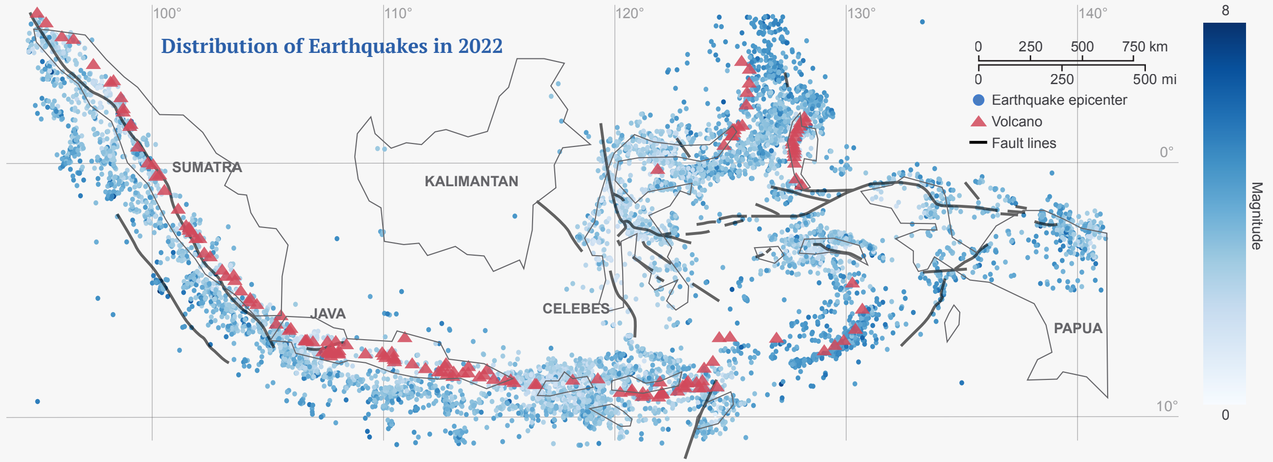
Indonesia is positioned on active fault lines within the Ring of Fire, a semi-circle of volcanoes and shifting plates along the Pacific Ocean's edge. There have been numerous earthquakes, volcanic activities, and tsunamis in the region due to ongoing geological pressures. In 2022, The Meteorology, Climatology, and Geophysics Agency (BMKG.go.id) recorded 10,792 earthquakes. The severity of these earthquakes varies, with the most intense occurring in 2004, reaching a magnitude of 9.2.

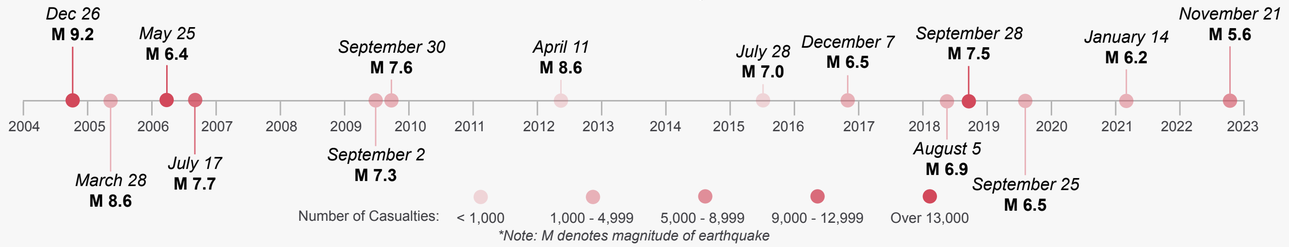
What impact do earthquakes have?

Before

After

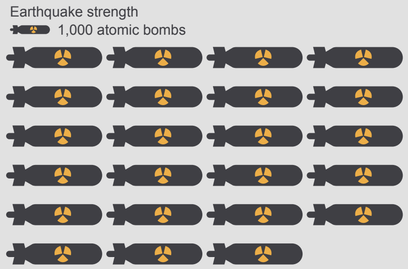
Bay Ismoyo/AFP/Getty Images — Saget, Mahyuddin/AFP/Getty Images

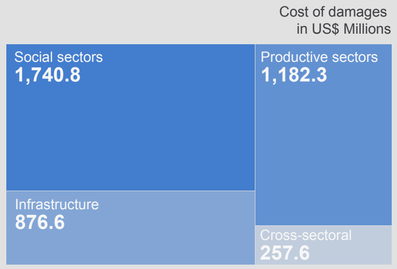




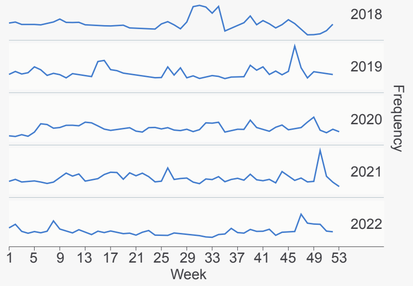
*Note: M denotes magnitude of earthquake

Most Devastating Earthquake in Indonesia: December 26, 2004

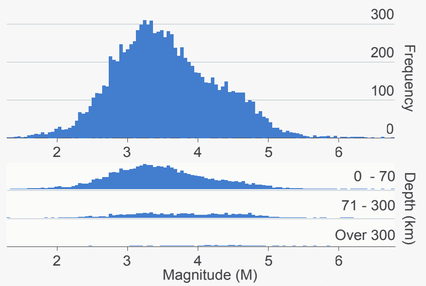




Are earthquakes seasonal?



How severe were earthquakes in 2022?



Sources: bmkg.go.id, worlddata.info, data.humdata.org

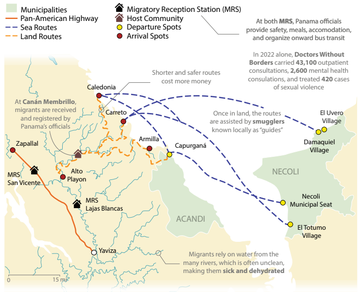
Poster by Michela Effendi

Defying death

This year, over 400,000 migrants and asylum seekers have traversed the challenging expanse of the Central American jungle known as the Darién Gap, as reported by the government of Panama. Despite the formidable dangers and obstacles within the jungle, it stands as the sole terrestrial route linking South America to Central America. Those undertaking this journey face numerous human rights violations, including sexual violence, homicides, disappearances, trafficking, robbery, and intimidation perpetrated by organized criminal groups.

Major routes taken to cross the Darién Gap

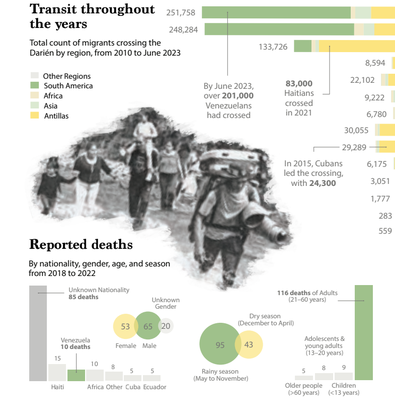
A detailed map of the most frequented routes in 2023. Each route varies in difficulty, dangers, and costs. Depending on weather conditions, the journey to reach an MRS can take several days to weeks



Sources: GIFMM/R4V; IOM UN Migration; Médecins Sans Frontières

Transit throughout the years

Total count of migrants crossing the Darién by region, from 2010 to June 2023



Reported deaths

By nationality, gender, age, and season from 2018 to 2022

Venezuela's migration rates lead the Darién

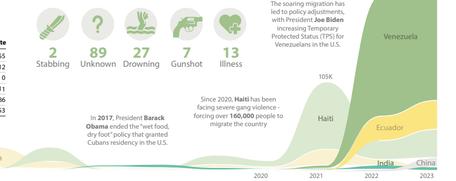
Total count of people migrating through the Darién Gap from 2010 to June 2023. The top five nationalities that cross the Darién Gap over the years have been selected to highlight Venezuela's migration boom

Migration rates
Migrant(s) per 1,000 people as of October 2023

Country	Migration Rate
Venezuela	13.55
India	0.12
Ecuador	0
China	-0.11
Haiti	-1.86
Cuba	-2.53

Main death causes

Official count from 2018 to 2022. These numbers represent only a fraction of the real casualties, as deaths are not officially reported to the authorities



Sources: National Migration Service of Panama
Graphics by: Daniela A. González

Poster by Daniela González

A puzzling question;

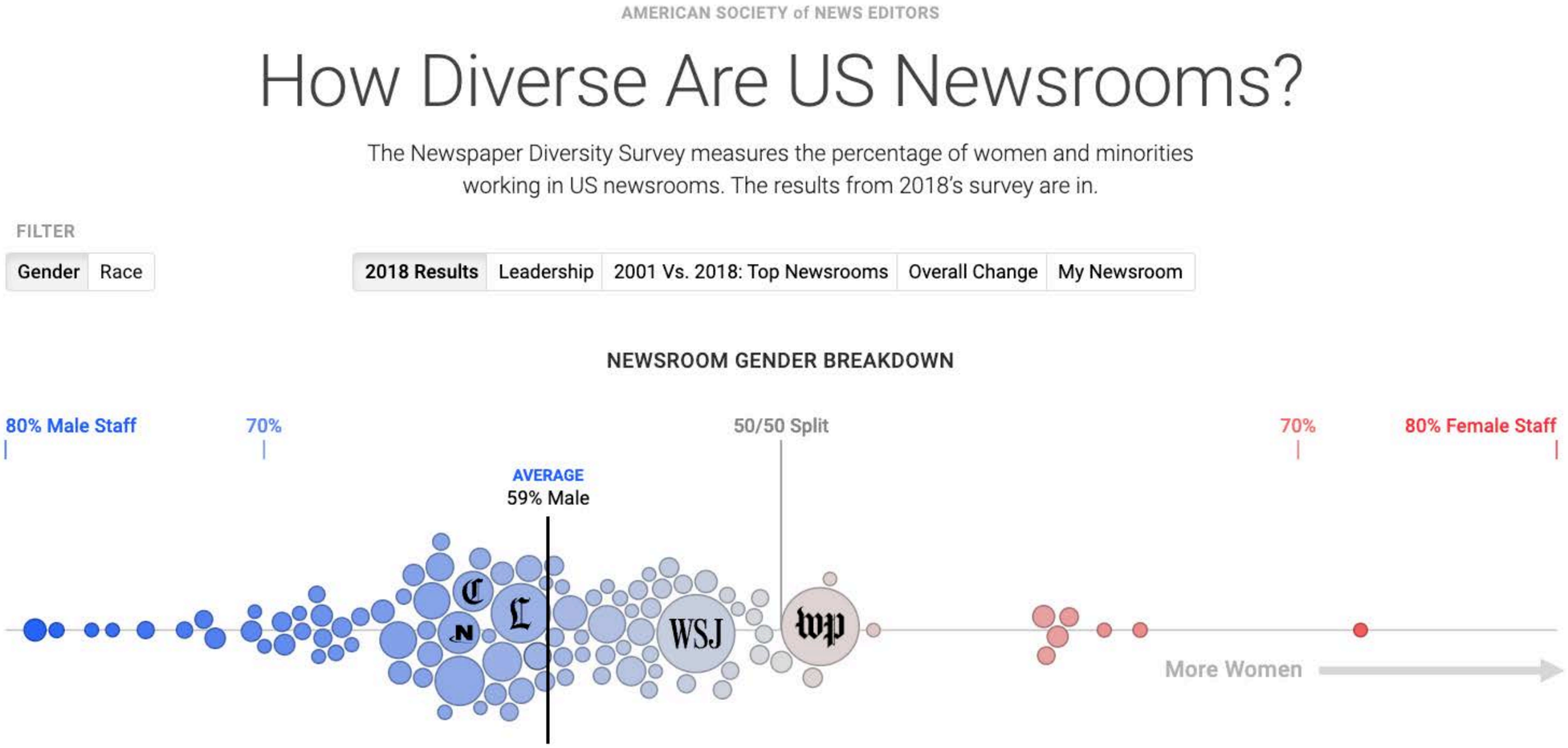
“What are the **rules** of data visualization design”?

Like **writing**, visualization design is **more a craft than a science.**

(Although some guidance and heuristics can be derived from scientific research on different areas, such as human-computing interaction, visualization, accessibility, perception, or cognitive science).

A good exercise: To reverse-engineer existing visualizations

"If I were the designer who created this, what choices would lead me to this solution?"



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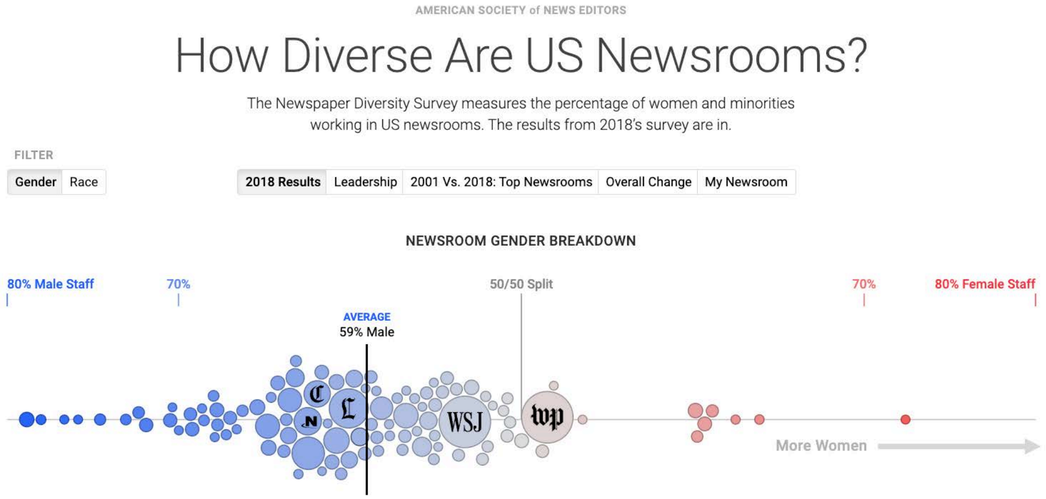

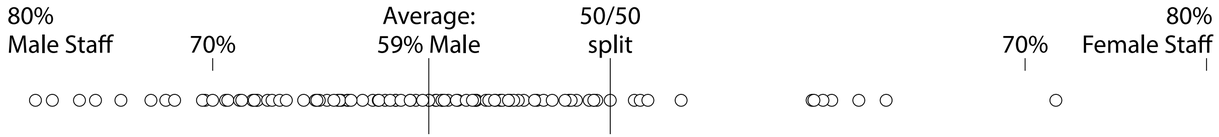

Designing information graphics and data visualizations doesn't consist of applying **rules**, but of **reasoning** about choices, and **justifying** them.

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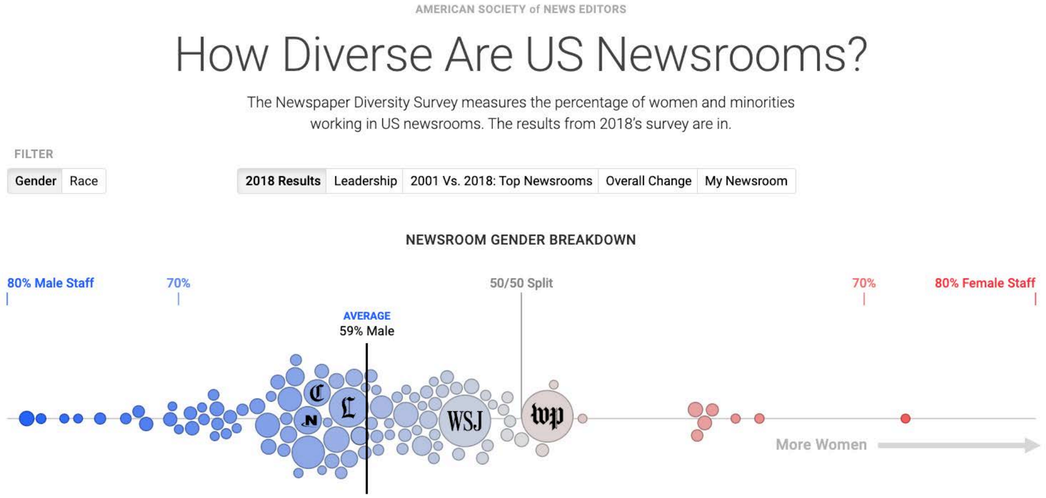
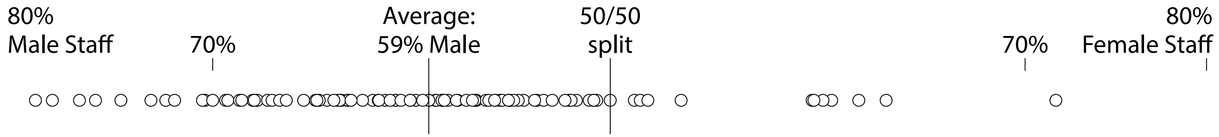
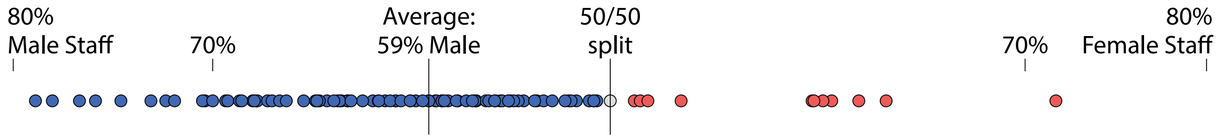
but it should never be **arbitrary**.







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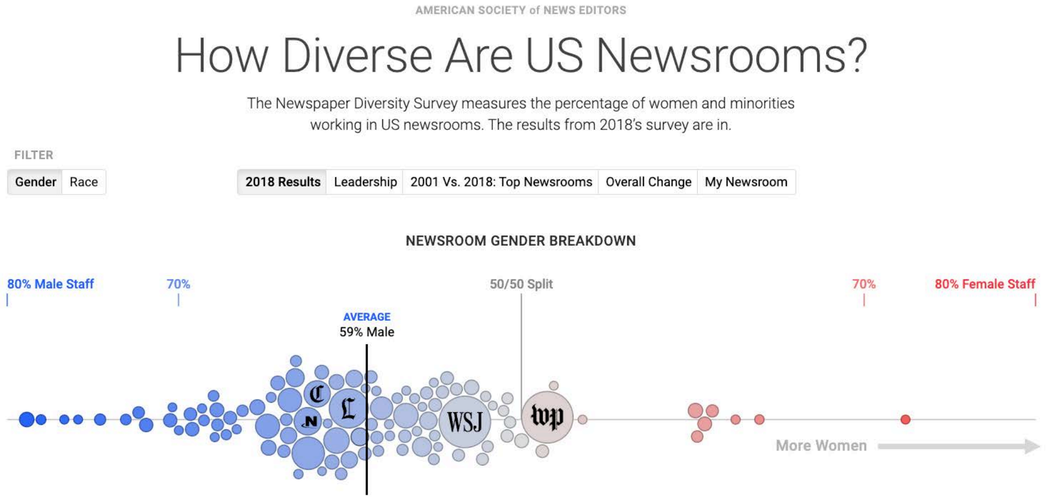

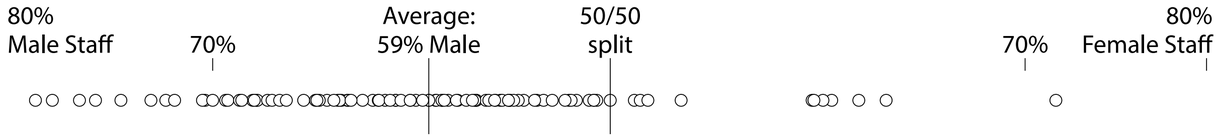

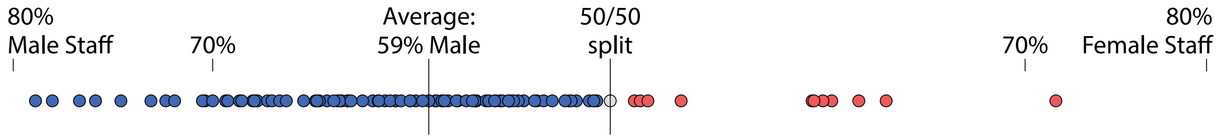

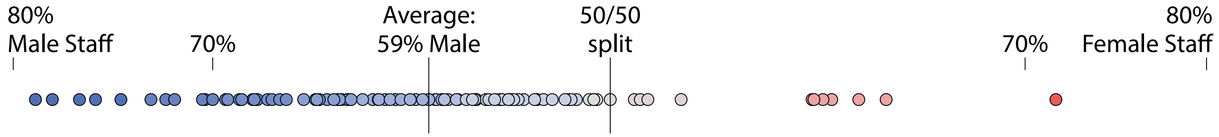

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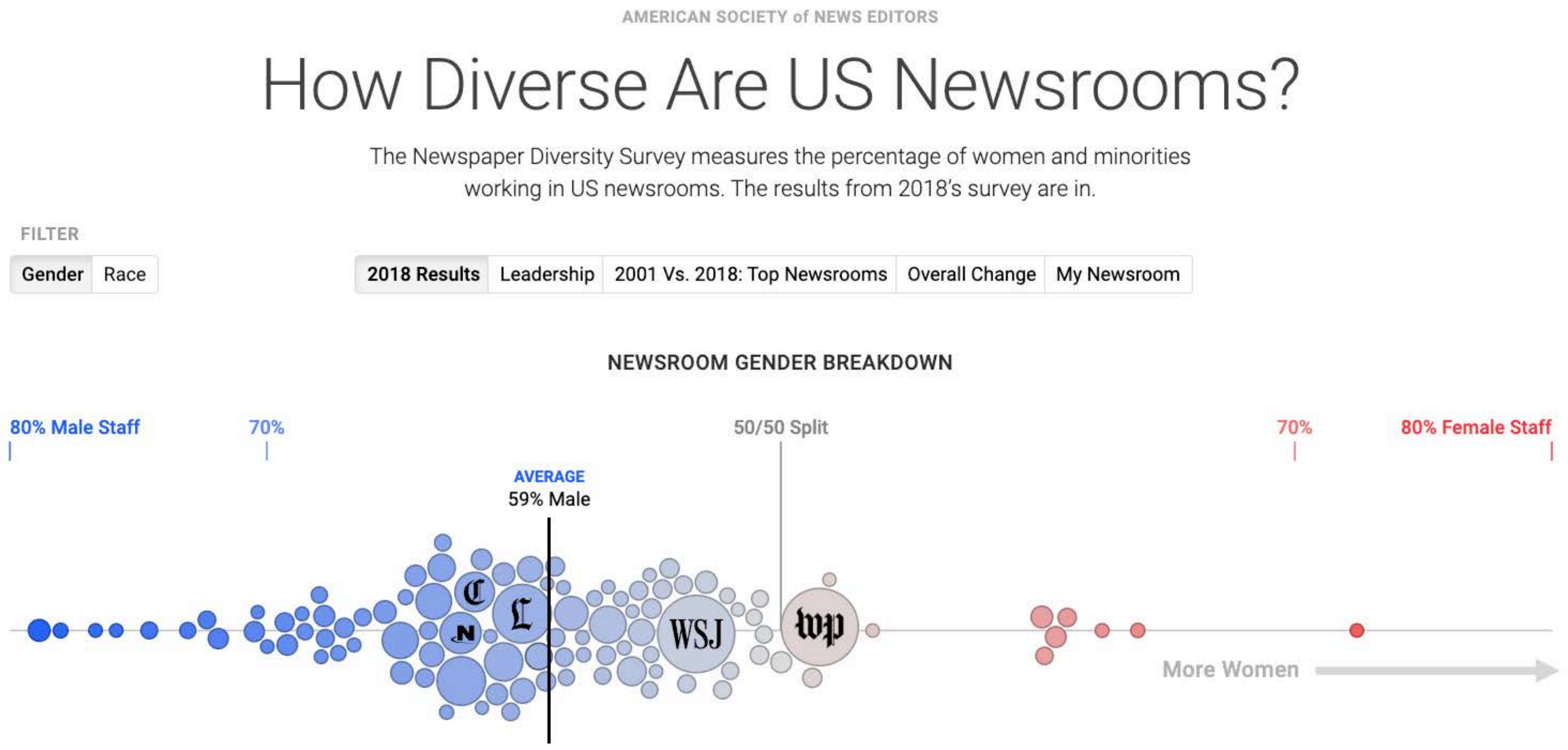

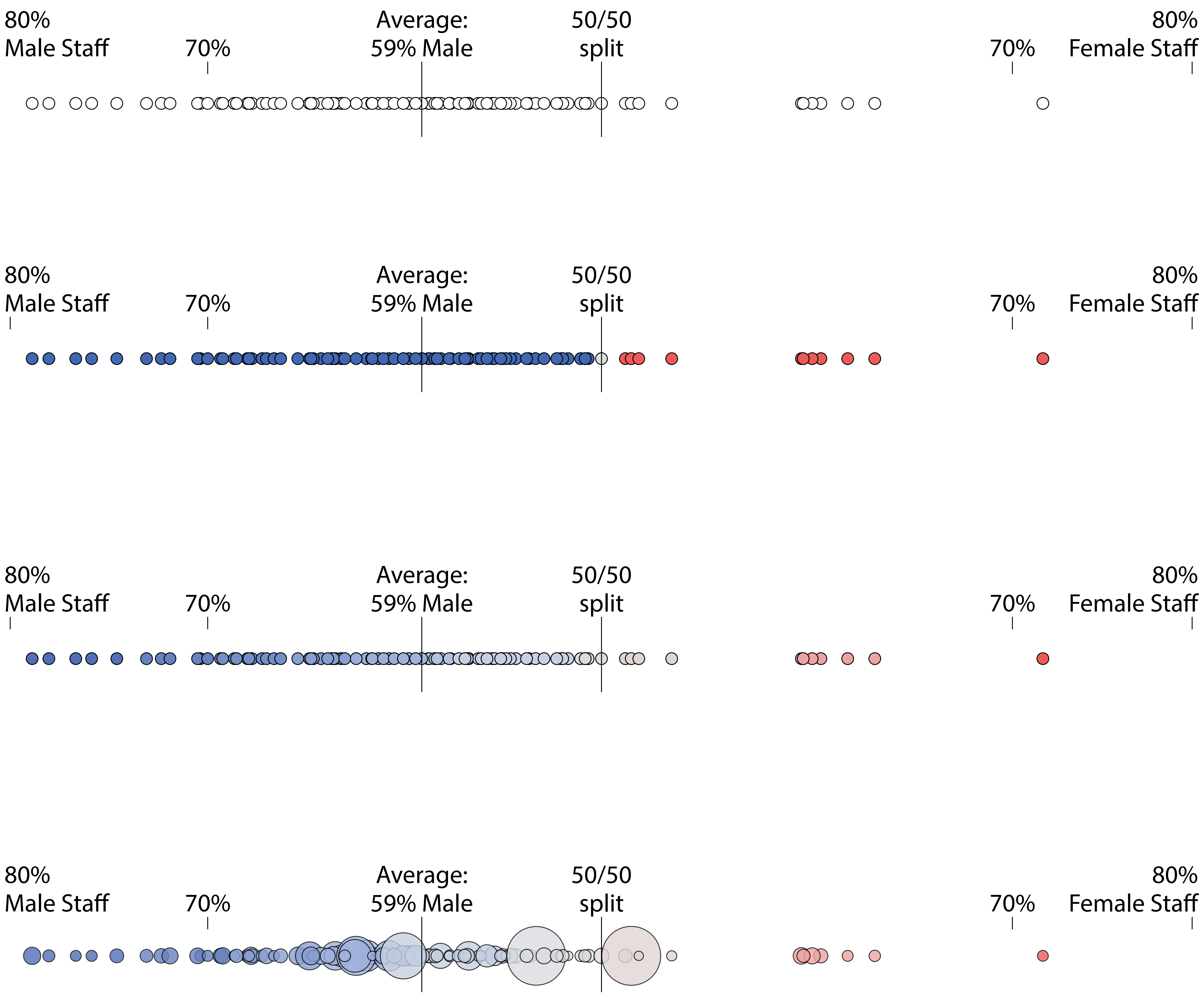

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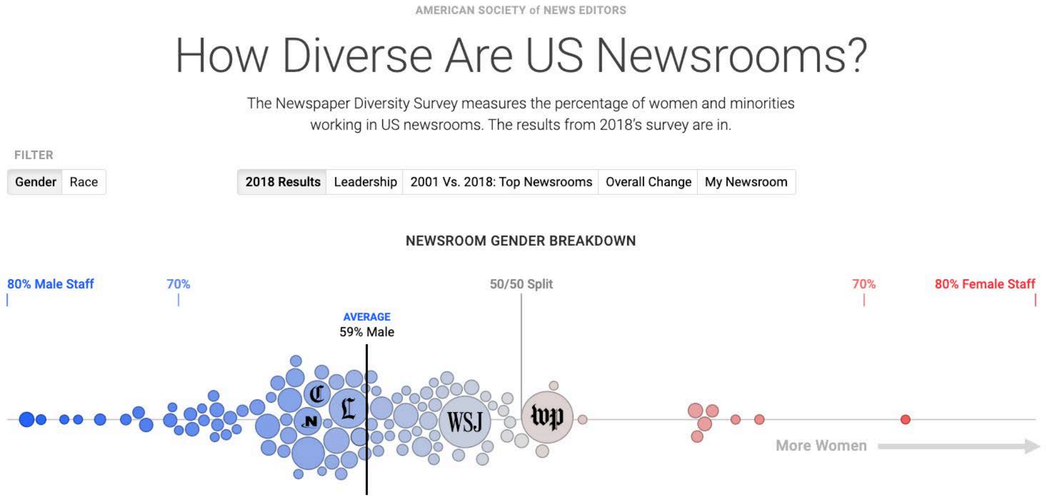

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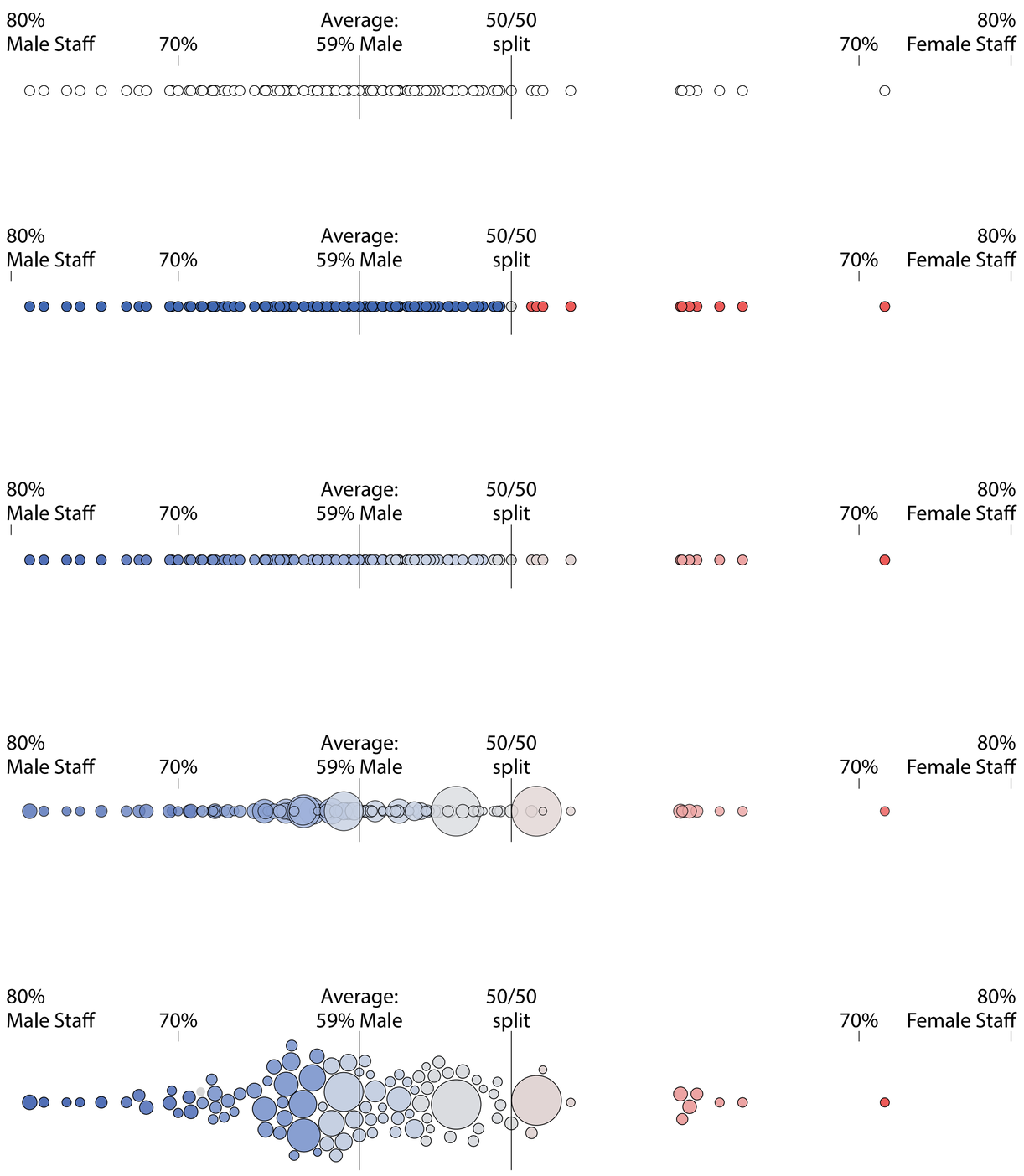

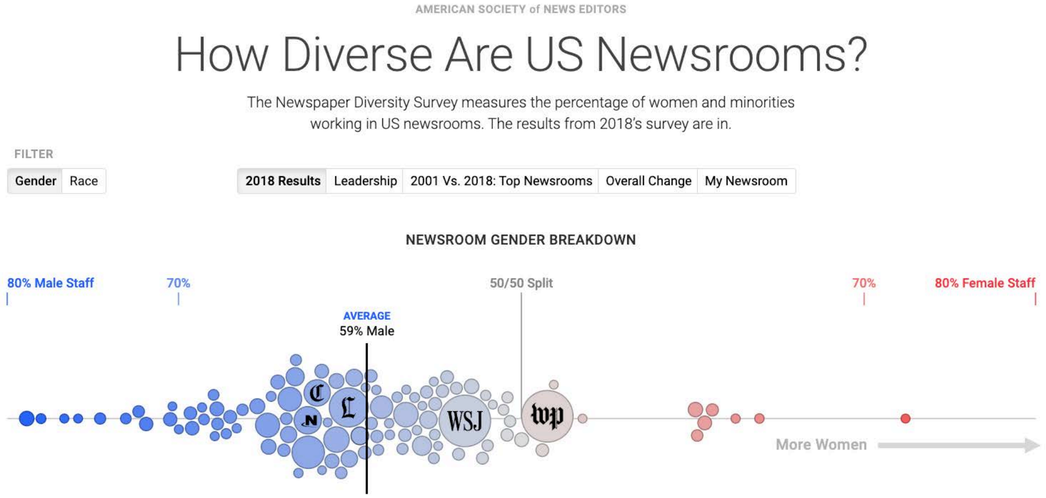

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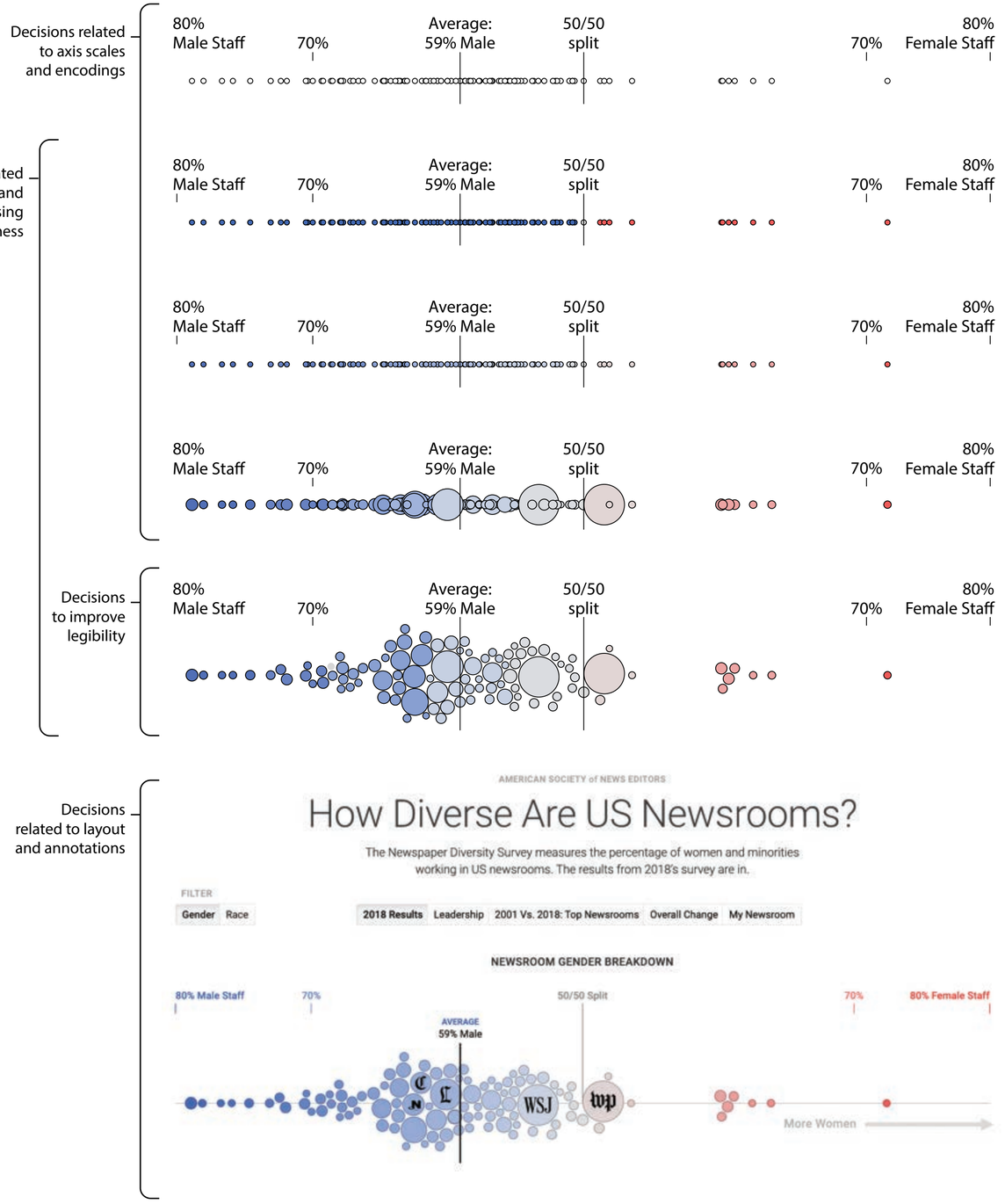
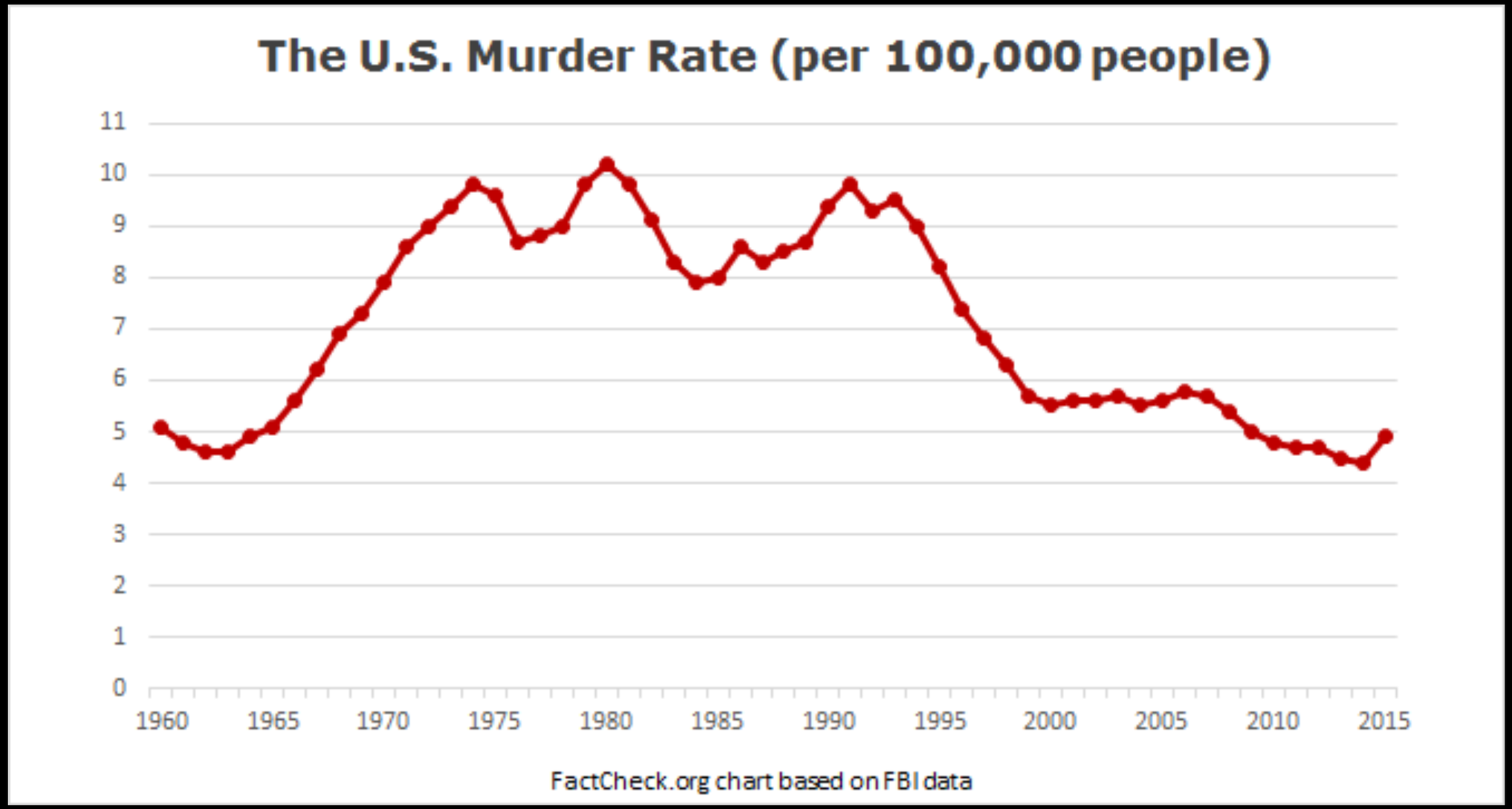
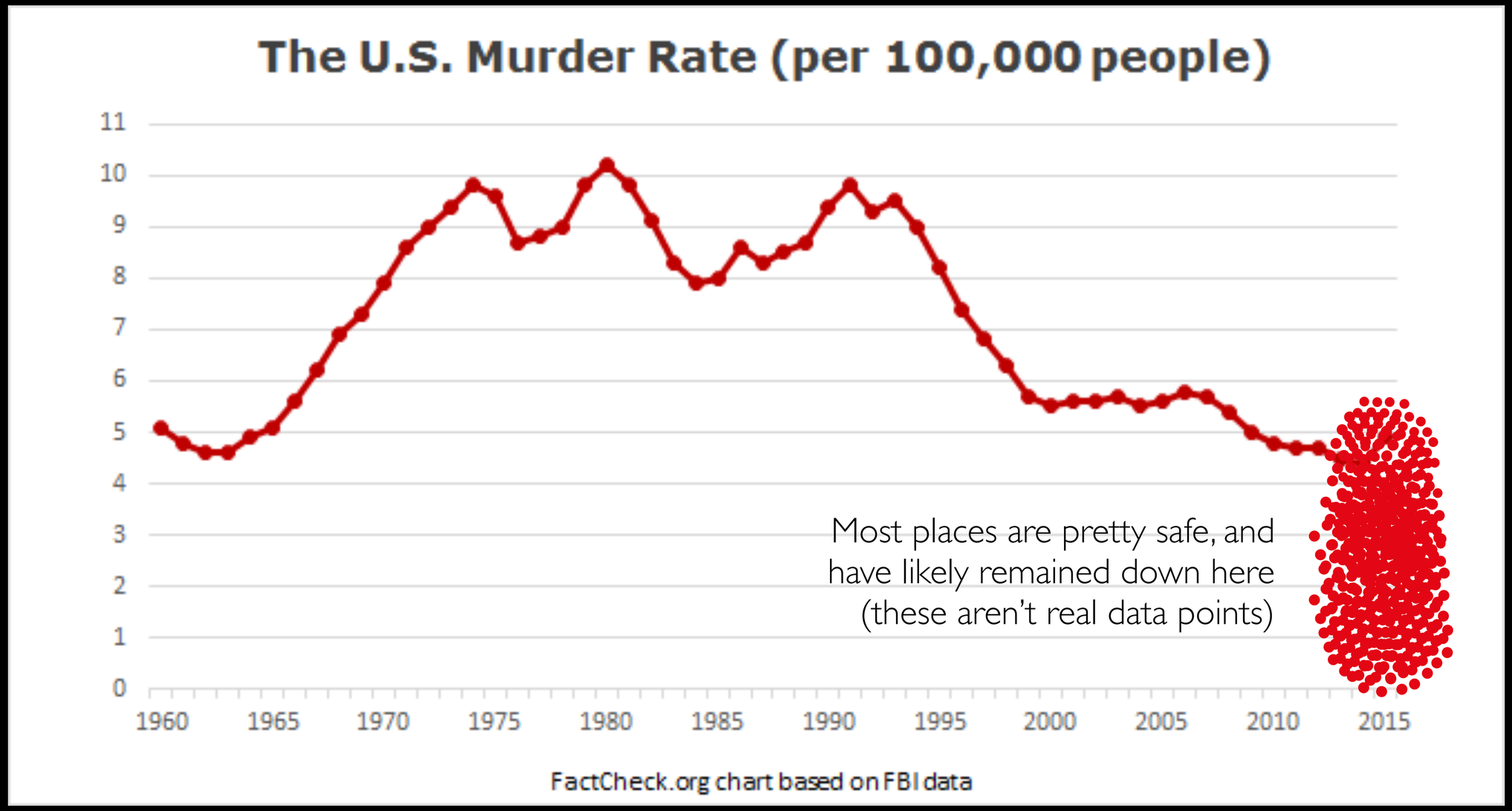


What to show and how much to show?


The U.S. Murder Rate (per 100,000 people)
11
10
9
8
7
6
5
4
3
2
1
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
FactCheck.org chart based on FBI data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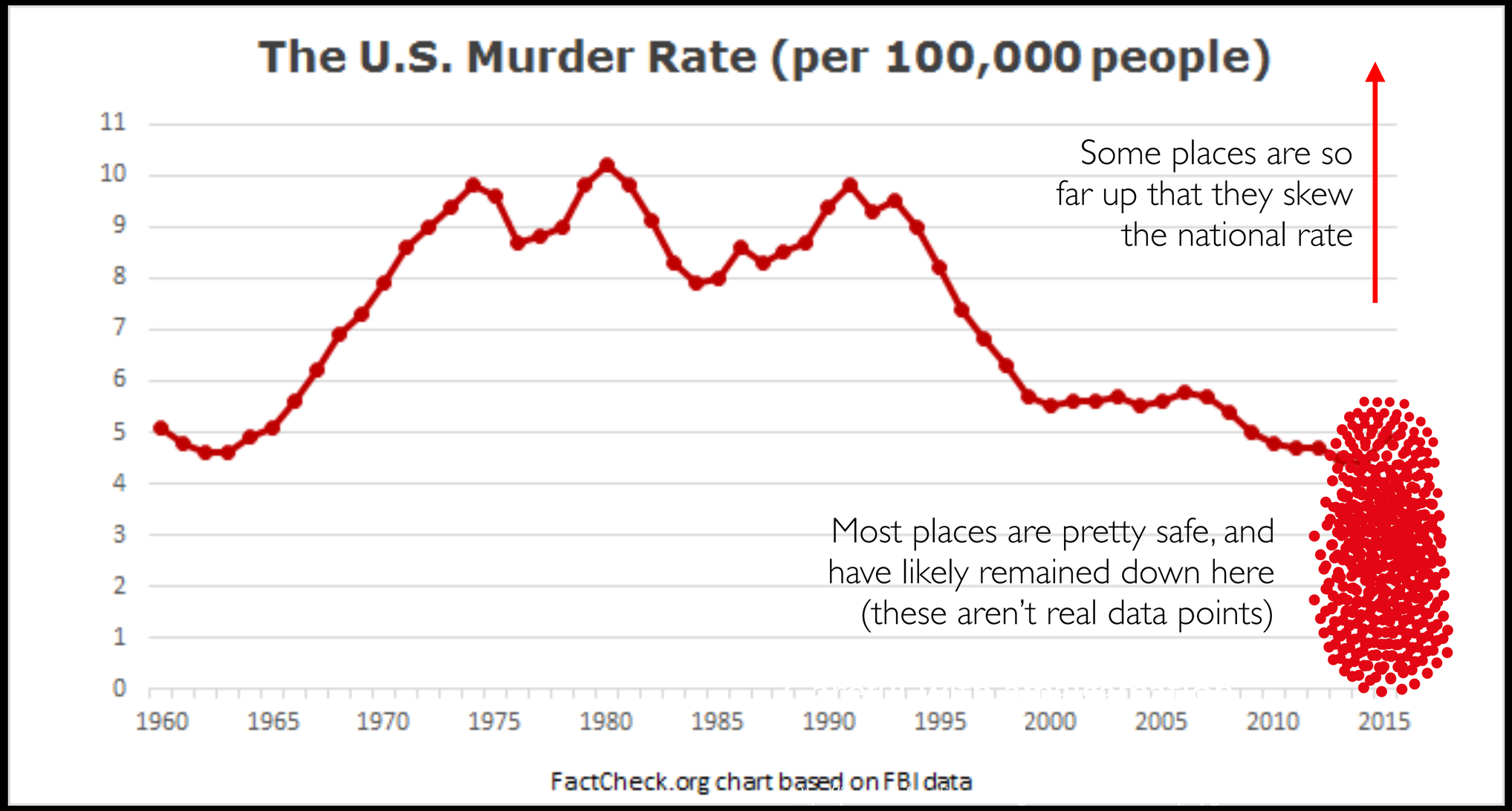
Most places are pretty safe, and
have likely remained down here
(these aren't real data points)
FactCheck.org chart based on FBI data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1965
1970
1975
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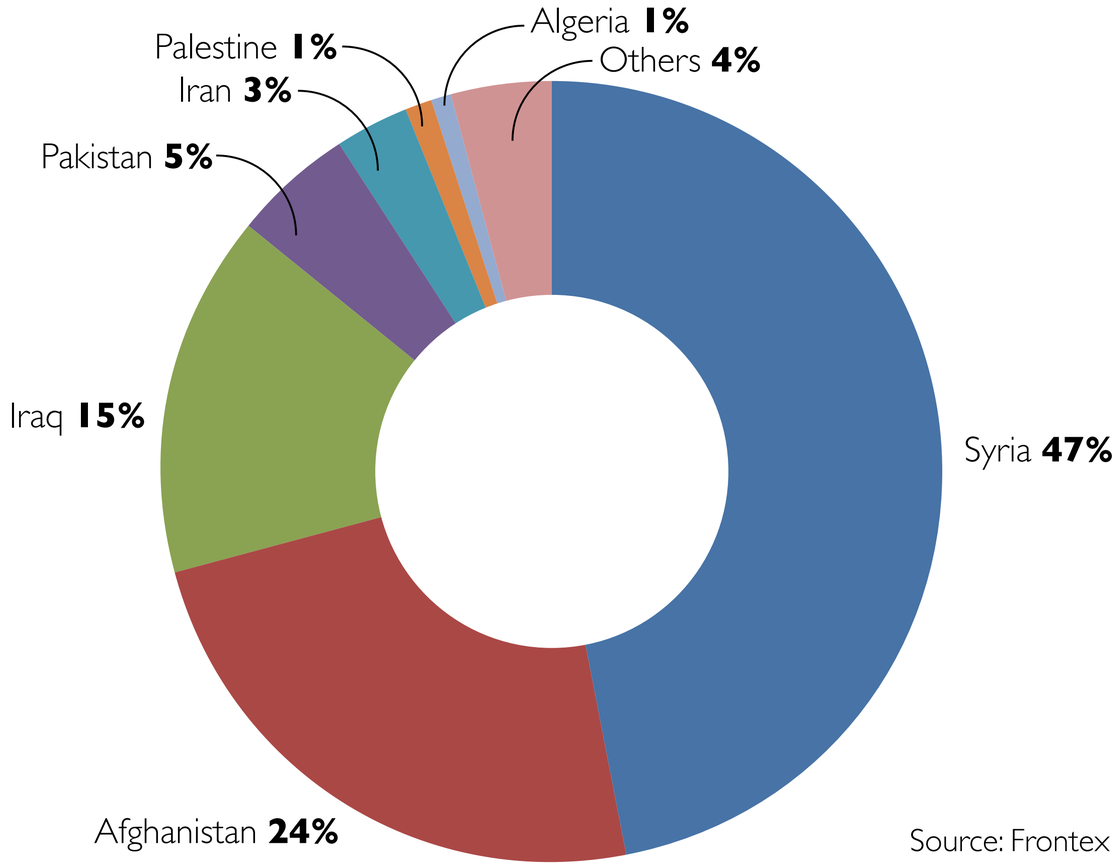
2005
2010
2015
Some places are so far up that they skew the national rate
Most places are pretty safe, and have likely remained down here (these aren't real data points)
FactCheck.org chart based on FBI data

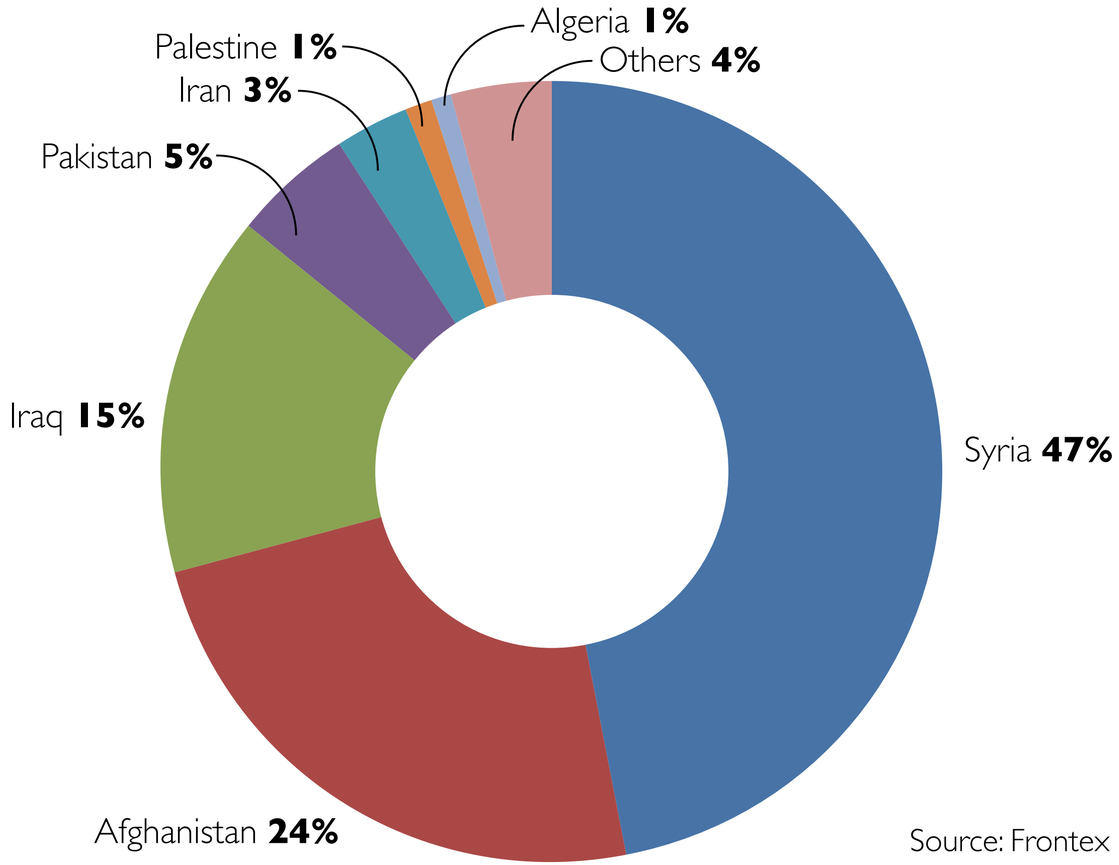
How to show it?

GREECE - Main nationalities of arriving migrants in 2016



Source: Frontex

GREECE - Main nationalities of arriving migrants in 2016



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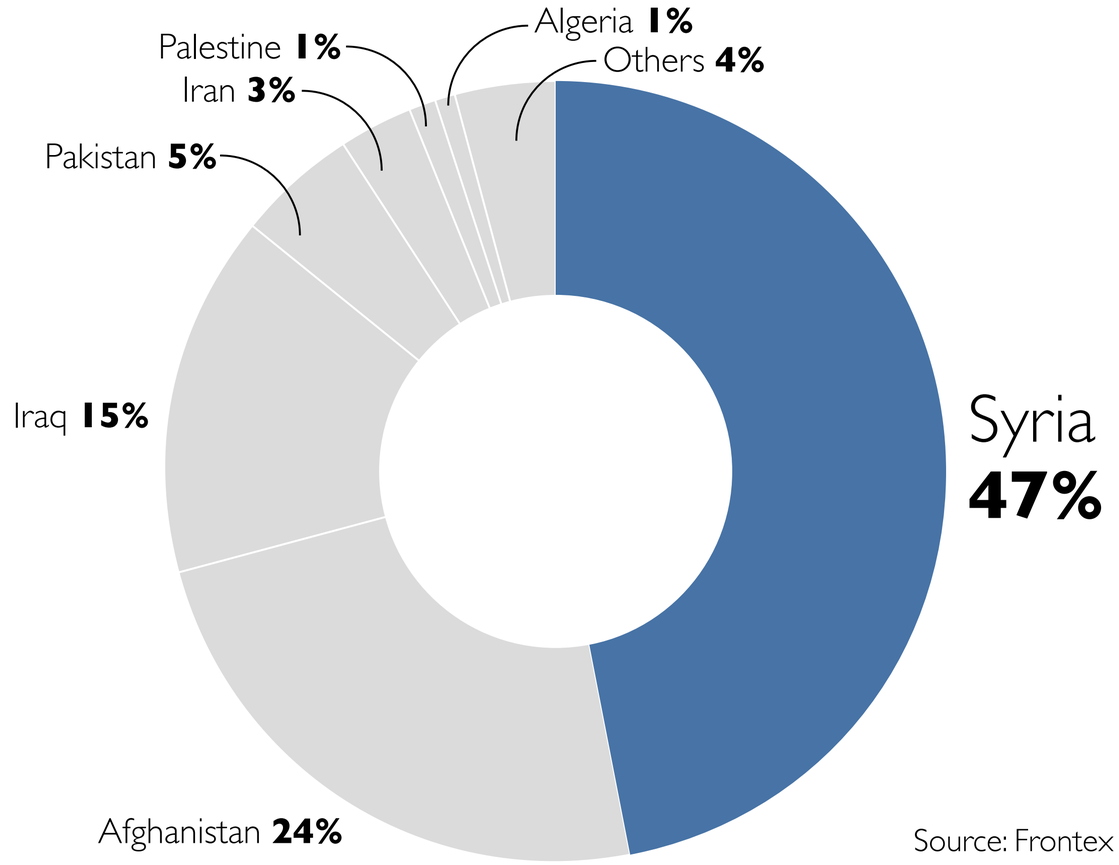

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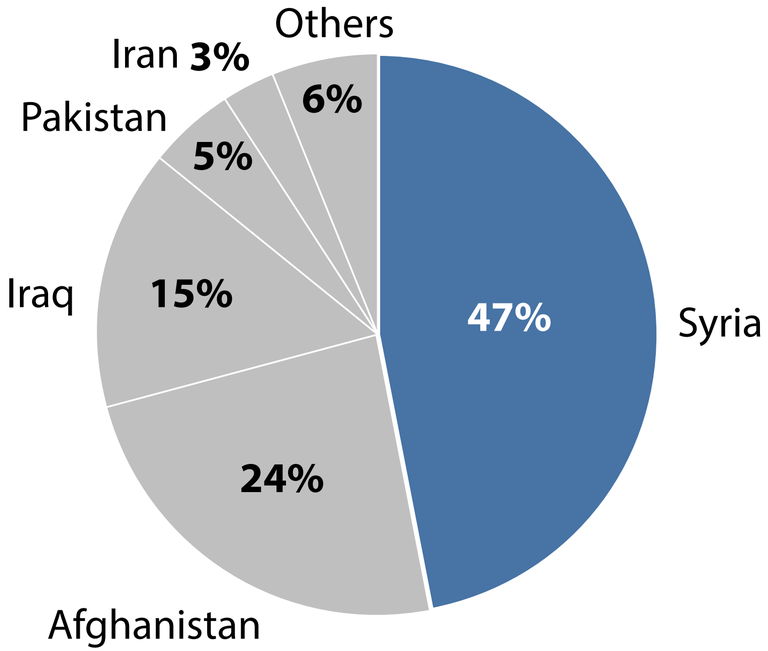
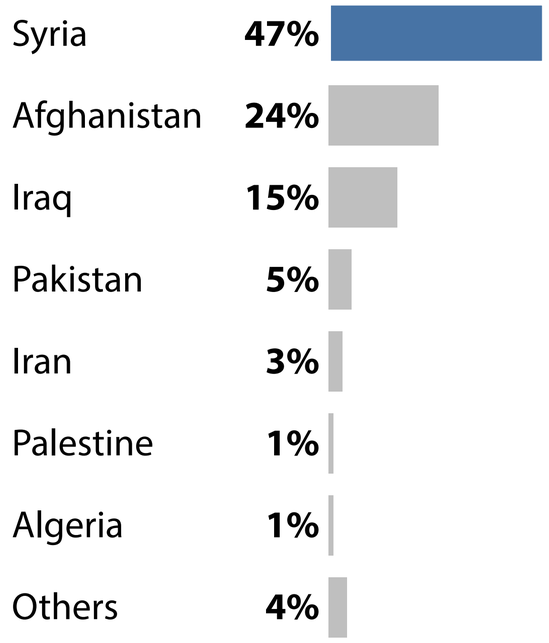
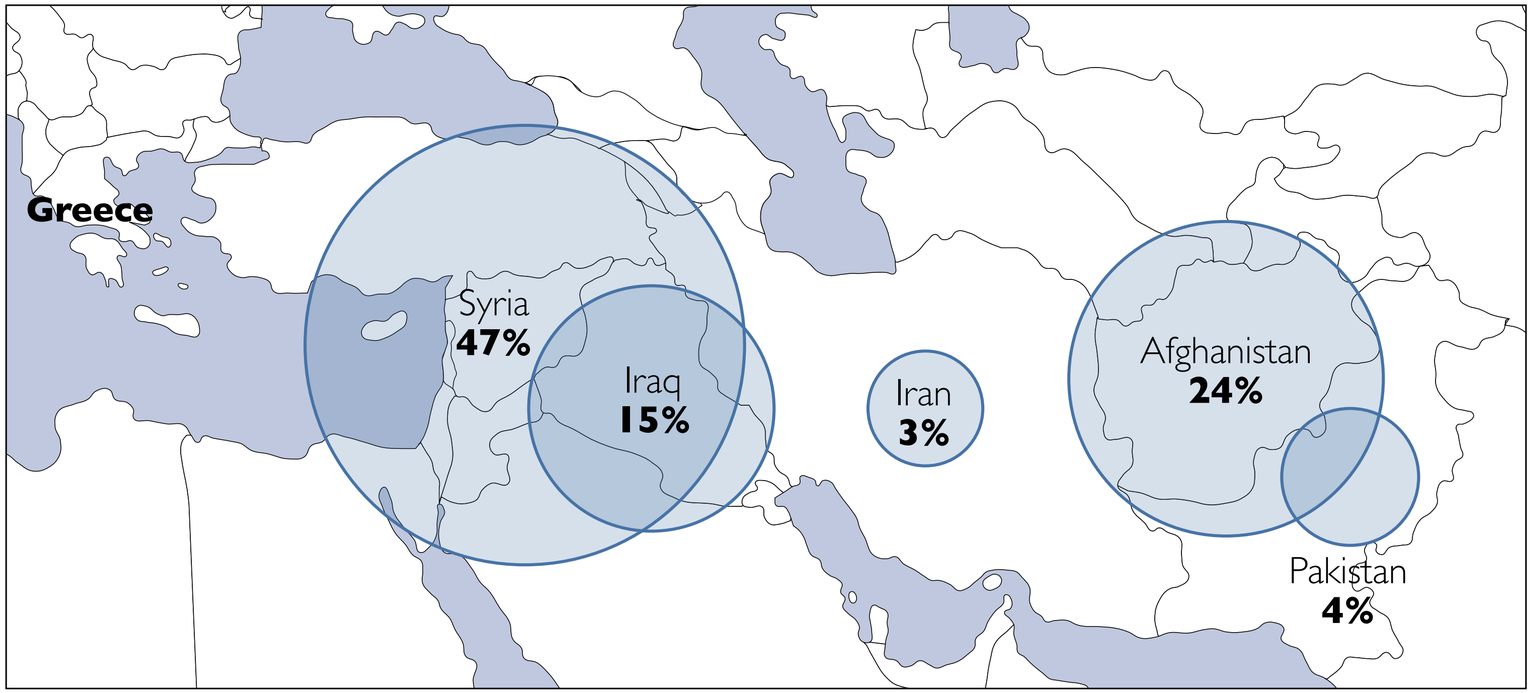

Others
Iran 3%
Pakistan
5%
Iraq
15%
47%
Syria
24%
Afghanistan
6%

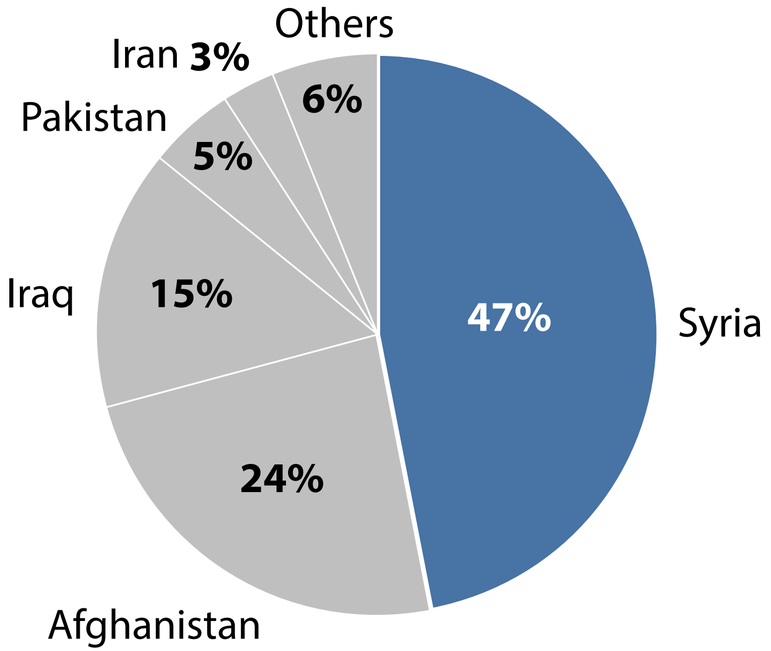

Syria 47%
Afghanistan 24%
Iraq 15%
Pakistan 5%
Iran 3%
Palestine 1%
Algeria 1%
Others 4%

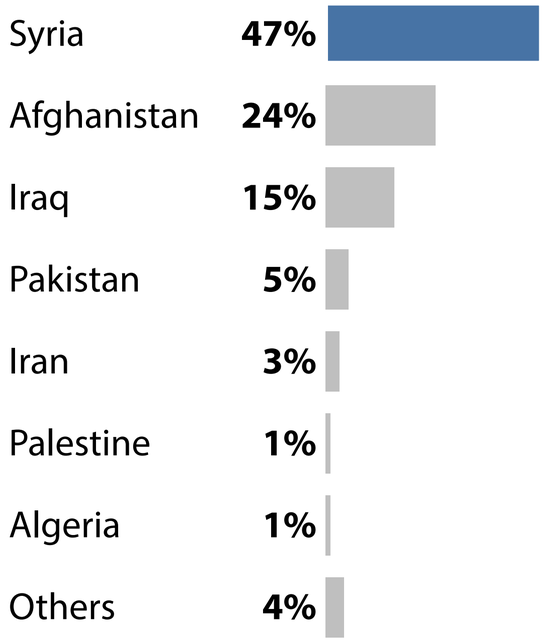
None of these charts is *right* or *wrong*, *good* or *bad* per se.

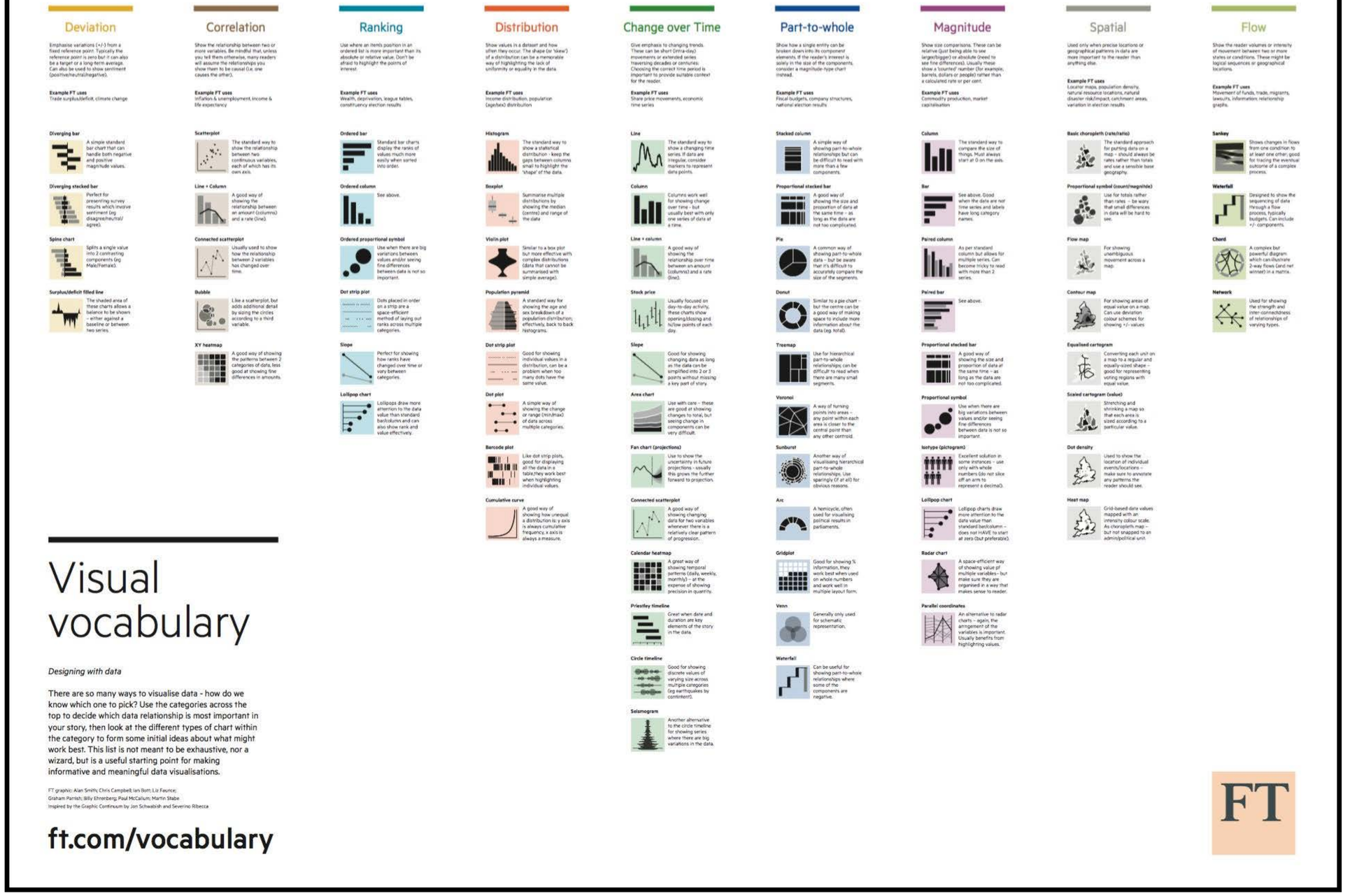
They are just ***better*** or ***worse*** depending on our **intent**:

What it is that we want to communicate, what we want our reader to **be able to see in the data.**









https://github.com/ft-interactive/chart-doctor/blob/master/visual-vocabulary/Visual-vocabulary.pdf

http://www.datavizcatalogue.com/

Who is the audience?


RALEIGH
ATLANTA
WPTV FIRST ALERT WEATHER
11:00 PM
Hurricane Lee
15.4°N , 47.7°W
Max Winds: 80 mph
Moving: WNW at 14 mph
Pressure: 989 mb
WEST PALM BEACH
CUBA
DOMINICAN REPUBLIC
GUADELOUPE
Mon 8:00 PM
145 mph
Sun 8:00 PM
150 mph
Sat 8:00 PM
Sat 8:00 AM
150 mph
Fri 8:00 AM
120 mph
Thu 8:00 PM
100 mph
Thu 8:00 AM
85 mph
4
4
4
4
4
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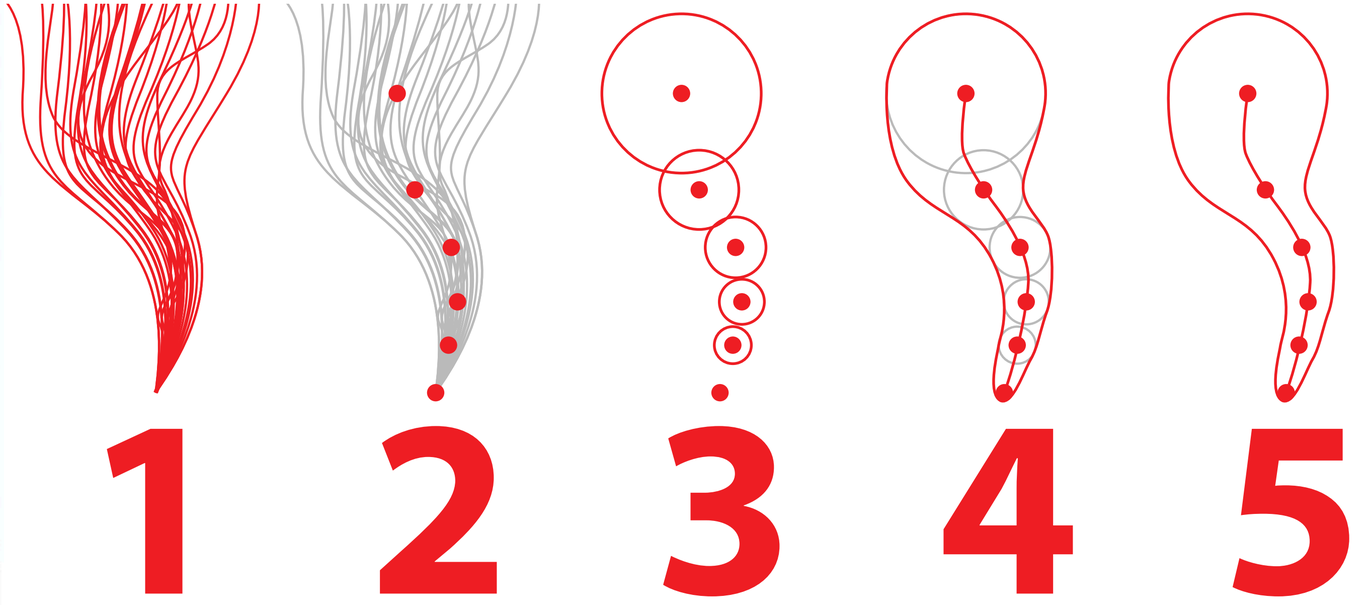
2
1
1

What we design…

What we design…

…is not what people see

How to read the NHC cone of uncertainty



Opinion

Those Hurricane Maps Don't Mean What You Think They Mean

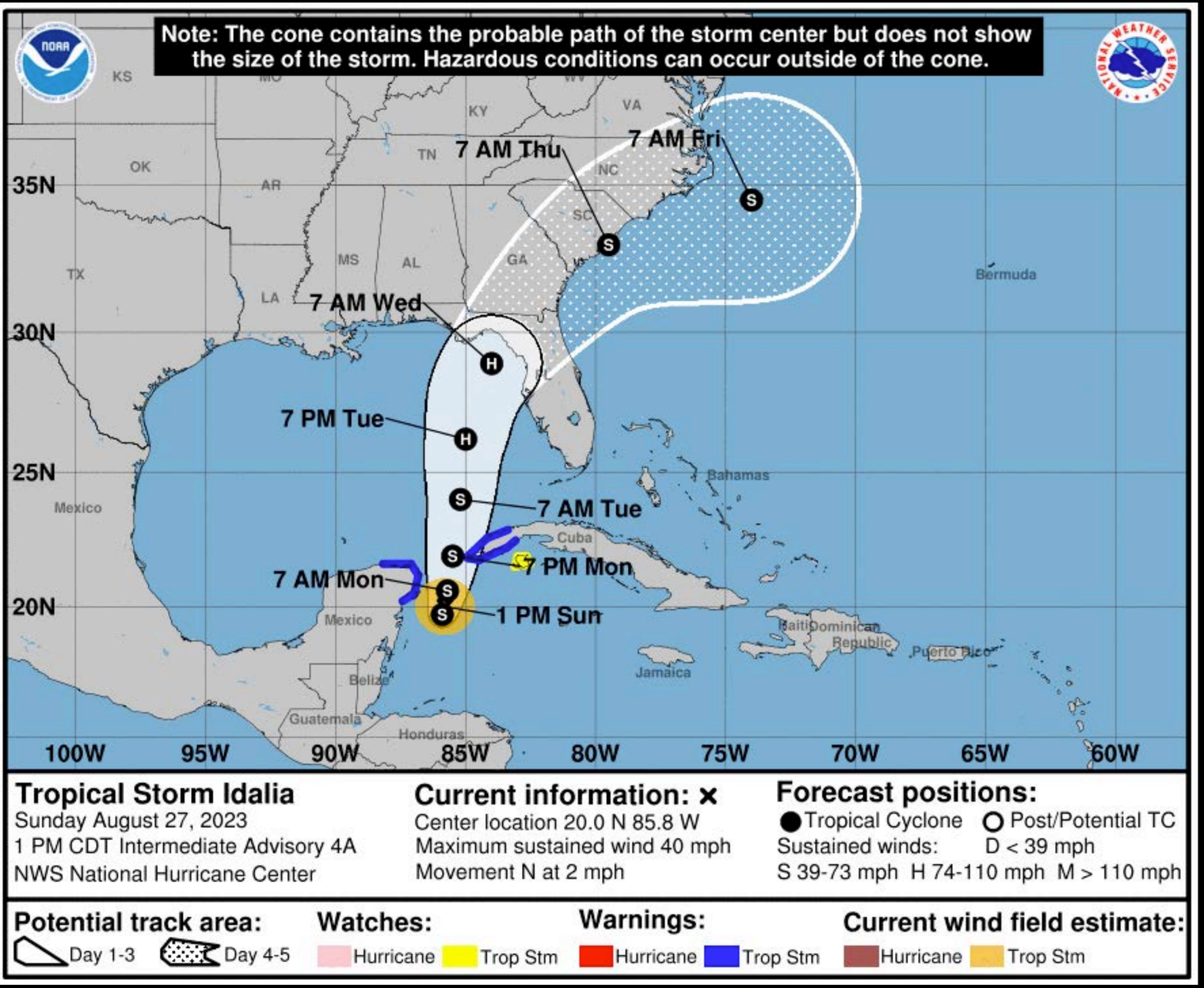
We use hurricane forecasts to warn people. Why do we misinterpret them so often?

By Alberto Cairo
With Tala Schlossberg

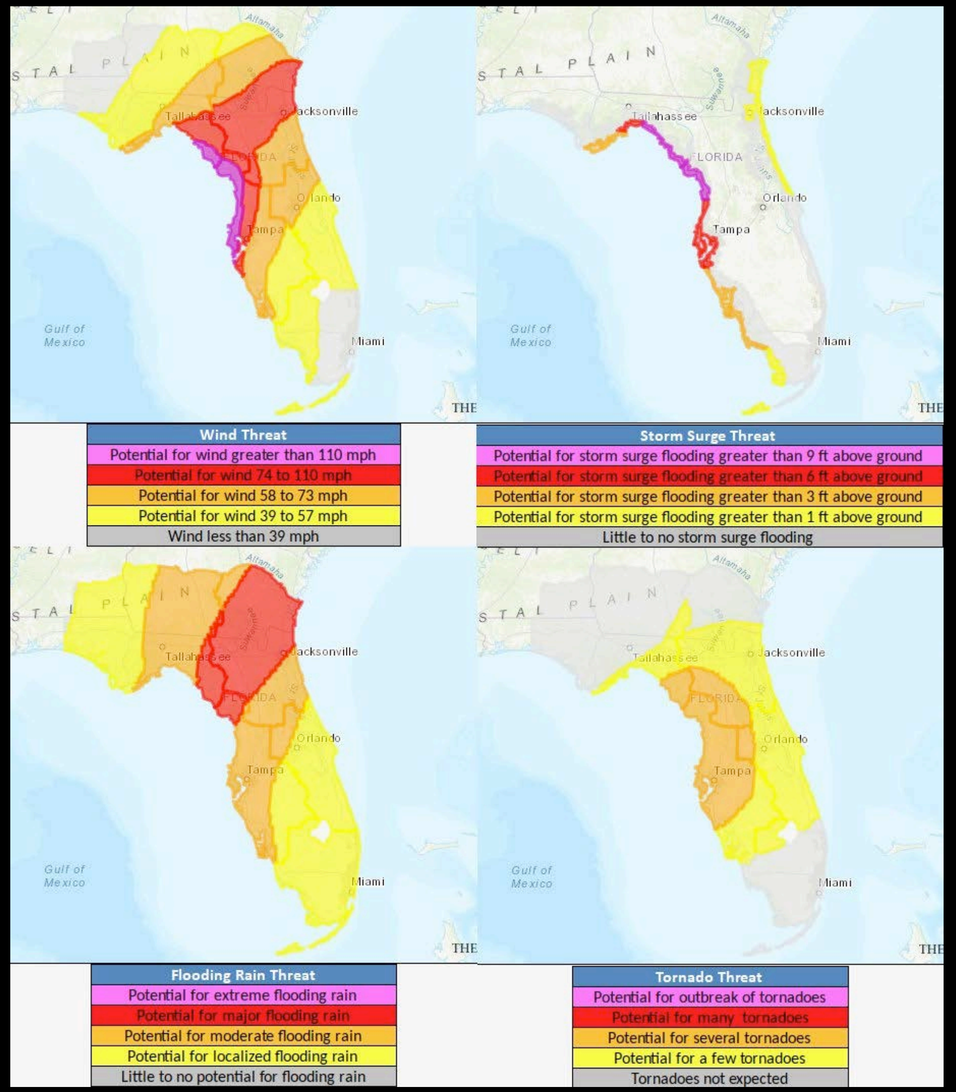
https://www.nytimes.com/interactive/2019/08/29/opinion/hurricane-dorian-forecast-map.html

What do readers *really* need to know?

The possible path?



Or a hurricane's threats and impacts (HTI)?



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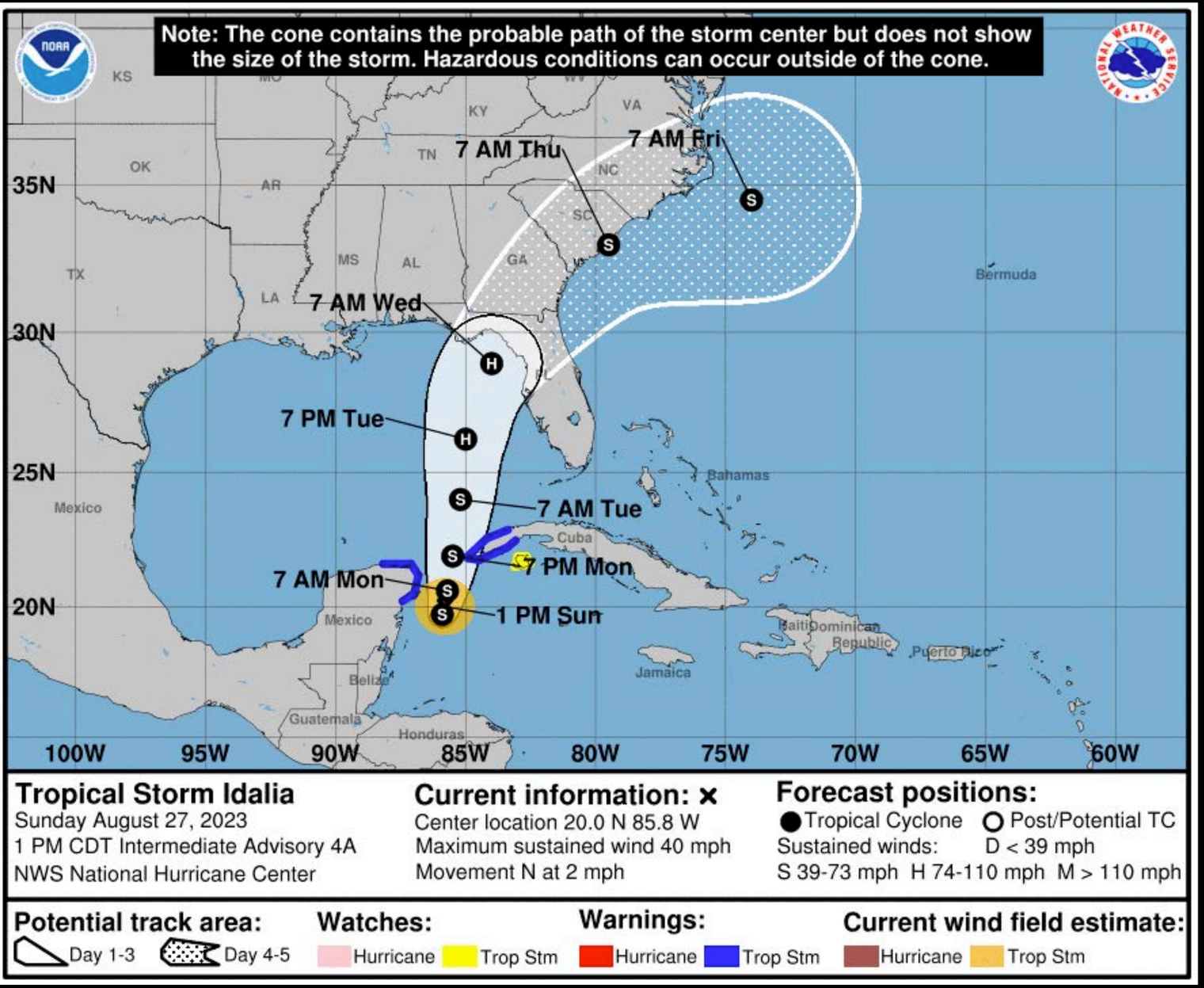

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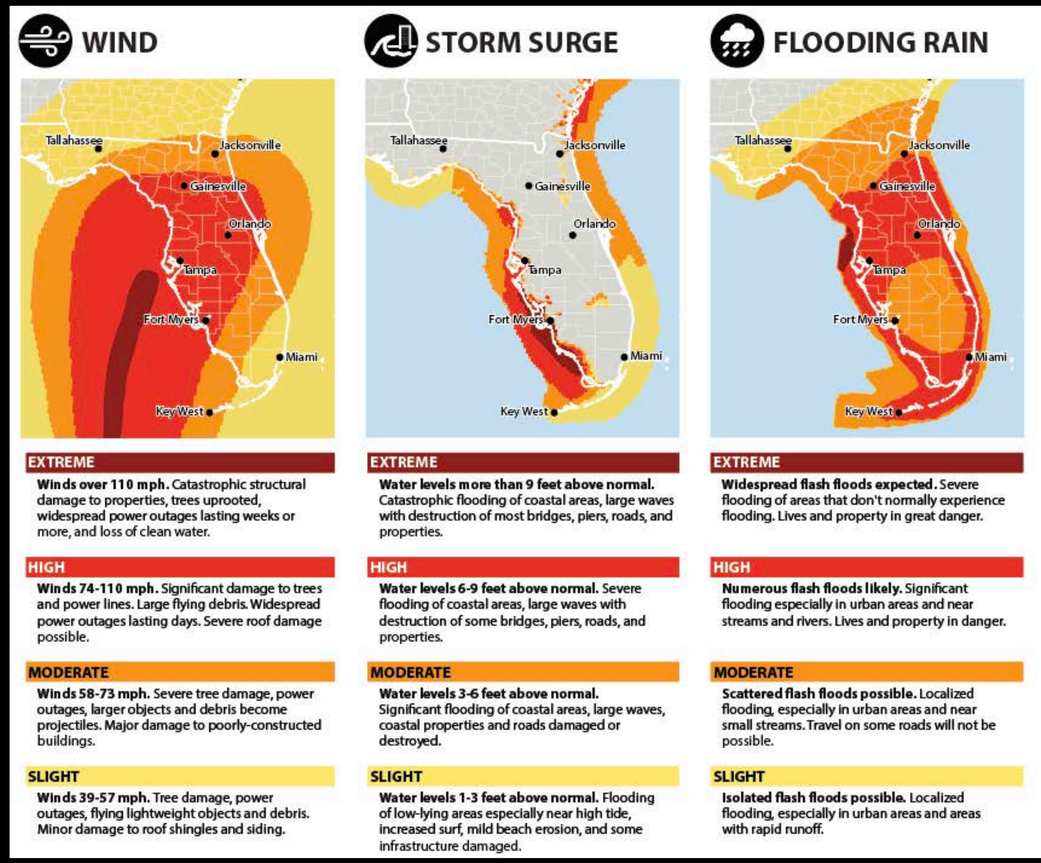

Designs by the University of Miami's 'Hurakan' research group

How to make it look good?

Multi-scale Modeling and Assessment of Malaria Risk in Northern South America

Alimi, T. O.[1]; Fuller, D. O.[1,2] and Beier, J.C.[1,3]

[1] Abess Center for Ecosystem Science and Policy; [2] Department of Geography and Regional Studies; [3] Department of Epidemiology and Public Health, University of Miami

UNIVERSITY OF MIAMI
ABESS CENTER for ECOSYSTEM SCIENCE & POLICY

Polishing our designs

1. Introduction

The public health problem posed by malaria has made it a top priority for control efforts and the general consensus globally, is that its elimination is crucial for continued international development. Consequently, there is ongoing research in different regions including South America (SA) to better understand the disease dynamics with the intent that findings may establish scientific framework that would support the development of new intervention strategies for malaria elimination in areas with seasonal malaria. One of such investigations is undertaken by the International Centers of Excellence in Malaria Research (ICEMR) under a National Institutes of Health (NIH) grant.

While only about 3% of the global malaria burden is borne by SA[1], undertaking malaria research in the region is currently important because an estimated 23million people are still at risk[2] and approximately about 80% of clinical cases are found in Northern South America (NSA)[3]. A key factor limiting effective control is lack of data and uneven implementation of control measures, including use of bed-nets, sprays, early diagnosis, and treatment. As part of the ICEMR investigation, this project seeks to model the spatial patterns of malaria risk in NSA through vector distribution and land-use changes. Furthermore, I intend to investigate the perceptions of malaria risk in order to identify barriers to adoption and how they can be circumvented.

2. Significance

Spatial distribution of malaria risk is still perceived as broadly categorized by the WHO's traditional risk maps which are highly generalized, of low resolution and have broad categories with uncertain boundaries (see da Nunes-Silva et al. 2012). There is need for up- to-date high resolution risk maps which can aid malaria control efforts. Secondly, modeling distribution of principal malaria vectors and land use changes which may explain the observed distribution and risk are useful tools which would guide future management strategies. Finally, understanding the perceptions of at risk populations may help address barriers to adoption of interventions and influence policies. Overall, findings will empower NMCPs to achieve effective control and move them closer to elimination.

3. Specific Aims

- Specific Aim 1: Model the spatial patterns of malaria risk through vector distribution and land use changes
  - Hypothesis 1.1: GIS-based Multi-Criteria Evaluation (MCE) model can accurately predict spatial extent of malaria risk areas. Objective: Generate risk maps that represent risk of malaria transmission.
  - Hypothesis 1.2: The Maximum Entropy (Maxent) model can accurately depict actual and predict potential distribution of three *Anopheles* species. Objective: Model observed and potential spread of *An. albimanus, An. darlingi,* and *An. nuneztovari.*
  - Hypothesis 1.3: Land- use changes can explain the variations in predicted malaria risk. Objective: Characterize land use land cover (LULC) and investigate changes in areas of risk.
- Specific Aim 2: Investigate the perceptions of malaria risk in order to identify barriers to adoption and how they can be circumvented.
  - Hypothesis 2.1: Knowledge of perception of malaria risk can aid design of malaria control strategies. Objective: Obtain and analyze data on subjective perceptions of risk.
  - Hypothesis 2.2: Identification of barriers to adoption of malaria control interventions provide means of tackling them. Objective: Analyze data addressing perceived barriers and policy implications

*Only ongoing work on Hypothesis 1.1 in presented here

4. Materials and Methods

- Study Area: is NSA comprising of ten countries- Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Panama, Peru, Suriname and Venezuela. These countries account for approximately 90% of clinical cases in the region hence, the choice as study area (Fig. 1).

Figure1: Map of study area

- Research Approach: Due to the complexity of malaria problem, I'm employing an interdisciplinary approach to address the problem (Fig. 2).

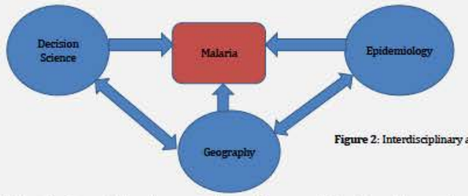

Figure 2: Interdisciplinary approach

- Materials: Raster data layers of environmental, climatic and anthropogenic parameters from satellite imageries, weather monitoring stations, global land cover and population data were collected from Worldclim, Digital Charts of the World, Globcover and Landscan. Vector data was collected from field sampling by our collaborators and the Walter Reed Biosystematics Unit. Sociological data would be collected through questionnaires to be administered in one of the study area. Other data will be collected as needed.
- Procedure: To test hypothesis 1.1, raster data of parameters that influence mosquito distribution (rivers, wetlands, urban areas, roads, population and elevation) were combined using a Multi-Criteria Evaluation in Idrisi GIS package. This produced a map of potential exposure to malaria vectors which is used as a proxy for risk of malaria transmission. All the data layers were gridded at 1km spatial resolution. A set of distance layers had been created for discrete factors using standard GIS operations. All factors were subsequently standardized into a continuous common numeric range on a byte 0-255 probability scale using a fuzzy function based on knowledge of mosquito interaction with the factor. Weights were generated for each factor based on the importance of the factor to malaria transmission by expert opinions and then assigned using Analytical Hierarchy Process. The risk maps produced were validated statistically using data on *An. darlingi* distribution and malaria case data from some parts of the study area. See preliminary results (Fig. 3,4,5)

5. Preliminary Results

- Areas of high to moderate risk corresponded with locations of some of the anophelines collected.

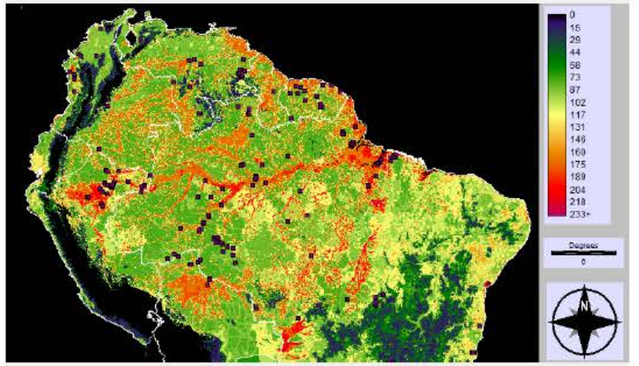

Figure 3: Potential risk of exposure to malaria vectors across NSA (0 indicate little or no risk while 233 indicate high risk)

- Risk scores for mosquito occurrence points were significantly higher than those generated randomly (Fig. 4).

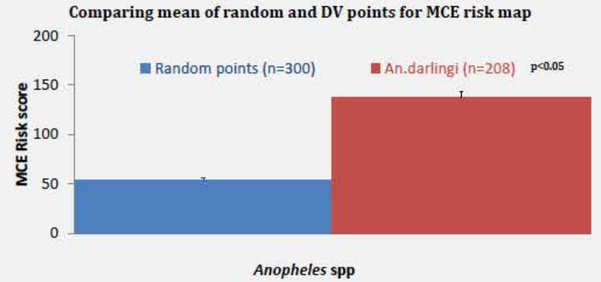

Figure 4: Plot showing the MCE risk values for randomly sampled points and for occurrence points of a DV, *An. darlingi*

6. Conclusion

Findings from preliminary results suggest that the MCE approach is a viable method to modeling spatial risk. The high resolution risk map produced aligned well with sampled vector points and may therefore be used to plan control of malaria vectors. Further analysis is planned to generate and validate risk maps with actual measures of malaria transmission, results of which could be used to plan containment of future outbreaks.

References

1. WHO. (2007). MALARIA ELIMINATION: A field manual for low and moderate endemic countries
2. PAHO (2012) PAHO Honors 2012 Malaria Champions of the Americas. Available: http://new.paho.org/hq/index.php?option=com_content&view=article&id=7429&Itemid=39639
3. Gusmao R. (1999) Overview of malaria control in the Americas. Parasitologia 41:355-60.
4. Da Silva-Nunes, M., Moreno, M., Conn, J.E., Gamboa, D., Abeles, S., Vinetz, J.M., and Ferreira, M.U. (2012) Amazonian malaria: Asymptomatic human reservoirs, diagnostic challenges, environmentally driven changes in mosquito vector populations, and the mandate for sustainable control strategies. *Acta Tropica* **121** (3): 281-29

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UNIVERSITY OF MIAMI
ABESS CENTER for ECOSYSTEM SCIENCE & POLICY

Polishing our designs

INTRODUCTION

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While only about 3% of the global malaria burden is borne by SA1, undertaking malaria research in the region is currently important because an estimated 23million people are still at risk 2 and approximately about 80% of clinical cases are found in **Northern South America (NSA)** 3. A key factor limiting eective control is lack of data and uneven implementation of control measures, including use of bednets, sprays, early diagnosis, and treatment. As part of the ICEMR investigation, this project seeks to model the spatial patterns of malaria risk in NSA through vector distribution and land-use changes. Furthermore, I intend to investigate the perceptions of malaria risk in order to identify barriers to adoption and how they can be circumvented.

SIGNIFICANCE

Spatial distribution of malaria risk is still perceived as broadly categorized by the WHO's traditional risk maps which are highly generalized, of low resolution and have broad categories with uncertain boundaries (see da Nunes-Silva et al. 2012). There is need for up- to-date high resolution risk maps which can aid malaria control eorts . Secondly, modeling distribution of principal malaria vectors and land use changes which may explain the observed distribution and risk are useful tools which would guide future management strategies . Finally, understanding the perceptions of at risk populations may help address barriers to adoption of interventions and influence policies. Overall, findings will empower NMCPs to achieve eective control and move them closer to elimination .

AIMS

Specific Aim 1: Model the spatial patterns of malaria risk through vector distribution and land use changes

- **Hypothesis 1.1:** GIS-based Multi-Criteria Evaluation (MCE) model can accurately predict spatial extent of malaria risk areas. **Objective:** Generate risk maps that represent risk of malaria transmission
- **Hypothesis 1.2:** The Maximum Entropy (Maxent) model can accurately depict actual and predict potential distribution of three Anopheles species. **Objective:** Model observed and potential spread of An. albimanus, An. darling , and An. nuneztovari.
- **Hypothesis 1.3:** Land- use changes can explain the variations in predicted malaria risk. **Objective:** Characterize land use land cover (LULC) and investigate changes in areas of risk.

Specific Aim 2: Investigate the perceptions of malaria risk in order to identify barriers to adoption and how they can be circumvented.

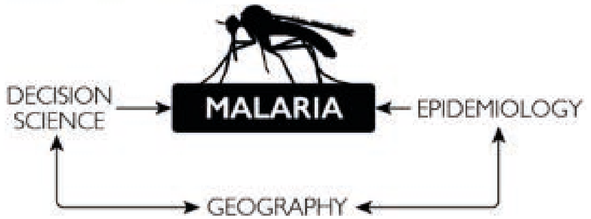
- **Hypothesis 2.1:** Knowledge of perception of malaria risk can aid design of malaria control strategies. **Objective:** Obtain and analyze data on subjective perceptions of risk .
- **Hypothesis 2.2:** Identification of barriers to adoption of malaria control interventions provide means of tackling them. **Objective:** Analyze data addressing perceived barriers and policy implications

***Only ongoing work on Hypothesis 1.1 in presented here**

MATERIALS AND METHODS

NSA comprising of ten countries - Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Panama, Peru, Suriname and Venezuela. These countries account for approximately 90% of clinical cases in the region

Research approach: Due to the complexity of malaria problem, I'm employing an interdisciplinary approach to address the problem.

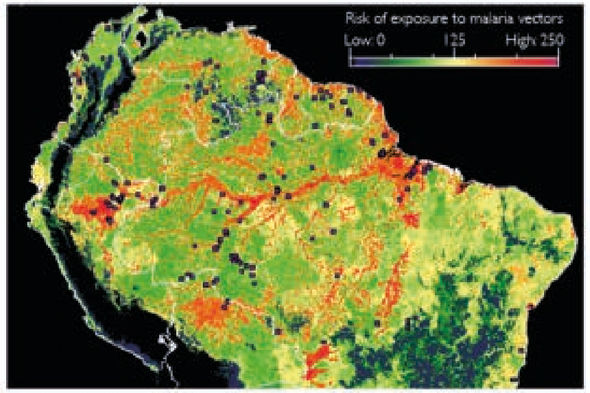


Materials: Raster data layers of environmental, climatic and anthropogenic parameters from satellite imageries, weather monitoring stations, global land cover and population data were collected from Worldclim , Digital Charts of the World, Globcover and Landscan. Vector data was collected from field sampling by our collaborators and the Walter Reed Biosystematics Unit. Sociological data would be collected through questionnaires to be administered in one of the study area. Other data will be collected as needed.

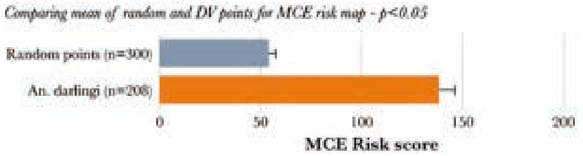
Procedure: To test hypothesis 1.1, raster data of parameters that inence mosquito distribution (rivers , wetlands, urban areas, roads, population and elevation) were combined using a Multi-Criteria Evaluation in Idrisi GIS package. This produced a map of potential exposure to malaria vectors which is used as a proxy for risk of malaria transmission . All the data layers were gridded at 1km spatial resolution . A set of distance layers had been created for discrete factors using standard GIS operations. All factors were subsequently standardized into a continuous common numeric range on a byte 0-255 probability scale using a fuzzy function based on knowledge of mosquito interaction with the factor. Weights were generated for each factor based on the importance of the factor to malaria transmission by expert opinions and then assigned using Analytical Hierarchy Process . The risk maps produced were validated statistically using data on An. darlingi distribution and malaria case data from some parts of the study area. See preliminary results

RESULTS

Areas of high to moderate risk corresponded with locations of some of the anophelines collected.



Risk scores for mosquito occurrence points were significantly higher than those generated randomly.



CONCLUSION

Findings from preliminary results suggest that the MCE approach is a viable methods to modeling spatial risk. The high resolution risk map produced aligned well with sample vector points and may therefore be used to plan control of malaria vectors. Further analysis is planned to generate and validate risk maps with actual measures of malaria transmission, results of which could be used to plan containment of future outbreaks.

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Designing information graphics and data visualizations doesn't consist of applying **rules**, but of **reasoning** about choices, and **justifying** them.

Every choice in design is **subjective**, and therefore debatable, but it should never be **arbitrary**.

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