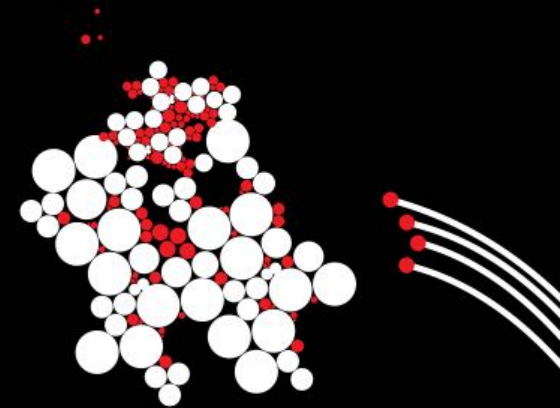


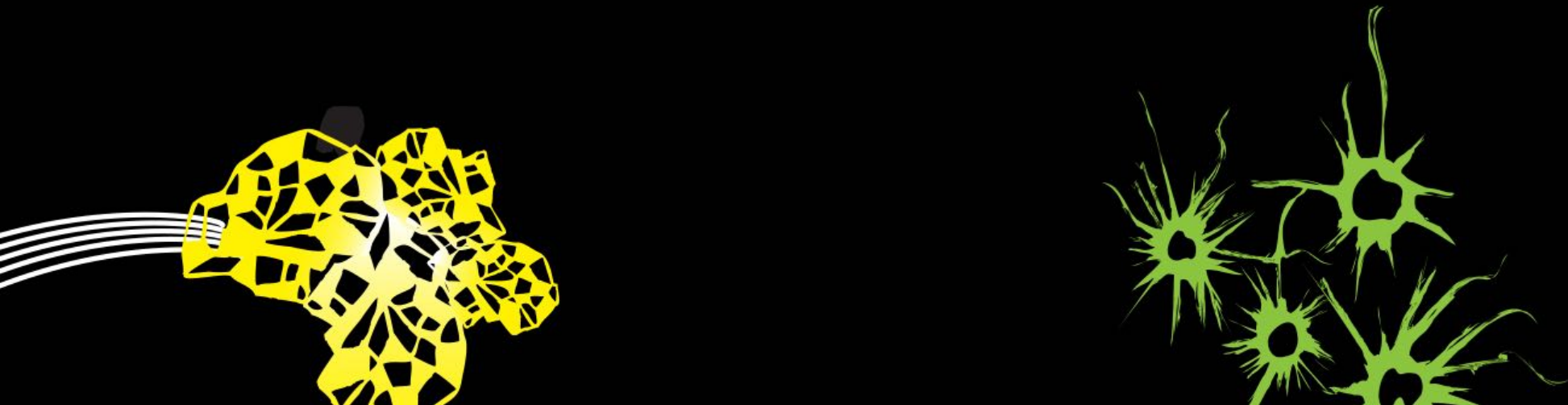
UNIVERSITY OF TWENTE.

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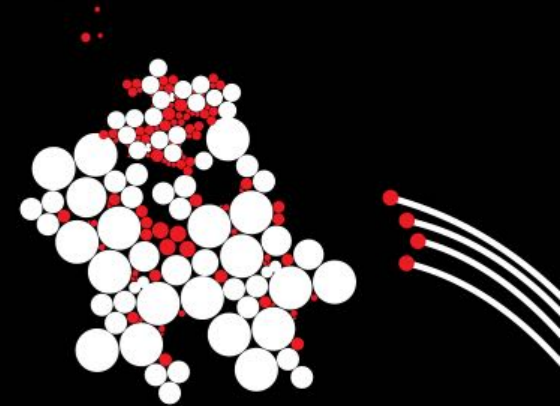
Using effective visualization in maps and diagrams to better understand the SDGs

Menno-Jan Kraak



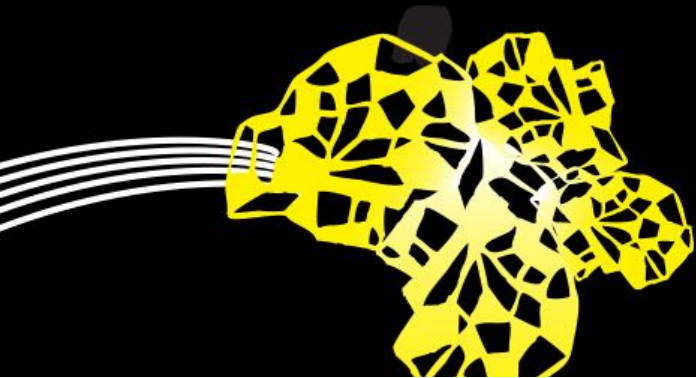
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My maps, The good, the bad and the ugly

Menno-Jan Kraak



Workshop



Using effective visualization in maps and diagrams to better understand the SDGs

- Introduction

Exercise: Who is who?

- SDG Indicator characteristics

Exercise: design your own map: Gender Inequality Index

- Cartographic workflow

Exercise: define your own world view

- Design choices

- Conclusions

Exercise: Who is Who?



Draw the contour of your country

Ask your neighbor if she / he can tell were you're from

SDG

Indicator characteristics




Sustainable Development Goals



Example: Goal 4 Education

- Goals

 4 QUALITY EDUCATION
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

- Targets

4.1 4.2 4.3 4.4 4.5 4.6 4.7

- Indicators

4.1.1 4.2.1 4.3.1 4.4.1 4.5.1 4.6.1 4.7.1
4.1.2 4.2.2 4.4.2 4.6.2 4.7.2

<http://www.un.org/sustainabledevelopment/education/>

Goal 4: Education - Sample Targets

- **4.1** By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes
- **4.2** By 2030, ensure
-

[https://sustainabledevelopment.un.org/content/documents/6754Technical%20report%20of%20the%20UNSC%20Bureau%20\(final\).pdf](https://sustainabledevelopment.un.org/content/documents/6754Technical%20report%20of%20the%20UNSC%20Bureau%20(final).pdf)

Goal 4: Education - Sample Indicators

- **4.1** *By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes*
- **Indicator 4.1.1** Percentage of children who achieve minimum proficiency standards in reading and mathematics at end of: (i) primary (ii) lower secondary
- **Indicator 4.1.2** Completion rate (primary, lower secondary, upper secondary)

Goal 4: Education - Analyzing the data

% minimum proficiency

Completion **rate** levels of education

% of 15yrs proficiency of environmental science and geoscience

Early Childhood Development **Index**

Participation **rate** in organized learning

Participation **rate** among 25-65 years

Enrollment **ratios** by level and type

% of computer and information literate

% of proficient

Youth/adult literacy **rate**

% of 13yrs promoting governance

Parity **indices** (female/male, urban/rural, .

Indicators and data types

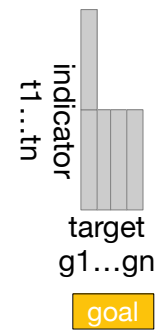
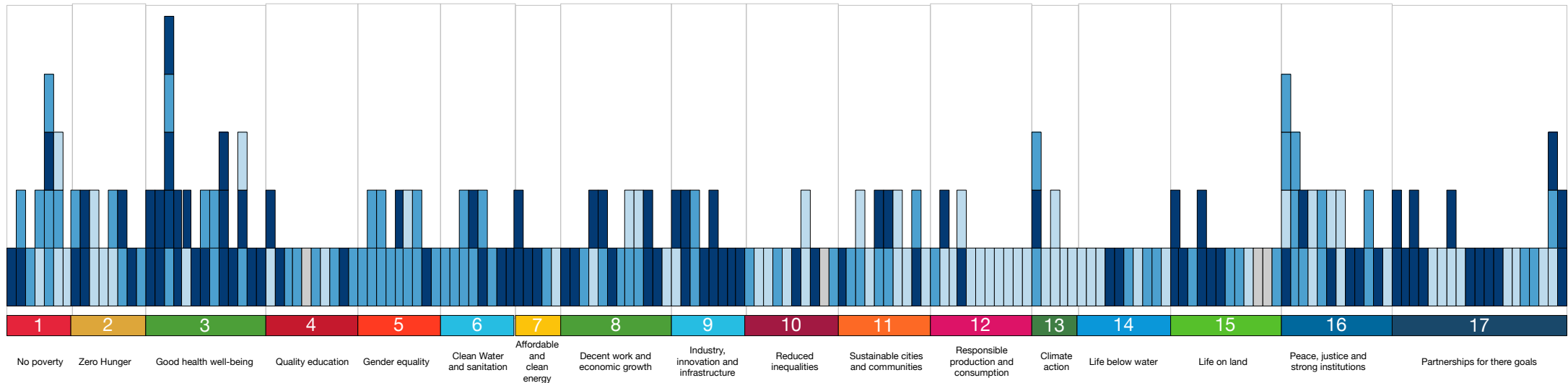
| scale type | absolute / relative | variables | data type (name) | | description (X and Y are variables) |
|------------|--|--------------------|------------------|--------------------------------|--|
| ratio | absolute (one value) | one variable | absolute value | | count X |
| | relative (calculated using two or more values) | one variable | proportion | proportion of total population | % of total population |
| | | | | other proportion | % of X, other than population |
| | | two variables | rate | rate per population unit | count X per capita / population |
| | | | | change rate (per time unit) | % change or count X per time |
| | | | | other rate | X per Y, other than population or time |
| | many variables | index (calculated) | | formula | |
| ordinal | one variable | ordinal value | | level or rank | |
| nominal | one variable | nominal value | | in SDG indicator all: yes/no | |

SDG indicator tiers

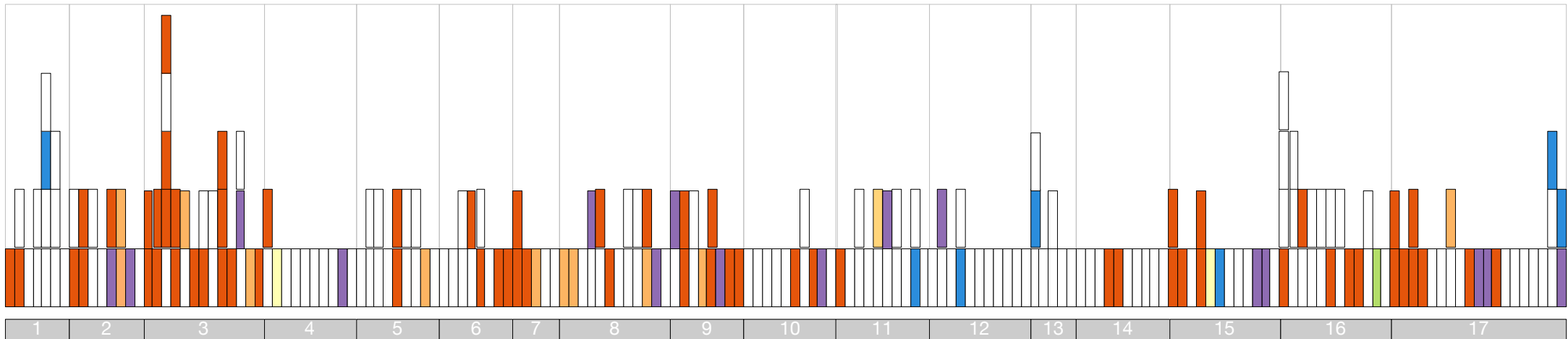
Incomplete indicators

- **Tier I:** internationally established methodology and standards
 - Data regularly produced for at least 50 percent of countries and of the population in every region
- **Tier II:** data not regularly produced by countries
- **Tier III:** methodology or standards are being (or will be) established

Indicators and their TIER level



Nature of the indicators



Absolute value
 Proportion
 Rate
 Index
 Ordinal value
 Nominal value

Exercise: design your own map



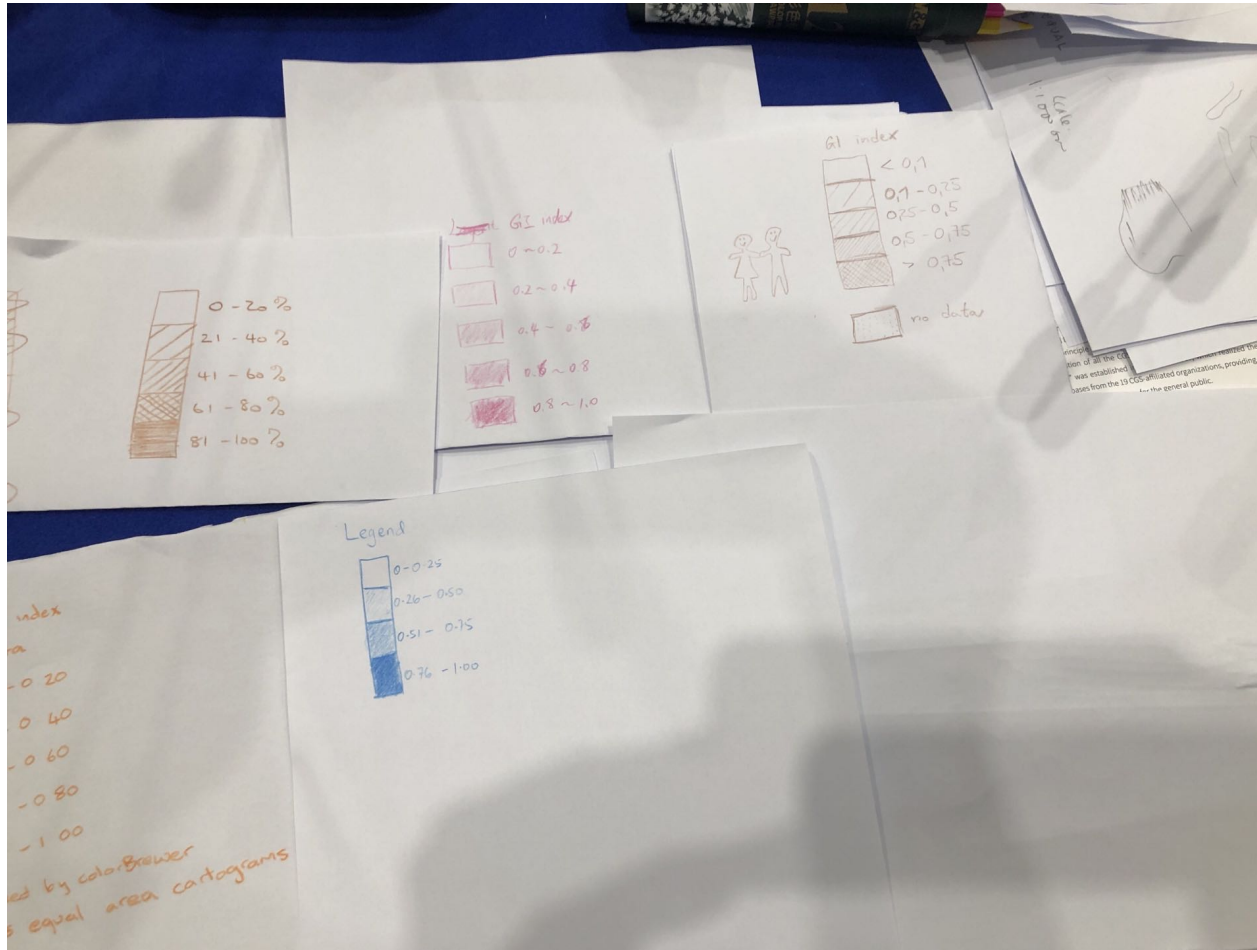
Gender inequality index

| Name | GI index | Name | GI index | Name | GI index | Name | GI index | Name | GI index | Name | GI index |
|----------------------|----------|-----------------|----------|---------------|----------|---------------|----------|------------------|----------|--------------------------|----------|
| Afghanistan | 0,67 | Cote d'Ivoire | 0,67 | Guinea | - | Kuwait | 0,33 | Norway | 0,05 | Serbia | 0,18 |
| Angola | - | Cameroon | 0,57 | Gambia | 0,64 | Laos | 0,47 | Nepal | 0,50 | Suriname | 0,45 |
| Albania | 0,27 | Dem. Rep. Congo | 0,66 | Guinea-Bissau | - | Lebanon | 0,38 | New Zealand | 0,16 | Slovakia | 0,18 |
| United Arab Emirates | 0,23 | Congo | 0,59 | Eq. Guinea | - | Liberia | 0,65 | Oman | 0,28 | Slovenia | 0,05 |
| Argentina | 0,36 | Colombia | 0,39 | Greece | 0,12 | Libya | 0,17 | Pakistan | 0,55 | Sweden | 0,05 |
| Armenia | 0,29 | Costa Rica | 0,31 | Greenland | - | Sri Lanka | 0,39 | Panama | 0,46 | Swaziland | 0,57 |
| Australia | 0,12 | Cuba | 0,30 | Guatemala | 0,49 | Lesotho | 0,55 | Peru | 0,39 | Syria | 0,55 |
| Austria | 0,08 | N. Cyprus | - | Guyana | 0,51 | Lithuania | 0,12 | Philippines | 0,44 | Chad | 0,69 |
| Azerbaijan | 0,33 | Cyprus | 0,12 | Honduras | 0,46 | Luxembourg | 0,07 | Papua New Guinea | 0,59 | Togo | 0,56 |
| Burundi | 0,47 | Czechia | 0,13 | Croatia | 0,14 | Latvia | 0,19 | Poland | 0,14 | Thailand | 0,37 |
| Belgium | 0,07 | Germany | 0,07 | Haiti | 0,59 | Morocco | 0,49 | Puerto Rico | - | Tajikistan | 0,32 |
| Benin | 0,61 | Djibouti | - | Hungary | 0,25 | Moldova | 0,23 | North Korea | - | Turkmenistan | - |
| Burkina Faso | 0,62 | Denmark | 0,04 | Indonesia | 0,47 | Madagascar | - | Portugal | 0,09 | Timor-Leste | - |
| Bangladesh | 0,52 | Dominican Rep. | 0,47 | India | 0,53 | Mexico | 0,35 | Paraguay | 0,46 | Trinidad and Tobago | 0,32 |
| Bulgaria | 0,22 | Algeria | 0,43 | Ireland | 0,13 | Macedonia | 0,16 | Palestine | - | Tunisia | 0,29 |
| Bahamas | 0,36 | Ecuador | 0,39 | Iran | 0,51 | Mali | 0,69 | Qatar | 0,54 | Turkey | 0,33 |
| Bosnia and Herz. | 0,16 | Egypt | 0,57 | Iraq | 0,53 | Myanmar | 0,37 | Romania | 0,34 | Taiwan | - |
| Belarus | 0,14 | Eritrea | - | Iceland | 0,05 | Montenegro | 0,16 | Russia | 0,27 | Tanzania | 0,54 |
| Belize | 0,38 | Spain | 0,08 | Israel | 0,10 | Mongolia | 0,28 | Rwanda | 0,38 | Uganda | 0,52 |
| Bolivia | 0,45 | Estonia | 0,13 | Italy | 0,08 | Mozambique | 0,57 | W. Sahara | - | Ukraine | 0,28 |
| Brazil | 0,41 | Ethiopia | 0,50 | Jamaica | 0,42 | Mauritania | 0,63 | Saudi Arabia | 0,26 | Uruguay | 0,28 |
| Brunei | - | Finland | 0,06 | Jordan | 0,48 | Malawi | 0,61 | Sudan | 0,57 | United States of America | 0,20 |
| Bhutan | 0,48 | Fiji | 0,36 | Japan | 0,12 | Malaysia | 0,29 | S. Sudan | - | Uzbekistan | 0,29 |
| Botswana | 0,44 | Falkland Is. | - | Kazakhstan | 0,20 | Namibia | 0,47 | Senegal | 0,52 | Venezuela | 0,46 |
| Central African Rep. | 0,65 | France | 0,10 | Kenya | 0,56 | New Caledonia | - | Solomon Is. | - | Vietnam | 0,34 |
| Canada | 0,10 | Gabon | 0,54 | Kyrgyzstan | 0,39 | Niger | 0,70 | Sierra Leone | 0,65 | Vanuatu | - |
| Switzerland | 0,04 | United Kingdom | 0,13 | Cambodia | 0,48 | Nigeria | - | El Salvador | 0,38 | Yemen | 0,77 |
| Chile | 0,32 | Georgia | 0,36 | South Korea | 0,07 | Nicaragua | 0,46 | Somaliland | - | South Africa | 0,39 |
| China | 0,16 | Ghana | 0,55 | Kosovo | - | Netherlands | 0,04 | Somalia | - | Zambia | 0,53 |
| | | | | | | | | | | Zimbabwe | 0,54 |



Design & draw
the map legend

Your work



World Gender Inequality

Option I - Color size each country

Legend

| | | |
|-------|---------|------|
| 0.0 | 0.5 | 1.0 |
| blue | green | red |
| white | unknown | data |

⇒ Small countries
Very good to see
→ solution

- < 0.15
- 0.15 - 0.2
- 0.31 - 0.4
- 0.46 - 0.5
- > 0.7

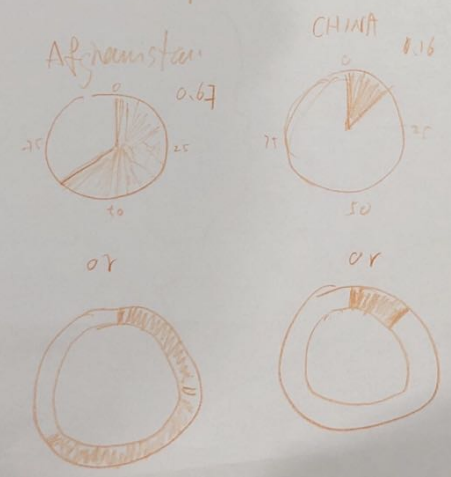
Legend

- Highest (with high colour value) → 0.9 - 1
- → 0.6 - 0.8
- → 0.4 - 0.6
- → 0.2 - 0.4
- Lowest (with lower colour value) → 0 - 0.2
- → no data

Legend for bar chart map

| Color | Label | Index Value |
|--|----------------|-------------|
| | low gender eq. | 0 - 0.20 |
| | Mid-low " | 0.21 - 0.40 |
| | Mid-high " | 0.41 - 0.60 |
| | High " | 0.61 - 1.0 |
| | Missing value | Missing |

Gender Inequality Index



0.04 - 0.1

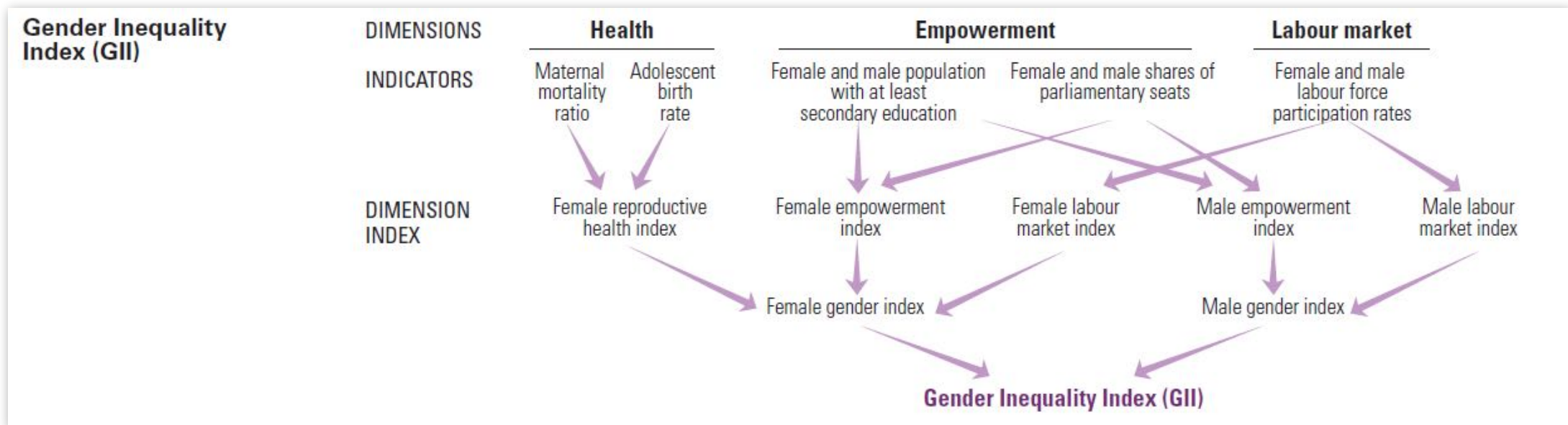
- 0.04 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.6 - 0.7
- 0.7 - 1

use to use to different
color to render
the country

Cartographic Workflow



Gender inequality index

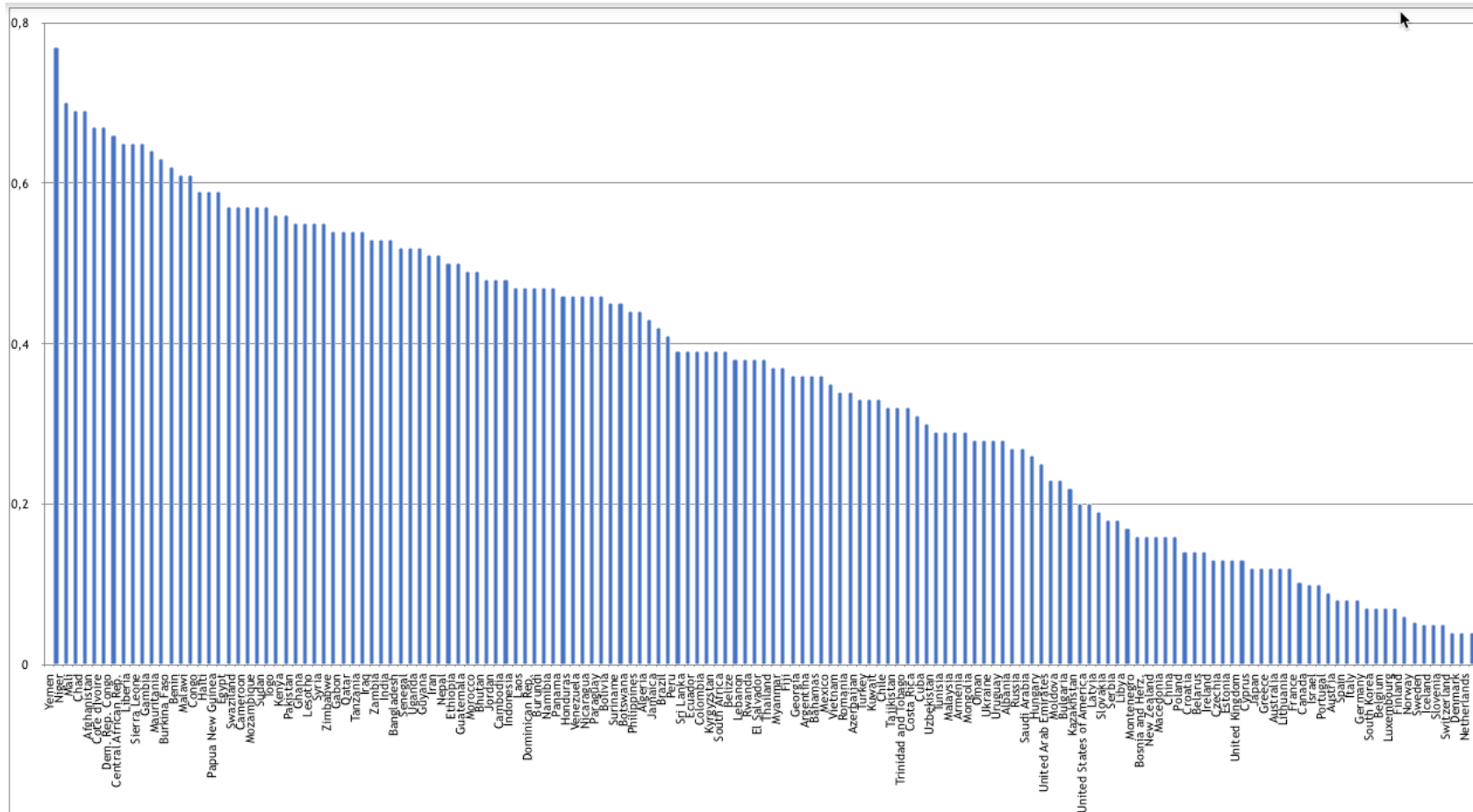


<http://hdr.undp.org/en/composite/GII>

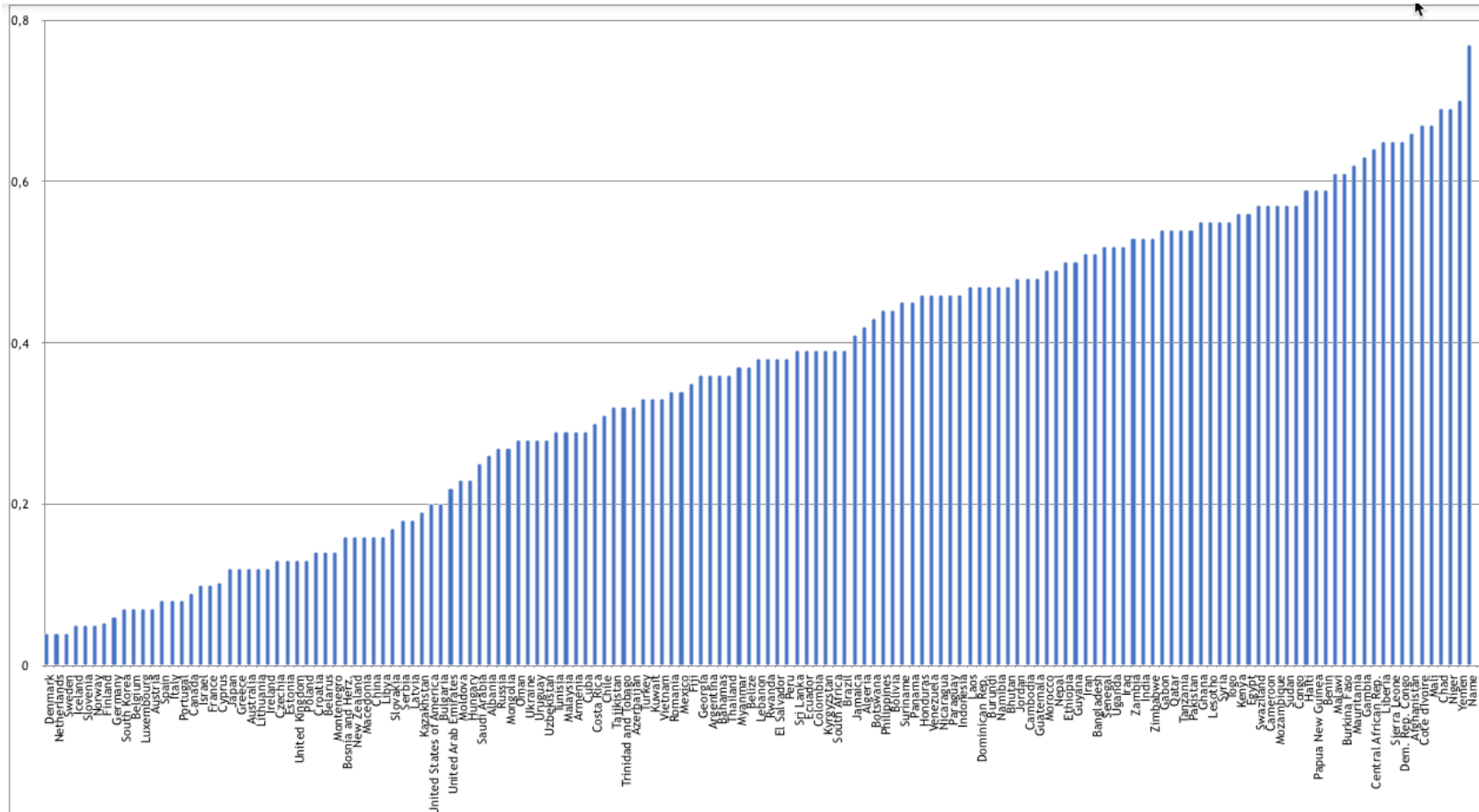
Gender inequality index

| Name | GI index | Name | GI index | Name | GI index | Name | GI index | Name | GI index | Name | GI index |
|----------------------|----------|-----------------|----------|---------------|----------|---------------|----------|------------------|----------|--------------------------|----------|
| Afghanistan | 0,67 | Cote d'Ivoire | 0,67 | Guinea | - | Kuwait | 0,33 | Norway | 0,05 | Serbia | 0,18 |
| Angola | - | Cameroon | 0,57 | Gambia | 0,64 | Laos | 0,47 | Nepal | 0,50 | Suriname | 0,45 |
| Albania | 0,27 | Dem. Rep. Congo | 0,66 | Guinea-Bissau | - | Lebanon | 0,38 | New Zealand | 0,16 | Slovakia | 0,18 |
| United Arab Emirates | 0,23 | Congo | 0,59 | Eq. Guinea | - | Liberia | 0,65 | Oman | 0,28 | Slovenia | 0,05 |
| Argentina | 0,36 | Colombia | 0,39 | Greece | 0,12 | Libya | 0,17 | Pakistan | 0,55 | Sweden | 0,05 |
| Armenia | 0,29 | Costa Rica | 0,31 | Greenland | - | Sri Lanka | 0,39 | Panama | 0,46 | Swaziland | 0,57 |
| Australia | 0,12 | Cuba | 0,30 | Guatemala | 0,49 | Lesotho | 0,55 | Peru | 0,39 | Syria | 0,55 |
| Austria | 0,08 | N. Cyprus | - | Guyana | 0,51 | Lithuania | 0,12 | Philippines | 0,44 | Chad | 0,69 |
| Azerbaijan | 0,33 | Cyprus | 0,12 | Honduras | 0,46 | Luxembourg | 0,07 | Papua New Guinea | 0,59 | Togo | 0,56 |
| Burundi | 0,47 | Czechia | 0,13 | Croatia | 0,14 | Latvia | 0,19 | Poland | 0,14 | Thailand | 0,37 |
| Belgium | 0,07 | Germany | 0,07 | Haiti | 0,59 | Morocco | 0,49 | Puerto Rico | - | Tajikistan | 0,32 |
| Benin | 0,61 | Djibouti | - | Hungary | 0,25 | Moldova | 0,23 | North Korea | - | Turkmenistan | - |
| Burkina Faso | 0,62 | Denmark | 0,04 | Indonesia | 0,47 | Madagascar | - | Portugal | 0,09 | Timor-Leste | - |
| Bangladesh | 0,52 | Dominican Rep. | 0,47 | India | 0,53 | Mexico | 0,35 | Paraguay | 0,46 | Trinidad and Tobago | 0,32 |
| Bulgaria | 0,22 | Algeria | 0,43 | Ireland | 0,13 | Macedonia | 0,16 | Palestine | - | Tunisia | 0,29 |
| Bahamas | 0,36 | Ecuador | 0,39 | Iran | 0,51 | Mali | 0,69 | Qatar | 0,54 | Turkey | 0,33 |
| Bosnia and Herz. | 0,16 | Egypt | 0,57 | Iraq | 0,53 | Myanmar | 0,37 | Romania | 0,34 | Taiwan | - |
| Belarus | 0,14 | Eritrea | - | Iceland | 0,05 | Montenegro | 0,16 | Russia | 0,27 | Tanzania | 0,54 |
| Belize | 0,38 | Spain | 0,08 | Israel | 0,10 | Mongolia | 0,28 | Rwanda | 0,38 | Uganda | 0,52 |
| Bolivia | 0,45 | Estonia | 0,13 | Italy | 0,08 | Mozambique | 0,57 | W. Sahara | - | Ukraine | 0,28 |
| Brazil | 0,41 | Ethiopia | 0,50 | Jamaica | 0,42 | Mauritania | 0,63 | Saudi Arabia | 0,26 | Uruguay | 0,28 |
| Brunei | - | Finland | 0,06 | Jordan | 0,48 | Malawi | 0,61 | Sudan | 0,57 | United States of America | 0,20 |
| Bhutan | 0,48 | Fiji | 0,36 | Japan | 0,12 | Malaysia | 0,29 | S. Sudan | - | Uzbekistan | 0,29 |
| Botswana | 0,44 | Falkland Is. | - | Kazakhstan | 0,20 | Namibia | 0,47 | Senegal | 0,52 | Venezuela | 0,46 |
| Central African Rep. | 0,65 | France | 0,10 | Kenya | 0,56 | New Caledonia | - | Solomon Is. | - | Vietnam | 0,34 |
| Canada | 0,10 | Gabon | 0,54 | Kyrgyzstan | 0,39 | Niger | 0,70 | Sierra Leone | 0,65 | Vanuatu | - |
| Switzerland | 0,04 | United Kingdom | 0,13 | Cambodia | 0,48 | Nigeria | - | El Salvador | 0,38 | Yemen | 0,77 |
| Chile | 0,32 | Georgia | 0,36 | South Korea | 0,07 | Nicaragua | 0,46 | Somaliland | - | South Africa | 0,39 |
| China | 0,16 | Ghana | 0,55 | Kosovo | - | Netherlands | 0,04 | Somalia | - | Zambia | 0,53 |
| | | | | | | | | | | Zimbabwe | 0,54 |

Perception

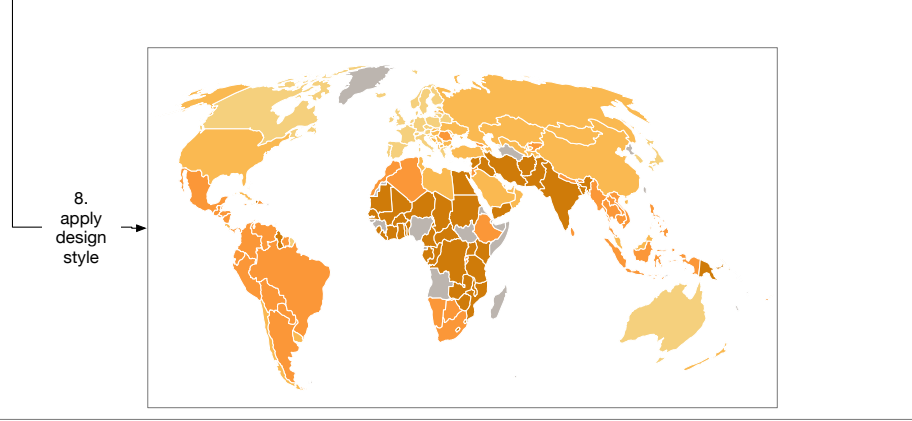
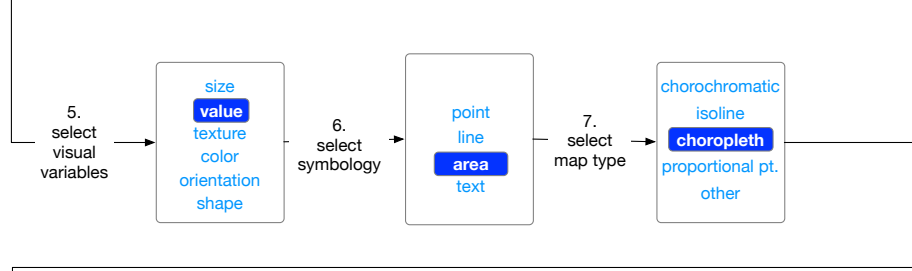
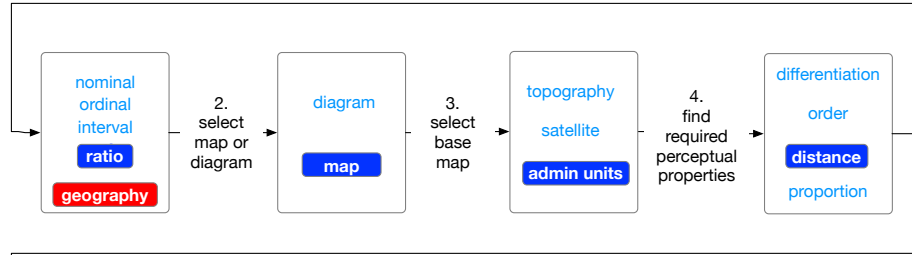


Perception

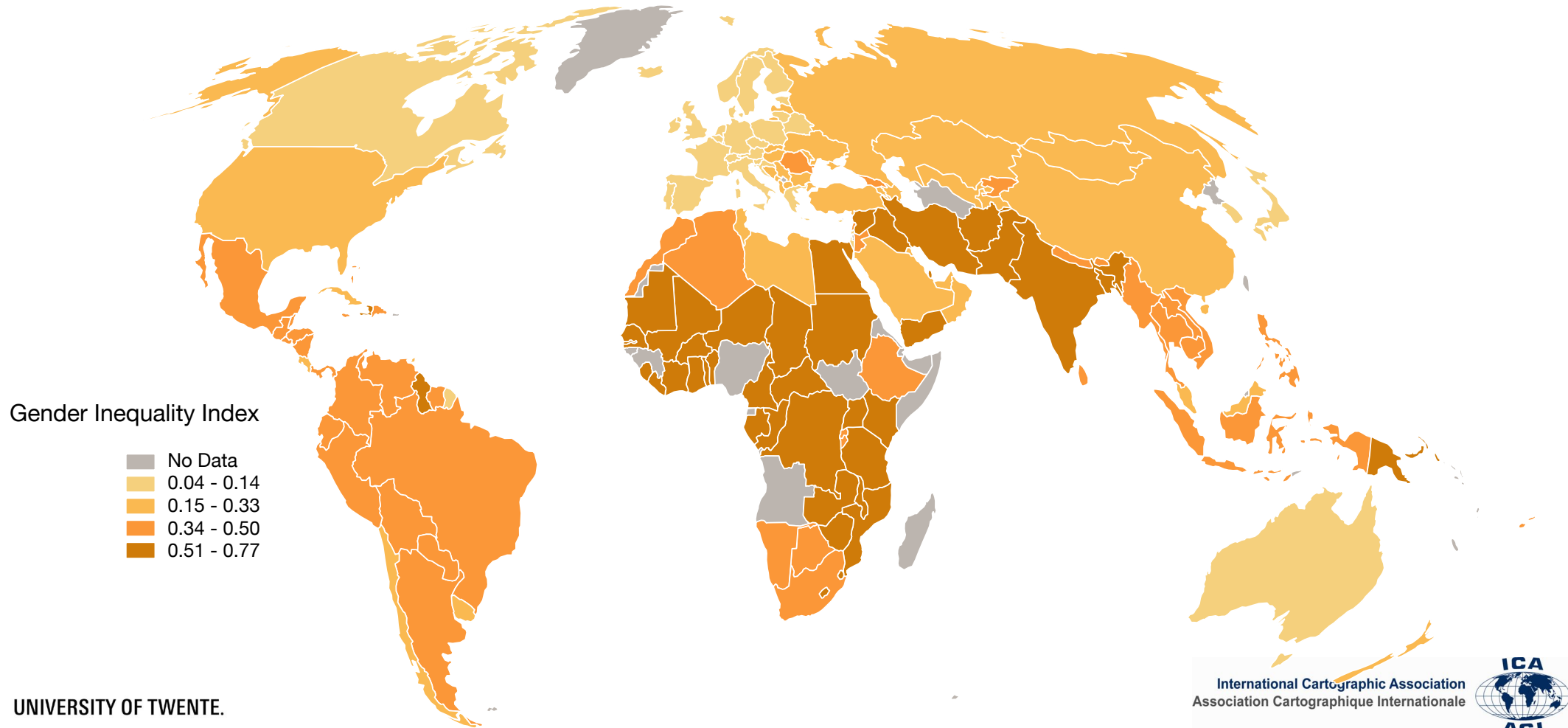


| Name | GI index | Name | GI index | Name | GI index | Name | GI index | Name | GI index | Name | GI index |
|----------------------|----------|-----------------|----------|---------------|----------|-------------|----------|------------------|----------|--------------------------|----------|
| Algeria | 0.67 | China | 0.67 | Guinea | 0.64 | Russia | 0.33 | Norway | 0.05 | Serbia | 0.18 |
| Algeria | - | Comoros | 0.37 | Ghana | 0.64 | Latvia | 0.47 | Spain | 0.09 | Sri Lanka | 0.45 |
| Algeria | 0.27 | Dem. Rep. Congo | 0.46 | Guinea Bissau | 0.46 | Libanon | 0.36 | New Zealand | 0.16 | Slovakia | 0.18 |
| United Arab Emirates | 0.33 | Congo | 0.39 | Eg. Guinea | - | Liberia | 0.08 | Chad | 0.28 | Slovenia | 0.05 |
| Argentina | 0.36 | Colombia | 0.39 | Guinea | 0.12 | Ulyss | 0.17 | Pakistan | 0.35 | Sweden | 0.09 |
| Bahrain | 0.19 | Costa Rica | 0.19 | Grenada | - | Si Lanka | 0.36 | Pakistan | 0.46 | Switzerland | 0.17 |
| Australia | 0.12 | Cuba | 0.30 | Guatemala | 0.49 | Laos | 0.15 | Peru | 0.39 | Syria | 0.55 |
| Austria | 0.08 | W. Cyprus | - | Guyana | 0.51 | Lithuania | 0.37 | Philippines | 0.44 | Chad | 0.49 |
| Azerbaijan | 0.33 | Cyprus | 0.12 | Honduras | 0.46 | Luxembourg | 0.07 | Papua New Guinea | 0.39 | Tajikistan | 0.54 |
| Bahrain | 0.67 | Czechia | 0.13 | Croatia | 0.14 | Latvia | 0.29 | North Korea | 0.14 | Tajikistan | 0.57 |
| Belgium | 0.07 | Germany | 0.07 | Haiti | 0.59 | Morocco | 0.49 | Puerto Rico | - | Tajikistan | 0.57 |
| Belize | 0.61 | El Salvador | - | Hungary | 0.29 | Moldova | 0.29 | North Korea | - | Tajikistan | 0.57 |
| Burkina Faso | 0.42 | Denmark | 0.04 | Indonesia | 0.47 | Malaysia | - | Portugal | 0.09 | Timor-Leste | - |
| Burkina Faso | 0.11 | Dominican Rep. | 0.47 | India | 0.55 | Mexico | 0.35 | Paraguay | 0.04 | Togo and Togo | 0.43 |
| Bulgaria | 0.32 | Egypt | 0.43 | Indonesia | 0.13 | Macedonia | 0.36 | Peru | - | Turkey | 0.29 |
| Burkina Faso | 0.38 | Guatemala | 0.29 | Iran | 0.11 | Mali | 0.08 | Qatar | - | Turkey | 0.33 |
| Burkina Faso | 0.36 | Guinea | 0.17 | Iran | 0.53 | Mexico | 0.37 | Romania | 0.34 | Taiwan | 0.14 |
| Burkina Faso | 0.14 | Guinea | 0.04 | Ireland | 0.00 | Moldova | 0.36 | Russia | 0.27 | Tanzania | 0.14 |
| Burkina Faso | 0.38 | Guinea | 0.08 | Ireland | 0.10 | Mongolia | 0.28 | Russia | 0.38 | Tanzania | 0.14 |
| Burkina Faso | 0.45 | Guinea | 0.13 | Raf | 0.08 | Mozambique | 0.57 | W. Sahara | - | Ukraine | 0.28 |
| Burkina Faso | 0.41 | Guinea | 0.50 | Jamaica | 0.42 | Murcia | 0.42 | South Africa | 0.26 | Uganda | 0.28 |
| Burkina Faso | 0.06 | Iran | 0.06 | Japan | 0.48 | Malawi | 0.83 | Sudan | 0.57 | United States of America | 0.29 |
| Burkina Faso | 0.48 | Iran | 0.36 | Japan | 0.12 | Malaysia | 0.23 | S. Sudan | - | United States of America | 0.29 |
| Burkina Faso | 0.44 | Iran | 0.10 | Kazakhstan | 0.30 | Namibia | 0.47 | Senegal | 0.52 | Venezuela | 0.46 |
| Burkina Faso | 0.65 | Iran | 0.10 | Russia | 0.56 | New Zealand | 0.29 | Sierra Leone | - | Vietnam | 0.14 |
| Burkina Faso | 0.10 | Iran | 0.54 | Kyrgyzstan | 0.39 | Niger | 0.79 | Sierra Leone | 0.65 | Vietnam | 0.14 |
| Burkina Faso | 0.04 | Iran | 0.13 | Camodia | 0.48 | Nigeria | 0.48 | Sierra Leone | 0.38 | Vietnam | 0.14 |
| Burkina Faso | 0.12 | Georgia | 0.36 | South Korea | 0.07 | Nicaragua | 0.46 | Sierra Leone | - | South Africa | 0.39 |
| Burkina Faso | 0.16 | China | 0.55 | Russia | 0.08 | Netherlands | 0.08 | Sierra Leone | - | Zambia | 0.33 |
| Burkina Faso | - | - | - | - | - | - | - | - | - | Zimbabwe | 0.53 |

1. data analysis



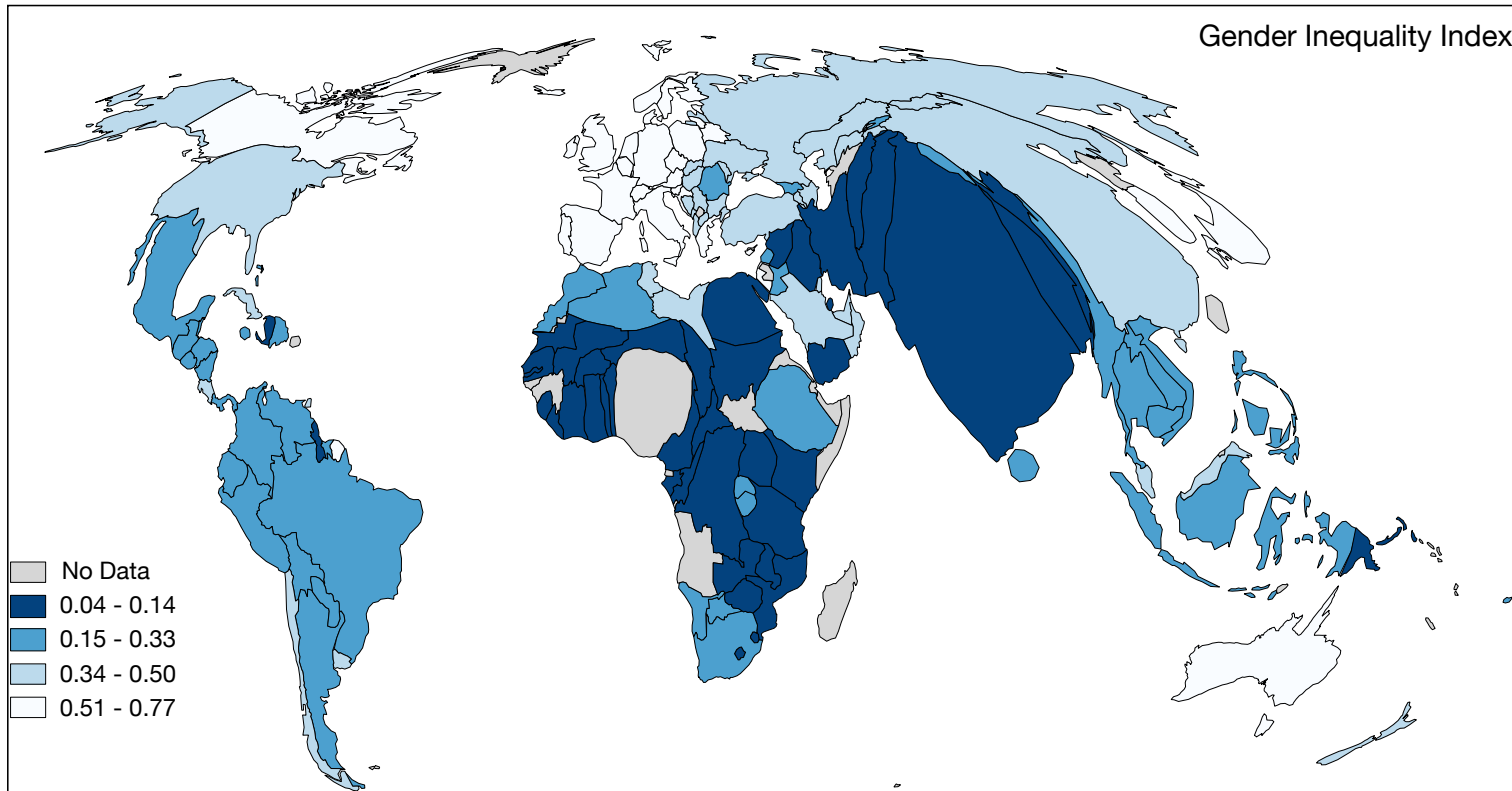
Gender inequality index



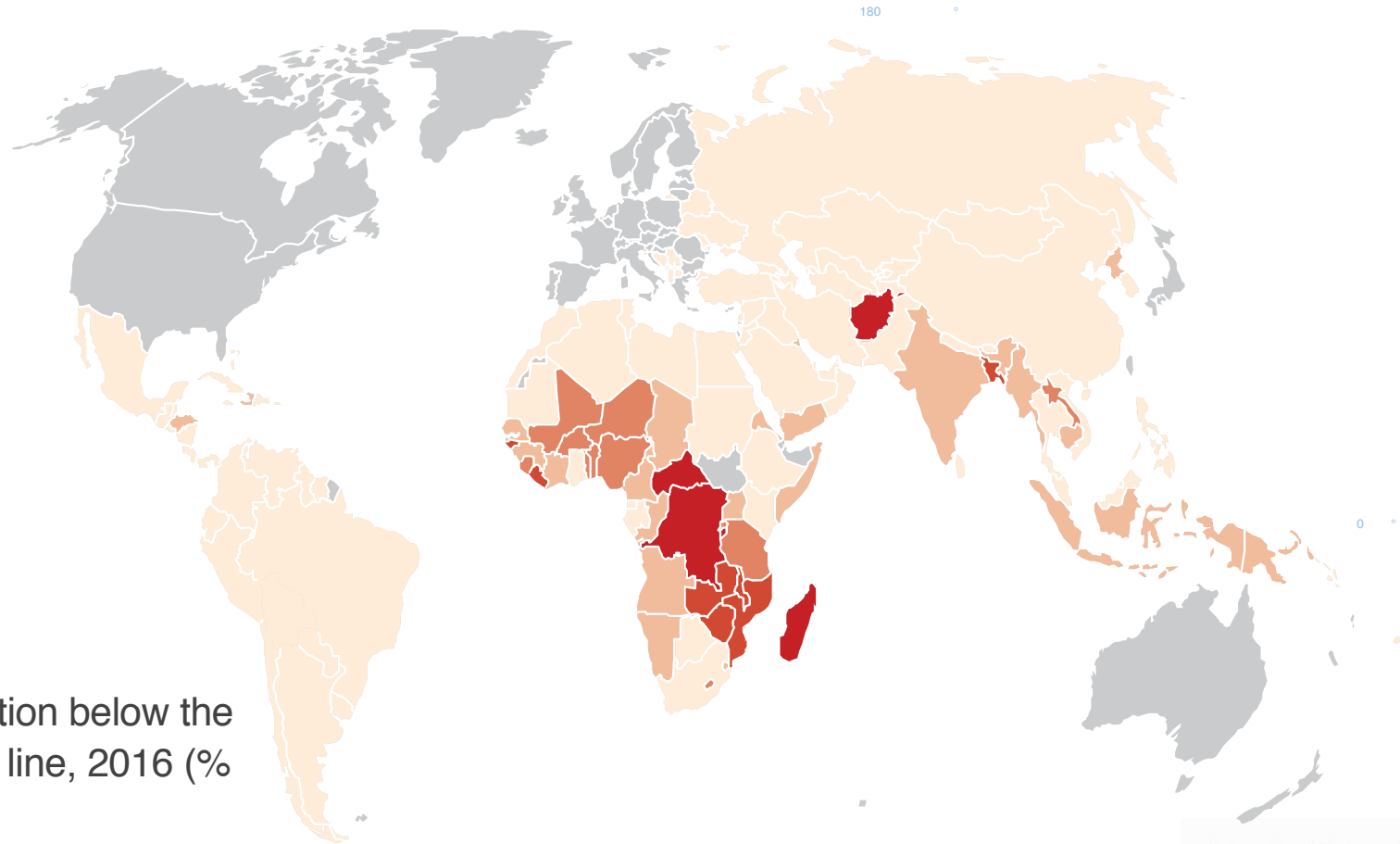
Base Maps



Map projections



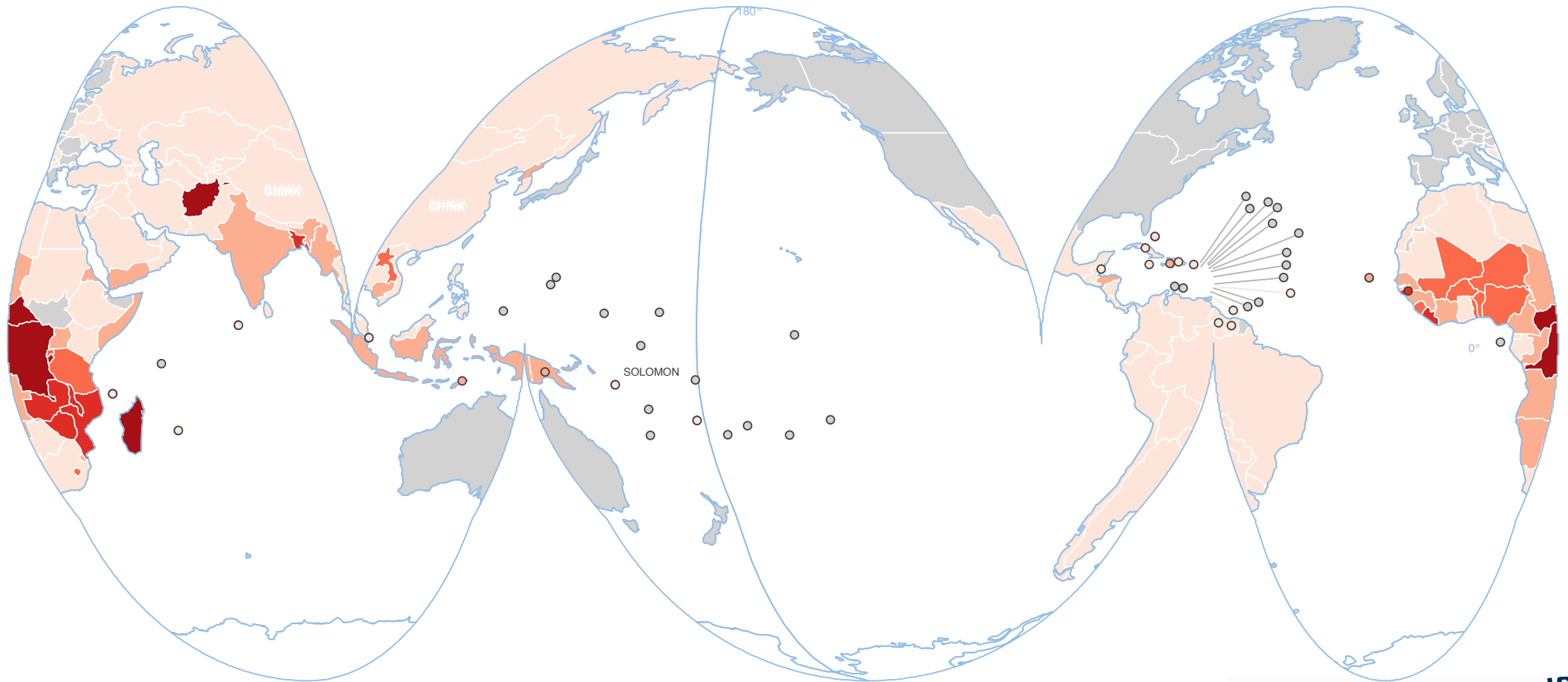
Not visible: Small Island Developing States (SIDS)?



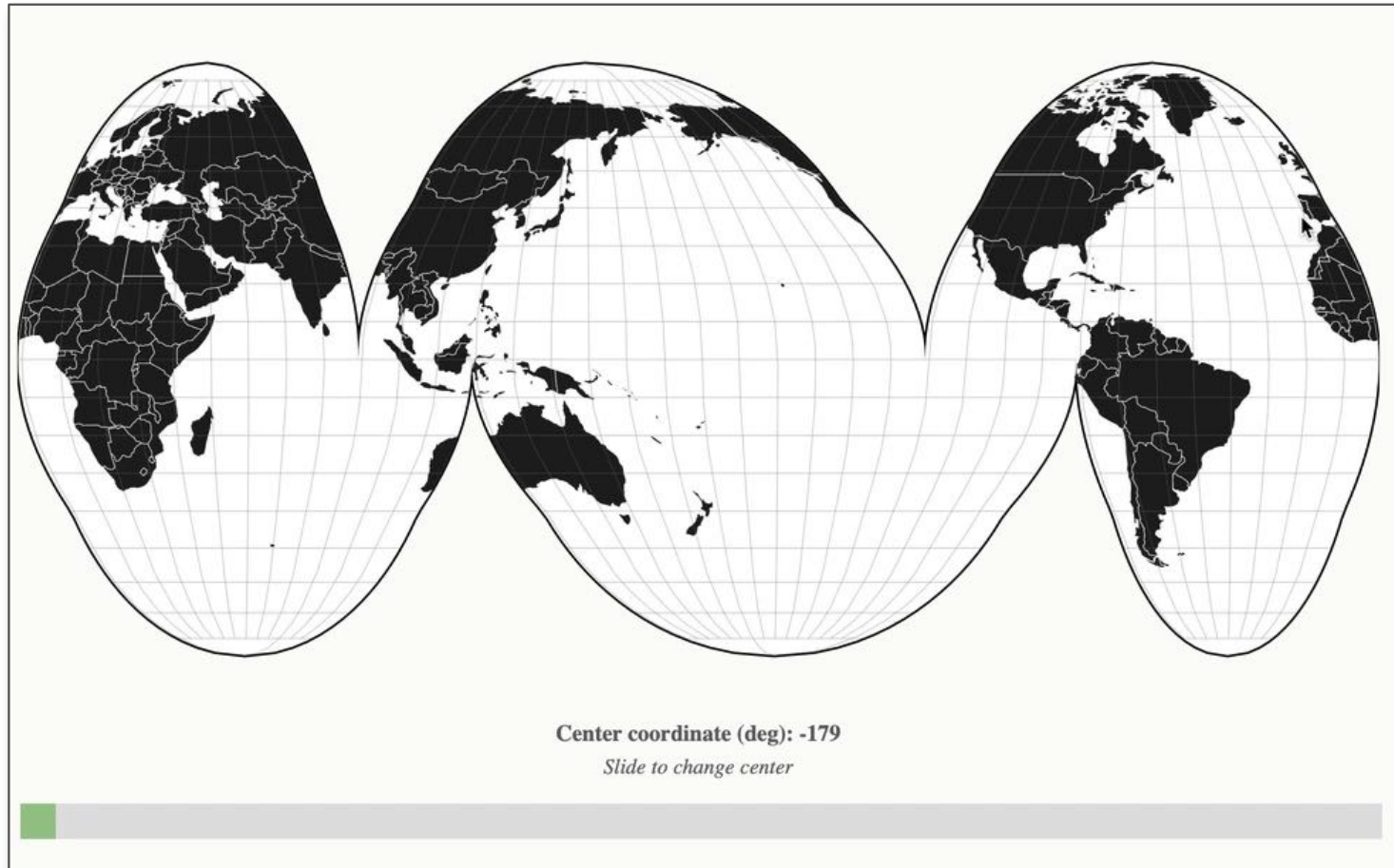
Proportion of population below the international poverty line, 2016 (%)

Visible SIDS

Jessica Gosling-Goldsmith



Moving central meridian



Exercise: define your own world view



Go to: <https://worldview.calisto.pt>

Move the central meridian on the scroll bar below each map into a position you think gives your best global perspective, and click save


Select your country

<https://worldview.calisto.pt>

How should your world look like?

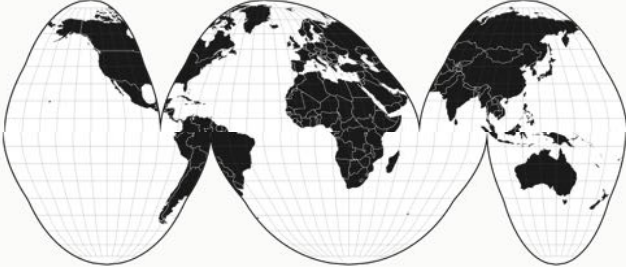
Move the central meridian on the scroll bar below each map into a position you think gives you best global perspective and click save.

Mollweide map projection



Center coordinate (deg): 0
Slide to change center

Goode's interrupted homolosine map projection

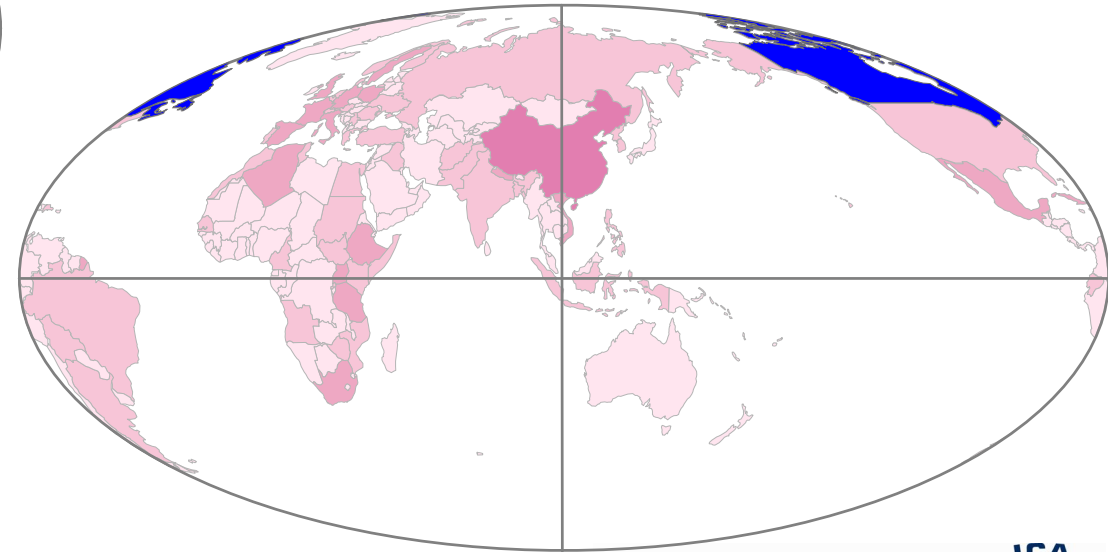
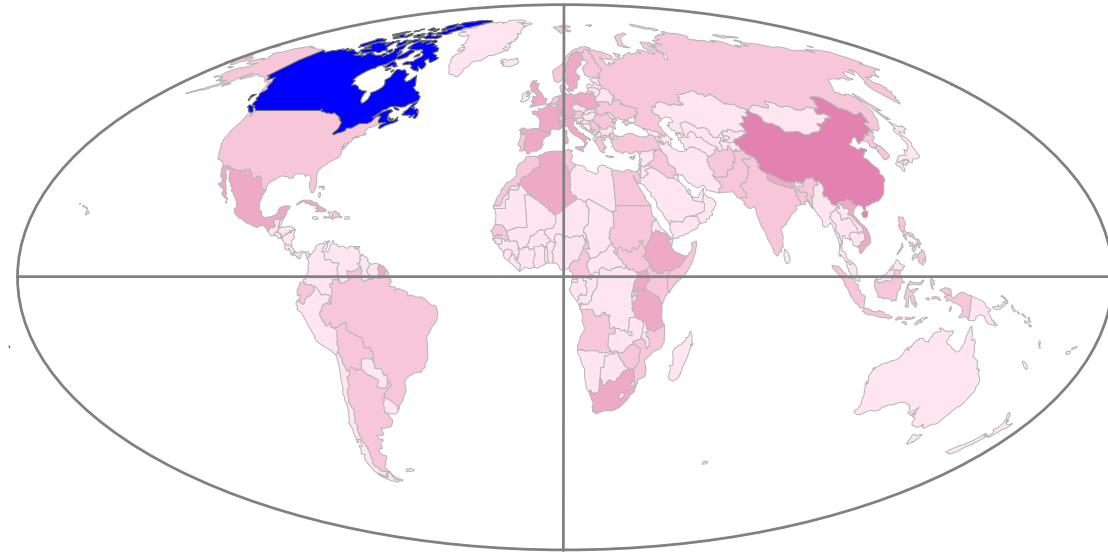
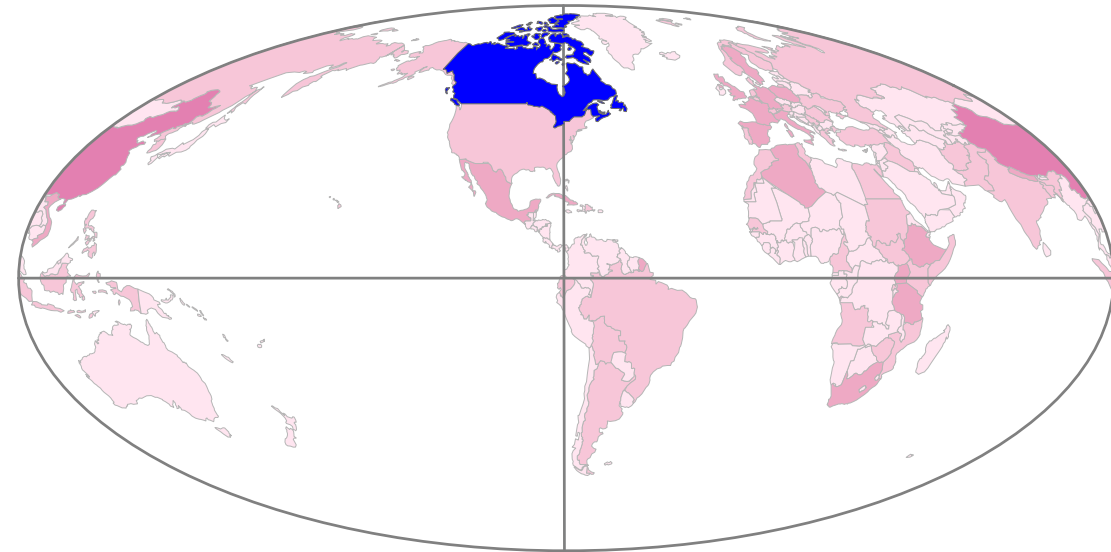


Center coordinate (deg): 0
Slide to change center

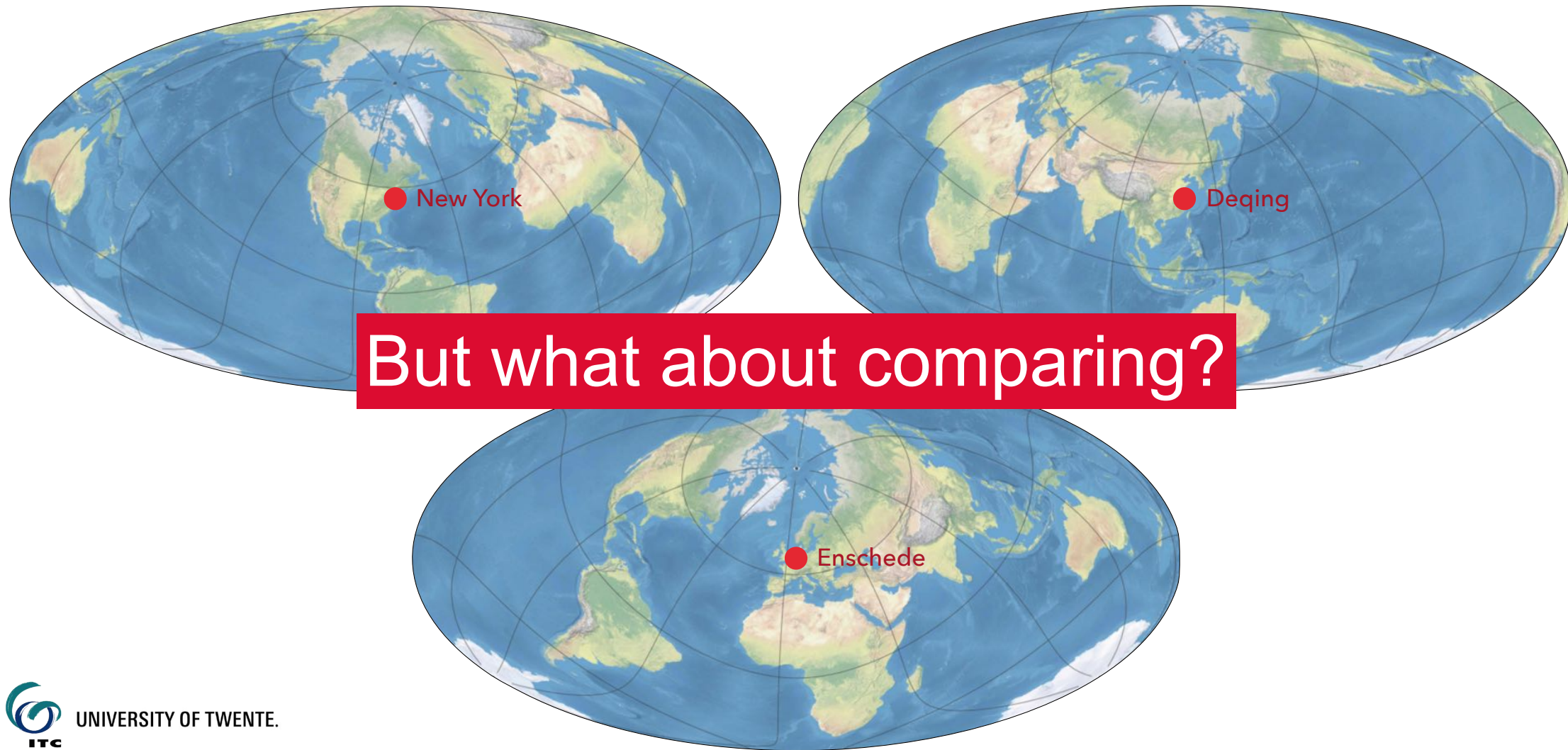
What is your country of residence?

SAVE

Local perspective



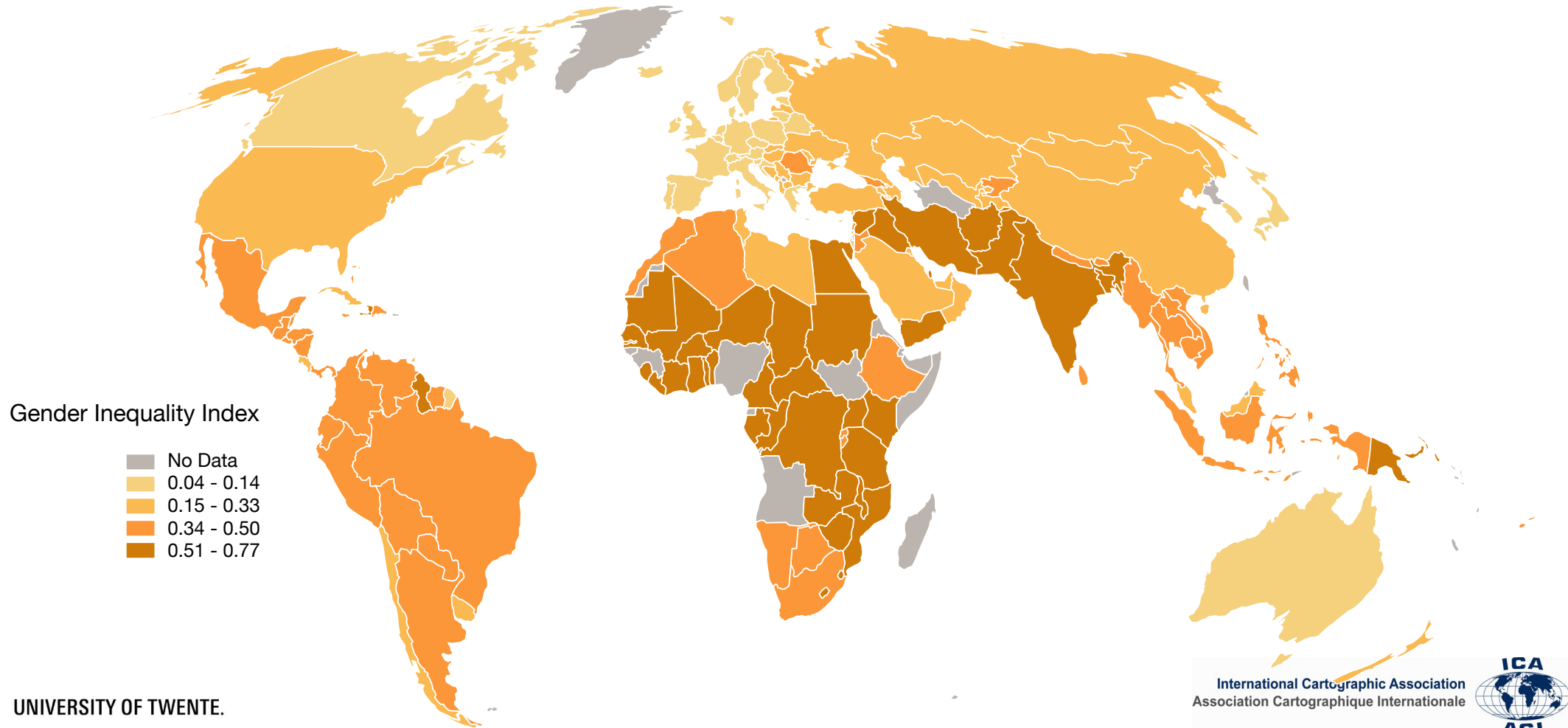
'Local' point for global perspective



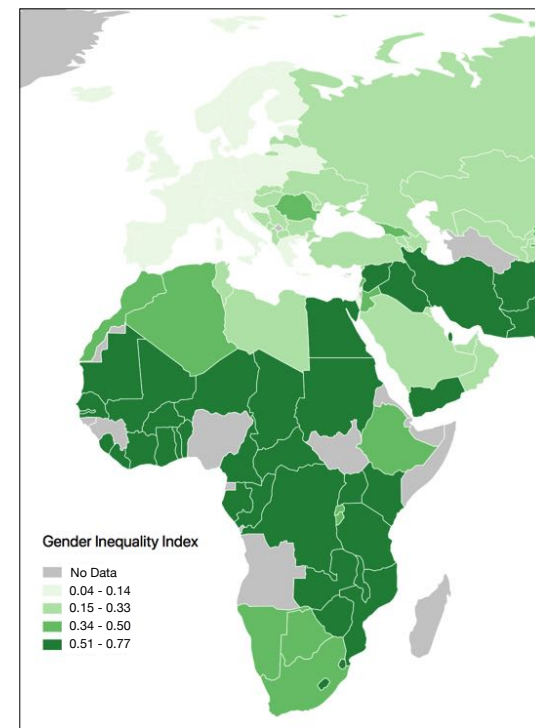
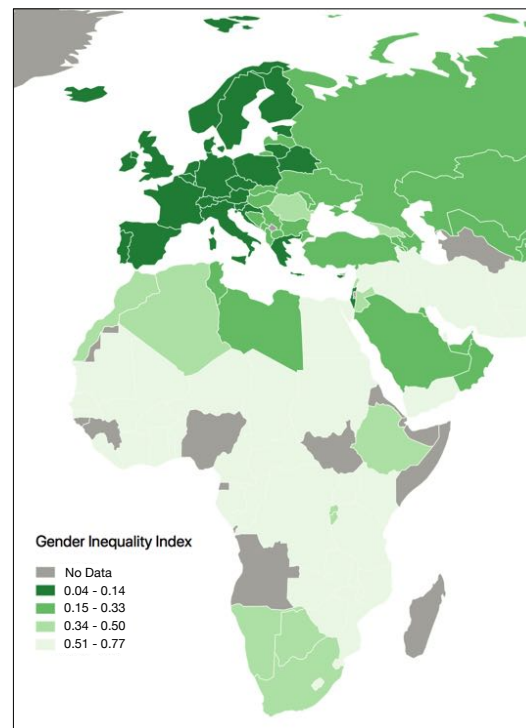
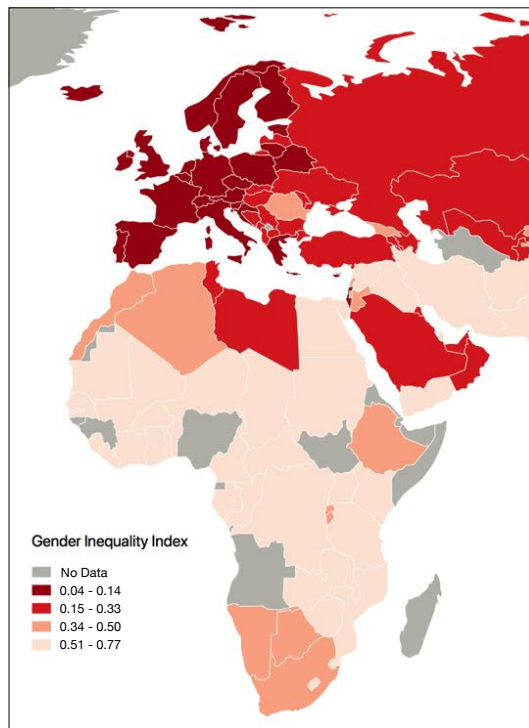
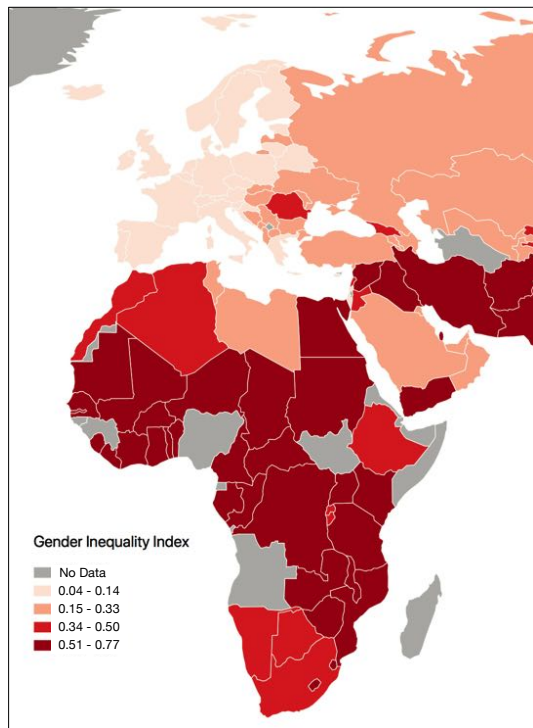
Design choices



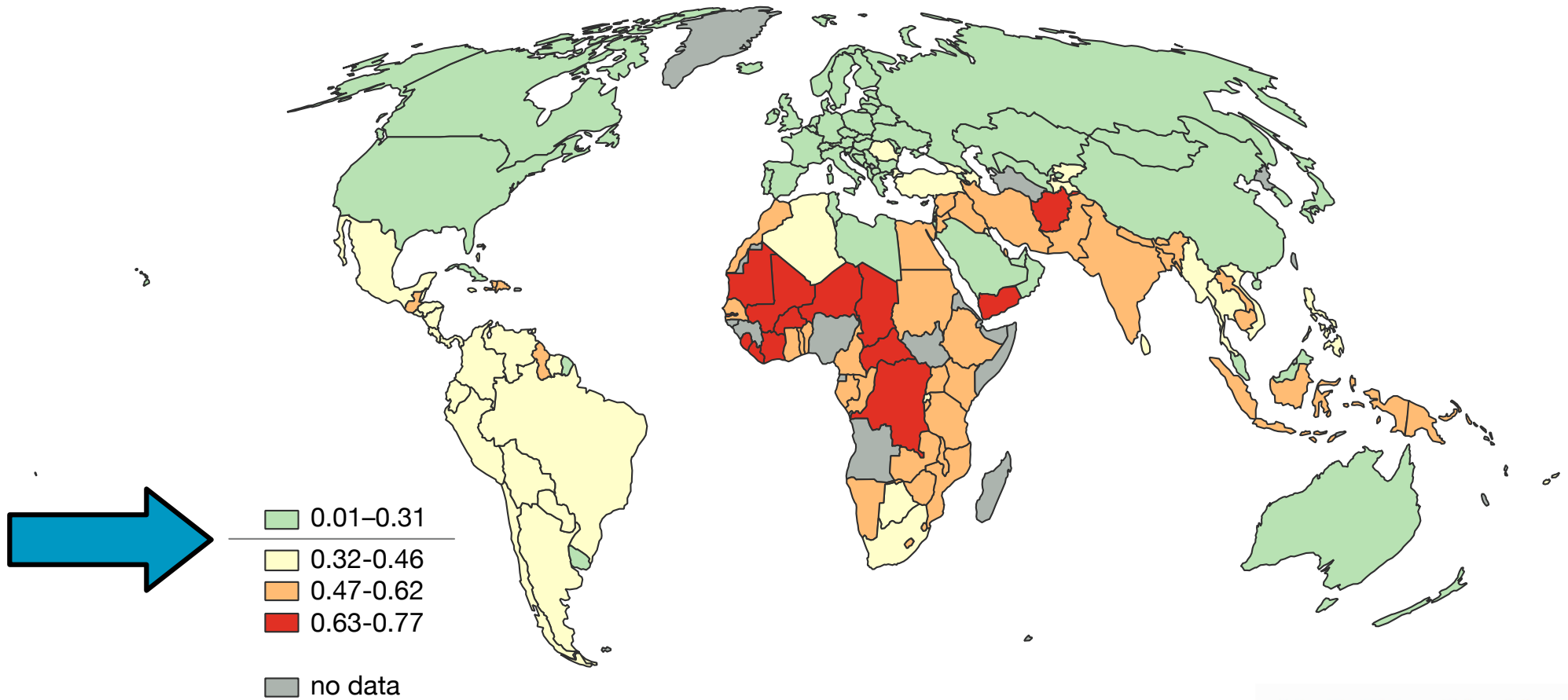
Gender inequality index



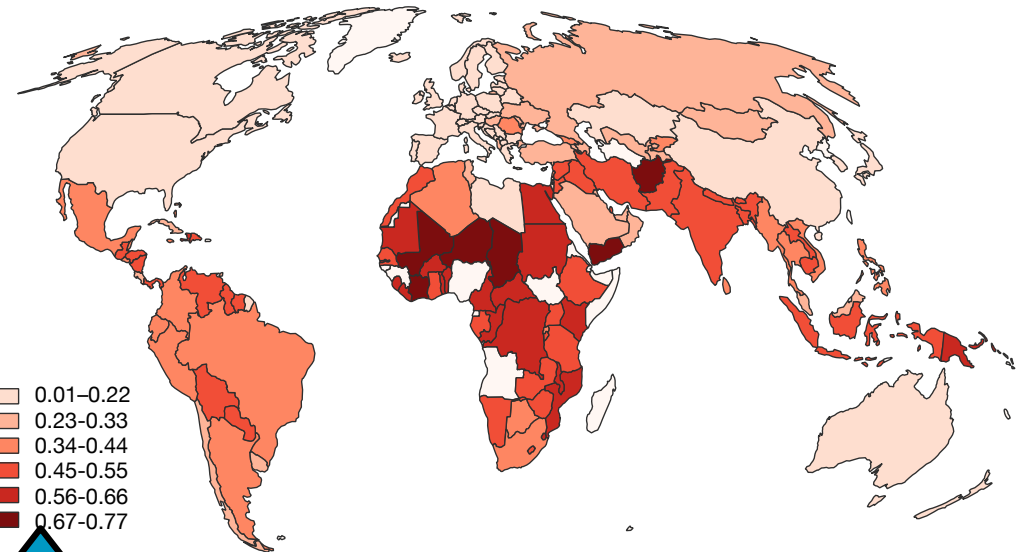
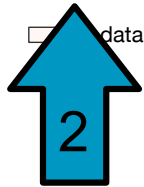
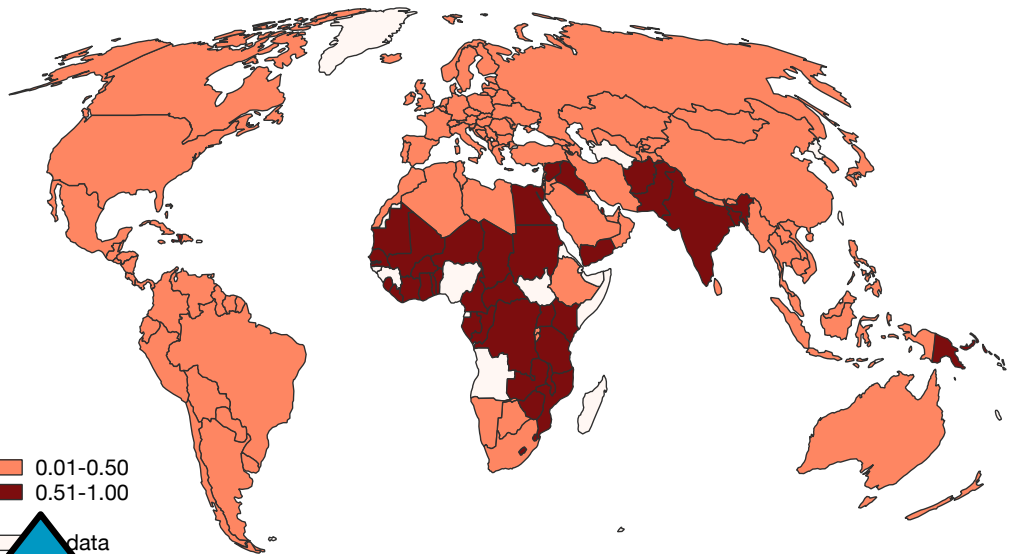
Choice of color - what do you want to tell?



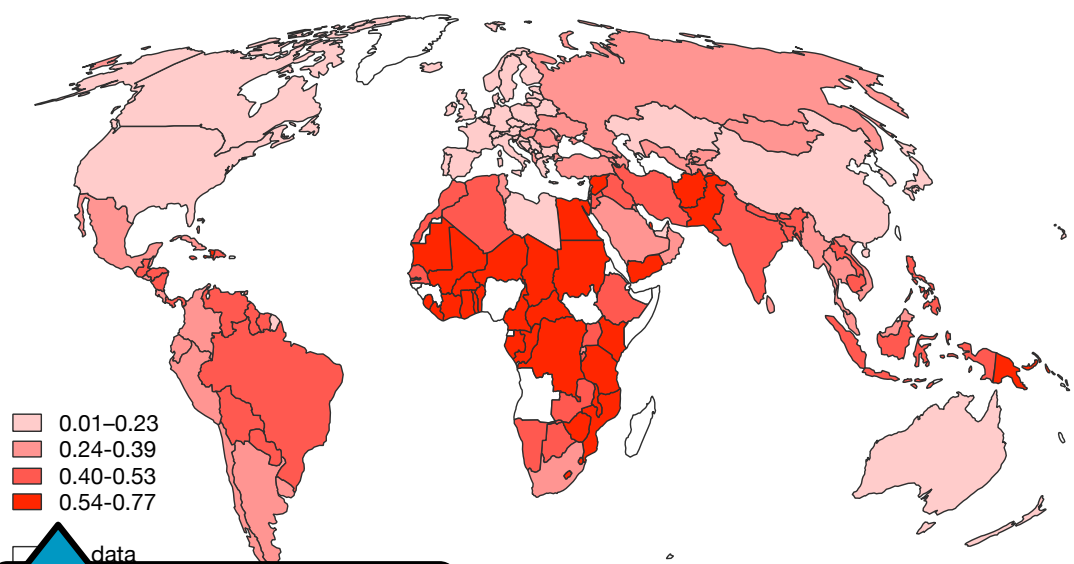
Choice of color - bivariate solution



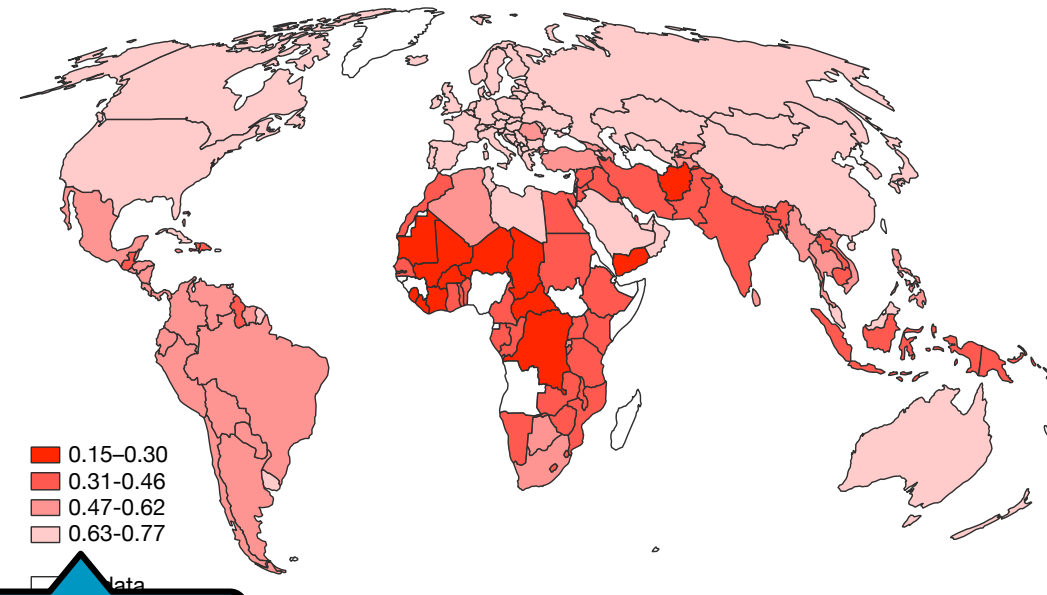
Different patterns because of number of classes



Different patterns because of classification



Same amount of observations per class

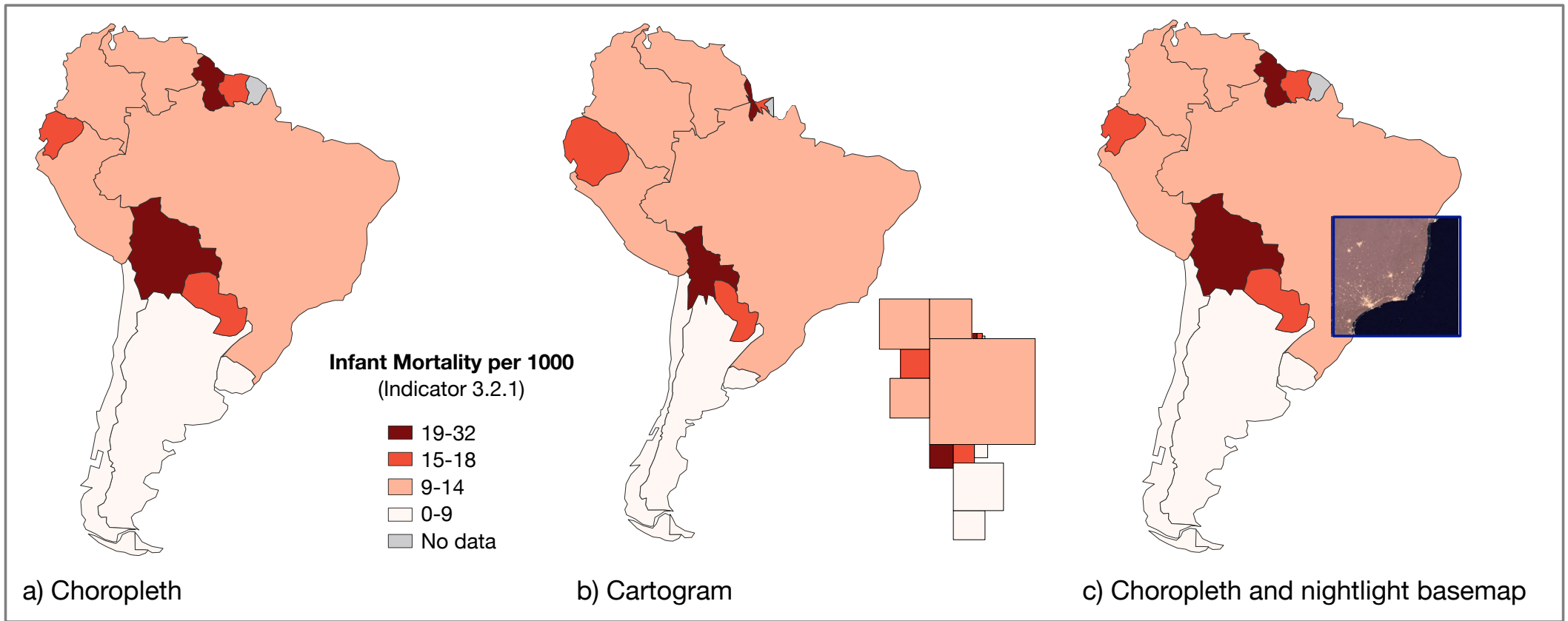


Equal class size

Population related topics



Alternative representations



Conclusions



Mapping problems

- Base map
 - Projection (web services work with Mercator projection....)
 - Content (often satellite imagery / open street map are used....)
- Administrative units
 - Size
 - Distribution within unit (people, other)
- Design flaws
 - Choice projection / adm. units
 - Data handling
 - Application of visual variables
- There is a limited use of the available graphic representations

ICA's objective

Offer guidelines and best practices for mapping the UN SDGs to...

- Best support the SDGs through Cartography with help of the cartographic community
- Transfer knowledge and expertise via the book *Mapping a sustainable world* and various training related activities





Let's make the world a better place with maps