Side Event of the UN Geospatial Network at the Eleventh Session of UN-GGIM

Mapping For A Sustainable World
MAPPING FOR A SUSTAINABLE WORLD
SUSTAINABLE DEVELOPMENT GOALS

17 GOALS TO TRANSFORM OUR WORLD

1. NO POVERTY
2. ZERO HUNGER
3. GOOD HEALTH AND WELL-BEING
4. QUALITY EDUCATION
5. GENDER EQUALITY
6. CLEAN WATER AND SANITATION
7. AFFORDABLE AND CLEAN ENERGY
8. DECENT WORK AND ECONOMIC GROWTH
9. INDUSTRY, INNOVATION AND INFRASTRUCTURE
10. REDUCED INEQUALITIES
11. SUSTAINABLE CITIES AND COMMUNITIES
12. RESPONSIBLE CONSUMPTION AND PRODUCTION
13. CLIMATE ACTION
14. LIFE BELOW WATER
15. LIFE ON LAND
16. PEACE, JUSTICE AND STRONG INSTITUTIONS
17. PARTNERSHIPS FOR THE GOALS
CONSERVE AND SUSTAINABLY USE THE OCEANS, SEA AND MARINE RESOURCES FOR SUSTAINABLE DEVELOPMENT

OCEAN ACIDITY HAS INCREASED BY 26% SINCE PRE-INDUSTRIAL TIMES

IT IS EXPECTED TO RAPIDLY INCREASE BY 100–150% BY 2100

THE INCREASE IN OCEAN ACIDITY IS A NEGATIVE PHENOMENON. IT IMPACTS THE ABILITY OF THE OCEAN TO ABSORB CO₂, AND ENDANGERS MARINE LIFE.

MORE THAN 90% OF DEATHS DUE TO DISASTERS OCCUR IN LOWER-MIDDLE INCOME COUNTRIES

THE PROPORTION OF FISH STOCKS WITHIN BIOLOGICALLY SUSTAINABLE LEVELS DECLINED FROM 90% IN 1974 TO 67% IN 2016.

87 COUNTRIES SIGNED THE AGREEMENT ON PORT STATE MEASURES, THE FIRST BINDING INTERNATIONAL AGREEMENT ON ILLEGAL, UNREPORTED, AND UNREGULATED FISHING.

17% OF WATERS UNDER NATIONAL JURISDICTION ARE COVERED BY PROTECTED AREAS. MORE THAN DOUBLE THE 2010 COVERAGE LEVEL

ACHIEVE GENDER EQUALITY AND EMPOWER ALL WOMEN AND GIRLS

18% OF EVER-PARTNERED WOMEN AND GIRLS AGED 15 TO 49 YEARS HAVE EXPERIENCED PHYSICAL OR SEXUAL PARTNER VIOLENCE

GLOBAL INVESTMENT IN RESEARCH AND DEVELOPMENT IS $2 TRILLION PER YEAR, $728 BILLION IN MEDIUM-HIGH AND HIGH-TECH SECTORS

90% OF PEOPLE LIVE IN A RANGE OF 3.0 $ PC. HIGHER QUALITY ECONOMIC ACTIVITY, BUT NOT ALL ECONOMIC ACTIVITY IS GOOD OR BAD.
Conserve and sustainably use the oceans, seas and marine resources for sustainable development

THE GLOBAL GOALS
For Sustainable Development

**Target**
Goal 14 targets include reducing marine pollution, strengthening ecosystem resilience, restoring habitats, reducing acidification, ending overfishing, conservation and improving research.

**Indicator**
Numerous indicators provide a way of assessing the extent to which targets are met. This poster illustrates a range of indicators and how different designs can support understanding and the overall goal.

**TRADITIONAL MAPPING**
When we think about mapping the oceans we think of traditional hydrological charts. They convey a wealth of detail and remain important in both paper and digital form.

**INTERACTIVE CARTOGRAPHY**
Oceans are inherently three-dimensional with much of it yet to be fully explored. By creating interactive 3D cartographic representations, such as this model of sediment and geologic analysis for Monterey Bay Canion or the interactive map of ocean currents, we offer a unique, immersive and fascinating insight into the world below water.

**MAPPING MEASUREMENTS**
Sea surface temperature is a key climate and weather measurement used for weather predictions, ocean forecasts, tropical-cyclone forecasts, and in coastal applications such as fisheries, pollution monitoring and tourism. El Niño, La Ninña are two qualitatives of climate events which are tracked through the use of sea surface temperature maps.

**MAPPING THE SCIENCE**
The transportation of dissolved gases in water is of prime importance in considering the quality of water. Sufficient amounts of dissolved oxygen are required for marine life survival.

**MAPPING THE HUMAN IMPACT**
Commercial shipping activity can lead to ship strikes of large animals, noise pollution, and a risk of ship groundings or collisions. Ships from many countries voluntarily participate in shipping agreements to reduce the risk of such events.
Open and free publication to
Ensure inclusive and equitable quality education
And promote lifelong opportunities for all

**Mapping for a Sustainable World**
New York: United Nations

Available in UN Digital Library and UNiLibrary
[https://digitallibrary.un.org/record/3898826](https://digitallibrary.un.org/record/3898826)
[https://www.un-ilibrary.org/content/books/9789216040468/read](https://www.un-ilibrary.org/content/books/9789216040468/read)
Onlaps with UN- GGIM topics and working streams:

Partnerships
Data quality and availability
Innovation and geospatial science
Capacity building and Education
Statistical and Geospatial integration
Common geographies
Enumeration areas
Sustainable Development Goals
Use of SDG indicators
Showcase of integration for national context
Structure

The book comprises four sections. Section 1 introduces the SDGs and their relation to geospatial data, describing SDG indicators and data transformations for mapping. Section 2 describes foundational design decisions in the cartographic workflow including projections, scale, generalization, symbolization, typography, and visual hierarchy among others. Section 3 introduces common map types (e.g., choropleth maps, proportional symbol maps, diagrammatic maps, bivariate maps, cartograms) and diagrams (e.g., bar charts, scatterplots, timelines) for representing the SDG indicators. Finally, Section 4 discusses considerations for map use environments such as audiences, user interfaces and interaction options, mobile and web media, storytelling versus exploration, and open access.

SDGs & Geospatial Data

Map design considerations

Maps & diagrams

Map Use Environments

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BACK MATTER

Afterword

Figure Notes

Glossary

UN GEOSPATIAL NETWORK
GLOBAL UNITED NATIONS COMMITTEE ON
UNIVERSAL GEOSPATIAL INFORMATION MANAGEMENT

The Committee and the names shown and the designations used in the book do not imply official endorsement or acceptance by the United Nations.
3.7 Bivariate Maps

A bivariate map (for two, variate variables) depicts two data attributes in comparing an absolute frequency to a relative percentage or an unnormalized single thematic map. Bivariate maps indicator to a normalized variant.
can be powerful for visual interpretation of spatial patterns, particularly for reading the original X and Y indicators.
comparing the spatial distribution of two potentially related SDG indicators as well as promoting reading of the X, Y relationship between indicators, making it easier for identifying outlier locations that do not conform to an expected relationship that do not conform to the expected relationship (Figure 3.7.3). Use integral bivariate maps for confusing and maps for dependent indicators in the even misleading because they exhibit increased information complexity and are found less frequently in popular media.

In practice, it is useful to consider three kinds of bivariate maps based on A configurational bivariate map maintains combinations of the visual variables—reading the original X and Y attributes separable (e.g., thematic map combinations, shaded cartograms, shaded proportional symbols); integral (e.g., bivariate choropleth maps); and configurational (e.g., split symbol maps). Bivariate map legends should be plotted with X- and Y-axes to show all possible symbol combinations (Figure 3.7.3) and, thus, inform how each symbol combination should be read in the resulting map. A separable bivariate map preserves reading of both original X and Y indicators in the map, with a separable map functionally serving like two different maps on a single page (Figure 3.7.2). Use separable maps for independent indicators with different attribute units, such as

\[ \text{Negative Correlation} \]

\[ \text{X: Low} \quad \text{Y: Low} \]

\[ \text{X: Medium} \quad \text{Y: Medium} \]

\[ \text{X: High} \quad \text{Y: High} \]

\[ \text{X: Low} \quad \text{Y: High} \]

\[ \text{X: Medium} \quad \text{Y: Medium} \]

\[ \text{X: High} \quad \text{Y: Low} \]

\[ \text{X: High} \quad \text{Y: Low} \]

\[ \text{Positive Correlation} \]

\[ \text{X: Low} \quad \text{Y: High} \]

\[ \text{X: Medium} \quad \text{Y: Medium} \]

\[ \text{X: High} \quad \text{Y: High} \]

\[ \text{X: Low} \quad \text{Y: Low} \]

\[ \text{X: Medium} \quad \text{Y: Medium} \]

\[ \text{X: High} \quad \text{Y: Low} \]

\[ \text{X: High} \quad \text{Y: Low} \]

Figure 3.7-2: Separable bivariate map, indicator 4.3.1 (2016) on the percentage of women in formal and non-formal education and training is mapped as a choropleth and indicator 5.5.2 (2016) on the per cent of women in managerial positions and in management is mapped with proportional symbols. Separate maps preserve X and Y but do not have an emergent positive (+) dimension.

Figure 3.7-3: Integral bivariate map, indicator 4.3.1 (2016) and 5.5.2 (2016) are remapped using a bivariate choropleth, which has an emergent positive (+) dimension. Because both indicators have the same attribute unit (percentage), the bivariate choropleth map is in a better solution than the thematic map combination in Figure 3.7.2.

Figure 3.7-4: Configural bivariate map, indicator 4.3.1 (2016) and 5.5.2 (2016) are remapped as a split proportional symbol map. Configural solutions preserve X and Y but also have an emergent + dimension. The split proportional symbol map is more informative than the integral bivariate choropleth in Figure 3.7-2 because it shows independence at different attributes is assumed.

Figure 3.7-5: Reading bivariate maps. Bivariate map legends should be arranged in two dimensions to show examples symbol combinations. Different bivariate maps types vary by how the X- and Y-axes and positive (+) correlation are presented.

Section 3.7: Bivariate Maps 71
94 SDG Maps!
68 Schematic Maps!
35 SDG Diagrams!
30 Other Figures!
Compelling stories about our world…

…using maps and geospatial information
Mapping for the Goals
Cartographic planning and design
What is the narrative?

1. Define the Project Goals
   - Subject/Goal
   - Audience
   - Environment
   - Data selection
   - Decision on representation

2. Review Available Datasets
   - Review available datasets
   - Collect official SDG indicator data

3. Clean and Format Datasets
   - Choose software
   - Clean and Reformat
   - Choose Enumeration areas
   - Align attributes
   - Assess completeness
   - Manage missing data
   - Join temporal data

4. Transform & Analyze Data for Insights
   - Data transformation
   - Normalize to enumerated areas
   - Classification scheme
   - Review data distribution
   - Check anomalies or patterns

5. Execute the Map Design
   - Projection
   - Symbolization
   - Scale & extent
   - Thematic map type
   - Visual variable
   - Symbol/shape
   - Annotation/Typography

6. Evaluate and Edit the Map Design
   - Complete a self-edit
   - Consultation/feedback
   - Revise and finalization
## SDG Indicator Data

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Goal 1: By 2030, end poverty in all its forms everywhere.

Target 1.1: By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.90 a day.

Indicator 1.1.1: Proportion of the population living below the international poverty line by sex, age, employment status.

Target 1.2: By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its forms everywhere.

[SDG Indicators Database](https://unstats.un.org/sdgs/indicators/database/)
Transform & Analyze

Statistical distribution analysis and classification

Figure 1.9-1: Data distributions and classification. Left: The histogram depicts the left-skewed attribute distribution for Indicator 11.6.2 (2016) on the annual mean levels of urban fine particulate matter. Right: The resulting arithmetic scheme increases distances between class breaks in a regular progression, here expanding each class width by 5 μg/m³ to provide more detail for features in the clustered side of the distribution rather than emphasizing outliers.

Geographic transformation

Figure 3.8-2: Types of cartograms. Indicator 4.b.1 (2018) on the total official flows for scholarships, by recipient country (Millions USD) is mapped for South American countries as a choropleth atop four different population-based cartograms. Top-centre: Contiguous. Top-right: Non-contiguous. Bottom-left: Circular. Bottom-right: Rectangular.
Execute map design

Figure 3.1-1: Thematic map types. The four maps depict Indicator 12.2.2 (2016) on domestic petroleum consumption. **Top-left:** Proportional Symbol. **Top-right:** Dot density. **Bottom-left:** Choropleth. **Bottom-right:** Shaded Isoline.

Figure 3.1-2: Choosing a thematic map type. Section 3.2 treats nominal maps, Section 3.3 choropleth maps, and Section 3.4 proportional symbol maps.
GOAL 1: END POVERTY IN ALL ITS FORMS EVERYWHERE

1. Mapping for the Goals Publication
   General public

2. Statistical - SDG indicators as:
   Proportion of pop. living below poverty line (most current values)
   Geospatial - UN Geodata

3. Enumeration Areas as:
   Sub- & intermediary regions

4. Choropleth Classification scheme
   Review data distribution

5. Symbol and Color value
   Scale and extent
   Annotation and graphics

6. Review

The UN Secretary-General meets people living in a camp for internally displaced persons (IDPs) in the town of Bangassou, Central African Republic. (Source: UN Photo/Eskinder Debebe, 2017)
GOAL 1: END POVERTY IN ALL ITS FORMS EVERYWHERE

SDG Target 1.1
Eradicate extreme poverty for all people everywhere

▲ 736 million people lived in extreme poverty in 2015

413 Million
Sub-Saharan Africa

323 Million
Rest of the World

▲ Most people that earn less than 1.90 USD per day live in Sub-Saharan Africa

Proportion of Population Living Below the International Poverty Line
(Most Current Value: 2012–2016)

▲ The map depicts Indicator 1.1.1 (most current value for 2012–2016) on the proportion of population living below the international poverty line (at or at 1.90 USD per day) as a choropleth by SDG groupings. The M49 standard is a multi-level, global set of region, sub-region, and intermediate region groupings for obtaining greater homogeneity in sizes of demography. The SDG groupings are derived from the M49 methodology and use a combination of regions and sub-regions.

Indicator 1.1.1 is a ratio level, relative value (a proportion) and, thus, is normalized for choropleth mapping to mitigate effects from the modifiable areal unit problem. The choropleth map uses an arithmetic classification for the left-skewed attribute distribution and a sequential colour scheme for an apparent increase from low to high.

The UN Secretary-General meets people living in a camp for internally displaced persons (IDPs) in the town of Bangassou, Central African Republic. (Source: UN Photo/Eskinder Debebe, 2017)

The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.
GOAL 5: ACHIEVE GENDER EQUALITY AND EMPOWER ALL WOMEN AND GIRLS

- Only 24% of parliamentary leaders were women in 2020

> 24% Women
> 76% All Others

- Only four national parliaments have 50% or greater representation by women

Proportion of Seats held by Women in National Parliaments
(Per cent of Total Seats; 2020)

- Cuba: 53.2%
- Bolivia: 63.1%
- Rwandan: 61.3%
- United Arab Emirates: 50.0%

SDG Target 5.5

Ensure women’s full and effective participation and equal opportunities for leadership at all levels of decision-making

The map depicts Indicator 5.5.1 (2020) on the proportion of seats held by women in national parliaments as a choropleth map. Countries in the choropleth map are highly generalized to show only the overall thematic patterns, simplifying the message. This style also increases the visual weight of smaller nations. UN Women promotes this basemap for its publication on “Women in Politics.”

Although simplified, the map remains projected in the Eckert IV equivalent projection used throughout the book, allowing for comparison of areas in the choropleth. The choropleth map uses an equal interval classification for the uniform attribute distribution and a sequential colour scheme that crosses yellow to green colour hues but primarily relies on the ordered visual variable colour value.
GOAL 9: BUILD RESILIENT INFRASTRUCTURE, PROMOTE SUSTAINABLE INDUSTRIALIZATION, & FOSTER INNOVATION

32 billion tons of CO₂ were emitted globally in 2017

CO₂ Emissions (Billions of Tons)

The two largest national economies by GDP also emit the most CO₂ worldwide

Gross Domestic Product Purchasing Power Parity (Billions of USD; 2017)*

*Areas rated by CO₂ emissions from fuel combustion (2017)

The map depicts Indicator 9.4.1 (2017) on CO₂ emissions in metric tons per chained dollars as a contiguous cartogram. Rather than mapping the normalized indicator as a choropleth map, the relative rate is reweighted to the original absolute attributes and then mapped using two different visual variables: countries are scaled by total CO₂ emissions from fuel combustion (size) and then shaded by gross domestic product (GDP) purchasing power parity (colour value).

The resulting bivariate cartogram visually normalizes GDP by CO₂ emissions, showing dramatic differences among regions. As temperatures rise an estimated 1.5°C by 2100, the cartogram reveals that the Global North has a disproportionate responsibility in reducing CO₂ emissions through sustainable infrastructure and industries.

A Mongolian family uses solar panels to generate power for their ger, a traditional Mongolian tent, in Tariatlan, Province of Uvo in Mongolia. The solar panels are sponsored by the United Nations Development Fund to empower herder groups to use clean energy. (Source: UN Photo/Olinder Deboho, 2009)
GOAL 13: TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE

Climate change affected more than 39 million people in 2018

SDG Target 13.1
Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters

Only 85 countries have plans to meet the Sendai framework to reduce disaster risk

Persons Directly Affected by Disasters (Highest Value 2010–2019)

Total Number

<table>
<thead>
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Secretary-General of the World Meteorological Organization (WMO) briefs reporters on its State of the Climate 2019 Report. A world map of global temperature differences between 1981–2010 and 2019 is shown in the background. (Source: UN Photo/Manuel Elias, 2020)

The map depicts Indicator 13.1.1 (highest value 2010–2019) on directly affected persons attributed to disasters using shaded proportional symbols by country. Affected persons is depicted in two ways: the absolute total as proportional symbols (size) and the relative rate per 100,000 people through shading (colour value).

Climate change affects everyone, but developing countries and marginalized populations often shoulder a disproportionate burden from climate-related hazards such as severe weather, fires and flooding, and food and water scarcity. Representing Indicator 13.1.1 in two ways tells the story of both the overall magnitude of the problem through the proportional symbols and the impact on specific populations through the colour shading.

The translations and names shown and the designations used in this brief do not imply official endorsement or acceptance by the United Nations.
WHAT IS NEXT?
REFERENCES


Sustainable Development Goals: https://sdgs.un.org/goals
IAEG-SDGs: https://unstats.un.org/sdgs/iaeg.sdgs/
WG on Geospatial Information: http://ggim.un.org/UNGGIM-wg6/
UN-GGIM: https://ggim.un.org/
UN Geospatial website: https://www.un.org/geospatial/
Partnership information between ICA and UNGIS: https://www.un.org/geospatial/programmes
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