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SEDAC: Bridging Earth & Social Sciences

SESAC Symposium – 5 March 2026

Alex de Sherbinin, PhD
CIESIN Director
Former SEDAC DAAC Manager

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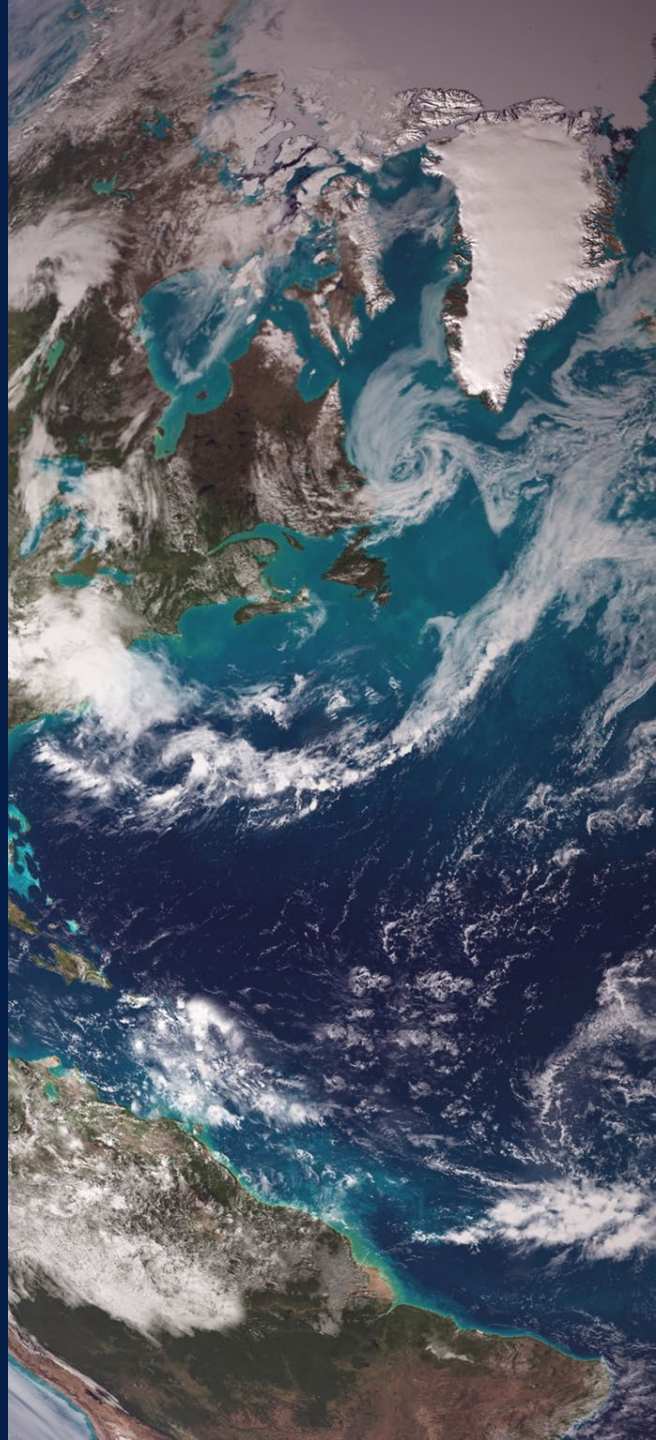
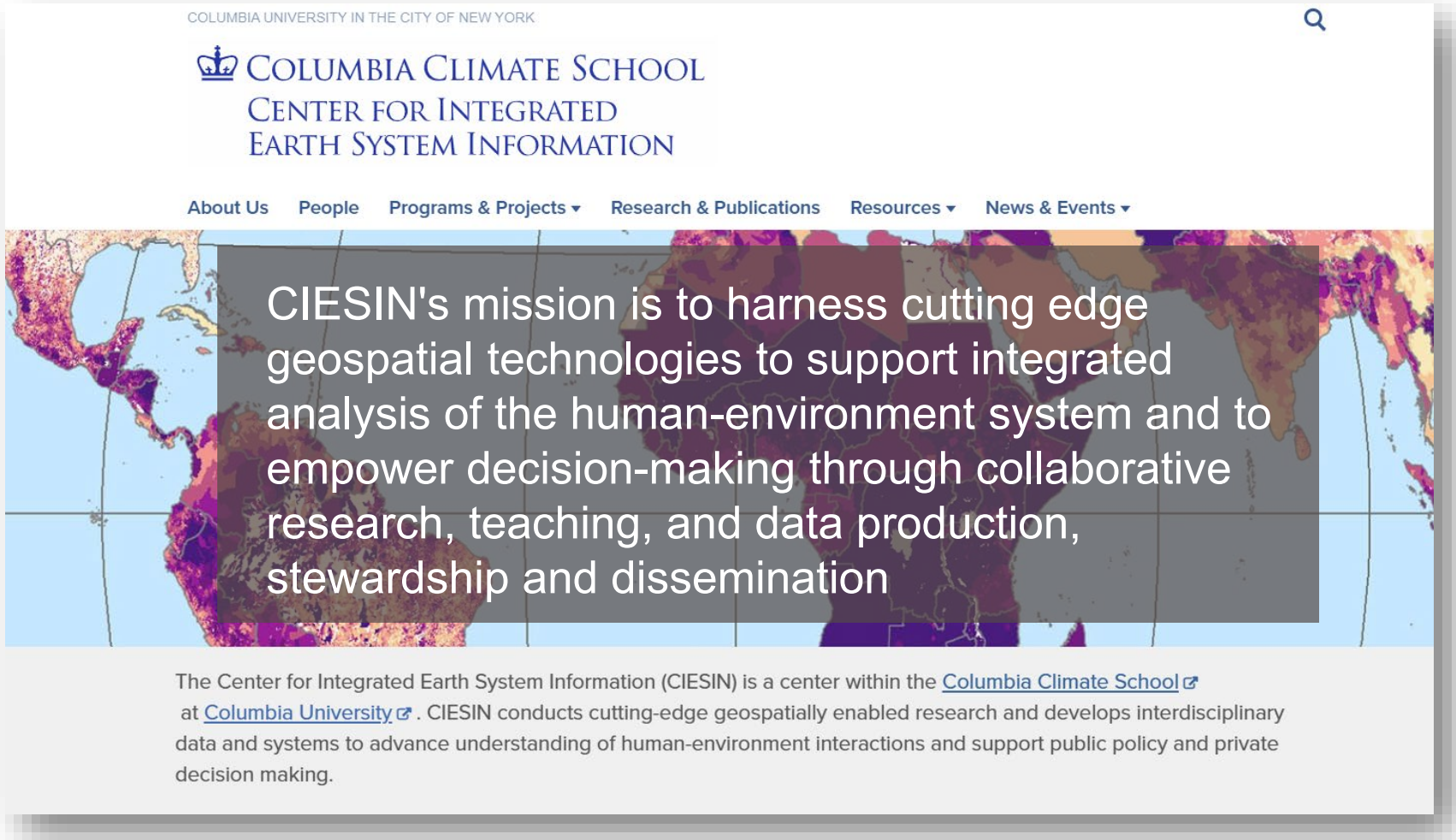


CIESIN history and mission

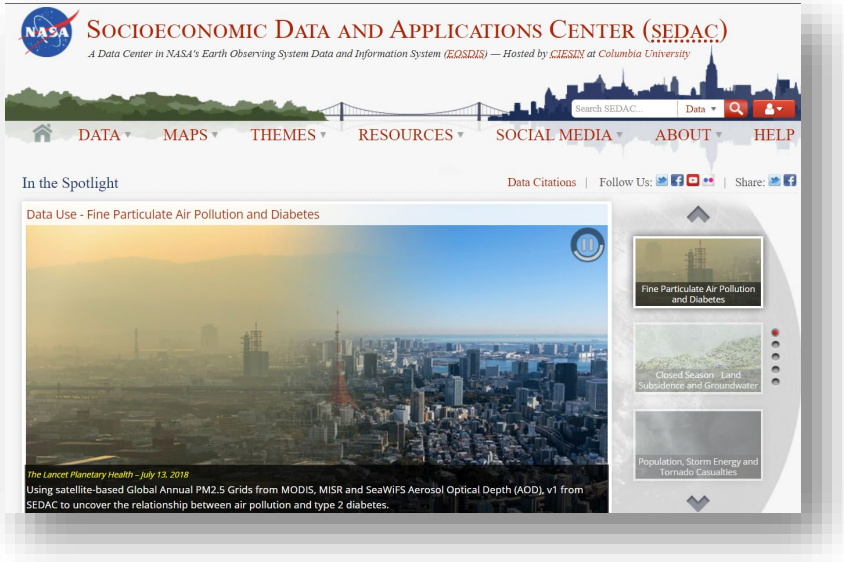
- Established in 1989 in Saginaw, Michigan as a Consortium of universities
- Joined Columbia University's Earth Institute in 1998



NASA Socioeconomic Data and Applications Center (SEDAC) – 1998-2025

- Set up by NASA with the express purpose of bridging earth and social sciences
- >300 data sets comprising many >60k granules, 6 TB total archive size
- Approximately 800 citations of SEDAC data per year in the peer reviewed literature, including 38 in the *Nature* family of journals, 6 in *Global Change Biology*, 4 in *PNAS*, and 6 papers published in *Science* or *Science Advances*.
- A large use by applied users in disasters, humanitarian, development, planning and other fields

Project Summary
The SEDAC was a $30m 5-year contract to run a data center that is part of the Earth Observation System Data and Information System (EOSDIS). SEDAC provides the data that put “people” in the pixel.



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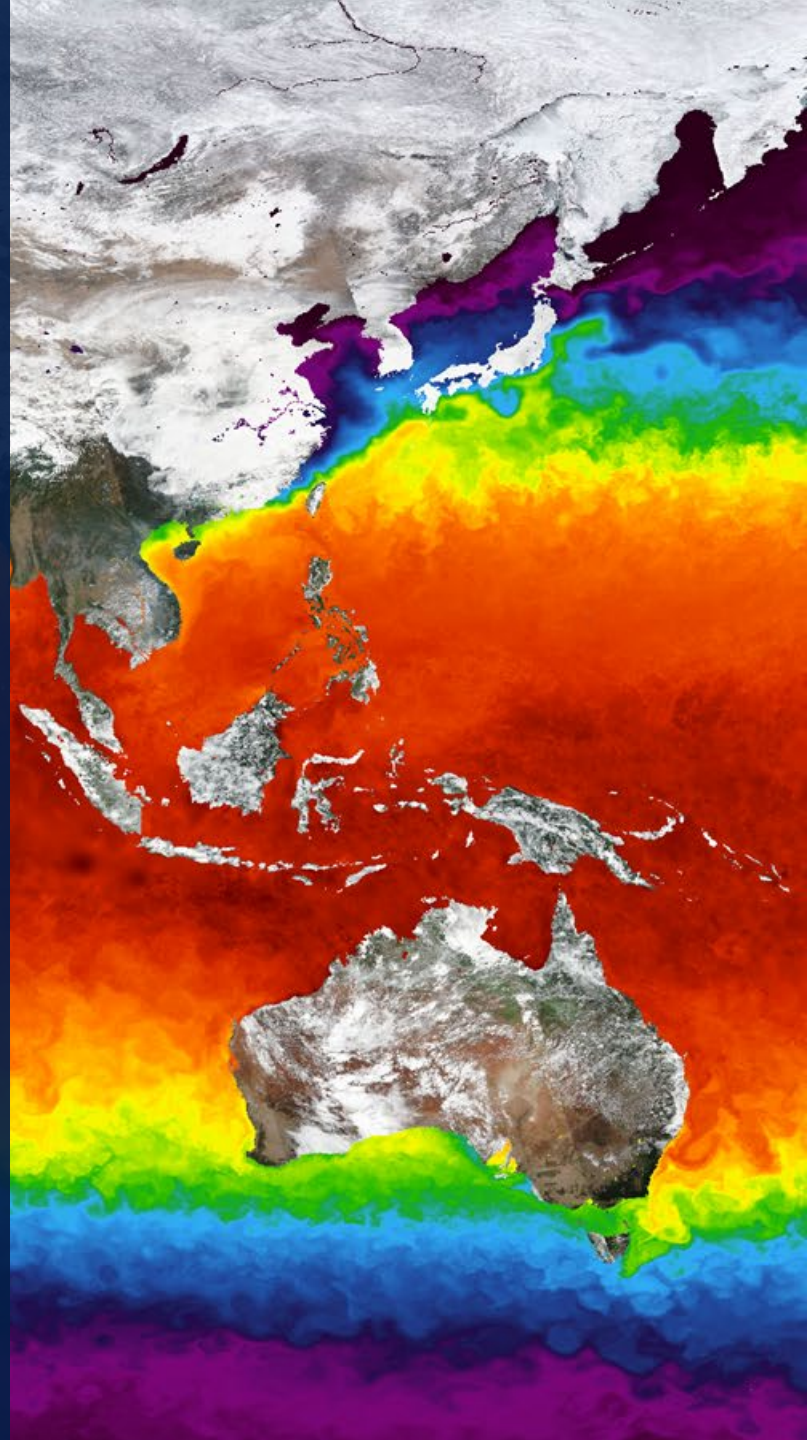
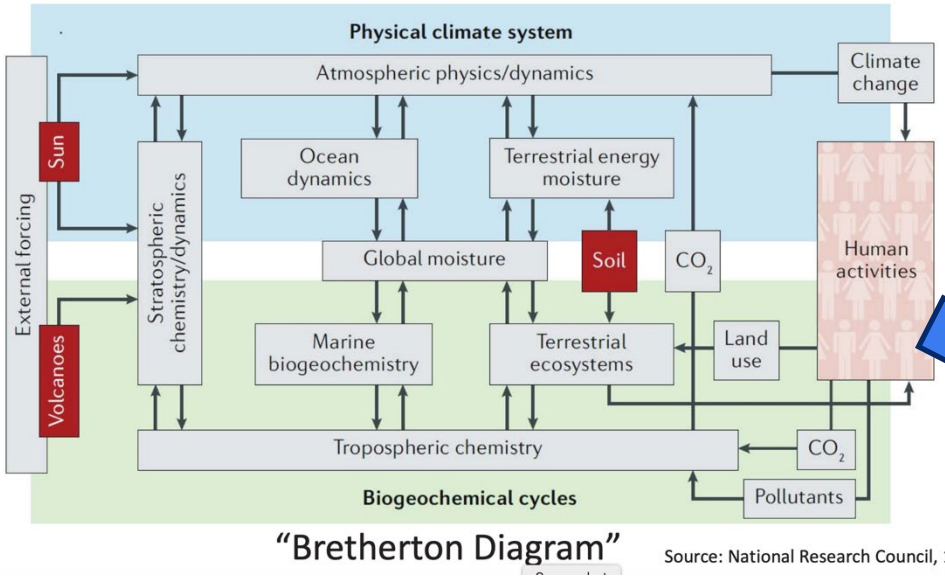
SEDAC History & Rationale Within NASA



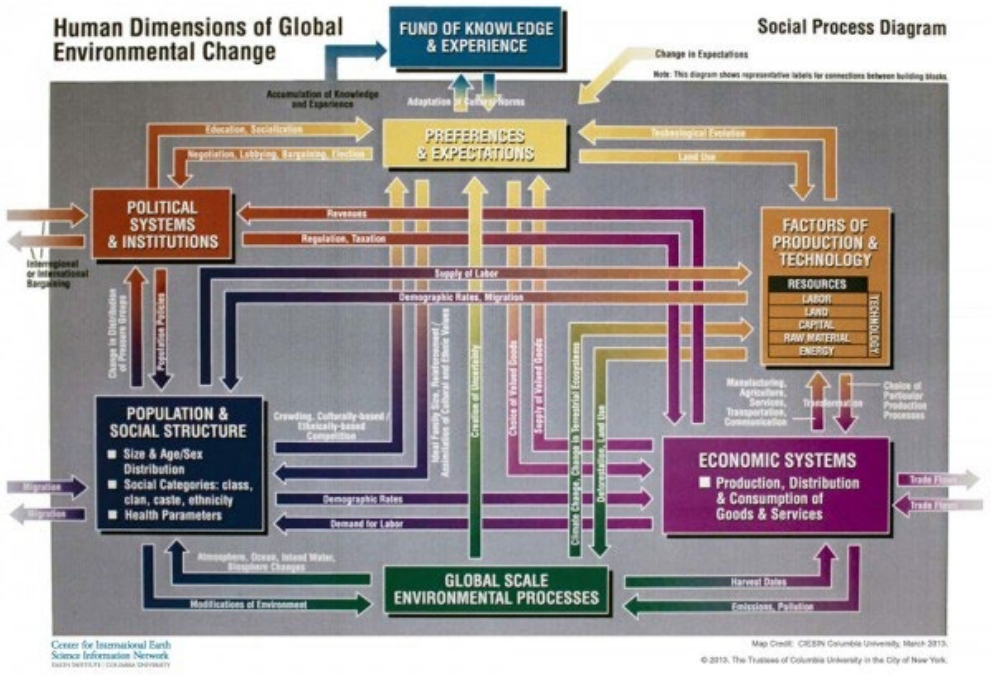
Mission to Planet Earth (MTPE) built on early thinking about Earth System Science and the importance of the human dimensions of global change



"Bretherton Diagram"

Source: National Research Council, 1986

"The "Bretherton Report" was the crucible for both the interdisciplinary field of Earth System Science and NASA's Earth Observing System." – G. Williams, 2009



https://news.climate.columbia.edu/2013/03/04/a-road-map-towards-better-understanding-of-global-environmental-change/

Missions planned or operational in the 1990s:

- Landsat 7
- TRMM
- Terra & Aqua (MODIS, MISR, CERES, MOPITT, and ASTER)
- SeaWiFS

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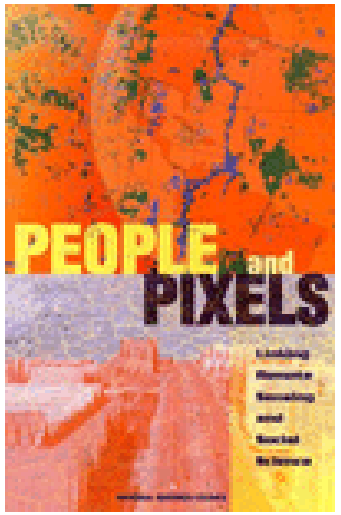
NASA recognized the need for integration of Earth science and socioeconomic data and information to support applications and decision making

Research on Human Dimensions

The human dimensions of environmental change are important elements in understanding the Earth as a system. Social science research is primarily conducted by other Federal agencies, such as the National Science Foundation, the Environmental Protection Agency, and the Department of Health and Human Services. The Enterprise works directly with these agencies to develop the data and information from NASA's observatories and decision support systems for their applications. Additionally, the results of this important research that are relevant to global change and Earth system science are distributed through the Socioeconomic Data Archive Center (SEDAC), located at Columbia University. As part of the integrated NASA Earth science data and information system, SEDAC provides geospatial data and information vital to understanding the Earth as a system and represents a focal point for interaction between scientific efforts at NASA and those at other agencies, as well as communication with the public and social science communities.

Box on Human Dimensions Research from the *Earth Science Enterprise Strategy* (NASA, 2003, p. 8).

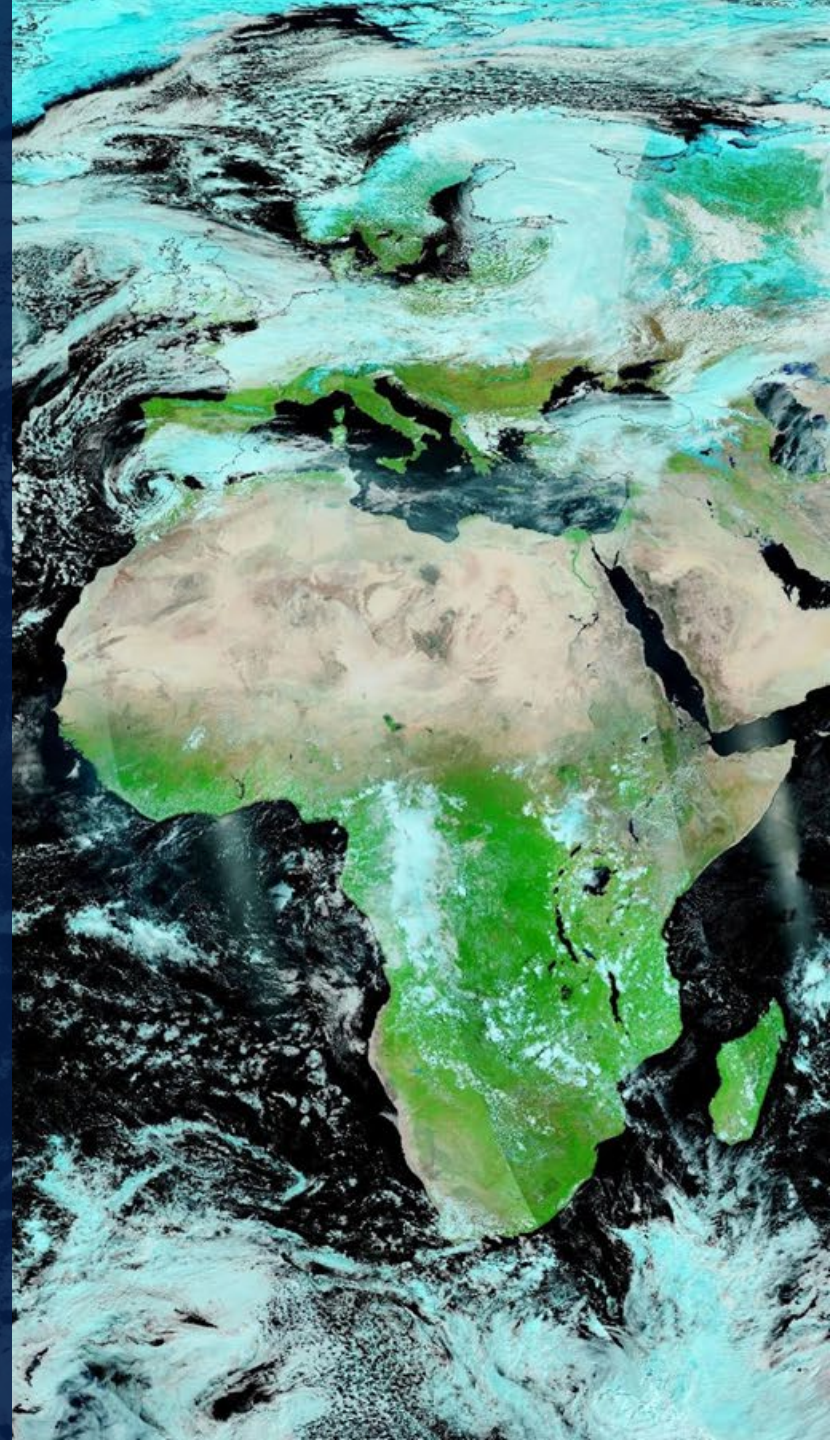
- The 1998 NRC report, *People and Pixels*, had a strong influence on the importance of data integration and on SEDAC's mission and focus
- *SEDAC Statement of Work, June 1998*
  - The mission of SEDAC as an institutional element with EOSDIS encompasses two areas of equal priority:
    - Development and consequent operation of applications which support the user community
    - Improvement of the exchange of data and information between Earth scientists and socioeconomic data users



https://doi.org/10.17226/5963

Ronald Rindfuss
SEDAC UWG Chair, 1998-2001

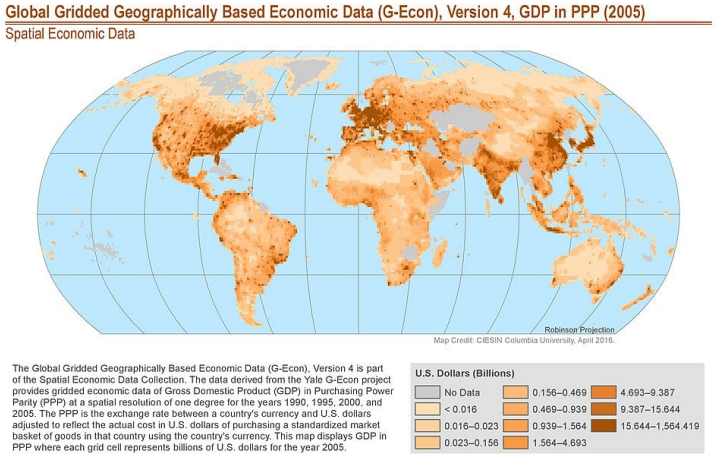
Sample Data Products and Applications

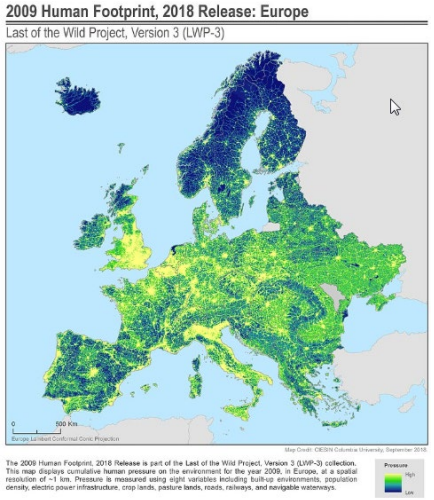


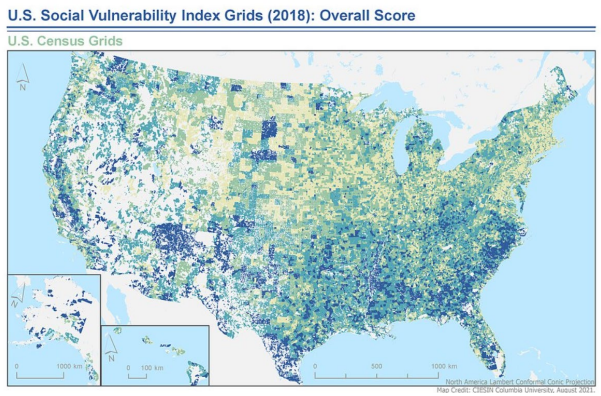
SEDAC distributed many different data sets across a range of topics and application areas

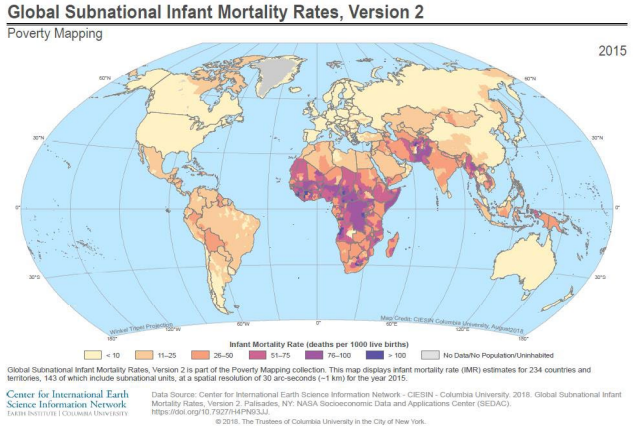
Current SEDAC Mission Areas

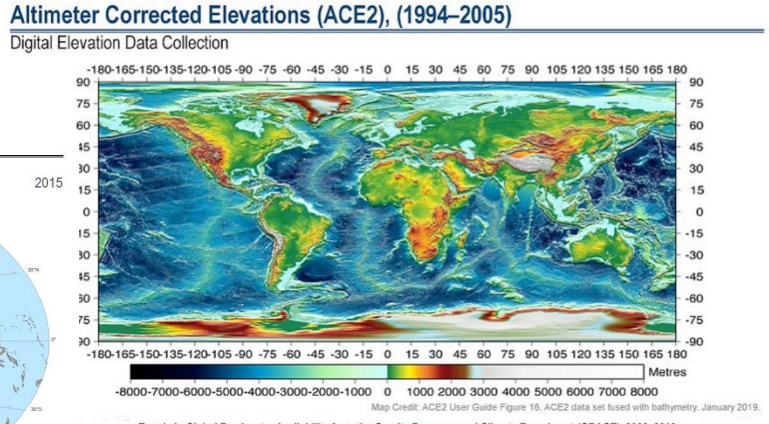
- Population Land-Use and Emissions (PLUE)
- Mitigation, Vulnerability and Adaptation (MVA)
- Hazard Vulnerability Assessment (HVA)
- Poverty and Food Security (PFS)
- Environment and Sustainable Development (ESD)

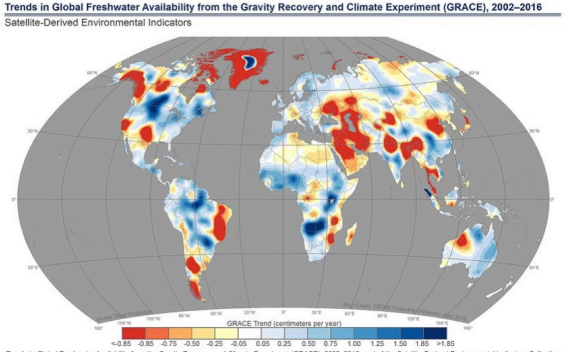


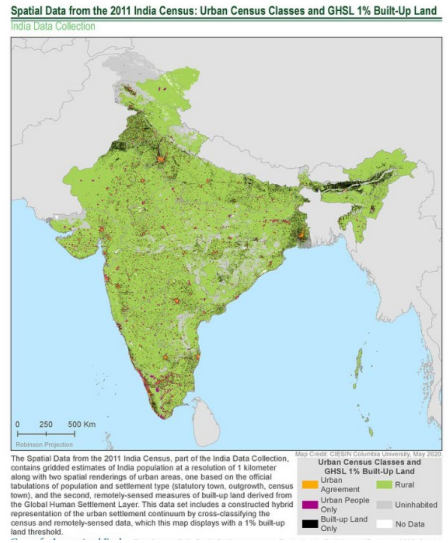












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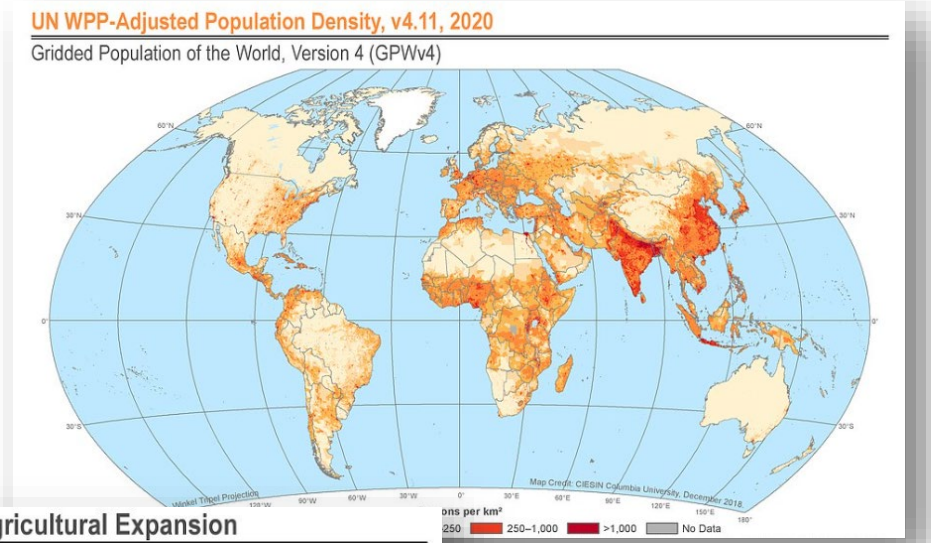
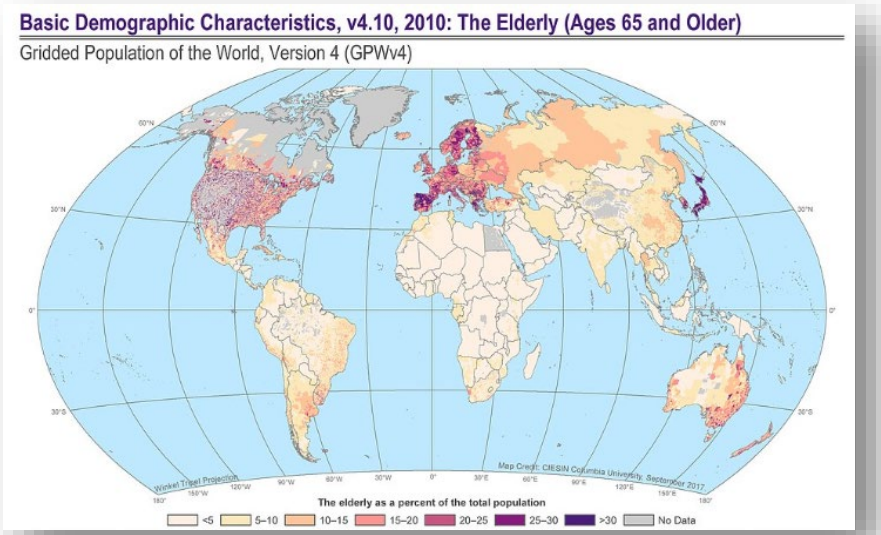
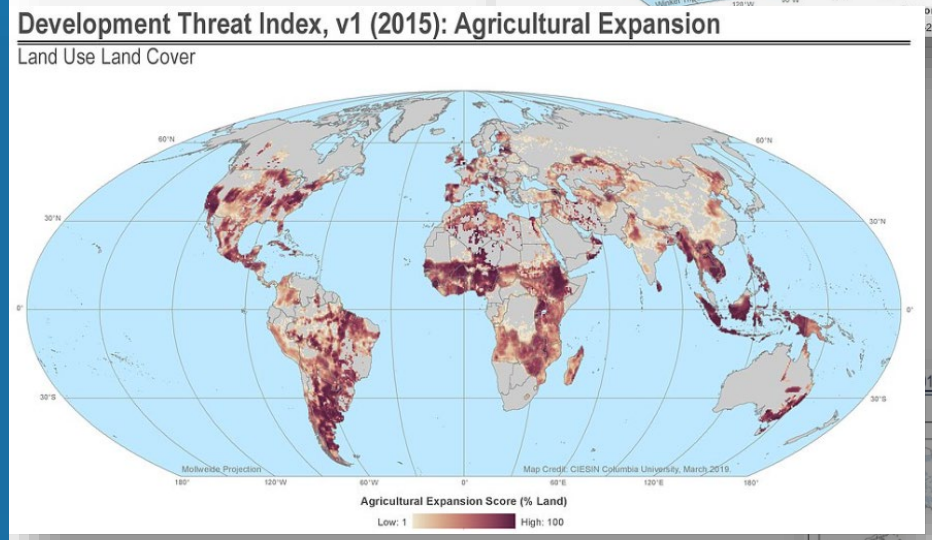
NASA

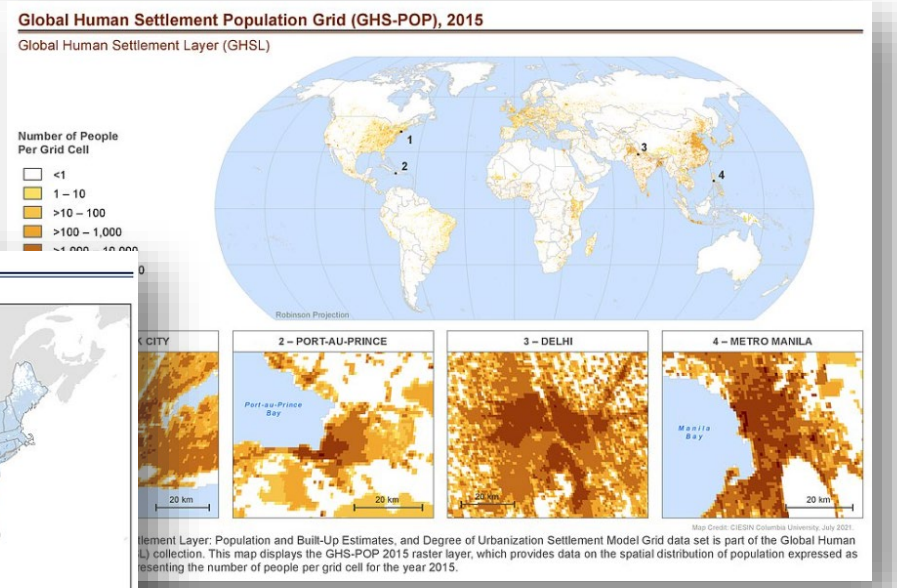
PLUE

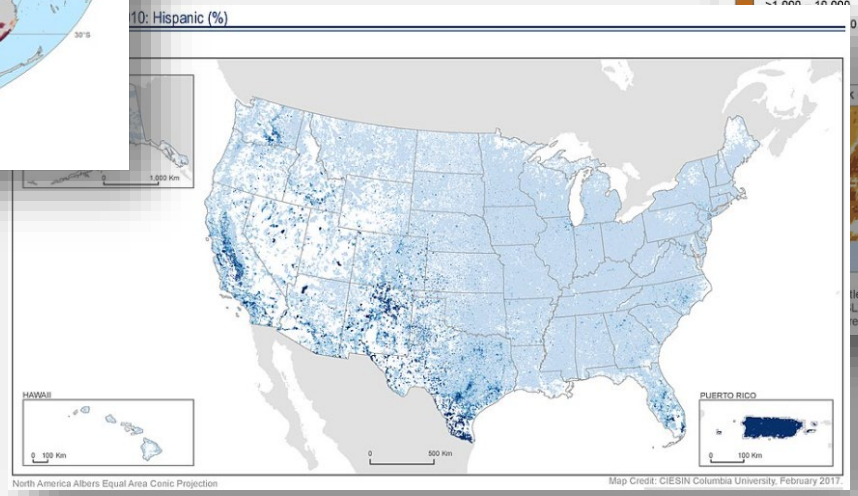
Population, Land
Use and Emissions











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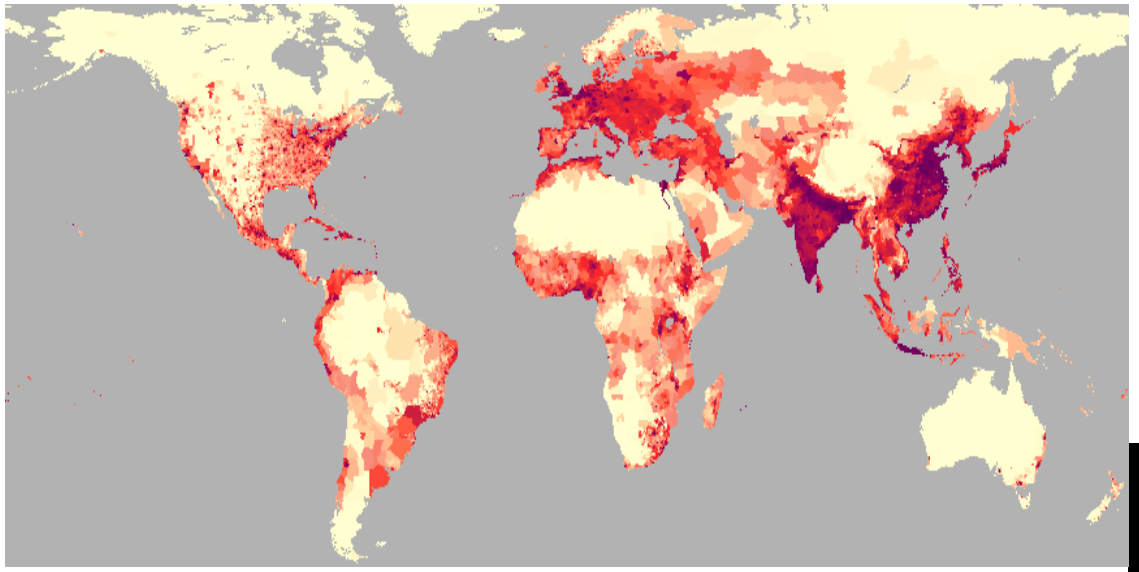
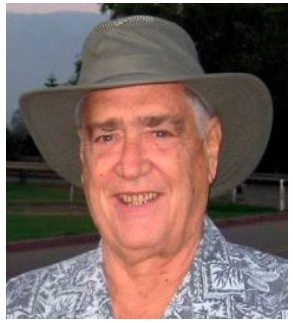
SEDAC's flagship data product, Gridded Population of the World, has evolved significantly since 1995, building on improved data and tools

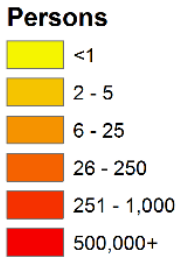


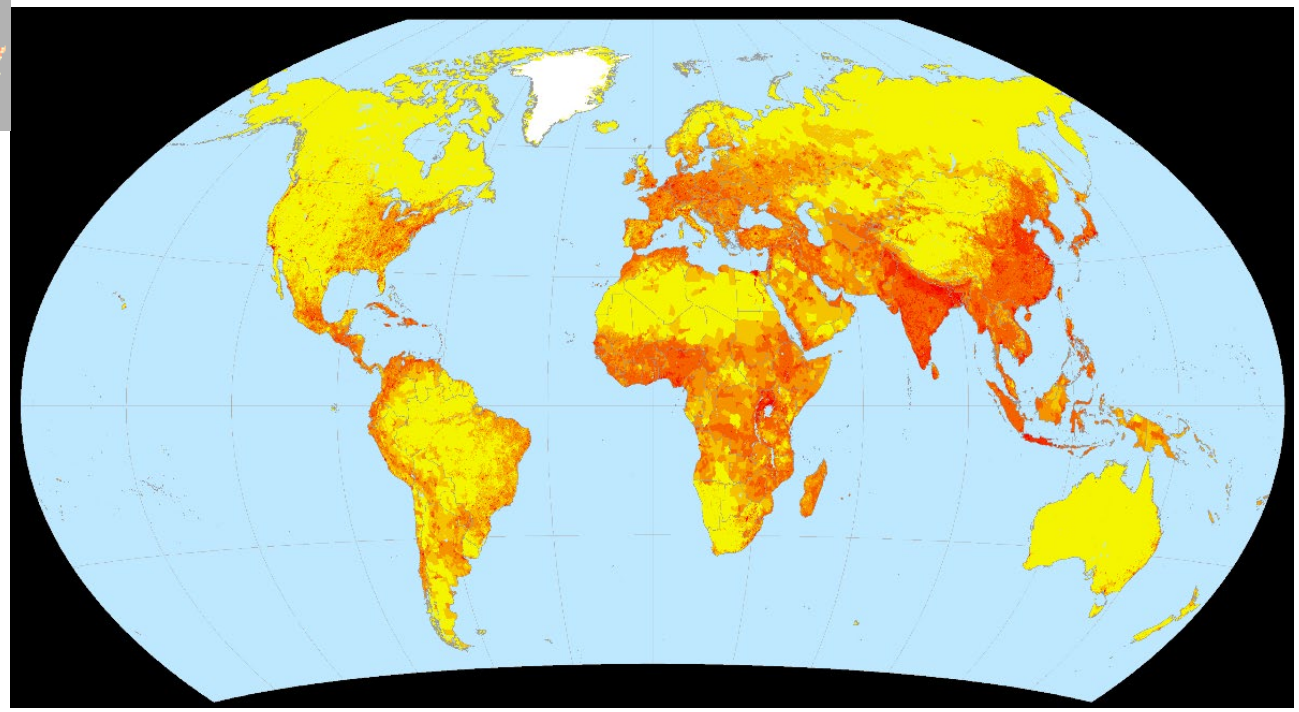
- GPWv1: total population on a 5 arc-minute grid, 19,000 admin units
- GPWv4: total pop, age, sex on a 30 arc-second grid, >12 million admin units
- GPWv5: under development



Waldo Tobler (deceased)

Uwe Deichmann





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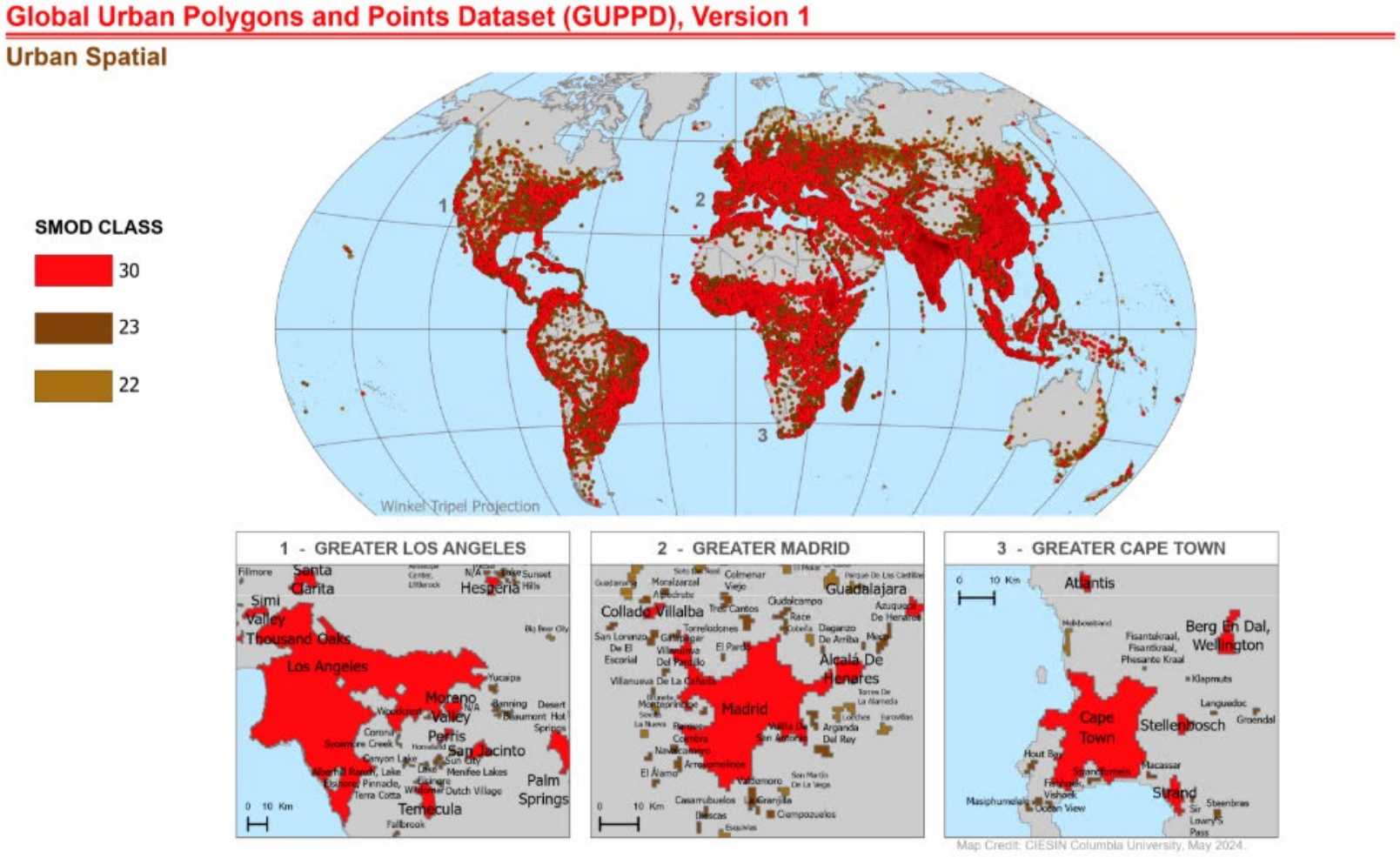
Global Urban Points and Polygons Dataset (GUPPD), v1

https://doi.org/10.7927/brq1-xc29

A global dataset of ~124k urban settlements with place names and population for the years 1975-2030 in five year increments. It includes a hierarchy of settlements, from **urban center**, **dense urban cluster**, to **semi-dense urban cluster.** GUPPD uses open data sources and automated algorithms to assign city names to polygons.

- Key inputs: GHS-SMOD, Global Urban Centres Database, GHS-POP R2023



Global Urban Points and Polygons Dataset (GUPPD), Version 1 is a part of the Urban Spatial Data collection. This map represents the spatial distribution of GHS-SMOD R2019A level 30 (urban centers), 23 (dense urban clusters) and 22 (semi-dense urban clusters) polygons named by CIESIN included in the data set. GUPPD is a vector data set with population data for 1975 to 2030 in 5-year increments.

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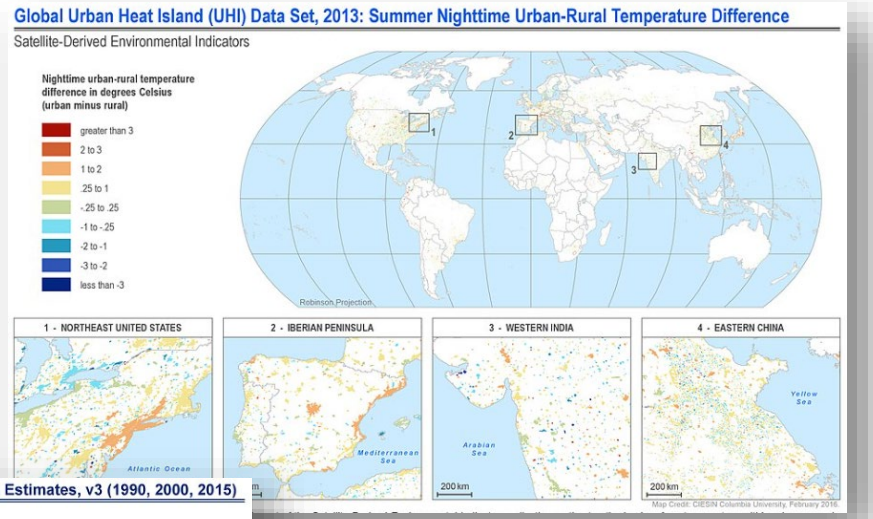
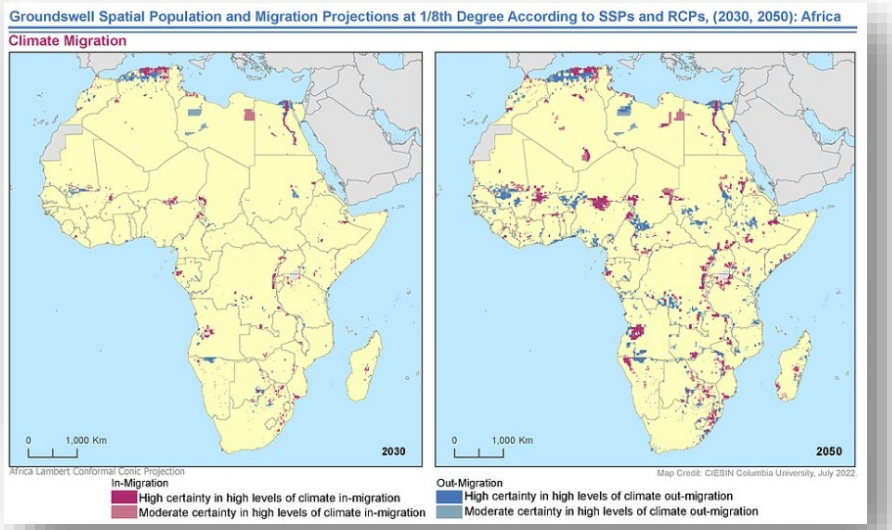
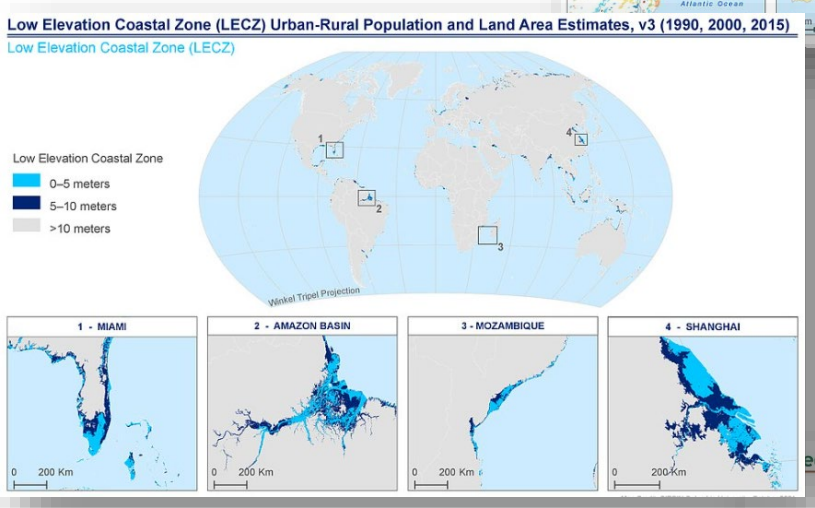
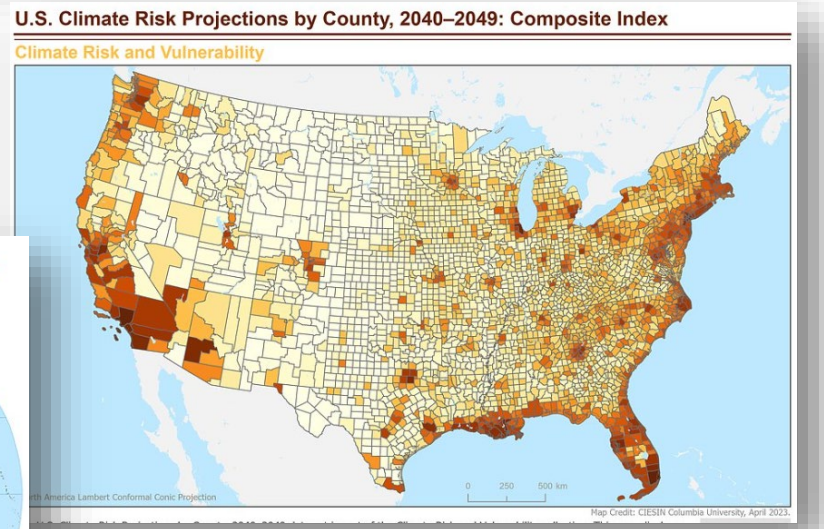
MVA

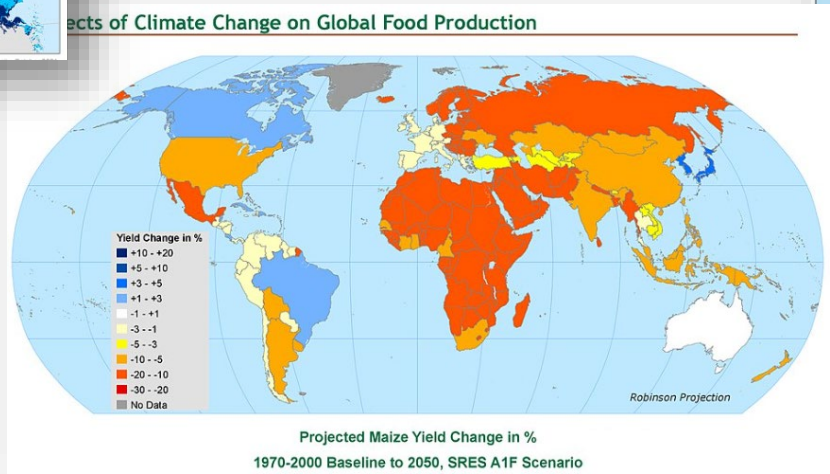
Mitigation, Vulnerability, and Adaptation











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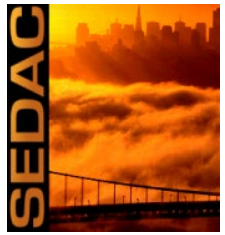
The Low Elevation Coastal Zone (LECZ) Delta Population and Land Area Estimates, v1

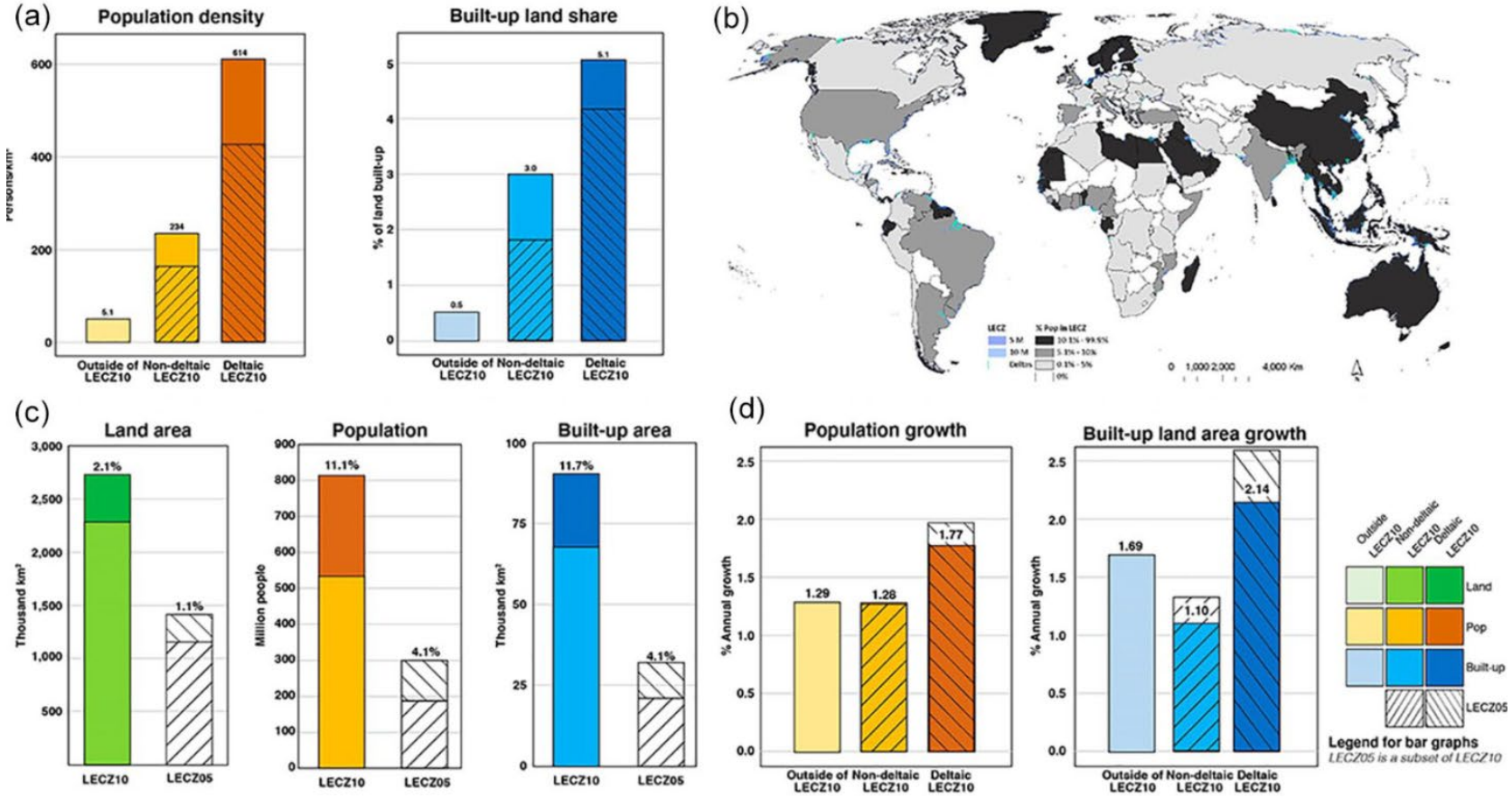
(1990, 2000, 2014, 2015)



https://doi.org/10.7927/4hgr-db70

The Low Elevation Coastal Zone (LECZ) Global Delta Urban-Rural Population and Land Area Estimates, Version 1 data set provides country-level estimates of urban, quasi-urban, rural, and total population (count), land area (square kilometers), and built-up areas in river delta- and non-delta contexts.

- Key inputs: MERIT-DEM, SRTM, LECZv3, Delta Boundaries



a. Global densities of population and built-up area, outside LECZ10 and in and out of deltaic areas of LECZ10 (and LECZ05), 2015; b. Countries of the world shown by the percentage of the population in the Low Elevation Coastal Zone (LECZ10), overlaid with land area of the LECZ10 and deltas; c. Global quantities of land, population and built-up area, in and out of deltaic areas of LECZ10 (and LECZ05), 2015. Percentages above columns are of LECZ quantities as a % of total quantity (i.e. including outside the relevant LECZ); d. Global annual growth rates of population and built-up area, outside LECZ10 and in and out of deltaic areas of LECZ10 (and LECZ05), 1990–2015

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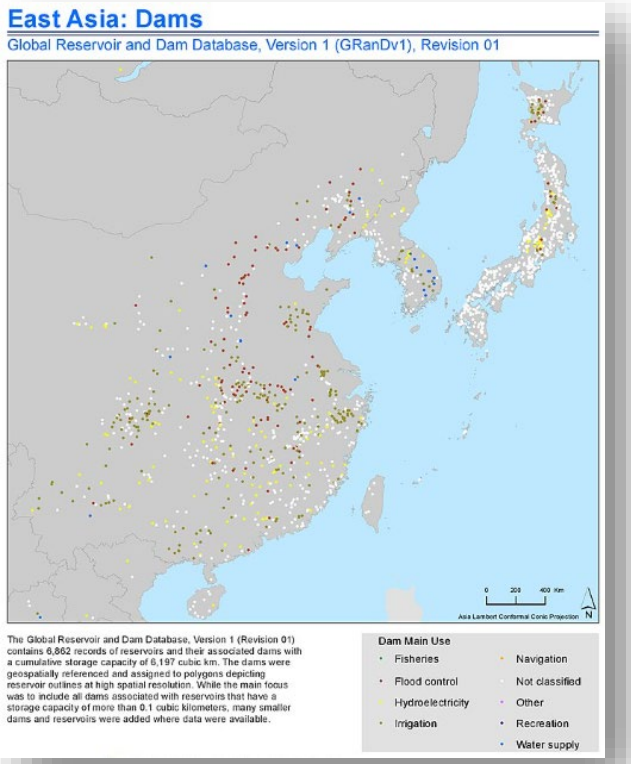
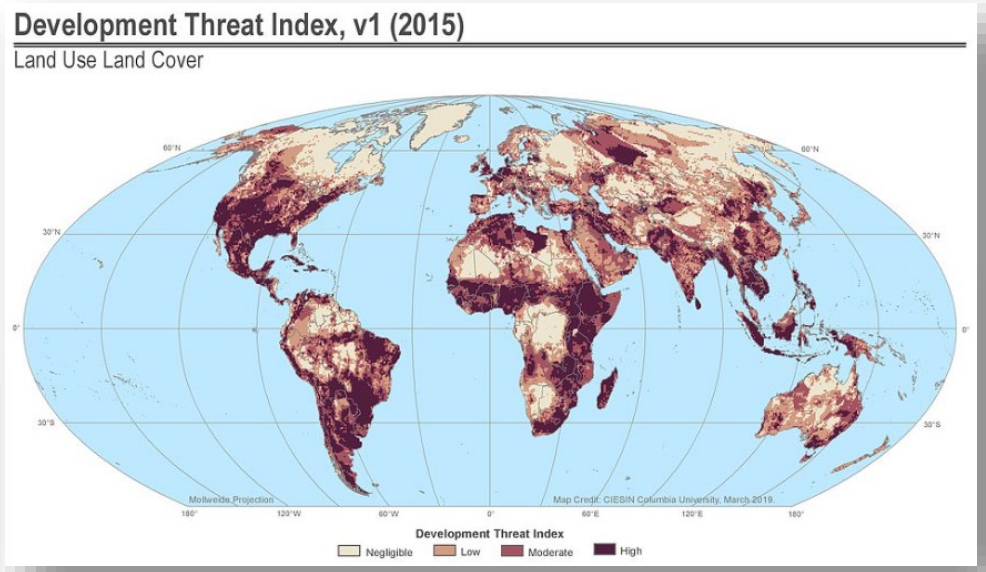
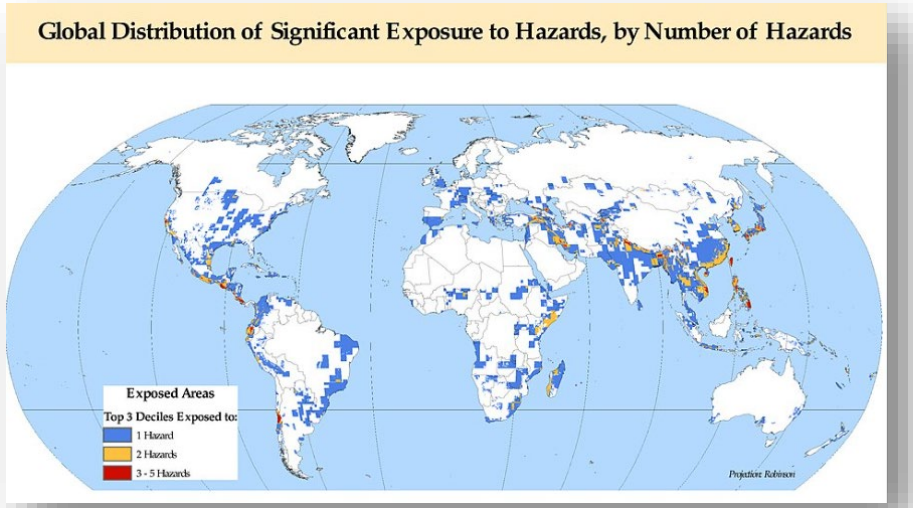
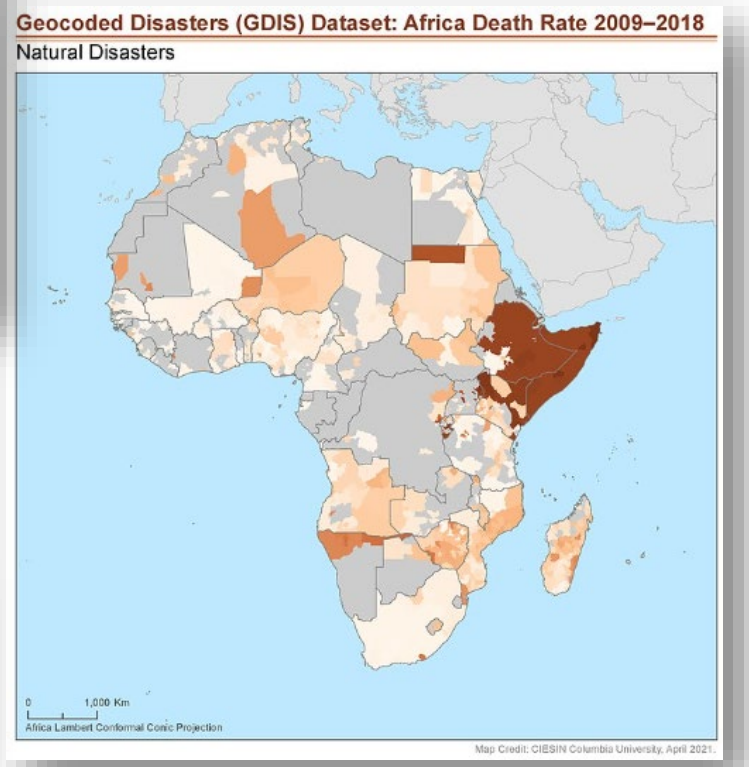
HVA

Hazard Vulnerability Assessment









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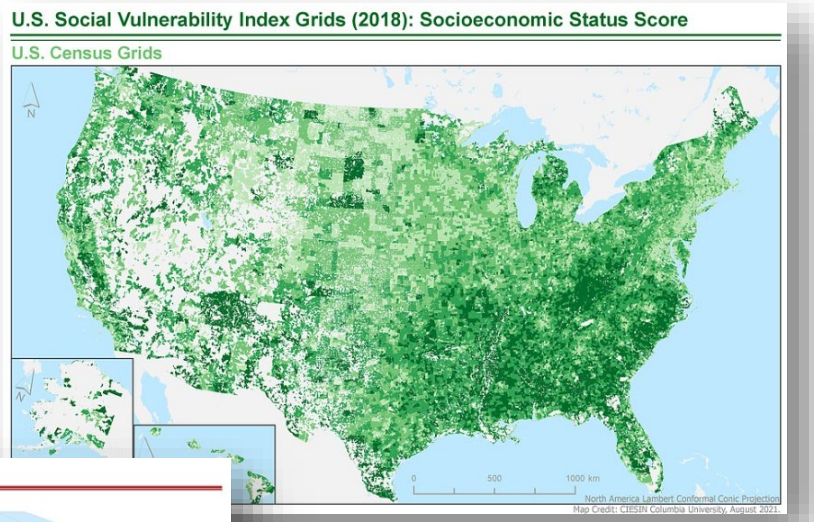
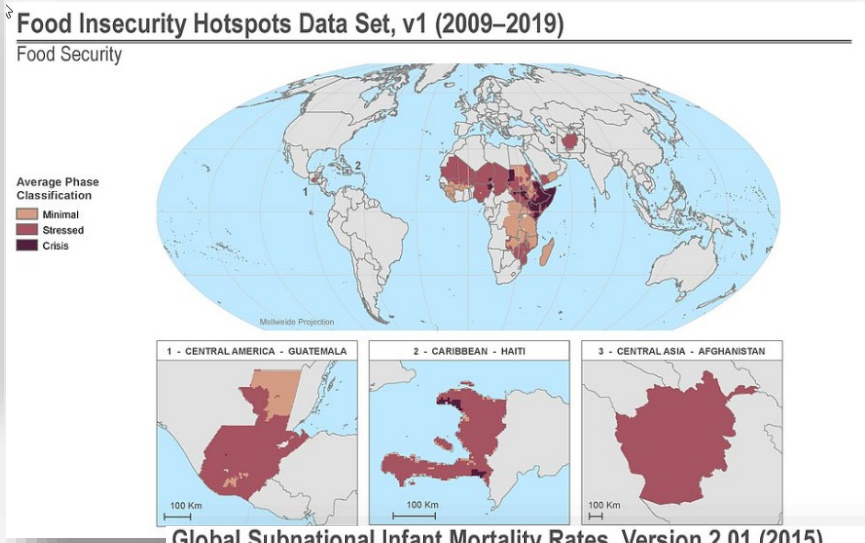
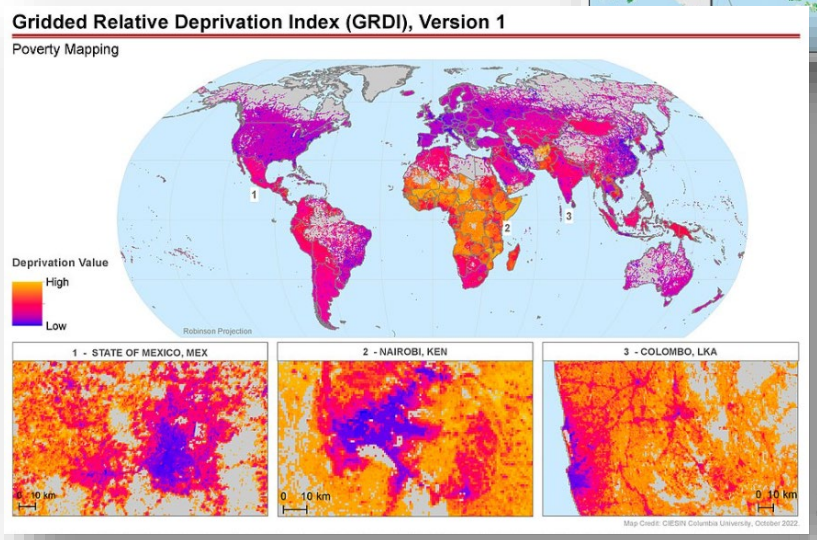
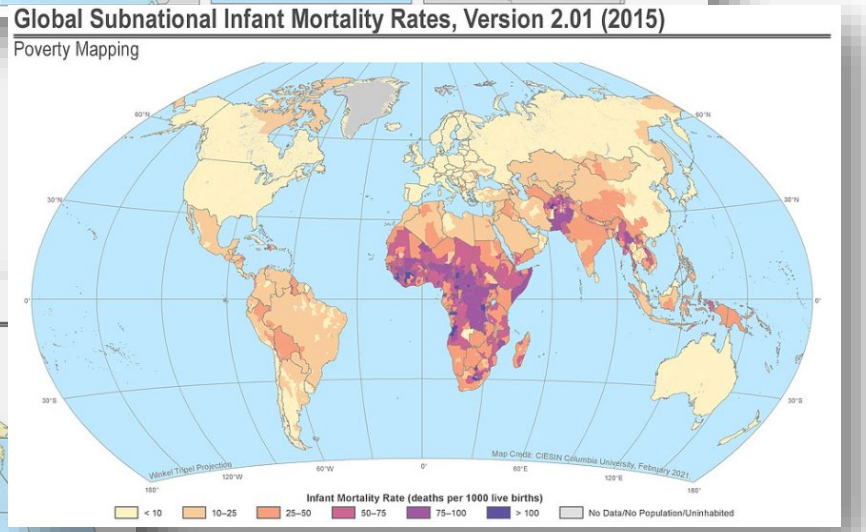
PFS

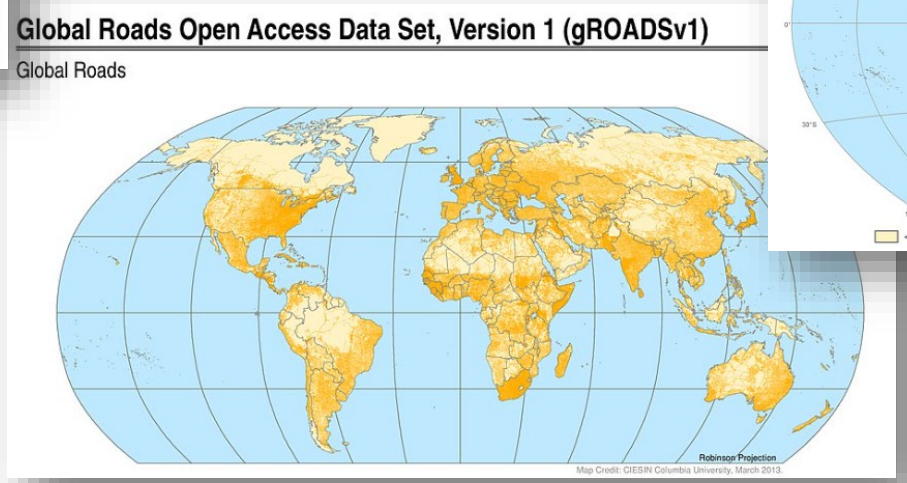
Poverty and Food Security











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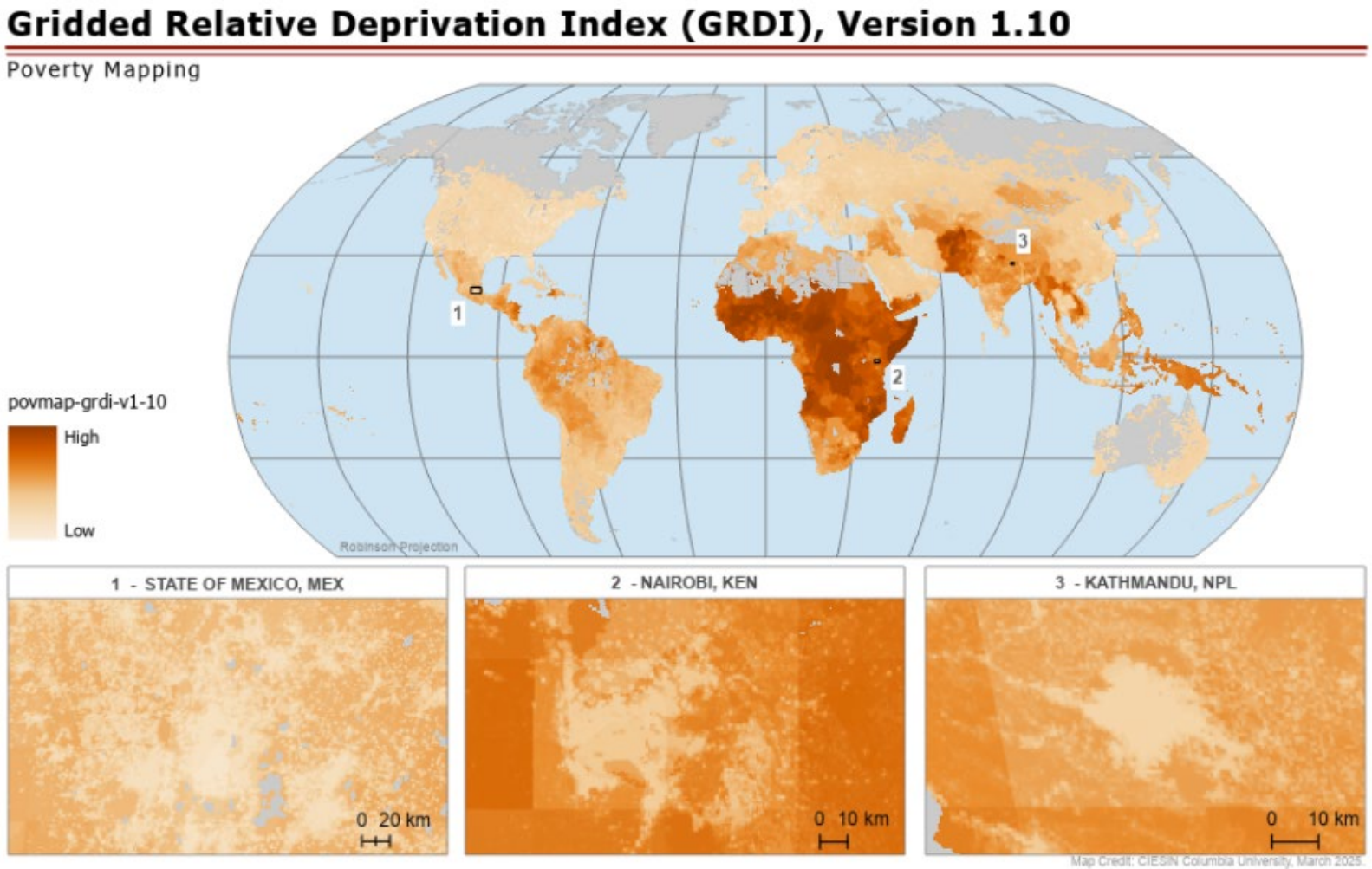
Global Relative Deprivation Index v1.10

- **Child Dependency Ratio (CDR):** Higher CDR implies higher dependency on working population.
- **Infant Mortality Rate (IMR):** Common indicator of poverty at the low end of the development spectrum.
- **Subnational Human Development Index (SHDI):** Assesses human well-being through education levels, life expectancy, and GDP
- **Ratio of built-up area (BUILT):** We assume rural populations are more likely to experience higher degrees of multidimensional poverty compared to urban populations
- **Nighttime Lights (VNL 2020):** Stable night lights are closely associated with anthropogenic activities, economic output, and infrastructure development.



The Global Gridded Relative Deprivation Index (GRDI), Version 1.10 (GRDI v1.10) data set characterizes relative levels of multidimensional deprivation and poverty at 30 arc-seconds spatial resolution (~1 km at the equator) ranging from 0 (lowest) to 100 (highest). GRDI v1.10 is built from sociodemographic and satellite data inputs from five global spatial layers that were spatially harmonized, indexed, and aggregated into an index. These include subnational Human Development Index (SHDI) and infant mortality rate (IMR) data, gridded child dependency ratios (CDR), nighttime lights intensity, and proportion of the grid cell that is built up.

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Data Source: Center for Integrated Earth System Information (CIESIN), Columbia University. 2025. Global Gridded Relative Deprivation Index (GRDI), Version 1.10. Palisades, New York: Center for Integrated Earth System Information (CIESIN), Columbia University. https://doi.org/10.7927/q57x-jt34.

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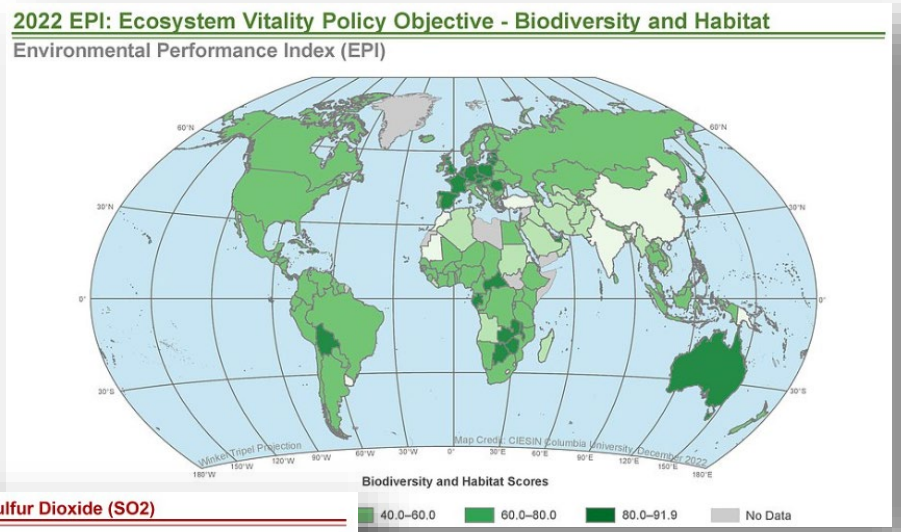
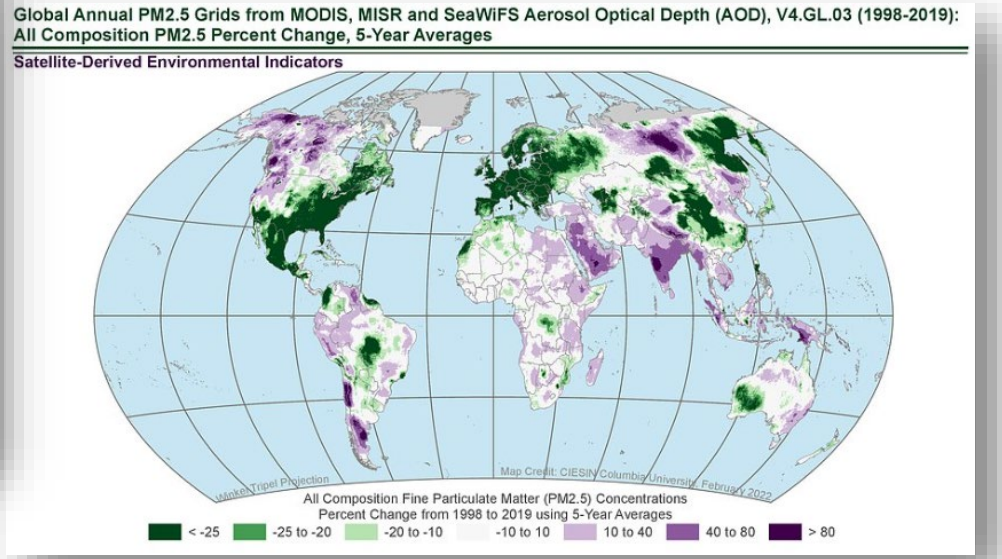
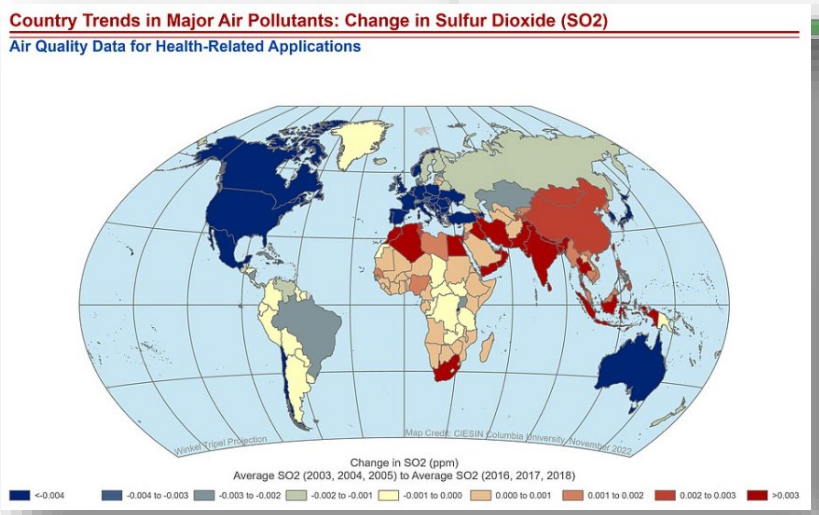
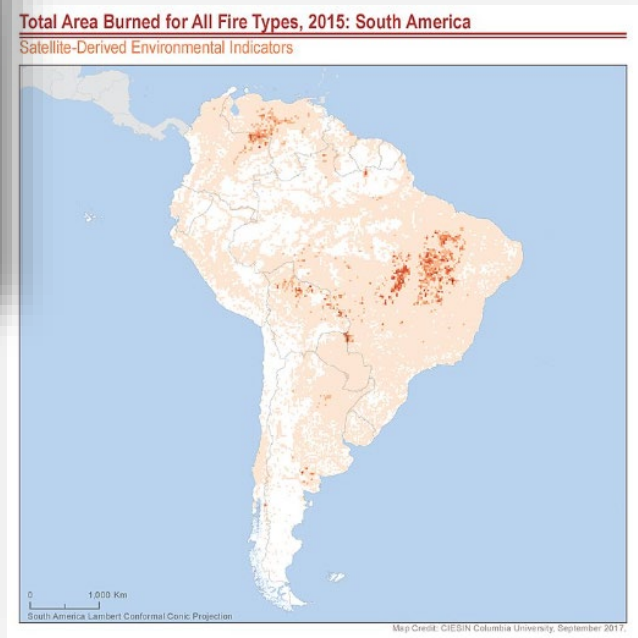
ESD

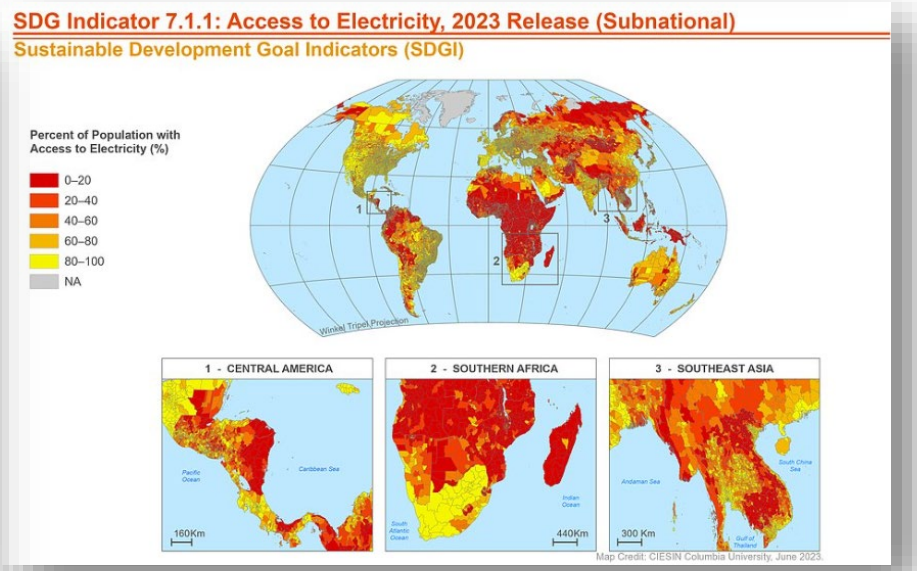
Environment and Sustainable Development











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Data available at:

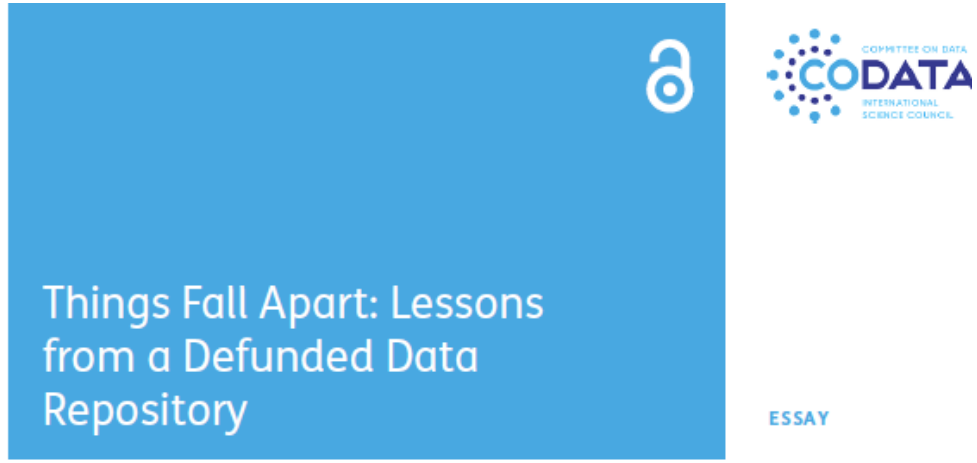
https://www.earthdata.nasa.gov/topics/human-dimensions/data-access-tools

&

https://dataverse.harvard.edu/dataverse/SEDAC

HARVARD Dataverse

CAFE



Things Fall Apart: Lessons from a Defunded Data Repository

ESSAY

ALEX DE SHERBININ

ubiquity press

Chinua Achebe's award winning novel, *Things Fall Apart* (1958), chronicles the cultural disintegration that occurred during the early phases of the British colonization of Nigeria. Any moment of abrupt cultural change is unsettling, and its results are unpredictable. The same can be said of the current moment in which belief systems that were foundational in the new era of digital data preservation are being shaken to the core. Since the start of the second Trump administration, we have seen a progressive removal of climate, environmental, and socioeconomic data from federal websites, with further threats to dismantle data infrastructure looming.[1] This essay represents a short personal account of the data rescue efforts of the NASA Socioeconomic Data and Applications Center (SEDAC), which was run by Columbia University's Integrated Earth System Information (CIESIN) since the late 1990s, and for which I served as deputy manager and then manager for nearly 20 years. I share this account to offer lessons for other data repositories and to underscore the importance of solidarity in the data community in the face of shrinking resources and foundering political support.

SEDAC was established in the 1990s, as part of NASA's Mission to Planet Earth, to serve as a bridge between the Earth and social science research communities. It provided data complementary to NASA's satellite remote sensing assets—such as gridded data representing population distribution, economic activity, poverty and social vulnerability, as well as infrastructure and sustainability data sets—all with the goal of serving the human dimensions of global change research community. SEDAC's flagship data product, the Gridded Population of the World (GPW), was the first raster representation of global population, setting the stage for increasingly sophisticated modeled population distributions such as Landscan, WorldPop, and GHS-POP. The American Geophysical Union (AGU) recently recognized GPW as an 'impactful dataset,' defined as one that supports the broad spectrum of research, analysis, and decision-making. SEDAC data were also widely used by practitioners such as urban planners and humanitarian and development organizations, as well as [illegible].

DOI: 10.5334/dsj-2026-009

For SEDAC, the rumblings in Washington DC began just days after the inauguration in late January 2025, when we were notified by NASA that terms related to environmental justice, diversity, equity, and inclusion needed to be scrubbed from all its data center websites. These sad but required changes became more impactful for SEDAC when, on March 7th, SEDAC received a stop work order from NASA, part of a larger set of orders that were issued to all Columbia University principal investigators of federally funded projects. Although concerning, we hoped that this could be reversed through negotiations, and indeed eventually, most of the federal funding was restored to Columbia as part of a settlement agreement. However, by late March, we learned that SEDAC was on a list of the Department of Government Efficiency

CORRESPONDING AUTHOR:
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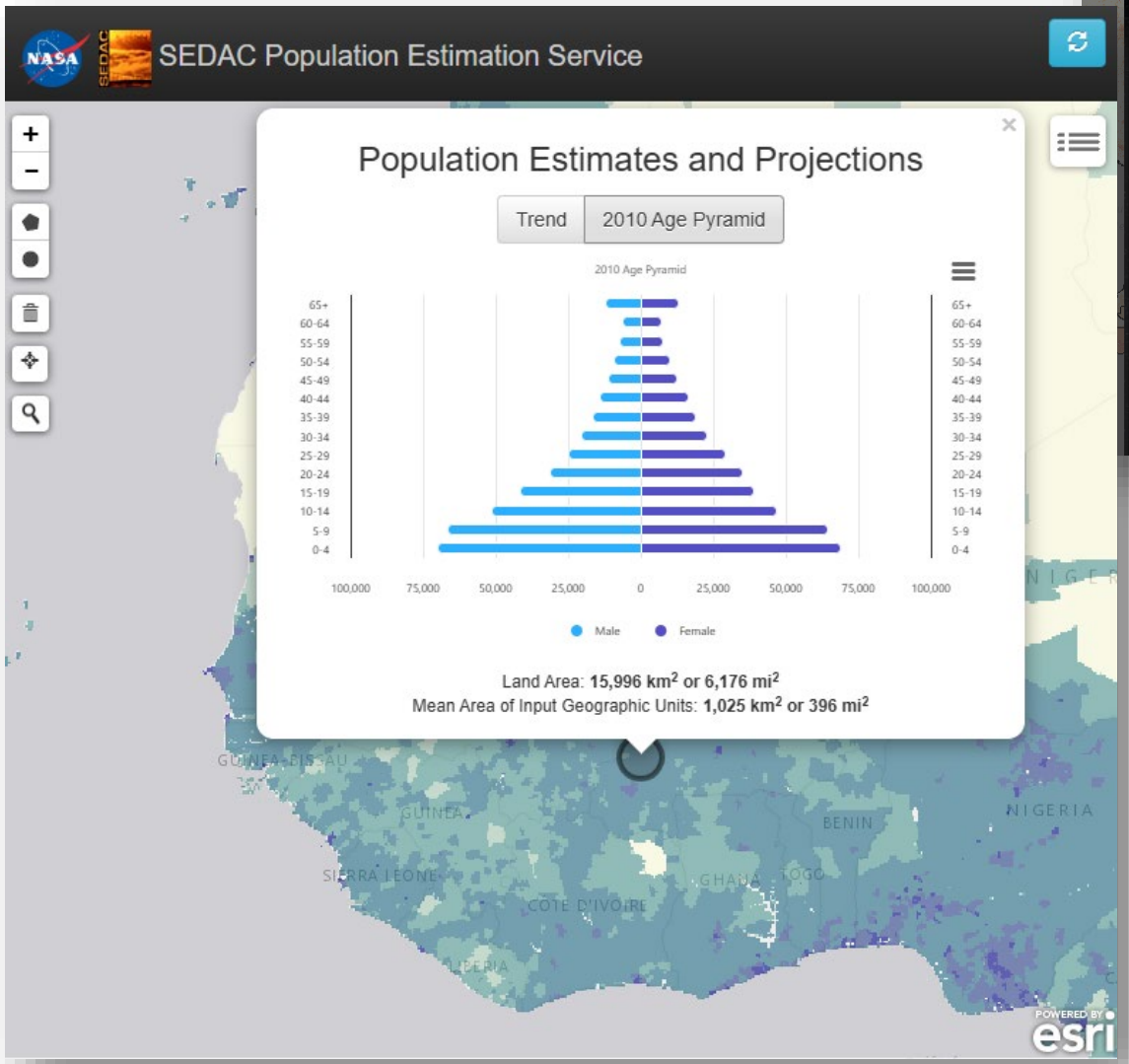
Center for Integrated Earth System Information (CIESIN), Columbia Climate School, US
amd155@columbia.edu

KEYWORDS:
data repositories; data preservation

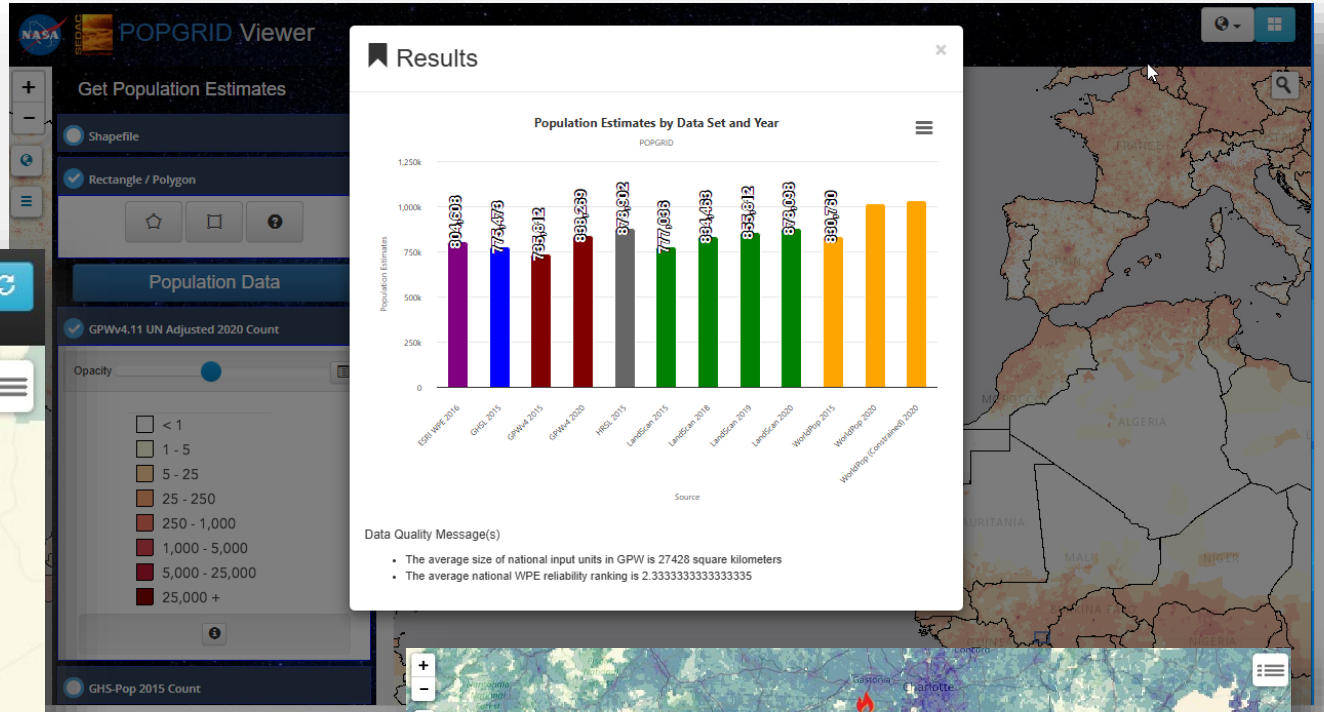
TO CITE THIS ARTICLE:
de Sherbinin, A 2026 Things Fall Apart: Lessons from a

Applications

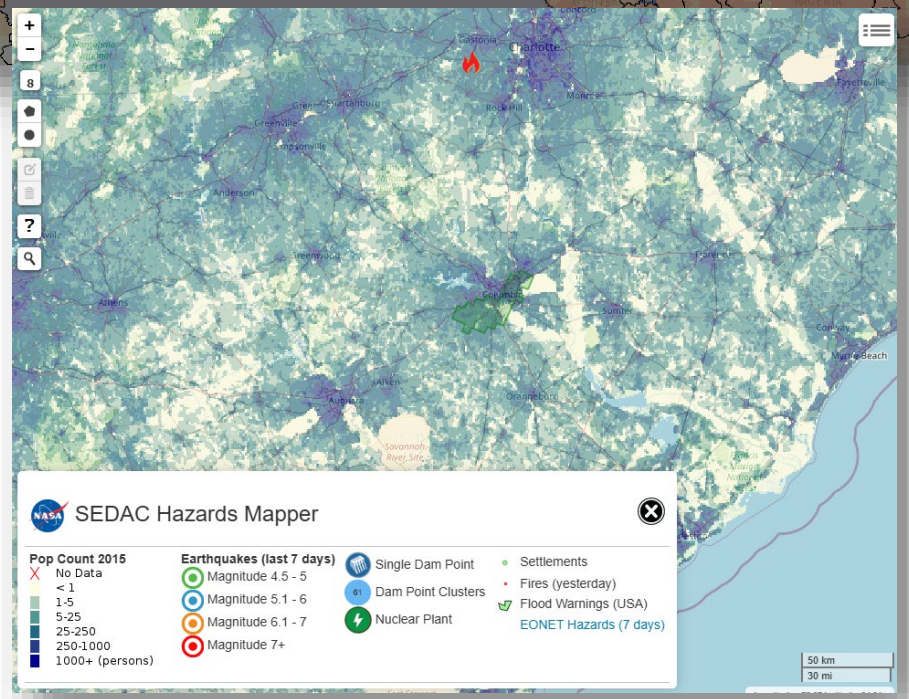
Population Estimation Service (PES)



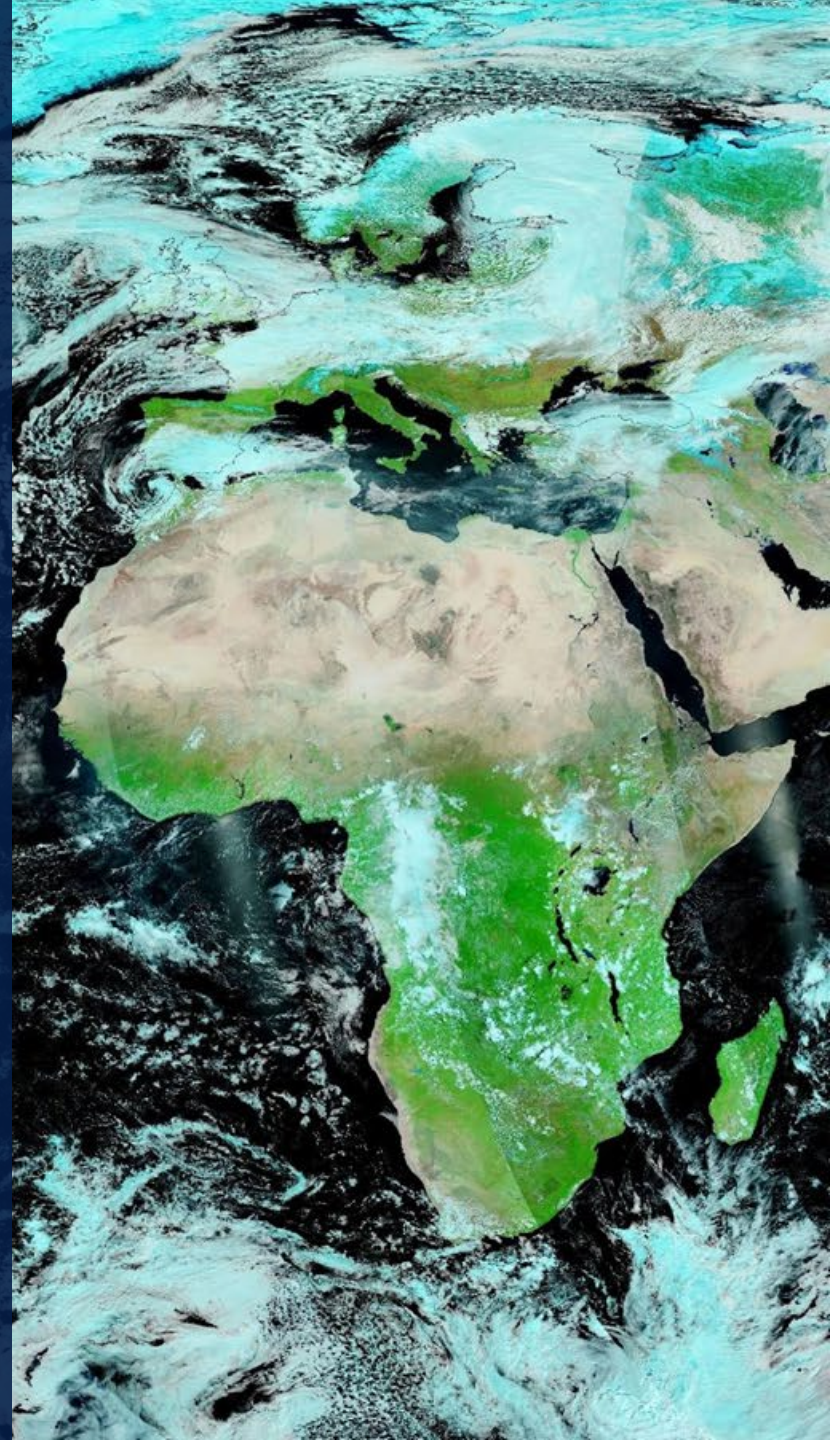
POPGRID Viewer



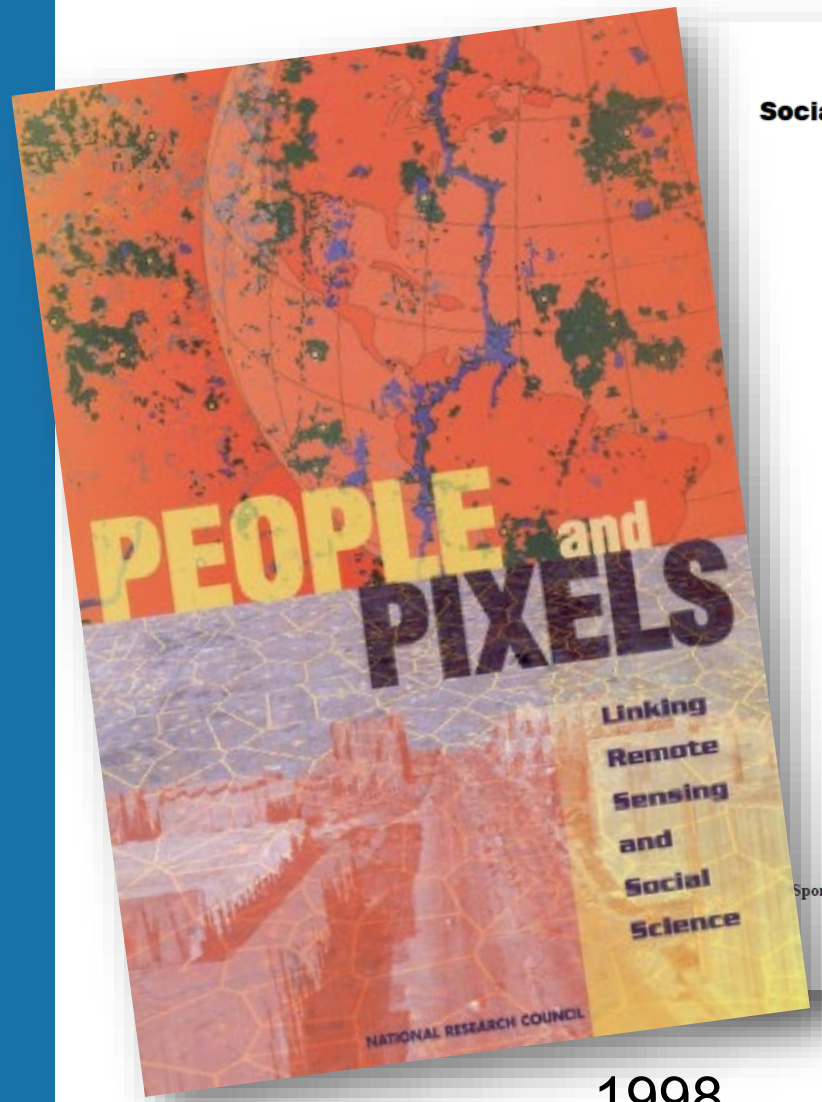
SEDAC Hazards Mapper



Analysis of SEDAC data citations



SEDAC sought to support social scientists in the use of EO data…



1998


A CIESIN Thematic Guide to
Social Science Applications of Remote Sensing

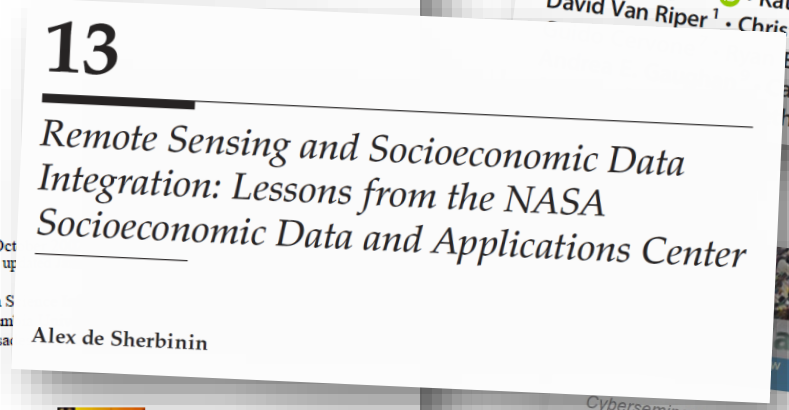
Alex de Sherbinin [1]
Deborah Balk
Karina Yager
Malanding Jaiteh
Francesca Pozzi
Chandra Giri
Antroinette Wannebo

Center for International Earth S
Colum
Palisa

CIESIN Columbia University SEDAC

Sponsored by the Socioeconomic Data and Applications Center (SEDAC) of the U.S. National Aeronautics and Space Administration, Goddard Space Flight Center under contract NAS5-98162

2002


13

Remote Sensing and Socioeconomic Data Integration: Lessons from the NASA Socioeconomic Data and Applications Center

Alex de Sherbinin

2016


Population and Environment
https://doi.org/10.1007/s11111-019-00326-5

ORIGINAL PAPER

People and Pixels 20 years later: the current data landscape and research trends blending population and environmental data

Check for updates

Tracy A. Kugler [1] · Kathryn Grace [2] · David J. Wrathall [3] · Alex de Sherbinin [4] · David Van Riper [1] · Christoph Aubrecht [5] · Douglas Comer [6] · Susana B. Adamo [4] · Engstrom [8] · Carolynne Hultquist [7] · atherine Linard [10] · Emilio Moran [11] · Forrest Stevens [9] · Tellman [13] · Jamon Van Den Hoek [3]

2018

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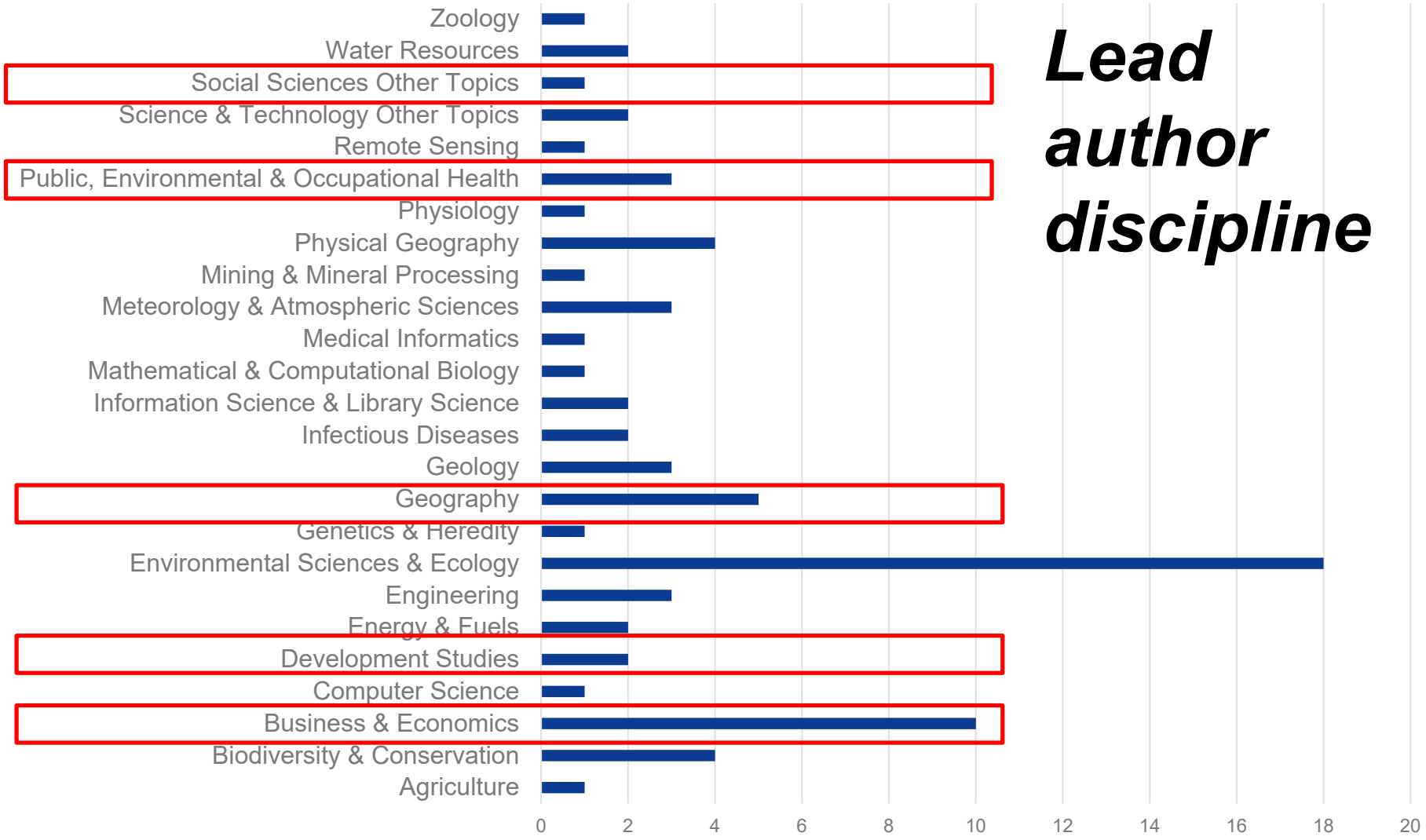
Analysis of 75 peer-reviewed articles that cited SEDAC data (2021-2022)

Randomly selected 75 articles of 1,434 that cited SEDAC data during 2021-2022

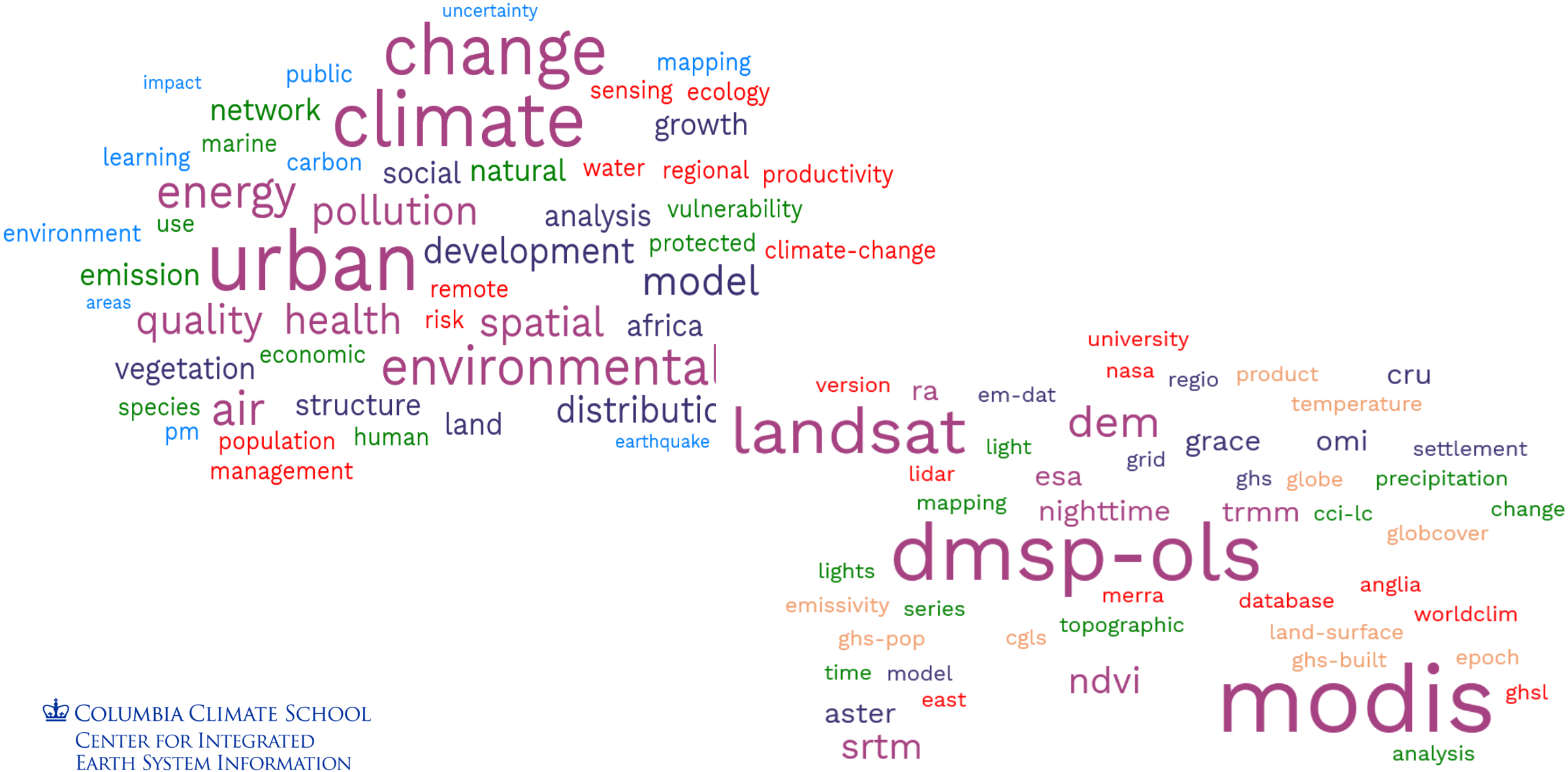
We were interested in **characteristics** of current SEDAC data users, **data integration** and **scientific tools and workflows**



Lead author discipline

Columbia Climate School
Center for Integrated Earth System Information

Thematic areas and EO instruments cited



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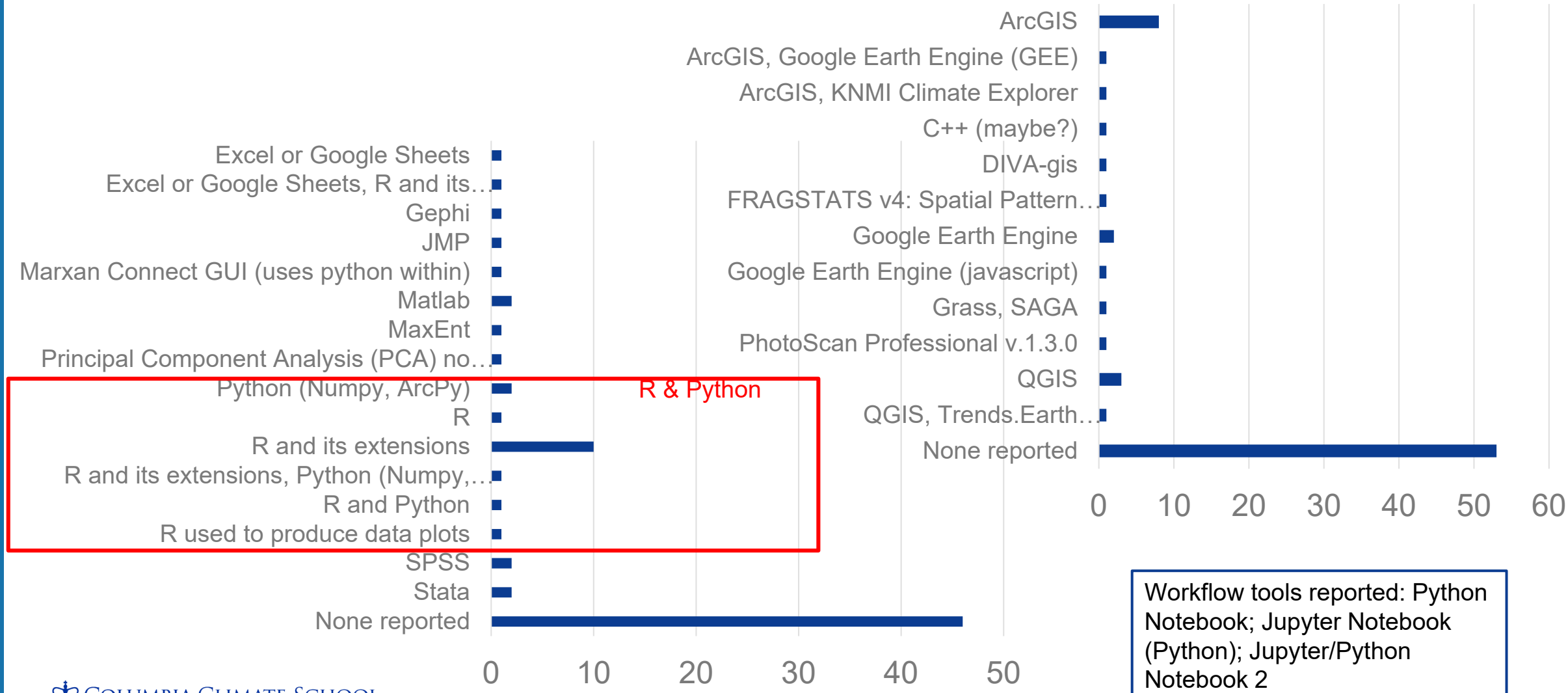
EARTH SYSTEM INFORMATION

Commonly used tools for analysis



Workflow tools reported: Python Notebook; Jupyter Notebook (Python); Jupyter/Python Notebook 2

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SEDAC Open Science Workshop, 9 January 2024

Sixty participants convened to address applications **cloud-based** and **open data** and **code** to human-environment research

https://zenodo.org/records/10636022

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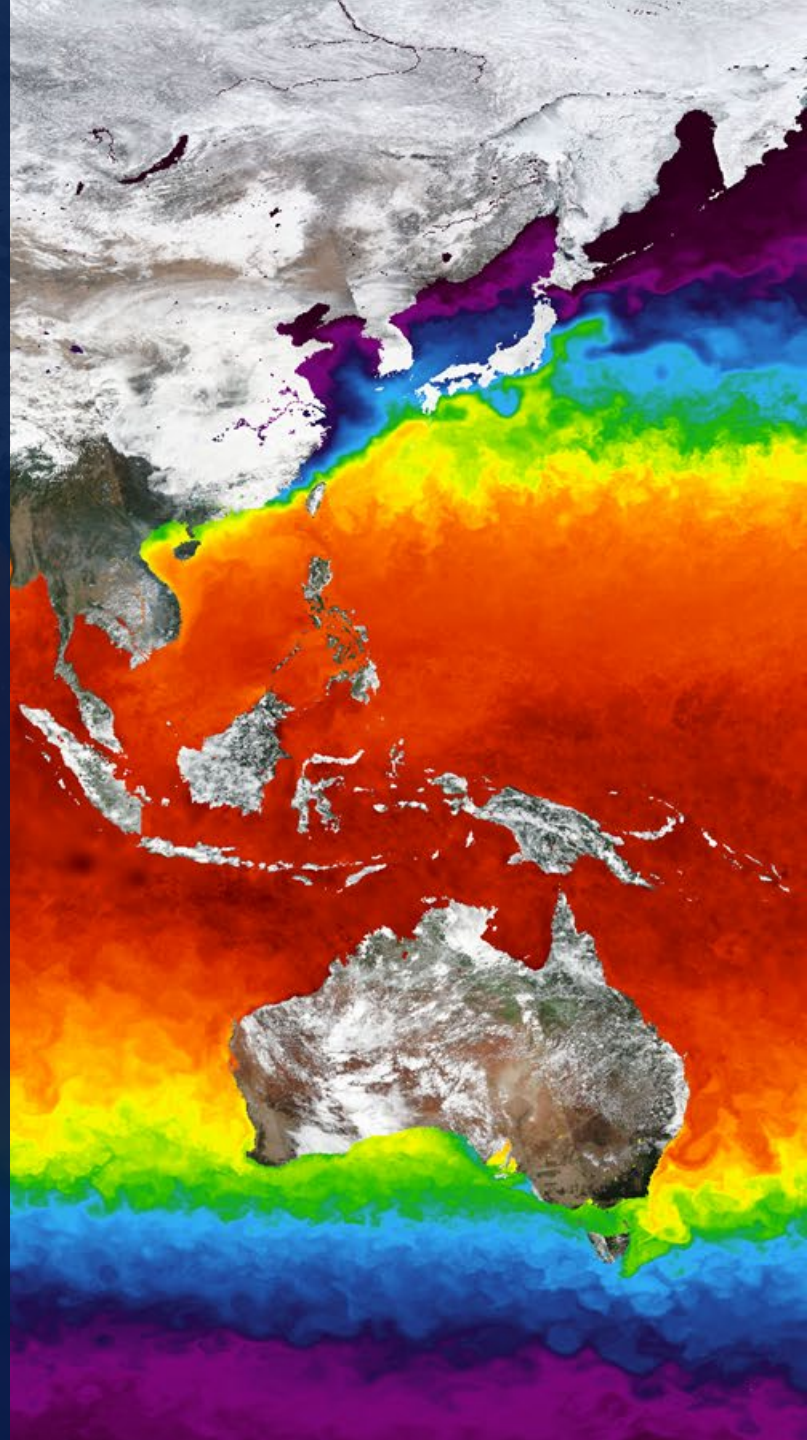
Examples of EO-Socioeconomic Data Integration



The Satellite Derived Indicators Collection

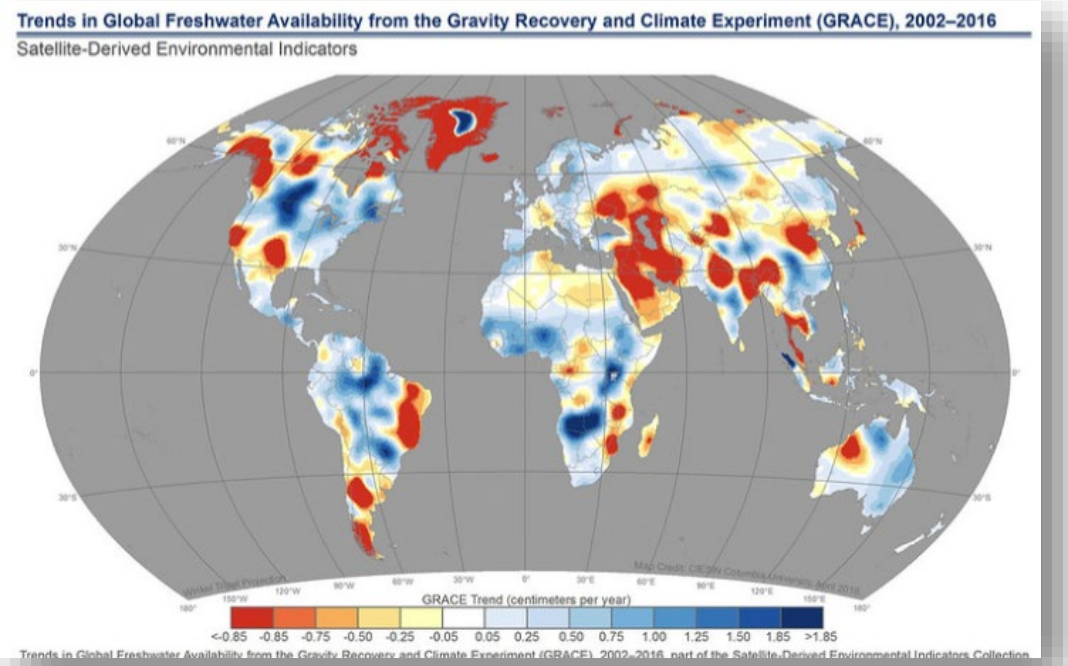

OPEN ACCESS
IOP Publishing
Environ. Res. Lett. 9 (2014) 084013 (12pp)
Environmental Research Letters
doi:10.1088/1748-9326/9/8/084013

Using satellite data to develop environmental indicators

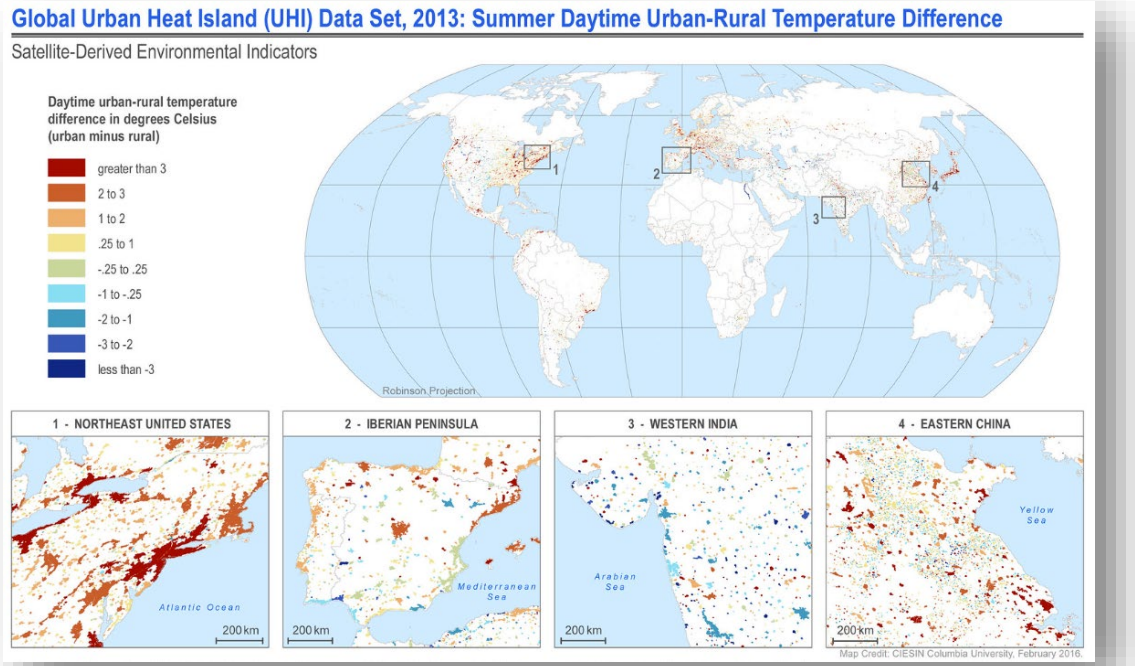
Alex de Sherbinin[1], Marc A Levy[1], Erica Zell[2], Stephanie Weber[2] and Malanding Jaiteh[1]

- Based on a NASA ROSES research grant SEDAC developed a collection of easily interpreted EO-derived data sets describing environmental changes

Global Changes in Freshwater Availability based on GRACE

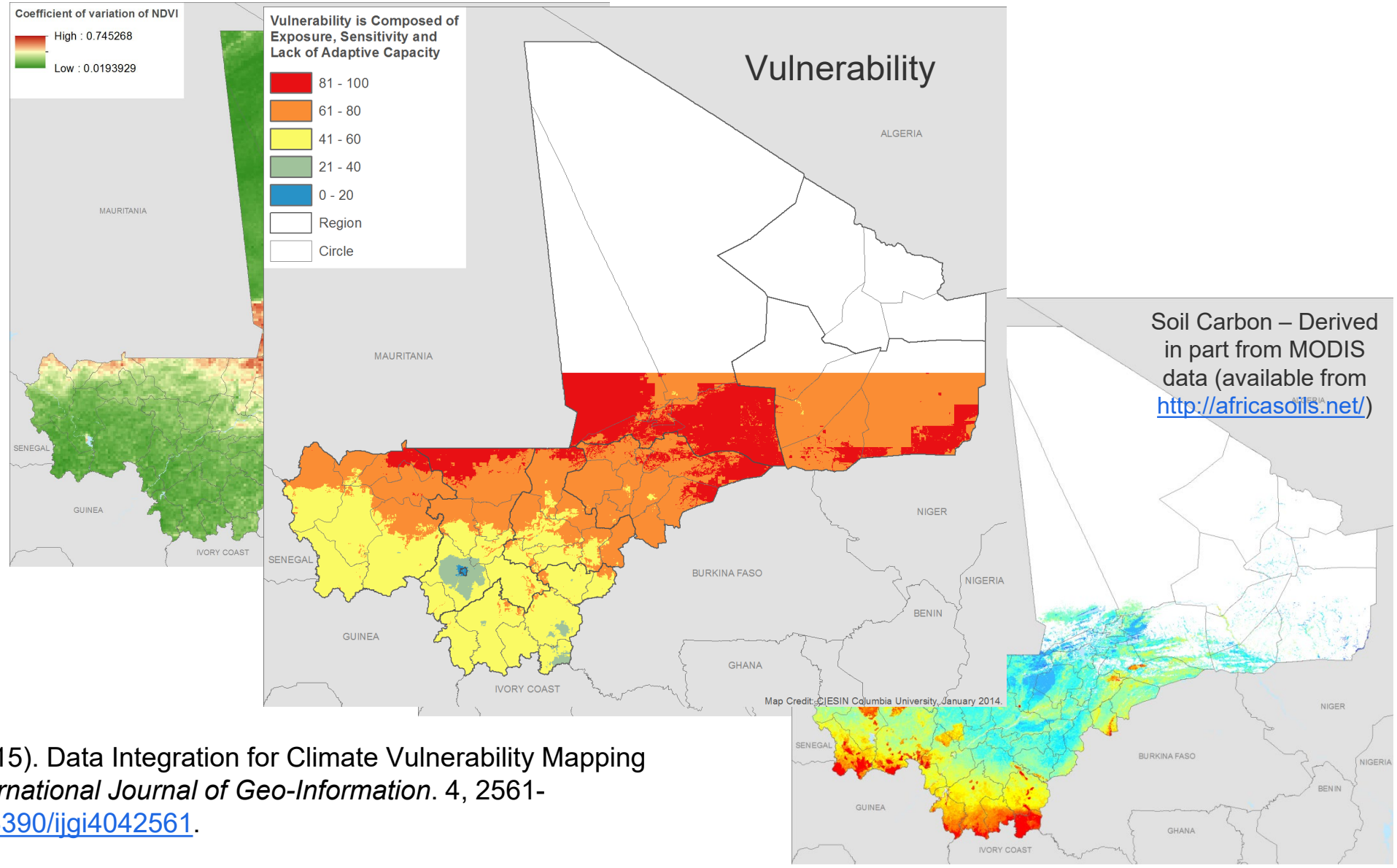


Global Urban Heat Island Data Set combining MODIS LST & GRUMP



Decision support: Mali climate vulnerability mapping using EO and socioeconomic data

For USAID, CIESIN compiled spatial indicators across the three dimensions of vulnerability – exposure, sensitivity, and adaptive capacity – including EO and spatially explicit data on poverty and related indicators

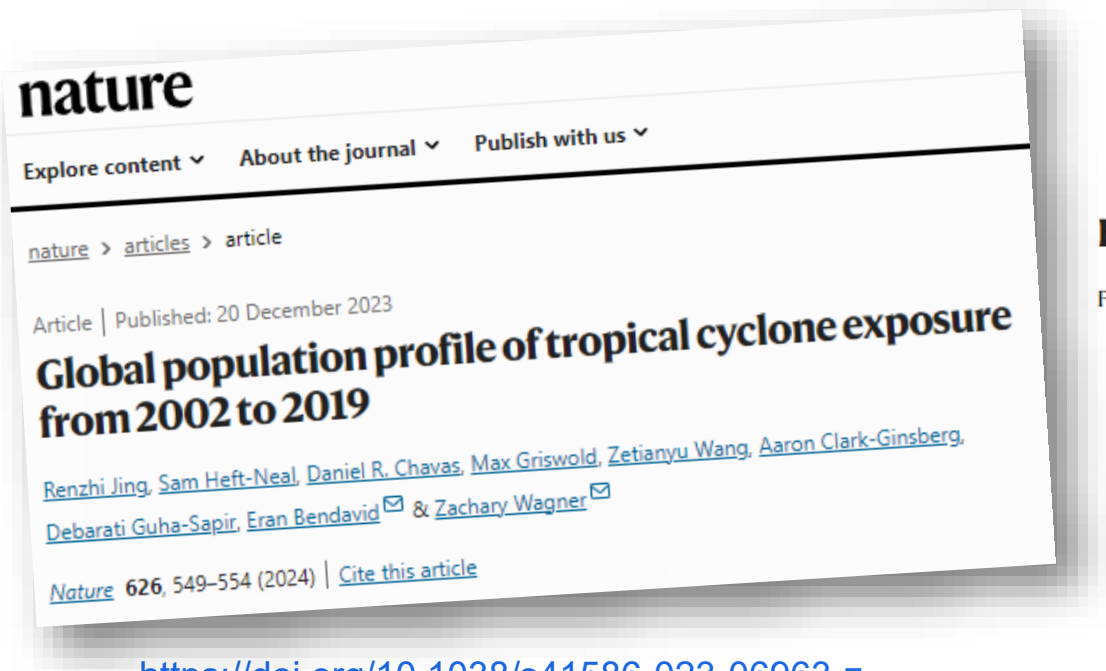


USAID FROM THE AMERICAN PEOPLE

de Sherbinin, A., et al. (2015). Data Integration for Climate Vulnerability Mapping in West Africa. *ISPRS International Journal of Geo-Information*. 4, 2561-2582. http://dx.doi.org/10.3390/ijgi4042561.

Data Citations: GRDIv1

Global Gridded Relative Deprivation Index v1 (GRDIv1)



nature

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Article | Published: 20 December 2023

Global population profile of tropical cyclone exposure from 2002 to 2019

Renzhi Jing, Sam Heft-Neal, Daniel R. Chavas, Max Griswold, Zetianyu Wang, Aaron Clark-Ginsberg, Debarati Guha-Sapir, Eran Bendavid & Zachary Wagner

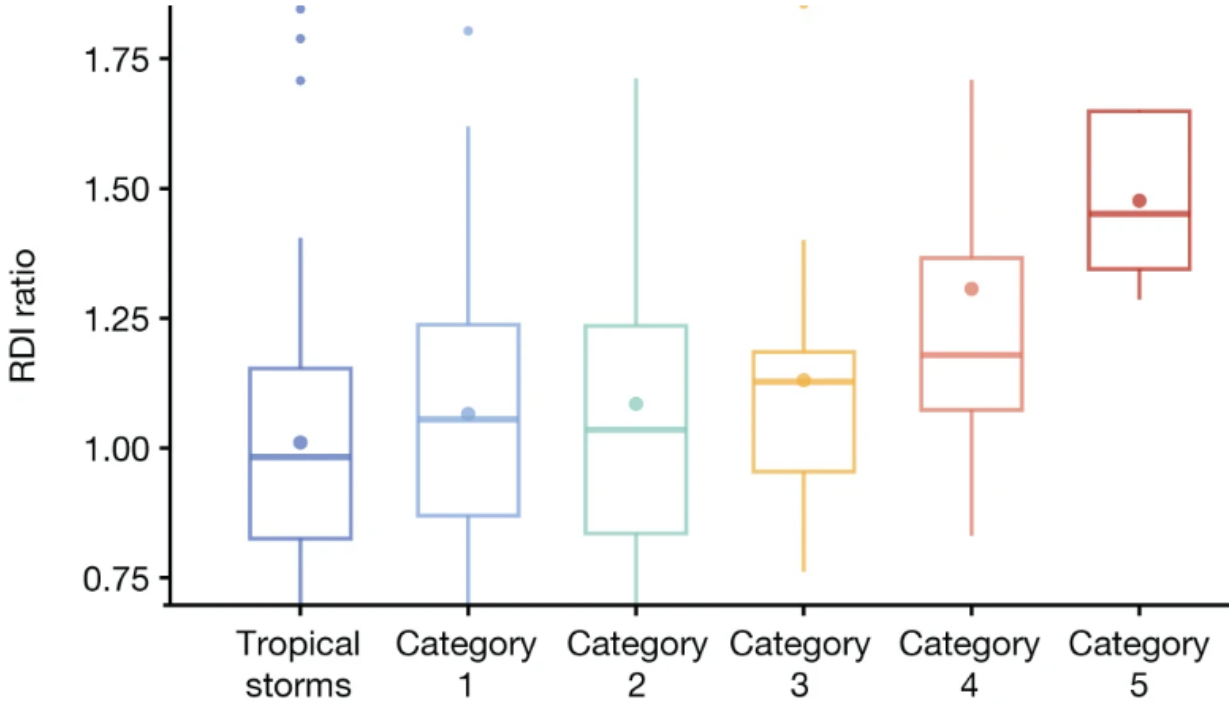
Nature **626**, 549–554 (2024) | Cite this article

https://doi.org/10.1038/s41586-023-06963-z

Impact Factor: 64.8

Fig. 5: The relative deprivation is accentuated with increasing storm severity.

From: Global population profile of tropical cyclone exposure from 2002 to 2019



COLUMBIA CLIMATE SCHOOL
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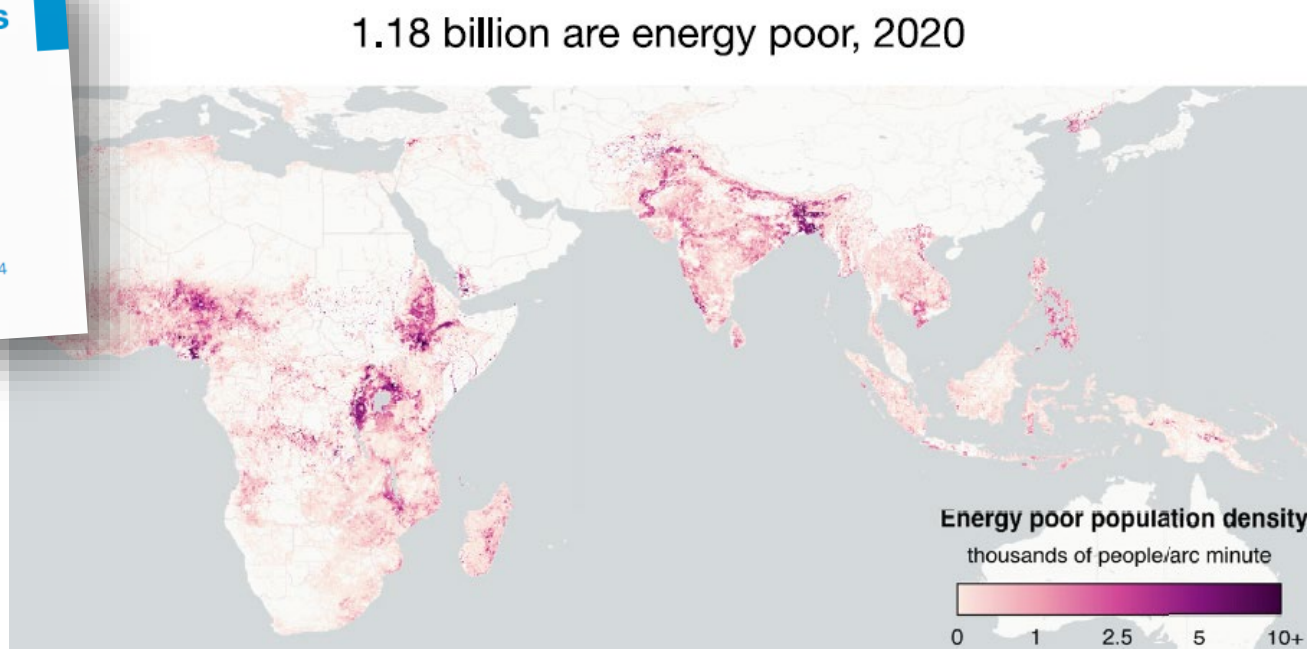
Data Citations : Remote Sensing Integration

Gridded Population of the World (GPW), v4.11, Global Human Settlement Layer-Population (GHS-POP), High Resolution Settlement Layer (HRSL), DMSP-OLS (Defense Meteorological Satellite Program Operational Linescan System) and VIIRS-DNB (Visible Infrared Imaging Radiometer Suite Day/Night Band)

https://doi.org/10.1016/j.joule.2024.05.001

Impact Factor: 39.8



Data Citations: Remote Sensing Integration

Gridded Population of the World (GPW), v4.11,
NASA Gravity Recovery and Climate Experiment (GRACE), and
Global Land Data Assimilation System (GLDAS)

nature sustainability

https://doi.org/10.1038/s41893-023-01247-w

Article

Living within the safe and just Earth system boundaries for blue water

Received: 25 April 2023
Accepted: 11 October 2023
Published online: 16 November 2023
Check for updates

Ben Stewart-Koster[1], Stuart E. Bunn[1], Pamela Green[2], Christopher Ndehedehe[1], Lauren S. Andersen[3], David I. Armstrong McKay[4,5,6], Xuemei Bai[7], Fabrice DeClerck[8,9], Kristie L. Ebi[10], Christopher Gordon[11], Joyeeta Gupta[12,13], Syezlin Hasan[1], Lisa Jacobson[14], Steven J. Lade[5,7,14], Diana Liverman[15], Sina Loriani[3], Awaz Mohamed[16], Nebojsa Nakicenovic[17], David Obura[18], Dahe Qin[19,20,21], Crelis Rammelt[12], Juan C. Rocha[5,14], Johan Rockström[3,22], Peter H. Verburg[23,24] & Caroline Zimm[17]

https://doi.org/10.1038/s41893-023-01247-w

Impact Factor: 27.2

Fig. 1.b: Surface water deficits and the groundwater required to meet them.

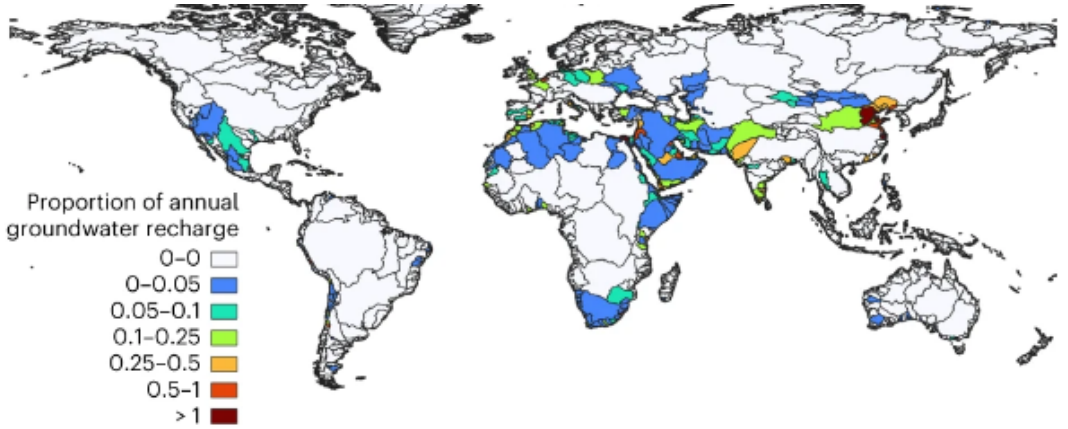
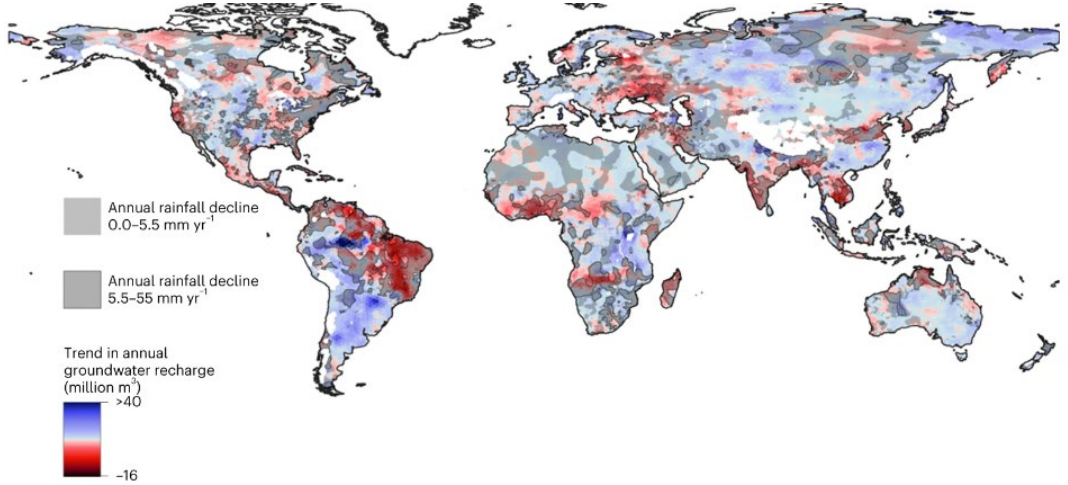


Fig. 2.b: Groundwater recharge and trends.



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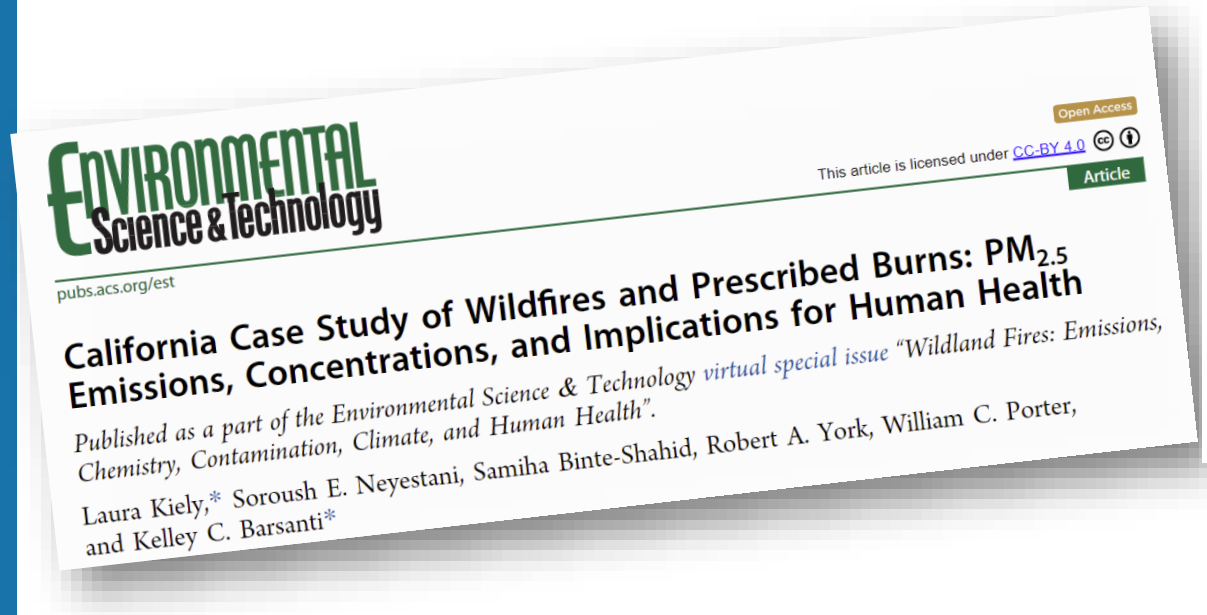
Data Citations: Remote Sensing Integration

Gridded Population of the World (GPW), v4.11 and
NASA Moderate Resolution Imaging Spectroradiometer (MODIS)



https://doi.org/10.1021/acs.est.3c06421

Impact Factor: 11.4

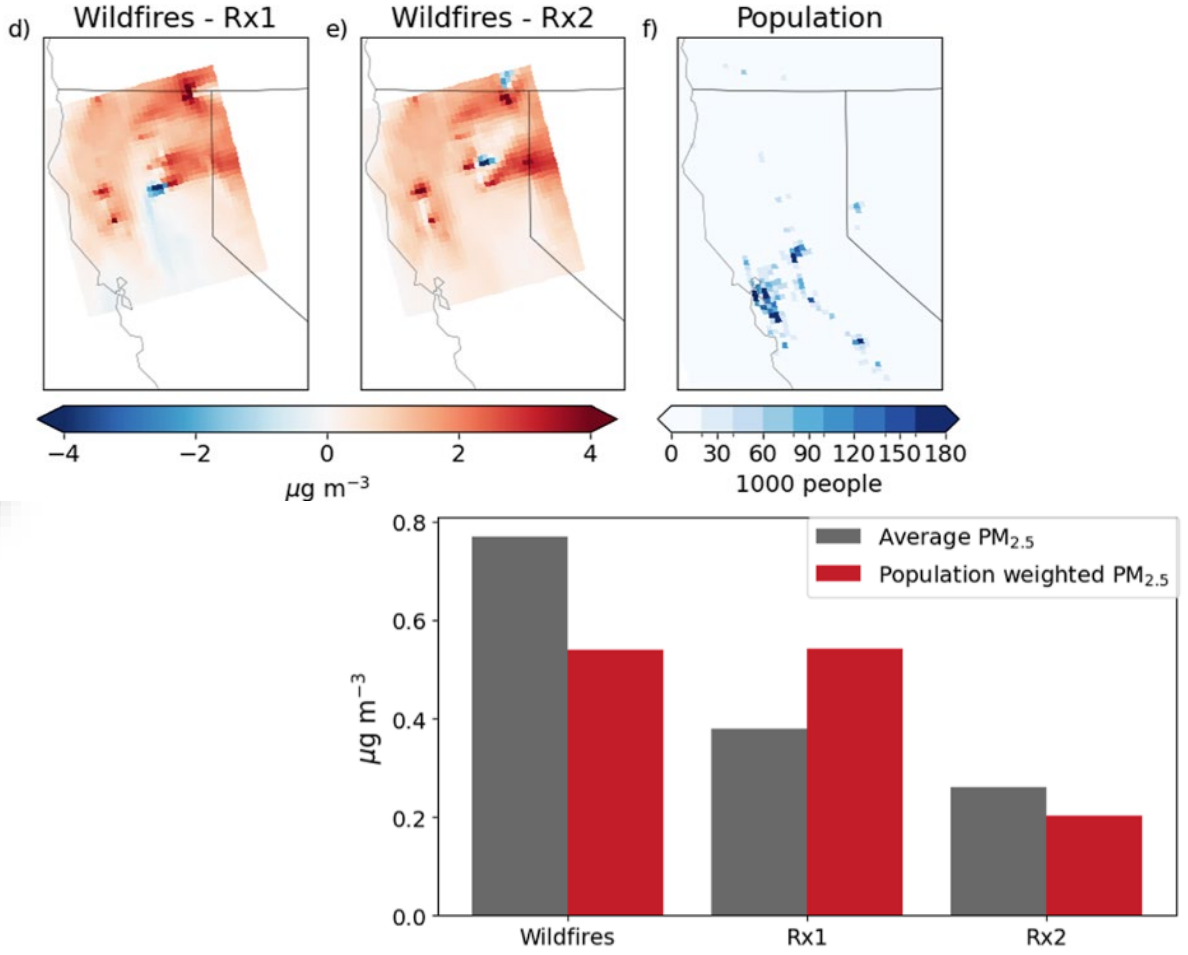


Figure 5. Modeled annual average surface fire-derived $PM_{2.5}$ concentrations and population-weighted $PM_{2.5}$ across the study area under the wildfire and Rx1 and Rx2 scenarios.

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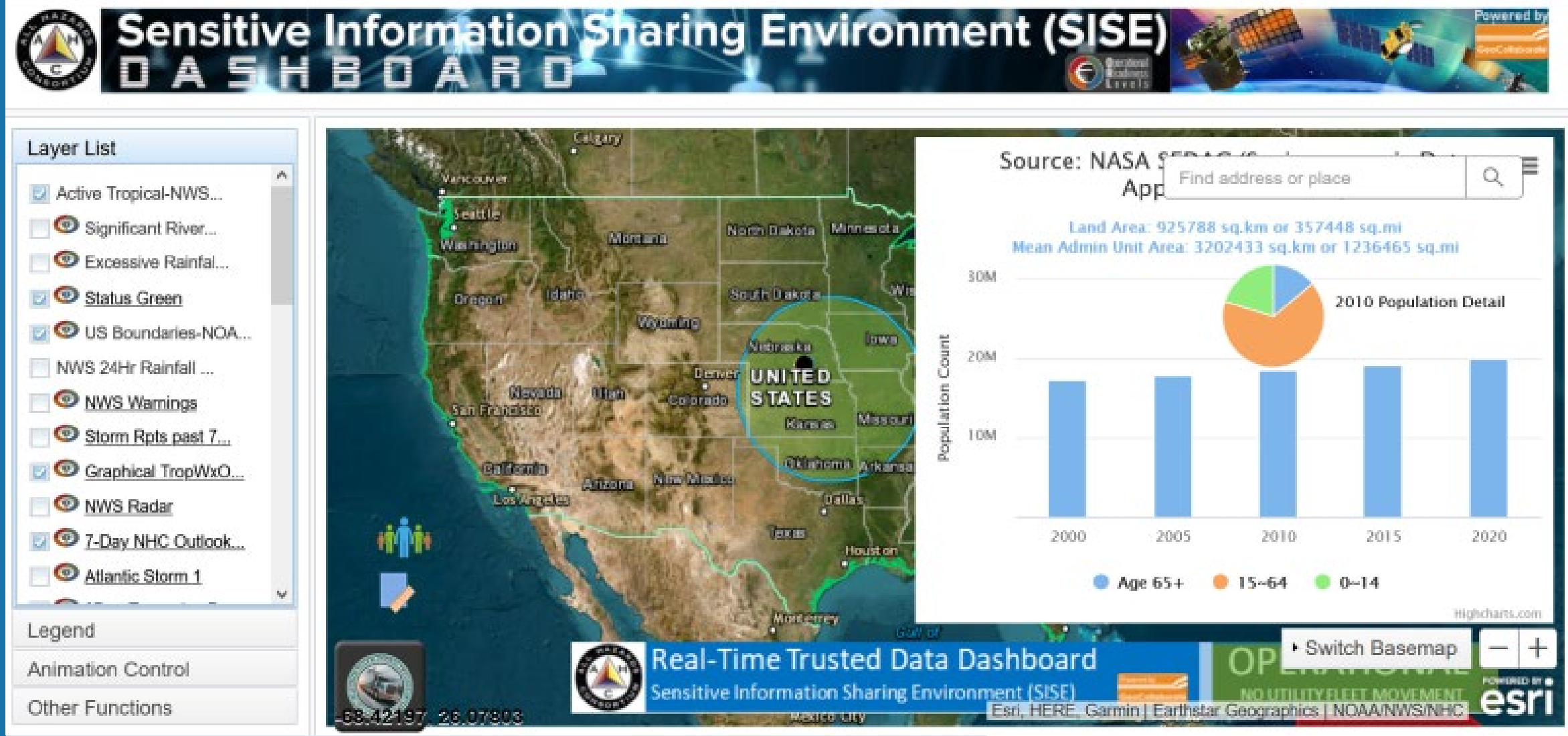
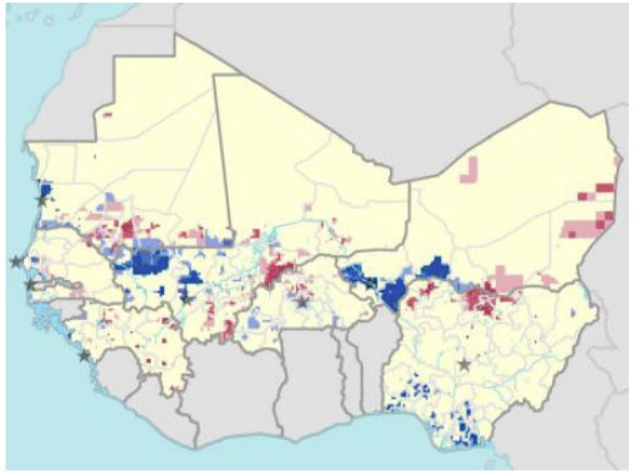
Integration of Data and Services for Disaster Response



Collaboration with StormCenter Communications, Inc.

Example SEDAC data use: Predictive analytics



UNHCR
The UN Refugee Agency

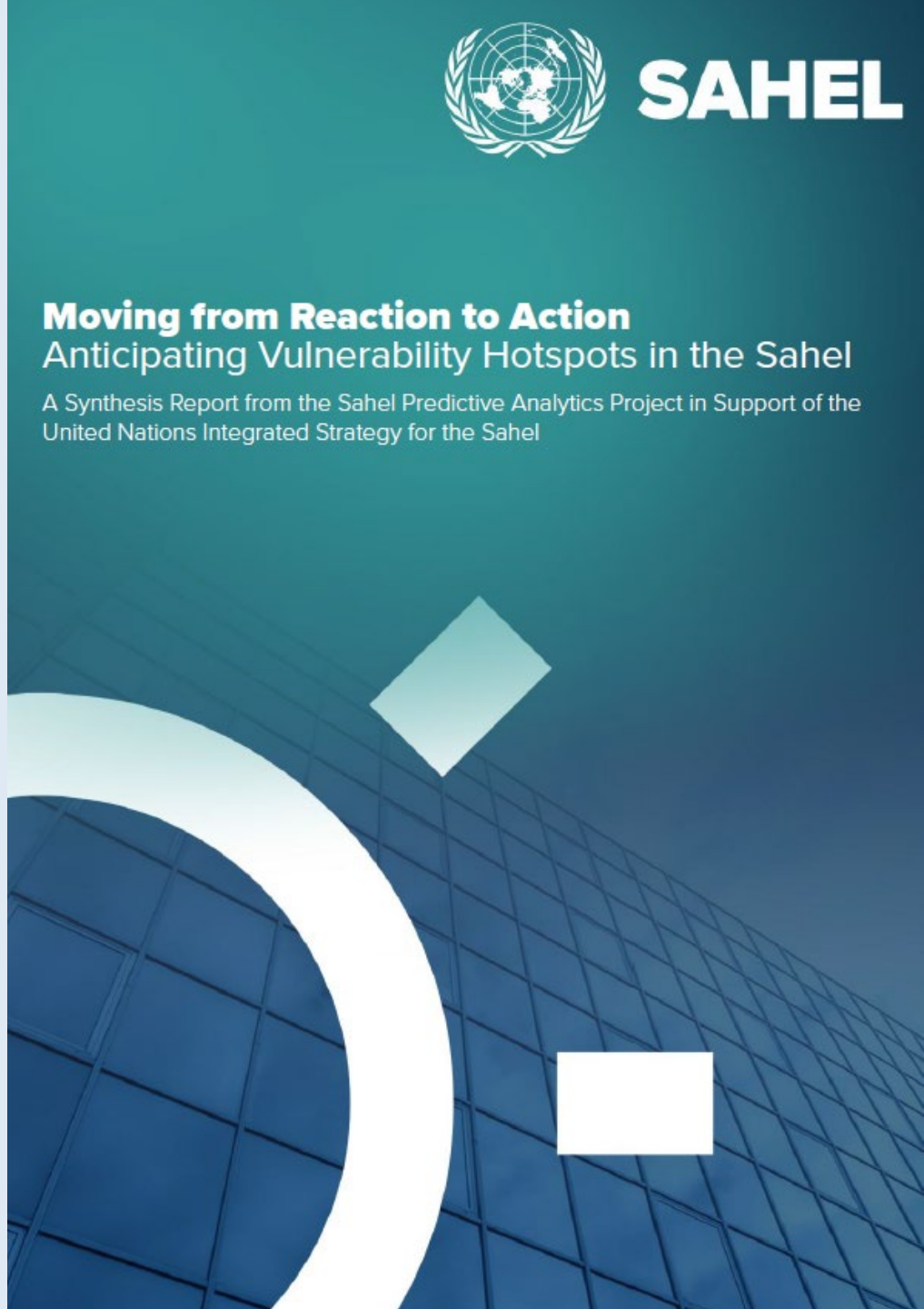
In-Migration
- High certainty in high levels of climate in-migration
- Moderate certainty in high levels of climate in-migration
- Low certainty in high levels of climate in-migration

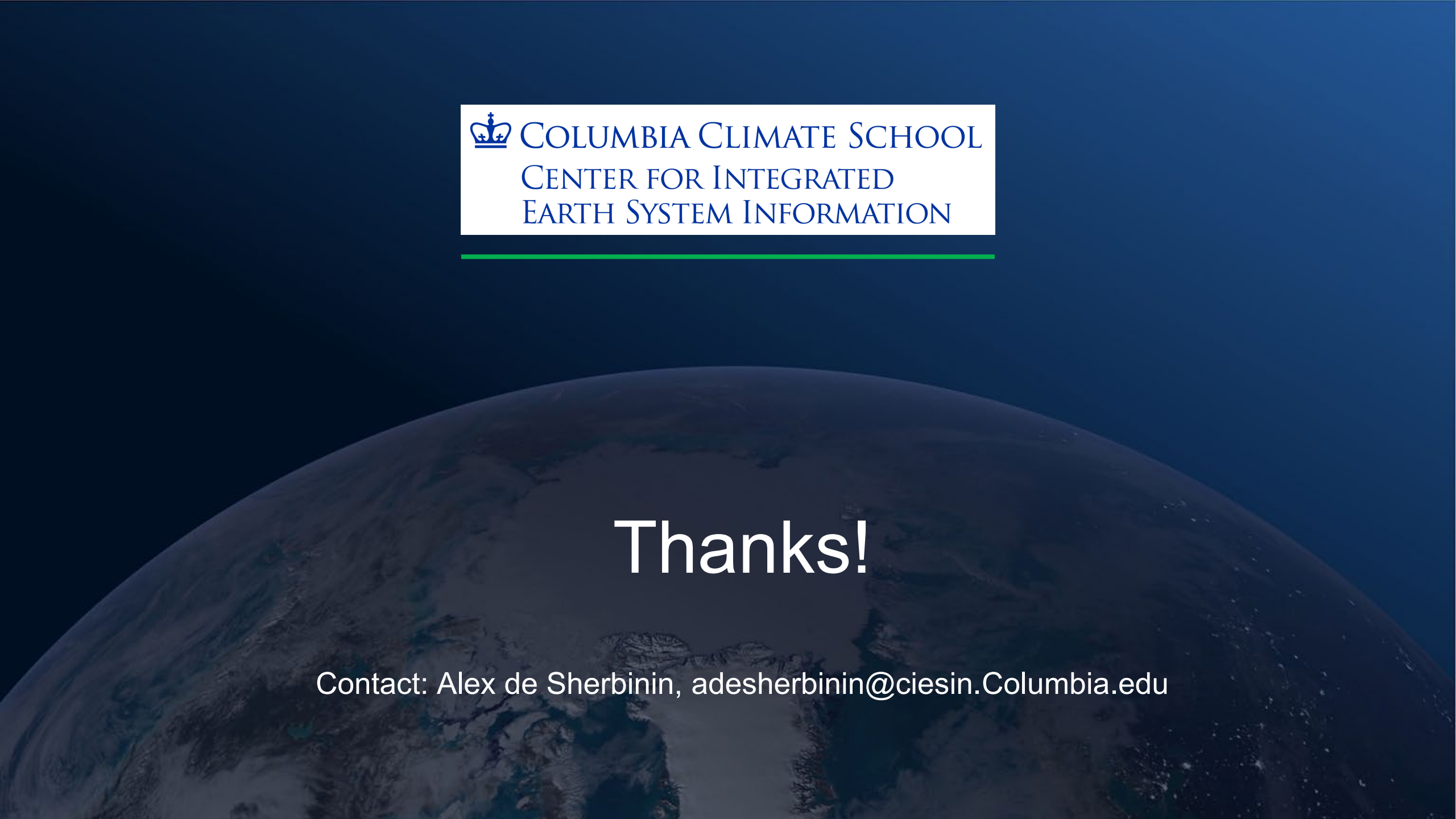
Out-Migration
- High certainty in high levels of climate out-migration
- Moderate certainty in high levels of climate out-migration
- Low certainty in high levels of climate out-migration

★ National capital

Figure 34: Hotspots of internal climate in- and out-migration for the Sahel region from the Groundswell Africa modelling work for 2050.

Geraldine Henningsen and David Wells of UNHCR's predictive analytics team reported to SEDAC that they use SEDAC's gridded population data and Global Urban Polygons and Points Dataset (GUPPD) in a project seeking to predict the risk of forced displacement at the grid cell level across Africa, with a special focus on climate change. The data help to overcome challenges related to the paucity of up-to-date population data for Africa.

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CENTER FOR INTEGRATED
EARTH SYSTEM INFORMATION
Thanks!
Contact: Alex de Sherbinin, adesherbinin@ciesin.Columbia.edu