



Integrating Earth Observations and Socioeconomic Data to Address Health, Equity, and Environmental Justice

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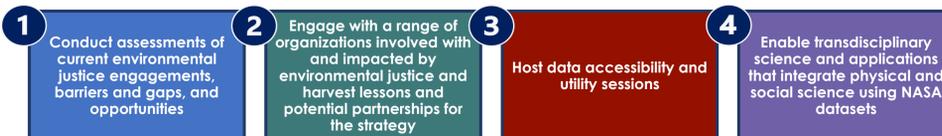
Introduction

Access to reliable data about the characteristics of populations is a crucial component of decision-making, policy development, and the assessment of progress towards strategic goals. Social determinants of health provide insight into the status of social and economic conditions within populations that have profound effects on public health, equity, and vulnerability. International frameworks such as the Sustainable Development Goals (SDGs) fundamentally focus on equality, but to efficiently address targets and indicators, socioeconomic data and Earth observations must be integrated to help identify populations most vulnerable to the impacts of climate change, natural disasters, health disparities, and poor policy planning. The ability to identify vulnerable populations with data analysis has the potential to empower community stakeholders with spatial awareness needed to inform decision-making that addresses equity and environmental justice issues within their communities. The EPA defines environmental justice (EJ) as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies.” NASA’s Earth Science Division (ESD) recognizes the benefits that Earth observations with NASA satellites create by equipping individuals with the knowledge to address community challenges. NASA’s Socioeconomic Data and Applications Center (SEDAC) supports the integration of socioeconomic and Earth science data as an “informational gateway.” This integration of data is advancing health, equity, and environmental justice initiatives.

NASA Equity & Environmental Justice

In a call to action, the Biden-Harris Administration announced Executive Order 13985 - Advancing Racial Equity and Support for Underserved Communities Through the Federal Government. Engagement opportunities with members of underserved communities and a priority to address the lack of equitable data are outlined as goals aimed to advance equity, racial justice, and equal opportunity. The Capacity Building Program (CBP) and NASA DEVELOP have worked towards advancing equity with the development of the Virtual Environmental Justice (VEJ) node. VEJ projects conducted in the spring of 2022 addressed these goals through a listening tour with community-based organizations working in the areas of environmental justice, disasters, and health and air quality. Additionally, many DEVELOP projects use socioeconomic data with Earth observations for the analysis of vulnerable populations in order to help mitigate environmental challenges, especially in underserved communities. These actions also address focus area three in NASA’s 2022 Equity Action Plan.

NASA Earth Science Division Equity and Environmental Justice Goals



Socioeconomic Datasets & Example Uses of Integration with Earth Observations

Socioeconomic data can be integrated with NASA Earth observation data to illustrate the location of vulnerable communities affected by environmental issues. Additionally, population datasets combined with vulnerability indices provide insight into the likelihood that a population or community is at risk of adverse events like natural disasters and public health crises that often disproportionately affect marginalized and underserved communities. Integration of data can provide better understanding of issues equipping decision-makers with the information needed for mitigation efforts in order to reduce risk, provide equitable response, and prevent the loss of life or property.

Global Population Datasets			
Dataset Product	Spatial Resolution	Year(s) Represented	Additional Notes & Distribution Policy
SEDAC: Gridded Population of the World, Version 4 (GPW4)	1 km (30 arc-seconds)	2000, 2005, 2010, 2015, 2020	This data uses national population data sourced from: • Official country census from 2010 • United Nations Population Division (UNPD) estimates and projections Data Access: Open Source
SEDAC: Global Rural-Urban Mapping Project, Version 1 (GRUMPv1)	1 km (30 arc-seconds)	2000, 1995, 1990	This data uses national population data sourced from: • United Nations Population Division (UNPD) estimates and projections Data Access: Open Source
European Commission Joint Research Centre (JRC): Global Human Settlement Population Grid (GHS-POP)	100 m, 1 km, 3 arc-seconds, 30 arc-seconds	5-year intervals between 1975 and 2020 Projections to 2025, 2030	This data uses national population data sourced from: • CIESIN/SEDAC GPWv4.11 • UN World Urbanization Prospects 2018, 2019 Data Access: Open Source
Oak Ridge National Laboratory: LandScan Global	• 1 km (30 arc-seconds) Global • 90 m (3 arc-seconds) LandScan USA & LandScan HD	2000 - 2020	This data uses national population data sourced from: • U.S. Census Bureau Data Access: Open Source
WorldPop: WorldPop	100 m (3 arc-seconds)	2000 - 2020	This data uses national population data sourced from: • Country-official estimates • United Nations Population Division (UNPD) estimates and projections Data Access: Open Source
Netherlands Environmental Assessment Agency (PBL): History Database of the Global Environment (HYDE)	10 km (5 arc-minutes)	10,000 BC - 2000 AD	This data uses national population data sourced from: • Updated historical population estimates • Land use for the past 12,000 years Data Access: Open Source
Continental Regional Country Population Datasets			
Dataset Product	Spatial Resolution	Year(s) Represented	Additional Notes & Distribution Policy
Data for Good at Meta (previously Facebook): High Resolution Settlement Layer (HRSL)	30 m (1 arc-seconds)	2015	140 countries + more in progress Data Access: Open Source
SEDAC: U.S. Census Grids	1 km (30 arc-seconds)	• 1990, 2000, 2010 Decennial Census Grids • 2000, 2010, 2014, 2016, 2018 Social Vulnerability Grids	United States Data Access: Open Source
U.S. Census Bureau: Gridded Population Mapping (Demobase)	100 m	1998 - 2021 Country Specific	Saint Vincent and the Grenadines, Dominica, Bahamas, South Sudan, Rwanda, Pakistan, Haiti Data Access: Open Source
U.S. Census Bureau: Subnational Population by Sex, Age, & Geographic Area	Country Specific	2000 - 2040	Countries mainly in south Africa and Asia Data Access: Open Source
U.S. Census Bureau: International Database: World Population Estimates & Projections	Country Specific	From base year to 2100	200+ countries with populations of 5,000 or more Data Access: Open Source
Eurostat: GEOSTAT	1 km (vector grid)	2011	Europe Data Access: Open Source
Esri: Regional: Africa, Asia, Europe, North America, Oceania, South America	150 km, Country Specific	2020-2021, updated every two years	Countries in Africa, Asia, Europe, North America, Oceania, South America Data Access: Esri Membership

Charles River Water Resources

Assessing Flooding Vulnerability to Assist High Water Intervention and Urban Planning Programs in the Charles River Watershed

Objectives:

- Map impervious surfaces and population density to show potential for watershed degradation
- Assess flood vulnerability and flood susceptibility across the watershed

Population Data used: 2010 U.S. Census

Huntsville Urban Development

Utilizing NASA Earth Observations to Evaluate Urban Tree Canopy and Land Surface Temperature for Green Infrastructure Development and Urban Heat Mitigation in Huntsville, AL

Objectives:

- Quantify the impacts of Huntsville’s urban expansion on decreasing tree canopy coverage
- Identify hot spots within the city that are experiencing the UHI Effect and the vulnerable populations within them

Population Data used: CDC Health Data + U.S. Census

Southern Bhutan Ecological Forecasting III

Utilizing NASA Earth Observations to Model Land Cover Change and Elephant in Southern Bhutan Wildlife Corridors

Objectives:

- Refine LULC maps to include locations of human settlements
- Update the potential biological corridor map for Asian elephants to incorporate information on built-up urban areas and rural human settlements

Population Data used: SEDAC

NASA Capacity Building Program