Assessing Population Exposure and Vulnerability for Health Applications

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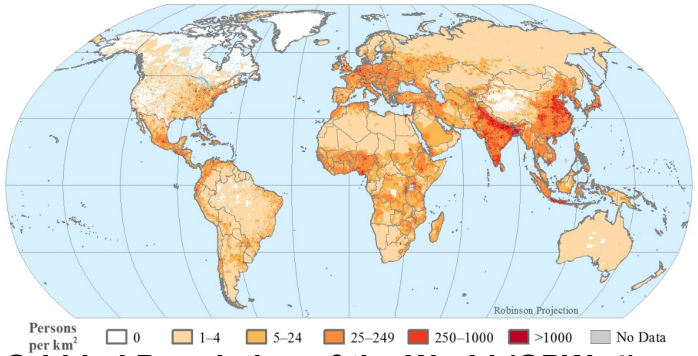
NASA Socioeconomic Data and Applications Center (SEDAC)

- SEDAC data provide the human context for NASA's remote sensing data
- Focus on human dimensions of environmental change
- Big emphasis on data integration
- Direct support to scientists, applied and operational users, decision makers, and policy communities
- Strong links to geospatial data community

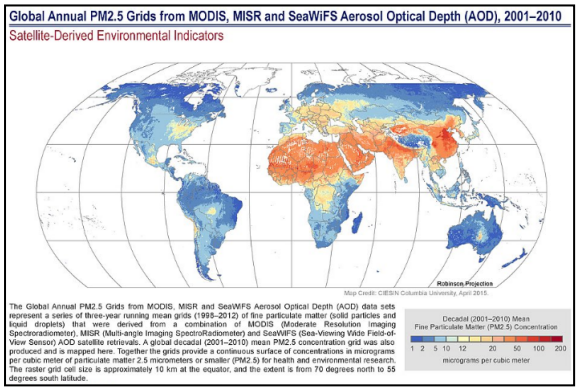
http://sedac.ciesin.columbia.edu

Key Questions Regarding Exposure and Vulnerability

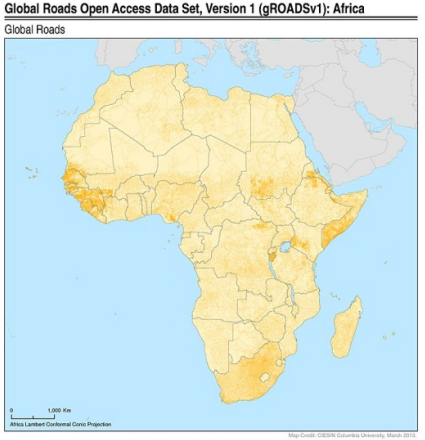
- Where do people live and work relative to poor air quality (persistent and episodic), and how is exposure changing over time?
- Where are there concentrations of vulnerable groups, e.g., young children, elderly, poor people, outdoor workers?
- What is the distribution of built infrastructure and key attributes that may affect indoor/outdoor exposure and vulnerability, e.g., roads, power plants, building types and heights?



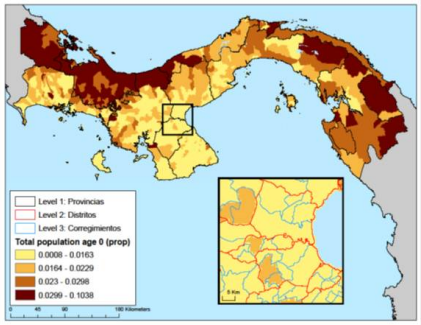
Gridded Population of the World (GPWv4)



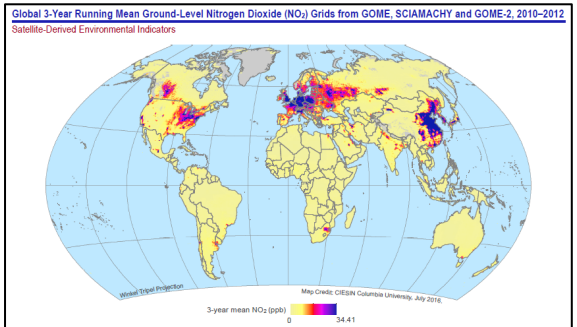
PM2.5 and NO2 Grids from Dalhousie University



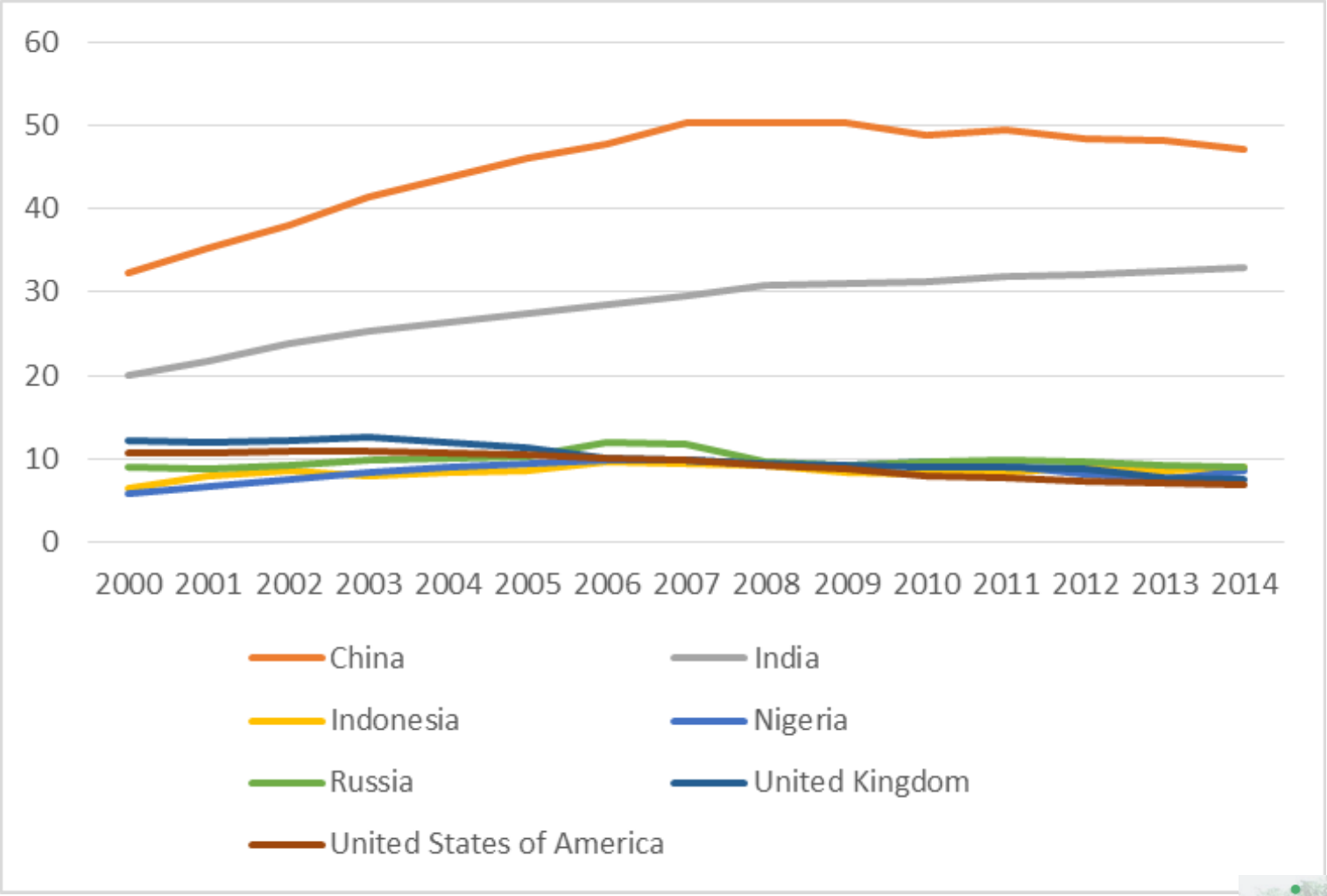
Global Roads Open Access Data Set, Version 1 (gROADS)



GPWv4 Age Structure for 2010

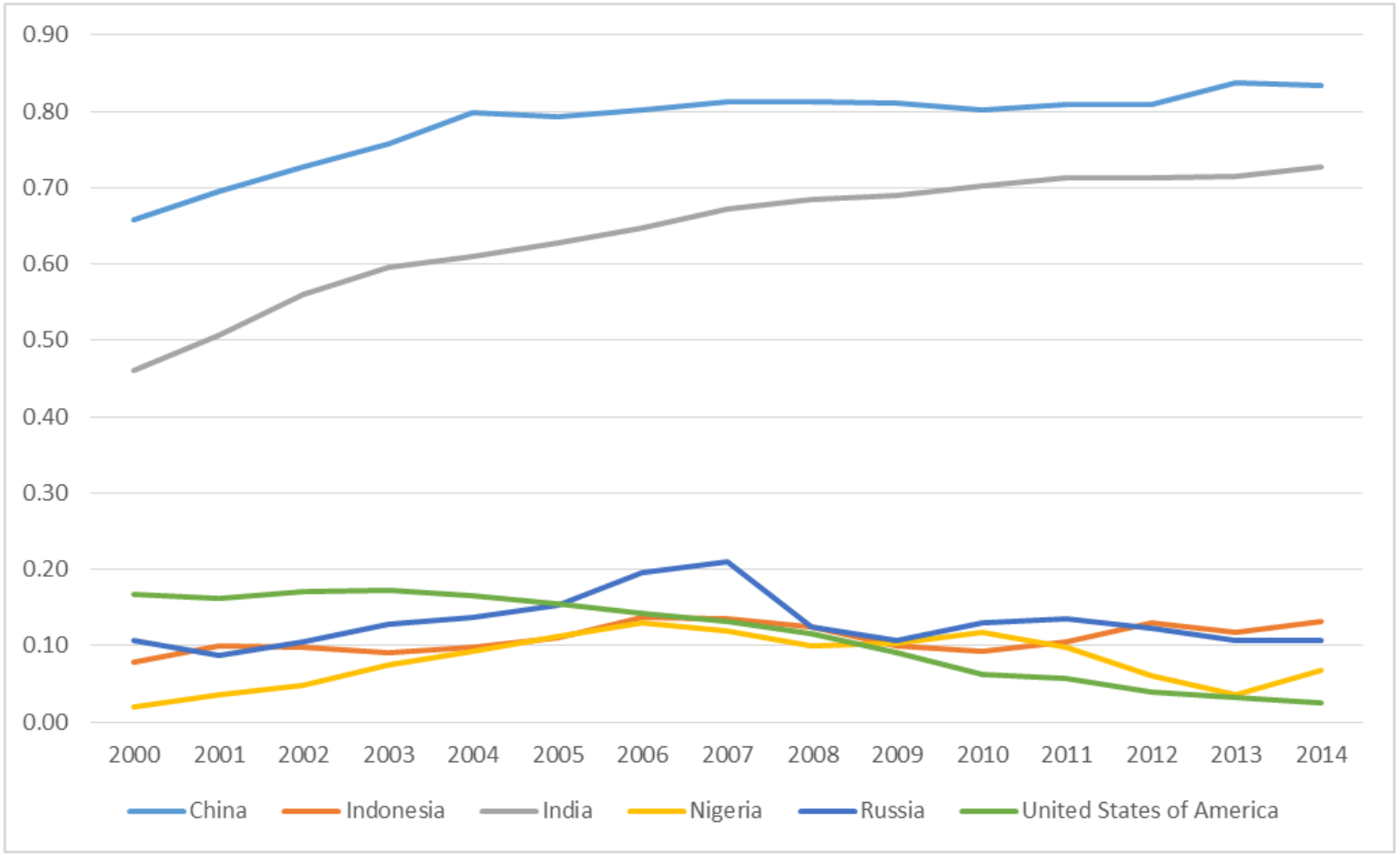


Trend in Average Annual PM2.5 Concentrations



Source: 2016 EPI, http://sedac.ciesin.columbia.edu/data/set/epi-environmental-performance-index-2016

Trends in Proportion of Population Exposed to PM2.5 in Exceedance of 25 ug/m3



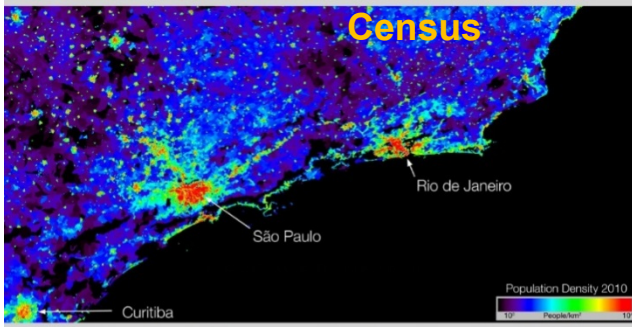
Source: 2016 EPI, http://sedac.ciesin.columbia.edu/data/set/epi-environmental-performance-index-2016

Recent Papers that Use SEDAC Population Data for Air Pollution Exposure Studies

- Cohen, A.J. et al. 2017. Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015. ***The Lancet***. 389(10082): 1907-1918
- Giannadaki, D. et al. 2017. The impact of fine particulate outdoor air pollution to premature mortality. ***Perspectives on Atmospheric Sciences***, Ed(s): Karacostas, Theodore; Bais, Alkiviadis; Nastos, T. Panagiotis. pp: 1021-1026
- Liao, Z. et al. 2017. The impact of synoptic circulation on air quality and pollution-related human health in the Yangtze River Delta region. ***Science of The Total Environment***. 607–608: 838-846
- Brauer, M. et al. 2016. Ambient air pollution exposure estimation for the global burden of disease 2013. ***Environmental Science & Technology***. 50(1): 79-88
- Gu, Y., and Yim, S.H.L. 2016. The air quality and health impacts of domestic trans-boundary pollution in various regions of China. ***Environment International***. 97: 117-124
- Lelieveld, J., et al. 2015. The contribution of outdoor air pollution sources to premature mortality on a global scale. ***Nature***. 525(7569): 367-371

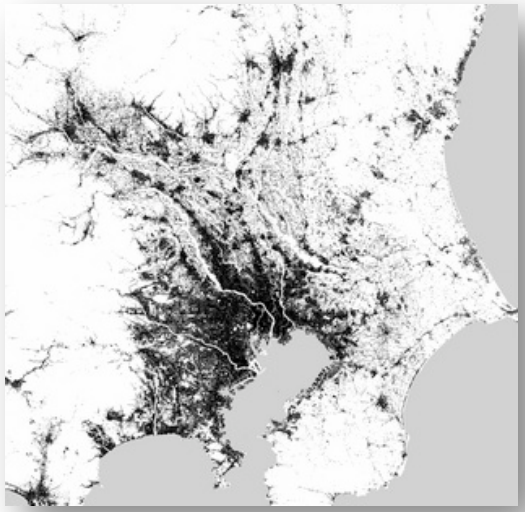
Use of Remote Sensing to Map Urban vs. Rural Areas, Settlements, Infrastructure

- Night-time lights (DMSP >1 km → VIIRS ~750m)
- Landsat (~30 m)
- Radar (~12 m)
- High resolution imagery (< ~3m resolution)

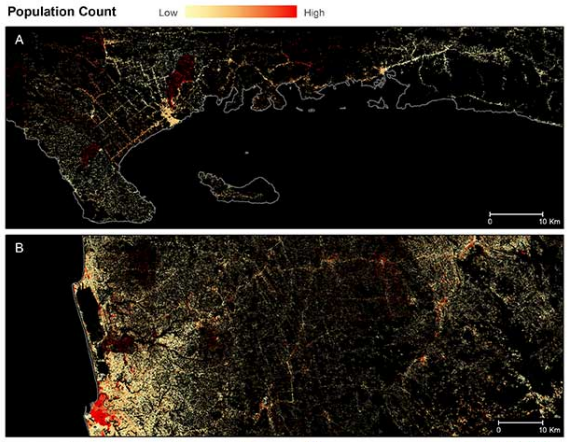


DLR

internet.org by facebook



http://ciesin.columbia.edu/data/hrsl/



https://urban-tep.eo.esa.int/#

http://ghslsys.jrc.ec.europa.eu/index.php

JRC EUROPEAN COMMISSION

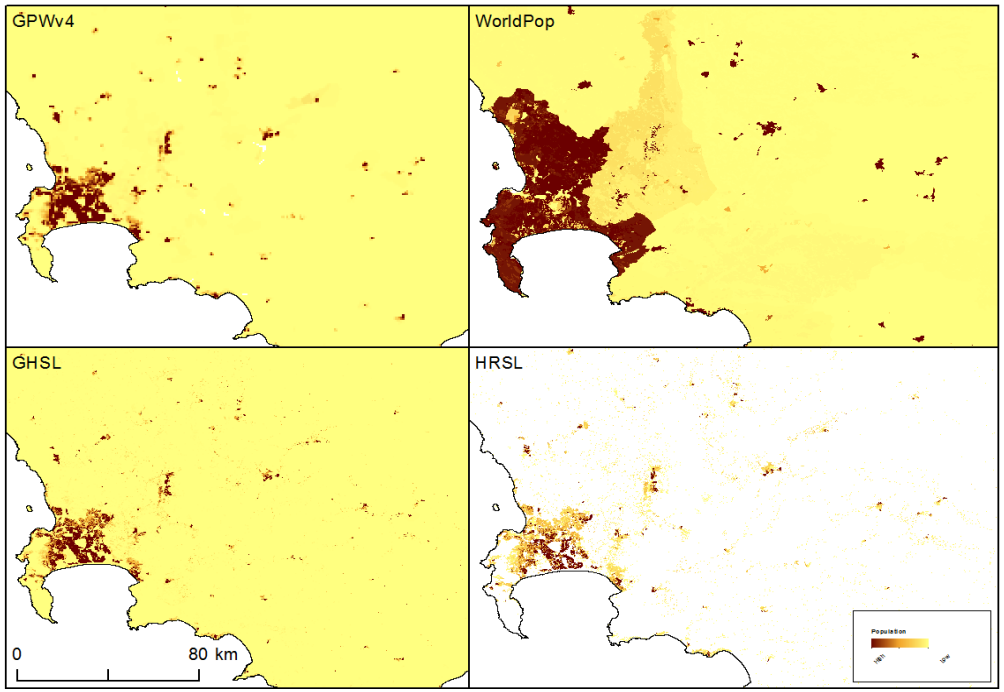
Diversity of Products with Different Characteristics

Project	Prop. Allocation	Dasymetric	Statistical / machine learning	Multiple Time Points	Imagery / spectral data	Radar	Nominal Spatial Resolution
GPW	✔			✔			1km
Landscan		✔	✔?	✔	✔		1km
WorldPop			✔	✔ *			100m
GHSL		✔	✔	✔	✔		30m, 250m, 1km
GUF		✔	✔			✔	~12m for scientific research ~84m public
Esri		✔					250m
HRSL			✔		✔		30m
GMIS/HBASE			✔		✔		30 m

* Exists for some countries, planned for WorldPop Global

Some Challenges in Using These Data for Air Quality Research & Applications

- Access is scattered; not all open access
- Methods not clear; inconsistent documentation, metadata
- Some are 1-time, research-oriented products; not updated regularly
- Quality may vary by region, time period
- No rigorous validation or intercomparison conducted
- Not interoperable or well integrated with other related data, e.g., on critical infrastructure, administrative units, water bodies, pop projections



Four population models for Cape Town and environs, South Africa:

- Gridded Population of the World, version 4 (GPWv4)
- WorldPop South Africa
- Global High Resolution Settlement Layer, Population (GHSL)
- High Resolution Settlement Layer (HRSL)

A "Data Collaborative" for Settlement, Infrastructure, and Population Data

- Public-private data partnership involving intergovernmental organizations, national & academic research institutions, large and small companies, NGOs, foundations, universities, data stewards, etc.
- Overall Goal: Accelerate the development and use of high quality, highly usable georeferenced data on population, human settlements, and infrastructure, drawing on an international, interdisciplinary community of data developers and users from both the public and private sectors.

Participation Welcome!

- **POPGRID Google Group**
  https://groups.google.com/forum/#!forum/popgrid
- **GEO Human Planet Initiative**
  https://www.earthobservations.org/activity.php?id=119
- **American Geophysical Union**
  New Orleans LA, 11-15 December 2017
  http://fallmeeting.agu.org/2017/
  - POPGRID sessions scheduled on 15 December (2 oral, 1 poster, >25 papers)
  - Working meeting on 14 December
- **Second POPGRID working meeting**
  Columbia U., New York, 28 Feb-2 Mar 2018
- **American Association of Geographers**
  New Orleans LA, 10-14 April 2018
  http://annualmeeting.aag.org/
  - Three POPGRID sessions organized