Using environmental data from remote sensing in demographic analysis: An introduction

EDSD, 12-15 Dec 2022

Ankit Sikarwar & Valérie Golaz

ined
INSTITUT NATIONAL D'ÉTUDES DÉMOGRAPHIQUES

www.ined.fr

Day 2 / Session 1

Hands-on..

- Adding base map and extracting data
- Joining data with shapefiles
- Data presentation and symbology
- Map layout and exportation
- An intro to MAGRIT (mapping platform)

Using environmental data from remote sensing in demographic analysis: An introduction

EDSD, 12-15 Dec 2022

Ankit Sikarwar & Valérie Golaz

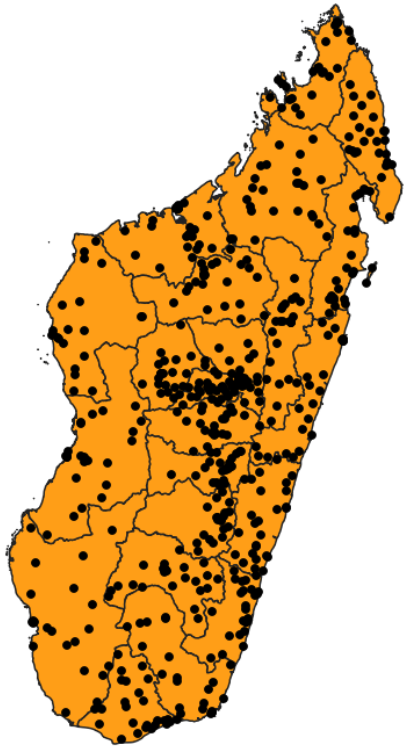
ined
INSTITUT NATIONAL D'ÉTUDES DÉMOGRAPHIQUES

www.ined.fr

Day 2 / Session 2

- Environmental data sources
- Worldpop data
- Demonstration

An example of a set of environmental indicators:



The DHS Program Geospatial Covariate Datasets Manual

DHSID	GPS_Dataset	DHSCC	DHSYEAR	DHSCLUST	SurveyID	All_Population_Count_2005	All_Popula
MD200800000001	MDGE53FL	MD	2008.0	1.0	MD2008DHS	95446.21875	110001.0
MD200800000002	MDGE53FL	MD	2008.0	2.0	MD2008DHS	93231.875	107448.984
MD200800000003	MDGE53FL	MD	2008.0	3.0	MD2008DHS	267251.15625	308004.812
MD200800000004	MDGE53FL	MD	2008.0	4.0	MD2008DHS	157708.0625	181757.281
MD200800000005	MDGE53FL	MD	2008.0	5.0	MD2008DHS	85130.7734375	98112.5312
MD200800000006	MDGE53FL	MD	2008.0	6.0	MD2008DHS	295217.65625	340236.0
MD200800000007	MDGE53FL	MD	2008.0	7.0	MD2008DHS	104555.703125	120499.601
MD200800000008	MDGE53FL	MD	2008.0	8.0	MD2008DHS	146056.46875	168328.921
MD200800000009	MDGE53FL	MD	2008.0	9.0	MD2008DHS	312870.28125	360580.468
MD200800000010	MDGE53FL	MD	2008.0	10.0	MD2008DHS	250947.109375	289214.5

- Different sources of information for the same type of indicator
- Different types of information produced by the same project/provider
- University-led programmes for building open access international databases
- Spatial scale : Averaged indicators over the buffer zone for each sample geo-location
- Temporal scale : 5y …… we might want to do differently……

Weather/Climate data

CHIRPS: Climate Hazards center InfraRed Precipitation with Station data
(Rainfall Estimates from Rain Gauge and Satellite Observations)
"Since 1999, USGS and CHC scientists—supported by funding from USAID, NASA, and NOAA—have developed techniques for producing rainfall maps, especially in areas where surface data is sparse."

CRU-TS: the UK Climate Research Unit's time series datasets
(exclusively based on weather stations observation)
The last version, released 26 May 2022, covers the period 1901-2021
Coverage: All land areas (excluding Antarctica) at 0.5° resolution
Variables: temperature • volume of hydrological precipitation • vapour pressure • wet days • cloud cover

Demonstration:

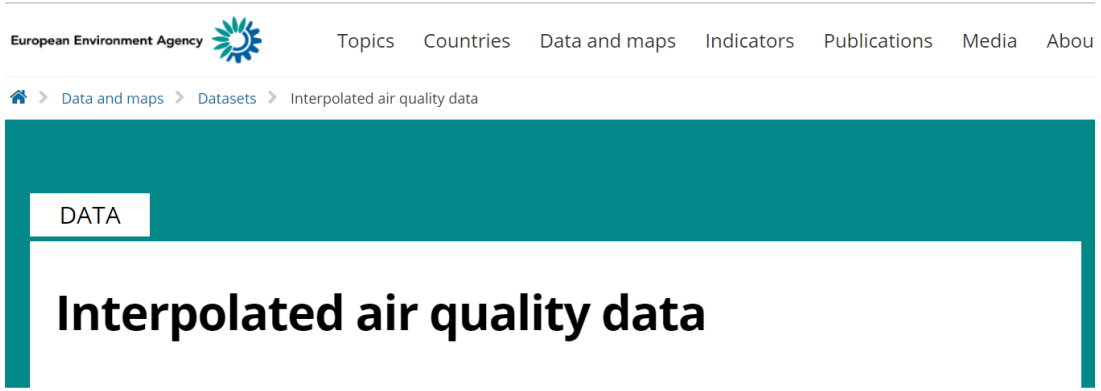
Worldclim (temperature and precipitation data at various resolution)

https://www.worldclim.org/data/worldclim21.html

Atmospheric data

- Gridded data on air-quality indicators

Data based on ground observations:



Demonstration:

Atmospheric Composition Analysis Group (PM2.5, NO2..)

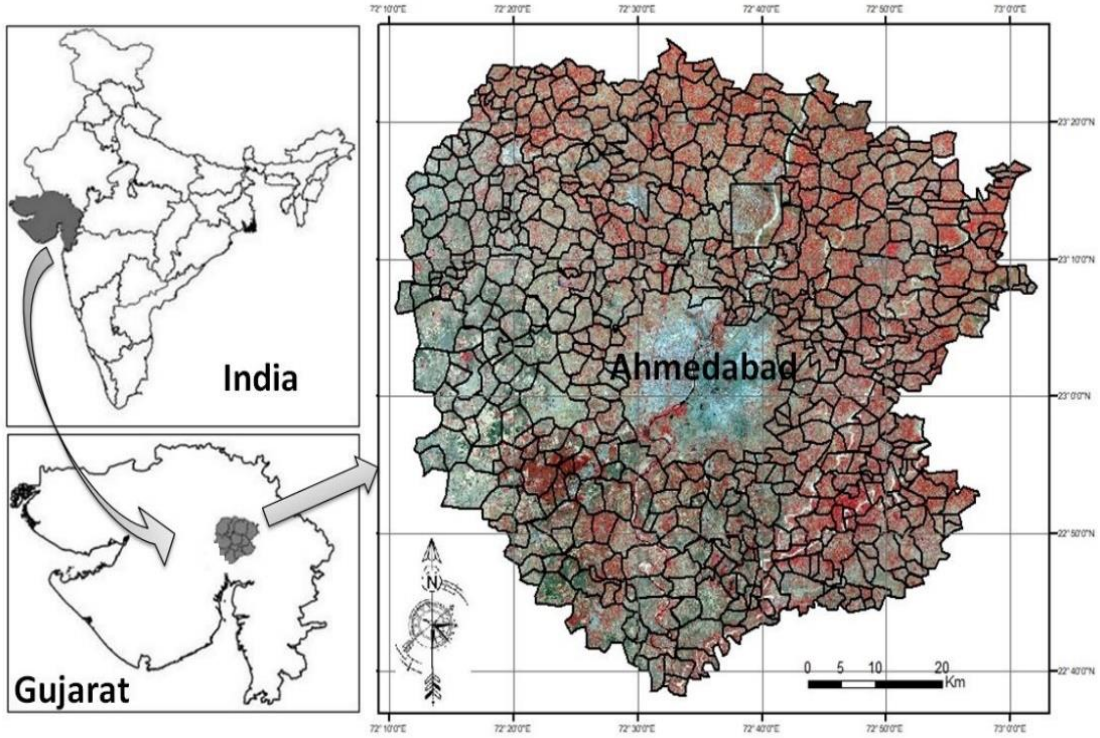
https://sites.wustl.edu/acag/datasets/

Land use / Land cover data

- Data on types of Land-use/Land-cover: Built-up, agricultural, water, forest, open-space, etc.

- Can be done classification techniques for small areas: very accurate but time consuming

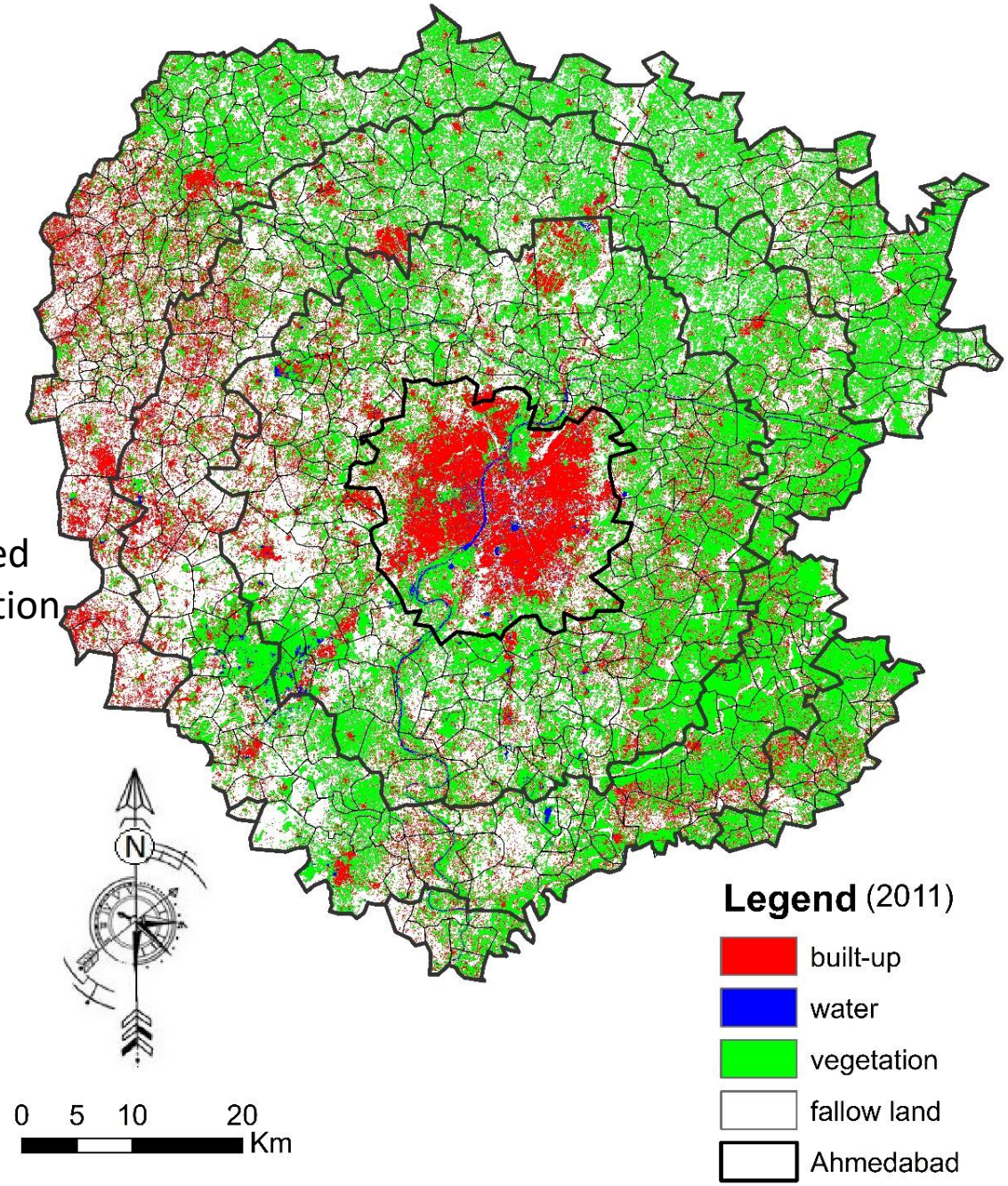
For example:



LANDSAT TM-5 imagery

(From the PhD thesis of Ankit Sikarwar)

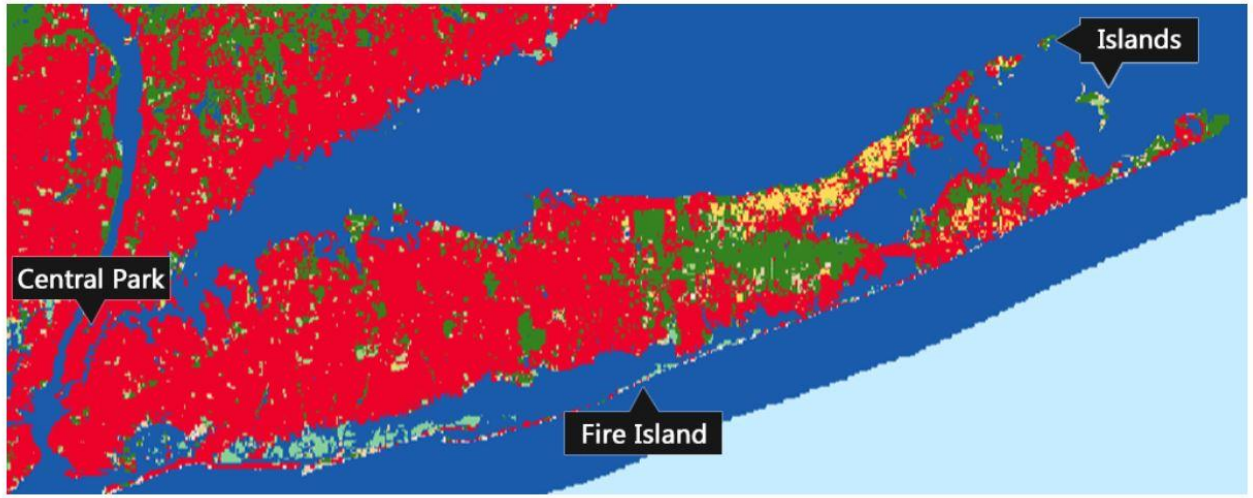
Supervised classification



Land use / Land cover data

- Pre-processed data sets:
- Multiple sources of data (varying in spatial resolution, temporal scales, methods, and categories)
- For example:

1. Esri Land Cover 10m



2. Global Land Survey (GLS)

Demonstration:

ESRI living Atlas (ready to use LULC data)

https://livingatlas.arcgis.com/landcover/

More details and other sources:

https://gisgeography.com/free-global-land-cover-land-use-data/

Satellite data sources

MODIS : the Moderate Resolution Imaging Spectroradiometer on NASA Terra (and Aqua) satellite(s) (temperature data retrieved at the moment)
« viewing the entire Earth's surface every 1 to 2 days, acquiring data in 36 spectral bands - These data will improve our understanding of global dynamics and processes occurring on the land, and in the lower atmosphere.

SENTINEL : The Copernicus Program is an ambitious initiative headed by the European Commission in partnership with the European Space Agency (ESA). The Sentinels include all-weather radar images from Sentinel-1A and -1B, high-resolution optical images from Sentinel 2A and 2B, as well as ocean and land data suitable for environmental and climate monitoring from Sentinel 3.

How to access them ?
Copernicus - Google Earth Engine –Earth Explorer

Demonstration:

NASA: earth explorer (satellite images)
Platform to access satellite images for specific times and regions...

https://earthexplorer.usgs.gov/

Global gridded population data

Methodology : more or less modelling…

-census data and administrative boundaries

-satellite signal, day and night, radar and images

From GPW (gridded population of the world) in 1995 [1kmx1km, little modelling (areal weighting/Protected areas and water bodies)]

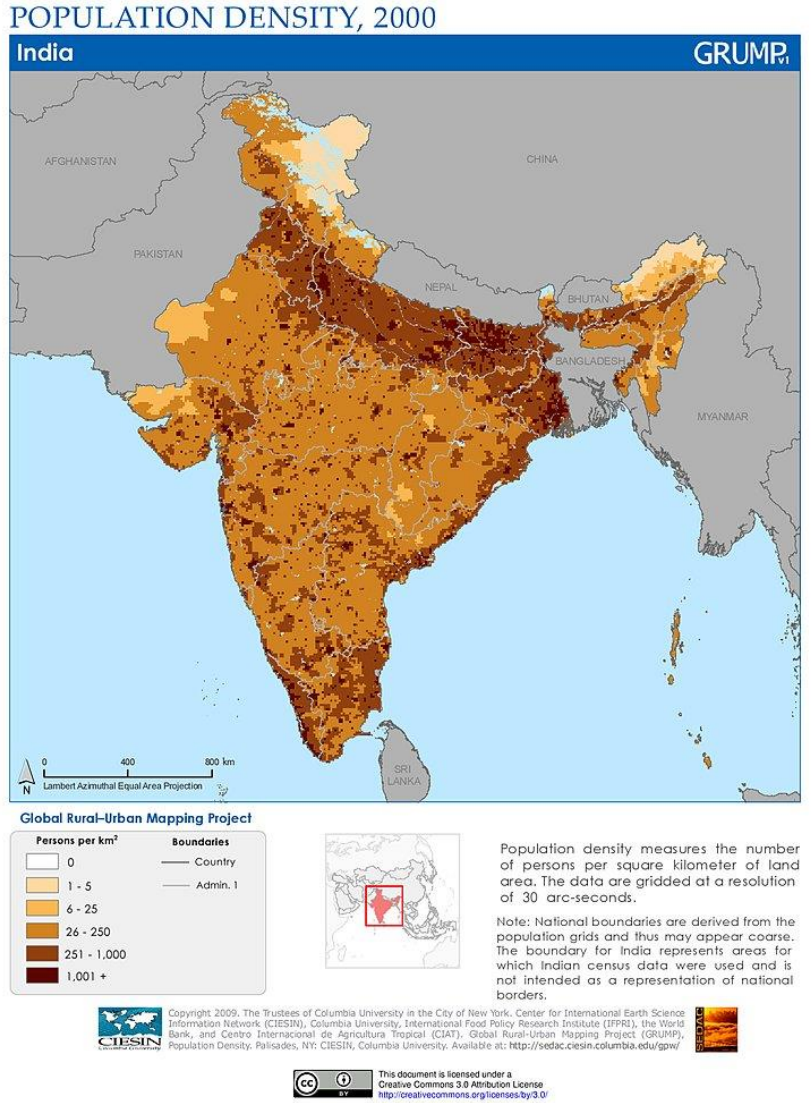
… to GRUMP from 2011 (a little more modelling, using night lights)

… to Worldpop today [100m x 100m, more modelling (machine learning / Roads, land cover, built structures, cities or urban areas, night time lights, infrastructure, environmental, protected areas, and water bodies)]

Demonstration:

PopGrid: a compilation of different gridded data for demographic indicators https://www.popgrid.org/

https://worldpop.org



Sources :

- TReNDS and SDSN, 2020, *Leaving no one off the map. A guide for gridded population data for sustainable development*, Report by the Thematic Research Network on Data and Statistics (TReNDS) of the UN Sustainable Development Solutions Network (SDSN) in Support of the POPGRID Data Collaborative.
- GRUMP map: https://sedac.ciesin.columbia.edu/data/collection/grump-v1/