GLOBAL URBAN DATA GAPS: MACHINE LEARNING, EARTH OBSERVATION AND DEPRIVED URBAN AREAS

Earth Observation Data in Support of Poor Communities against COVID-19

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IDEA MAPS Network

SLUMAP

ACCOUNT

belspo
COVID-19: ROLE OF ROUTINE MAPS OF URBAN DEPRIVATION

GLOBAL SPATIAL DATA FOR COVID-19 RESPONSES ARE MISSING
COVID-19: ROLE OF ROUTINE MAPS OF URBAN DEPRIVATION

BASE DATA IS MISSING FOR COVID-19 RESPONSES

Location/Area
Infrastructure/Facilities
Socio-economic conditions
Monitoring + Community advocacy
Physical characteristics
Environment (waste, sewer, etc)
Densities (built/population)
Information for all urban areas

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THE UNACCOUNTED SPACES
OFFICIAL SLUM DATA OFTEN OMIT A LARGE PART OF THE DEPRIVED AREAS

The Example of Bangalore, India

- Indian Census report: 8.4% slum population
- Slum Board report: recognized 597 slums
- Local survey mapped: almost 1,500 slums

Omitted temporary settlements

Source: Dynaslum Project

SPATIAL DATA ON SLUM POPULATION

- Missing the spatial dimension of deprivation
- Population estimates are very uncertain
- Official slum data have large data gaps

Source: UN-Habitat, 2014
THE GLOBAL DATA GAPS ON CLIMATE AND ENVIRONMENT

Covid-19 and other climate and environmental risks

Urban Heat

Mumbai, India
Population: 22 M
Slum population: 42%
Major risk exposure: Storm/Heat/Flooding
Urban class: Mega city
City mean sea level: 47.5 m
Slums mean height: 15.4 m

MULTI-HAZARD RISK

Source: https://www.justempower.org/
MAJOR REASONS FOR GLOBAL DATA GAPS

- Local context and training data
- Scalability and transferability – VHR imagery
- Official slum data have large data gaps
- Aggregation and validation - ethics

SLUMAP (Remote Sensing for Slum Mapping and Characterization in sub-Saharan African Cities):

- **Open-source framework** that allows for the processing of remote sensing images for (i) providing information on the location and extension of slums (ii) characterizing the physical environment within slums at limited cost.

- Methods will be tested in sub-Saharan cities, e.g. Ouagadougou (Burkina Faso), Nairobi and Kisumu (Kenya)

[http://slumap.ulb.be/]
Source: http://slumap.ulb.be/
DEPARTING FROM BINARY MAPS OF DEPRIVATION

DEPARTING FROM THE BINARY – SLUM VERSUS NON-SLUM VISION....

Ajami, Kuffer, Persello and Pfeffer, 2019
DEPARTING FROM BINARY MAPS OF DEPRIVATION

DEPARTING FROM THE BINARY – SLUM VERSUS NON-SLUM VISION....

Legend
- All slums

SoEcVa
-3.32 - -3.28
-3.27 - -2.63
-2.62 - -1.97
-1.96 - -1.31
-1.30 - -0.66
-0.65 - 0.00
0.01 - 0.66
0.67 - 1.31
1.32 - 1.97
1.98 - 2.63
2.64 - 3.28

CNN-based model Transfer learning

Classification problem
Distinctive features
2000 samples for training

Regression problem
Predicting Deprivation indices
4121 samples for training

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NEED FOR DEPRIVED AREAS MAPS

NEW NETWORK WITH FUNDING FROM A UK RESEARCH AND INNOVATION (UKRI) GRANT.

90% of the global population increase through 2030 will be in LMIC cities – mostly in deprived urban areas

Kibera slum, Nairobi, Kenya

https://www.mdpi.com/2076-0760/9/5/80
CURRENT “SLUM” MAPPING APPROACHES

Field Mapping
using GPS or drawing on printed imagery. Often performed by residents to generate data for planning and advocacy.

Census & Survey approaches use household-level data to classify “slum” households, then aggregate. An area with >50% “slum” households is a “slum” area.

Computer models
using AI or machine-learning methods and satellite imagery. Requires training data of slum/non-slum areas.

Digitizing imagery is done manually in GIS software, often by a person unfamiliar with the local context. Digitized imagery is often used to train computer models.
Depiction of IDEAMAPS outputs

Platform outputs
(for each 100x100m cell)
- Degree of deprivation
- Dominant deprivation(s)
- Population estimate

Translation for practice
- Classify “slum” areas
- Estimate “slum” population by administrative area

IDEAMAPS Modelling Approach Paper https://www.mdpi.com/2072-4292/12/6/982
FINAL THOUGHTS

- COVID-19 is making large data gaps more obvious
- Combining community based data with EO data
- Invitation to join IdeaMaps
- User requirement survey: https://slummap.net/index.php/take-a-survey/

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