Leveraging nighttime light data to measure economic development

Ran Goldblatt, Ph.D.
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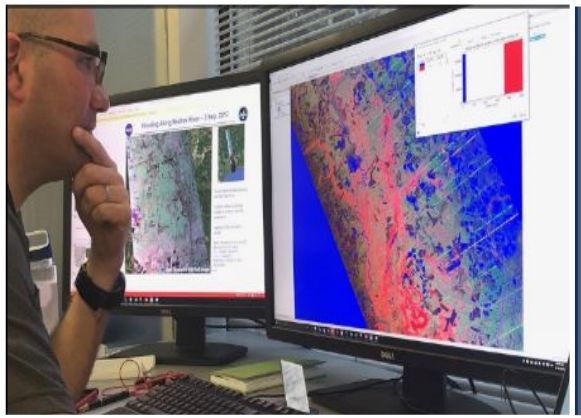
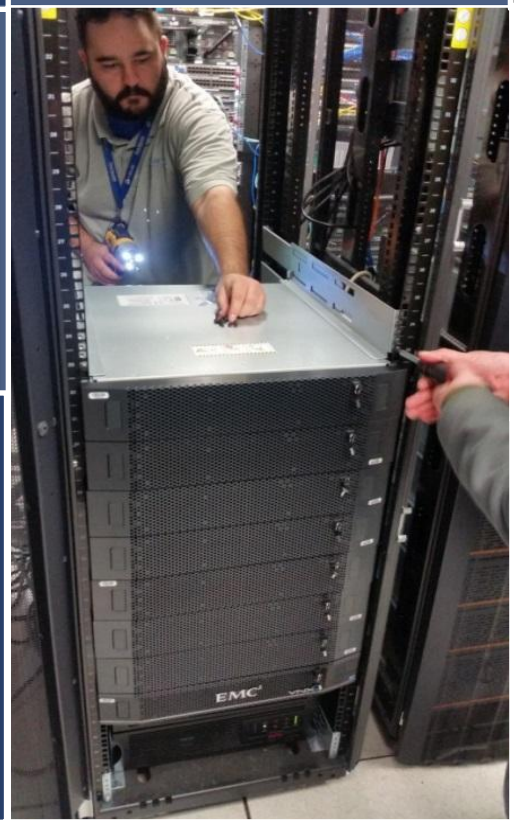
Enterprise IT & Cloud



Geospatial & Remote Sensing



Application Development

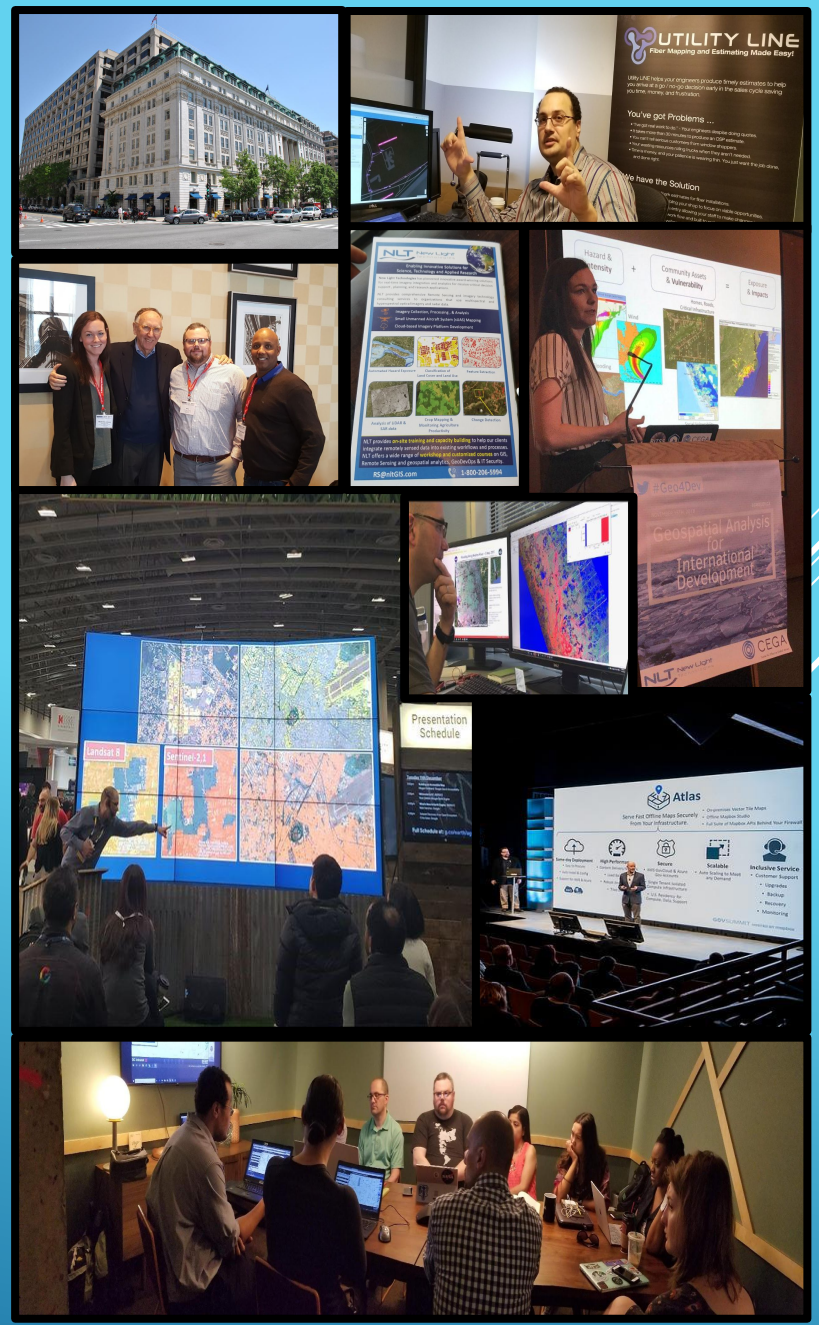
Data Science & Visualization

IT Consulting, Staffing, Training

Scientific Research & Development

COMPANY OVERVIEW

- **Founded in 2001** in Washington DC.
- Trusted mission-oriented **multi-disciplinary team**: Remote sensing scientists, geographers, data scientists, economists, researchers, engineers, technologists, computer scientists, project managers, trainers.
- **Integrated** Full Lifecycle Cloud, Cyber, Software Dev, Analytics, Geospatial, Research, Training, Project Management Services.
- Expertise in **broad domains**, including homeland security, public safety, emergency management, telecom, transportation, environment, urban planning, economics, healthcare and more.
- Diversified portfolio across **all sectors**, including federal state, local government, academia, non-profits, industry, and international organizations.
- Expertise in utilization of nighttime light imagery for various applications, nationally and internationally.



SECTORS AND CLIENTS (PARTIAL)

Federal Government

USDA
US Army Corps of Engineers
U.S. AIR FORCE
United States Census Bureau
U.S. DEPARTMENT OF ENERGY
FEMA
FCC

State & Local Government

DC.gov
Louisiana Department of Health
Metro
Maryland.gov
The Maryland-National Capital Park and Planning Commission
City of Flagstaff

Non-Profit & Community-Based Organizations

World Bank Group
3ie International Initiative for Impact Evaluation
Carlos Rosario International Public Charter School
Child Trends
Golden Triangle
Joint Center for Political and Economic Studies
National Trust for Historic Preservation

Commercial

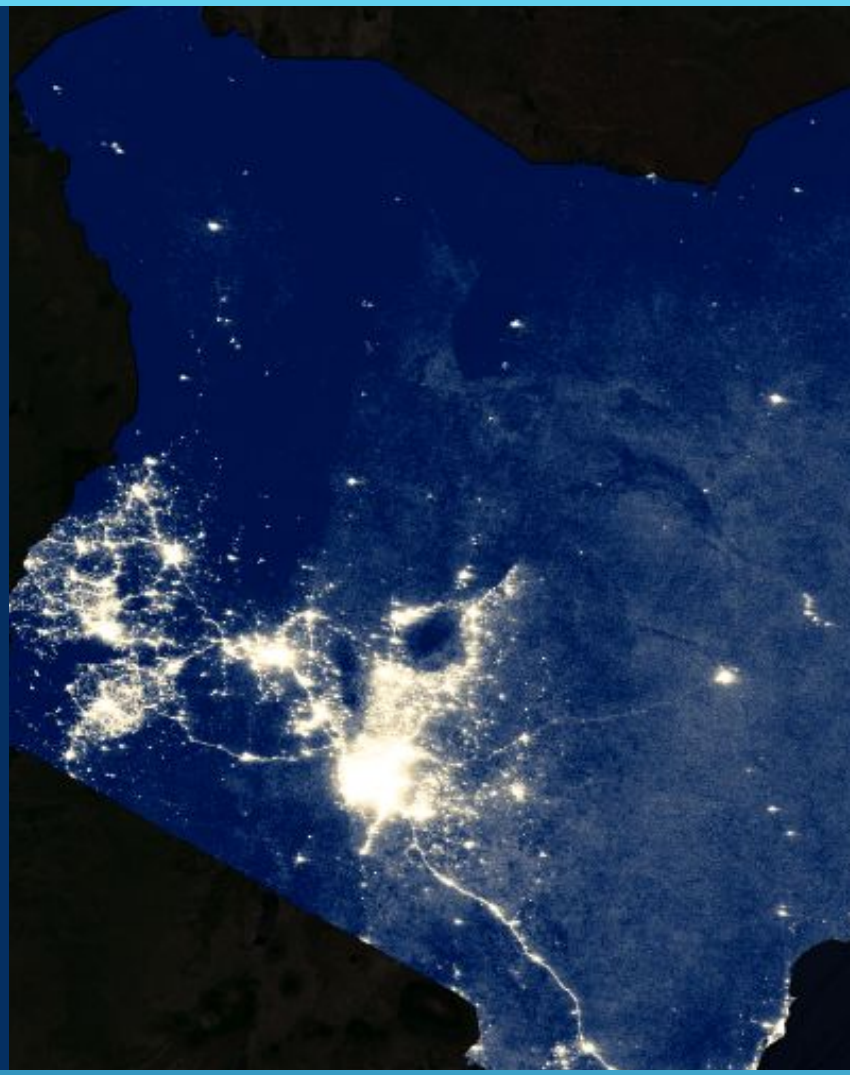
JMT
Information Builders
Louis Berger
mapbox
Owens & Minor
paymerang
Revolution Energy Solutions
SocialKnowledge

REMOTE SENSING ANALYSIS SERVICES

- **Disaster management**
  - Flood detection
  - Wildfires detection
  - Damage assessment
  - Tracking power outages and recovery
- **Geospatial Impact Evaluation (GIE)**
- **LULC / LULCC** (primarily per-pixel supervised image classification)
- **Forestation and deforestation**
- **Built-up land cover** and **Urbanization processes**
- **Economic activity** and **economic development**
- Mapping and tracking physical elements related to the **SDGs**
- **Cities resilience**
- **Equity** and **Social justice** (e.g., access to green open spaces)
- **Governance** (e.g., assessing tax gaps)
- **Urban Heat Island** and urban and regional planning
- Environmental, physical, social impacts of **conflicts**
- Environmental, physical, social impacts of **shocks**
- **Country Diagnostics** (World Bank)
- The relationship between physical environment and **public health**

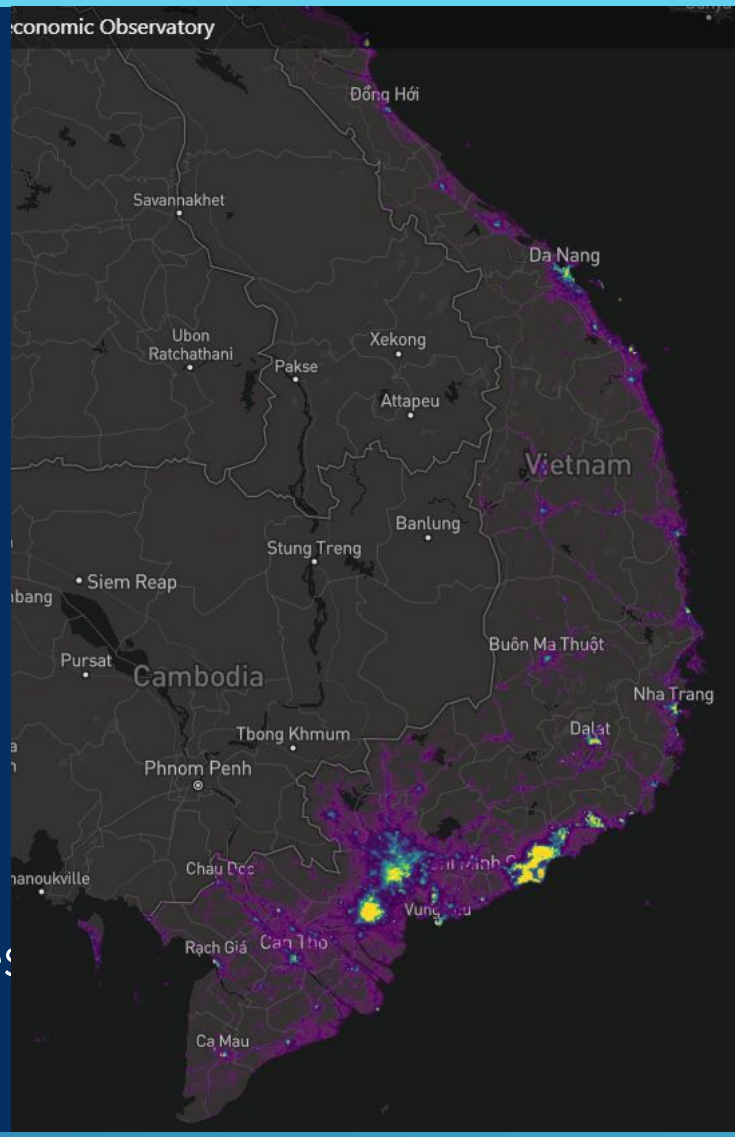
REMOTELY SENSED NIGHTTIME LIGHTS: APPLICATIONS

- **Systematic Country Diagnostic (SCD): challenges & opportunities** (economic activity, economic development)
  - E.g., Nepal, Macedonia
- **Economic activities in conflict-affected areas**
  - E.g., Myanmar, Timor-Leste, Yemen
- Open Access **Satellite Data Feeds** for **Economic tracking**
  - E.g., Vietnam, Indonesia, India
- **Impact evaluation** (e.g., economic benefits of infrastructure investments)
  - E.g., Bangladesh, Bhutan, India, Nepal, Niger
- **Economic impacts of shocks** (e.g., COVID)
  - E.g., Morocco, Algeria, Tunisia, Libya, Iraq



REMOTELY SENSED NIGHTTIME LIGHTS: APPLICATIONS

- Open-source measures and metrics for **efficient governance**
  - E.g., Burkina Faso, Ethiopia, Vietnam, Myanmar
- Nighttime lights for **Urban resilience** and **sustainable planning**
  - E.g., South Africa, Saudi Arabia, Israel, Peru, Liberia
- Economic impacts of **infrastructure projects**
  - E.g., Poland, India, Macedonia, Bolivia, China, Cambodia
- Nighttime lights for **Risk and Exposure Assessment**
  - E.g., Nepal, Haiti, Dominica, St. Lucia
- Estimating spread of power outages during **disasters and recovery**
  - E.g., US
- **Training** on nighttime lights (e.g., estimating GDP in developing countries
  - E.g., US, Vietnam, Myanmar, Nepal



DMSP-OLS

Examples of past projects (Partial!)

DETECTING URBAN MARKETS

Journal of Urban Economics xxx (xxxx) xxx

Contents lists available at ScienceDirect

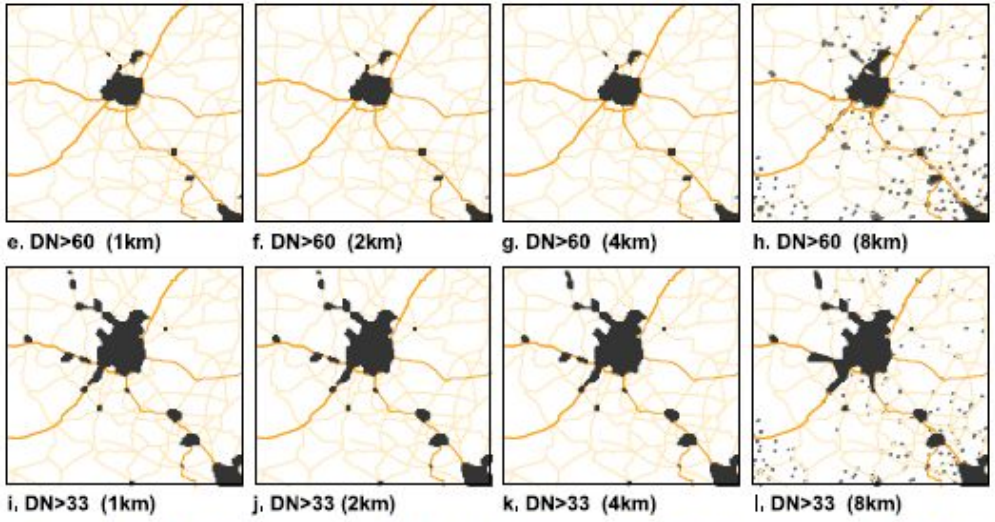
Journal of Urban Economics

journal homepage: www.elsevier.com/locate/jue

Detecting urban markets with satellite imagery: An application to India☆

Kathryn Baragwanath[a], Ran Goldblatt[b], Gordon Hanson[c,*], Amit K. Khandelwal[d]

[a] UCSD, United States
[b] New Light Technologies, United States
[c] UCSD & NBER, United States
[d] Columbia GSB & NBER, United States



Comparison between daytime (multiple resolutions) and nighttime imagery to detect urban markets

Working paper

International Growth Centre

Detecting urban markets with satellite imagery

An application to India

Kathryn Baragwanath Vogel
Ran Goldblatt
Gordon Hanson
Amit K. Khandelwal

March 2019

When citing this paper, please use the title and the following reference number:
C-89448-INC-2

DIRECTED BY LSE OXFORD

FUNDED BY UKaid

ECONOMIC BENEFITS OF TRANSPORTATION CORRIDORS

ELSEVIER

Journal of Development Economics

Available online 30 May 2022, 102900

In Press, Journal Pre-proof

Regular Article

Wider economic benefits of transport corridors: Evidence from international development organizations

Muneeza Alam [a], Matias Herrera Dappe [a], Martin Melecky [b], Ran Goldblatt [c]

Show more

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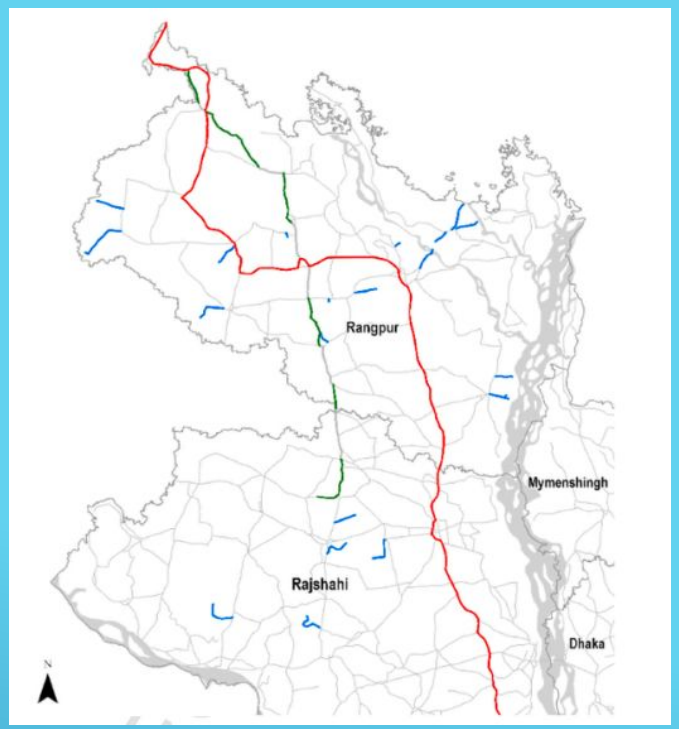

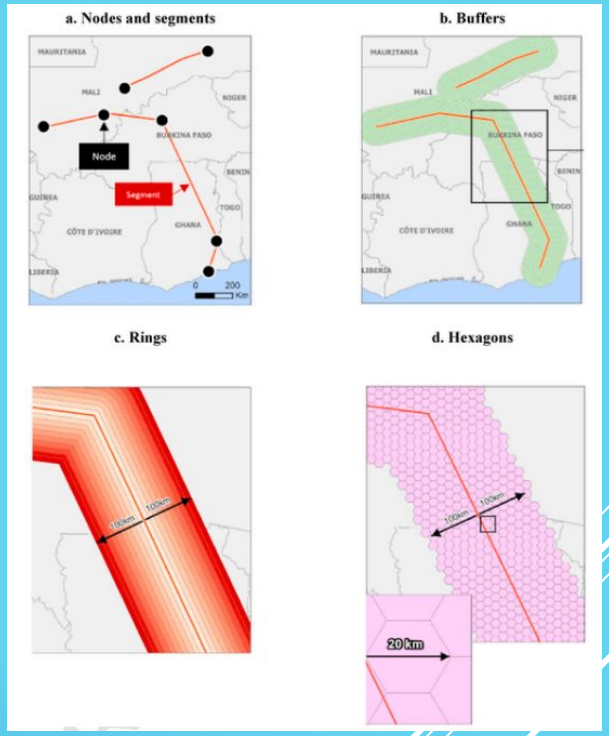

- Country and local conditions are not associated with changes in economic activity.
- **New corridors are associated with higher economic activity than improved corridors.**
- **In the short/medium-term, nightlights increase more in corridors with a larger geographic scope.**

MAPPING URBANIZATION WITH DMSP-OLS AND LANDSAT

Remote Sensing of Environment 205 (2018) 253–275

Contents lists available at ScienceDirect

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

Using Landsat and nighttime lights for supervised pixel-based image classification of urban land cover

Ran Goldblatt[a,*], Michelle F. Stuhlmacher[b], Beth Tellman[b], Nicholas Clinton[c], Gordon Hanson[a], Matei Georgescu[b], Chuyuan Wang[b], Fidel Serrano-Candela[d], Amit K. Khandelwal[e], Wan-Hwa Cheng[b], Robert C. Balling Jr[b]

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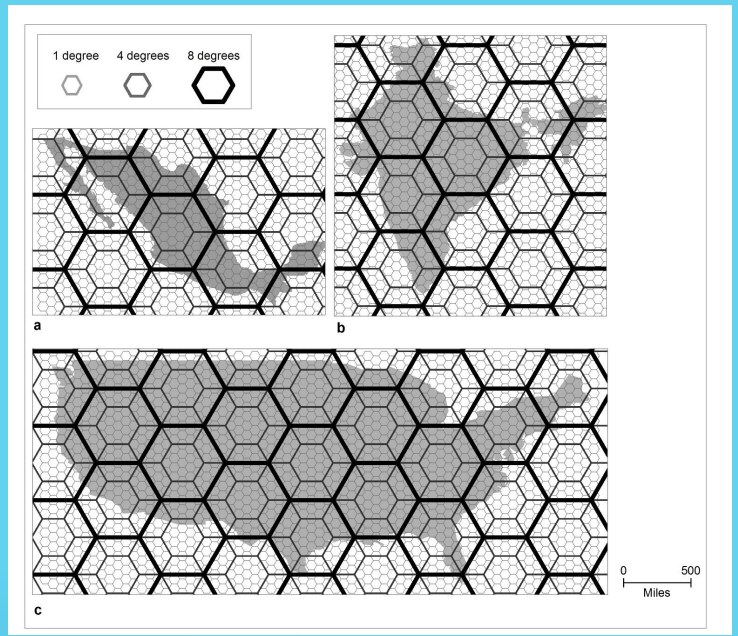
[e] Columbia Business School, Columbia University, New York, NY 10027, USA

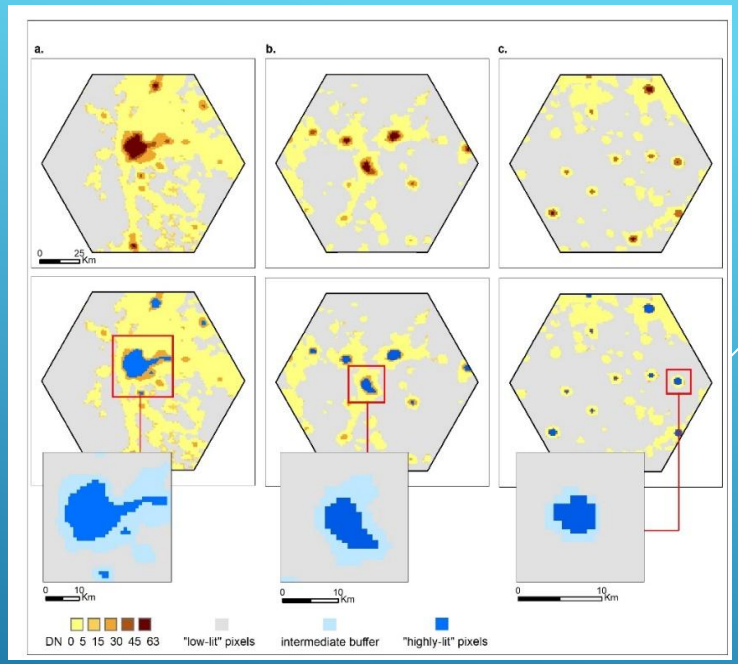
ARTICLE INFO

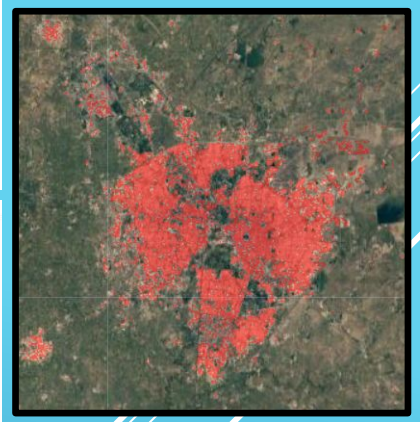
Keywords:
Urbanization
Built-up land cover
Nighttime light
Image classification
Google Earth Engine

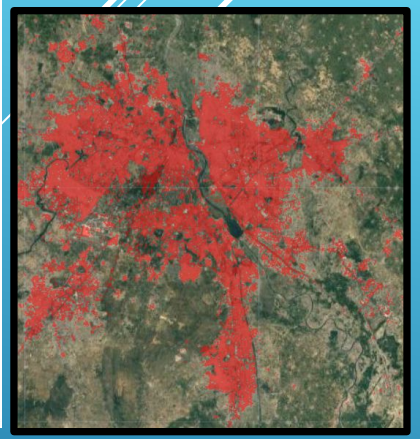
ABSTRACT

Reliable representations of global urban extent remain limited, hindering scientific progress across a range of disciplines that study functionality of sustainable cities. We present an efficient and low-cost machine-learning approach for pixel-based image classification of built-up areas at a large geographic scale using Landsat data. Our methodology combines nighttime-lights data and Landsat 8 and overcomes the lack of extensive ground-reference data. We demonstrate the effectiveness of our methodology, which is implemented in Google Earth Engine, through the development of accurate 30 m resolution maps that characterize built-up land cover in three geographically diverse countries: India, Mexico, and the US. Our approach highlights the usefulness of data fusion techniques for studying the built environment and is a first step towards the creation of an accurate global-scale map of urban land cover over time.









NIGHTTIME LIGHTS AND EPIDEMIOLOGY

Current Psychology
https://doi.org/10.1007/s12144-022-02754-3

Nighttime lights, urban features, household poverty, depression, and obesity

Yi-An Liao[1,2,3] · Liliana Garcia-Mondragon[1,2,3] · Deniz Konac[4,5] · Xiaoxuan Liu[6,7] · Alex Ing[8] · Ran Goldblatt[9] · Le Yu[6,10] · Edward D. Barker[4]

Accepted: 19 January 2022
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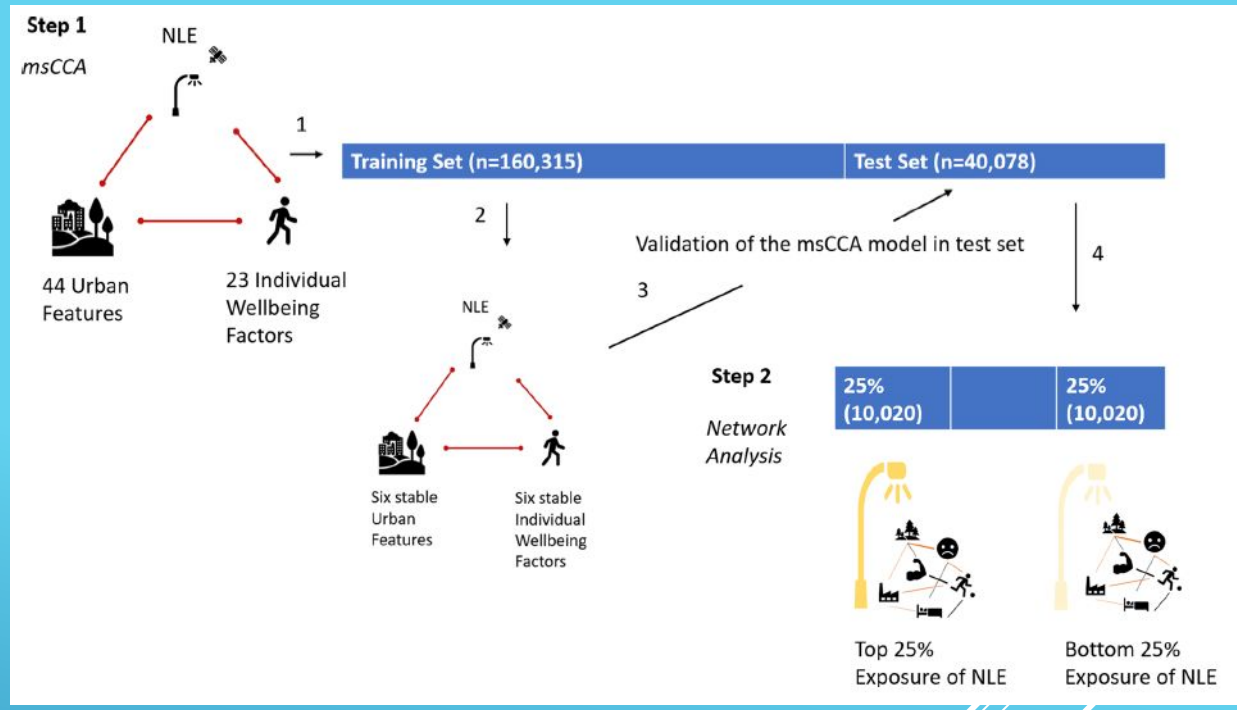
Abstract

Nighttime Light Emission (NLE) is associated with diminished mental and physical health. The present study examines how NLE and associated urban features (e.g., air pollution, low green space) impact mental and physical wellbeing. We included 200,393 UK Biobank Cohort participants with complete data. The study was carried out in two steps. In Step1, we assessed the relationship between NLE, deprivation, pollution, green space, household poverty and mental and physical symptoms. In Step2, we examined the role of NLE on environment-symptom networks. We stratified participants into high and low NLE and used gaussian graphical model to identify nodes which bridged urban features and mental and physical health problems. We then compared the global strength of these networks in high vs low NLE. We found that higher NLE associated with higher air pollution, less green space, higher economic and neighborhood deprivation, higher household poverty and higher depressed mood, higher tiredness/lethargy and obesity ($R_{training\_mean}=0.2624$, $P_{training\_mean}<.001$; $R_{test\_mean}=0.2619$, $P_{test\_mean}<.001$). We also found that the interaction between environmental risk factors and mental, physical problems (overall network connectivity) was higher in the high NLE network than in the low NLE network ($t=0.7896$, $P<.001$). In areas with high NLE, economic deprivation, household poverty and waist circumference acted as bridge factors between the key urban features and mental health symptoms. In conclusion, NLE, urban features, household poverty and mental and physical symptoms are all interrelated. In areas with high NLE, urban features associate with mental and physical health problems at a greater magnitude than in areas with low NLE.

Keywords Nighttime Light Emission · Urban features · Depression · Obesity · Network analysis



Nighttime lights are associated with higher air pollution, lower green space, as well as depressed mood, disinterest, tiredness and obesity.

NIGHTTIME LIGHTS AND EPIDEMIOLOGY

nature human behaviour

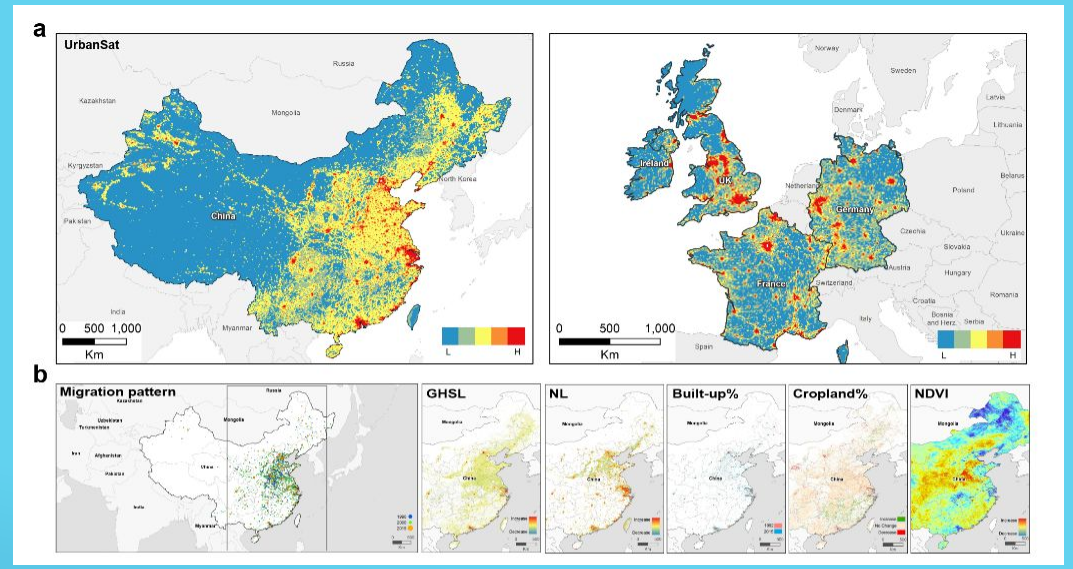
ARTICLES

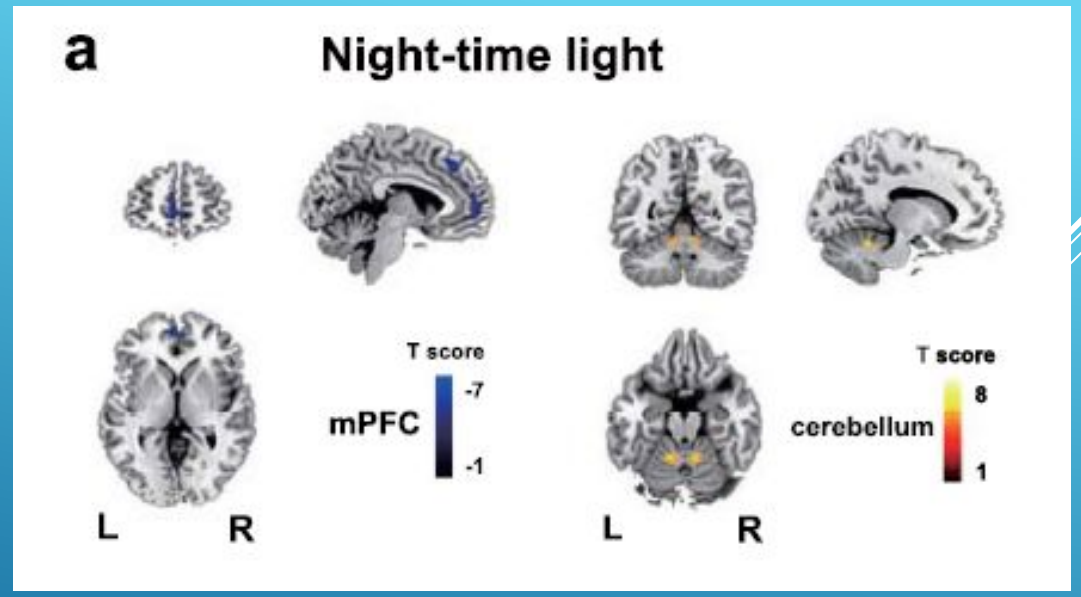
https://doi.org/10.1038/s41562-021-01204-7

Check for updates

Global urbanicity is associated with brain and behaviour in young people

Jiayuan Xu[1,2], Xiaoxuan Liu[3], Qiaojun Li[4], Ran Goldblatt[5], Wen Qin[1], Feng Liu[1], Congying Chu[2], Qiang Luo[6,7], Alex Ing[2], Lining Guo[1], Nana Liu[1], Huaigui Liu[1], Conghong Huang[3], Jingliang Cheng[8], Meiyun Wang[9], Zuojun Geng[10], Wenzhen Zhu[11], Bing Zhang[12], Weihua Liao[13], Shijun Qiu[14], Hui Zhang[15], Xiaojun Xu[16], Yongqiang Yu[17], Bo Gao[18], Tong Han[19], Guangbin Cui[20], Feng Chen[21], Junfang Xian[22], Jiance Li[23], Jing Zhang[24], Xi-Nian Zuo[25], Dawei Wang[26], Wen Shen[27], Yanwei Miao[28], Fei Yuan[29], Su Lui[30], Xiaochu Zhang[31], Kai Xu[32], Longjiang Zhang[33], Zhaoxiang Ye[34], Tobias Banaschewski[35], Gareth J. Barker[36], Arun L. W. Bokde[37], Herta Flor[38,39], Antoine Grigis[40], Hugh Garavan[41], Penny Gowland[42], Andreas Heinz[43], Rüdiger Brühl[44], Jean-Luc Martinot[45], Eric Artiges[46], Frauke Nees[35,38], Dimitri Papadopoulos Orfanos[40], Herve Lemaitre[47], Tomáš Paus[48,49], Luise Poustka[50], Lauren Robinson[51], Sarah Hohmann[35], Juliane H. Fröhner[52], Michael N. Smolka[52], Henrik Walter[43], Robert Whelan[53], Jeanne Winterer[54,55], Kevin Patrick[56], Vince Calhoun[57], Mulin Jun Li[58], Meng Liang[59], Peng Gong[3,60], Edward D. Barker[51], Nicholas Clinton[61], Andre Marquand[62], Le Yu[3], Chunshui Yu[1,63] ✉, Gunter Schumann[64,65] ✉, the CHIMGEN* and IMAGEN Consortia*





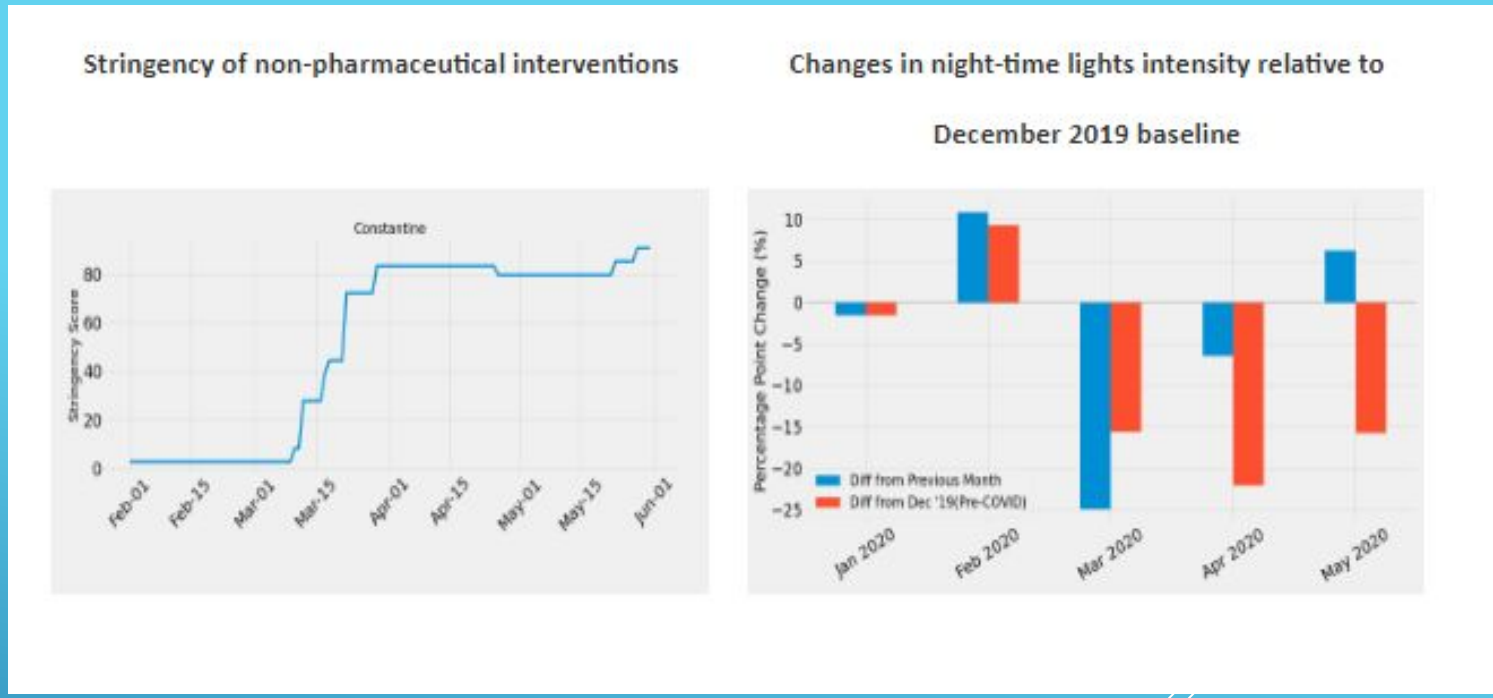
UrbanSat estimates of urbanicity were correlated with brain volume, cortical surface area and brain network connectivity in the medial prefrontal cortex and cerebellum.

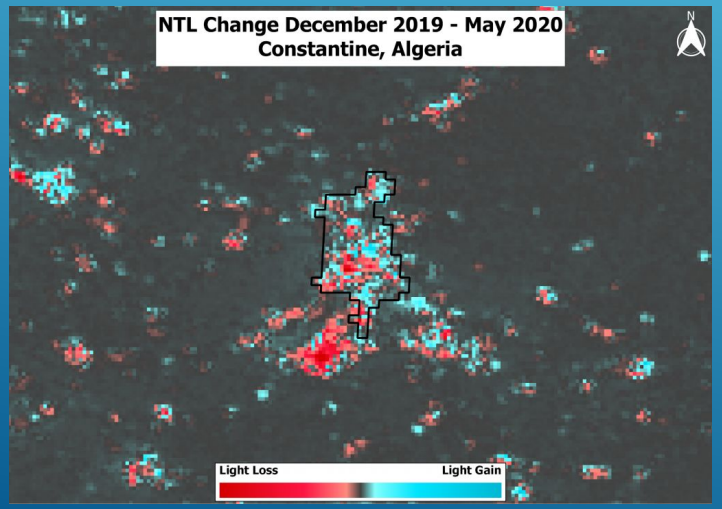
VIIRS

Examples of past projects (Partial!)

THE ECONOMIC IMPACTS OF COVID (MENA REGION)

Objective: Estimate the Urban Economic Impacts of COVID-19 in the Middle East & North Africa (MENA). We used VIIRS data to provide near-real-time tracking of economic activity and its relation to the pandemic.

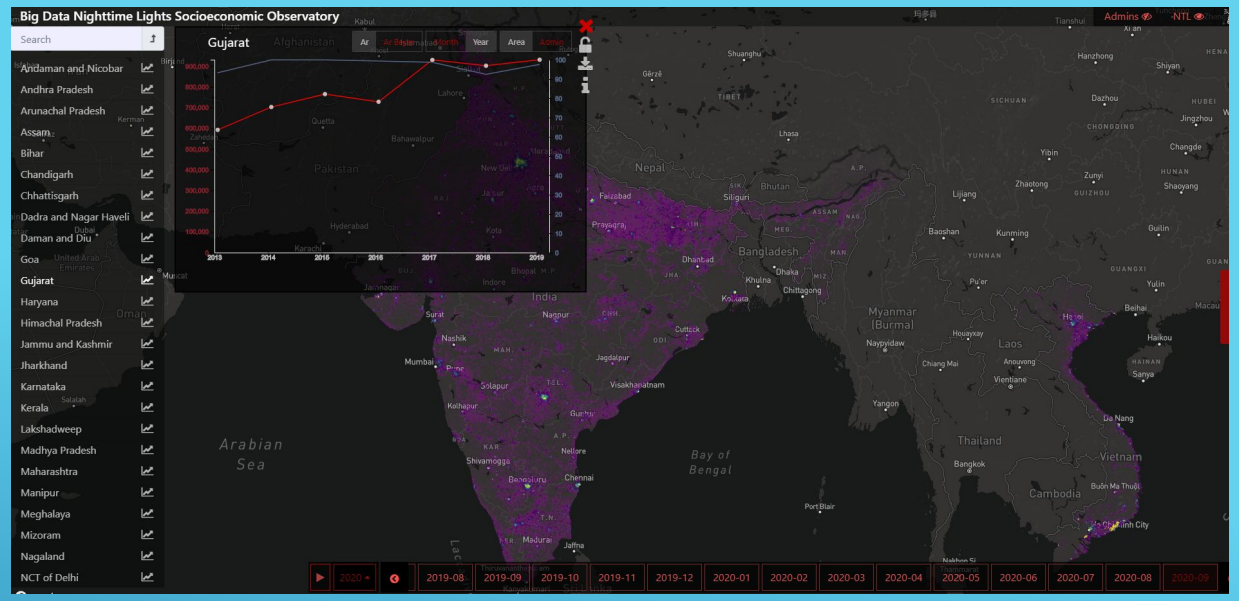


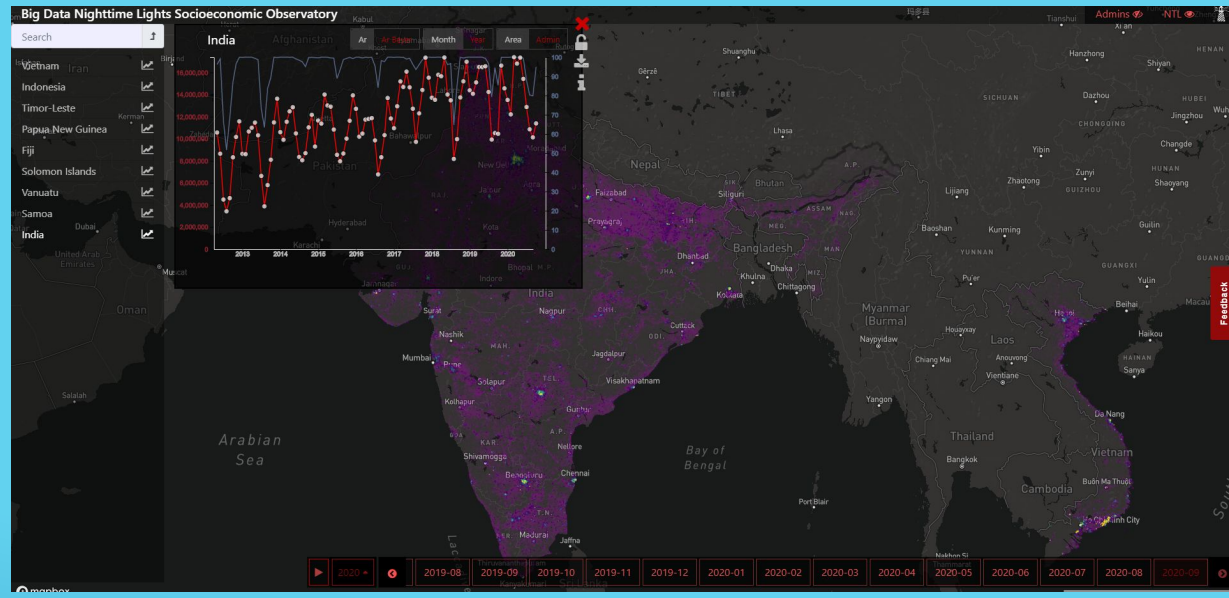


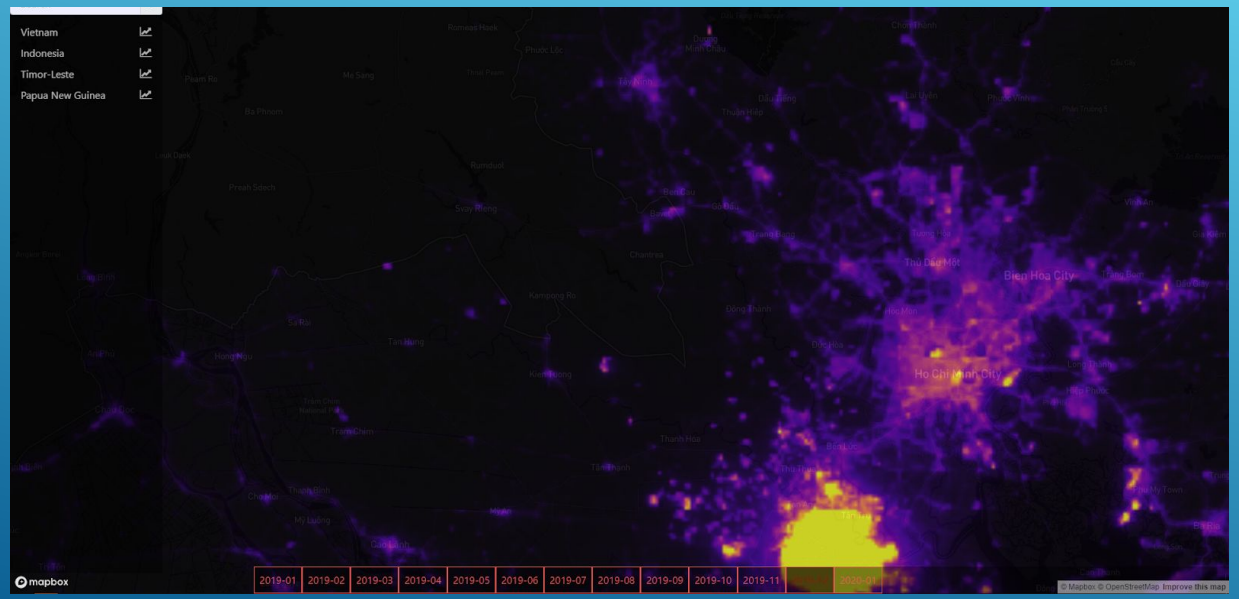
The evolution of night-time lights
Constantine, Algeria

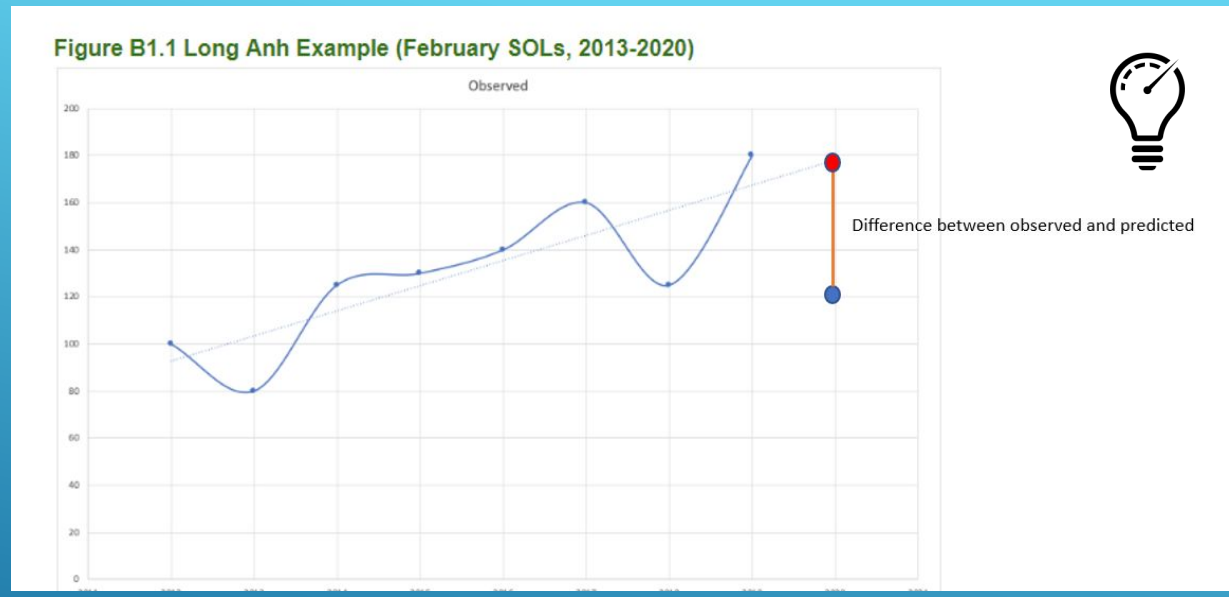
https://blogs.worldbank.org/arabvoices/when-lights-go-out-how-covid-19-affected-cities-middle-east-and-north-africa

BIG DATA NIGHTTIME LIGHTS SOCIOECONOMIC OBSERVATORY

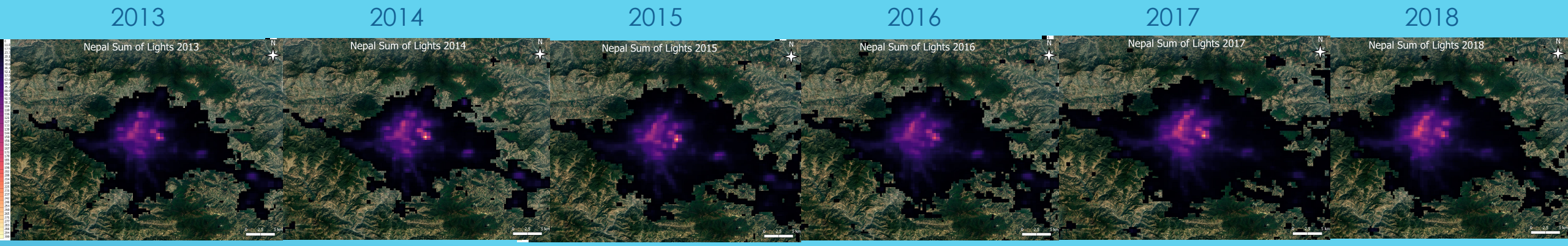


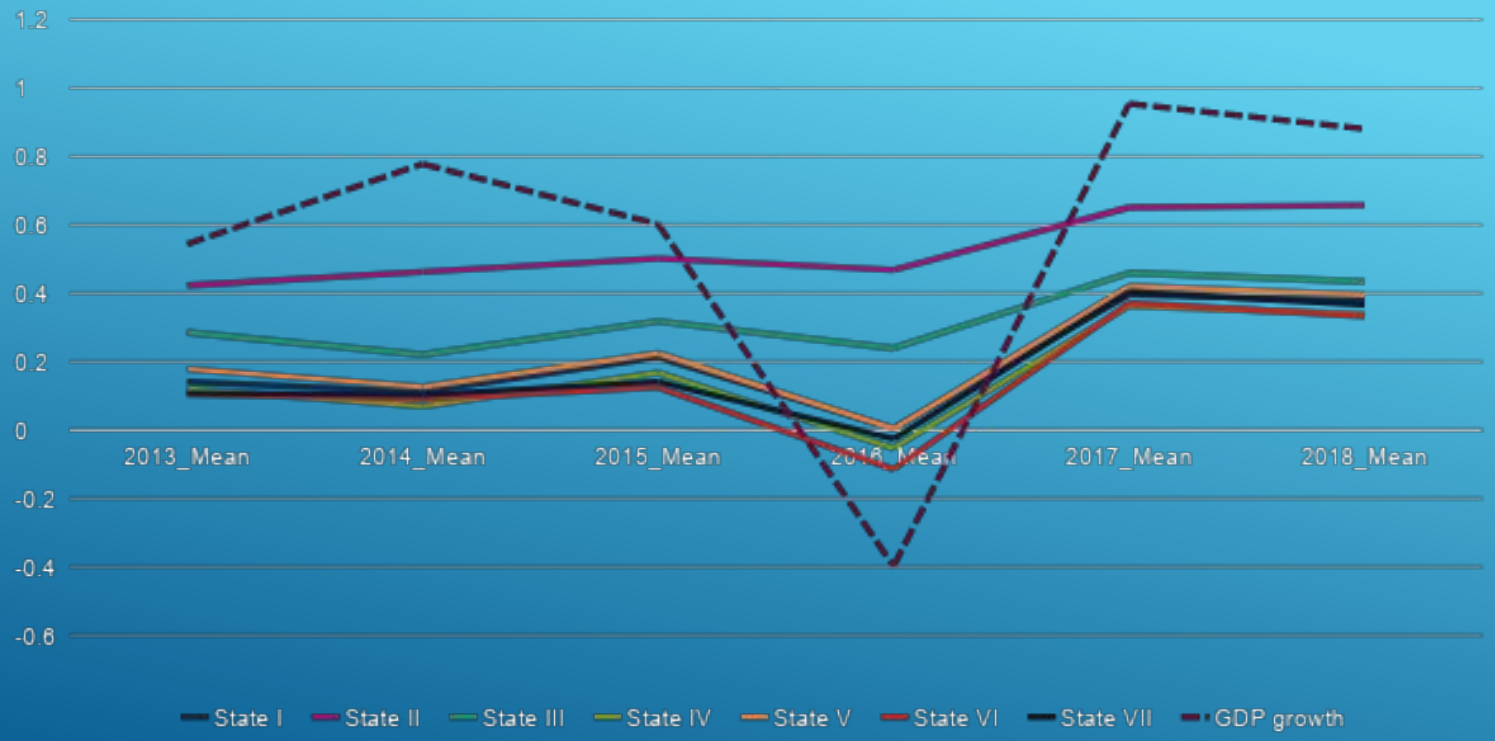






TRACKING ECONOMIC SHOCKS WITH NIGHTTIME LIGHTS: NEPAL





2016: Disruption of economic activity, especially in agricultural and industrial production.

GDP growth dipped to its lowest level since FY2002

- The **2015 Nepal Earthquake**
- Trade and supply disruption (9/ 2015 – 2/2016).

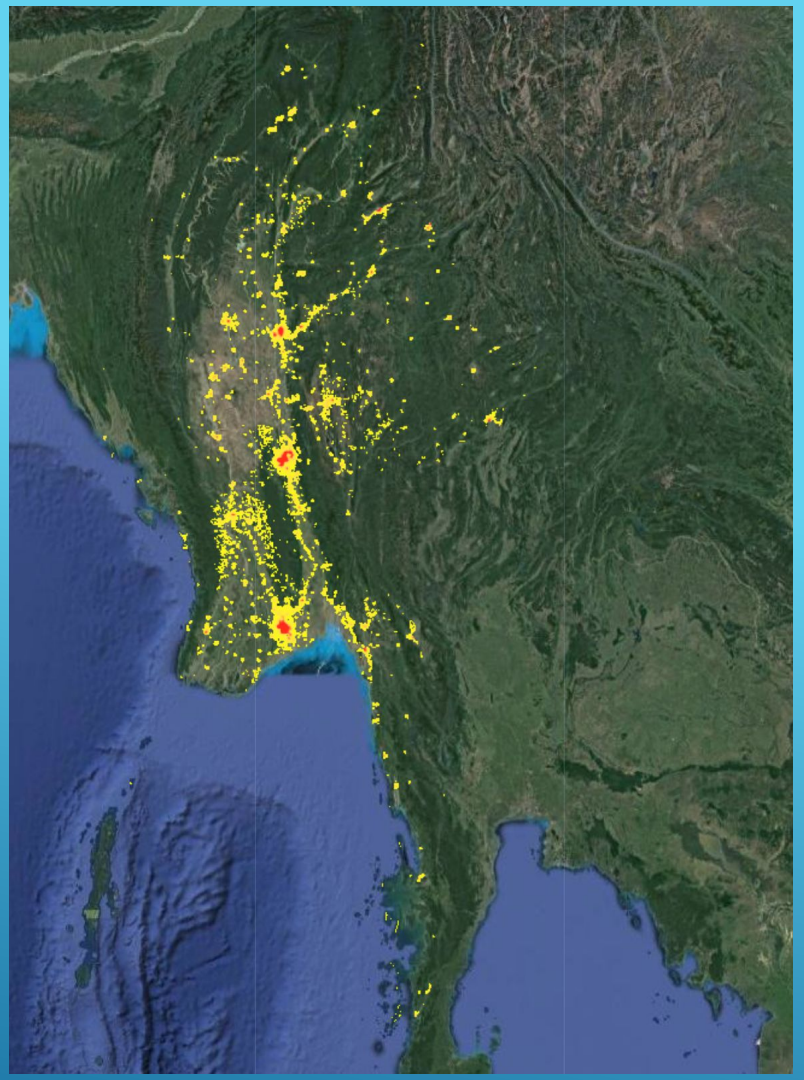
(source: ADB, 2016)

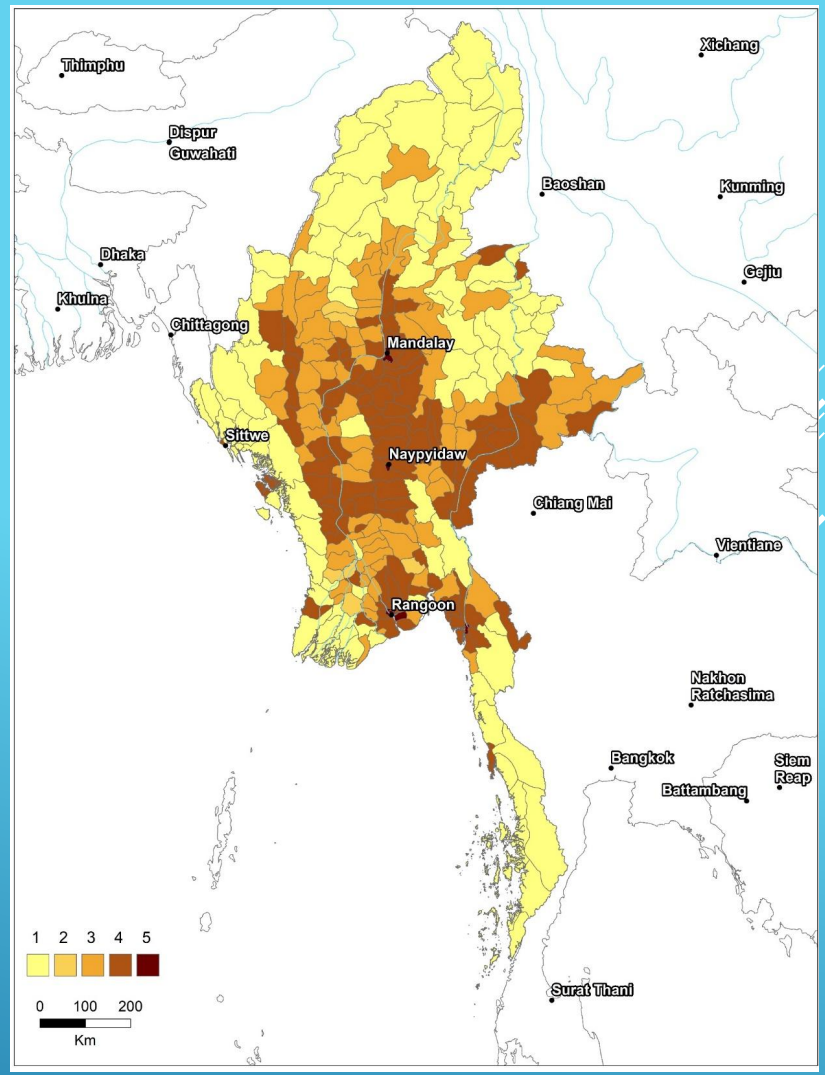
THE ECONOMIC IMPACTS OF CONFLICTS: MYANMAR

Myanmar's economic and political transitions accompanied by decades of internal armed conflicts.

About one-third of townships in Myanmar have been affected by conflicts which have displaced thousands of people internally and externally.

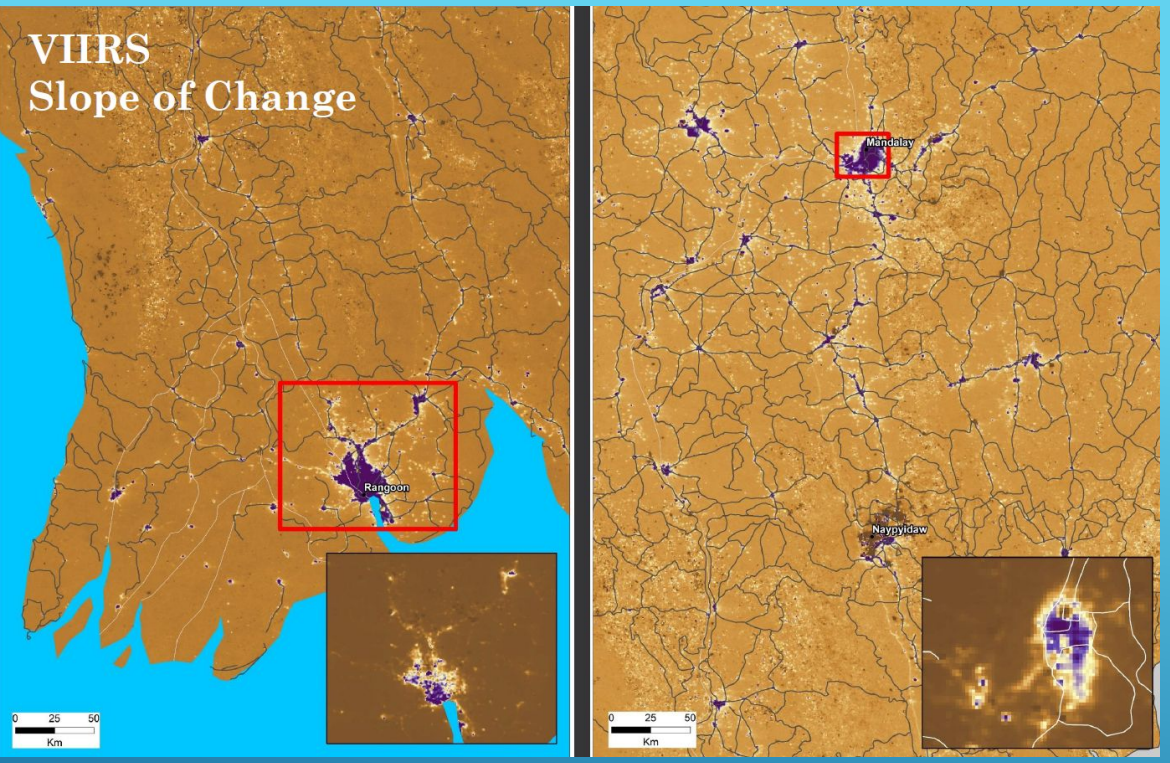
Project objective: Develop a set of tools and methods to measure economic dynamics in Myanmar and to provide a better understanding on how the evolution of the conflict in the country correlates with economic activities in affected areas.



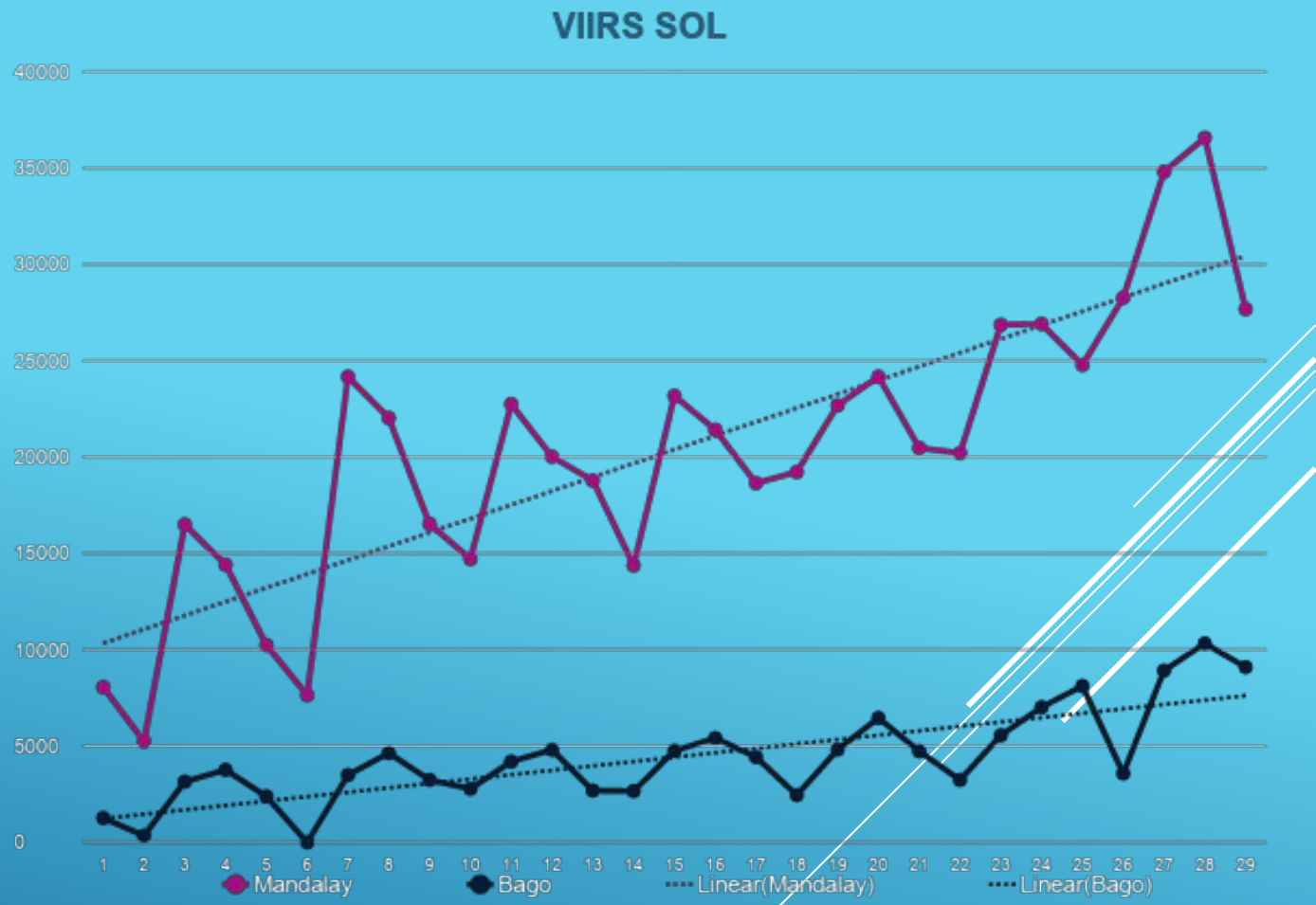


VIIRS SOL 2019 Rank (admin #3)

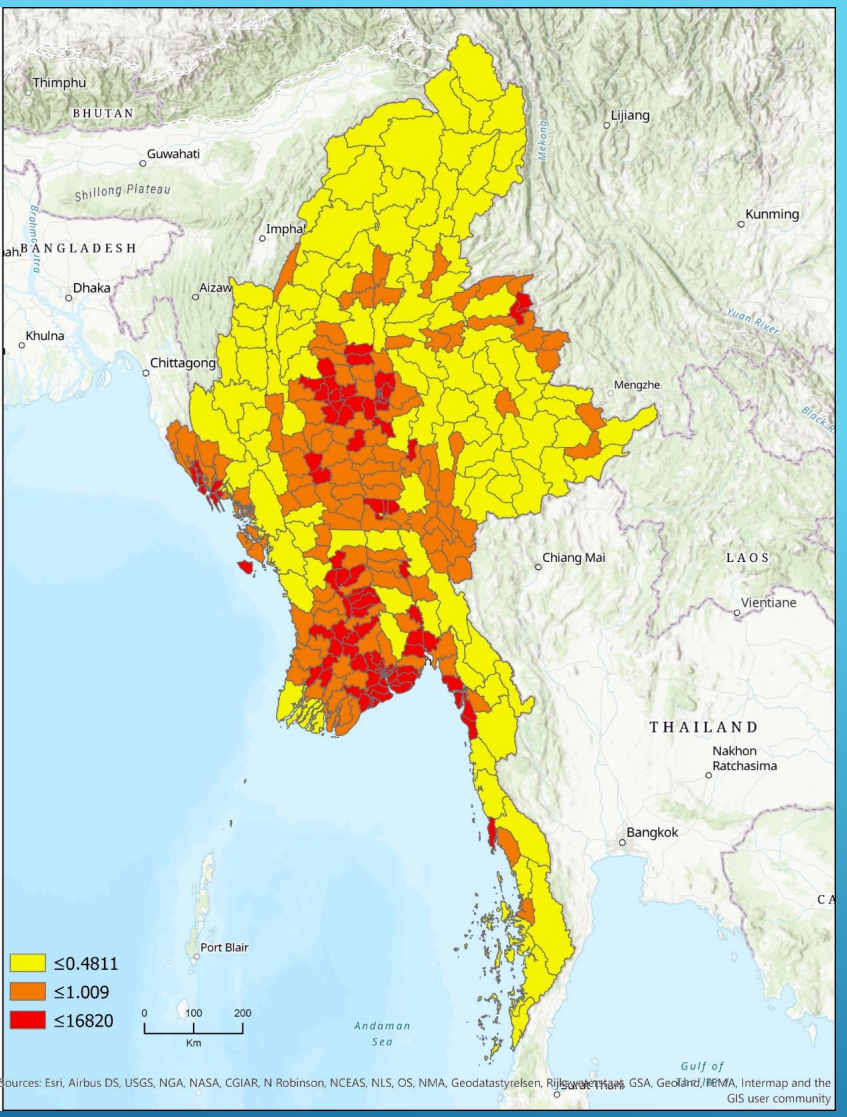
THE ECONOMIC IMPACTS OF CONFLICTS: MYANMAR



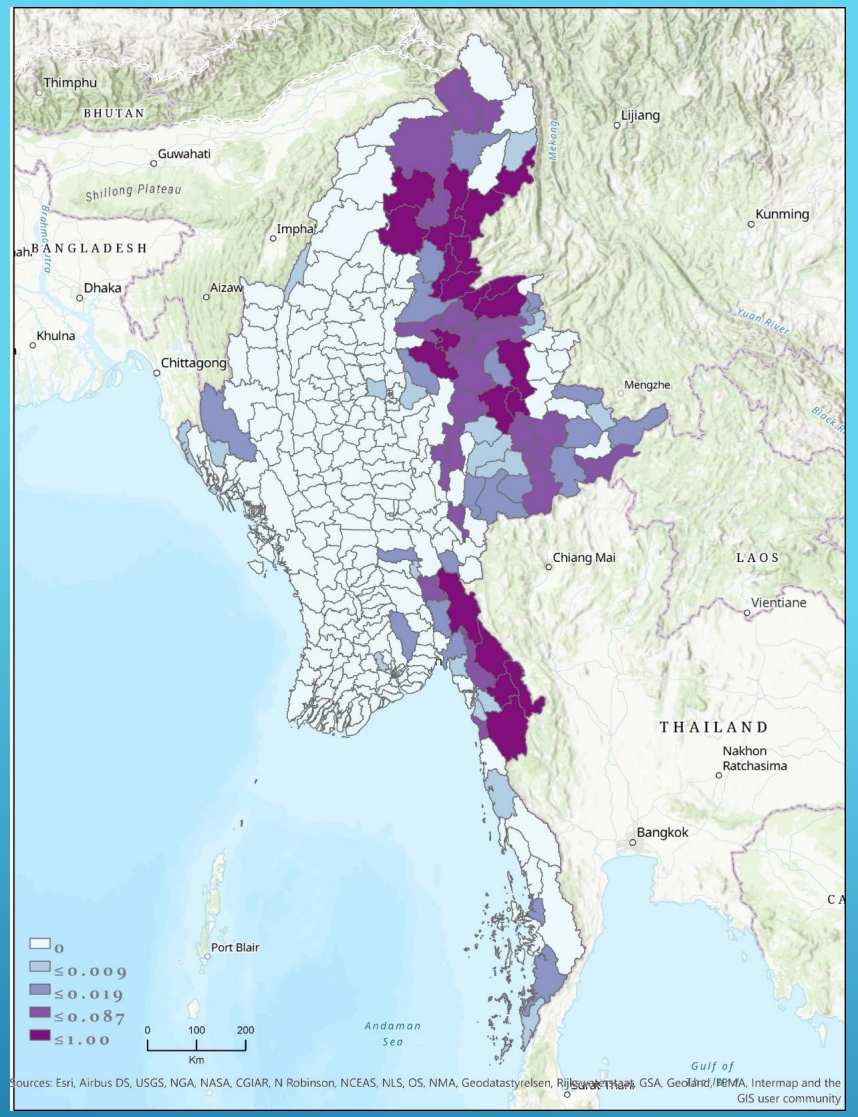
VIIRS Slope of Change



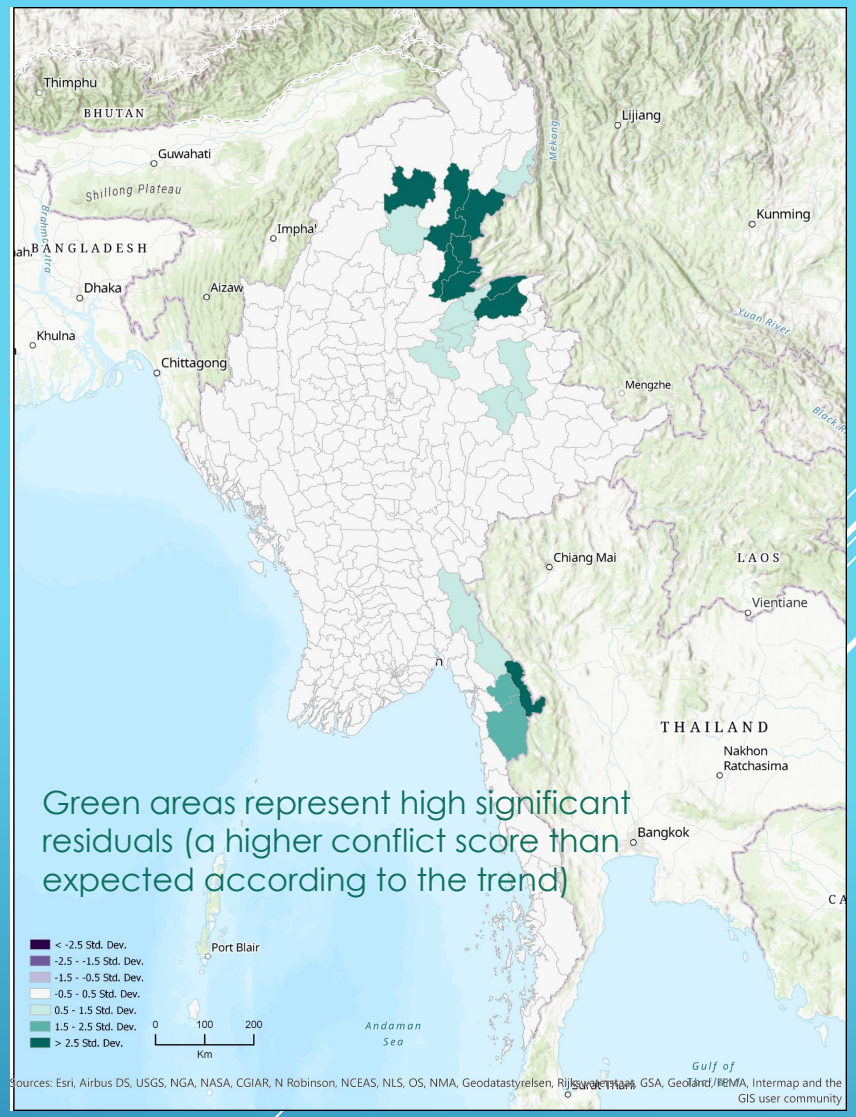
THE ECONOMIC IMPACTS OF CONFLICTS: MYANMAR



VIIRS Slope of Change
(2013-2019)
(weighted by township area)



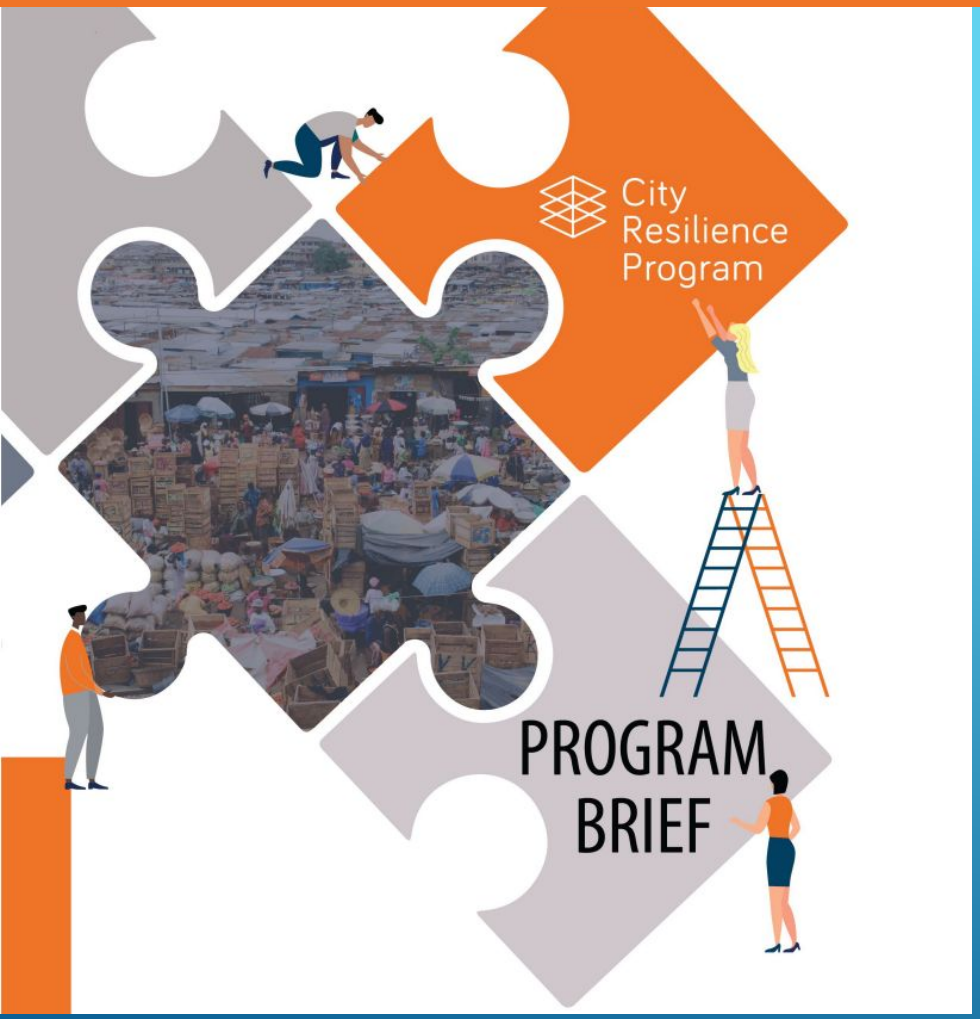
"Conflict index" per township.

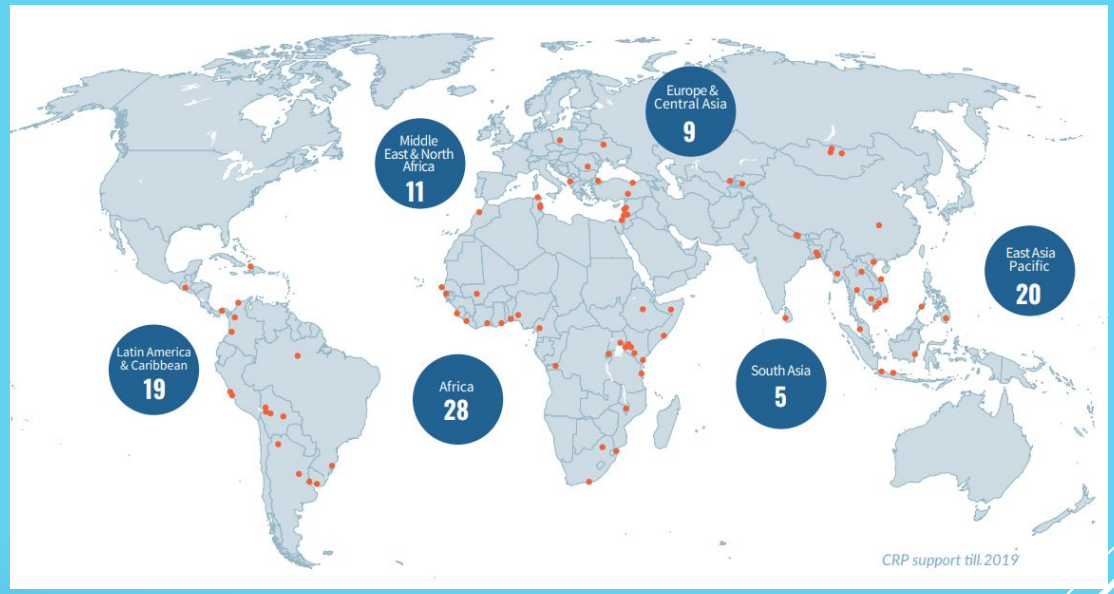


Residuals of the regression line
per township
VIIRS SOC / Conflict index

NIGHTTIME LIGHTS FOR A STRONGER CITY RESILIENCE

THE CITY RESILIENCE PROGRAM





CITY SCANS

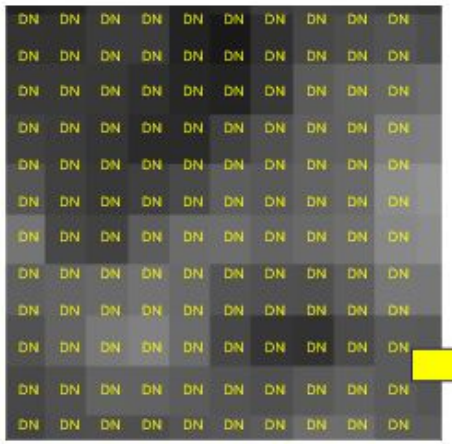
Using spatial data to help cities visualize the interplay of **climate and infrastructural challenges they face**.

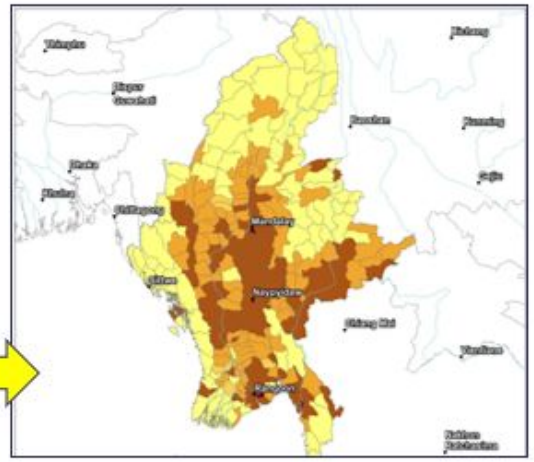
A series of maps, visualizations and analyses that describe **key resilience challenges** and provide a starting point for discussing solutions during a subsequent **Resilience Investment Planning Workshop**.

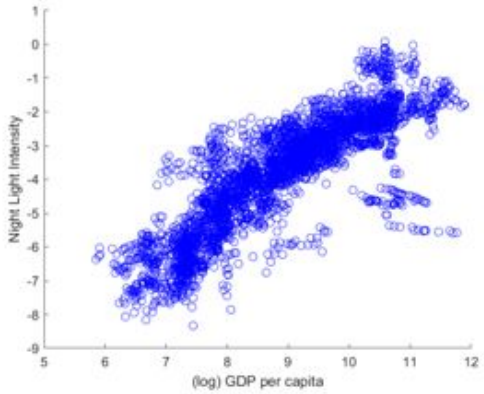
Enabling decision-makers at the city-level and World Bank teams to work towards resolving them.

NIGHTTIME LIGHTS FOR A STRONGER CITY RESILIENCE

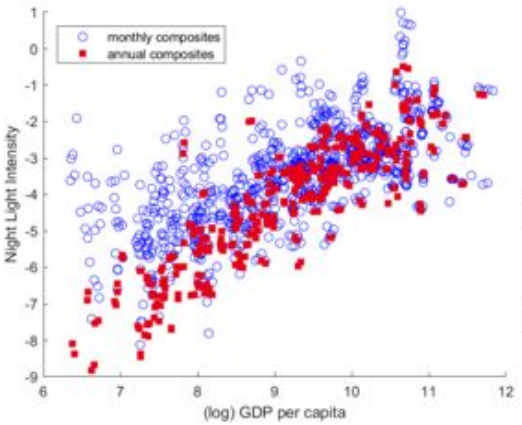
APPROACH 1: Sum of Lights (SOL)







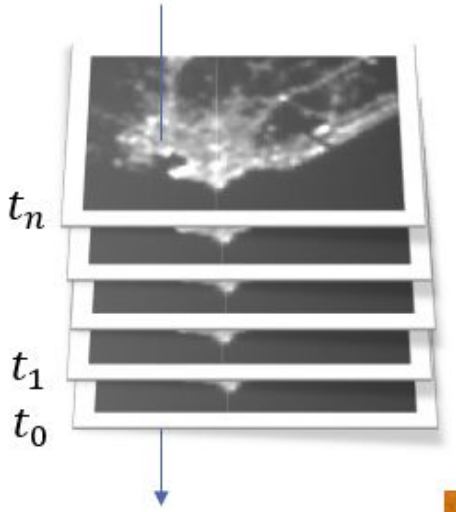
(a) DMSP/OLS 1992-2013



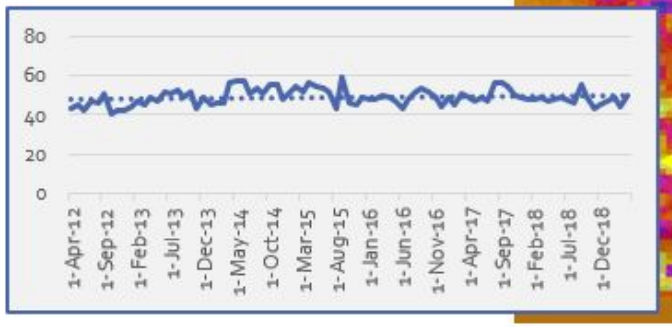
(b) VIIRS 2013-2017

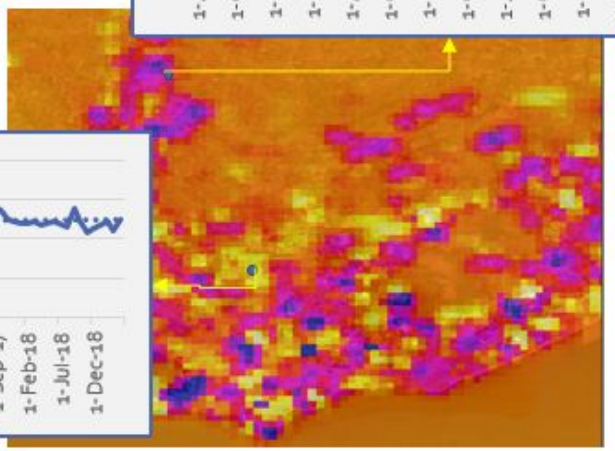
Hu and Yao, 2019

APPROACH 2: Slop of Change



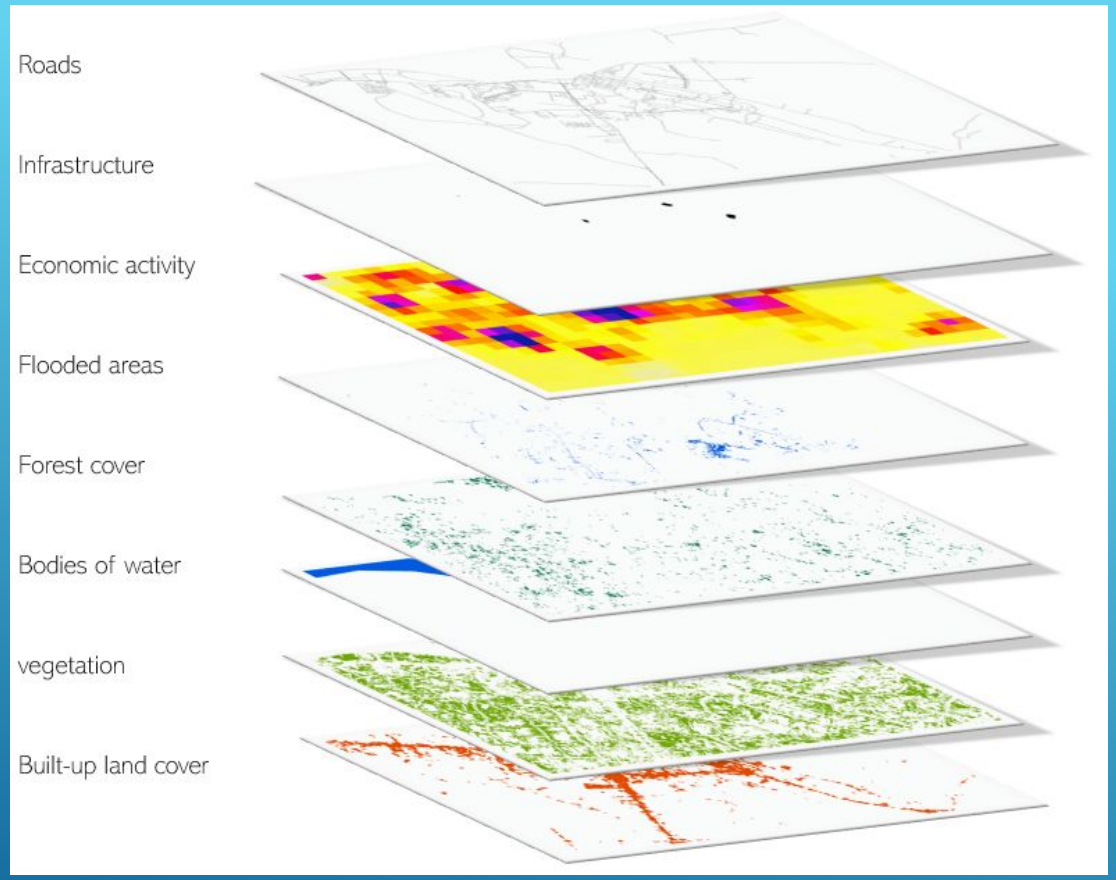
SOC (DN/t)

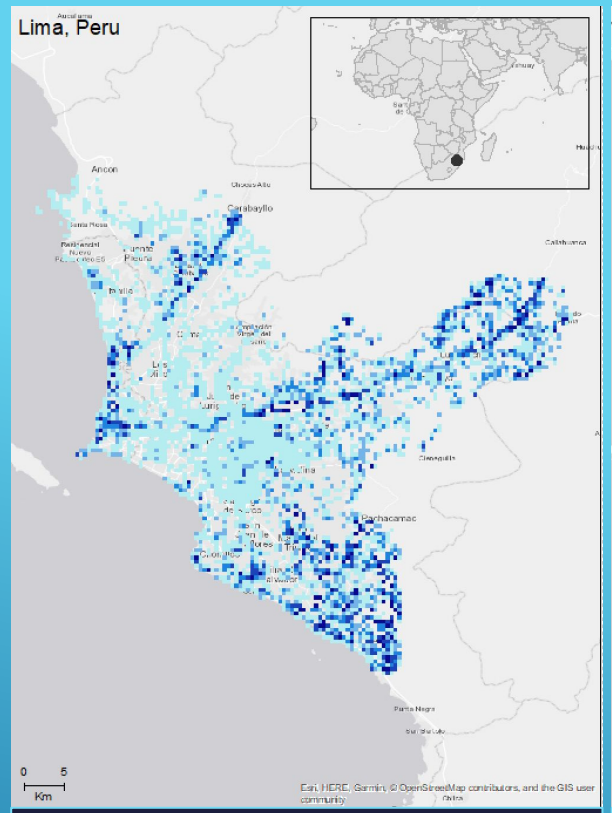




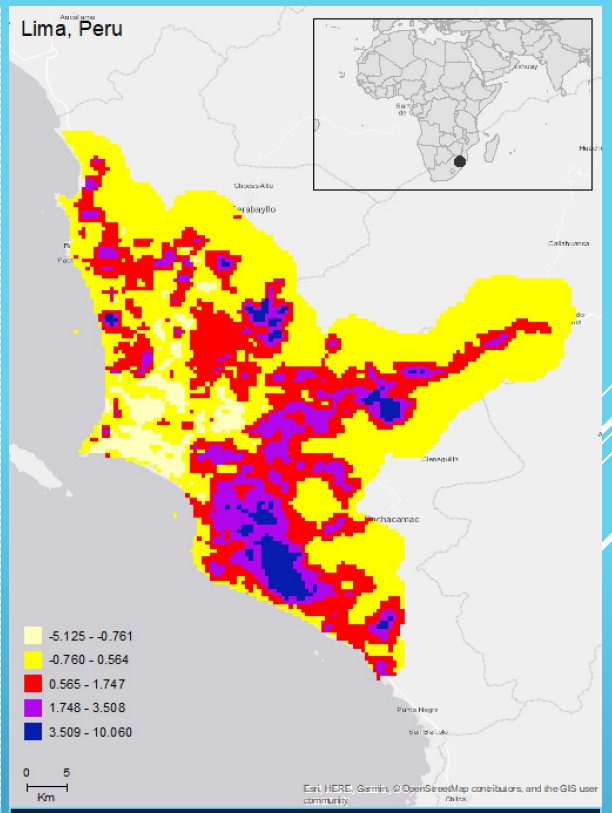
NIGHTTIME LIGHTS FOR A STRONGER CITY RESILIENCE

THE CITY RESILIENCE PROGRAM





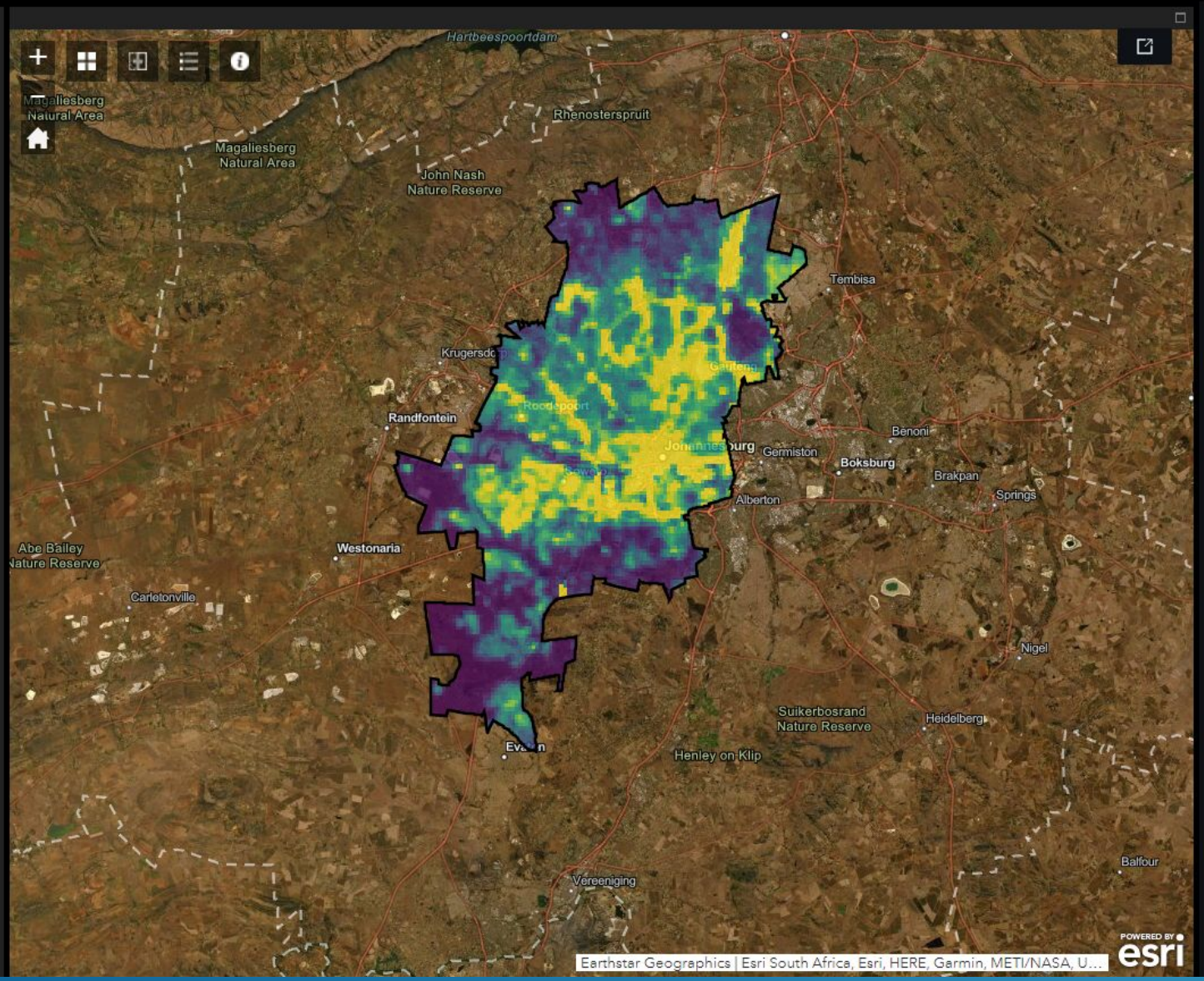
Flood occurrence



Economic hotspots

StoryMaps FOR CITY RESILIENCE

City Competitiveness and Economic Growth



Economic Hotspots

Most of Metro Johannesburg's economic hotspots are clustered around the City of Johannesburg, Sandton, and Soweto. In contrast, the outskirts of the Municipality – in the suburb of Sunrella and around Elandsfontein – showed significantly less economic activity.

This map illustrates the sum of all nighttime light emission from 2013 to 2019 within a particular area. Nighttime lights are highly correlated with levels of economic activity; the map shows zones of greater and lesser economic activity over this time period.

ASSESSING THE COMPLETENESS OF OSM

remote sensing

MDPI

Article

Assessing OpenStreetMap Completeness for Management of Natural Disaster by Means of Remote Sensing: A Case Study of Three Small Island States (Haiti, Dominica and St. Lucia)

Ran Goldblatt [1,*], Nicholas Jones [2] and Jenny Mannix [1]

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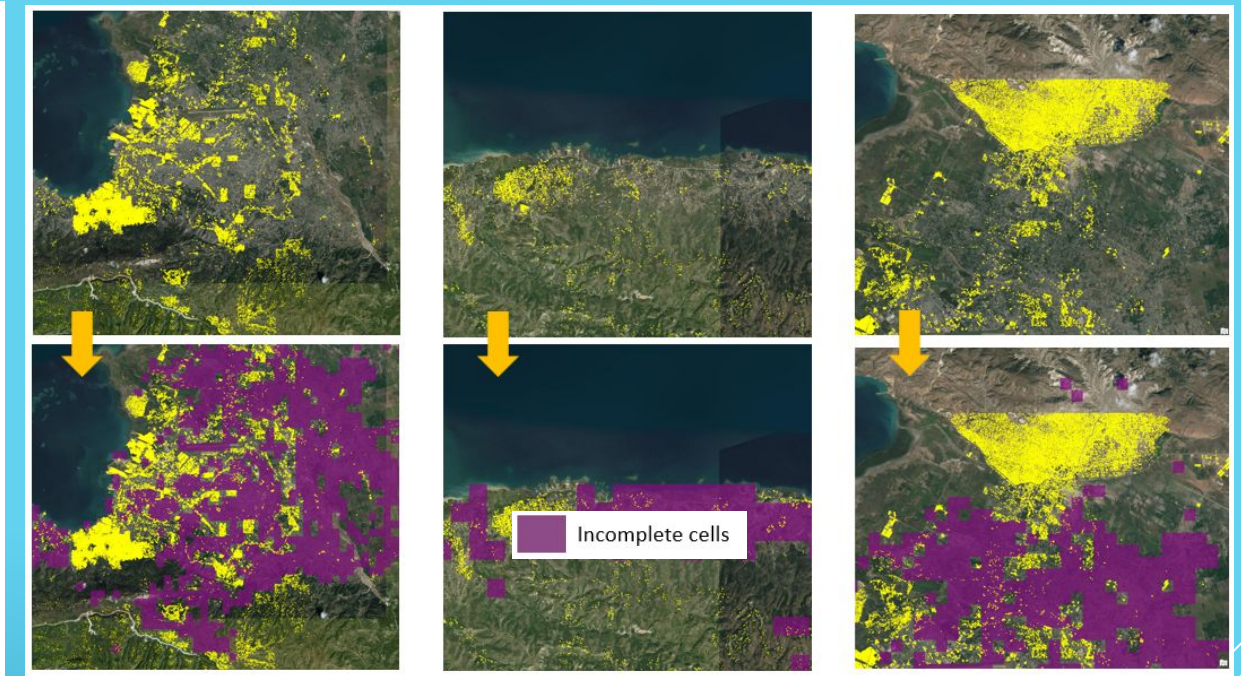
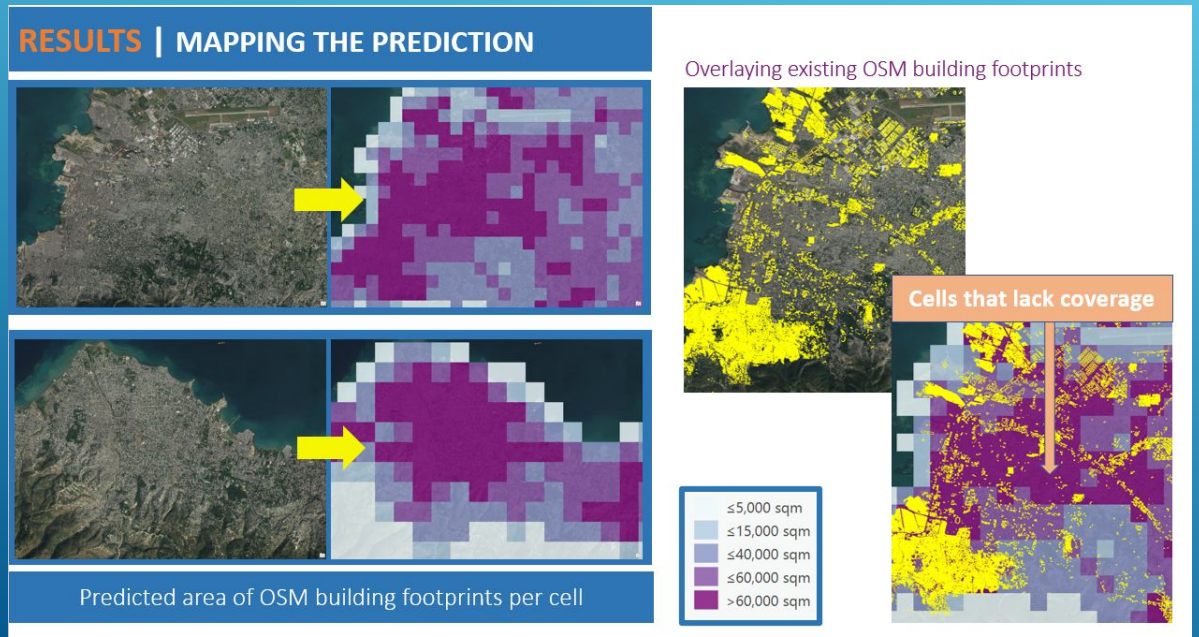
[2] Global Facility for Disaster Reduction and Recovery/World Bank, Washington, DC 20433, USA; njones@worldbankgroup.org
* Correspondence: ran.goldblatt@nltgis.com; Tel.: +1-202-630–0362

Received: 26 November 2019; Accepted: 25 December 2019; Published: 1 January 2020

check for updates





Objective:
Use remotely sensed imagery, including nighttime lights to predict the completeness of OSM and prioritize mapping efforts.

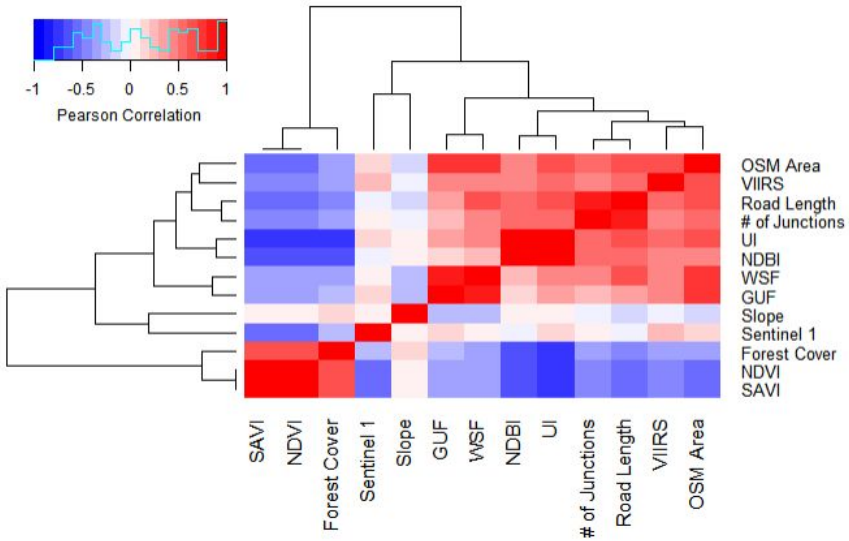
RESULTS | REGRESSION MODEL

Step	(1)	(2)	(3)	(4)
GUF	0.115 ***	0.124 ***	0.127 ***	0.138 ***
	(0.010)	(0.009)	(0.008)	(0.008)
WSF	0.141 ***	0.081 ***	0.050 ***	0.034 ***
	(0.010)	(0.009)	(0.009)	(0.009)
VIIRS		2214.671 ***	1276.821 **	1073.838 ***
		(124.738)	(127.805)	(126.619)
NDBI			−37.152 ***	−17.790
			(11.258)	(11.409)
NDVI			72,452.840 **	64,046.550 **
			(30,894.100)	(29,957.530)
SAVI			−48,312.220 **	−42,708.300 **
			(20,600.640)	(19,976.140)
UI			46.857 ***	25.415 **
			(9.751)	(10.191)
Forest cover			0.060 ***	0.051 ***
			(0.012)	(0.011)
Slope			179.453	274.377
			(192.545)	(187.222)
Sentinel-1			−696.229	−295.342
			(453.517)	(442.270)
Road length				1.470 ***
				(0.543)
No. of junctions				60.057 **
				(29.311)
Constant	0.716	−699.988	30,909.080 ***	17,403.480 ***
	(672.122)	(573.990)	(3897.596)	(4351.436)
Observations	835	835	835	835
R^2	0.663	0.756	0.813	0.825
Adjusted R^2	0.662	0.755	0.811	0.823
Residual Std. Error	12,460.39	10,615.940	9329.420	9029.806
F Statistic	818.245 ***	856.591 ***	357.937 ***	323.203 ***

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

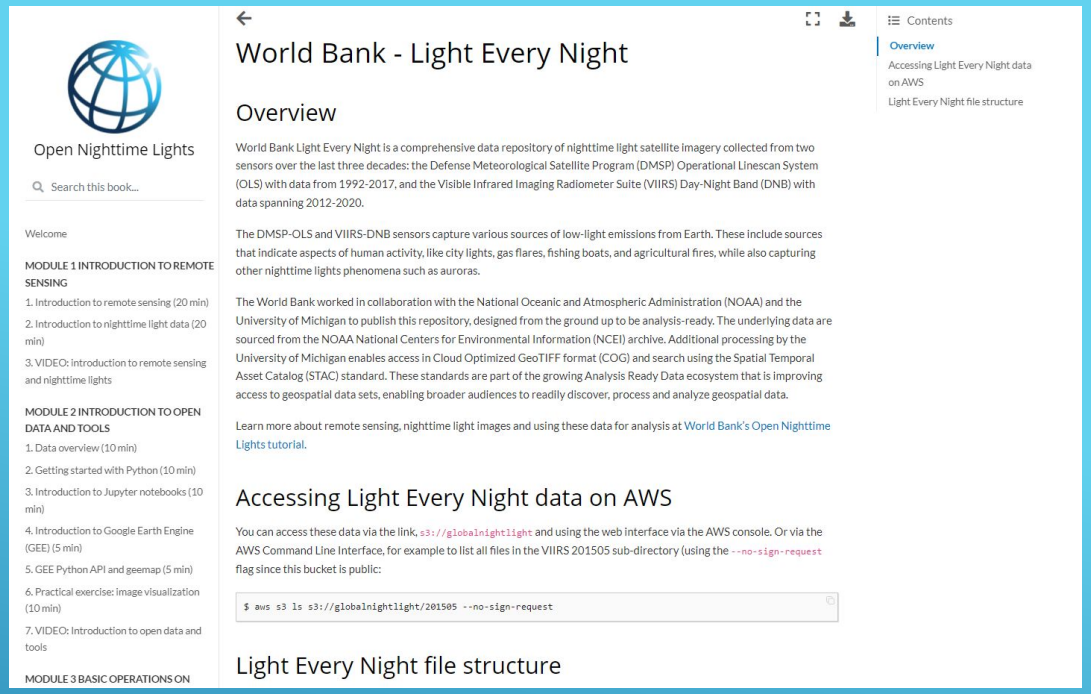
Four regression model outputs showing an improvement of model fit with the inclusion of four groups of variables:

(1) Only GUF and WSF
(2) Addition of VIIRS
(3) Addition of remotely sensed measures and derived products
(4) Addition of OSM road network features.



Goldblatt et al., 2019

“LIGHT EVERY NIGHT” TRAINING MODULE



- A collaboration between the World Bank, NOAA, and the University of Michigan.
- Supported by New Light Technologies
- Includes nearly 250 terabytes of data.
- Published under World Bank’s open data license
- Available via AWS open public data set program

DMSP-OLS nightly imagery (1993-2017, all nights):

- Visible-near infrared (VIS)
- Long-wave thermal infrared (TIR)
- lunar illuminance (LI)
- cloud mask (CM)
- sample position (SAM)
- stray light mask (SLM)

VIIRS DNB nightly imagery (2012-2020, all nights):

- DNB radiance
- I5 (LWIR) radiance
- lunar illuminance
- sample position within DNB scan
- quality bitflag or "vflag" grid with on/off states for these fields:
  - daytime/nighttime/near-terminator
  - zero lunar illuminance
  - VIIRS cloud mask
  - nightfire detection
  - lightning
  - high energy particle hit
  - stray light affected/corrected

https://worldbank.github.io/OpenNightLights/wb-light-every-night-readme.html

Light Every Night – New nighttime light data set and tools for development

BRIAN MIN, KIM BAUGH, TREVOR MONROE, RAN GOLDBLATT, BENJAMIN STEWART, WALKER KOSMIDOU-BRADLEY & DAYNAN CRULL | JANUARY 21, 2021

Open in Colab

2. Image clipping with VIIRS-DNB (5 min)

Satellite data, which often comes structured as a GeoTIFF if you recall from Data overview (10 min), can cover large areas geospatially. It's not always required to work with the entire file, in fact, it's often preferred to work only with a smaller Area Of Interest (AOI).

In this tutorial, we're going to show how you can clip a particular satellite raster file to a specific AOI, including a geometry from a geopolitical boundary. We'll also apply this clipping to an entire ImageCollection.

For this exercise, we'll work with the VIIRS-DNB data.

Our tasks in this exercise:

1. Get a monthly VIIRS-DNB composite and clip to a Geometry (a buffer around a point)
2. Clip the image to the geometry of the state of California.
3. Clip all the images in the VIIRS-DNB stray-light corrected image collection to the state of California

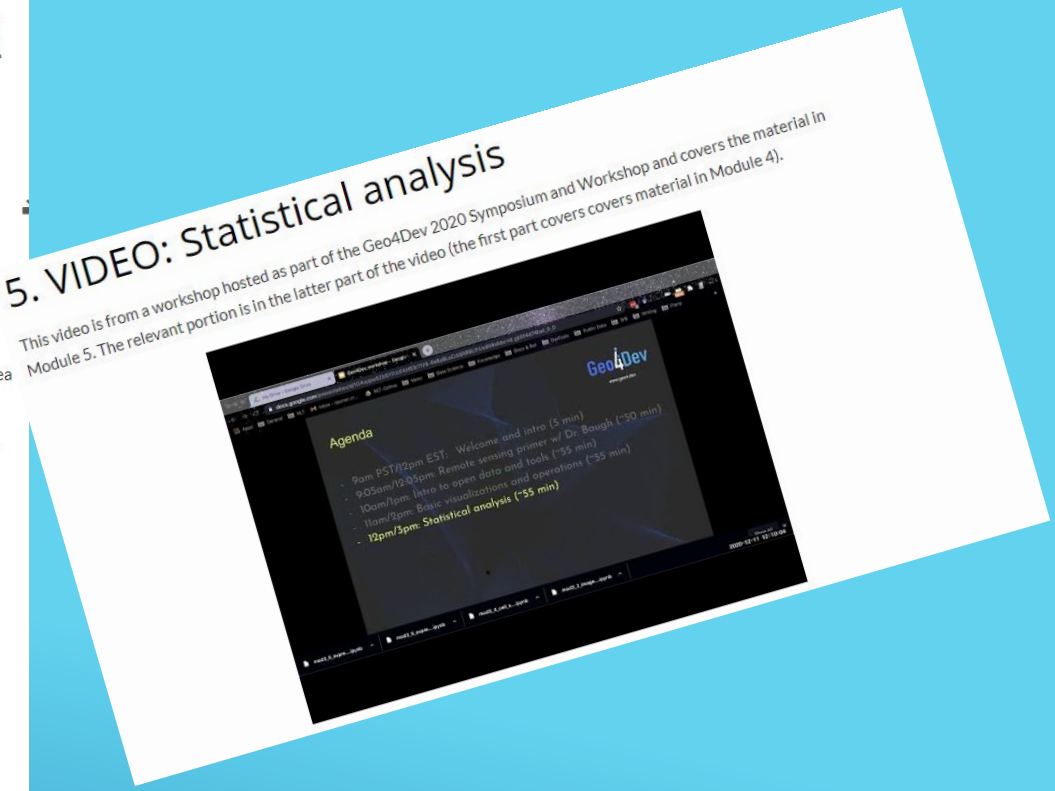
2.1. Get and clip a VIIRS-DNB monthly composite

For this exercise, we'll look at the VIIRS-DNB monthly composite for December 2019.

2.1.1. Initialize map, get image and add as layer

```
# reminder that if you are installing libraries in a Google Colab instance you will be prompted to restart yo

try:
    import geemap, ee
except ModuleNotFoundError:
    if 'google.colab' in str(get_ipython()):
        print("package not found, installing w/ pip in Google Colab...")
        !pip install geemap
    else:
        print("package not found, installing w/ conda...")
        !conda install mamba -c conda-forge -y
        !mamba install geemap -c conda-forge -y
    import geemap, ee
```



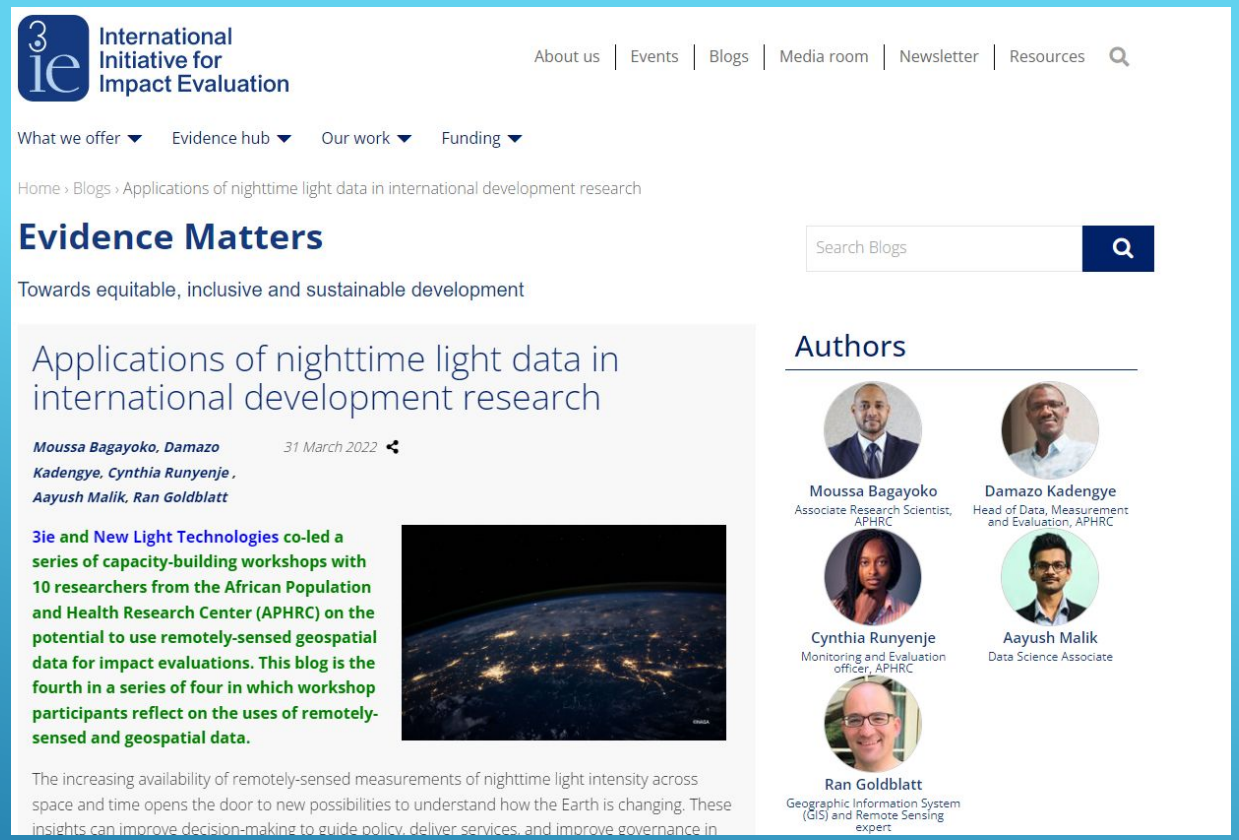
Tutorial`s covered topics include:

- Introduction to remote sensing
- Introduction to nighttime light data
- Python, Jupiter notebooks, GEE
- DMSP-OLS and VIIRS annual composites
- VIIRS image clipping
- Band math
- Charting
- Daytime-nighttime image fusion

World Bank, NOAA, and the University of Michigan

https://worldbank.github.io/OpenNightLights/wb-light-every-night-readme.html

REMOTELY SENSED NIGHTTIME LIGHTS – CAPACITY BUILDING



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Applications of nighttime light data in international development research

Moussa Bagayoko, Damazo Kadengye, Cynthia Runyenje , Aayush Malik, Ran Goldblatt

31 March 2022

3ie and New Light Technologies co-led a series of capacity-building workshops with 10 researchers from the African Population and Health Research Center (APHRC) on the potential to use remotely-sensed geospatial data for impact evaluations. This blog is the fourth in a series of four in which workshop participants reflect on the uses of remotely-sensed and geospatial data.

The increasing availability of remotely-sensed measurements of nighttime light intensity across space and time opens the door to new possibilities to understand how the Earth is changing. These insights can improve decision-making to guide policy, deliver services, and improve governance in

Authors

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Aayush Malik
Data Science Associate

Ran Goldblatt
Geographic Information System (GIS) and Remote Sensing expert

https://www.3ieimpact.org/blogs/applications-nighttime-light-data-international-development-research

DMSP-OLS / VIIRS DATA HARMONIZATION

Due to the substantial differences between DMSP-OLS and VIIRS, the data collected by the two sensors is not directly compatible across time.

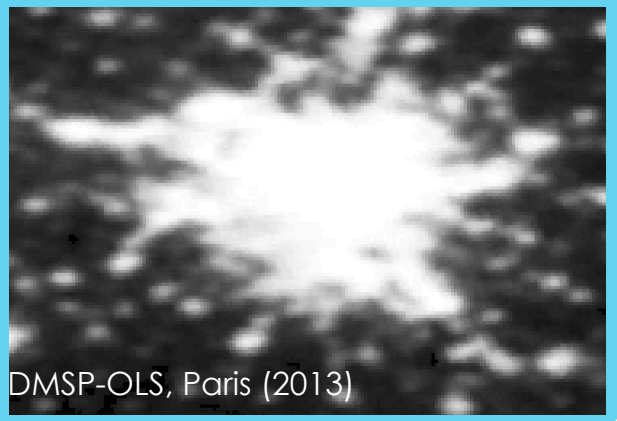
Several approaches have been proposed in the literature to make VIIRS data compatible with DMSP-OLS.

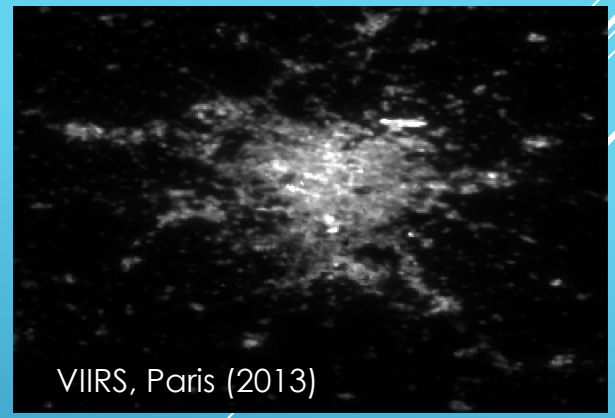
The majority of these studies focus on small regions (e.g., one country) rather than on a global scale.

This project introduced a methodology for determining the relationship between DMSP-OLS and VIIRS-DNB data based on a locally defined Region Of Interest (ROI), which is then generalized globally.

We used a XGBoost model, a Gradient Boosting Machine (GBM) decision-tree based algorithm

We developed an open-source Python software module and make this available for public use


DMSP-OLS, Paris (2013)

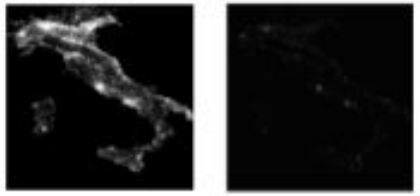

VIIRS, Paris (2013)

DMSP-OLS / VIIRS Data Harmonization

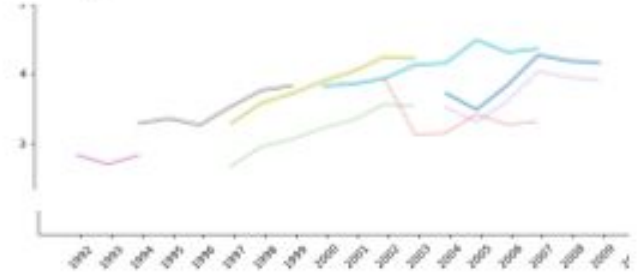
1. Download source data

2. User-defined AOI

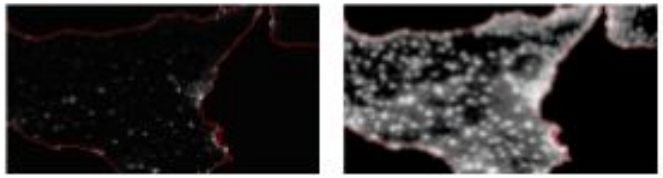
3. Clip to AOI

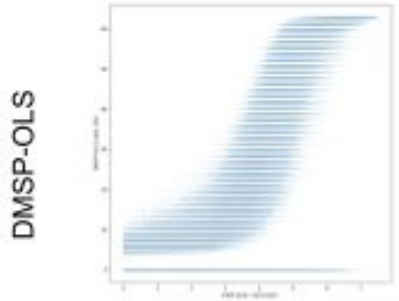


4. Stepwise DMSP intercalibration



5. VIIRS spatial and radiometric adjustments

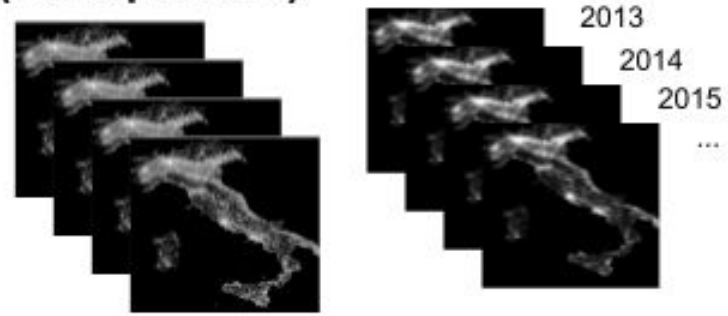




6. Fit model on 2013 data

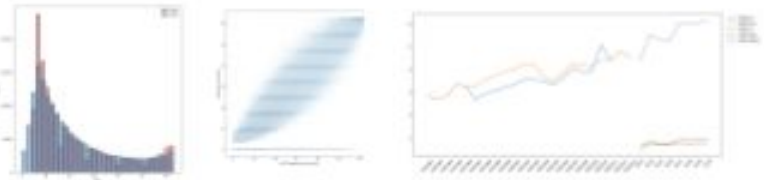
$$f(x \mid \theta) = \hat{y}$$
$$\arg\min_{\theta}(\mathcal{L}(\hat{y}, y))$$

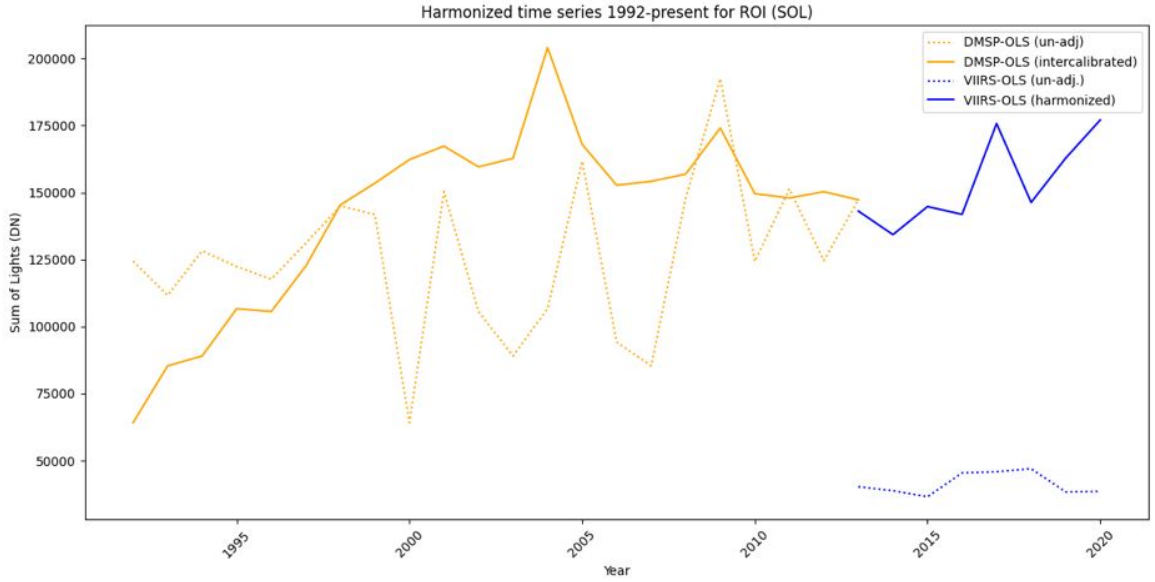
7. Transform VIIRS-DNB (2013-present)



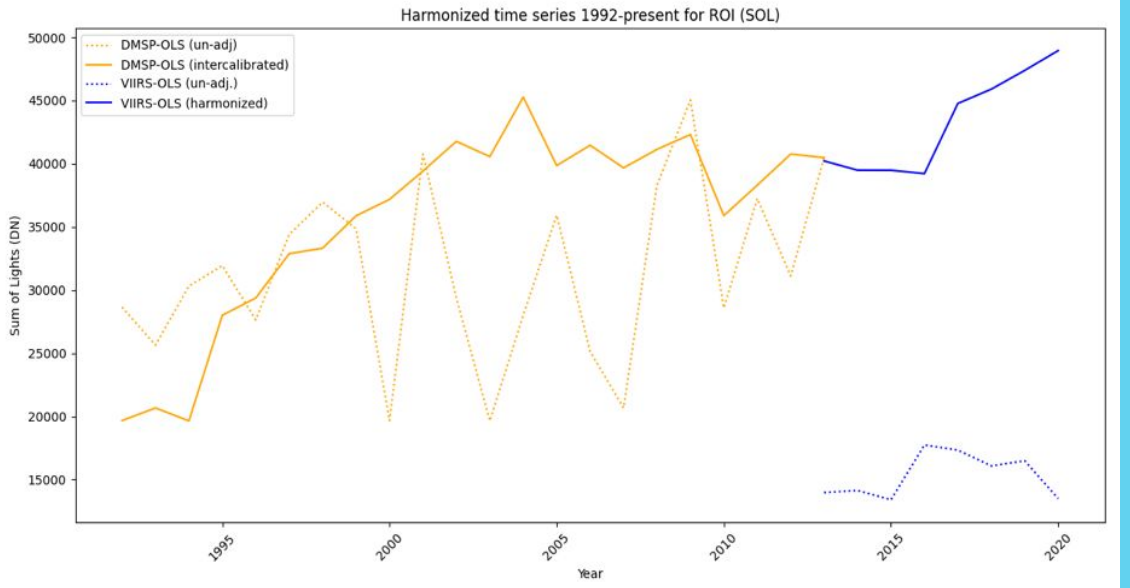
$$f(x \mid \theta) = \hat{x}$$

8. Evaluation and Analysis

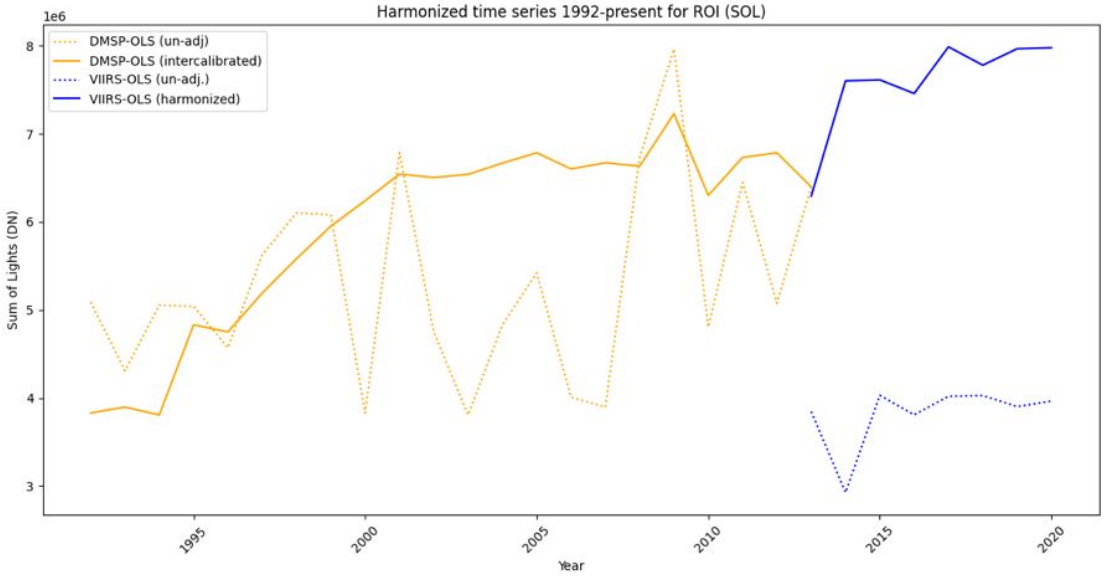




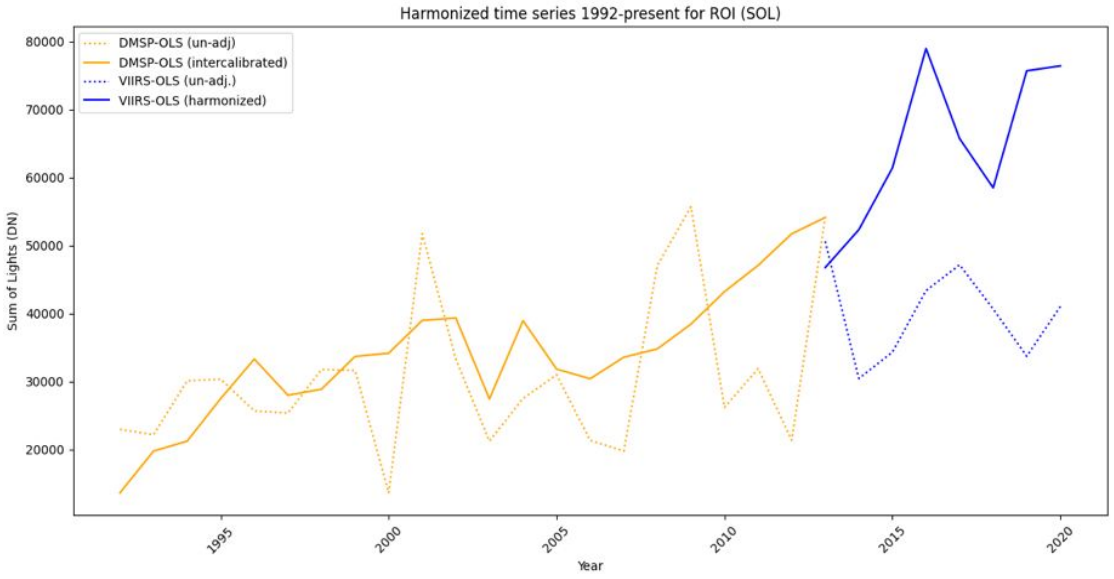
El Salvador



Mauritius



Spain



Uganda

VIIRS: GENERAL DISCUSSION AND INSIGHTS

BENEFITS OF VIIRS DATA TO MY WORK

- Much of our **international work** is done in **developing countries**.
- Main challenge: need for **granular**, **high-frequency** data on **economic activity** and socio-economic-demographic characteristics
- Need for free and open-source datasets to ensure the **sustainability of projects**
- VIIRS data can be pulled and analyzed in **free or open-source analytics platforms**
- Governments and local agencies look for free and accessible innovative data sources for a more **effective governance**
- Essential for **impact evaluation** work (measuring economic impacts) in inaccessible areas
- **COVID-19** really illustrated the advantages of nighttime light measurements
- We are working on multiple projects related to **disaster management and response** – VIIRS is essential to understand disasters impacts and provide rapid insights

FUTURE IMPROVEMENT AND "WISH-LIST"

- Increased **spatial resolution** to allow detection of **intra-city variations**
- Improved **cloud detection** to decrease measurement errors
- Finding better ways to deal with **glow and blooming**
- Processed products with **removed dimmed light** (noise)
- **Less "competition"** between institutions that provide processed VIIRS data and more collaboration to improve existing products
- A validated robust dataset with **temporal nighttime light data from 1992** (DMSP-VIIRS)
- Continued availability of **FREE processed VIIRS data**
- **Accessible near-real-time high-resolution feeds** (to estimate impacts of shocks in real time) – including in "easy to use" UIs.

remote sensing

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CITESCORE 7.4

Remote Sensing of Night-Time Light

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Deadline for manuscript submissions:
31 December 2022

Message from the Guest Editors

Since the early 1990s, with the launch of DMSP-OLS, remotely sensed observations of night-time lights have been a key tool for understanding almost every aspect related to human activity on Earth. Night-time lights can indicate the characteristics of a wide range of human-related aspects, from economic activity and development, urbanization processes, changes in GDP, migration patterns, economic impacts of conflicts, or the impacts of natural hazards on vulnerable populations. With advances in the availability and quality of night-time light data, improvements in data storage capabilities and the development of new methods and workflows for analyzing the data, there is an increase in the number of scientific applications that exploit remotely sensed night-time lights to better understand our world. This Special Issue of Remote Sensing will stimulate progress in the remote sensing research domain related to the utilization of night-time lights in a wide range of scientific domains, including economics, social sciences, disaster management, environmental sciences, ecology, urban research, and more.

mdpi.com/si/45129

Special Issue

Published papers (to date):

Urbanization Level in Chinese Counties: Imbalance Pattern and Driving Force
by Baifa Zhang, Jing Zhang and Changhong Miao

The VIIRS Day/Night Band: A Flicker Meter in Space?
by Christopher D. Elvidge, Mikhail Zhizhin, David Keith, Steven D. Miller, Feng Chi Hsu, Tilottama Ghosh, Sharolyn J. Anderson, Christian K. Monrad, Morgan Bazilian,J ay Taneja, Paul C. Sutton, John Barentine, William S. Kowalik, Christopher C. M. Kyba, Dee W. Pack and Dorit Hammerling

What Can We Learn from Nighttime Lights for Small Geographies? Measurement Errors and Heterogeneous Elasticities
by Richard Bluhm and Gordon C. McCord

A Global Assessment of Night Lights as an Indicator for Shipping Activity in Anchorage Areas
by Semion Polinov, Revital Bookman and Noam Levin

Night-Time Light Remote Sensing Mapping: Construction and Analysis of Ethnic Minority Development Index
by Fei Zhao, Lu Song, Zhiyan Peng, Jianqin Yang, Guize Luan, Chen Chu, Jieyu Ding, Siwen Feng, Yuhang Jing and Zhiqiang Xie

Examining the Economic and Environmental Impacts of COVID-19 Using Earth Observation Data
by William Straka III, Shobha Kondragunta, Zigang Wei, Hai Zhang, Steven D. Miller and Alexander Watts

The Dimming of Lights in China during the COVID-19 Pandemic
by Christopher D. Elvidge, Tilottama Ghosh, Feng-Chi Hsu, Mikhail Zhizhin and Morgan Bazilian

Pandemic Induced Changes in Economic Activity around African Protected Areas Captured through Night-Time Light Data
by Anupam Anand and Do-Hyung Kim

https://www.mdpi.com/journal/remotesensing/special_issues/RS_Night_Time_Light

THANK YOU!

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