



Nighttime lights: exploring data and applications in the Philippines

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Introduction

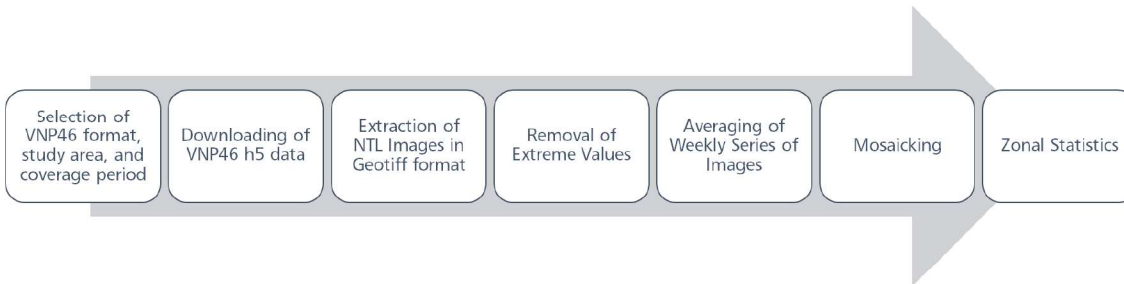
- Big data and innovative data are important for timely, evidence-based decision-making, and to bridge existing data gaps
- After the onset of the pandemic and rapid need for digitization, production of big data has been increasing and provides an opportunity to mainstream its use
- Earth observation and remote sensing data are commonly applied big data in economic research and analysis.
- Nighttime lights (NTL) as detected by satellites is considered a useful proxy for socioeconomic variables in developing countries, and the dataset has many advantages

Key contributions

- This study develops an automated pipeline for extracting NTL from VIIRS and processing into radiance indicators
- The study demonstrates the potential of NTL for macroeconomic monitoring and socioeconomic analysis
 - NTL has potential to be used in economies with scarce datasets for tracking **aggregate** economic growth and business cycle.
 - At **sub-national** level, NTL closely tracks regional GDP; can be useful for income inequality analysis; and shows strong correlations with socioeconomic variables - income, education, health, population, and poverty.
 - NTL can complement other high frequency data for understanding human mobility/activity in **small geographical units** like urban areas

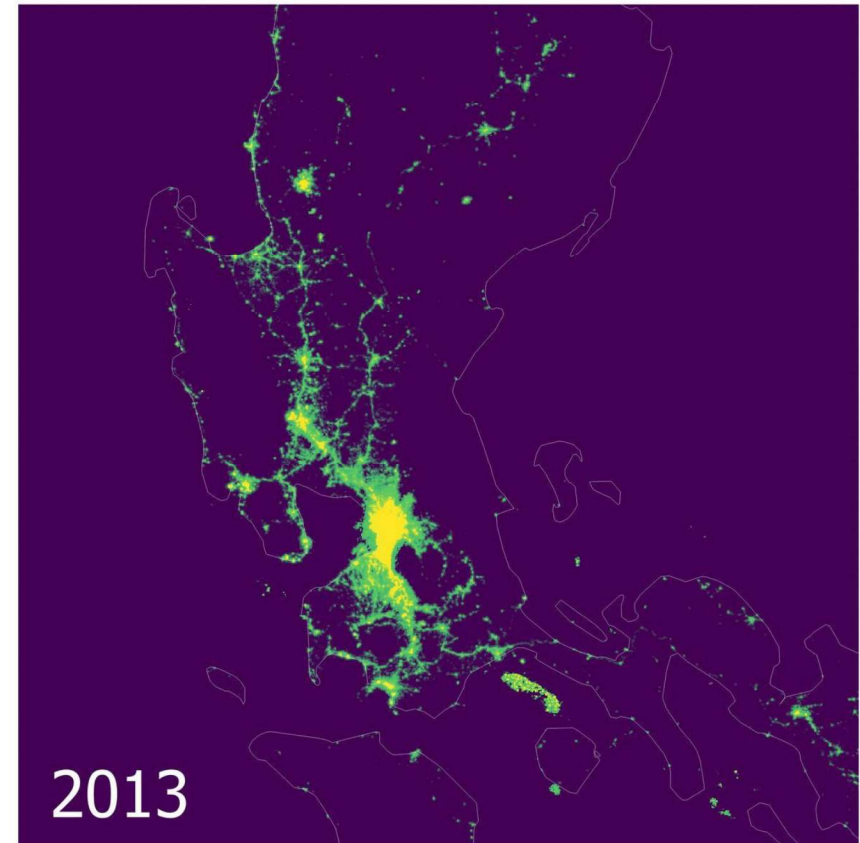
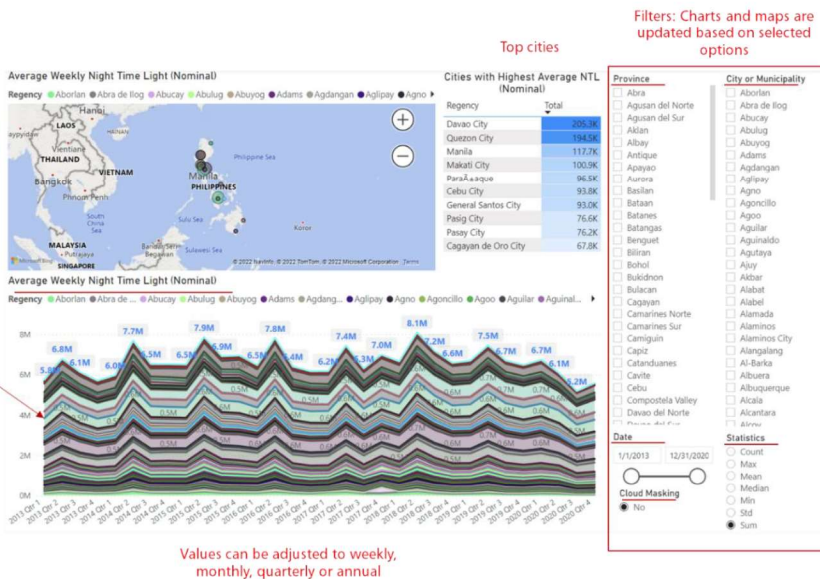
NTL Processing Pipeline

With huge amount of data and routine processing, there is a need for automation.



Map View (larger circle, larger average NTL)

Total values for the week (only shows limited no. of regencies)



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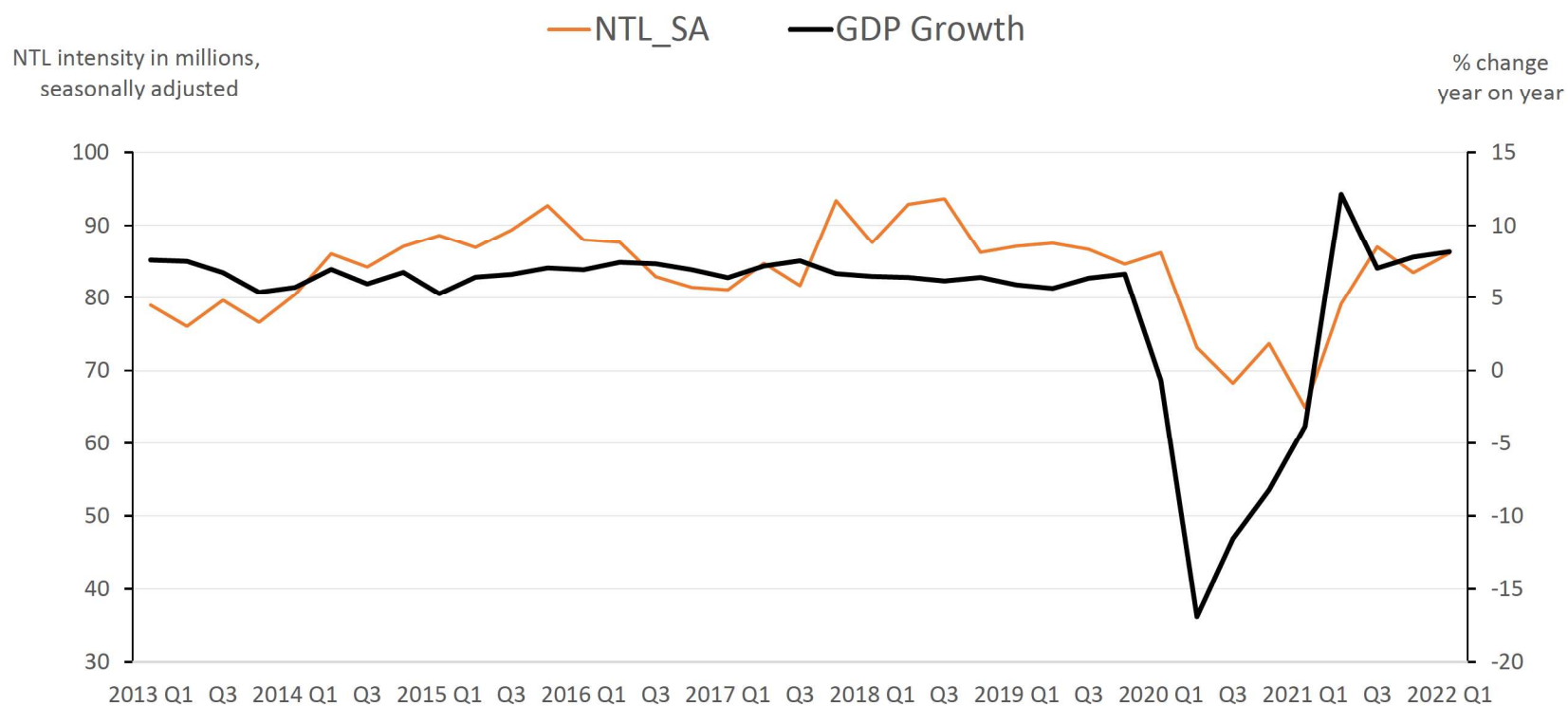
Applications

1. Macroeconomic monitoring
2. Sub-national analysis
3. Mobility in urban areas

Case study: Philippines

NTL in macroeconomic monitoring

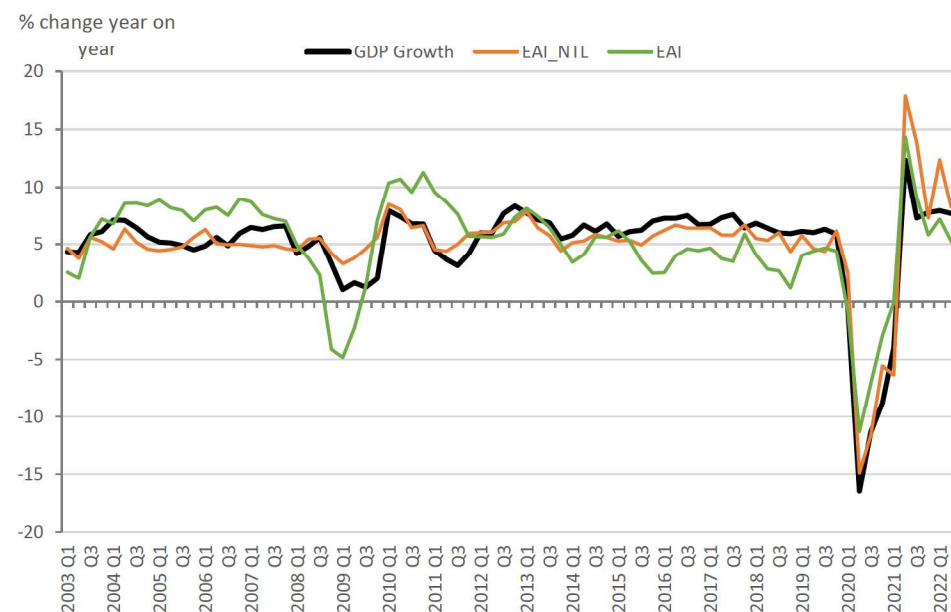
NTL generally tracks GDP growth



NTL in macroeconomic monitoring

Supplementing traditional monthly indicators with NTL in macroeconomic framework improves accuracy in tracking the business cycle

Traditional monthly indicators	Category
Visitor Arrivals: Total	Consumption
Remittances of Overseas Filipino Workers	Consumption
Consumer Price Index (CPI), seasonally adjusted	Consumption
Real Min. Daily Wage Rate: 2012 Prices: NCR: Agri: Plantation	Consumption
Real Min. Daily Wage Rate: 2012 Prices: NCR: Non-agricultural	Consumption
Net Sales Index (NSI): Volume	Consumption
Rice Stock Inventory: Total, year to date	Investment
Industrial Production Index (IPI): Volume	Investment
Private Bldg. Construction: Non-Residential (NR)	Investment
Government Expenditures	Government
International Reserves: Net, end of the period	Government
Equity Market Index: PSEi	Financial
Market Capitalization	Financial
US Institute for Supply Management Manufacturing PMI	External



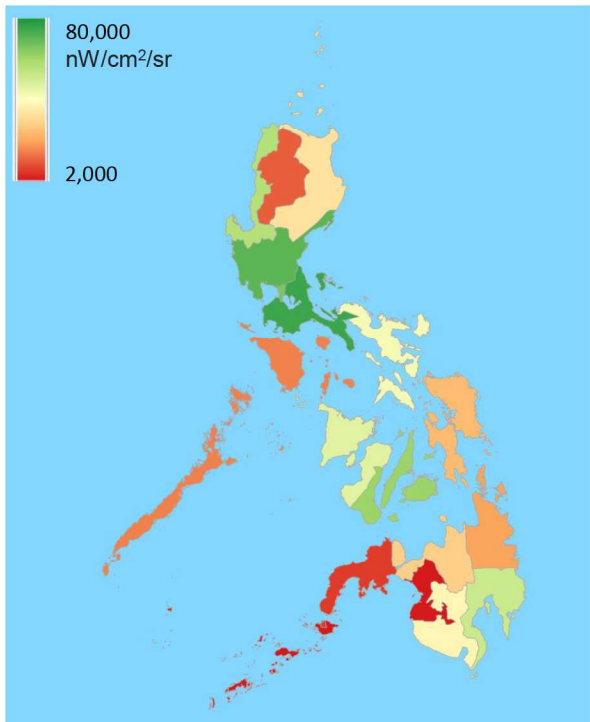
Note: EAI denotes economic activity index, an indicator developed by ADB to closely track a country's business cycle. Detailed information about the *TrackingAsia* framework can be accessed in this url: <https://asianbondsonline.adb.org/macroeconomictracker/>.

Source: CEIC data company; author's calculation using data from NASA Black Marble NTL Product Suite/ Earth Observation Group (both accessed 1 September 2022).

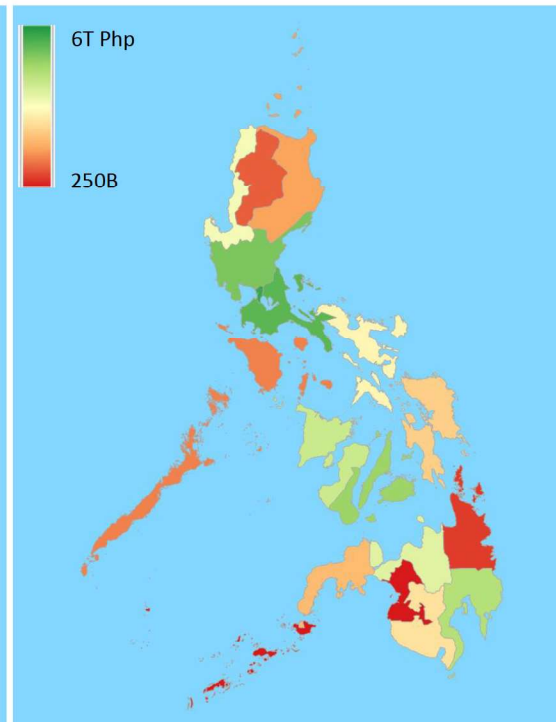
NTL as a proxy for subnational indicators

NTL concentration closely follows the distribution of regional output; correlation coefficient greater than 0.8 from 2013 - 2021.

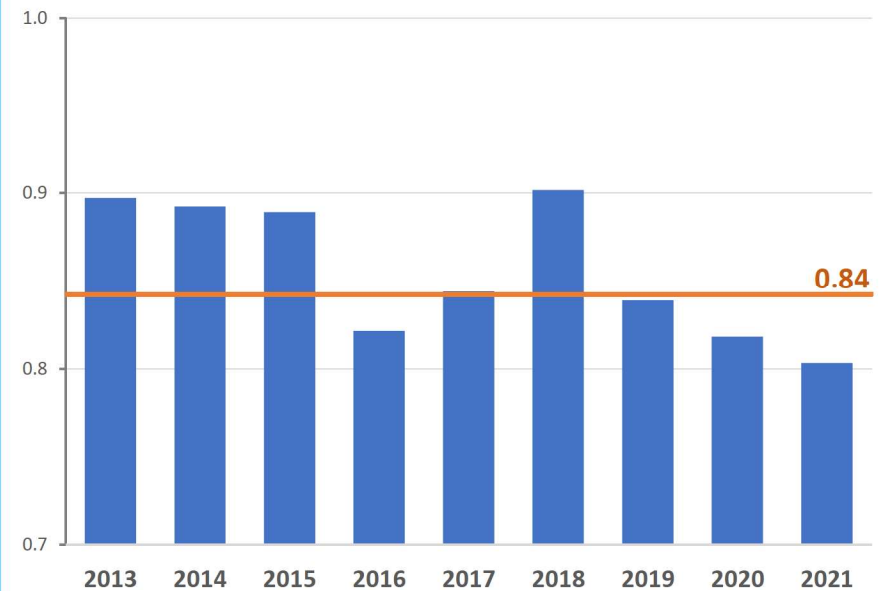
NTL intensity per Region (2021)



Regional GDP at 2018 Constant Prices (2021)



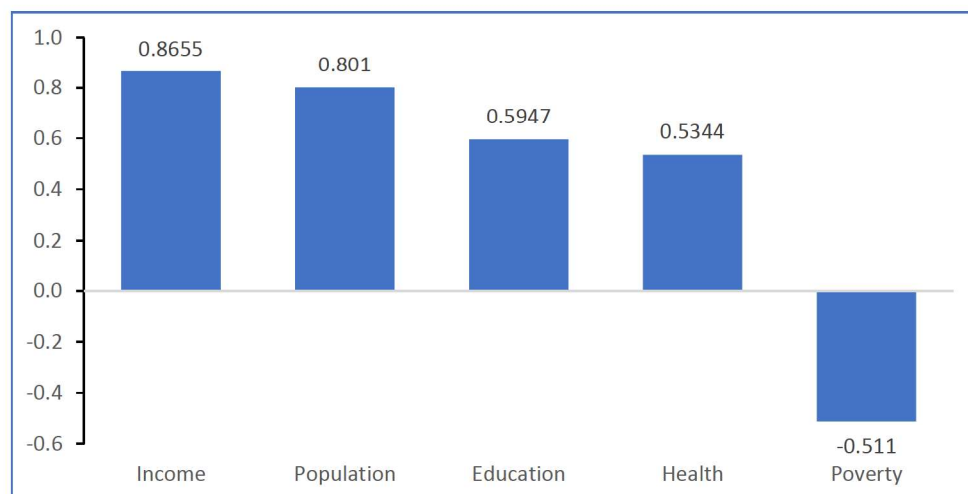
Correlation between regional NTL intensity and regional GDP



Note: Orange line is the correlation coefficient for the period 2013-2021. NTL indicator is the sum of NTL intensity.

NTL as a proxy for subnational indicators

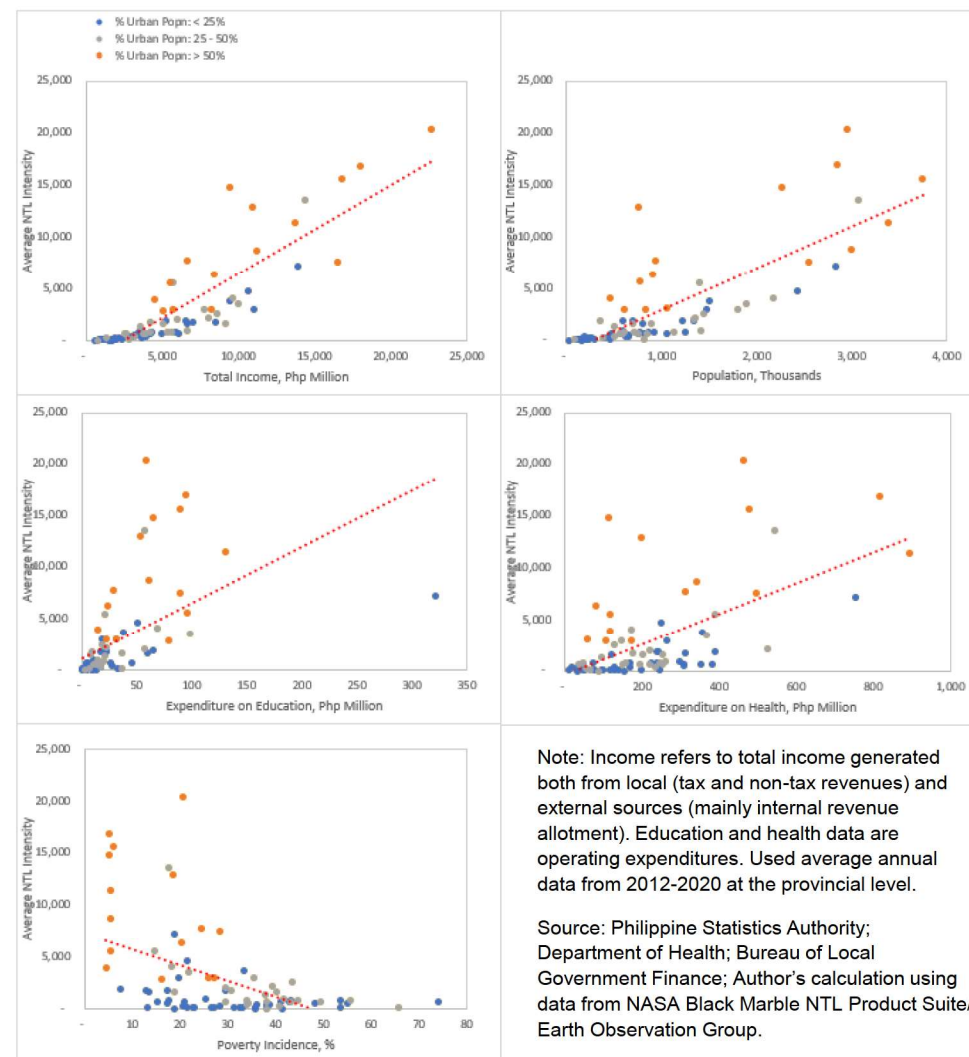
- NTL is positively correlated with **income, population, and education** while negatively correlated with **poverty** at the provincial level.
- When provinces are categorized according to the **level of urbanization**, higher NTL levels are observed in highly urbanized provinces



Note: Used average annual data from 2012-2020 at the provincial level.

Source: Philippine Statistics Authority; Department of Health; Bureau of Local Government Finance; Author's calculation using data from NASA Black Marble NTL Product Suite/ Earth Observation Group.

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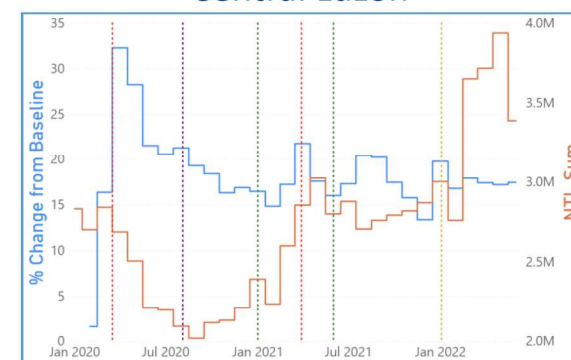
NTL in smaller geographic units

- Higher correlation across points of interest largely in the national capital region and the rest of Luzon and weaker correlations in Mindanao and some Visayas regions.

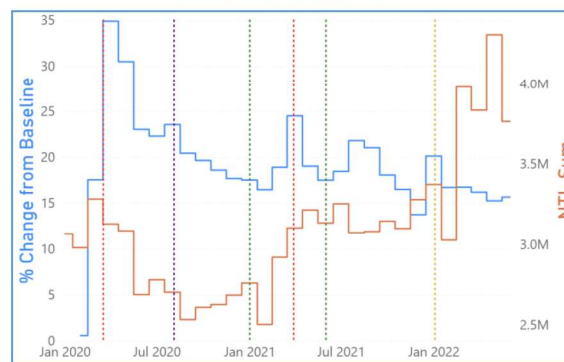
Region	Retail and Recreation	Grocery and Pharmacy	Parks	Transit Stations	Workplaces
Central Luzon	0.6229	0.6252	0.6416	0.6305	0.5076
Ilocos Region	0.5516	0.5238	0.5441	0.4127	0.3781
Metropolitan Manila	0.5477	0.5279	0.5056	0.5915	0.4705
CALABARZON	0.5150	0.5296	0.5340	0.6025	0.4560
Bicol Region	0.4033	0.4353	0.5002	0.3954	0.3719
Cagayan Valley	0.3796	0.3675	0.3989	0.2908	0.3249
MIMAROPA	0.3638	0.3055	0.4614	0.3832	0.3274
Western Visayas	0.3588	0.3537	0.4503	0.4255	0.3031
Eastern Visayas	0.3491	0.3395	0.4351	0.3758	0.2982
CAR	0.3432	0.2872	0.3787	0.3029	0.2971
Zamboanga Peninsula	0.2856	0.2832	0.3673	0.3215	0.2552
Northern Mindanao	0.2196	0.2142	0.2851	0.3035	0.1828
Davao Region	0.2091	0.2202	0.2833	0.2876	0.1893
CARAGA	0.2086	0.1947	0.2564	0.2431	0.1747
BARMM	0.1978	0.2071	0.2682	0.2797	0.2029
Central Visayas	0.1642	0.1705	0.1878	0.2087	0.1562
SOCCSKSARGEN	0.1160	0.1238	0.1606	0.1484	0.0977

- NTL can be associated with mobility patterns during the pandemic-induced lockdowns in cities.

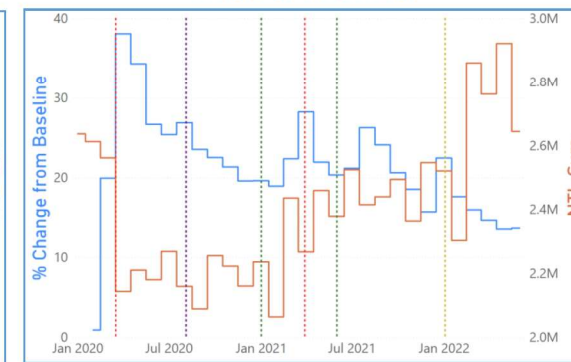
Central Luzon



CALABARZON



Metro Manila



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Conclusions and way forward

- The accessibility and sustainability of big NTL data has been addressed through the development of an automated processing pipeline;
- NTL offers advantages and value addition in socioeconomic analysis, but limitations need to be addressed and data combinations to be worked out
- This will encourage extensive use of NTL by government and other institutions
- Future research will explore additional applications of NTL data in economic analysis.