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## Measuring power outages in Ghana using satellite imagery



### In brief:

- Ghana recently experienced an extreme power crisis, which peaked in 2015, leading to substantial economic, social, and political problems.
- Despite the widespread impacts of the crisis, there is no reliable data on the variation in power supply quality across Ghana over this period.
- Our project estimates geographic variation in power outages using the Power Supply Irregularity (PSI) index: It identifies excess variability in night-time light output across all nightly images captured by satellites during each calendar year.
- Starting from 2012, there is a substantial increase in PSI levels across much of Ghana. Overall PSI levels peak in 2016 but decline in 2017. The highest PSI levels are observed in urban neighbourhoods.
- By 2017, improvements in power supply quality were most pronounced in areas with both high levels of power outages and large numbers of voters who supported the winning party in the December 2016 presidential election.
- Policy makers should effort in improving access to power supply data, enhance transparency in power outage scheduling, and increase research on the impacts of power outages.

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## Overview of the research

Power outages and reliability problems are among the most significant constraints facing households and businesses in much of the developing world. Power cuts anger business owners in darkened shops, frustrate teachers and students as they struggle through lesson plans, and antagonise families unable to turn on their lights and fans. While a growing body of research has focused on the measurement and impacts of improved energy access, there remains little research on the impact of intermittent supply and quality problems in the power sector.

Ghana is an important case, having recently experienced one of the most extreme power crises in the world. Following a disruption to the country's natural gas supply in 2012, systematic load shedding by the country's electricity providers resulted in widespread outages across the country. The outages, referred to locally as *dumsor*, reached a peak in 2015 and led to substantial economic, social, and political problems in Ghana. Despite the widespread impacts of the crisis, there is no reliable data on the variation in power supply quality across Ghana or over time.

[Our project](#) (see the working paper output, [Min, 2019](#)) estimates geographic variation in power outages using the new **Power Supply Irregularity (PSI) index**, which identifies excess variability in night-time light output across all nightly images captured by satellites during each calendar year. The satellite data come from the Visible Infrared Imaging Radiometer Suite (VIIRS), which accurately measures radiances from the visible to near-infrared band at wavelengths between .5 – .9 um.

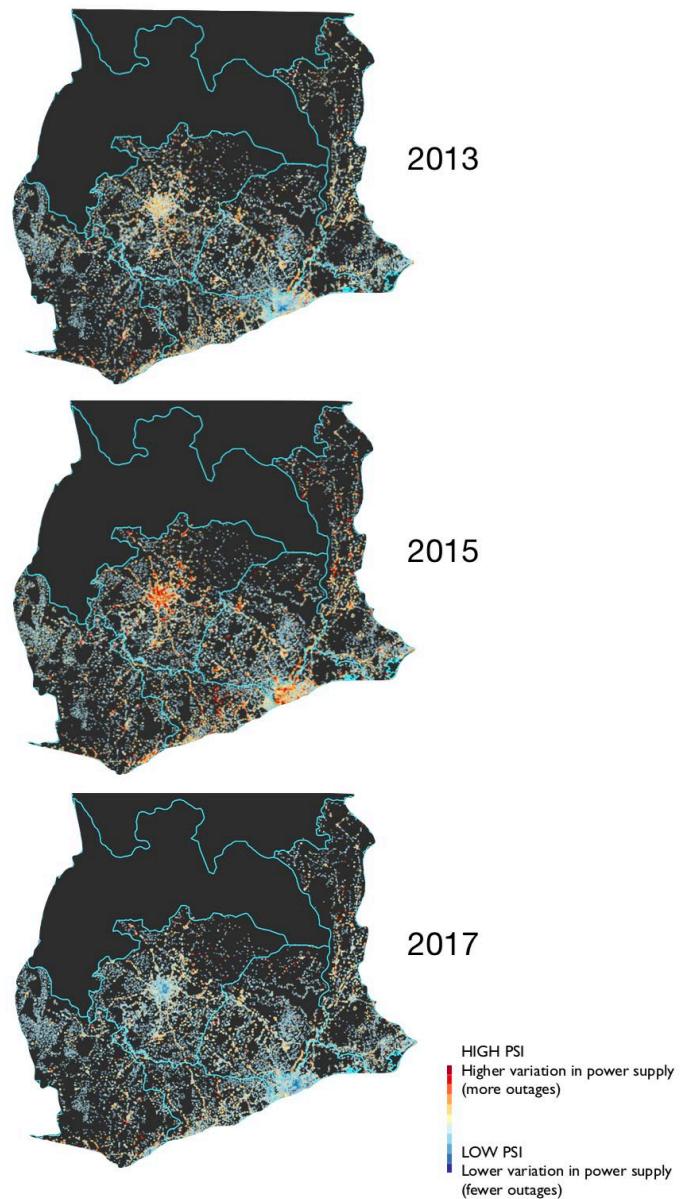
The data are captured every night and recorded on a constant 15-arcsecond grid (approximately 0.5 km x 0.5 km). The estimates allow for comparisons of power outage intensity at the neighbourhood-by-neighbourhood, or village-by-village levels, for each year from 2012 to 2017.

The underlying premise of the PSI index is that a location with stable electricity supply will generate a stable level of light output across a period of nights, while a location with unstable electricity supply will exhibit higher variability of light output over that same period. *PSI is the unexplained variability in light output relative to the predicted variability of light output for a pixel, calculated for each year using data over the entire 2012 – 2017 period.*

## The findings: Politics and power supply

- Starting from 2012, when the data begin, there is a substantial increase in PSI levels across much of Ghana. Overall PSI levels peak in 2016 but decline in 2017.
- There is significant geographic variation in PSI levels. In general, the highest PSI levels are observed in urban neighbourhoods, especially in Accra and Kumasi.
- By 2017, improvements in power supply quality were most pronounced in areas with both high levels of power outages and large numbers of voters who supported the winning party in the December 2016 presidential election.

**Figure 1: Power supply irregularity index in southern Ghana**



## Policy motivations of the research

Low quality electricity supply is a leading obstacle facing firms and households in Ghana and many parts of the developing world. We hope that new data on the incidence of power outages will enhance transparency and accountability in the power sector, help utilities identify problem areas, and enable civic organisations and citizens to track patterns across space and time.

## Policy recommendations

- **Improve access to power supply data**

The impact of power cuts is hugely important, yet detailed data on the supply of power is either unavailable or inaccessible, for a variety of reasons. New technologies enable new perspectives and approaches to measurement of both the incidence and impact of power cuts.

- **Enhance transparency in power outage scheduling**

A great source of frustration among consumers is that power cuts are known to be imposed by public sector officials, and yet the schedule and location of these power cuts is poorly communicated. Committing to schedules for power cuts can help consumers plan and respond accordingly. There must be careful consideration of the potential negative externalities of scheduled disruptions.

- **Increase research on the impacts of power outages**

Little remains known about the impacts of short-term and long-term disruptions in power supply to productivity and welfare at the level of individual firms and households. Widespread power supply problems are likely to increase in many countries given global commitments to improving energy access among the poor, predictable increases in electricity demand as economies grow, and the challenges associated with sustainable increases in power supply.