# Verification and Enhancement of VIIRS Day-Night Band (DNB) Power Outage Detection Product

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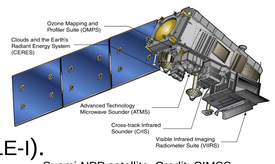
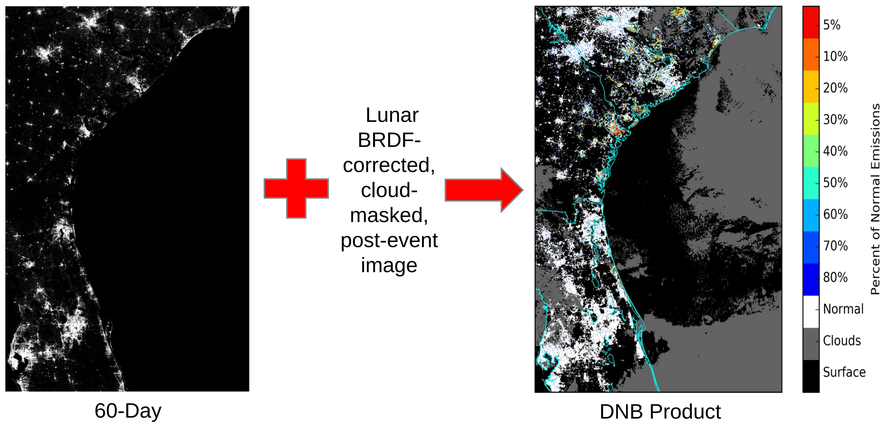
## Overview

This case study of Hurricane Matthew (October 2016) uses the NASA Short-term Prediction Research and Transition (SPoRT) Center DNB power outage product (using GSFC VIIRS DNB preliminary Black Marble product, Roman et. al 2017) and 2013 LandScan Global population data to look for correlations between the post-event %-of-normal radiance and the utility company-reported outage numbers (obtained from EAGLE-I).




Suomi-NPP satellite, Credit: CIMSS

## Day-Night Band Product

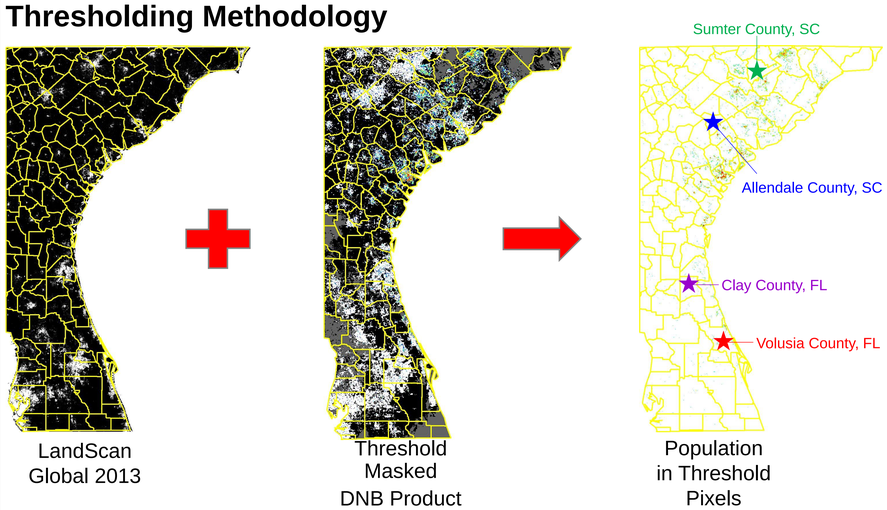



60-Day Radiance Composite

DNB Product

- A **Radiance Composite** serves as a baseline for "normal" emissions.
- This study used the **20th percentile** in radiance emissions **over 60 days** to define the normal emissions
- Post-event images are then compared to the composite to find the **"percent-of-normal"** emissions
- Example: the DNB product tells the viewer a pixel is at **5%**, which means **95%** of the normal radiance is gone

## Thresholding Methodology




LandScan Global 2013

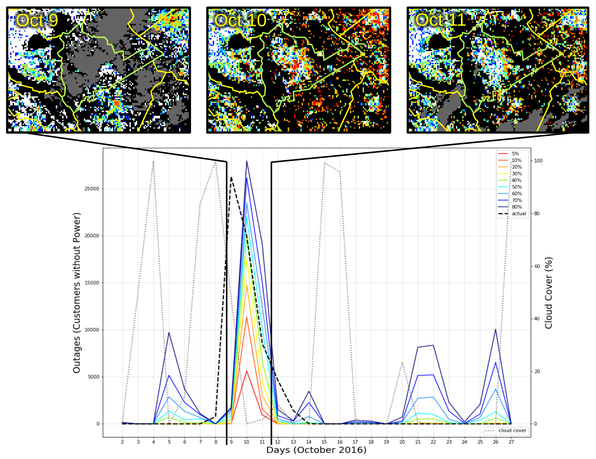
Threshold Masked DNB Product

Population in Threshold Pixels

- This methodology uses the **population** in each pixel under a certain **"percent-of-normal" threshold** as a way to replicate "outages" as reported by utility companies
- The population count contained in the pixels under the "percent-of-normal" threshold is summed by county
- A **"Customer Correction"** number is then applied to the population count to estimate actual outages

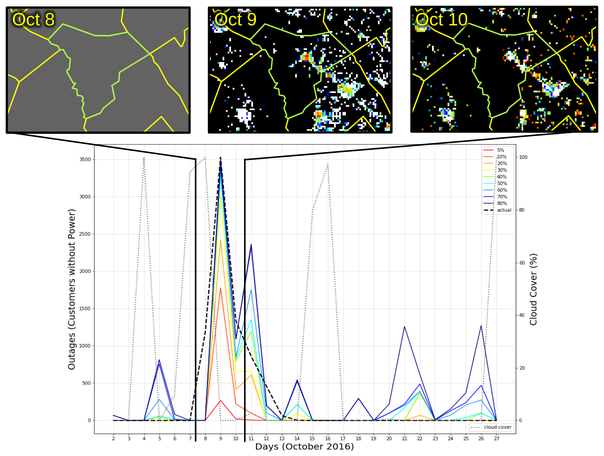
## Initial Results

### ★ Sumter County, SC



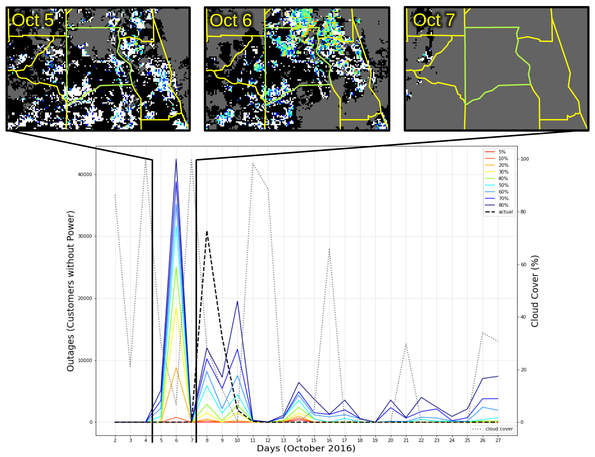

- Cloud cover on Oct 9 accounts for "lag" in %-of-normal threshold outages
- 40%-50% thresholds in agreement with reported outages

### ★ Allendale County, SC



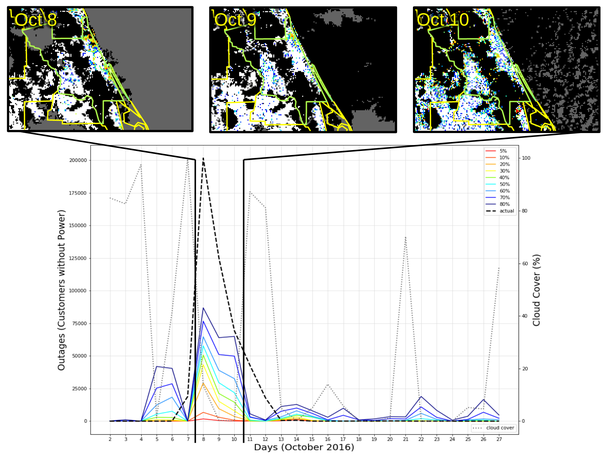

- Cloud cover on Oct 8 accounts for "lag" in %-of-normal threshold outages
- 70%-80% thresholds in agreement with reported outages

### ★ Clay County, FL




- No thresholds in agreement with reported outages, underreporting
- VIIRS cloud mask possibly missing clouds, causing radiance to seem "dimmer" – resulting in "outage" spike

### ★ Volusia County, FL




- Threshold-derived outages severely underreporting when compared to reported outages
- Again, VIIRS cloud mask possibly missing clouds, causing radiance to seem "dimmer" – resulting in "outage" spikes

## Challenges

- Both the DNB and LandScan Global 2013 products have a 1km resolution, while the lowest resolution for utility-reported outages is at the county level, which sacrifices precision in estimating outages
- This methodology uses population as a proxy for utility customers, which does not take into account the fact that some utility customers will contribute more to the overall change in radiance than other customers
- The DNB product is made from a VIIRS composite image, so the exact time the VIIRS imagery was taken is not known; which introduces a temporal source of error when compared to the utility-reported outages
- Cloud cover is large hindrance in monitoring radiance levels, especially for severe weather-related disasters

## Conclusions & Future Work

- The DNB product visually shows where the worst outages are located after a disaster, but the mismatch between the threshold-approximated outages and the actual outages remains an issue; a finer resolution of utility-reported outages is needed to quantify how many customers are contributing to the overall percent of radiance emissions
- The VIIRS cloud mask is likely failing to identify thin clouds, which could cause lit pixels to appear "dimmer" and be attributable to "outage" spikes when no outages were reported
- Additional instruments with DNB capabilities will improve the refresh time for the product, making it a more useful tool during disaster response and recovery; improvements to the product algorithm are ongoing for future research

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