Satellite-based assessment of electricity restoration efforts in Puerto Rico after Hurricane Maria

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Understanding the distribution and duration of power outages after a disaster is a precursor to minimizing their harmful consequences, especially to vulnerable communities. Here, we use satellite-derived daily estimates of lights to monitor electricity restoration efforts in Puerto Rico following Hurricane Maria, which caused the longest blackout in US history. Within all settlements, we track how long it took to restore electricity, and assess the characteristics of communities that shouldered the most extended outages. Our results show an 80% decrease in lights, in total, immediately after Hurricane Maria. During the recovery, a disproportionate share of long-duration power failures (> 120 days) occurred in rural municipalities (41% of rural municipalities vs. 29% of urban municipalities), and in the northern and eastern districts. Unexpectedly, we also identify significant disparities in electricity recovery within municipalities. Land use, proximity to highways, and the structure and density of the built environment were all factors that influenced restoration times. For many urban municipalities, poor residents lived in less dense, detached housing—where power restoration lagged. The results demonstrate the capability of nighttime satellite imagery to monitor power availability at a high spatial resolution, linking monitoring efforts to neighborhood-scale demographic data. They also identify the unintended consequences of current density-based power restoration protocols. Through the integration of in-situ, satellite, and socioeconomic data products, disaster responses to long-term events can become more strategic to minimize harm, incorporating adaptive community capacity as an additional variable to determine where power should be restored.

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