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Developing a composite map of the Southeast and East Asia power systems

Mengqi Ye, Elco Koks, and Philip Ward
Institute for Environmental Studies, VU Amsterdam, Amsterdam, Netherlands

Power systems provide vital services to modern society and are characterized by being highly interconnected in a variety of ways. The loss of power systems during weather extremes can potentially result in widespread, catastrophic impacts that may seriously disrupt socioeconomic activities. In practical terms, there are many interdependencies through which the indirect impacts of a major power outage ripple through social interactions and economic activities. However, both the scarcity of power infrastructure data and the complexity of power systems make it challenging to model these exact socioeconomic impacts of power outages in the aftermath of weather extremes. Unfortunately, power system datasets remain incomplete regarding most geographic areas, and the access to power infrastructure data in an open and standardized way is one of the main bottlenecks in risk modelling, especially for the medium and lower voltage distribution networks.

Limited spatial information on power infrastructure makes it difficult to respond to challenges in natural disasters and electricity reliability. Therefore, data collection of power systems should be the main priority in power infrastructure risk assessments. One of the possibilities to fill these data gaps is through the use of satellite imagery. However, automating the process of satellite imagery data classification and translating the extracted information into semantic classes, specifically for power infrastructure, has three main challenges: 1) images from different sources have complete different spatial resolutions, which makes it difficult to consistently identify power infrastructure; 2) most existing satellite imagery datasets are prepared for training classification models but do not include annotations for training detection models; 3) and there are few training datasets available for training power infrastructure detection models.

To fill this research gap, we will develop a state-of-the-art deep learning method to identify power infrastructure. Our methodology consists of two parts: 1) image segmentation for power lines by StackNetMTL, which helps to learn the interconnectivity within the system; 2) object detection for other power infrastructure (i.e., power plants, substations, and towers) by Mask R-CNN. This will provide us with a geospatial power infrastructure map of the Southeast and East Asia to support power systems risk assessment, for both the system itself and the potential societal impacts. This research will provide a consistent and reproducible way for machine-driven mapping of power infrastructure, paving the way for improved efforts in power system modelling and risk management in Southeast and East Asia.