Locating Charcoal Production Sites with Remotely Sensed Data in East Africa

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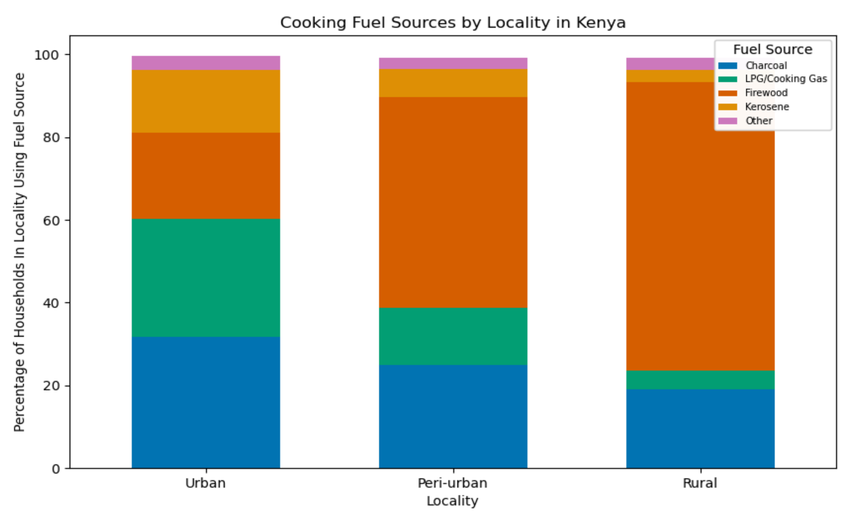
Introduction

- Charcoal is a major fuel source in urban Africa, and must be made more sustainable during the energy transition.
- Production bans are largely ineffective as sites are difficult to locate and little is known about the supply chain.
- A more effective approach is needed to document sites and establish beneficial regulations on production.



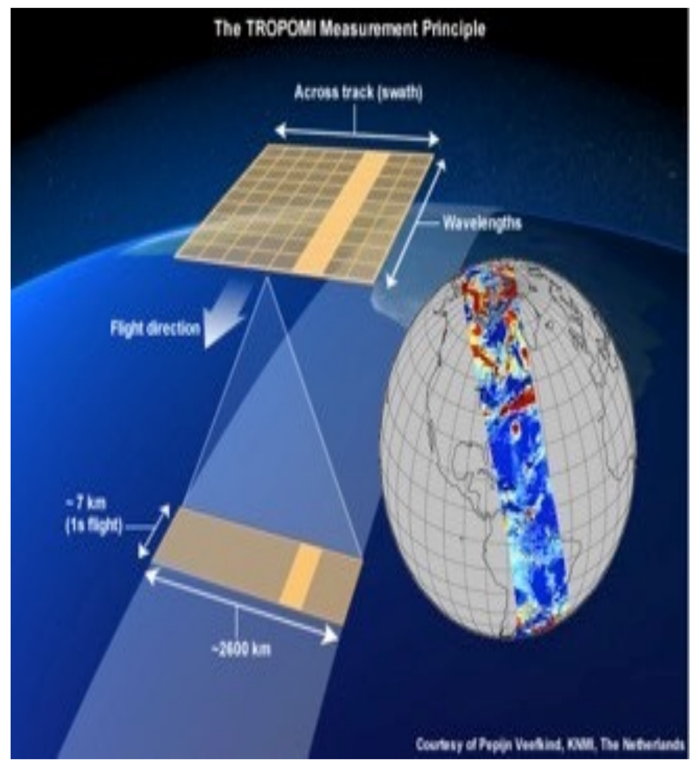
Kenya Cooking Fuel Source Mix by Locality

Charcoal Production Site—Earth Mound Kiln

We predict that outliers in spatiotemporal patterns at ground truth sites can be used to locate unconfirmed production sites.

Research Questions and Methods

To what extent can new metrics in advancing satellite technology be used to identify high-resolution patterns on Earth's surface?



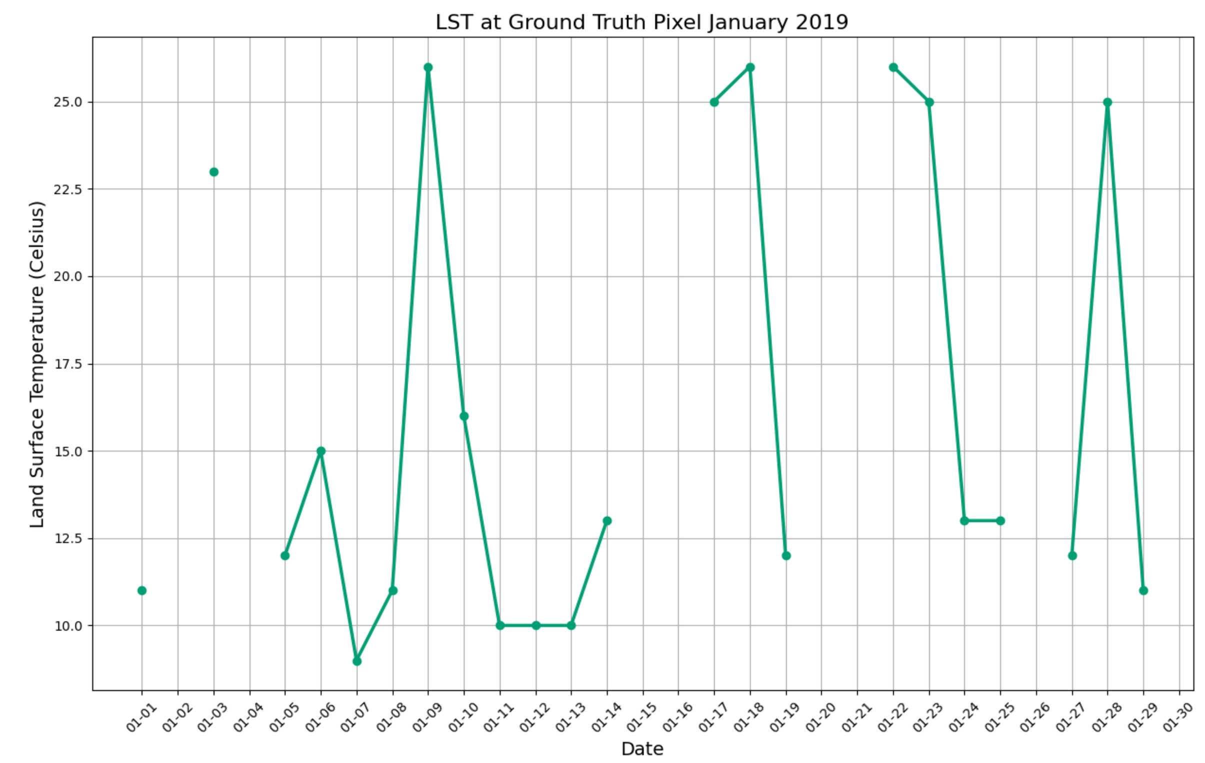
- Land surface temperature dataset: 750m spatial, <daily temporal resolution, from the Suomi NPP VIIRS Instrument
- CO and NO_2 pollutant data: 25km (interpolated to 1km) spatial, daily temporal resolution from TROPOMI instrument onboard the Copernicus Sentinel-5 Precursor Satellite.

Can land surface temperature (LST) and pollution concentrations be used to indicate production sites?

- How can these be combined to identify outliers in standard conditions at confirmed production locations?

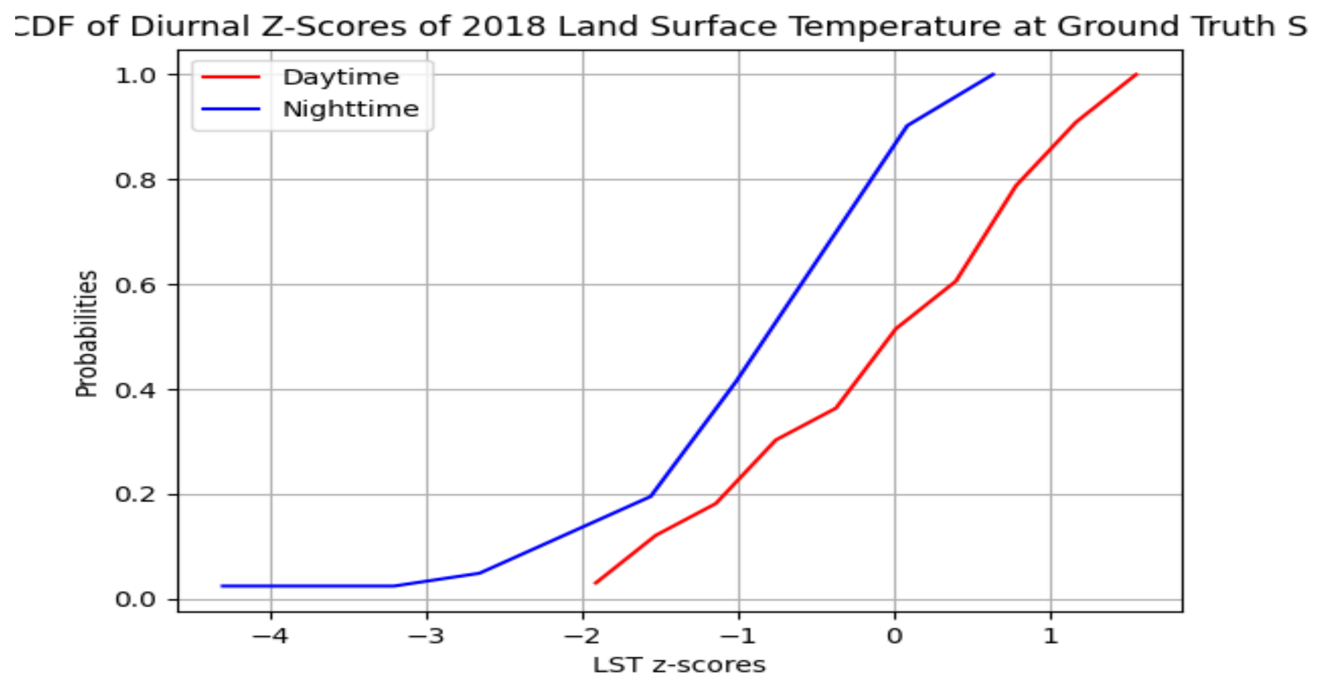
Results

LST data contains many temporal inconsistencies, making it difficult to discern periods of elevation.



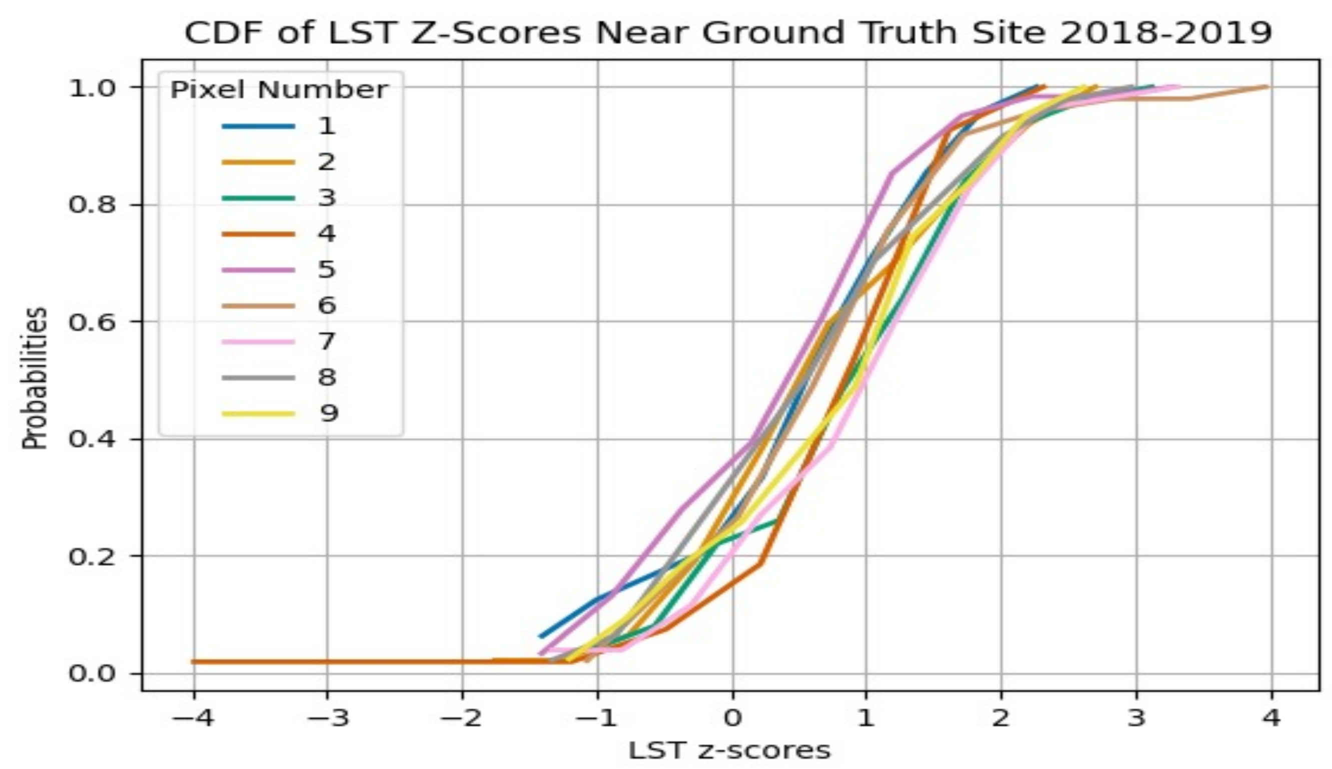
Kenya LST Time Series, January 2019

Diurnal variations in LST mask trends in daytime and nighttime LST variations.



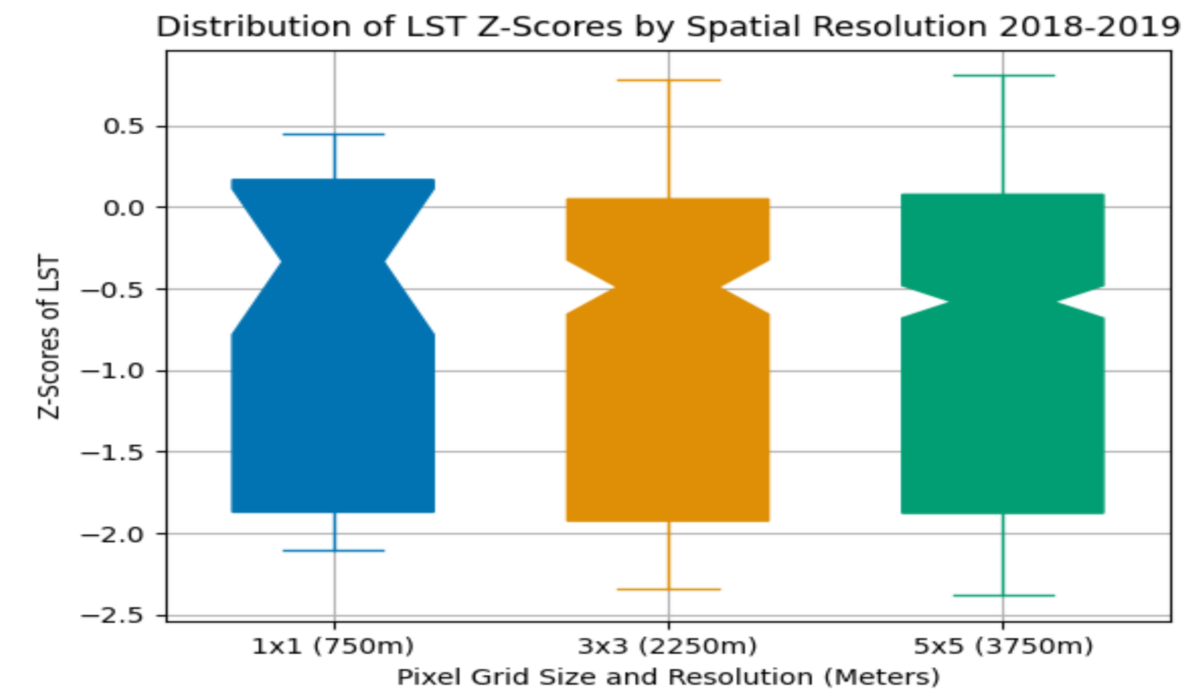
Cumulative Distribution Function of LST Z-Scores, 2018 January-June Mean, July-December Z-Scores

Minimal variation occurs between nearby pixels and most pixels have positive readings for this period.



CDF of Pollutant Concentration Z-Scores for Aggregated Ground Truth Region, 2019 January-June Mean, July-December Z-Scores

Aggregated LST data could indicate that nearby pixels have the same LST trend at the same times.



Distribution of LST Z-Scores over Aggregated Pixels, 2018 Mean, 2019 Z-Score

Conclusions

- In order to approach finding miniscule production sites using remotely sensed data, large datasets are needed to account for spatial and temporal gaps and find outliers within regular temporal trends, such as diurnal and seasonal variation. Aggregating mid-resolution data over larger areas accounts for gaps in data while still revealing outliers.
- Developing a method to analyze these conditions and find production sites could aid in furthering knowledge on the charcoal production chain and lend a path for adapting current government regulations and methods as needed.

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