

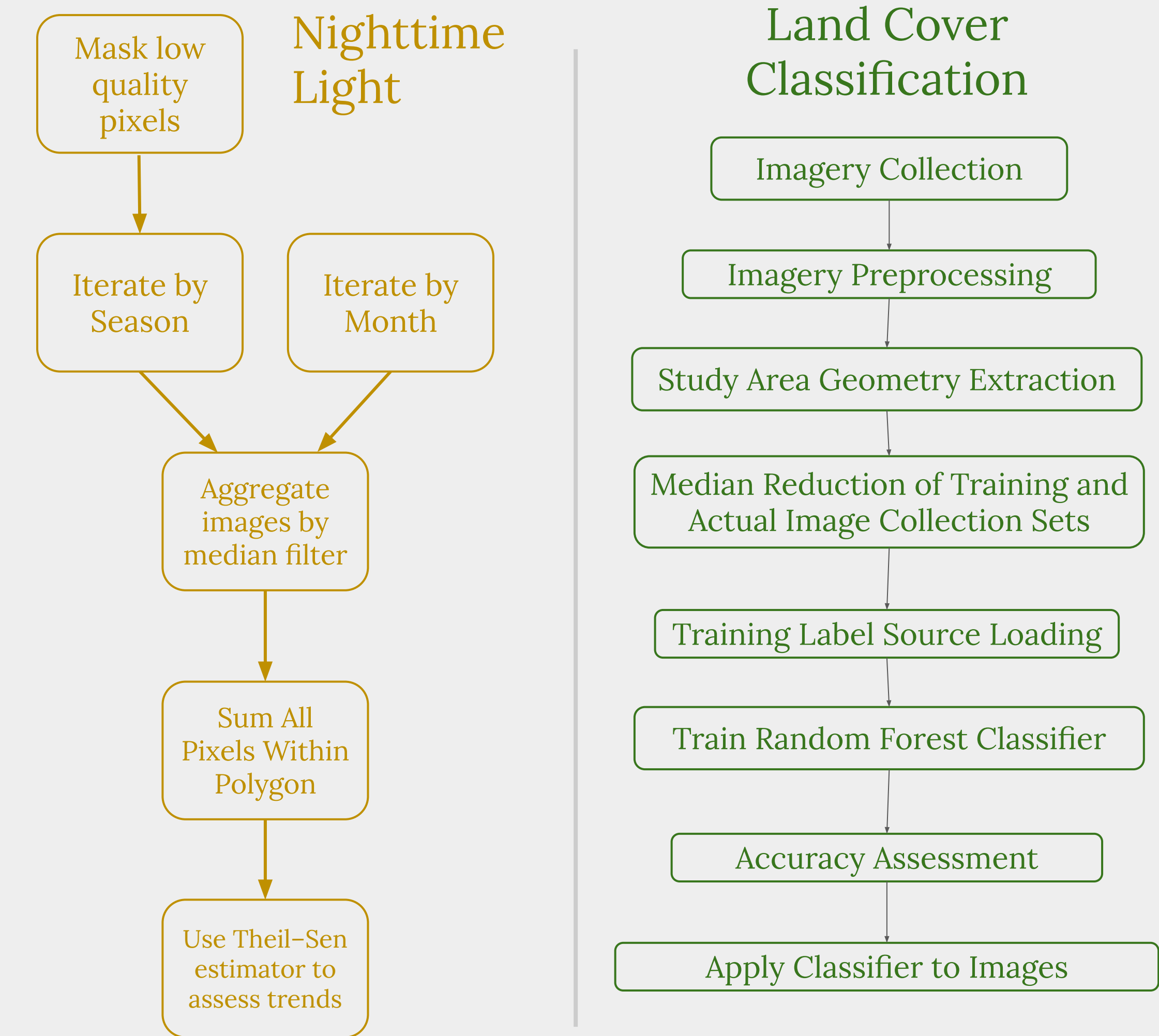
Impacts of War: A Comparative Analysis Between Land Cover and Nighttime Light Change during the Myanmar Civil War

Introduction

The Myanmar Civil War is an ongoing conflict which has persisted since the mid-20th century. With a military coup d'état in May 2021, the war has escalated, resulting in numerous violent war incidents such as raids and air bombing strikes. This has left villages and towns destroyed, leaving millions of innocent civilians displaced from their homes.

To better understand the spatiotemporal relationships between human displacement and environmental impacts in conflict zones, **night time light and land cover data**, derived from remotely sensed imagery can be used to analyze a large coverage area while conducting analysis in dangerous and inaccessible areas.

Methodology



Conclusion

Using a combination of land cover and nighttime light to analyze temporal trends during the Myanmar Civil War, it was found that within Kachin State there was:

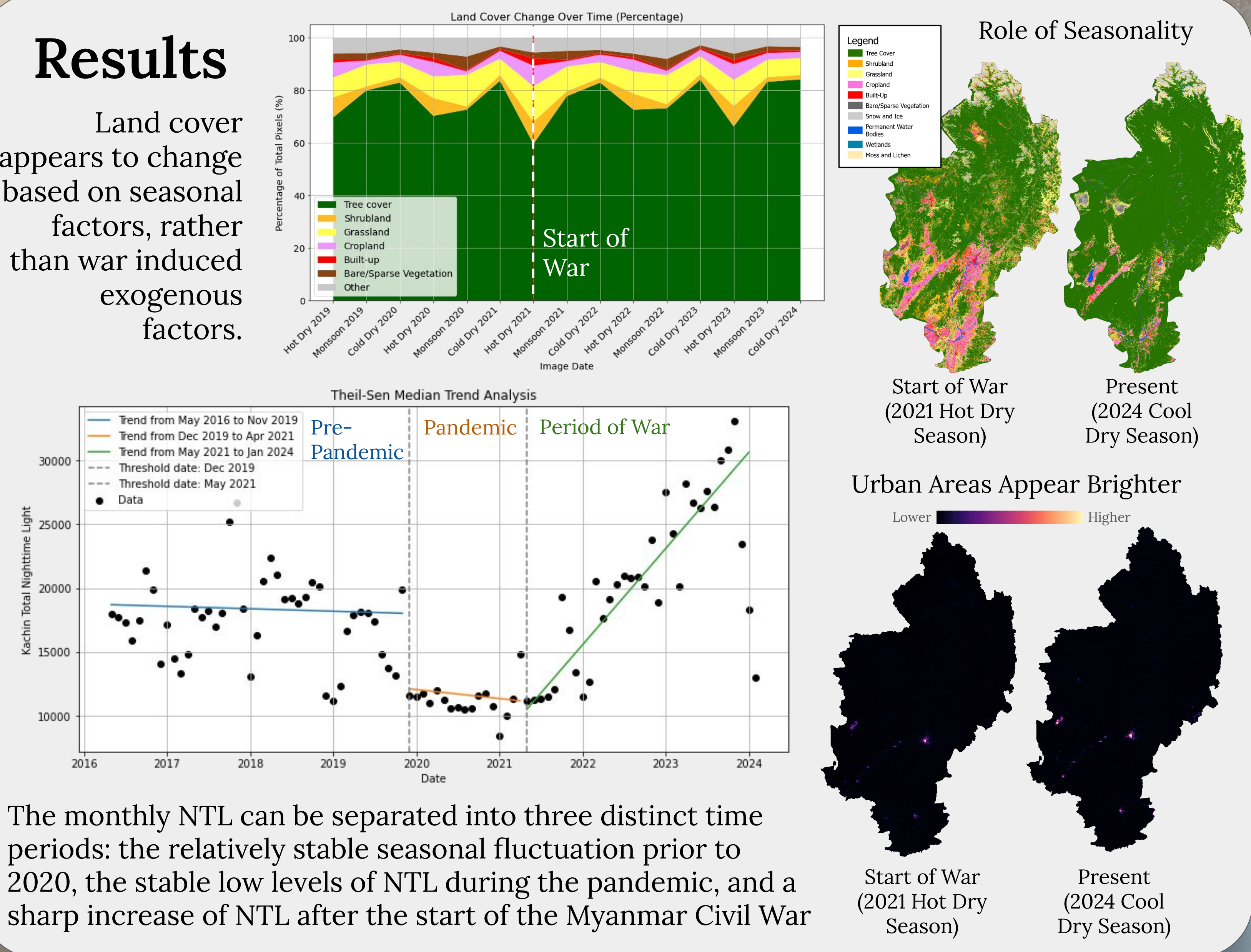
- A significant increase in nighttime light subsequent to the military coup in May 2021
- No significant change in land cover attributable to the conflict

By supplementing the nighttime light and land cover analysis with contextual information, it could be inferred that:

- Decreases in nighttime light could be explained by the potential displacement of populations from areas impacted by violence
- Low changes in land cover suggest minimal environmental impact from warfare activities.

Results

Land cover appears to change based on seasonal factors, rather than war induced exogenous factors.



Discussion

From the Theil-Sen Median Trend analysis, two distinct trends could be identified:

- The **stable yet reduced level** of nighttime light during the COVID-19 pandemic, attributed to **movement restrictions and economic downturns** due to diminished trade with China.
- The notable **increase** in nighttime light following the military coup possibly **driven by the displacement of people to urban areas and IDP camps** due to the conflict and economic hardships.

Land cover analysis using the Wilcoxon rank-signed test within this period revealed **no significant changes attributable to the conflict**, suggesting the environmental impact of the war in this region may be minimal.

The research aligns with SDG 16's objectives, particularly focusing on **conflict-related deaths and the displacement of populations**, demonstrating how the civil war has exacerbated these issues.

- The study, however, acknowledges several limitations:
- Nighttime light data is **less reliable at low light levels** and can be significantly affected by cloud cover.
 - The land cover classification faced **constraints due to the limited spatial resolution**, which lead to a lower validation accuracy of the classifier model.

Future research should explore techniques to **enhance the accuracy of nighttime light data in low-light conditions, implement cloud correction techniques, and utilize higher resolution imagery** for land cover classification to improve the validation accuracy of the model.

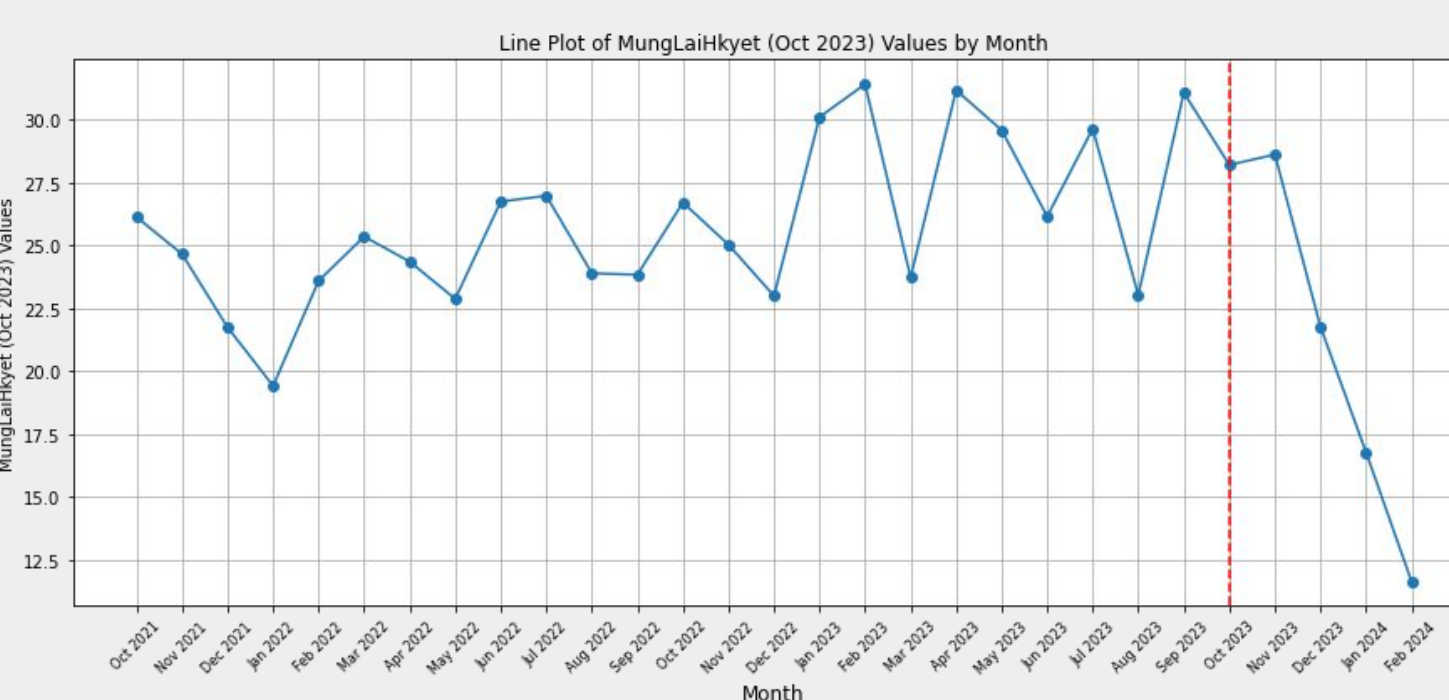
Study Area

Kachin State, the northernmost state in Myanmar was chosen for this study as due to its isolation, it has one of the strongest rebel groups, which fights for increased autonomy from the central government.

The instability of the region in addition to airstrike and bombing events presents a way to analyze the Myanmar Civil War from a unique perspective.

Case Study: Mung Lai Hkyet

Mung Lai Hkyet was bombed by the Myanmar Military on October 9th 2023, killing 28 civilians and leaving a crater visible from high resolution imagery (Dove Satellite - 3 m).



The October attack correlates with a decrease in night time light in a 5 km radius around the blast site.

Datasets

1. Classification Training Data: ESA WorldCover 2021
2. Classification Source: Harmonized Sentinel-2 MSI: MultiSpectral Instrument, Level-2A via GEE Catalog
3. Nighttime Light: Daily Lunar Gap-Filled BRDF Global Nighttime Light (500m) from VIIRS - VNP46A2
4. Administrative Boundary: GADM 4.1



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GEOG 471: Remote Sensing Project

Image credits: Background: ESRI, Earthstar Geographics. SDG16: UN. Myanmar Bombing (Introduction): AFP via Getty Images.