Mapping the Impact of Wildfire in the Pacific Palisades, California, Through Remote Sensing and GIS

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Introduction

Wildfires are uncontrolled fires that rapidly spread across landscapes, aided by dry vegetation, heat, and windy conditions (Thropp, 2024; Wibbenmeyer & Tastet, 2025). California has become one of the most wildfire-prone regions in the United States (Keeley & Syphard 2021), and the 2025 Palisades fire is one of the most devastating wildfires in Los Angeles history. This fire consumed thousands of acres and destroyed over 5,300 structures (Castleman et al., 2025). This disaster demonstrates the importance of using advanced techniques to assess wildfire damage and enhance mitigation strategies in urban areas, which are susceptible to such risks (Seydi, 2025).

Aim and Objectives

The aim of the study is to assess and map the spatial distribution and severity of vegetation and structural damage caused by the 2025 Palisades Fire using remote sensing and GIS techniques.

Study Area

The study focuses on Pacific Palisades, located in western Los Angeles County, California. Covering approximately 62.97km² (Wikipedia, Pacific Palisades, 2025), the area includes both dense urban neighborhoods and natural landscapes such as Topanga State Park and the Santa Monica Mountains.

The Palisades Fire ignited on January 7, 2025, burning 23,448 acres, killing 12 people, and destroying 6,837 structures—making it the third most destructive wildfire in California history (Wikipedia, Pacific Palisades, 2025).



Figure 1: The study area is Pacific Palisades, California.

Methodology

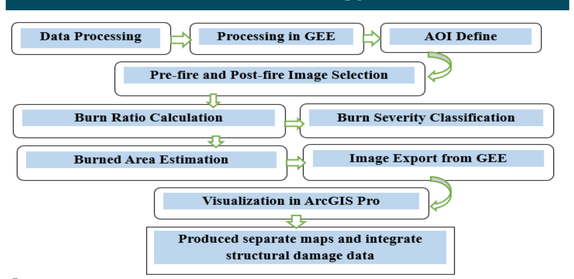


Figure 2: Methodological Workflow

Results and Discussion

Sentinel-2 Data Analysis: This study observed that the pre-fire image showed healthy vegetation while the post-fire image highlighted darker patches within the fire perimeter, indicating burned vegetation, structures, and surface changes (figure 3).

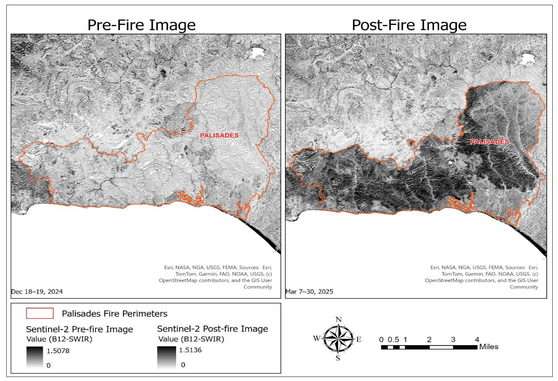


Figure 3: *Pre-Fire and Post-Fire Sentinel-2 Images of the Pacific Palisades Fire Area.*

Vegetation Condition and Burn Severity: The Normalized Burn Ratio (NBR) maps illustrate vegetation health before and after the wildfire

Pre-fire NBR values were mostly high (close to +1), indicating healthy vegetation, whereas post-fire NBR maps show lighter tones across large sections, reflecting extensive vegetation loss in eastern, central, and parts of the western regions (Figure 4).

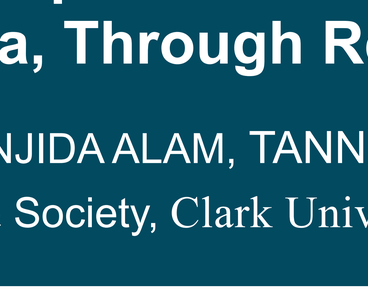


Figure 4: Sentinel-2 Pre-Fire and Post-Fire Normalized Burn Ratio (NBR) of the Pacific Palisades Fire Area

Figure 5: Differenced Normalized Burn Ratio (dNBR) and Burn Severity Maps (Sentinel-2) of the Pacific Palisades Fire Area.

The differenced NBR (dNBR) values range from -2 to 1.63. Higher positive values (up to 1.63) indicate severe burn severity, while lower or negative values show unburned areas or vegetation regrowth (Figure 5). Burn severity classification indicates that a significant portion of the area experienced moderate to high burn severity.

Structural Damage Assessment: The Pacific Palisades fire caused severe damage, mainly in the central and southeastern areas, while the western part was less affected. Many urban neighborhoods in the southeast and south-central regions were heavily damaged or destroyed (Figure 6).

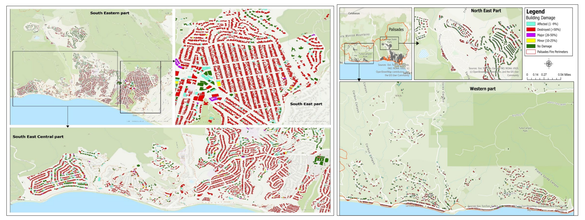


Figure 6: Spatial Distribution of Building Damage from the Pacific Palisades Fire

In total, 6,665 buildings were destroyed, 61 had major damage, 147 had minor damage, 660 were slightly affected, and 2,009 remained undamaged (Figure 7).

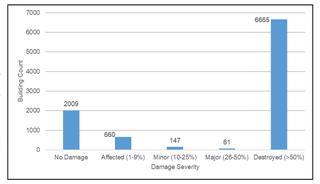


Figure 7: Building Damage Count from Los Angeles Count Palisades Fire Building Dataset.

Damage by Structure Type: This study observed that various structures—such as homes, commercial buildings, schools, and churches—were damaged across the region (Figure 8).

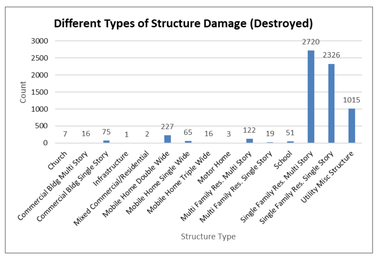


Figure 8: Count of structure types in Los Angeles Count Palisades Fire Building Dataset.

The southern coastal residential areas faced the most destruction, while the western and northern parts had little to no damage. The most affected building types were multi-story single-family homes (2,720), single-story homes (2,326), and utility structures (1,015), with less damage to public and commercial buildings.

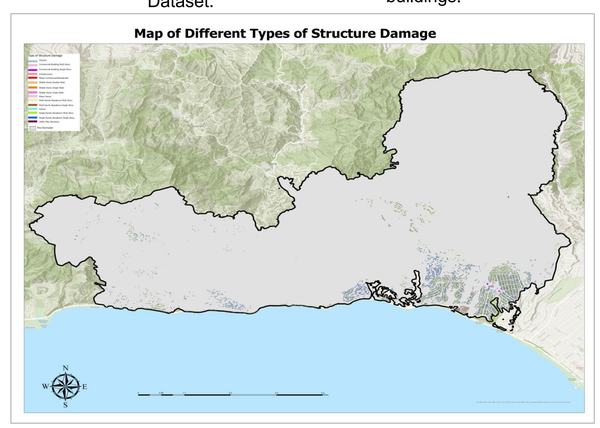


Figure 9: Map of structure types (data from County of Los Angeles)

Limitations

This study relied on Sentinel-2 data and post-fire assessments, which may not capture fine ground variations. Small-scale damages or vegetation recovery might be missed due to spatial limits. Limited field data and updated land-use information could also affect accuracy.

Recommendations

Future studies should combine satellite data with field surveys and high-resolution images to improve damage detection. Using thermal or LiDAR data can better show roof and interior losses. Studying more wildfire events and sharing data among agencies can improve wildfire mapping and preparedness.

Conclusion

This study observed the widespread vegetation loss in eastern, central, and parts of the western regions and structural damage mostly in the central and southeastern areas caused by the 2025 Palisades Fire. Most damaged structures were single-family homes, indicating high residential loss. Overall, the study highlights the value of remote sensing and GIS for wildfire impact assessment and supports their use in future disaster monitoring and recovery planning.

References

1. Castleman, T., Lin II, R.-G., Fry, H., Toohey, G., Winton, R., & Harter, C. (2025, January 9). More than 9,000 structures damaged or destroyed, at least 10 killed in L.A. County fires. Los Angeles Times. https://www.latimes.com/california/story/2025-01-09/palisades-eaton-fires-damage-deaths-los-angeles-county

2. Seydi, S. T. (2025). Assessment of the January 2025 Los Angeles County wildfires: A multi-modal analysis of impact, response, and population exposure. arXiv preprint arXiv:2501.17880. https://doi.org/10.48550/arXiv.2501.17880

3. Thropp, L. (2024, December 4). How do wildfires start? BME Fire Trucks. https://www.bmefire.com/how-do-wildfires-start/

4. Wibbenmeyer, M., & Tastet, A. M. (2021, July 30; updated 2025, March 21). Wildfires in the United States 101: Context and consequences. Resources for the Future. https://www.rff.org/publications/explainers/wildfires-in-the-united-states-101-context-and-consequences/

5. Wikipedia contributors. (2025, April 17). Pacific Palisades, Los Angeles. Wikipedia. https://en.wikipedia.org/wiki/Pacific_Palisades,_Los_Angeles

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