

Comparative Land Cover Analysis and Evaluation of Remote Sensing Tool Accuracy Using GLOBE Observer Photos

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Abstract

The applications of land cover data are numerous, as land cover includes both anthropogenic and natural material, from buildings to bodies of water. Accordingly, land cover change tells the story of a location in many ways because land cover is interconnected with human and animal activity, climate and weather, and natural disasters. Our team collected photos of the land cover in eight locations around the continental United States in order to explore local land cover trends. We compared our field observation photos with several land cover datasets from remote sensing sources, identifying consistencies between datasets and our observations, as well as land cover types where disagreement occurred between sources. Our diverse locations and broad range of land cover types, coupled with additional remote sensing data related to human activity and environmental conditions, appeared well suited to an analysis of the influence of land cover on wildfire risk potential. As a result of our land cover investigation, we seek to answer the question: **How can we utilize artificial intelligence, remote sensing, and land cover data to classify the susceptibility of a region to wildfire spread once one begins, to assist in safety procedures and containment efforts?** Our goal is to create FIRECAST: a Fire Index Risk Estimator using Climate, Anthropogenic, and Soil Trends. This exploratory tool will utilize machine learning to provide timely wildfire risk assessments to aid local communities in resource allocation and preventative measures. Key in development of FIRECAST will be our land cover photos, taken using the GLOBE Observer App, to validate land cover classification. As we continue our research, we hope to incorporate more input datasets, including more social aspects, to improve the accuracy of FIRECAST and ensure greater consistency with established fire risk indices.

Badges

I Work with Satellite Data:

- Compared field observations from GLOBE Observer to land cover tools accessed through Earth Map and generated using data from Sentinel-1/2 and WorldView-4
- Landsat Time Series Explorer satellite images from NASA's Landsat missions used to track land cover change over time

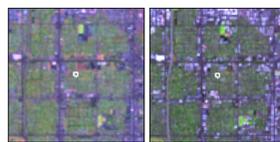


Figure 1: Images of Van Nuys, California in 1985 (left) and 2025 (right). (Landsat Time Series, Google Earth Engine, 1985 and 2025).



Figure 2: GLOBE Observer Photos of Cumming, GA. (author's own work).

I Am a Data Scientist:

- Researchers collected original land cover data through GLOBE Observer observations
- GLOBE Observer photos downloaded from GLOBE Visualization System for comparison with remote sensing tools

I Am a Problem Solver:

- Based on GLOBE Observer photos and remote sensing tool evaluation, we brainstormed an exploratory wildfire index risk estimation tool - FIRECAST
- FIRECAST utilizes machine learning and considers anthropogenic and environmental factors to provide timely risk assessments that will aid local authorities in resource allocation and preventative measures

Methods

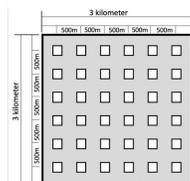


Figure 3: Adopt-a-pixel 3km Method (P. Nelson, n.d.)



Figure 4: 6x6 Sampling Grid (Wp_Admin, n.d.)

GLOBE Observer Land Cover Photos:

- At each AOI point, 6 photos taken
- Up, Down, West, South, East, North
- Photos uploaded to GLOBE Visualization System



Figure 5: GLOBE Observer Land Cover Photos - Up, Down, West, South, East, North (GLOBE Visualization System - <https://vis.globe.gov/GLOBE/>, n.d.)

Adopt-a-pixel 3km Method

- 6x6 grid and centroid point.
- Points spaced 500 meters apart.
- 100x100 meter sampling square at each point.
- 3 km area called "Area of Interest" (AOI).
- Each researcher collected data for their AOI resulting in 8 AOIs spanning the US.



Figure 6: GLOBE Observer App Land Cover Home Page (GLOBE Observer - GLOBE.gov, n.d.)



Figure 7: Researcher AOI locations around the US (Google Maps, n.d.)

Remote Sensing Data from Earth Map:

- Land Cover layers (Sentinel-1/2 data): Dynamic World 10m, ESRI 10m, World Cover 10m.
- Forestry layer (WorldView-4 data): WRI/Meta Global Canopy Height 1m.

Landsat Time Series Explorer and Annual National Land Cover Dataset used to compare land cover over past 41 and 39 years, respectively.



Figure 8: Earth Map data site (Earth Map, n.d.)



Figure 9: Top - Landsat Time Series image chips (Landsat Time Series, Google Earth Engine, 2007-2017). Bottom - Annual National Land Cover Dataset Fractional Impervious Surface images (National Land Cover Database - <https://www.mrlc.gov/>, n.d.)

Results

Land Cover Trends:

- An abundance of vegetation over urban and suburban areas.
- Tree cover spread throughout the grid.
- Small areas of majority-urban land.

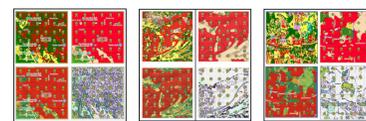


Figure 10: The grid areas of the cases studies of (left to right) Los Altos, CA; San Diego, CA; and Plymouth, MN. (Earth Map, n.d.)



Figure 11: AOI points 22, 23, and 24 in the case study of Cumming, Georgia. The datasets shown are (from left to right) Landsat Time Series, Tree Canopy Meta, World Cover, Dynamic World, and ESRI. (author's own work)



Figure 12: AOI points 19 and 20 in the case study of Houston, Texas. The datasets shown are (from left to right) Landsat Time Series, Tree Canopy Meta, World Cover, Dynamic World, and ESRI. (author's own work)

Discrepancy Examples:

- In Cumming, GA, tree cover is incorrectly represented by World Cover at point 24, and urban land is overrepresented by ESRI and Dynamic World at point 22.
- In Houston, TX, tree cover is not accurately represented by any dataset at point 20.
- The Landsat Time Series images show Los Altos gaining more vegetation, rather than urbanizing.

Discrepancies:

- ESRI and Dynamic World overrepresented urban land.
- Meta Tree Canopy and World Cover overrepresented tree cover.
- In some cases, Landsat Time Series did not accurately reflect community growth.

Discussion

Due to the discrepancies between our data sets, there is likely some error in our findings. However, we were able to identify which of the images were likely to be accurate by comparing them to our GLOBE Observer photos and Collect Earth Online satellite images. We determined that the datasets tended to overrepresent either tree cover or built-up land. This is surprising, since the data sources have the same resolution and are from the same missions. There are different explanations for the discrepancies.

Earth Map Datasets:

- May have different classification criteria.
 - World Cover requires less tree area to classify it as tree cover.
 - ESRI and Dynamic World require fewer buildings to classify land as built-up.
- Resolution (10 meters) may not be high enough for this purpose.
- Obstructions make land cover unclear.

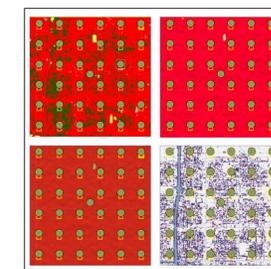


Figure 13: The land cover of the AOI grid of Van Nuys, California using World Cover (top left), ESRI (top right), Dynamic World (bottom left), and Tree Canopy Meta (bottom right). (Earth Map, n.d.)



Figure 14: Images of Los Altos, California in 1985 (left) and 2025 (right). (Landsat Time Series, Google Earth Engine, 1985 and 2025).

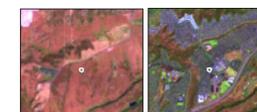


Figure 15: Images of San Diego, California in 1985 (left) and 2025 (right). (Landsat Time Series, Google Earth Engine, 1985 and 2025).

Landsat Time Series:

- The satellite may not have a large enough resolution.
- The trends in urbanization may not have been drastic enough to be visible from such a distance.
 - This may be true since larger trends, such as in San Diego, were very prominent.

GLOBE Observer Photos:

- Inaccessible AOI points led to data loss or land cover photos that were not representative of the desired location
- Issues with photo uploads led to data loss

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 The data that we compiled from these sources is made available in posters for each case study, contained in the following github: <https://github.com/sophia-mercy/inferointelResources.git>

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