# Land Classification and Change Detection using Python

A Project by

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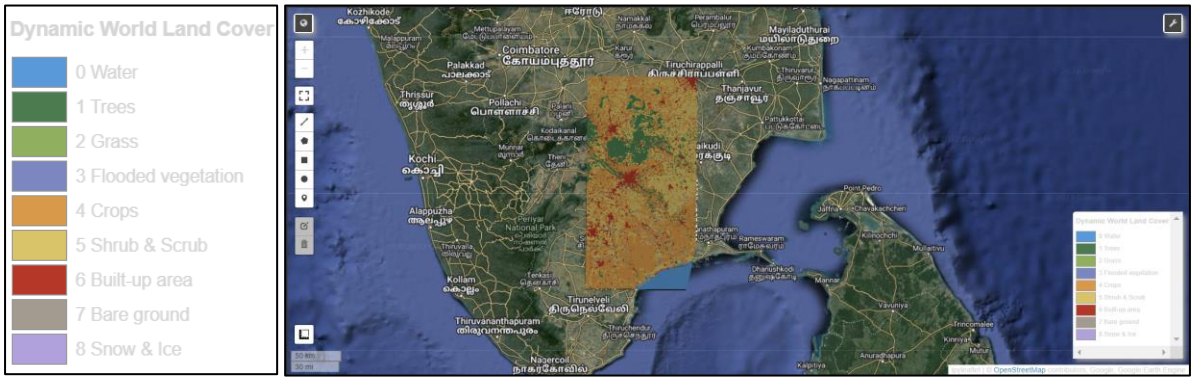
## INTRODUCTION

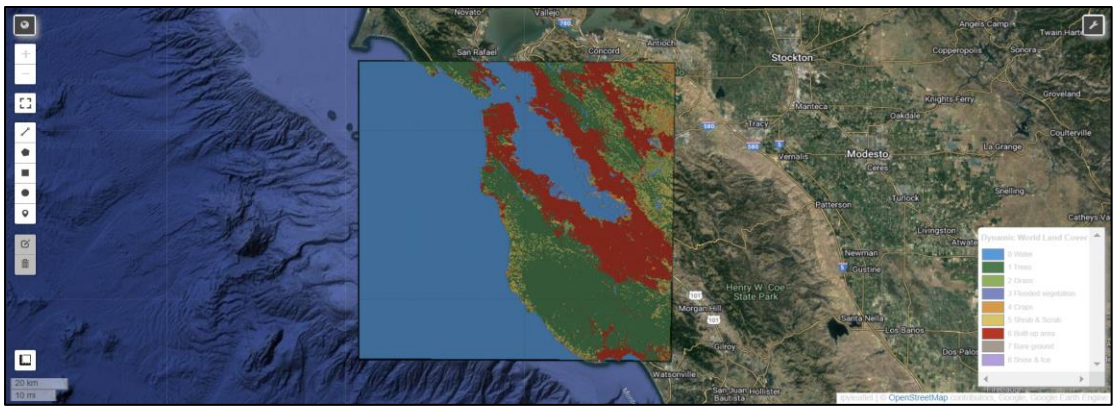
In this Project, we will be creating a Land Classification and Change Detection Model using Python. Geemap and Google Earth Engine are the two main python libraries that we will be using to create the model. We will be using supervised classification techniques for land classification and time series for change detection. This project helps us in tracking the environmental and land changes happening around us. We will also be comparing our classification map to a reference map and we will also be generating a confusion matrix. We will be classifying the Land into 9 main categories: Water, Trees, Grass, Flooded Vegetation, Crops, Shrub/Scrub, Built, Bare and Snow/Ice. This model helps us to monitor several land and environmental changes such as Urbanization, Deforestation, Vegetation Growth, Snow Deposits, etc. And you can monitor the change on a yearly basis. This model works on a global scale and has 10m resolution. We will be using Sentinel-2 Multi-Spectral Instrument, Level-2A Satellite Data for Primary Classification. And we will be using Dynamic World Land Cover Map for Reference.

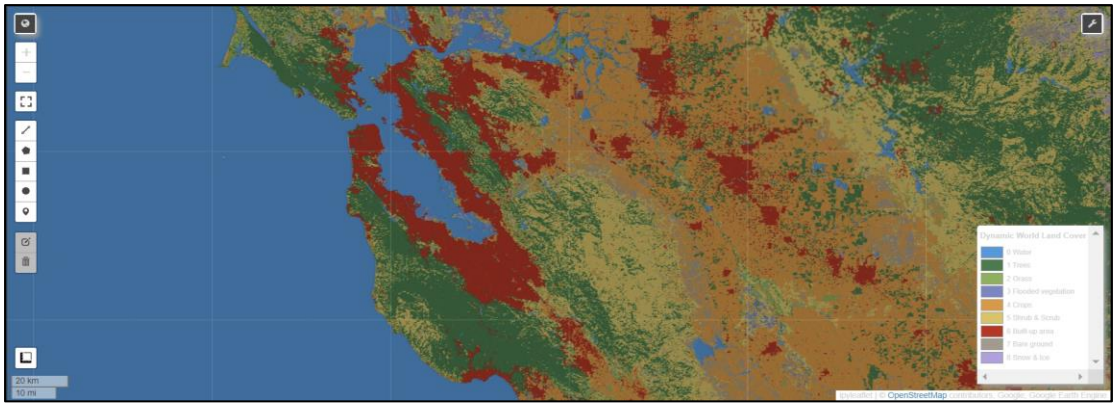
## CLASSIFICATION

For Classification, we will be using Supervised Classification Techniques. We will be classifying the Land into 9 different classes: Water, Trees, Grass, Flooded Vegetation, Crops, Shrub/Scrub, Built, Bare and Snow/Ice. We will first start by creating a Map from Copernicus Sentinel-2 Satellite Image. We will be using B4, B3 and B2 as Visualization Parameter Bands. We will be using Dynamic World Land Cover Map to create Label and to add Legend. Next, we will be creating training Dataset to Train the classifier. While training classifier, Bands from B1 to B7 are used for Prediction. We will be training a CART Classifier with default Parameters. Now, we can classify the image and display the clusters with random colours. Finally, we can render the categorical map with the needed colours and visualize the map with legend. For Reference Map, we can directly import and visualize the image from Dynamic World Land Cover Dataset in Google Earth Engine.




**LABELS / CLASSES** Figure (Above): Classification of Madurai Region in Tamil Nadu, India.



## CHANGE DETECTION

Before Change Detection, we will be comparing the classified map with the reference map. We will be using the functions in geemap to compare the Maps. The Maps can be compared on a yearly basis. Now coming to Change Monitoring and Detection, we will be using the Time Series for it. Dynamic World Time Series in geemap is used here. Add Labels and Legend in the Map. Finally, we can view and compare both the maps on yearly basis. And Detect and Monitor Land Changes.

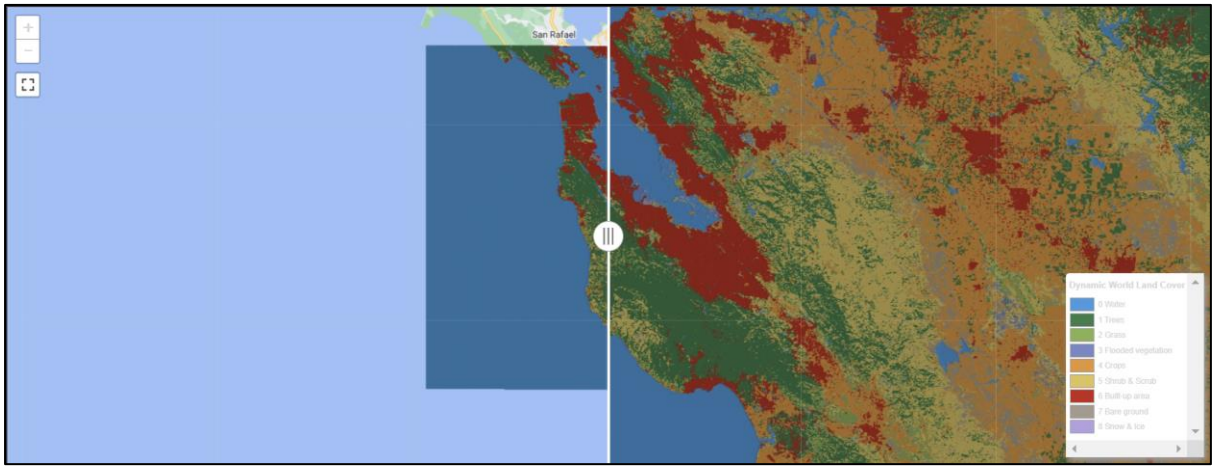



Figure (Above): Comparing the Classified Map with the Reference Map

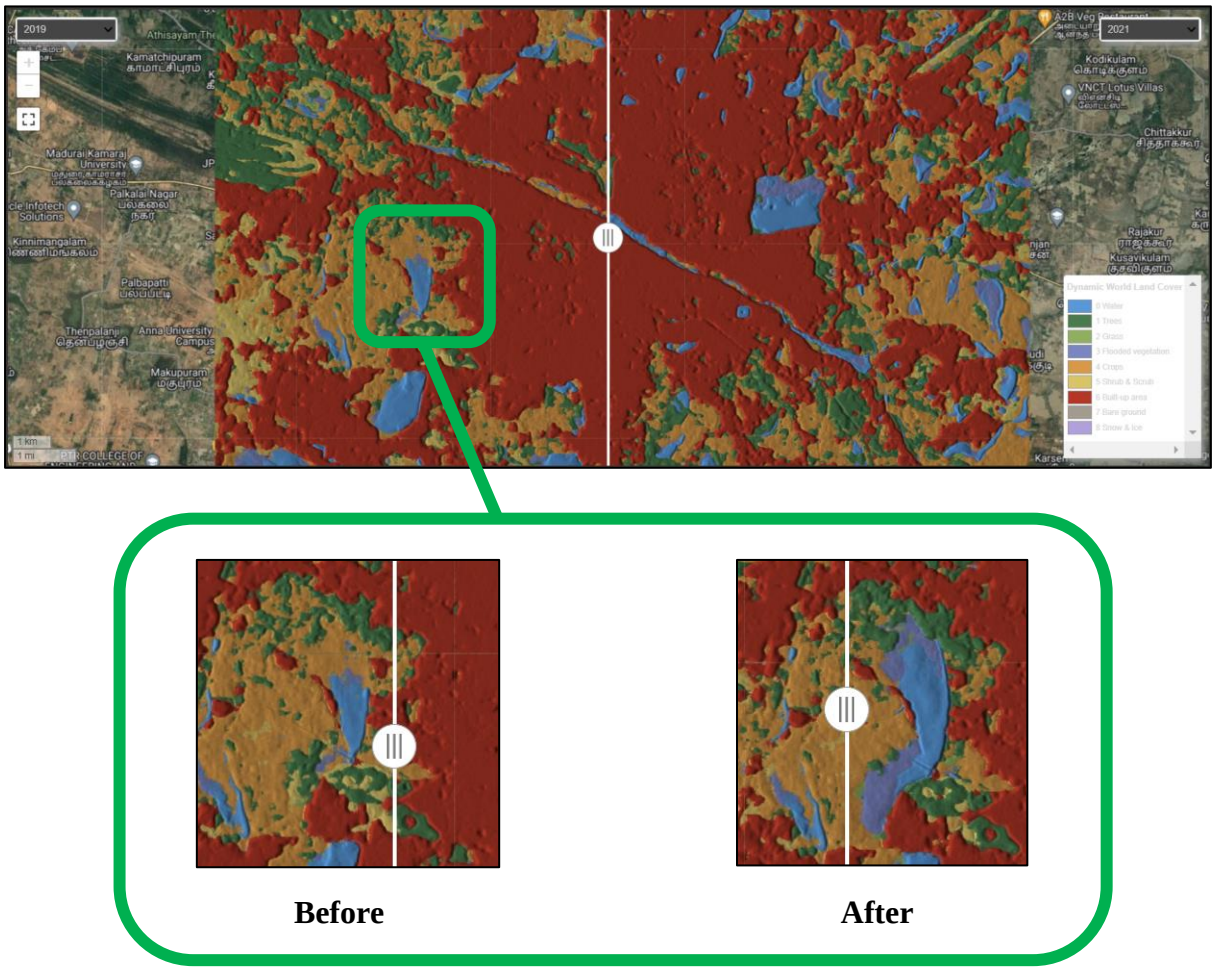
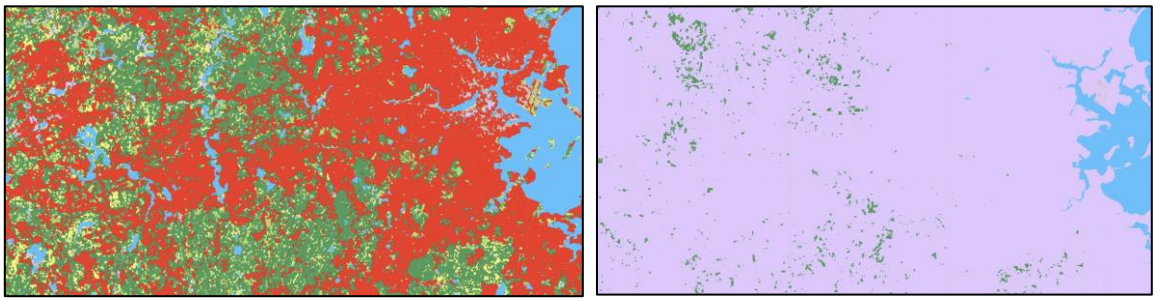



Figure (Above): Change Monitoring and Detection

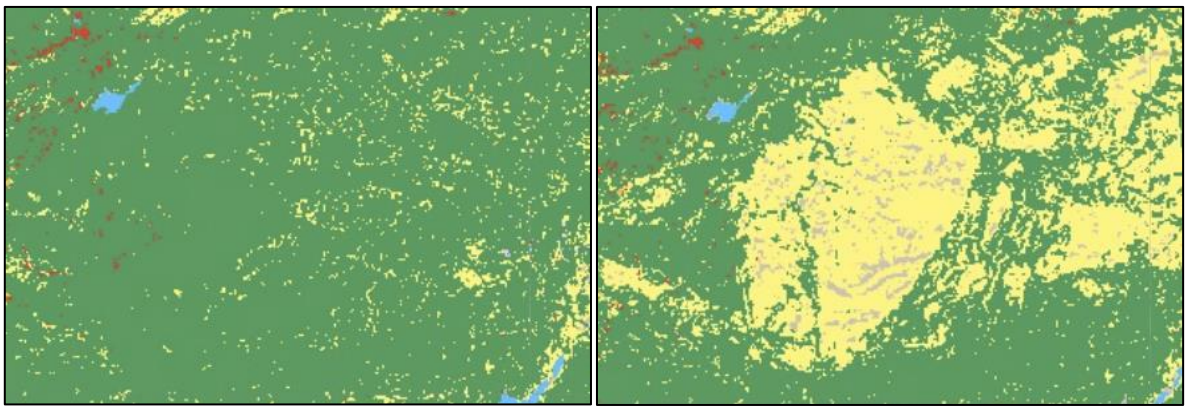
**TEST SITES**

- Snowstorm in Boston, MA, USA from January 2021 to February 2021.



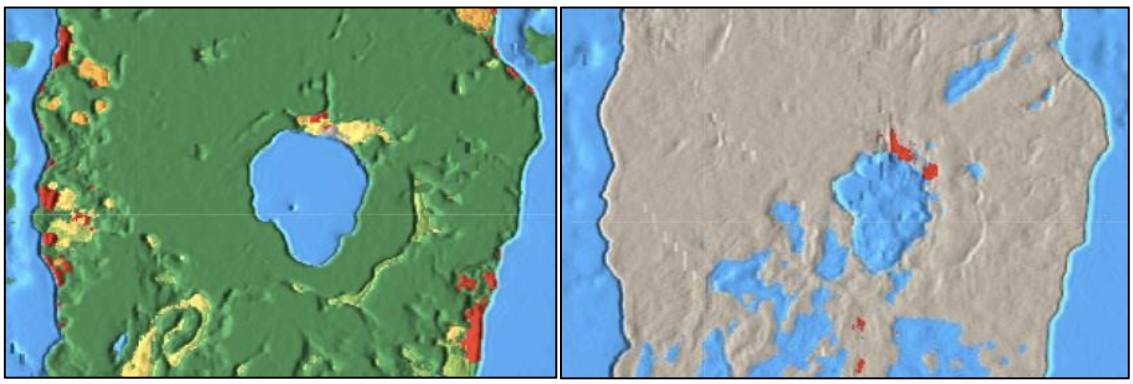
**Before** **After**

- Caldor Fire in California, USA from August 2021 to September 2021.



**Before** **After**

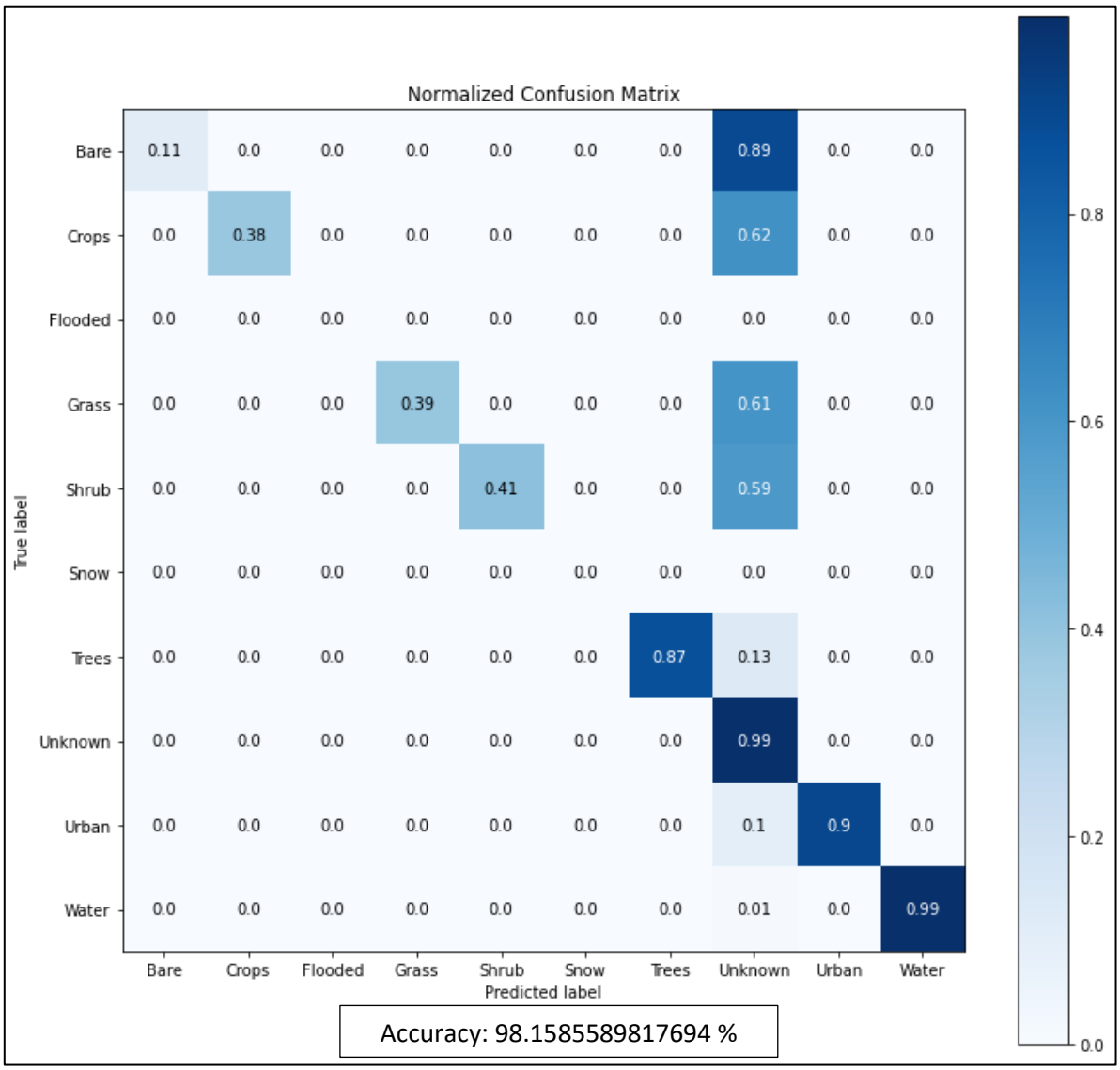
- Volcanic Eruption in Philippines from September 2019 to March 2020.



**Before** **After**

## ANALYSIS AND ACCURACY

We will analyse the accuracy of the model by generating a 10×10 Normalized Confusion Matrix. It consists of an Unknown class that represents the areas that our model failed to classify or detect.




## RESULTS AND CONCLUSIONS

In this Project, we have successfully developed a Land Classification and Change Detection Model using Python. And We also used two main Python Libraries, geemap and Google Earth Engine to create the model. We have successfully classified the Land into 9 different classes using Supervised Classification and we have also successfully created a change detection program using Time Series techniques. At last, we generated a confusion matrix to analyse the accuracy of our model. We have an Accuracy of 98.15 % and there is a lot of scope for improvement. This Project has a great potential and use case in real-time world.

## REFERENCES


- Wu, Q., (2020). geemap: A Python package for interactive mapping with Google Earth Engine. The Journal of Open-Source Software, 5(51), 2305. https://doi.org/10.21105/joss.02305

- Brown, C.F., Brumby, S.P., Guzder-Williams, B. *et al.* Dynamic World, Near real-time global 10 m land use land cover mapping. *Sci Data* 9, 251 (2022). https://doi.org/10.1038/s41597-022-01307-4

- Geemap – Dynamic World https://geemap.org/notebooks/114_dynamic_world/

- Dynamic World App https://dynamicworld.app/


## DATASET USED

- Dynamic World V1

https://developers.google.com/earth-engine/datasets/catalog/GOOGLE_DYNAMICWORLD_V1

- Sentinel-2 MSI: MultiSpectral Instrument, Level-2A

https://developers.google.com/earth-engine/datasets/catalog/COPERNICUS_S2_SR

## CODE

- Full Code – GitHub

https://github.com/schwitaaniyer/Land_Classification_and_Change_Detection

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*This Project was done during my* ***Internship*** *in* ***Indian Institute of Technology - Indore (IIT Indore)*** *under* ***Dr. Unmesh Govind Khati, Assistant Professor, Department of Astronomy, Astrophysics and Space Engineering (DAASE), IIT Indore.***

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