INTEGRATING SATELLITE AND CLOUD TECHNOLOGIES INTO A CUTTING-EDGE MULTI-SOURCE MACHINE LEARNING INTERFACE FOR FOREST RECOVERY

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Introduction

Forest wildfires are transformative agents that alter the composition and structure of ecosystems. In Israel, the frequency of wildfires is increasing annually, driven by changes in land use and climate change. Machine learning and cloud-based platforms offer new opportunities for analyzing large datasets efficiently and predicting post-wildfire vegetation recovery trends.

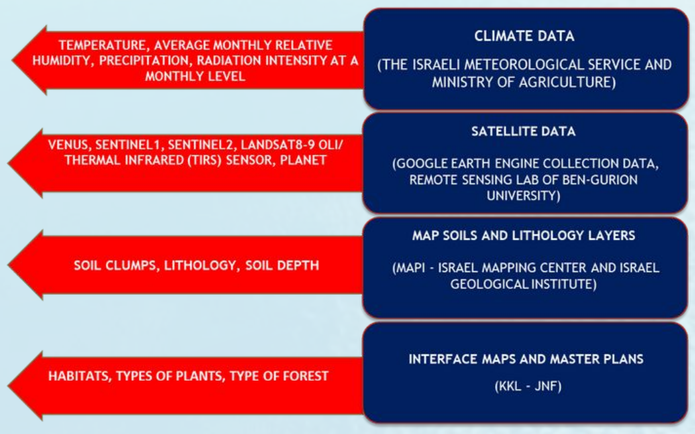
Purpose:

This study aims to develop and evaluate an innovative multi-source remote sensing tool that integrates satellite data, UAV imagery, climate data, and machine learning algorithms for assessing forest recovery after wildfires. The goal is to create a comprehensive monitoring approach for vegetation recovery and support forest management and rehabilitation efforts.

Methodology

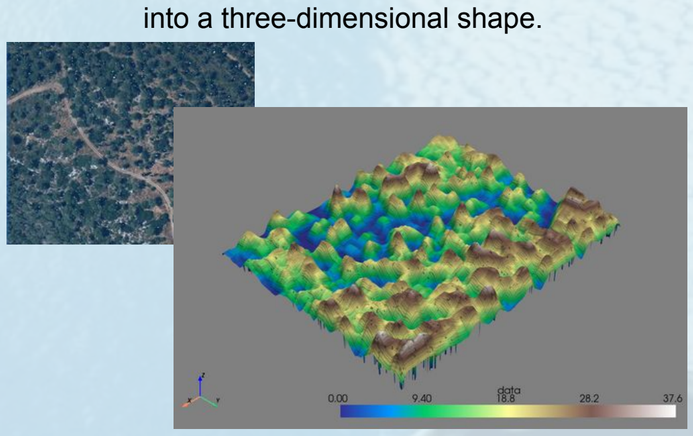
The study examines three wildfire-affected forest regions: Carmel, Birya, and Kdoshim Forests. Satellite, UAV, and climate data were collected and processed using a Python-based computational interface. The tool applies machine learning to predict vegetation recovery trends, generating thematic maps for vegetation development.

Data diagram



Biomass estimation

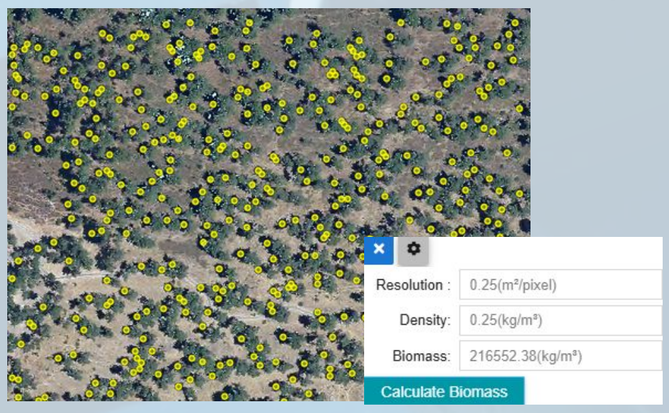
A unique model has been developed that allows biomass to be calculated by transforming the image into a three-dimensional shape.



Three-dimensional biomass map

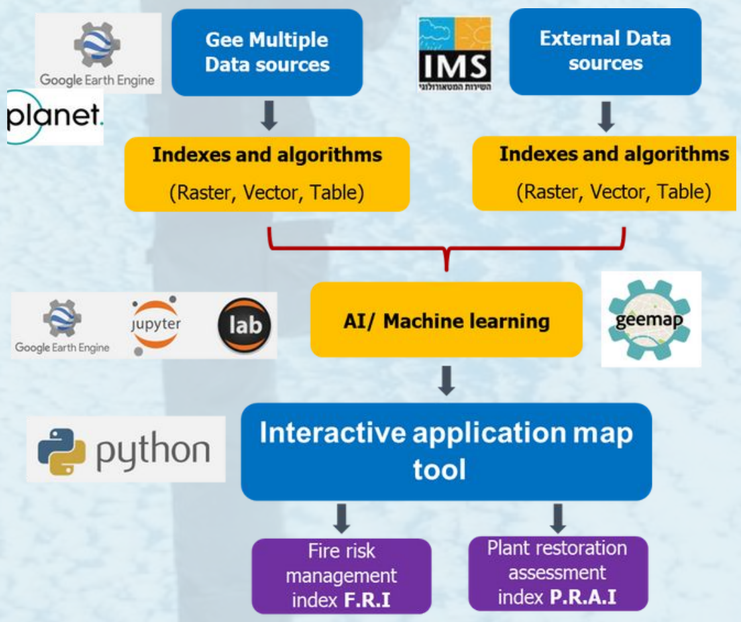
Trees count and density

The developed models allow counting the number of trees and calculating their density.



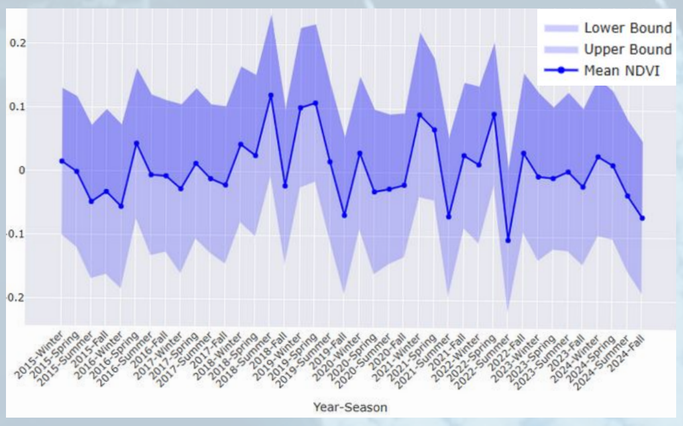
Trees density and count

General Diagram



Recovering temporal trends

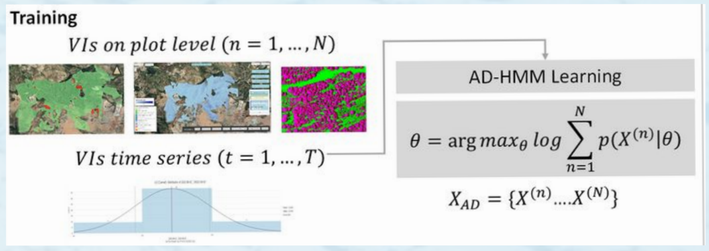
Temporal grow trends are recovered from indexes, and used in machine learning and predictions.



Temporal predicted standard deviation index values

Hidden Markov Prediction Model

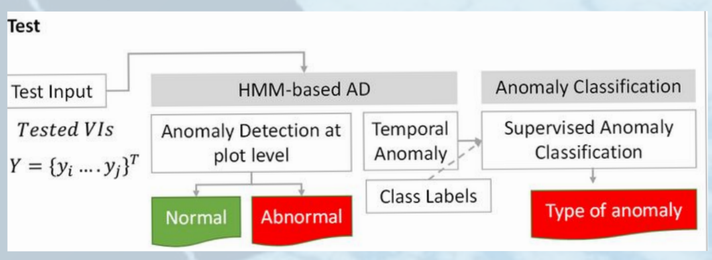
Stochastic process "Hidden Markov" model suitable for time series analysis according to time series for remote sensing data and supporting data (climate data, soil maps, lithology layers).



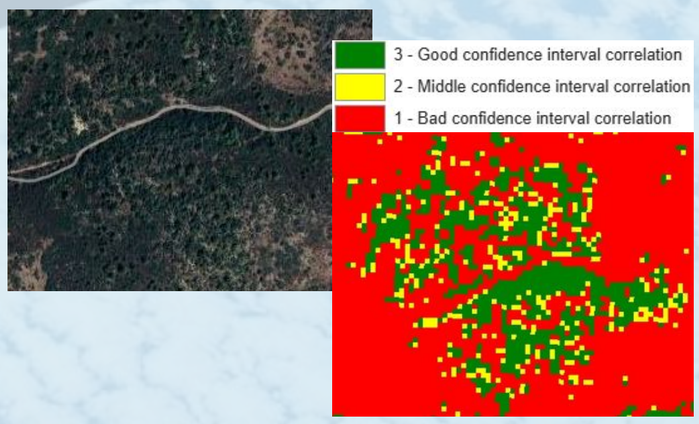
Prediction diagram

Supervised Classification

Performing supervised classification (Unmixing) by transforming indexes into one image bands and using predicted standard deviations as labels.



Classification map



Confidence interval correlation applied by supervised classification

Scientific Excellence and Innovation

This research contributes to scientific advancement by introducing a cutting-edge remote sensing tool that integrates satellite data, UAV imagery, and climate data with machine learning algorithms. The innovation lies in the development of an open-source, cloud-based interface that can process large datasets in real-time, producing accurate predictions about vegetation recovery. The tool's ability to integrate multiple data sources in a user-friendly manner sets it apart from traditional methods and opens the door for scalable applications in environmental monitoring, disaster response, and forest management.

Conclusion

This adaptive remote sensing interface, built using open-source cloud-based technology, generates maps that depict vegetation indices and soil conditions. It supports tree counting, biomass estimation, and vegetation growth prediction. The tool demonstrates innovative performance in integrating diverse data sources, applying machine learning for recovery prediction, and providing valuable insights for KKL's forest management.

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