Precision Mapping for Pest Identification in Mediterranean Pine Forest. Case study: Pine Processionary

by **ALEXANDROS THEOFANIDIS**

Cartography tools support the environmental efficient monitoring, management, protection, and conservation. In recent decades, the civil use of light platforms Unmanned Aerial Vehicles (UAVs), miniaturized sensors, new satellite missions, are providing us with high resolution imagery in very short time.

With the use of UAVs, we expect to increase the accuracy of the nest locations and create maps that illustrate pest breakouts so that the user has the ability to have a quick access to important information related to the behavior and the preferences of the Pine Processionary Moth (PPM).

OBJECTIVE

The main object of this thesis is to better understand how trees and Pine Processionary Moth (PPM) nests can be visualized for the development of web based application.

BACKGROUNG

The graphic dimensions across which a map or other visualization can be varied to encode information are referred as visual variables (Roth, 2017).

The main idea is to better understand what impact do some of the visual variables have on user's eyes and which can better deliver the message of a threat through maps.

METHODOLOGY

The methodology comprised six main stages presented in Fig. 1:

1. Airborne imagery
2. Multispectral UAV imagery
3. Image classification
4. PPM Nest location
5. Visualizing Trees and PPM Nests
6. User study

High resolution multispectral imagery data obtained with the use of UAVs in order to be able to identify PPM nests on infested trees.

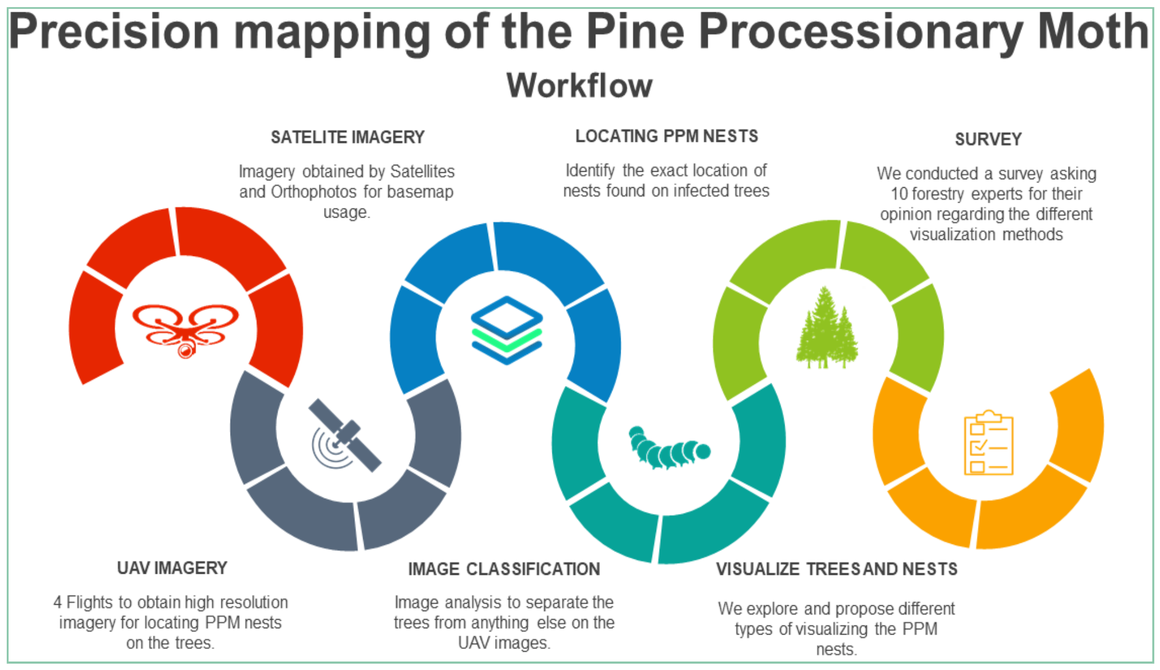

Fig. 1. The workflow of the methodology

VEGETATION INDICES

Vegetation indices are a remote sensing tool for identifying vegetation and measuring its health and vitality (Buczkowski, 2015).

Multispectral imagery compared to RGB imagery gave us the possibility to apply the Normalized Difference Vegetation Index and separate trees among the images (Fig. 2,) that were acquired with the use of the UAV.

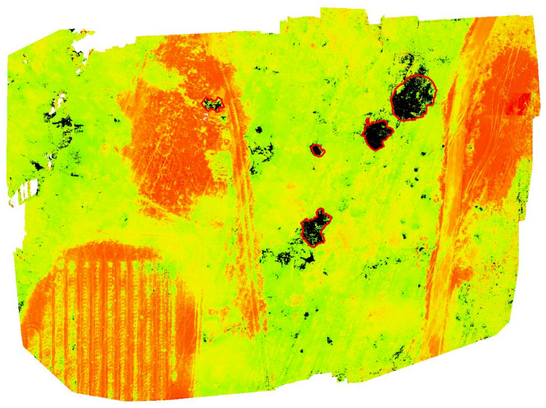

Fig. 2. NDVI Raster file. Black areas indicate high values of the NDVI Index that interpreted as healthy vegetation

PROTOTYPE

Diffrent visualisation methods were proposed to visualize infested trees and PPM nests on them (Fig.3) and a user study was contucted as questionnaire that was based on static screenshots of the prototype of the proposed visualization methods we proposed to 10 forestry experts.

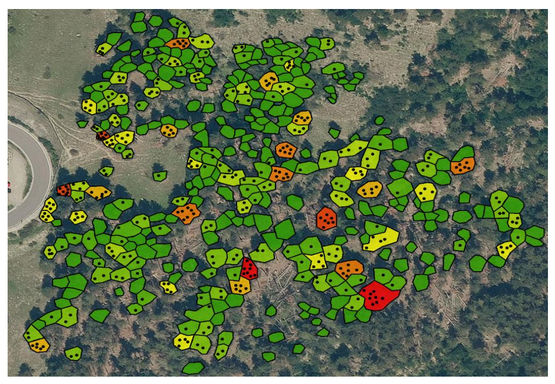

Fig. 3. Proposed visualization method of trees and PPM nests

RESULTS

Trees are better described as entities on maps by using polygons filled with colors that indicate their health condition. The representation of nests is efficient when dot used be efficient as red dots. Graduated symbol gave positive results on how users perceive the size of the symbol.

CONCLUSIONS

The user study produced positive results and gave ideas on which of the methods of the prototype better describes a critical situation for forest protection purposes. Forest rangers and scientists need high maps that show the exact location of the PPM nests with high accuracy. With proper visualization, they are able to make decision quickly regarding pest control and management. As a result, cartography contributes by making their mission more efficient, with less effort and with reduced cost as less ground controls are required.

THESIS CONDUCTED AT

Chair of Cartography Department of Aerospace and Geodesy
Techn0ische Universität München

Technische Universität München

THESIS ASSESSMENT BOARD

Chair Professor: Prof. Dr. Liqiu Meng, TUM

1st Supervisor: Dr.-Ing. Holger Kumke (TUM)

2nd Supervisor: Dr. Mejia Aguilar Abraham (Eurac Research)

Reviewer: Dr. Paulo Raposo (UT-ITC)

YEAR

2022

KEYWORDS

UAV, Visualizing Decision Making Map Layers, Pine Processionary Moth

REFERENCES

[1] Roth, R. E. (2017). Visual variables. International Encyclopedia of Geography: People, the Earth, Environment and Technology, 1–11.

[2] Buczkowski, A. (2015). *Beyond NDVI: What are vegetation indices, and how are they used in precision farming?* Geoawesomeness. https://geoawesomeness.com/eo-hub/beyond-ndvi-what-are-vegetation-indices-and-how-are-they-used-in-precision-farming/

This master thesis was created within the Cartography M.Sc. programme – proudly co-funded by the Erasmus+ Programme of the European Union.

Technische Universität München · TECHNISCHE UNIVERSITÄT WIEN · TECHNISCHE UNIVERSITÄT DRESDEN · ITC UNIVERSITY OF TWENTE. · Erasmus+ · cartographymaster.eu