# Land Use & Land Cover Mapping

## *Introduction*

Climate change will cause more variable and intense rainfall and temperatures in the Mediterranean, increasing the frequency of wildfires and their intensity (Rovithakis et al., 2022). Land use and land cover (LULC) mapping will be helpful in monitoring the progression of wildfires in this region of the Peloponnese. Land use change reduces the resilience of forests to fire (Rovithakis et al., 2022) due to increased fragmentation (Pueyo and Alados, 2006). This also has implications of erosion, as mass removals of vegetation, which stabilise soils, increase runoff erosion intensity. This increased erosion risk is also paired with increased flood risk (Evelpidou et al., 2021).

This area of the Peloponnese consists of roads, urban structures, such as barns and buildings, a man-made body of water, grass, bare soil and cropping land. The Peloponnese region is especially at risk for erosion, as the soil loss is naturally high (Evelpidou et al., 2021). It has a Mediterranean climate with dry, hot summers and mild winters.

## *Methods*

This analysis uses data from the Copernicus Program, which uses the Sentinel satellites. It collects samples at a 5 day frequency on 13 bands. The visible bands are collected at a 10m resolution. The data ranges from March 2017 to present. This analysis is conducted on data ranging from 2020-06-22 to 2020-08-26.

The unsupervised k-means clustering was conducted on Google Earth Engine with 15 clusters. It was then manually re-assigned to fall into the six categories visible in the RGB image (water, bare soil, forest, cropping, grass and urban).

## *Results*

This region of the Peloponnese is largely natural forests and agricultural area. This section contains a man-made water structure in the bottom right corner. There is a small cluster of urbanisation in the top right corner. The left hand side is dominated by forests. The center of the rectangular snippet is cropping land, pasture or bare soil.

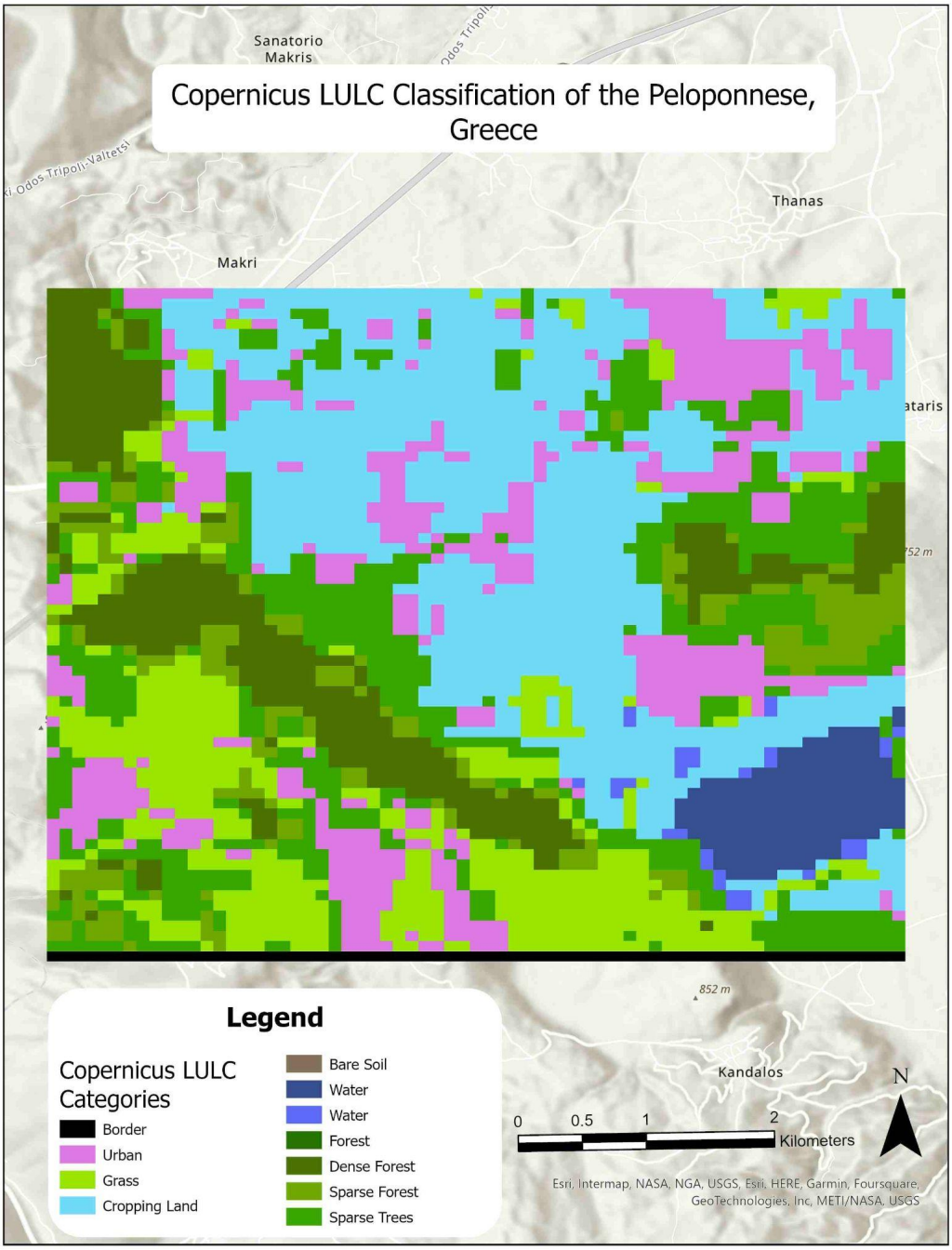


***Figure 1:*** Land use and land cover map for this section of the Peloponnese, Greece, constructed using existing Copernicus Sentinel Data

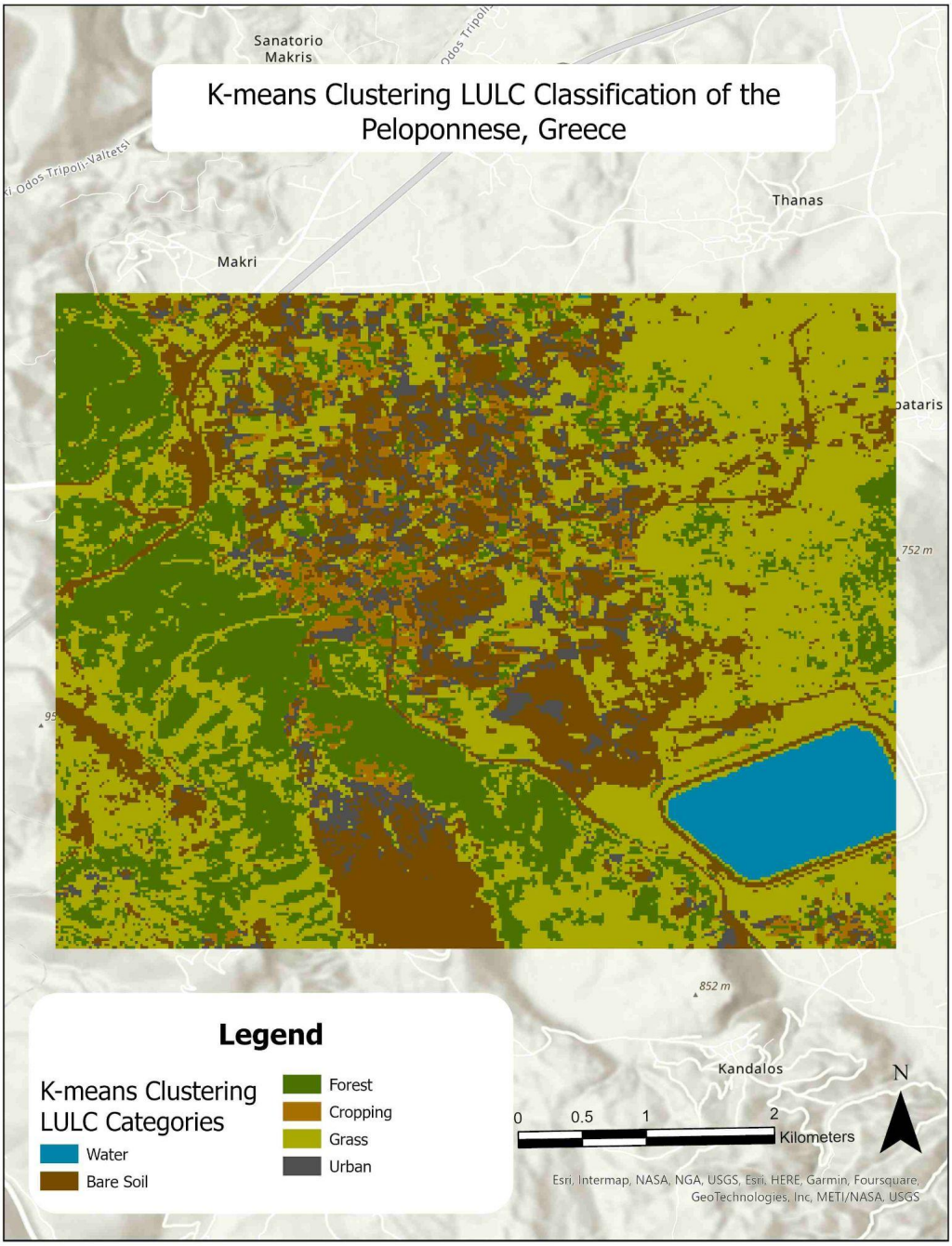


***Figure 2:*** Land use and land cover map for this section of the Peloponnese, Greece, constructed using k-means clustering (k=15) in Google Earth Engine.

***Table 1:*** Land use and Land Cover Area for k-means Clustering Method

| Category | Area ($m^2$) |
|---|---|
| Water | 122.23 |
| Bare Soil | 616.54 |
| Forest | 560.96 |
| Cropping | 180.39 |
| Grass | 1070.08 |
| Urban | 105.71 |

***Table 2:*** Land use and Land Cover Area for Copernicus Sentinel Data

| Category | Area ($m^2$) |
|---|---|
| Urban | 95.53 |
| Grass | 473.87 |
| Cropping Land | 738.23 |
| Bare Soil | 20.93 |
| Water | 107.82 |
| Forest | 302.86 |
| Dense Forest | 393.27 |
| Sparse Forest | 102.82 |
| Sparse Trees | 416.53 |

### *Discussion & Conclusions*

The LULC maps are similar in terms of general patterns but have many differences. The k-means clustering map is better as it has a better resolution and is able to be manually scrutinised and modified (both in terms of the number of clusters as well as during the reassigning process. They both have a similar area for the water and urban areas, but vary for all other categories. The Copernicus classification failed to identify areas of bare soil and was more likely to classify areas as forest rather than grass.

There are differences between the maps as they use different methods. The Sentinel-2 classification is done using deep learning AI, which is supervised. The Google Earth Engine classification was done using k-means clustering, which was unsupervised. The k-means clustering is also more likely to be biased on the Peloponnese area as that was the area it was trained on. The deep learning networks would have been trained on worldwide samples.

Upon visual inspection, the k-means clustering map is better as it is more accurate and has better resolution. Additionally, the process allows for tuning to discern how many clusters are necessary to best differentiate between land uses and covers. This LULC map can be improved by further increasing clusters and conducting ground truthing.

## *References*

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