GLOBE Estonia Learning Expedition

Land cover and biometry measurements

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Abstract

In our study of land cover and biometry measurements, we observed the land cover and collected data from two different sites near Varemurru, Pärnu county, Estonia. Field measurements were carried out on August 6-9, 2022. Main goals for this expedition were the following: to compare Sentinel-2 satellite images (made available by Estonian Land Board) with real on-the-ground conditions, test GLOBE Data Entry App, test new Data Sheets and determine the area's MUC code using MUC field guide.

We decided to compare two 30x30 meter areas in two different locations - one at the seaside and one in a pine-dominant forest (*Pinus Sylvestris*). On these sites, we proceeded to make different measurements, i.e. calculate tree canopy cover, determine MUC code and collect other necessary data (dominant species, etc.).

Before the study on chosen sites, two research questions and hypotheses were placed:

1. Are the dominant plants growing in our research area in correlation with the species mentioned in the MUC field guide?
2. Do the measurements made in the forest overlap with a different expedition group observing the exact same area?

Hypothesis no. 1: The dominant plant species on our selected sites are typical for the area and are in correlation with the MUC field guide.

Hypothesis no. 2: Measurements made by us overlap with the measurements made by the other group in the same exact site.

Why is it important to compare satellite data with real conditions on the ground?

The Earth's ground on satellite images is often unseen because of heavy and excessive cloud cover. This problem gets more serious especially when observing higher latitudes. Various agricultural and anthropological "patterns" could also lead to misinterpreting the actual situation regarding vegetation on the land. That is why *in situ* observations are valuable - they support the data collected via satellite images as well as increase confidence in decision-making when using remote sensing tools.

30x30 meters is the "real-life" size of a pixel, when measured on the ground. This type of pixel size is common for images made for civilian purposes. Below, on Figures 1 and 2 are two satellite images from Pärnu bay (Estonia), taken on two different dates, July 31 and September 26, 2021 accordingly.

On Figure 1, the satellite image has heavy cloud coverage and therefore cannot be used for exact land cover determination. However, on the second one (Figure 2) different types of land cover can be detected at quite a high level of accuracy. One could easily detect and differentiate between water, agricultural land, wetland, forests and anthropological sites (e.g. cities and infrastructure).

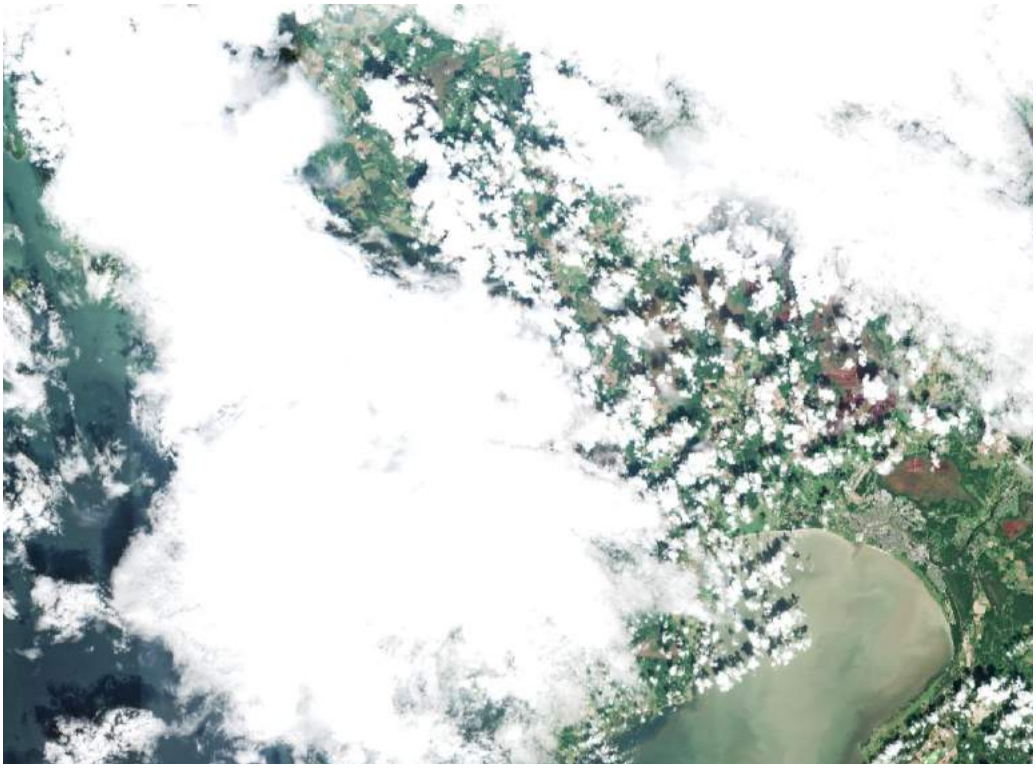

Figure 1. 31.07.2021 Sentinel-2 over the Pärnu bay area with heavy *Cumulus* and *Stratocumulus* clouds. (Source: Estonian Land Board)

Figure 2. 26.09.2021 Sentinel-2 over the Pärnu bay area with virtually no clouds (scattered). (Source: Estonian Land Board).

Methodology

For data collection, two 30x30 meter squares were measured in two different locations marking the size of one pixel of a standard satellite image. Both selected sites are near Varemurru, Pärnu county, the first being near the beach and the second one in the woods. A 100-meter long measuring tape was used for this action.

In both areas, we used the MUC field guide to find and determine the ground cover's MUC code. In addition, other measurements were made: canopy and ground coverage measurements and determining dominant plant species. Canopy coverage was calculated, using a densiometer on 21.2m long diagonal transects (see Figure 3, below) and clinometer for estimating tree height.

To carry out plant identification for plants growing in the limited 30x30 meter area, two plant identification guides were used: *Eesti taimede kukeaabits* (Kukk, 2015) and *Eesti taimede määraja* (Krall et al., 2010). In the case of the forest site, dominant tree height and tree circumference measurements were done (see Figure 4). All collected data was logged first on Globe Data Sheets and then inserted in the Globe Data Entry app. Especially for the digital data entry, photos of the measured sites from every arc (North, South, East, West) as well as upwards and downwards were taken and then uploaded.

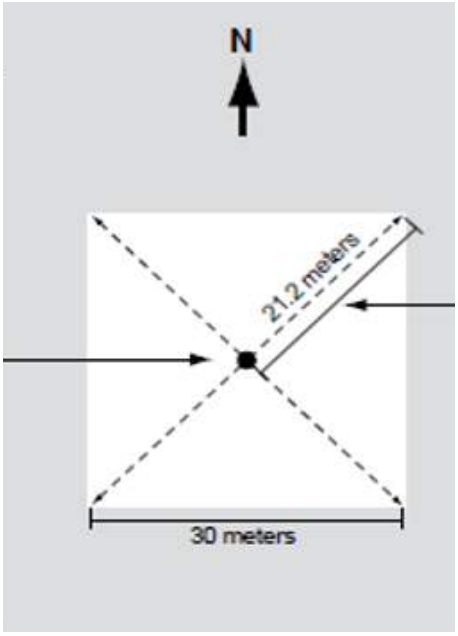

Figure 3. Scheme of a 30x30m area with 21.2m diagonals used for canopy cover measurements. (Source: globe.gov)

Figure 4. Marking down the 30m boundary; Measuring tree circumference.

Site 1 - Beach

The first site for carrying out fieldwork and ground cover measurements was located 20 from the Baltic Sea (see Figure 5, below) and on the following coordinates: N 58.374961° E 23.734063°. It's MUC code was 4320, which describes it as a flood meadow with few trees. Elevation from the sea level was 3m. Figure 6 (below) is a view of the site when facing West.

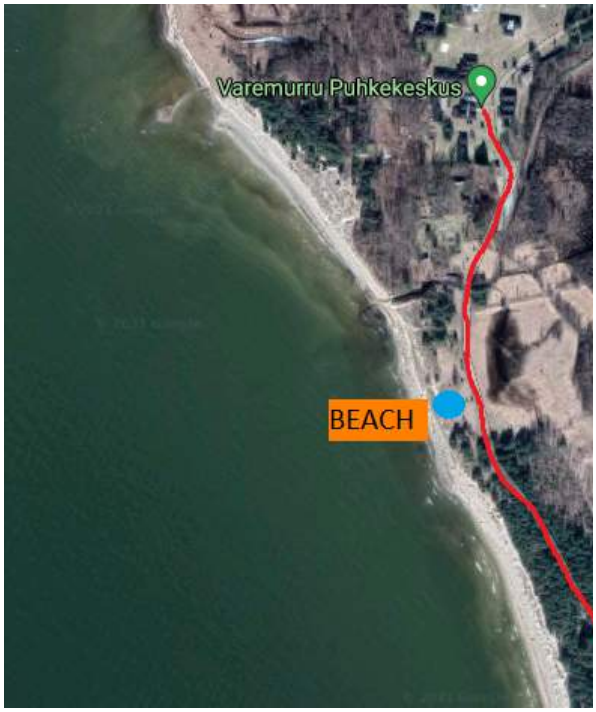

Figure 5. Site no. 1 (marked as blue) and the path to 1st site to 2nd (marked as red).

Figure 6. Site no. 1. Beach site, view to the West.

The dominant species (N=15) found on the beach site were:

Rumex thyrsiflorus, thyrse sorrel.
Festuca pratensis, meadow fescue.
Achillea millefolium, yarrow.
Malus sylvestris, European crab apple.
Lathyrus, fetchlings.
Cirsium arvense, creeping thistle.
Convolvulus arvensis, field bindweed.
Trifolium pratense, red clover.
Calystegia sepium, hedge bindweed.
Phleum phleoides, Boehmer's cat's-tail.
Betula pendula, silver birch
Juniperus communis, common juniper
Pinus sylvestris, Scotch pine,
Picea abies, European spruce
Veronica spicata, spiked speedwell

Site 2 - Woodland

The second site was located on the coordinates: N 58.372016° E 23.737736° and described as a pine forest grown on a sand dune, which lies approximately 9m above the sea level. MUC code was determined to be 1121.

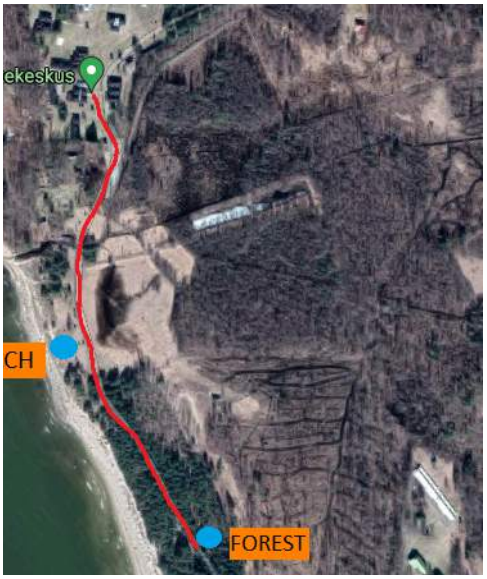

Figure 7 (left) and 8 (right). 7 - Site no. 2. (labelled); 8 - View to West.

The dominant species (N=19) on the woodland site were:

Dryopteris expansa, spreading wood fern
Ribes alpinum, mountain currant
Quercus robur, common oak
Acer platanoides, Norway maple
Rubus idaeus, raspberry
Prunus padus, bird cherry
Corylus avellana, common hazel
Melampyrum pratense, common cow-wheat
Convallaria majalis, lily of the valley
Frangula alnus, alder buckthorn
Filipendula vulgaris, dropwort
Urtica dioica, stinging nettle
Lonicera, honeysuckle
Trifolium montanum, mountain clover
Hylocomium splendens, glittering wood moss
Veronica spicata, spiked speedwell
Galium verum, yellow bedstraw
Trientalis europaea, Arctic starflower
Melampyrum pratense, cow wheat

Results

We compared our results about MUC code, land and canopy coverage as well as tree height and circumference from site 2 (woodland) with the other team that also measured the land cover there. Team 1 stands for our team and team 2 stands for the other team. All results can be seen in the table below (see Table 1).

Table 1. Measurement comparison of the woodland site (site 2) with team 2.

	Team 1	Team 2
MUC code	1121	1121
Land coverage (%)	71	75
Canopy coverage (%)	69	75
Avg. tree circumference (cm)	105.1	143.33
Average tree height (m)	16.44	17.9

Discussion

In this chapter, both teams' results are taken into account when describing the sites. From the results we learned that the plant species on our selected sites are typical in the area and therefore our identifications were correct. Trees in the woodland are not higher than 18 meters and their average circumference is between 105 -143cm. Canopy coverage stayed between 69-75 per cent and land vegetation coverage 71-75 per cent. Data shows that woodland is more than 50% covered with trees and therefore both teams got the same MUC code - 1121.

The biggest difference when comparing data from both groups, stands out when studying the average tree circumference data. Possible measurement mistakes that could have led to such different results: 1) we chose trees of different diameters as no particular tree was pointed out to carry out the measurements; 2) we took the directions of the arc in different ways.

The first hypothesis proved to be correct because the dominant plant species are common for the West coast of Estonia and correspond with the MUC code descriptions. The second hypothesis was mostly correct because the measurements were within the acceptable differences, except the slight difference in tree circumference.

Figure 9. Group photo.

References

Estonian Land Board. Satellite Image Depository. https://geoportaal.maaamet.ee/est/Satiladu-p733.html

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