National Forest Inventory in Slovenia (history and current design)

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SLOVENIAN FORESTRY INSTITUTE

Ljubljana, 23.4.2024

FOREST INVENOTY IN SLOVENIA – POINT SAMPLING

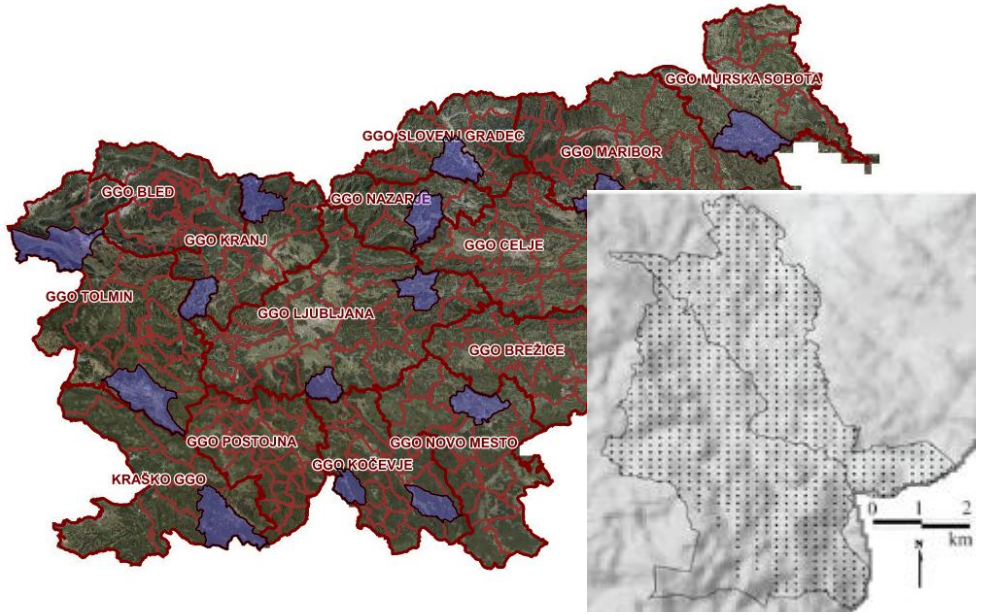
Two separate systems:

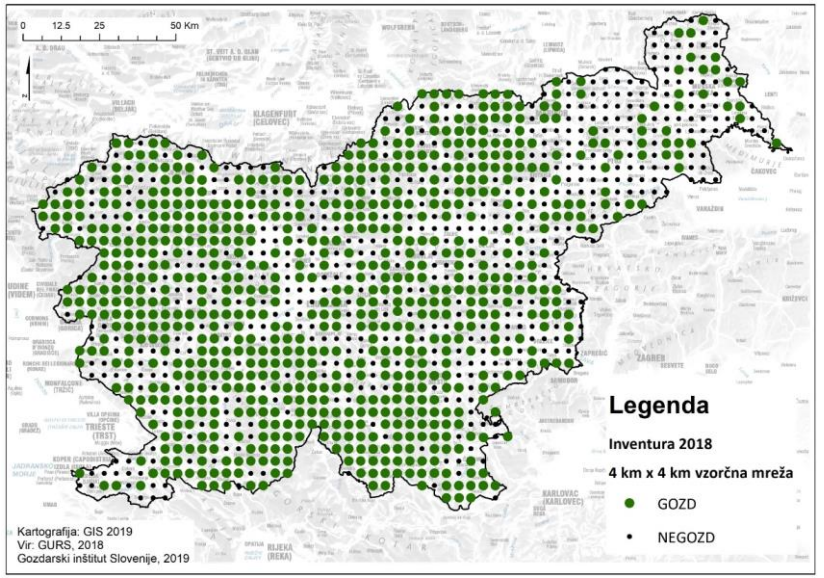
1. forest inventories for forest management (iGGN)

updates information on the state of forests in 1/10 forest management units (SFS)

2. national forest inventories (NGI or MGGE in our case).

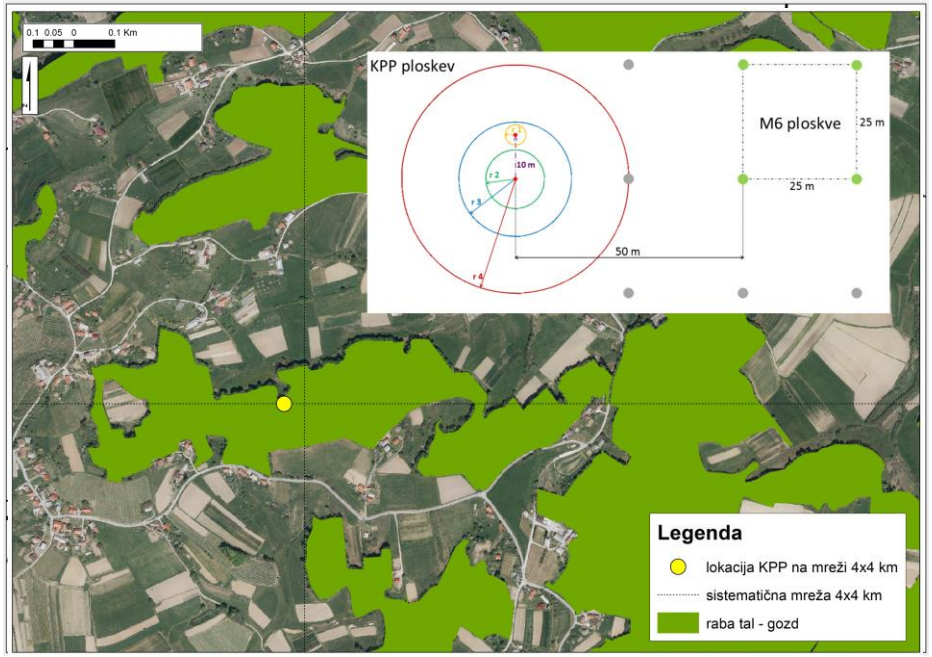
Data for national and international reporting on the state and development of forests (FORESTRY POLICY).





HISTORY OF LARGE-SCALE FOREST INVENOTY IN SLOVENIA

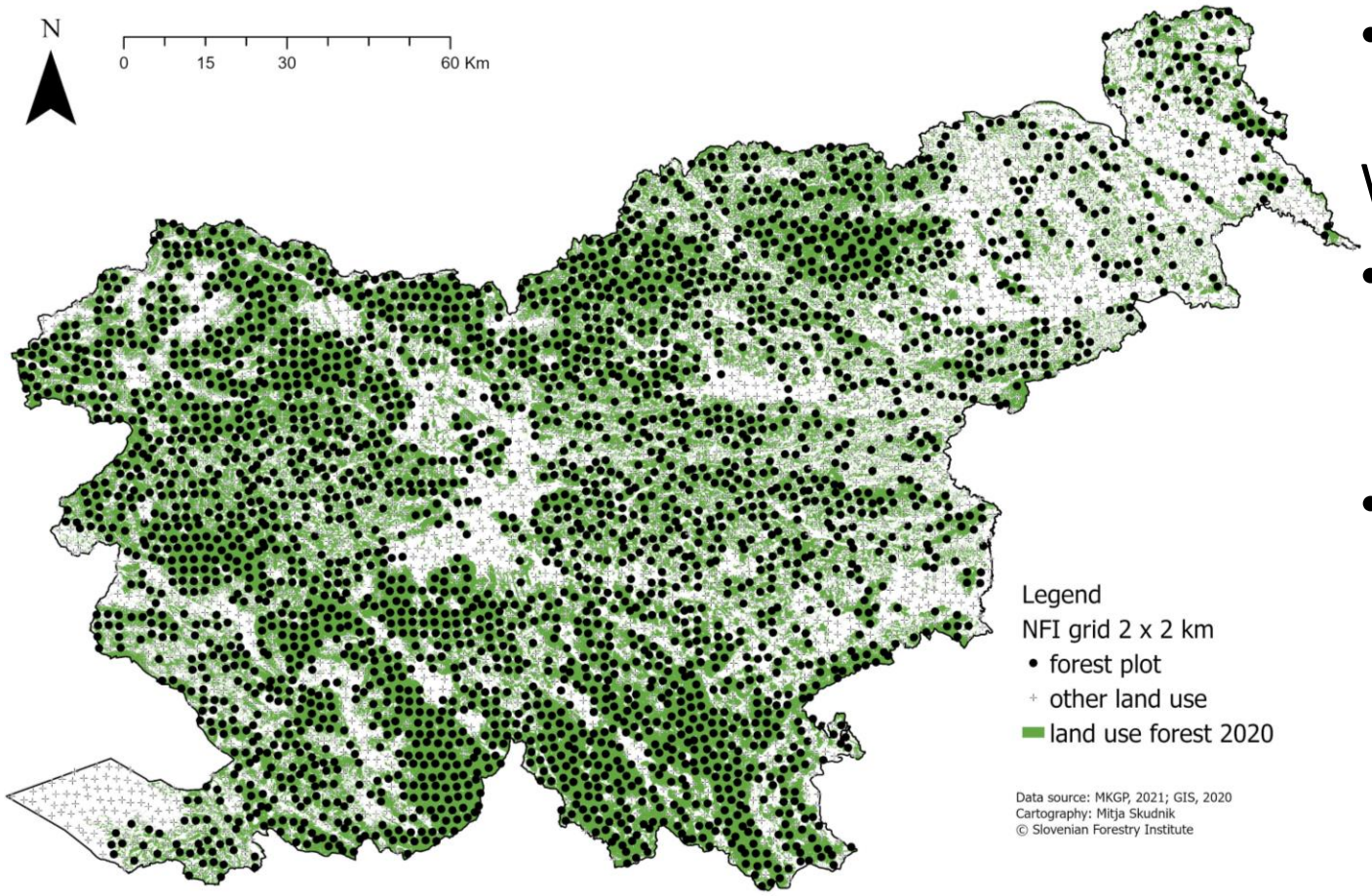
- Start in year 2000 (Forest and Forest Ecosystem Condition Survey)
- Sampling: centric systematic sampling on grid 4 km x 4 km
- Plots remeasured in years 2007, 2012 and 2018 (plan 2024)
- 2020 new sampling design -> NFI



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Large-scale FI																										

Pdf available on:
http://eprints.gozdis.si/566/

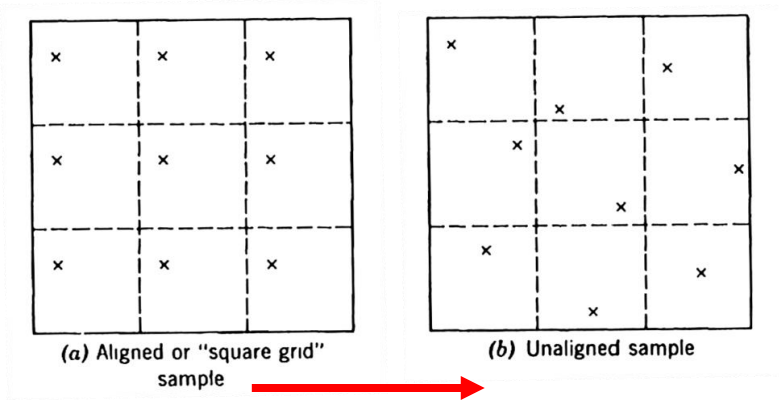
NEW SAMPLING DESIGN in 2020



- Unaligned systematic sampling (USS)
- Sampling density 2 km x 2km

WHY USS?

- USS identified as the most precise sampling design under the assumption of common types of spatial correlation
- increased precision in case of periodicities



Cochran W. G., 1977

ORGANISATION OF NFI SINCE 2020

- Interpenetrating panel system
- Yearly panel on grid 4 km x 4 km (1/4 of plots on grid 2 km x 2 km)
- 5-year inventory cycle

2020 – NFI panel 1 (cycle 1)

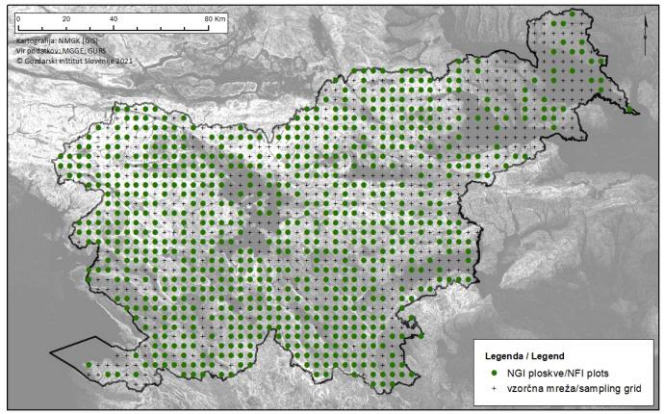
2021 – NFI panel 2

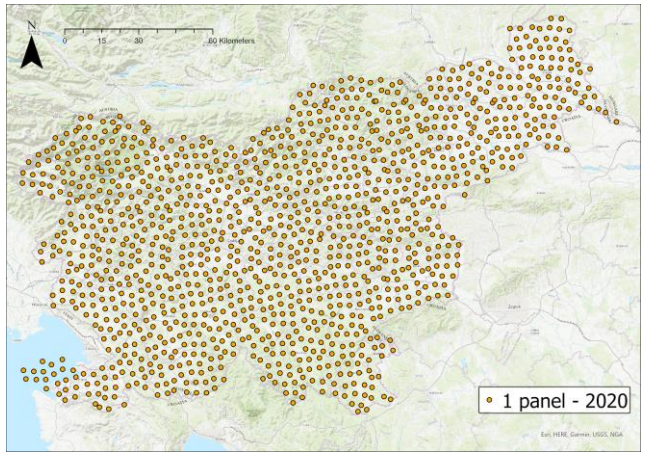
2022 – NFI panel 3

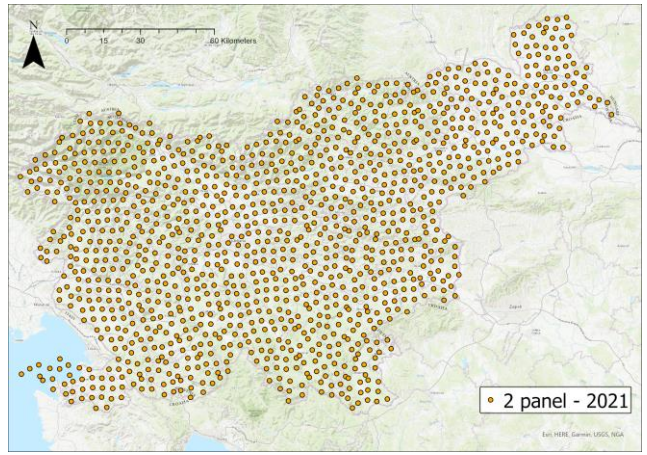
2023 – NFI panel 4

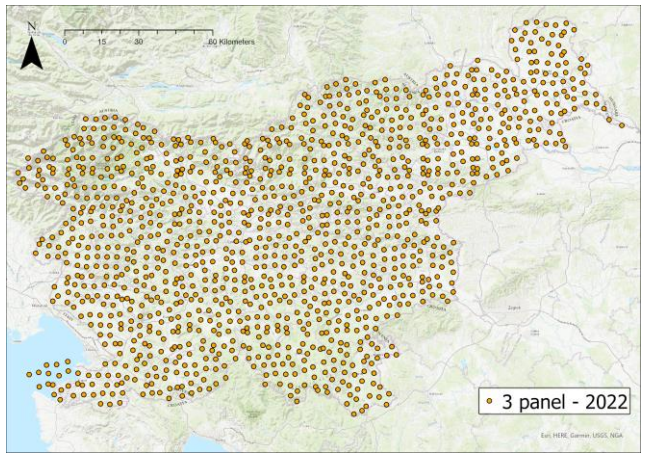
2024 – NFI panel 5 (old grid)

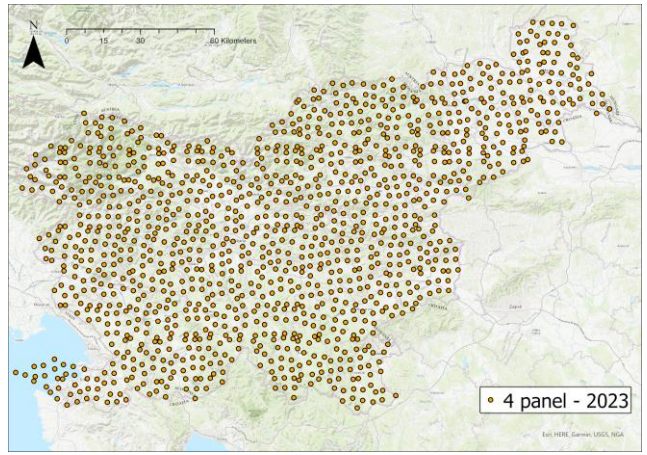
2025 – NFI panel 1 (cycle 2)





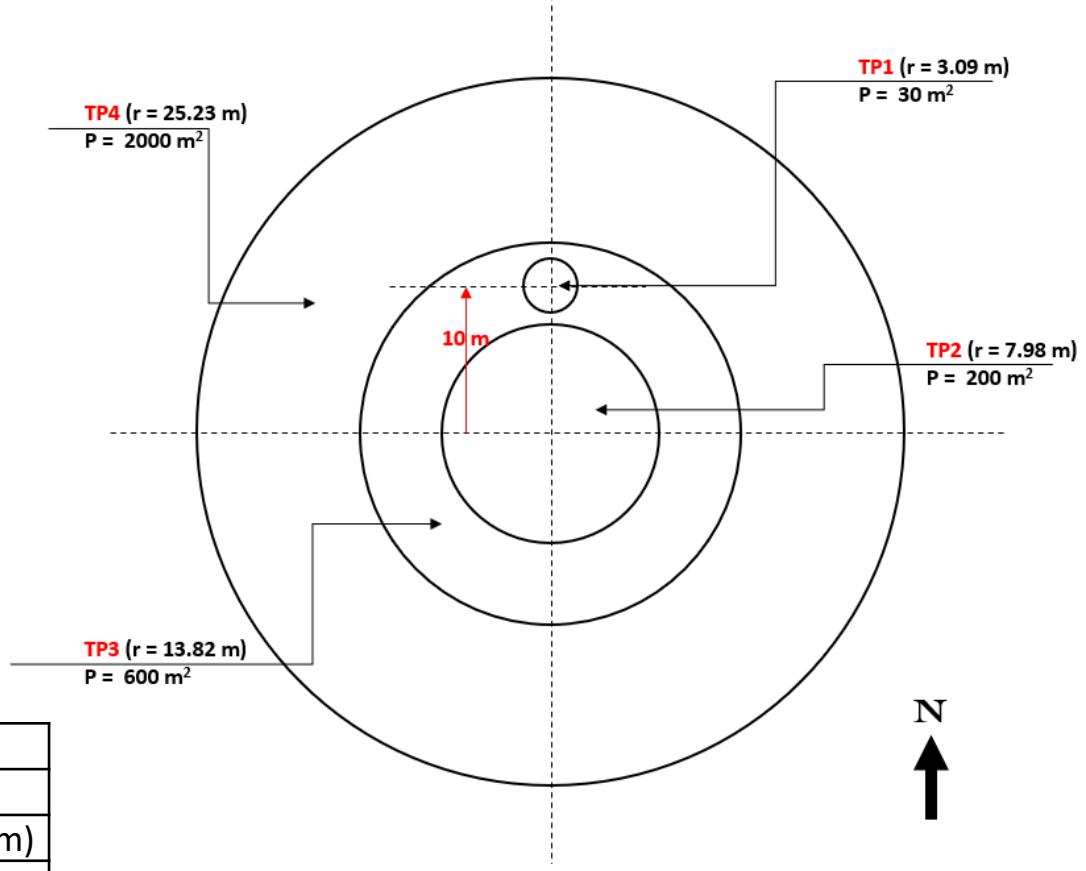




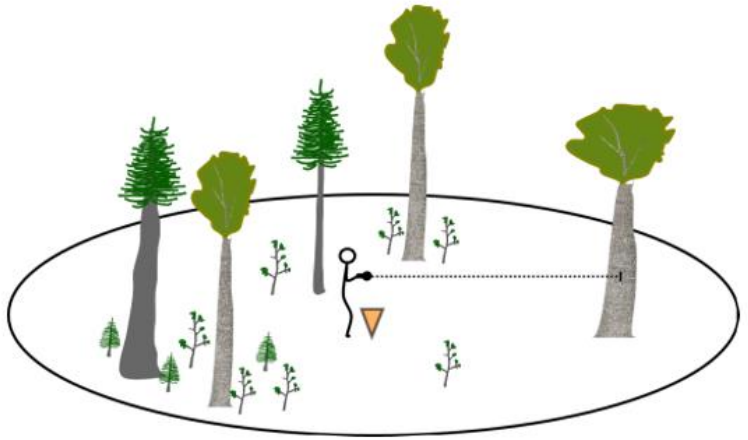


PLOT CONFIGURATION

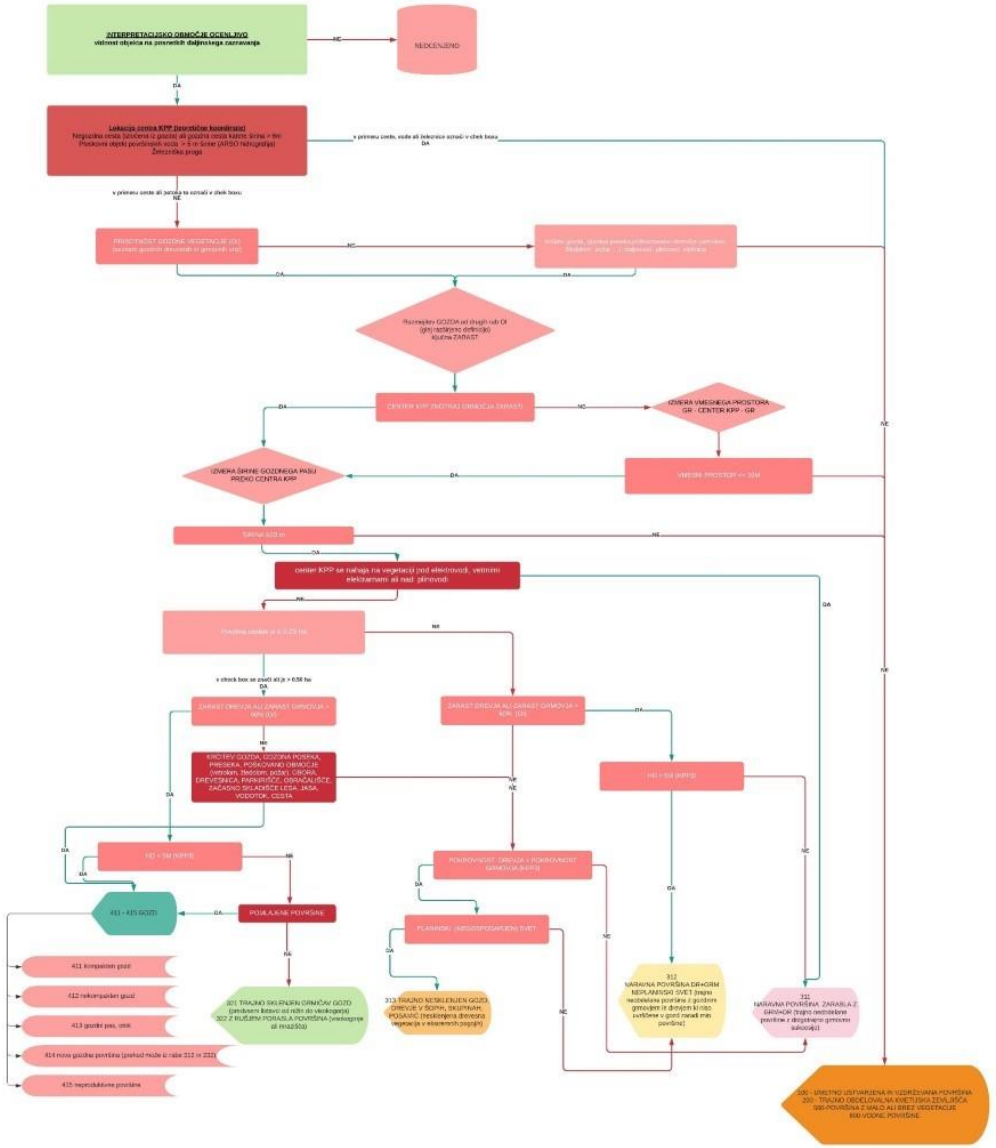
- Internationally harmonized indicators
- Detailed field manual
- Permanent circular plots with fixed radii



Indicator	Subplot and thresholds
Live trees $d_{1,3}$ < 10 cm in h ≥ 1,3 m	TP1
Live trees $d_{1,3}$ ≥ 10 cm	TP2 ($d_{1,3}$ ≥ 10 cm), TP3 ($d_{1,3}$ ≥ 30 cm)
Standing dead tree	TP2 ($d_{1,3}$ ≥ 10 cm), TP4 ($d_{1,3}$ ≥ 30 cm)
Lying dead tree	TP2 ($d_{1,3}$ ≥ 10 cm), TP4 ($d_{1,3}$ ≥ 30 cm)
Stump	TP2 ($d_{1,3}$ ≥ 10 cm, h ≥ 20 cm)
Snag	TP2 ($d_{1,3}$ ≥ 10 cm, h ≥ 50 cm), TP4 ($d_{1,3}$ ≥ 30 cm, h ≥ 50 cm)
Coarse woody debris (deadwood biomass)	TP2 ($d_{1,3}$ ≥ 10 cm, h ≥ 50 cm), TP4 ($d_{1,3}$ ≥ 30 cm, h ≥ 50 cm)
Plot characteristics	TP4
Stand characteristics	TP4 and sourounding
Horizontal forest structure	TP4
Vertical forest structure	TP4



FOREST / OTHER WOODED LAND / NO FOREST



MANUAL FOR FIELD WORK

Digitalni repozitorij raziskovalnih organizacij Slovenije

Uvodnik | Iskanje | Brskanje | Statistika | Obvestila | Kontakti

Izpis gradiva

Naslov: **Nacionalna gozdna inventura : interna navodila za terensko delo (2020-2024) : (ver. 02 / 2022) : dopolnitve 13. 5. 2022**

Avtorji: Skudnik, Mitja (Avtor)
Žlogar, Jure (Avtor)
Poljanec, Aleš (Avtor)
Pisek, Rok (Avtor)
Pintar, Anže Martin (Avtor)
Kušar, Gal (Avtor)
Guček, Matjaž (Avtor)
Grah, Andrej (Avtor)
Kovač, Marko (Avtor)
Grah, Andrej (Sodelavec pri raziskavi)
Guček, Matjaž (Sodelavec pri raziskavi)
Kovač, Marko (Sodelavec pri raziskavi)
Kušar, Gal (Sodelavec pri raziskavi)
Pintar, Anže Martin (Sodelavec pri raziskavi)
Pisek, Rok (Sodelavec pri raziskavi)
Poljanec, Aleš (Sodelavec pri raziskavi)
Žlogar, Jure (Sodelavec pri raziskavi)

Datoteke: PDF - Predstavitvena datoteka, prenos (4,71 MB)
MD5: 87B9DC9C594BD394A31EC99A56FEC7CC

Jezik: Slovenski jezik

Tipologija: 2.06 - Slovar, enciklopedija, leksikon, priročnik, atlas, zemljevid

Organizacija: SciVie - Gozdarski inštitut Slovenije

Ključne besede: nacionalna gozdna inventura, monitoring, terenske meritve, trajne vzorčne ploskve, navodila

Leto izida: 2020 - 2020

Objavi

Podobna

1. Značilr v siste gozdo

Podobna

1. Gozdn
2. Gozda stalne Natura
3. Gozdn
4. Presoj na stal
5. Navod MOTI

Postavite m povzetka. K sproži pren

NACIONALNA GOZDNA INVENTURA

INTERNA NAVODILA ZA TERENSKO DELO (2020-2024)

(ver. 02 / 2022)

Dopolnitve 13. 5. 2022

Urednik: dr. Mitja Skudnik

Avtorji: dr. Mitja Skudnik, Andrej Grah, mag. Matjaž Guček, dr. Marko Kovač, dr. Gal Kušar, Anže Martin Pintar, mag. Rok Pisek, dr. Aleš Poljanec, Jure Žlogar

GIS

Ljubljana 2020

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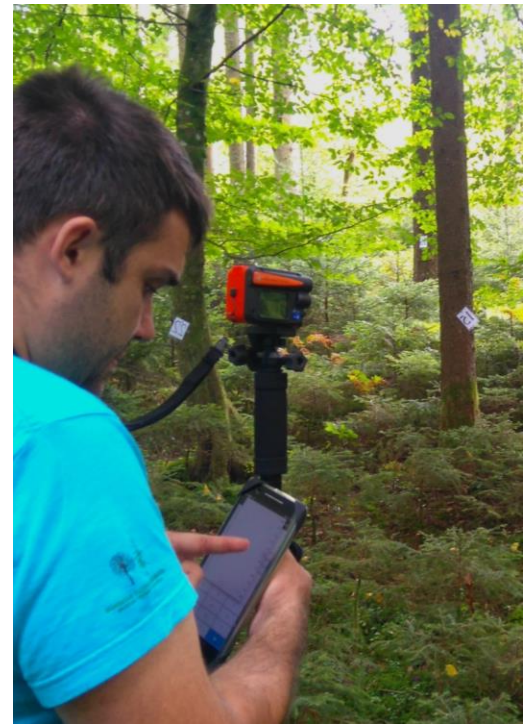
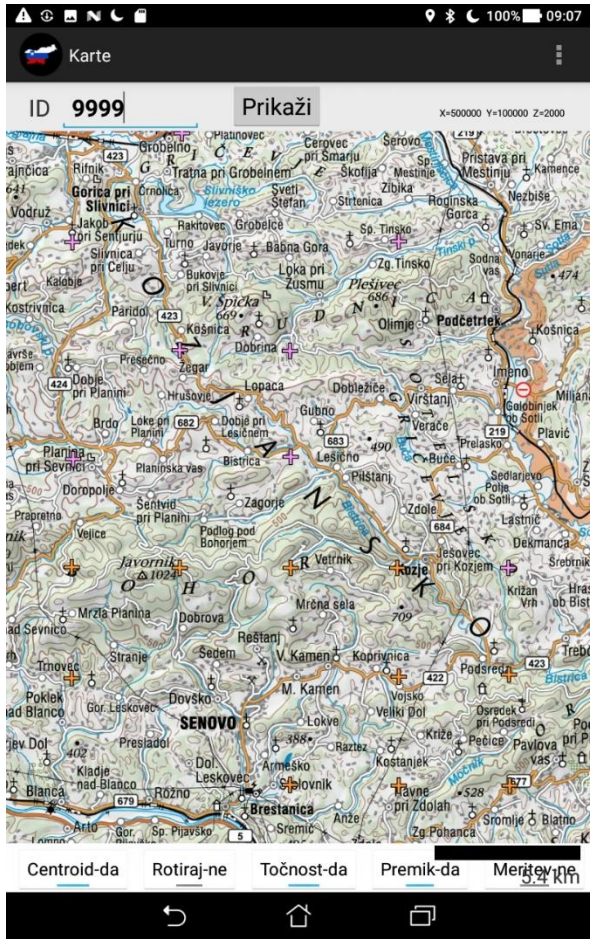
https://dirros.openscience.si/izpisgradiva.php?id=15132&lang=eng

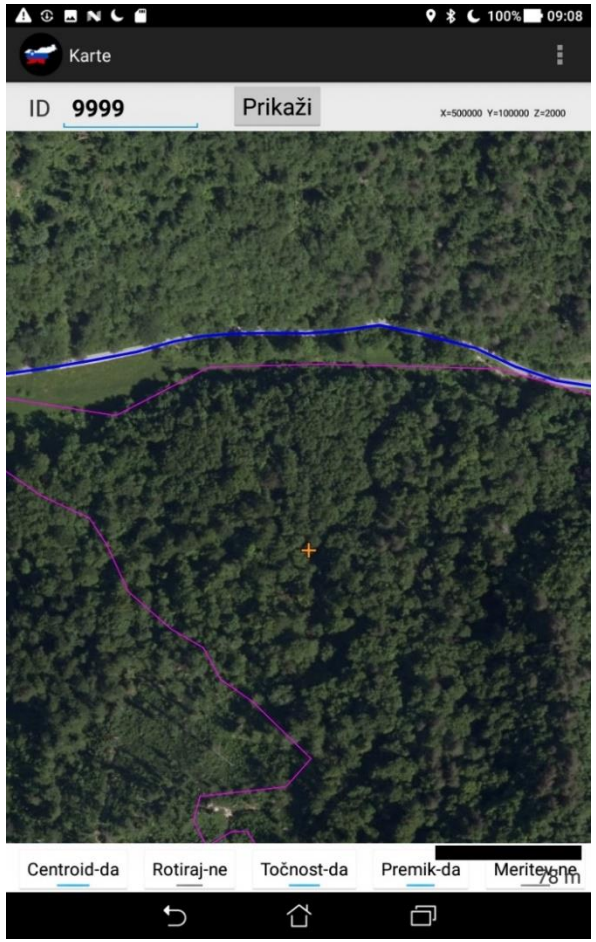
FIELD WORK

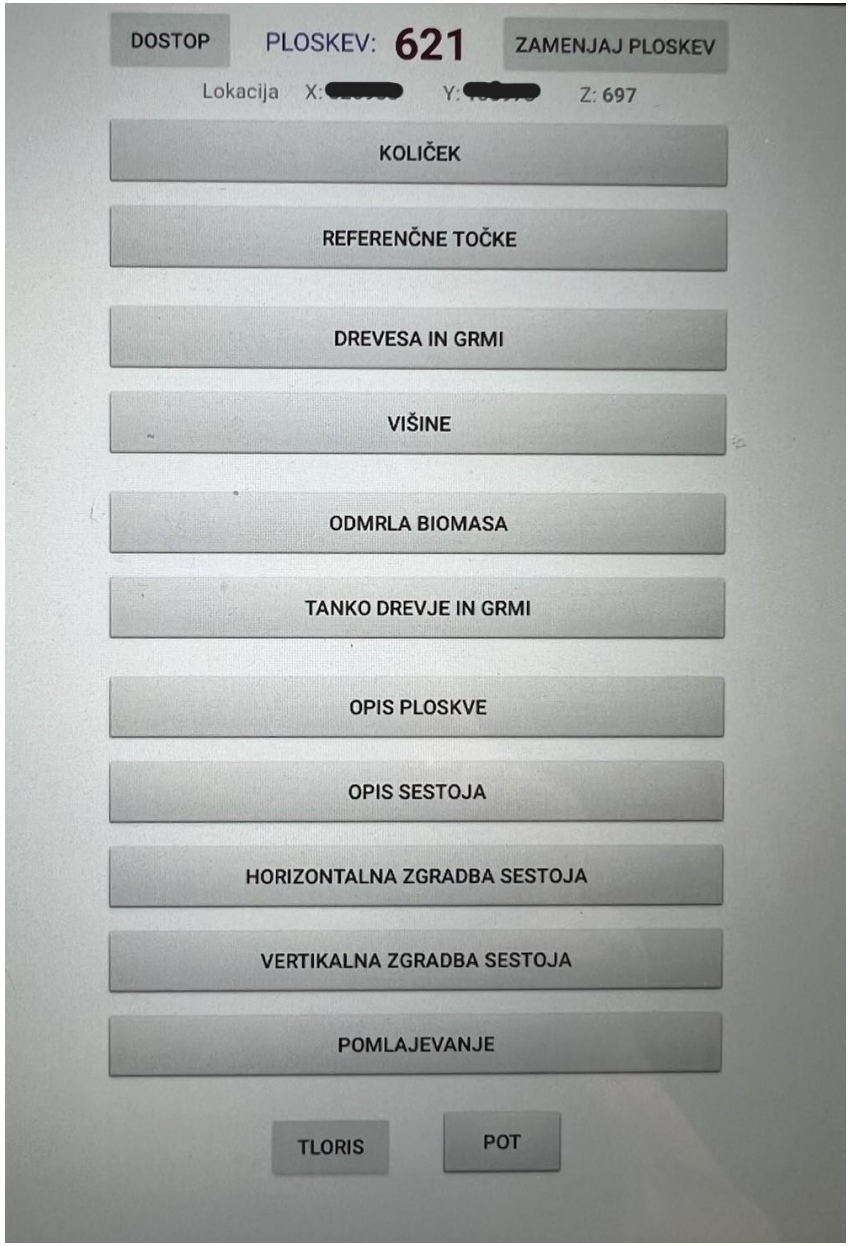
- Well-trained permanent field teams (6)
- “Modern” field equipment
- Independent quality control



LOCATION OF THE PLOT

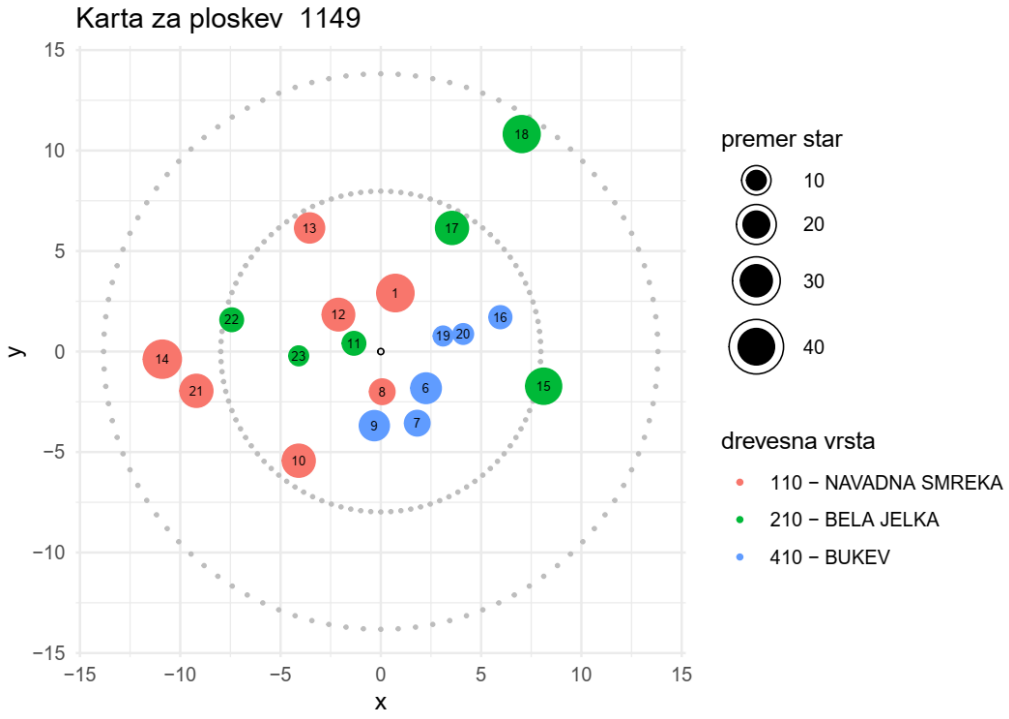




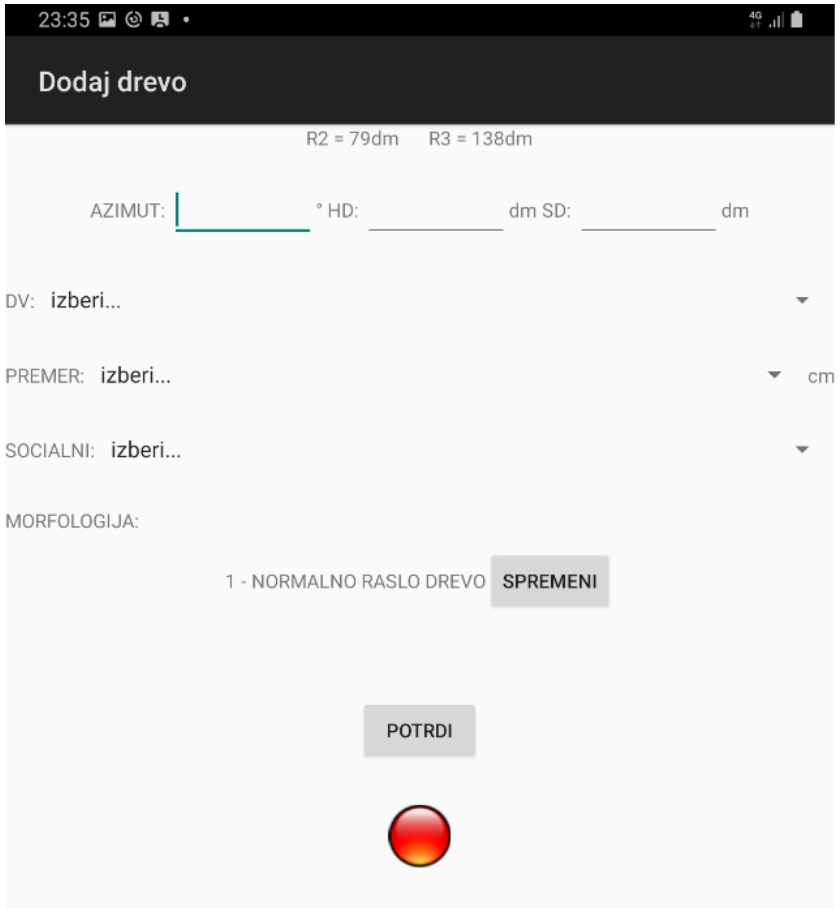


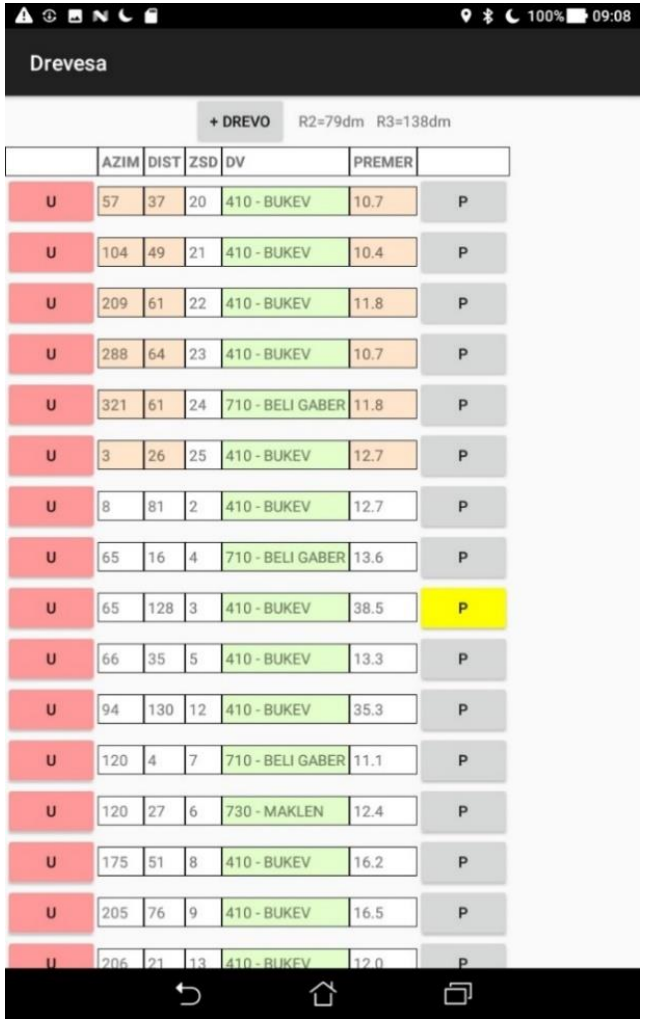
LOCATION OF THE PLOT

Zeno mobile application (RTK correction)



TREE MEASURMENTS





HEIGHT MEASURMENTS

DREVESA IN GRMI

VIŠINE

Seznam dreves za višine

AZIM	DIST	ZSD	DV	PREMER	VIŠ	VIŠ.DEBLA	
65	16	4	710 - BELI GABER	13.6			U
65	128	3	410 - BUKEV	38.5	274	145	U
94	130	12	410 - BUKEV	35.3			U
214	40	14	410 - BUKEV	10.8			U
250	125	10	410 - BUKEV	41.0	226	49	U
325	18	11	410 - BUKEV	12.7	159	100	U

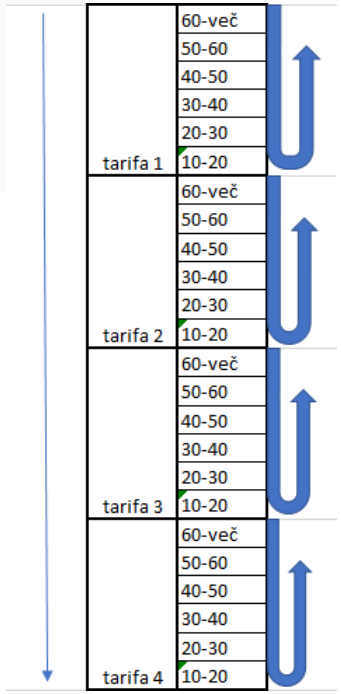
Vnos višine

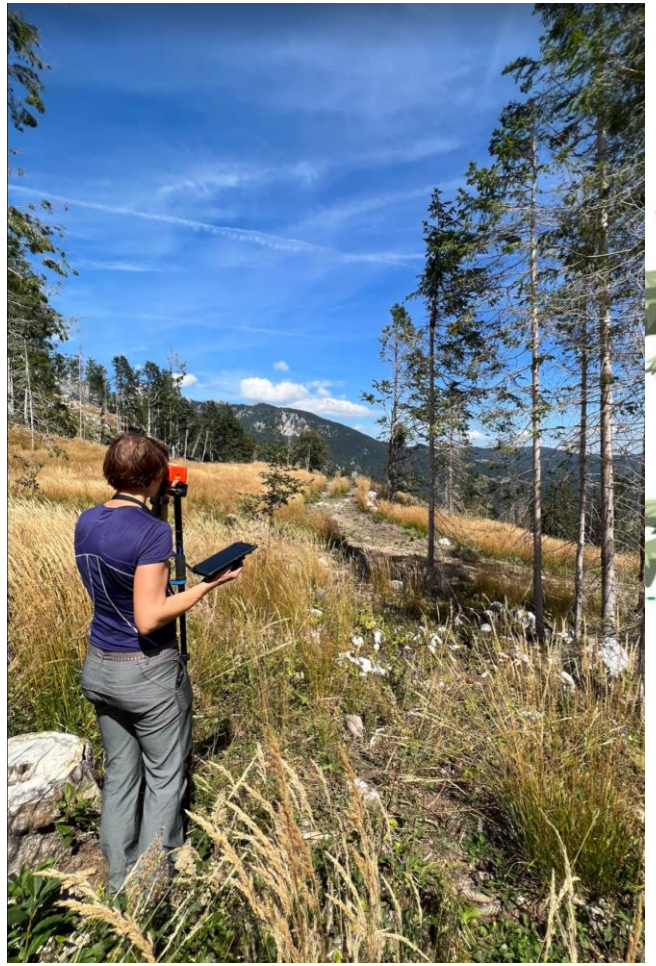
AZIM: 65 DIST: 128 **ZSD: 3** DV: 410 - BUKEV

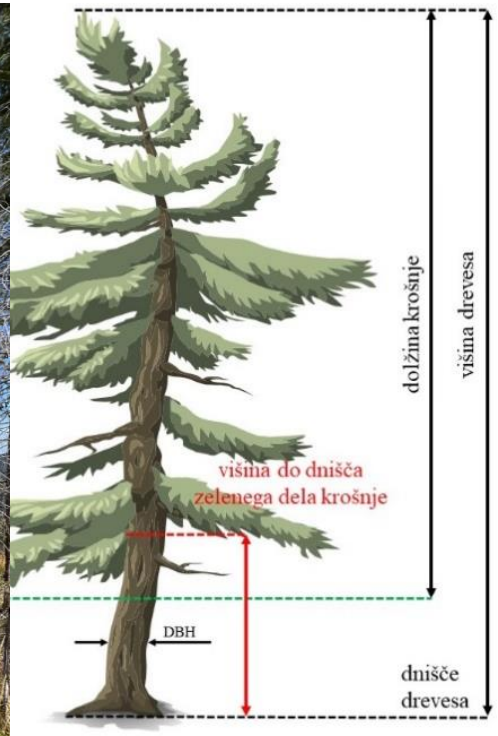
VIŠINA DREVESA: 274 dm

VIŠINA DEBLA: 145 dm

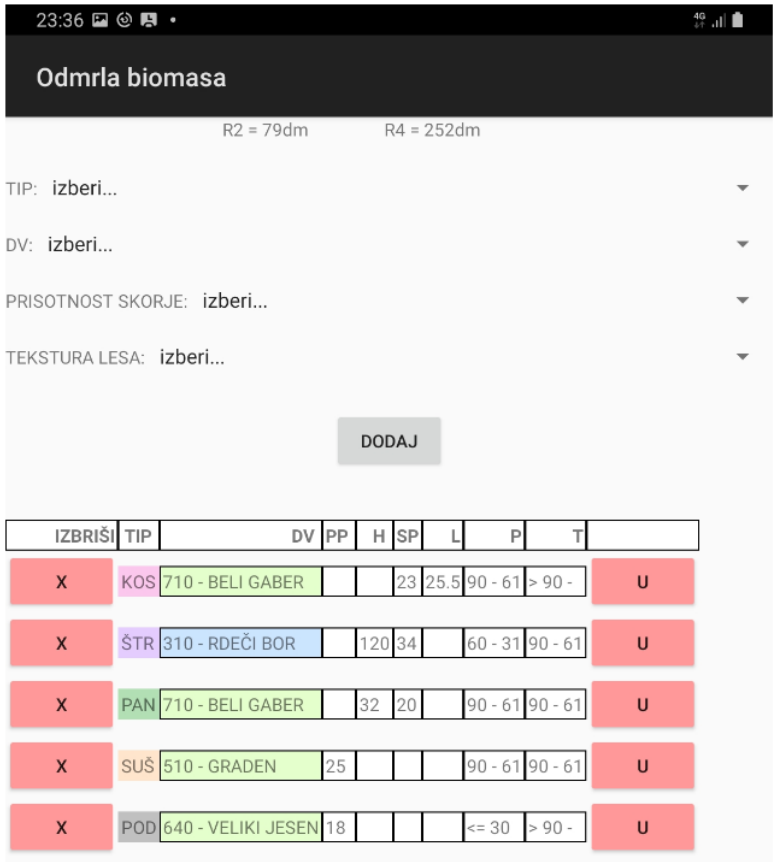
POTRDI

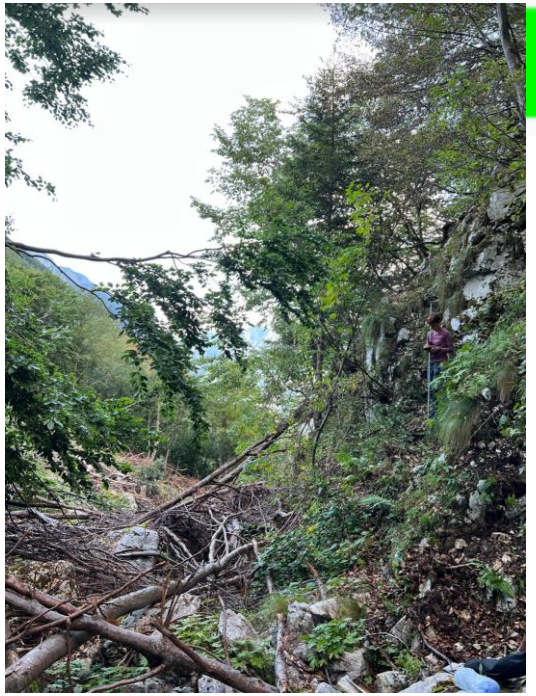


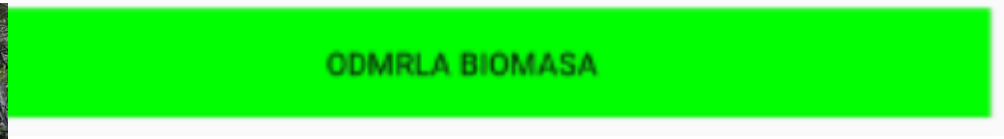




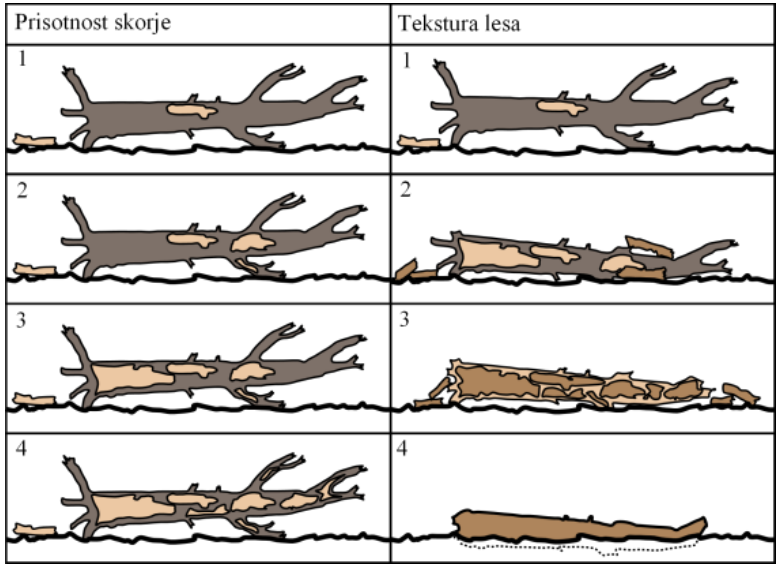
DEADWOOD

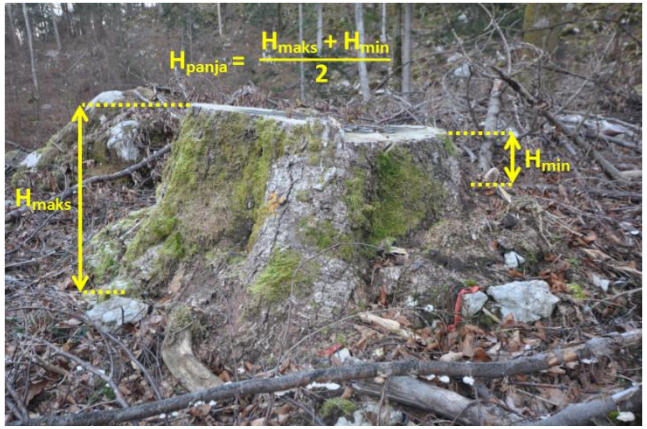

23:36
Odmrla biomasa
R2 = 79dm
R4 = 252dm
TIP: izberi...
DV: izberi...
PRISOTNOST SKORJE: izberi...
TEKSTURA LESA: izberi...
DODAJ
IZBRIŠI TIP DV PP H SP L P T
X KOS 710 - BELI GABER 23 25.5 90 - 61 > 90 - U
X ŠTR 310 - RDEČI BOR 120 34 60 - 31 90 - 61 U
X PAN 710 - BELI GABER 32 20 90 - 61 90 - 61 U
X SUŠ 510 - GRADEN 25 90 - 61 90 - 61 U
X POD 640 - VELIKI JESEN 18 <= 30 > 90 - U




ODMRLA BIOMASA

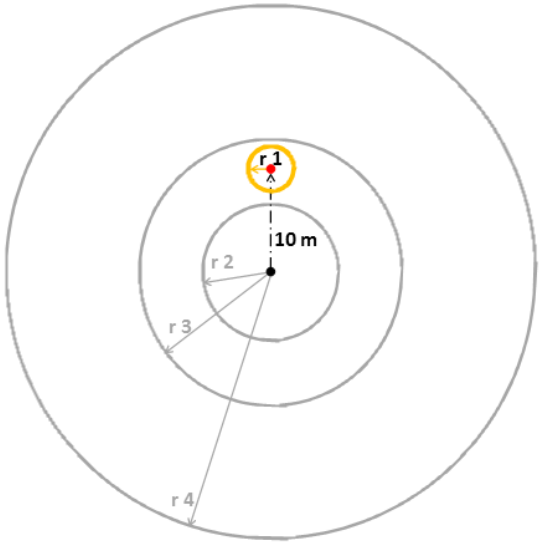

1
2
3
4
5


Prisotnost skorje
Tekstura lesa
1
2
3
4


$H_{panja} = \frac{H_{maks} + H_{min}}{2}$
H_{maks}
H_{min}

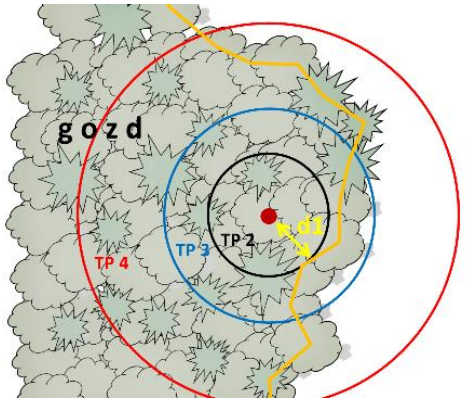
SMALL TREES

TANKO DREVJE IN GRMI



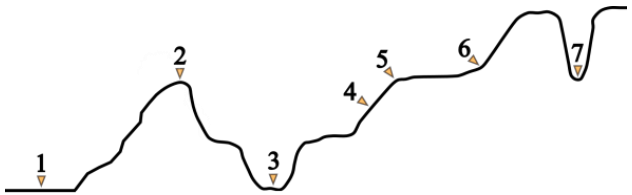
Znak ploskve	TP1
Radij ploskve [m]	3,09
Površina ploskve [ar]	0,3
Stoječe živo drevje	0 cm < $D_{1,3}$ < 10 cm; H ≥ 1,3 m

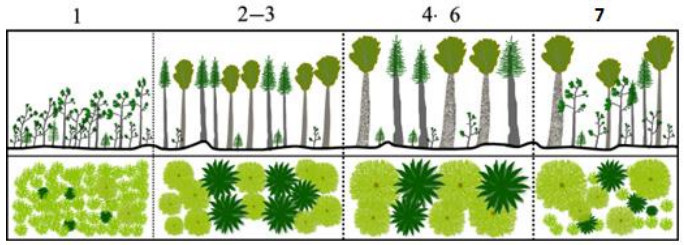
STAND

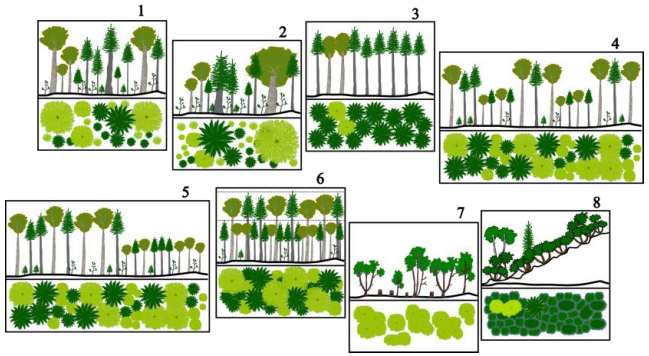


OPIS PLOSKVE

OPIS SESTOJA







23:38

Opis sestoja

Primorsko bukovje na flisu 64%
Preddinarsko-dinarsko toploljubno bukovje 33%
Predalpsko gorsko bukovje 3%

NARAVNOST 4: 31 - SPREMENJENI GOZDOVI

tnp: NE var: NE rez: NE

GOSPODARJENJE 4: 1 - NEGOSPODARJENO

TIP 4: 4 - drugi pretežno listnati gozdovi, če niso izpolnjeni pogoji pod 1–3 in je listavcev > 75 %

NEGOVANOST 4: 4 - NENEGOVAN OGROŽEN SESTOJ

ZGRADBA 4: 5 - VELIKOPOVRŠINSKA RAZNOMERNA (RAZNODOBNA)

SKLEP SESTOJA 4: 4 - VRZELAST

Št. dreves po debelinskih razredih:
10 - 19.9 5 kos
20 - 29.9 3 kos
30 - 39.9 2 kos
40 - 49.9 1 kos
50 - 59.9 2 kos

RAZVOJNA FAZA 4	TIP	STAROST	NAČIN DOLOČITVE
PRIMARNA:	3 - MOČNEJ..	4 - 61-80	3 - STROKO..
☑ SEKUNDARNA:	1 - MLADOV..	1 - <=20	3 - STROKO..

DELEŽ R.FAZ (PRIM:SEK): 70 — 30

POTRDI

23:38

Opis ploskve

RABA: GOZD CENTER ZNOTRAJ RABE: DA

RELIEF: 4 - POBOČJE

POPISOVALEC: ms ph

SKALOVITOST 4: 1 - BREZ SKAL

KAMNITOST 4: 1 - BREZ KAMNOV

CENTER PLOSKVE JE:

◉ ZNOTRAJ merjene rabe ○ ZUNAJ merjene rabe

4 - PRISOTNA DVA ROBA - center ZNOTRAJ linijskega objekta

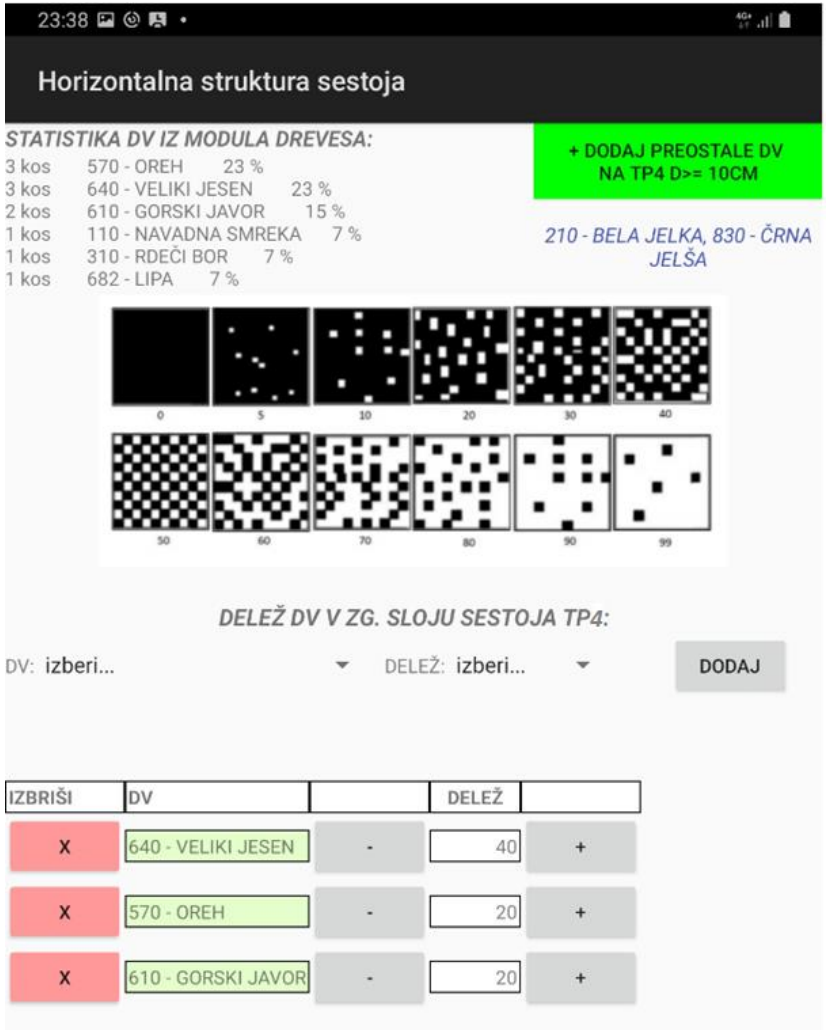
D1: 10 dm

D2: 50 dm

POTRDI

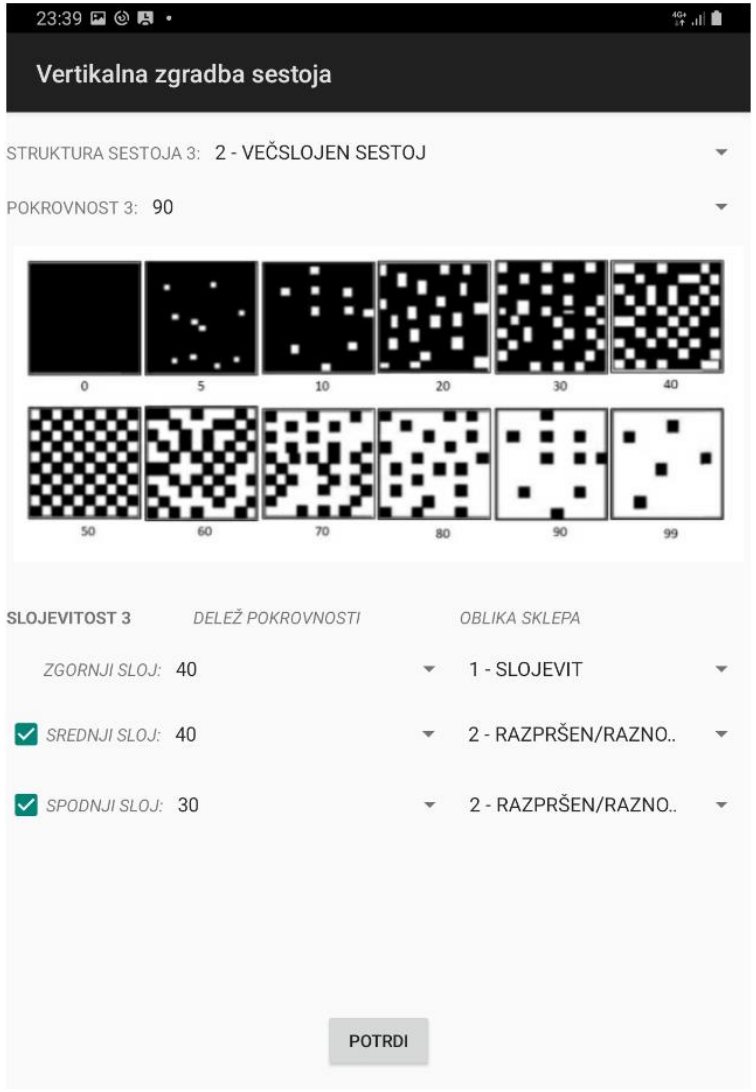
HORIZONTAL STRUCTURE

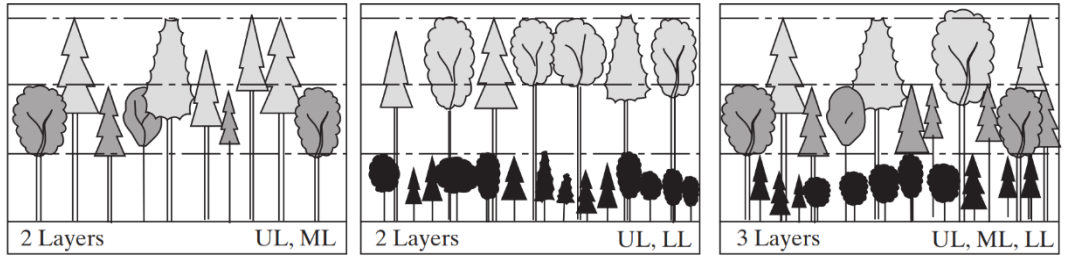
HORIZONTALNA ZGRADBA SESTOJA



VERTICAL STRUCTURE

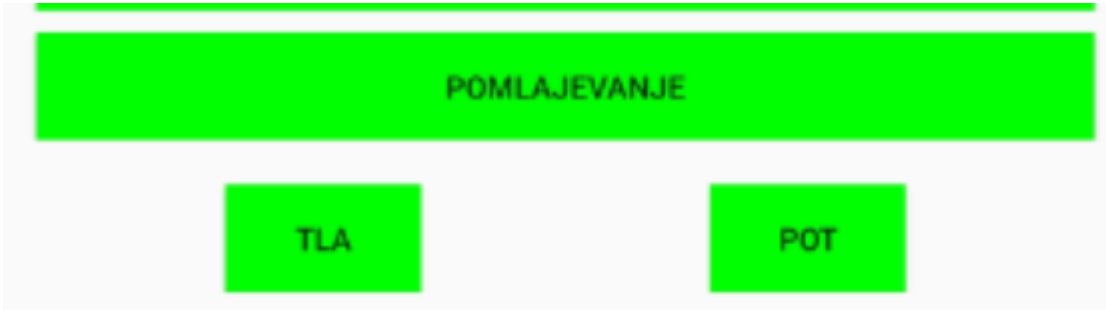
VERTIKALNA ZGRADBA SESTOJA

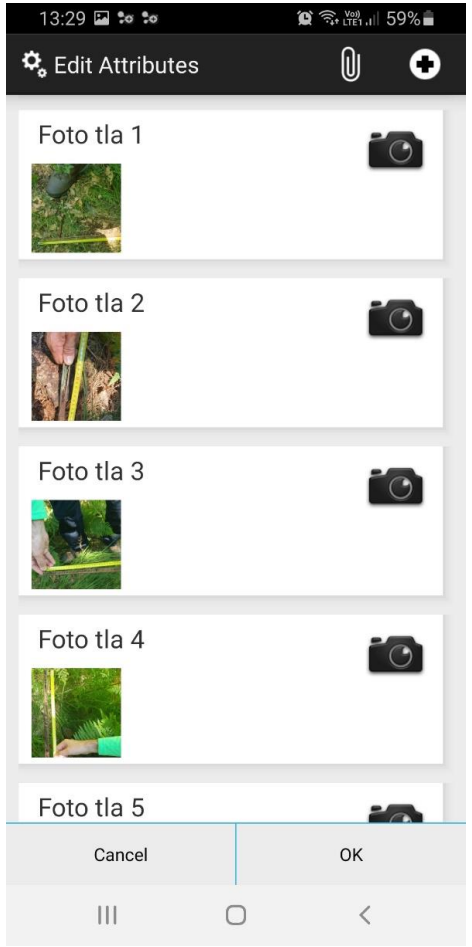




Povzeto po WSL Lfi.CH 2017

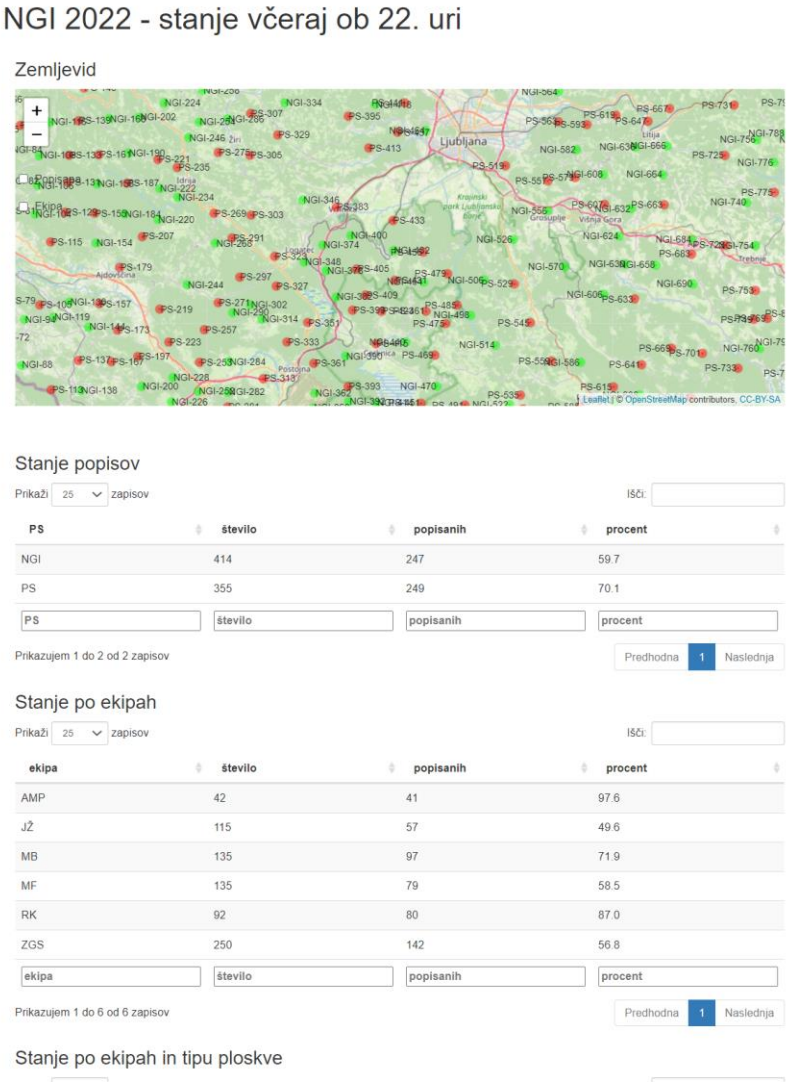
SOIL SAMPLING





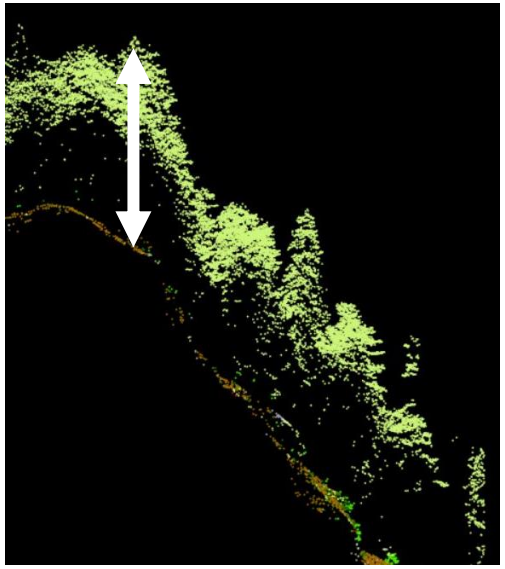
FIELD WORK - DATA SYNCHRONIZATION

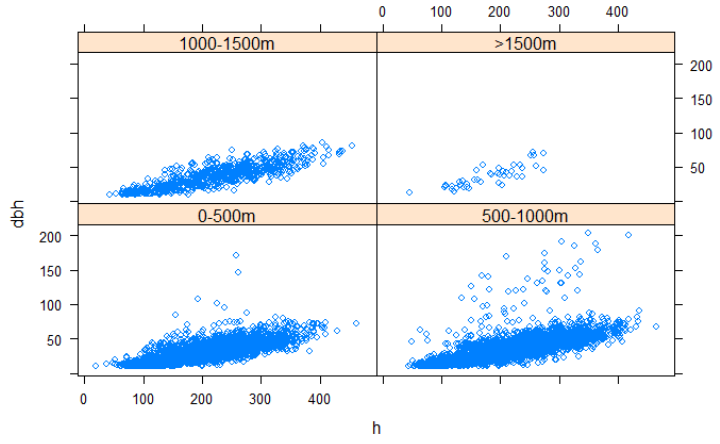
- Regular daily synchronization of data from field computers to SFI data server
- Daily updated work overview in webapp – access to teams and others involved in NFI



INACCESSIBLE NFI PLOTS

- Use of aerial images and lidar data
- Individual tree volume calculation
- height-diameter relationships (5908 trees)
- Mod DBH -> volume functions -> tree volume estimate





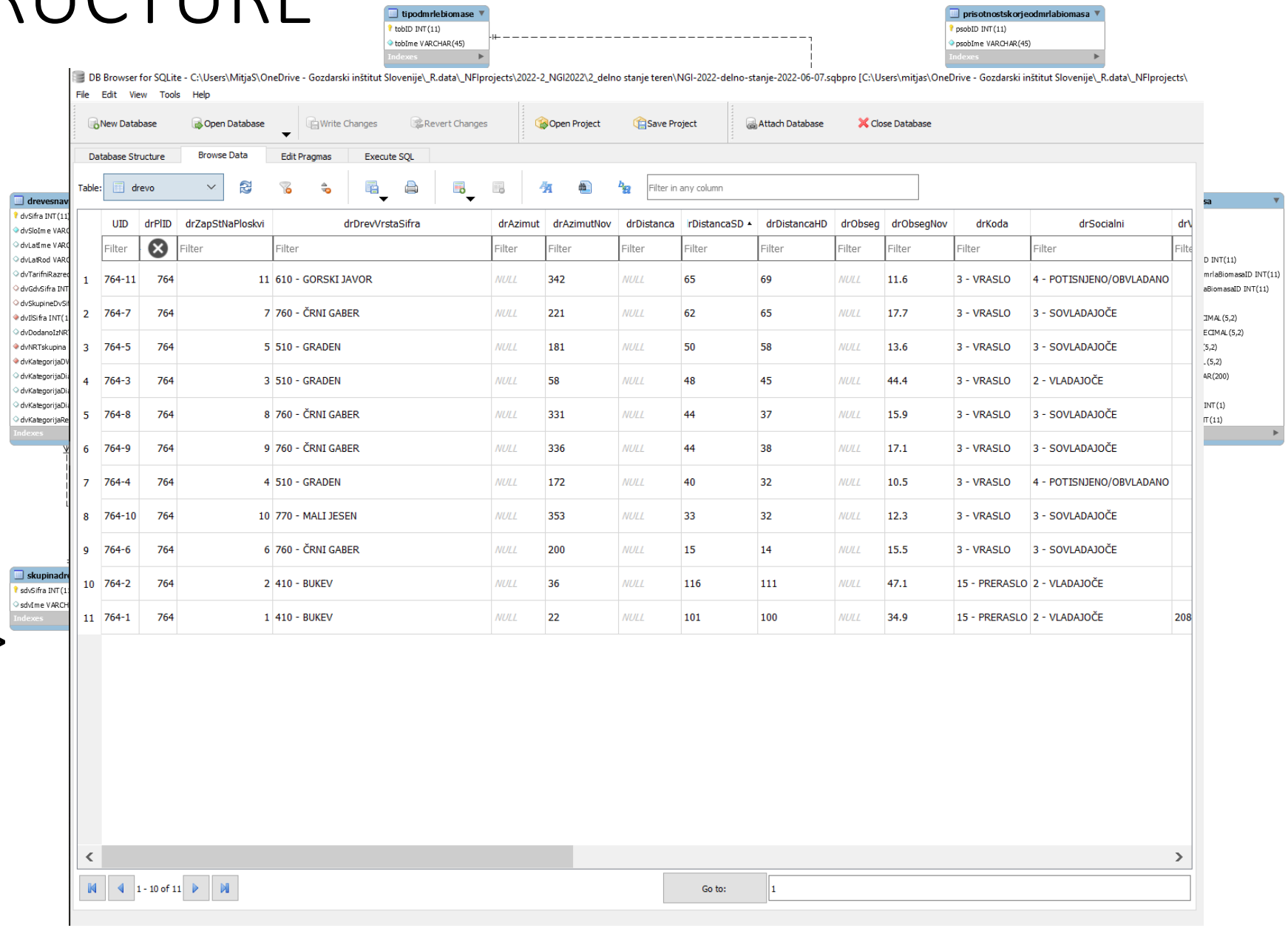
DATABASE STRUCTURE

Data base -> MySQL

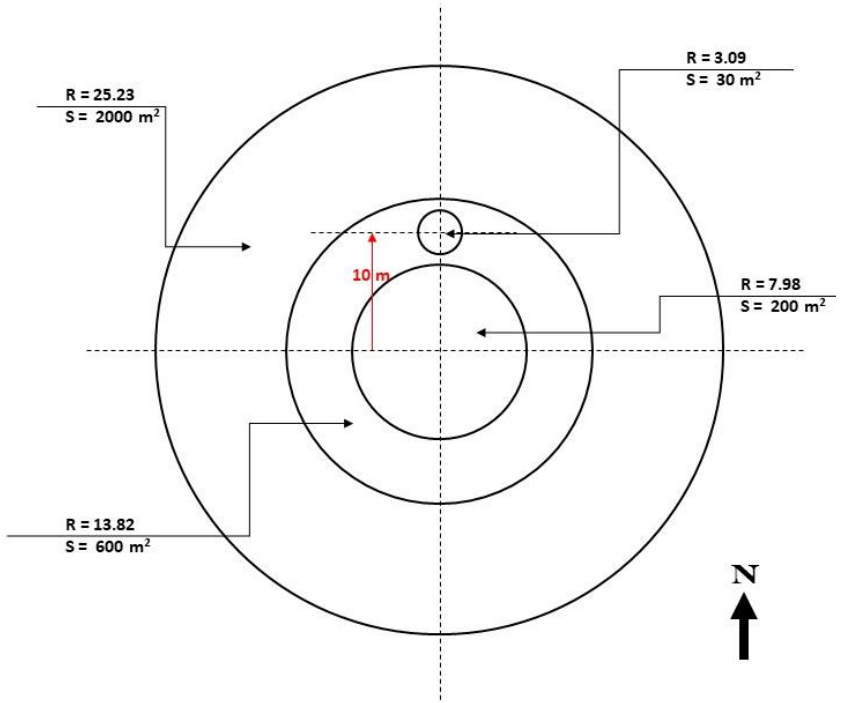
Internal GIS MySQL server

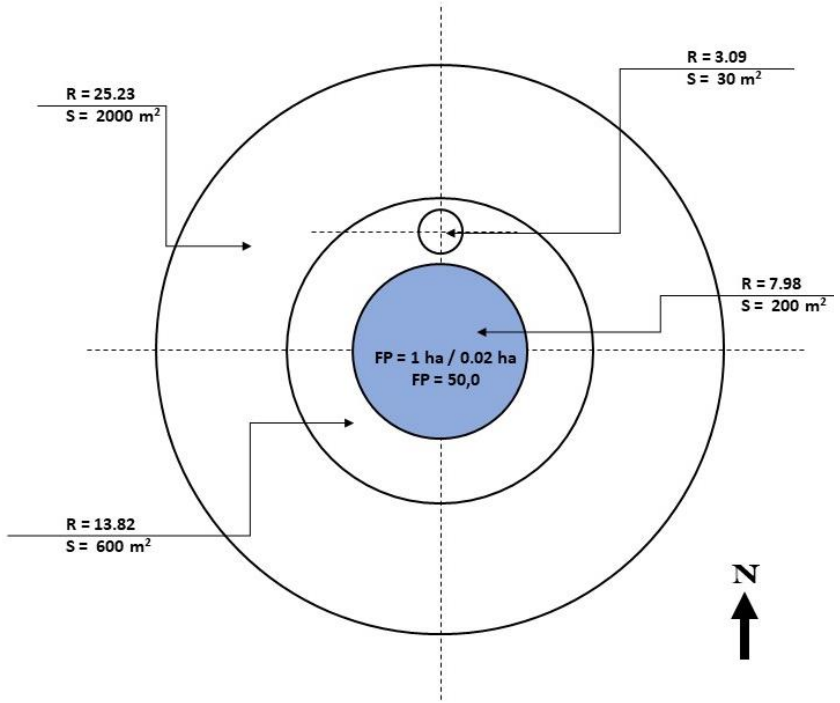
Calculations -> MySQL functions

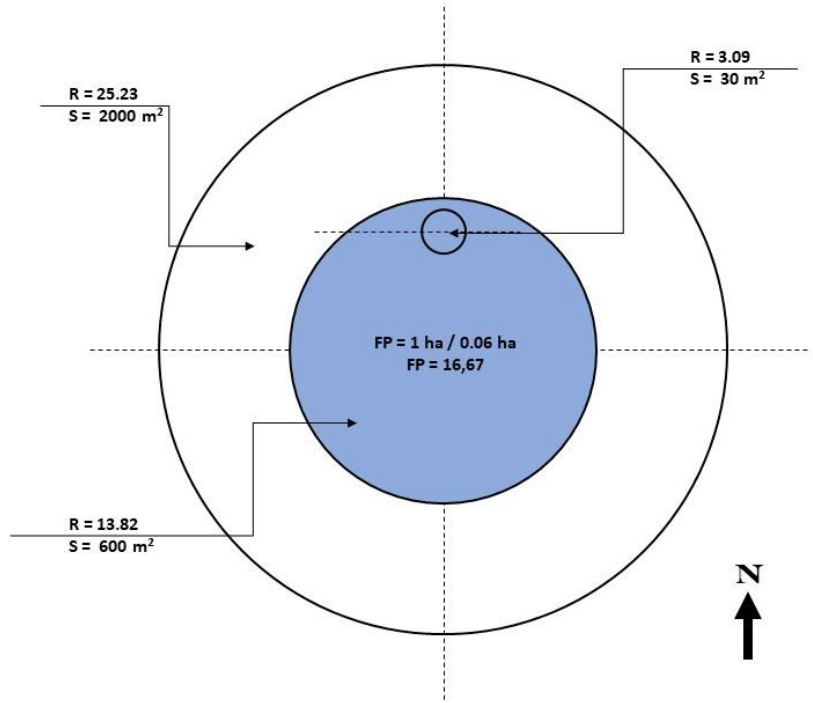
Graphical interface -> C#



CALCULATIONS







$$x_i = \sum_{j=1}^{d} y_j * FP$$

Plot level

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$$

Average estimation

$$s = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}}$$

Sampling standard deviation

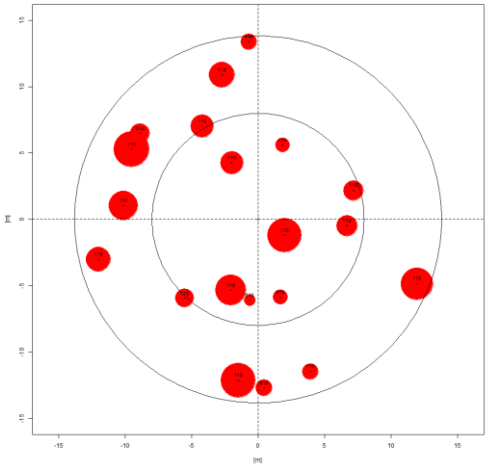
$$E\,\% = t * \frac{s}{(\sqrt{n})} / \overline{x} * 100$$

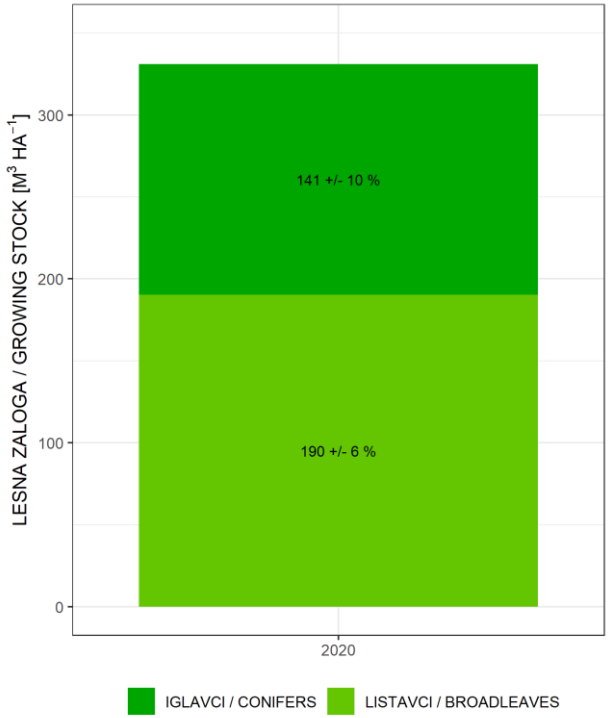
Sampling error

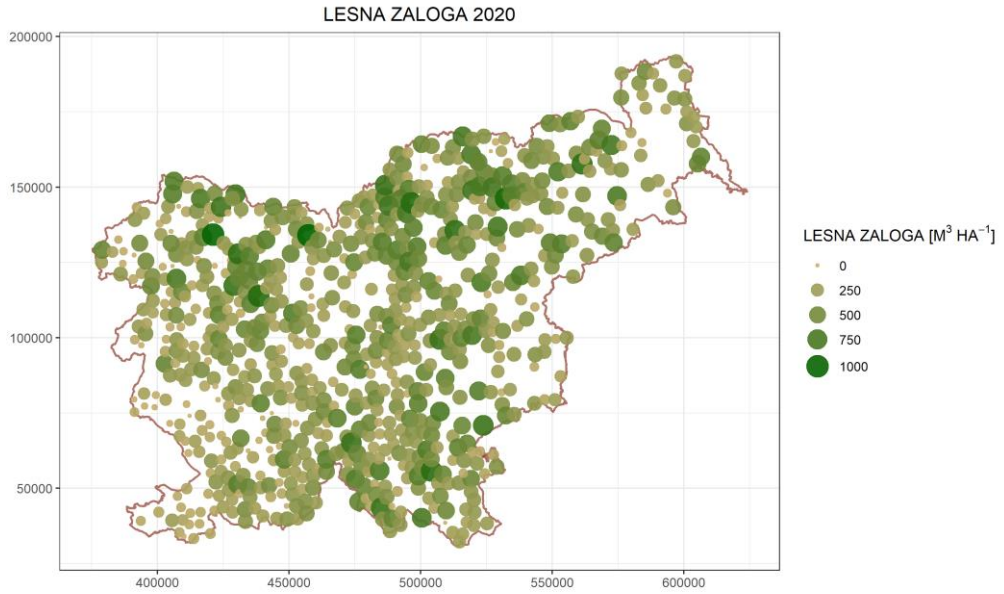
RESULTS

- Transparent calculation methods
- Estimation + known estimation errors (sampling)
- Used for international and national reporting
- **The most important available results:**

1. **State of the forest**: growing stock, basal area, number of trees, dominant height, volume of deadwood biomass, diversity indices …
2. **Changes in forest**: increment, harvest, mortality …
3. **Forest characteristics and data stratification**: Information on stand structure, vertical and horizontal forest structure …



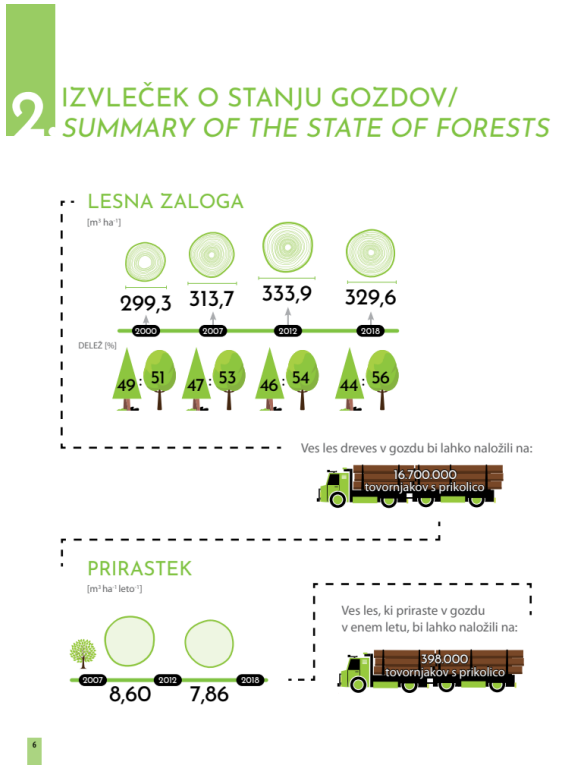


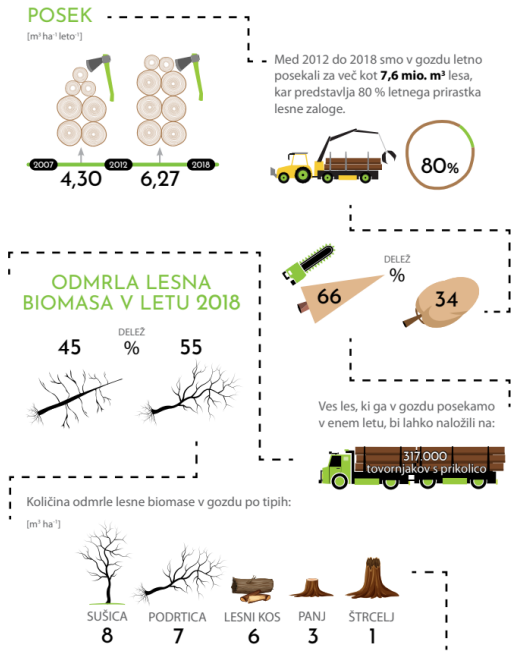


NACIONAL REPORTS

PUBLICATIONS AND REPORTS

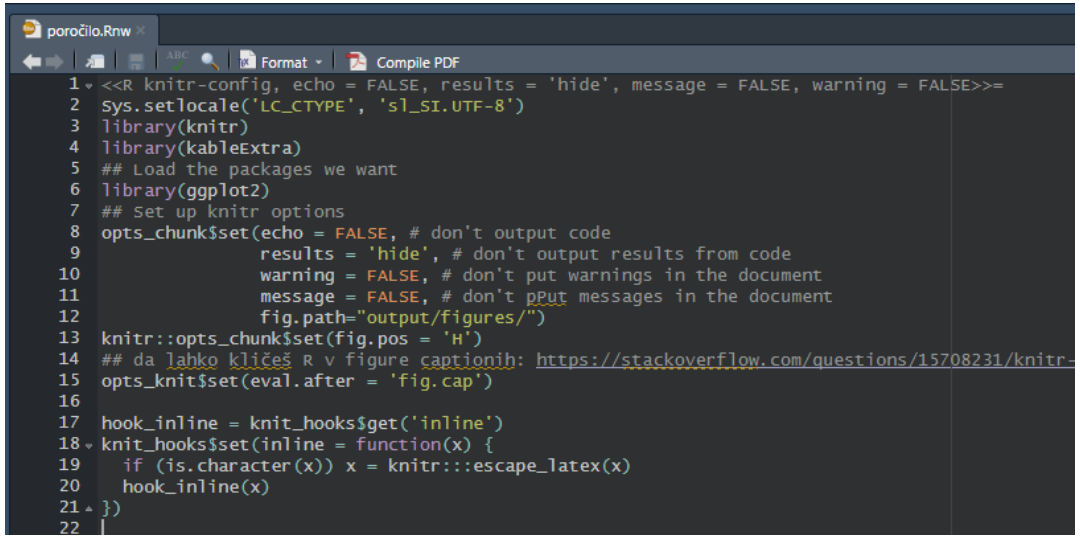
- State and changes of Slovenian forests in period (2000-2018) -> http://dx.doi.org/10.20315/SFS.181





RESULTS NGI 2020

- Publication -> NATIONAL REPORT
- Calculations in R and SQL scripts
- Semi-automated yearly reports -> R knitr

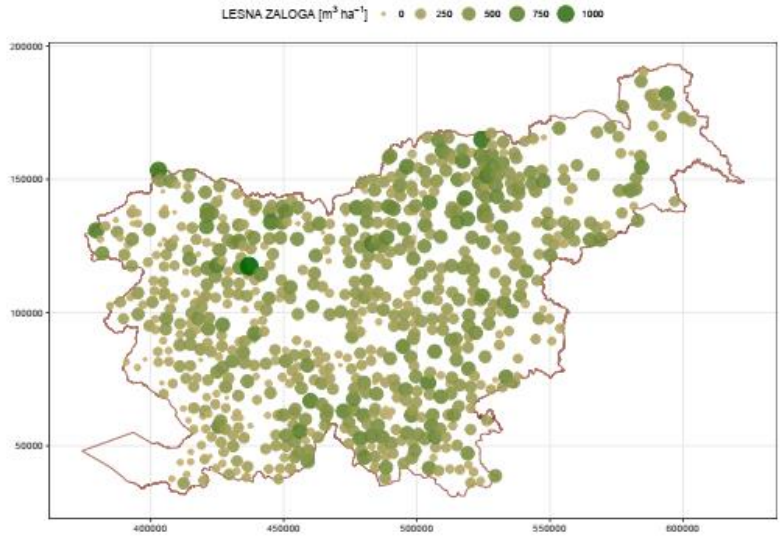



GOZDARSKI INŠTITUT SLOVENIJE
SLOVENIAN FORESTRY INSTITUTE

Poročilo o rezultatih letnega panela nacionalne gozdne inventure Slovenije

2023

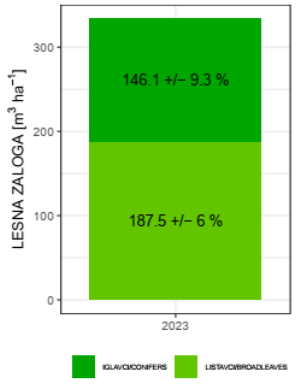
Ljubljana, januar 2024



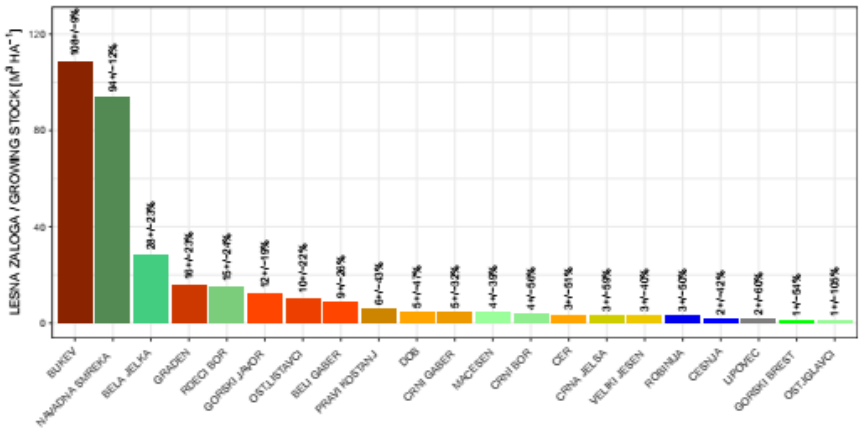
Slika 4: Ploskve po razredih lesne zaloge dreves.

Preglednica 2: Lesna zaloga v letu 2023

	Število ploskev	Povprečje $[m^3/ha]$	E [%]	Delež [%]
Listavci	756	187.5	6.0	56.2
Iglavci		146.1	9.3	43.8
Skupaj		333.5	4.2	100.0



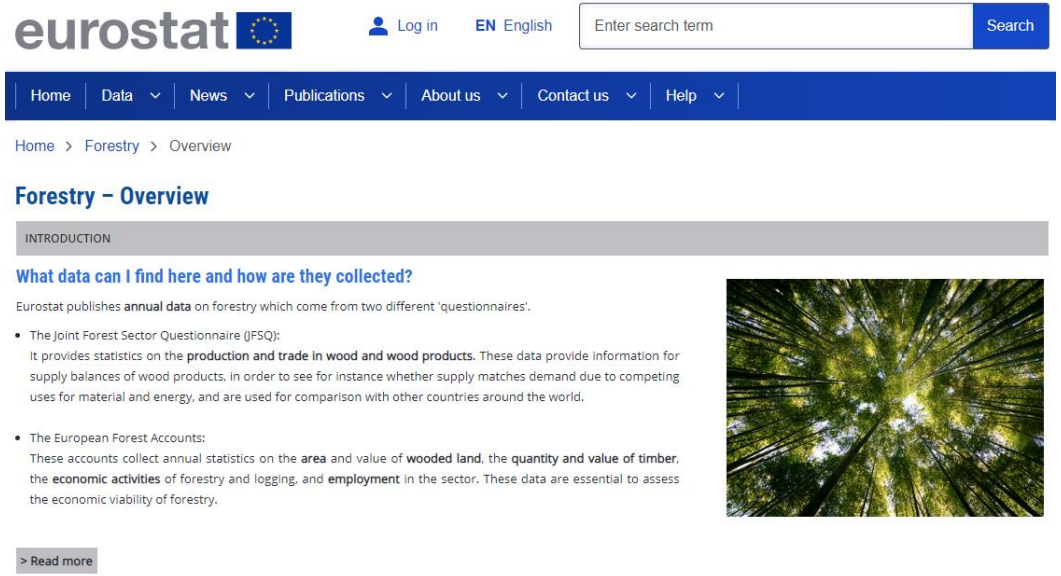
Slika 5: Lesna zaloga za iglavce in listavce.



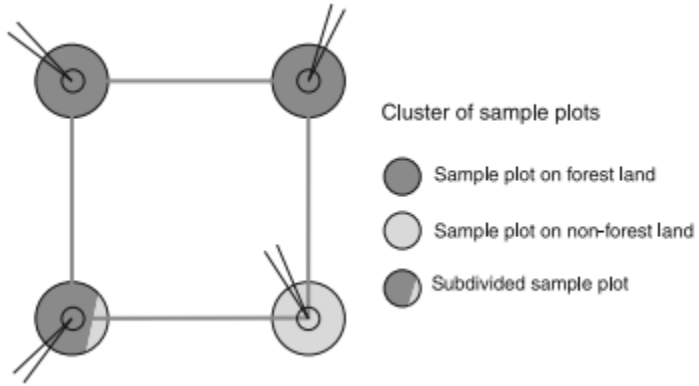
Slika 6: Lesna zaloga po drevesnih in grmovnih vrstah.

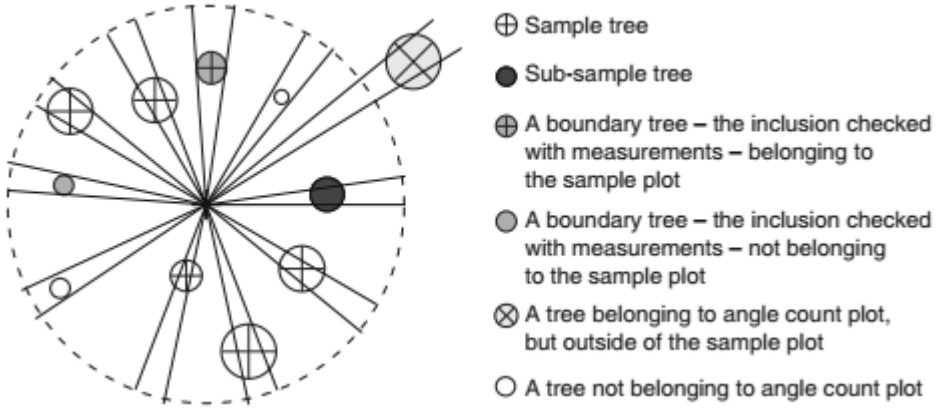
INTERNATIONAL REPORTS
- need for data harmonization

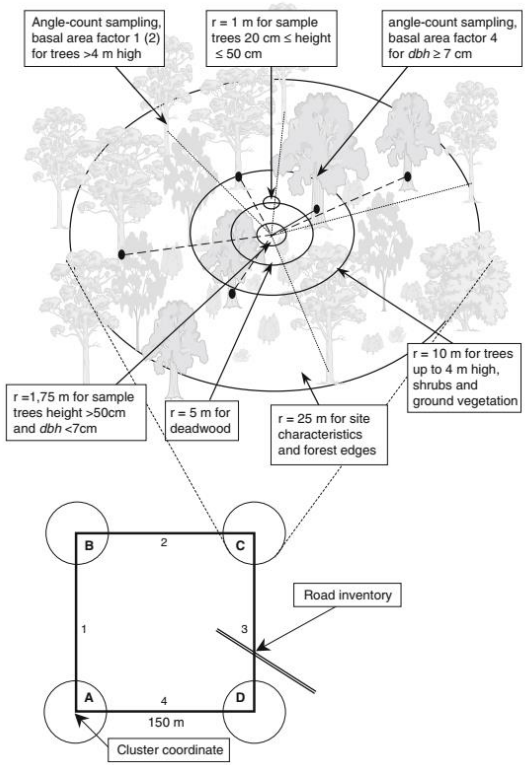
Food and Agriculture Organization
of the United Nations

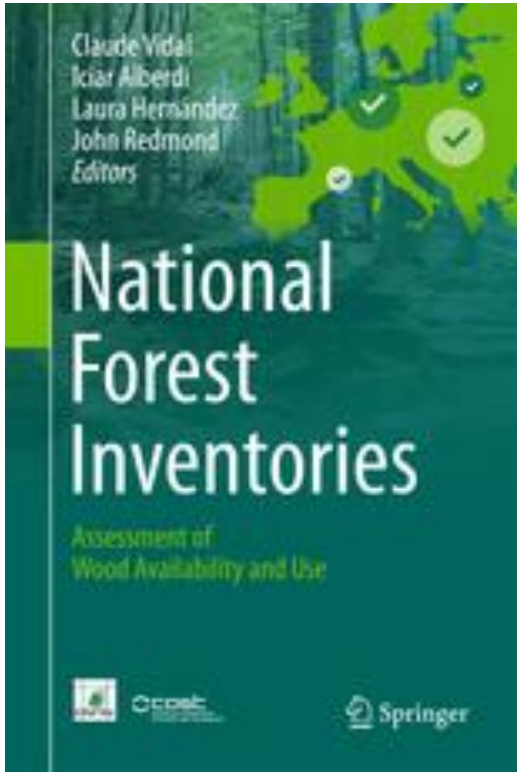


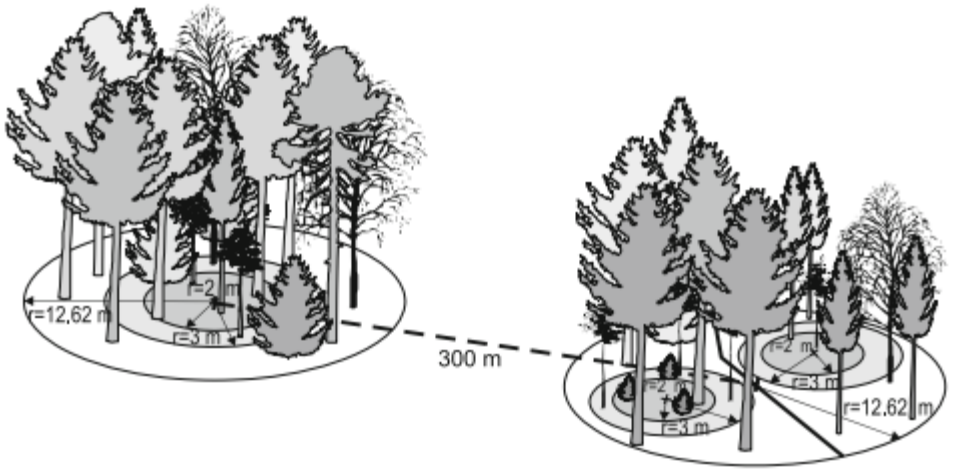
https://www.youtube.com/watch?v=l60ef3ZfEPw&t=146s

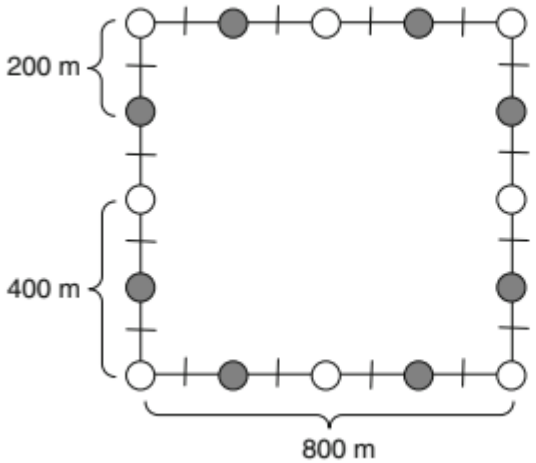


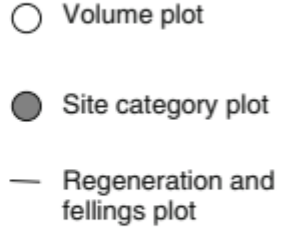












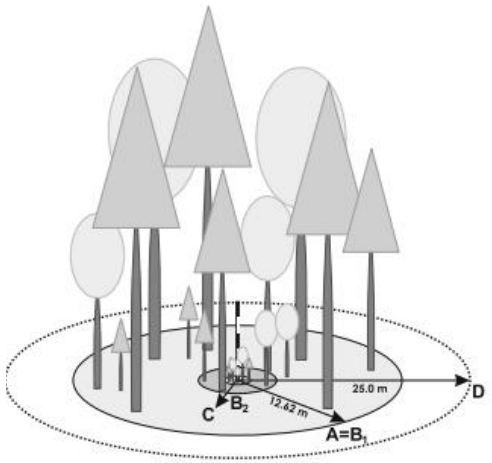


Fig. 8.1 A 300 m transect between plots with a duplex

EU HARMONISATION OF RESULTS

- STATISTICAL FOREST INVENTORIES – POINT SAMPLING -> volume estimation (biomass)
- One, two or three parametric functions ($d_{1.3}$, d_7, h)
- Harmonisation of volume estimates on European level

NFI—country	Growing stock (million m^3)		Difference (%)
	Country-level definition	Reference definition 2 Cost Action E43	
Austria	1106.5	1112.9	−0.6
Belgium	118.6	126.8	−6.5
Czech Republic	942.2	1028.0	−8.3
Denmark	133.1	110.7	+20.2
Estonia	476.0	462.4	+3.0
Finland	2343.4	2343.4	0.0
France	2566.5	2757.0	−6.9
Germany	3367.5	3185.8	+5.7
Hungary	390.4	352.7	+10.7
Ireland	97.5	99.4	−2.0
Latvia	660.3	660.9	−0.1
Lithuania	542.7	535.0	+1.4
Norway	1094.4	1126.3	−2.8
Portugal	158.1	179.4	−11.9
Romania	2156.5	1961.1	+10.0
Serbia	375.1	284.5	+31.9
Slovakia	569.5	608.8	−6.4
Slovenia	416.8	403.9	+3.2
Spain	1001.2	1088.5	−8.0
Sweden	3493.5	3493.5	0.0
Switzerland	409.7	408.2	+0.4

Gschwantner T. et al. 2019. Harmonisation of stem volume estimates in European National Forest Inventories. Annals of forest science 76:24

CONCLUSIONS

- NFI is important and internationally recognized source of data about forests on national level -> potentially part of EU forest monitoring
- Permanent long-term activity (need to be part of the funding system)
- Data dissemination -> web application (digitalization of information)
- Reporting – proper use of the data, citation, verification
- Additional information collecting on the NFI plots (forest soil and litter, forest functions, wood quality, biodiversity, age structure, AC/QC system …)
- NFI data – yearly (5 years) available information about the state of forest on country level, data time series …