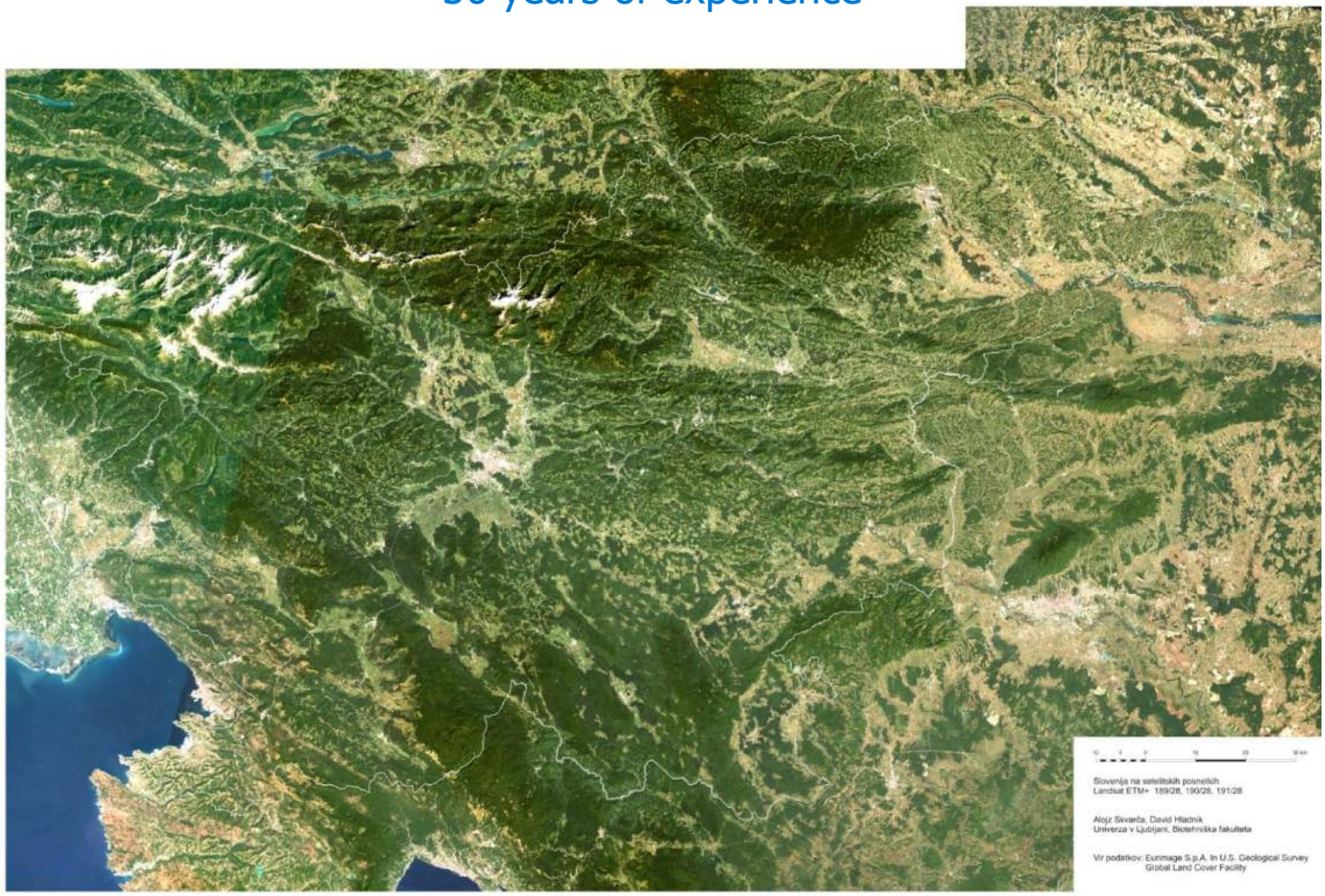
Forest and Forest Ecosystem Condition Survey in Slovenia

30 years of experience



Gozdarski inštitut Slovenije
Slovenian Forestry Institute

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Legislation framework

Forest and Forest Ecosystem Condition Survey (FECS)

- the term NATIONAL FOREST INVENTORY is not mentioned in legislation,

- Rules on forest protection nr. 92/2000 dictate that the inventorying is to be caried out annually on the 16 x 16 km grid and periodically (5-10 years) on the 4 x 4 km grid,

- in y. 2000 - ICP 4x4 km forest health monitoring system was upgraded with additional concentric permanent sampling plots and variables measured

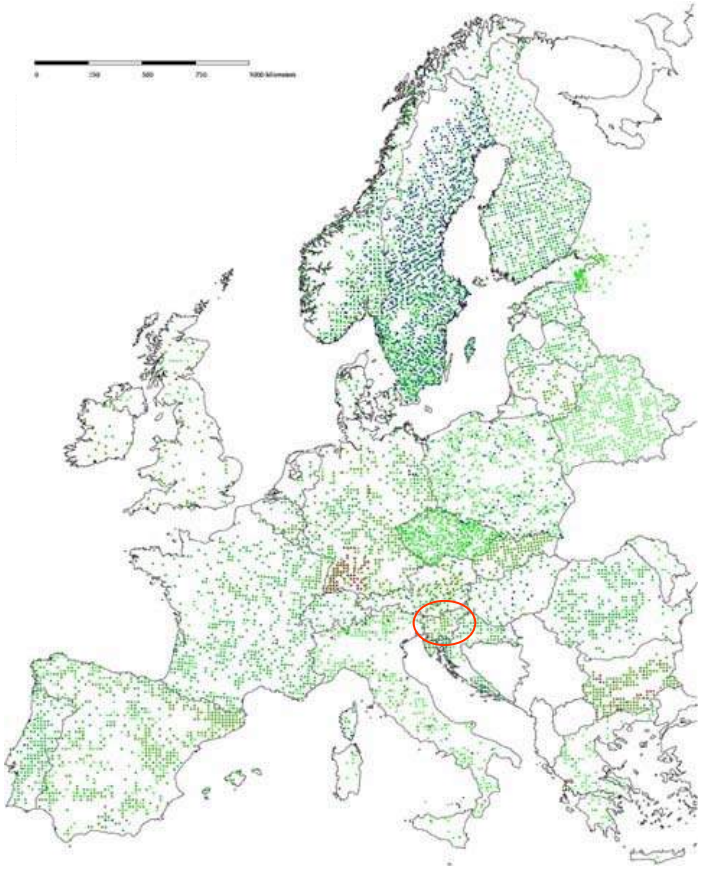
Data sources in forestry – two inventories

Slovenia forest service (SFS) inventory for forest management plans:

- stand wise inventory with permanent sampling plots,
- problems with consistent time series (change of method),
- 1/10 every year, not updated data, on average 5 years old estimates

Forest and Forest Ecosystem Condition Survey

- until y. 2000 no statistical based, reliable large scale forest inventory (national forest inventory) in Slovenia,



ICP Forests

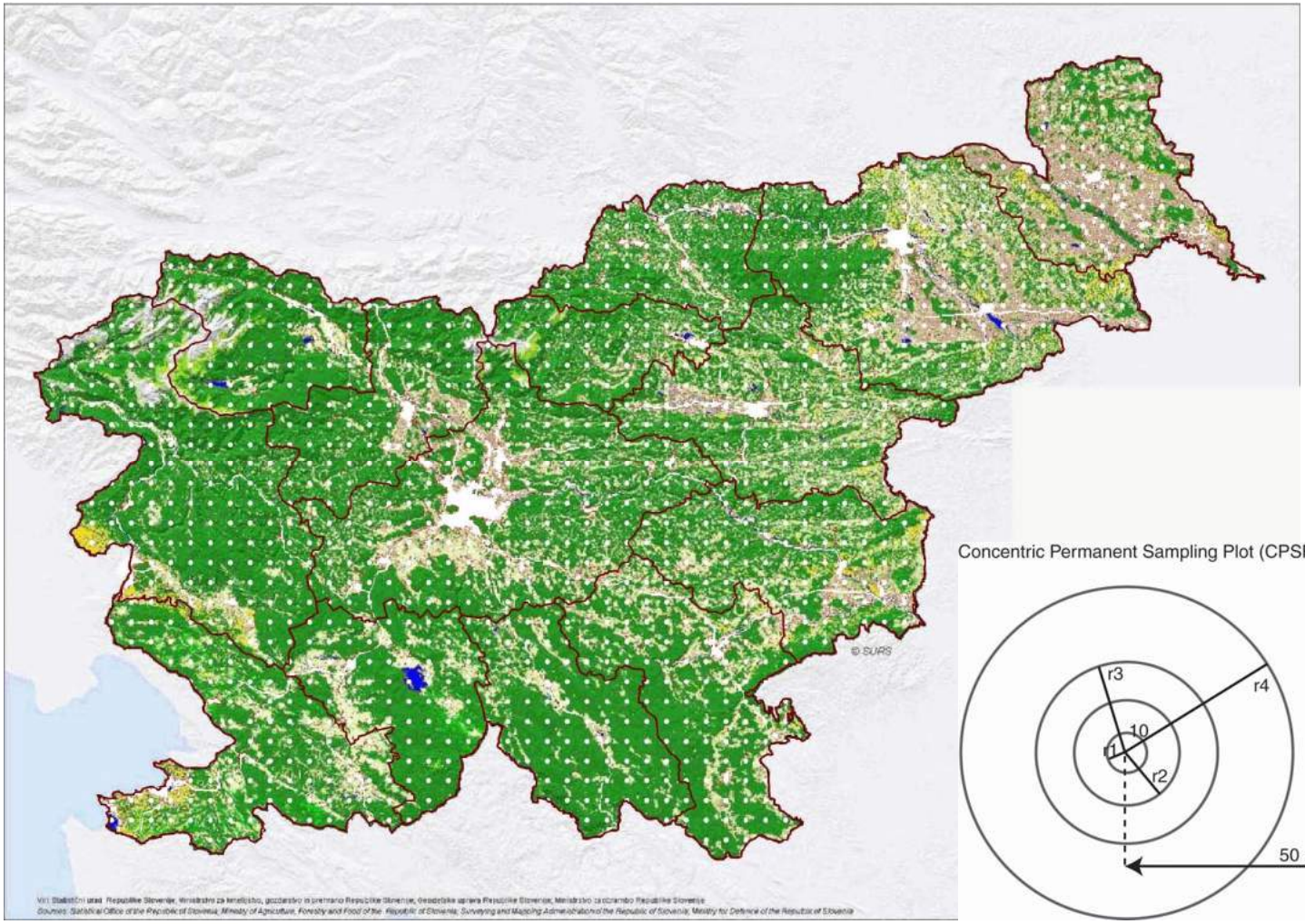
International Co-operative Programme on the Assessment and Monitoring of Air pollution Effects on Forests

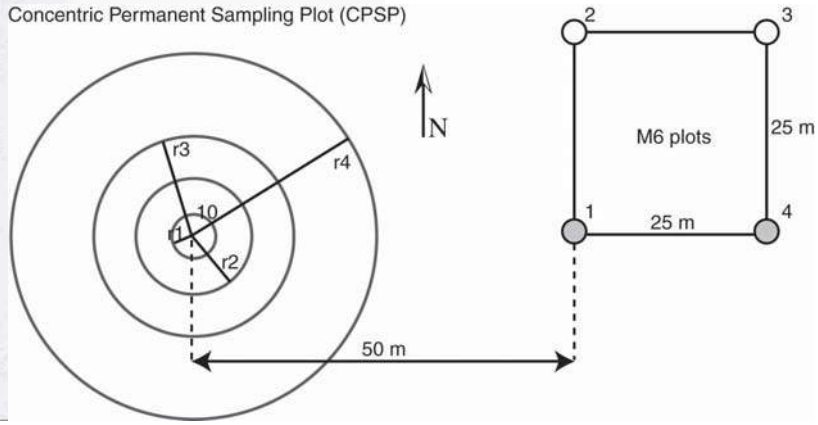
Level I	16 x 16 km	6000 plots EU
		40 plots SI
	4 x 4 km	700 plots SI

ICP Forests Level I

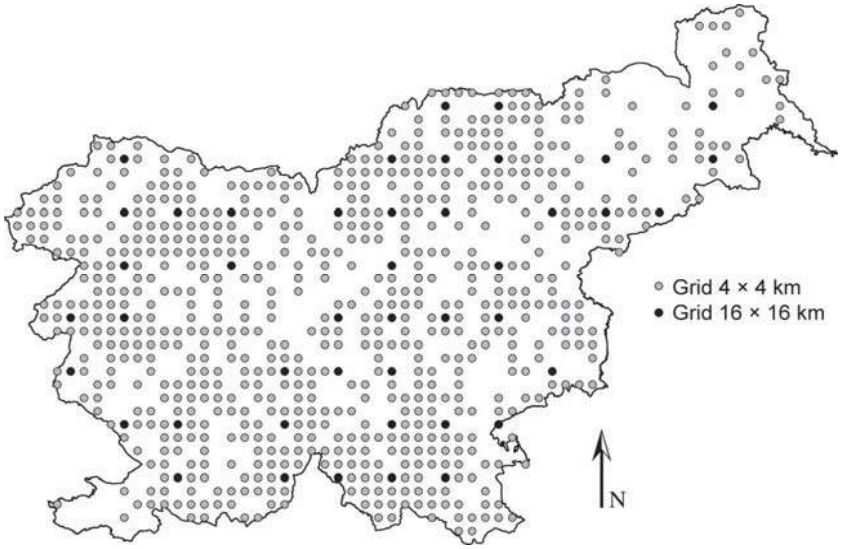
760 plots 4x4 km sampling grid

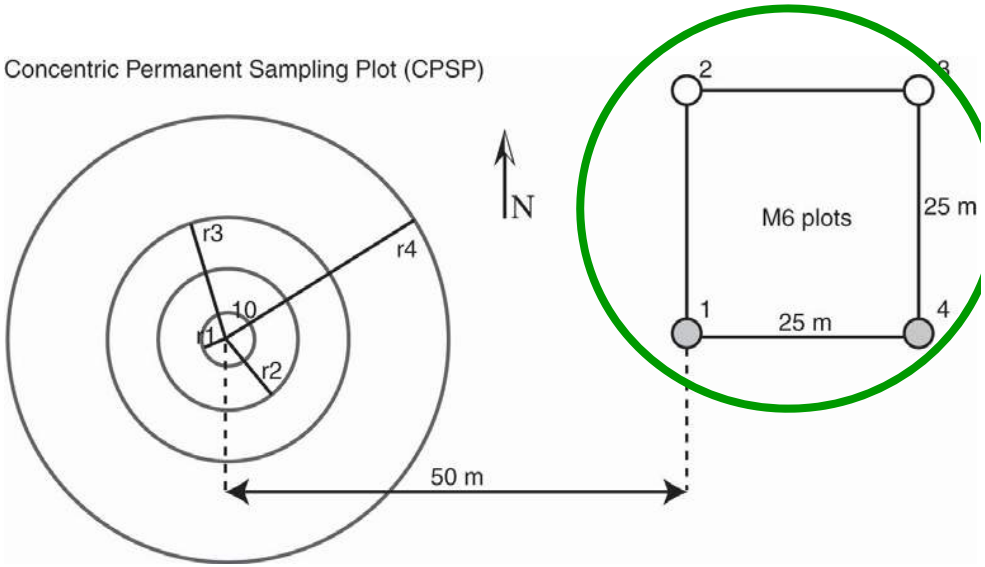
Hočevar M., Mavsar R., Kovač M., 2000. Zdravstveno stanje gozdov v Sloveniji v letu 2000. Zbornik gozdarstva in lesarstva 67, s. 119-159





Forest and Forest Ecosystem Condition Survey





Sampling grid

4x4 km (780 clusters)
- data from 2000, 2007
- periodical (5-10 years)

16x16 km (44 clusters)
- every year, to detect changes

Sampling cluster

4 M6 plots (ICP) (right), since 1985

1 concentric (four cycles) permanent sampling plot (left), since 2000

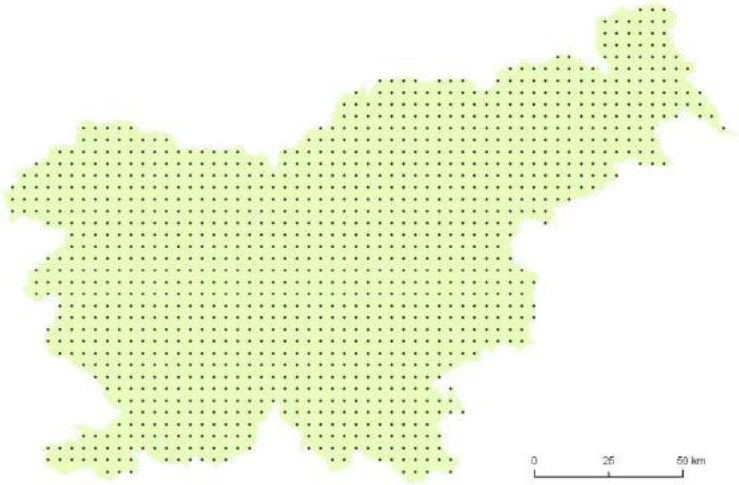
Forest Inventory 2007 / 2012 – plots, variables, thresholds

Plots	$CPSP_1$	$CPSP_2$	$CPSP_3$	$CPSP_4$
Radius (R) of the plots [m]*	3.09	7.98	13.82	25.23
Area (P) of the plots [m²]	30	200	600	2,000
Characteristics of stand and site	Area of 2,000 m²			
Standing living trees	dbh > 0 cm h ≥ 1.3 m	dbh ≥ 10 cm	dbh ≥ 30 cm	
Standing dead trees	dbh ≥ 10 cm		dbh ≥ 30 cm	
Lying dead trees	dbh ≥ 10 cm		dbh ≥ 30 cm	
Stumps	d ≥ 10 cm h ≥ 20 cm		/	
Snags	d ≥ 10 cm h ≥ 50 cm		d ≥ 30 cm h ≥ 50 cm	
Coarse woody debris – woody parts of trees (branches, parts of stem etc.)	d ≥ 10 cm l ≥ 50 cm		d ≥ 30 cm l ≥ 50 cm	

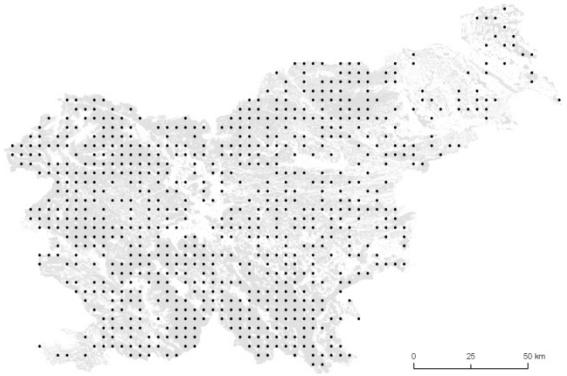
Forest Inventory 2012 – sampling design

Systematic grid spacing

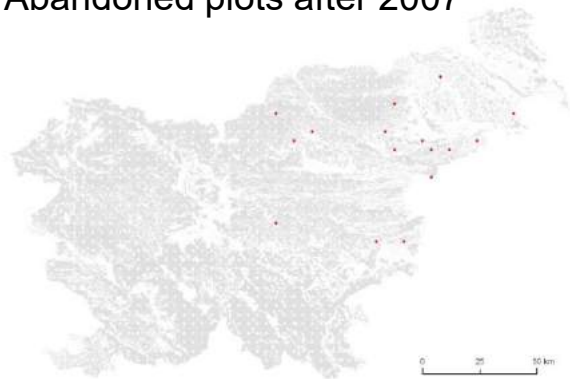
4 x 4 km



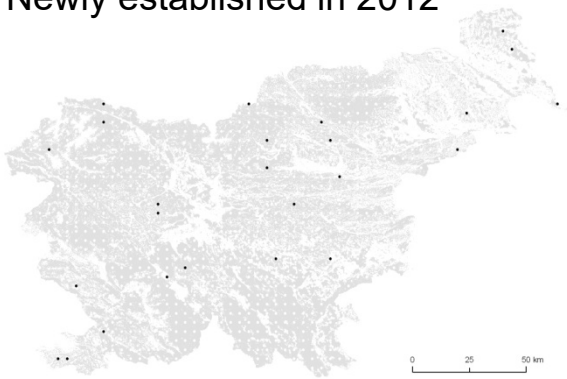
Forest cover 2012



Abandoned plots after 2007



Newly established in 2012



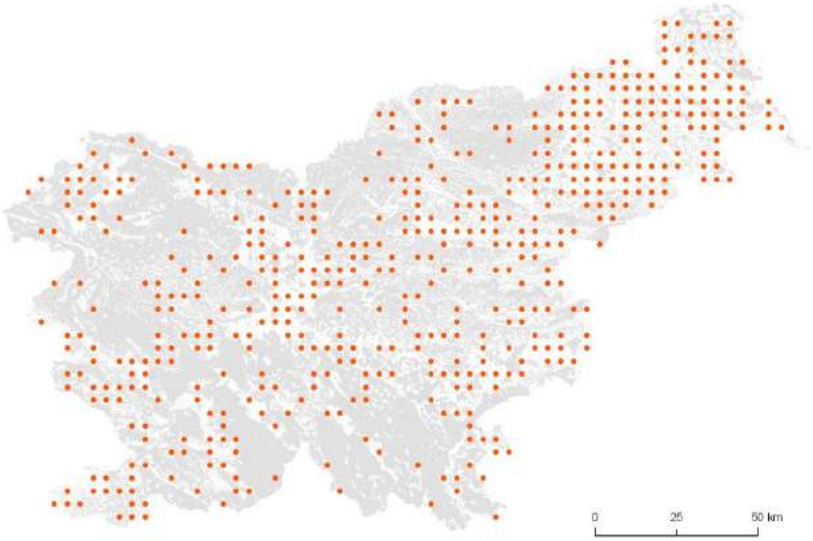
Forest Inventory 2012 - estimates

		E (%)
• number of plots	760	
• growing stock	333,7 m^3/ha	4,1
• deadwood	19,8 m^3/ha	25,8
• gross increment	8,5 m^3/ha year	4,3
• removal	4,2 m^3/ha year	19,7
• ingrowth	0,4 m^3/ha year	17,4
• $V_{2012} - V_{2007}$ = 20,1 m3/ha ▶	4,0 m^3/ha year	

Trees outside forest in 2012 – sampling design

Systematic grid spacing 4 x 4 km

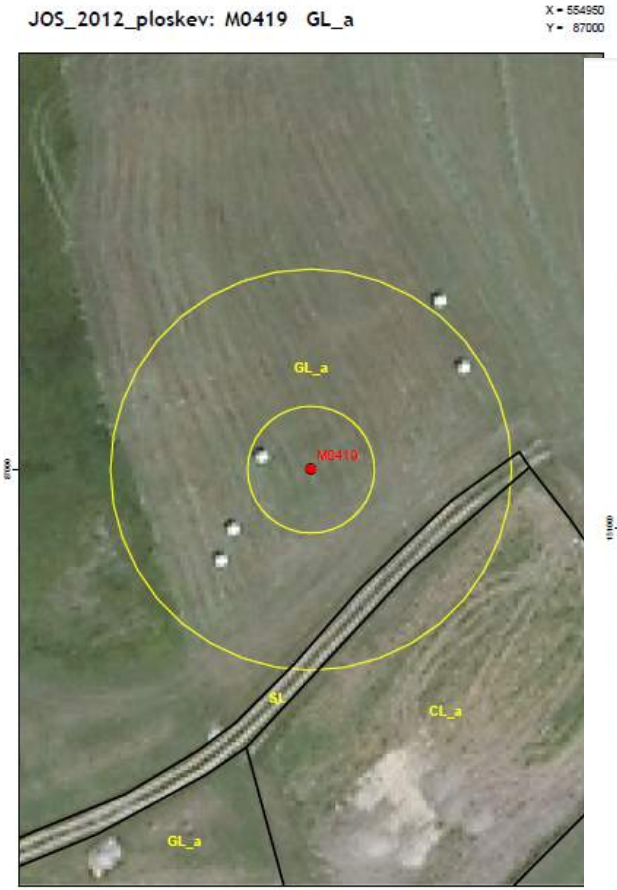
CL _ a	10 plots
CL _w	14
GL _ a	101
GL _ w	14
SL	39
WL	21

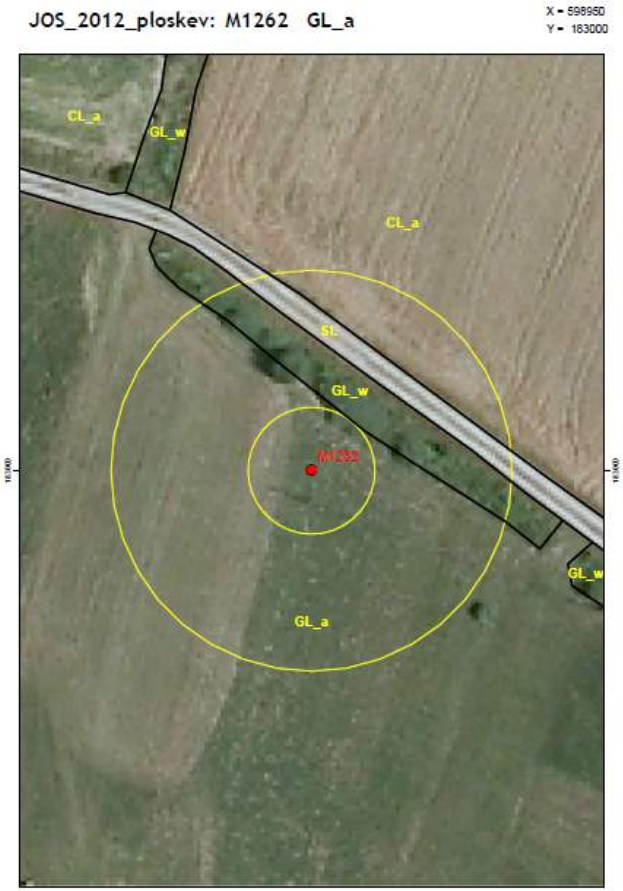


Stratification and additional plots on 1 x 1 km grid

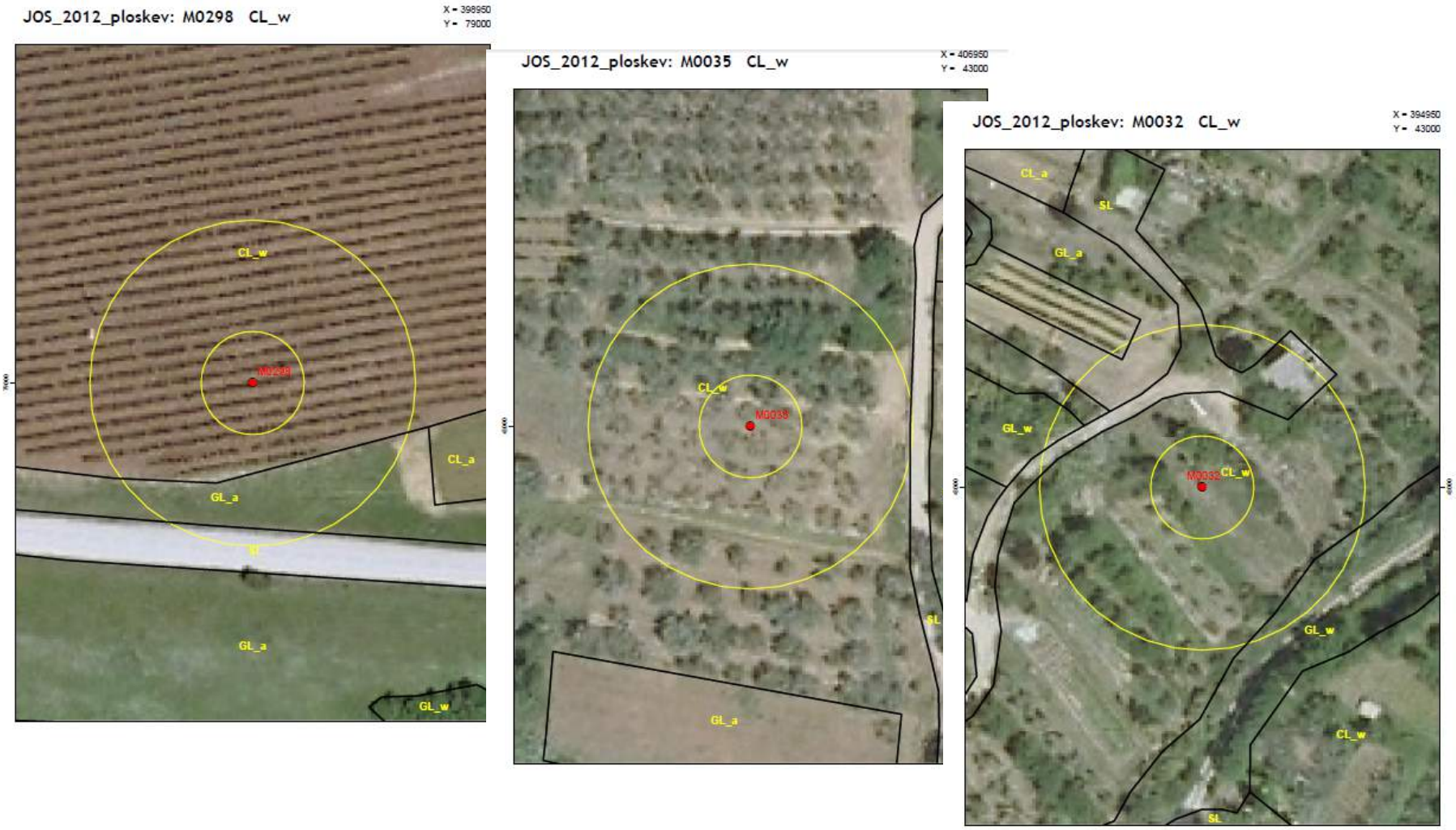
GL _ a	130 plots	
		(spontaneous afforestation)
GL _ w	143	(trees and shrubs)
		(small patches, linear elements)
SL	152	

Trees outside forest - inventory 2012





Trees outside forest - inventory 2012



Trees outside forest - inventory 2012

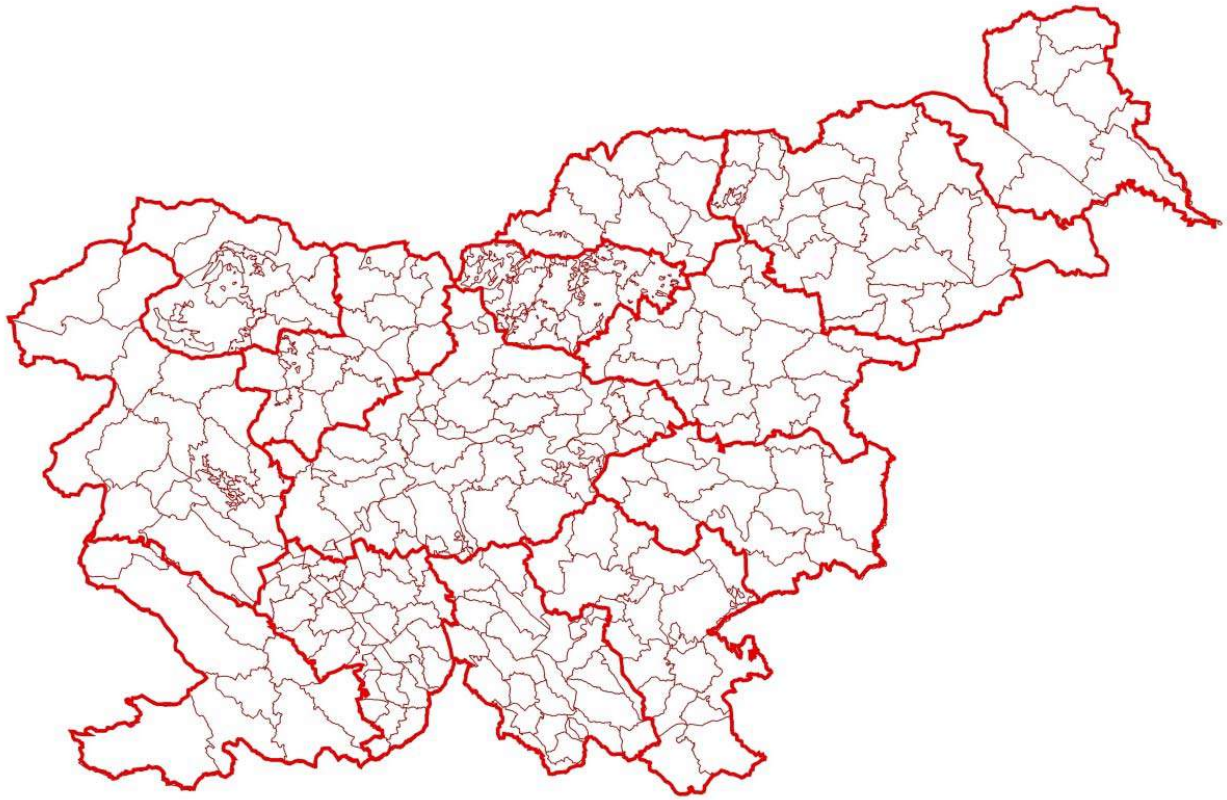
Trees outside forest - inventory 2012

Trees outside forest in 2012 – estimates

LULUCF	Growing stock (m^3)	E (%)
CL_a	504.059	(129,6)
CL_w	1.364.338	(50,7)
GL_a	4.090.300	49,7
GL_w	9.361.911	31,4
WL	571.538	(121,4)
SL	2.078.063	32,9
Total	17.970.209	

Forest management planning in forest management units

Slovenian Forest Service

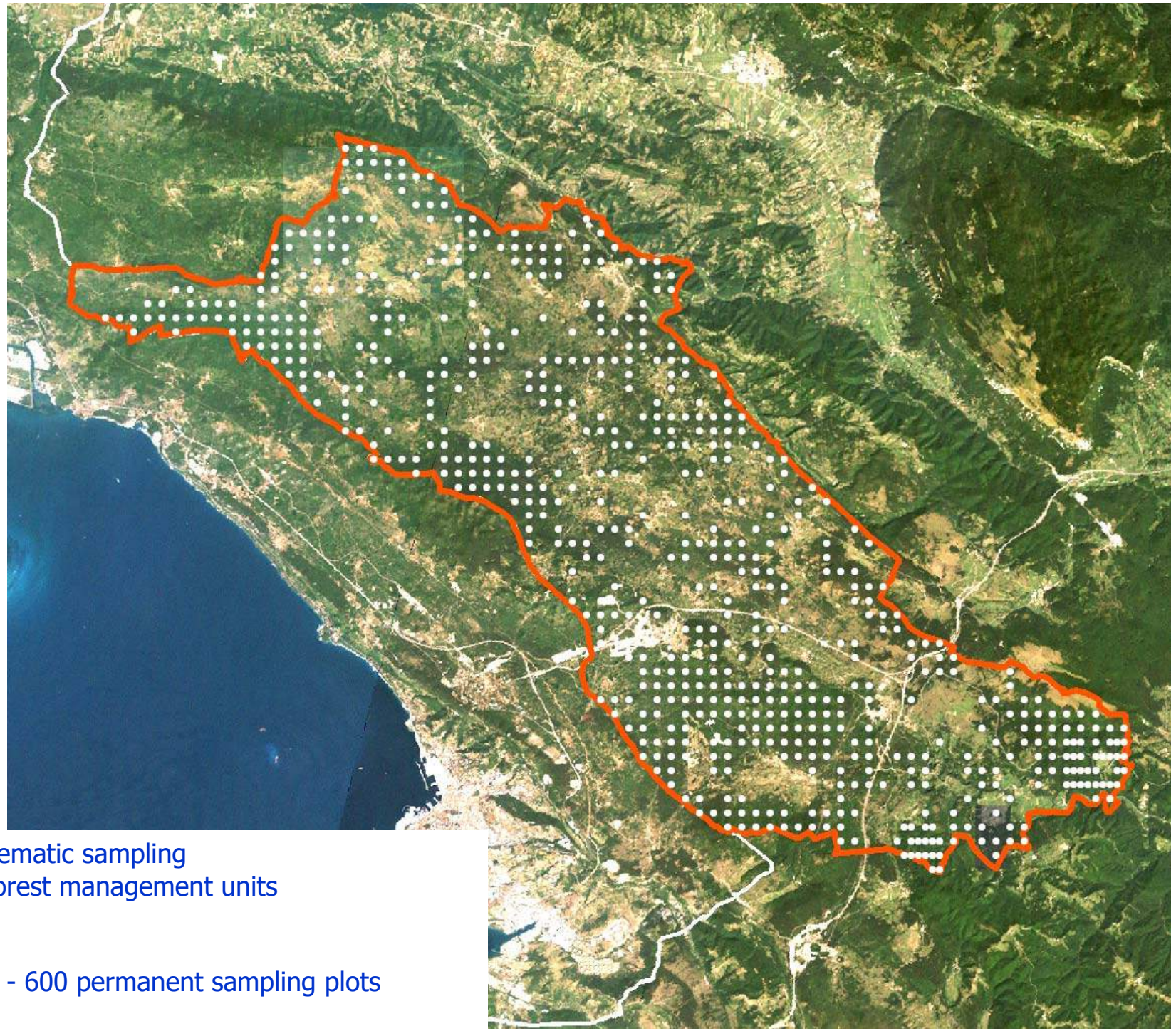


Control sampling method

105.000 permanent sampling plots

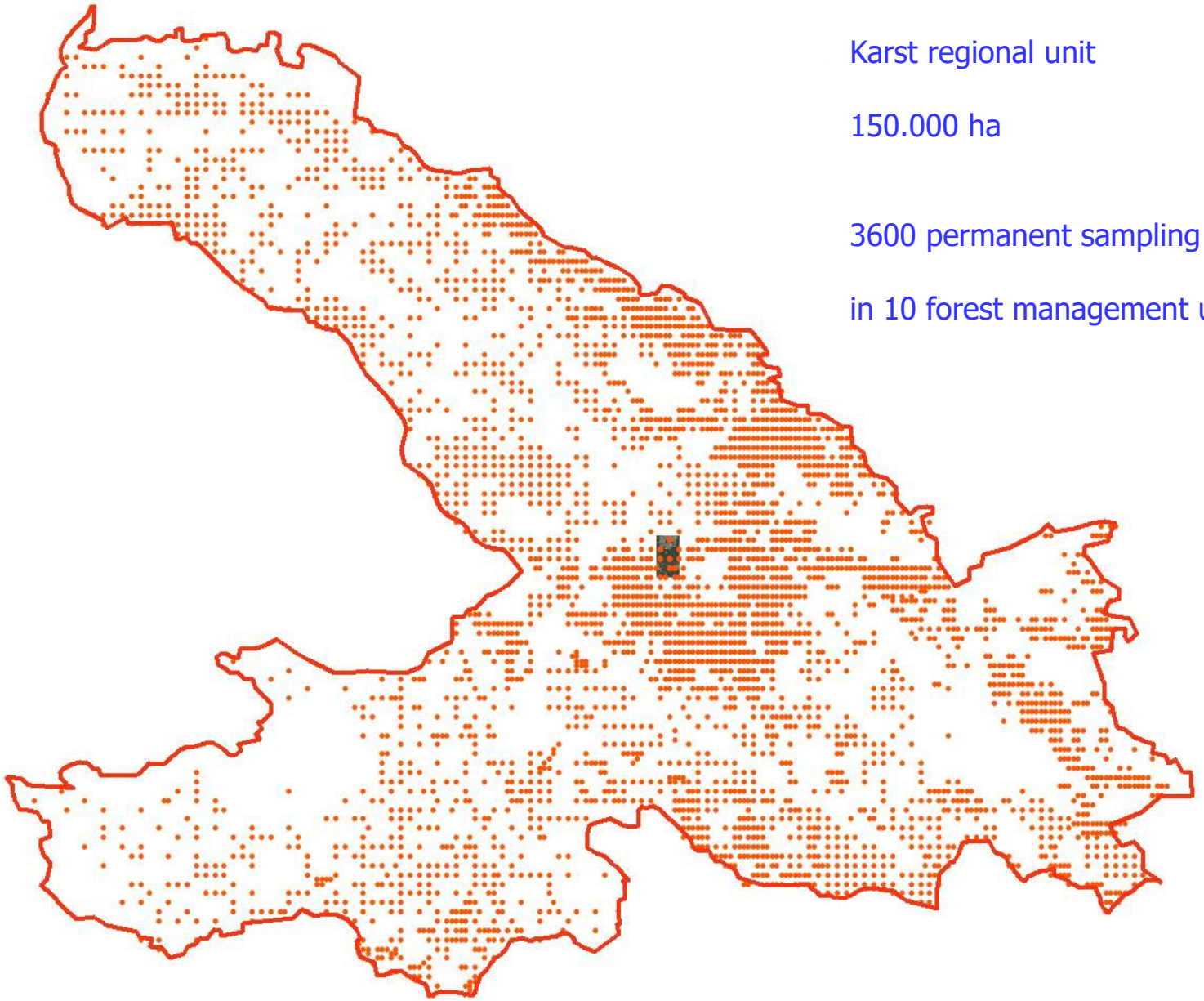
Sampling grids (Pisek, 2010)

200 x 200 m 200 x 250 m 250 x 250 m 250 x 500 m



Systematic sampling
in forest management units

400 - 600 permanent sampling plots



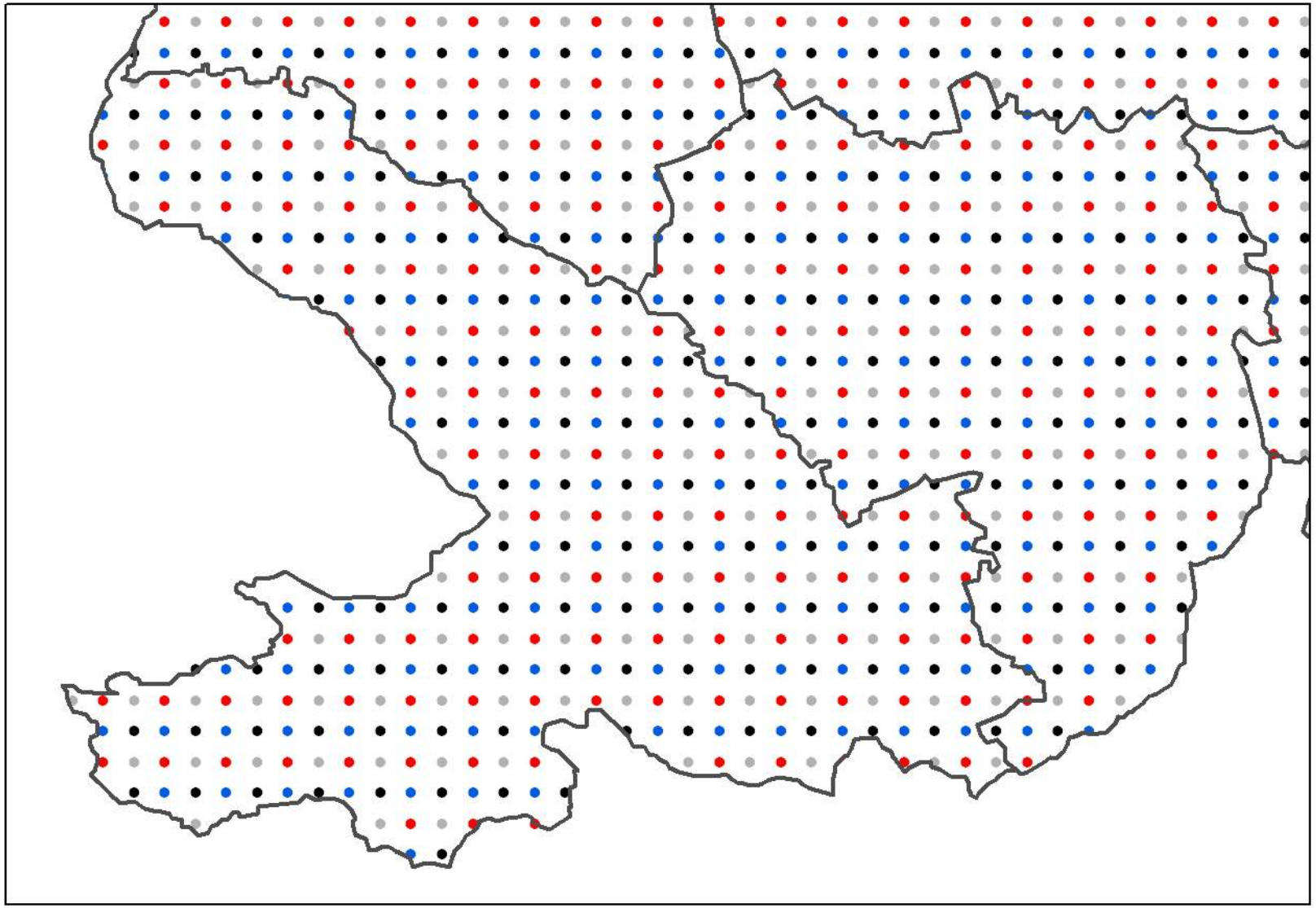
Karst regional unit

150.000 ha

3600 permanent sampling plosts

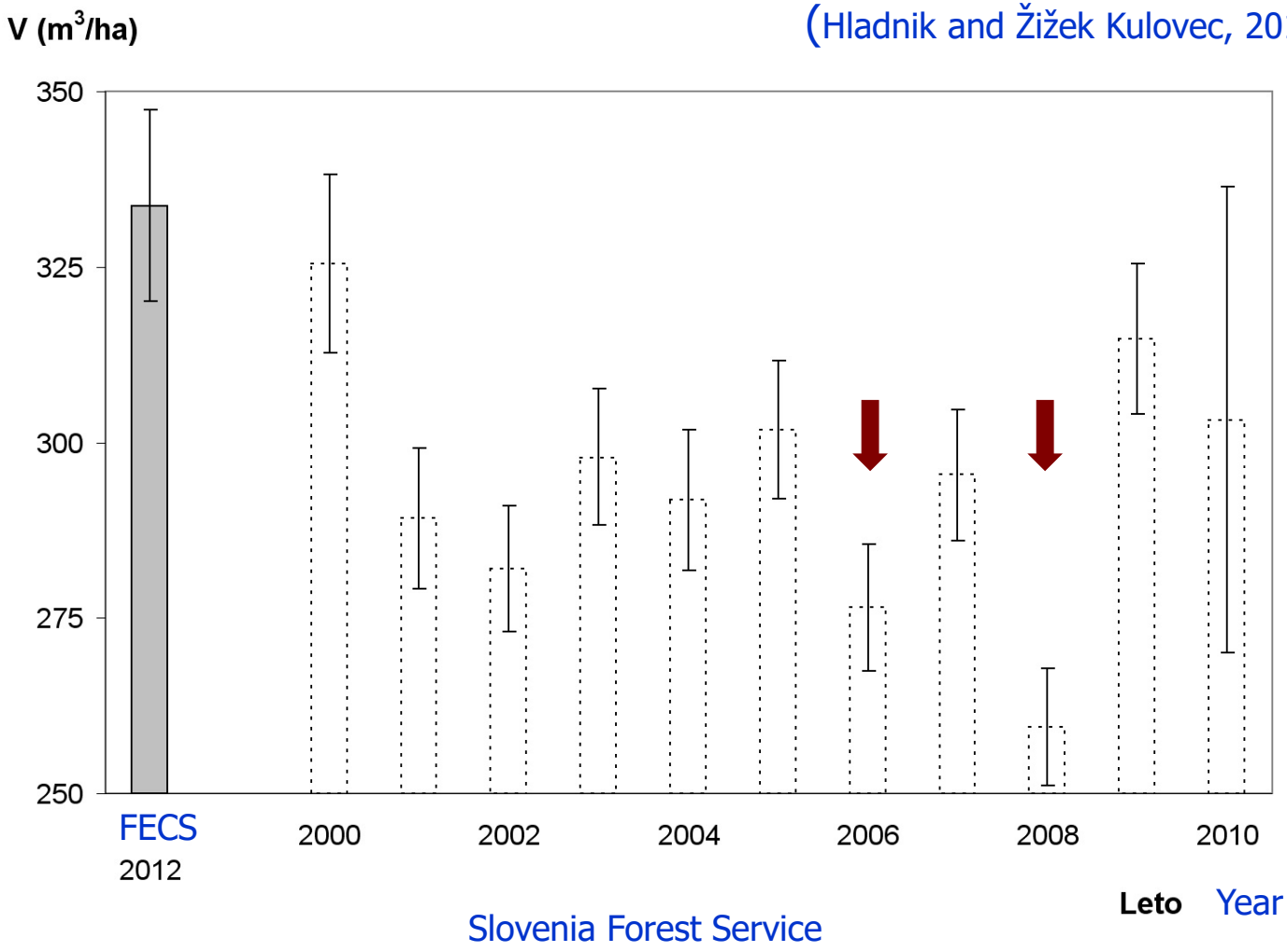
in 10 forest management units

Panel design of forest inventory

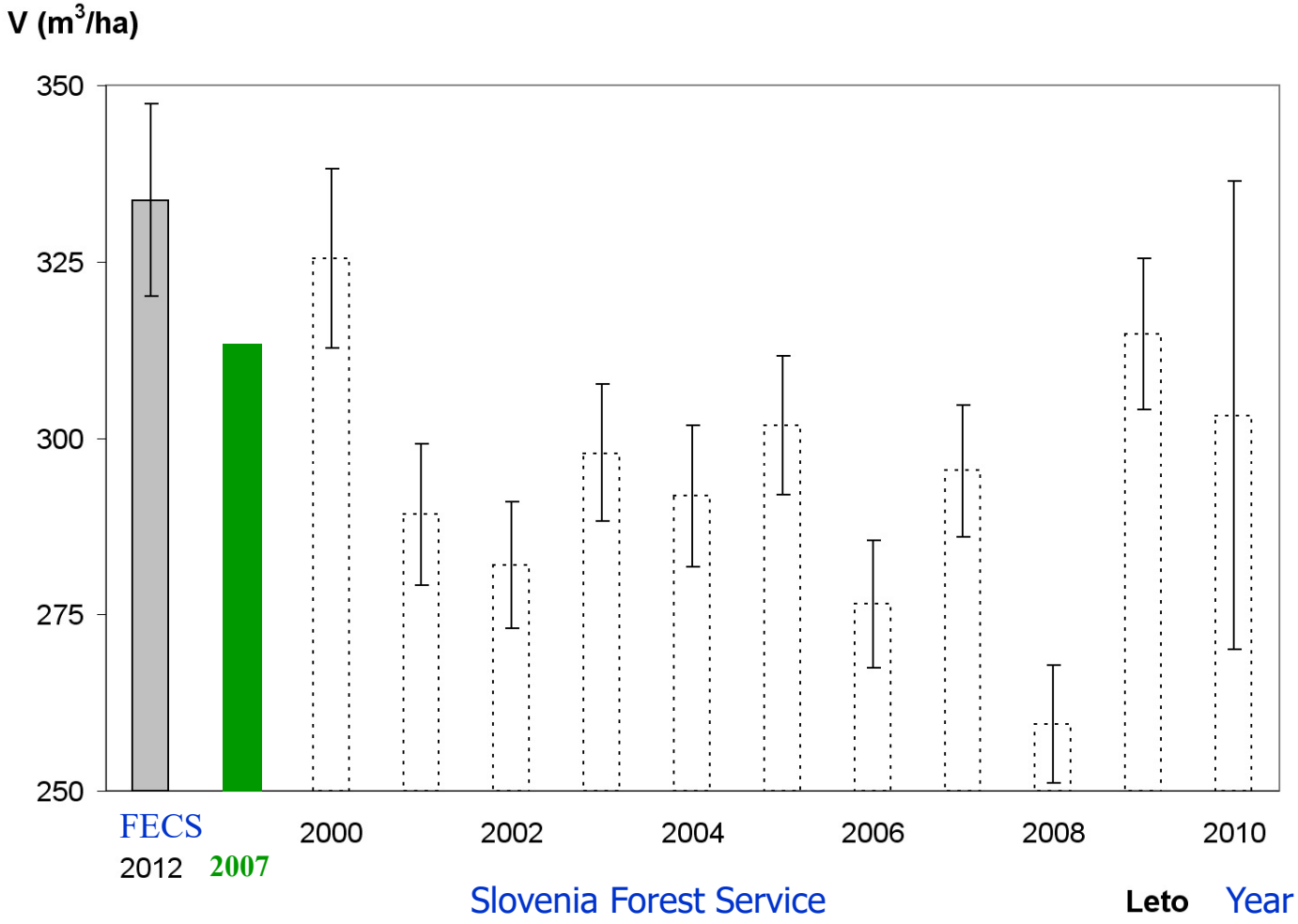


Estimates of average growing stock on 4 x 4 km sampling grid of the FECS in 2012 and on 1 x 1 km grid of permanent plots of forest management planning (SFS)

(Hladnik and Žižek Kulovec, 2014)



Slovenia Forest Service


V (m3/ha)
350
325
300
275
250
FECS
2012
2007
2000
2002
2004
2006
2008
2010
Slovenia Forest Service
Leto
Year

Forest Inventory 2007 / 2012 – calculation

Above-ground biomass (AGB):

- **tree volume** (m^3) input data: **DBH** and **tariffs**: V = f(DBH)
- **growing stock (GS)** (m^3/ha), * area (ha) → (m^3)
- from **GS** to **carbon stock** in **AGB** (tree species)
  - biomass expansion factors (**BEF**): **GS** (m^3) → **AGB** (m^3)
  - wood density (**WD**): **AGB** (m^3) → **AGB** (t)
  - biomass/carbon factor (**CC**): **AGB** (t) → $\mathbf{C_{DWB}}$ (t)

Below ground biomass (BGB):

- input data: **AGB** (t)
- from **AGB** to **carbon stock** in **BGB** (tree species):
  - Root-shoot ratio (**R**): **AGB** (t) → **BGB** (t)
  - biomass/carbon factor (**CC**): **BGB**(t) → $\mathbf{C_{BGB}}$(t)

Forest Inventory 2007 / 2012 – calculation

Dead wood biomass (outer circle, 20 ar**):**

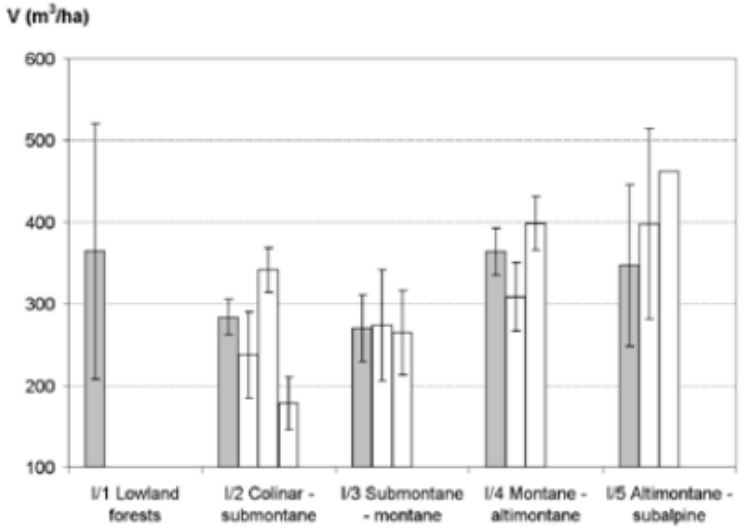
- **volume:** measuring: **diameter**, **length**
- **type**: large wood piece (D>10 cm, L > 1 m), stump, snag, dead trees (lying/standing)
- **decomposition rate**
- **tree species:** where possible

Dead wood biomass (DWB):

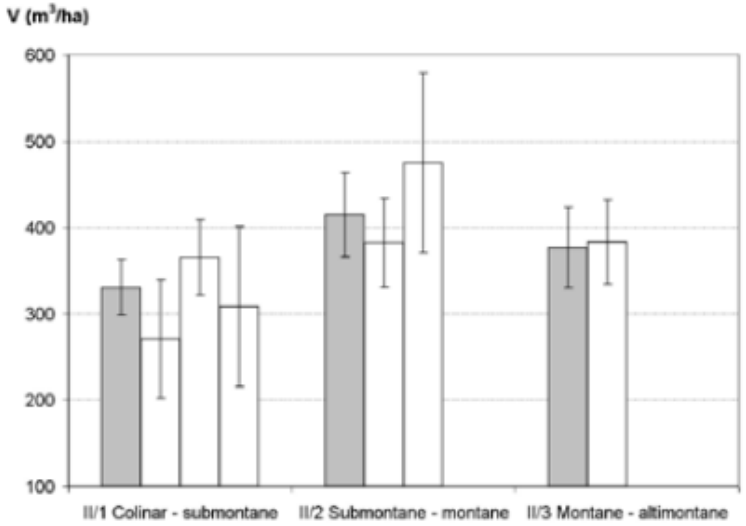
- dead wood **volume** (m^3) input data: **D** and **L, Huber equation, tariffs for trees**
- dead wood stock **(DWS)** (m^3/ha), * area (ha) → (m^3)
- from **DWS** to **carbon stock** in **DWS** (tree species):
  - wood density (**WD**): **DWB** (m^3) → **DWB** (t)
  - biomass/carbon factor (**CC**): **DWB** (t) → **C_{DWB}**(t)

Estimates of average growing stock in the year 2012

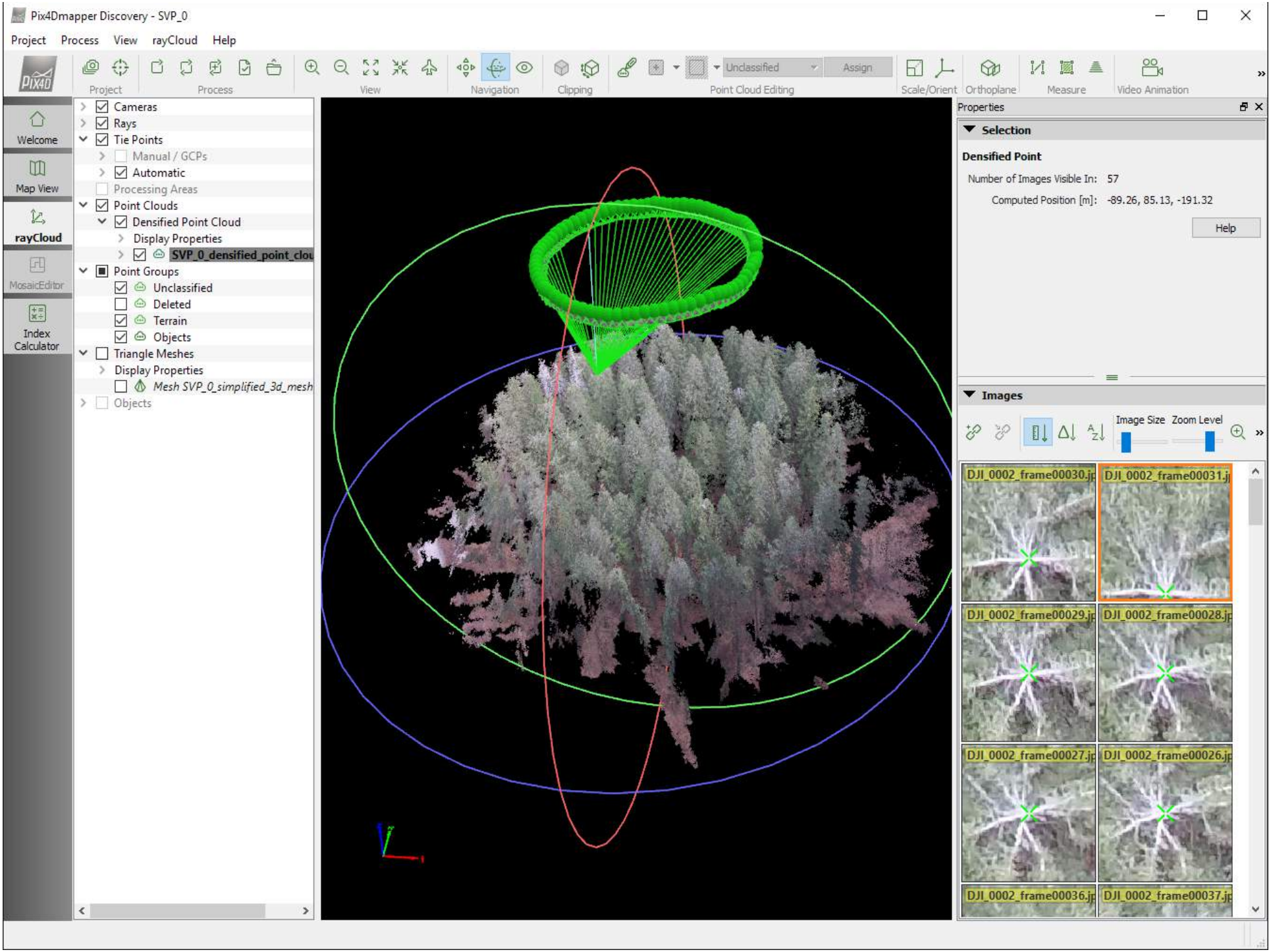
with 95% confidence intervals by groups of selected forest site types and selected vegetation units



I/ 1 Lowland forests on carbonate and mixed carbonate-silicate bedrock
I/ 2.1 Forests of *Carpinus betulus*, and of *Quercus petraea* on carbonate and mixed bedrock
2.2 Colinar-submontane *Fagus sylvatica* forests on carbonate and mixed bedrock
2.3 Forests and woodlands of thermophilous broadleaves
3.1 Non-thermophilous *Fagus sylvatica* forests
3.2 Thermophilous *Fagus sylvatica* forests
4.1 Montane-altimontane forests of *Fagus sylvatica* on carbonate and mixed bedrock
4.2 Forests of *Fagus sylvatica* with *Abies alba* on carbonate and mixed bedrock
5.1 Altimontane-subalpine forests of *Fagus sylvatica* on carbonate and mixed bedrock
5.2 Altimontane-subalpine forests of *Picea abies* on carbonate and mixed bedrock



II/1.1 Forests of *Carpinus betulus* with *Quercus petraea* on silicate bedrock
1.2 Colinar-submontane forests of *Fagus sylvatica* with *Quercus petraea* on silicate bedrock
1.3 Acidophilous *Pinus sylvestris* forests
2.1 Submontane-montane *Fagus sylvatica* forests on silicate bedrock
2.3 Submontane-montane forests of *Abies alba* on silicate bedrock
3.1 Montane-altimontane *Fagus sylvatica* forests on silicate bedrock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Project Process View rayCloud Help
Project Process View Navigation Clipping Point Cloud Editing Scale/Orient Orthoplane Measure Video Animation
Unclassified
Assign
Welcome
Map View
rayCloud
MosaicEditor
Index Calculator
Cameras
Rays
Tie Points
Manual / GCPs
Automatic
Processing Areas
Point Clouds
Densified Point Cloud
Display Properties
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Point Groups
Unclassified
Deleted
Terrain
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Triangle Meshes
Display Properties
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Objects
Properties
Selection
Densified Point
Number of Images Visible In: 57
Computed Position [m]: -89.26, 85.13, -191.32
Help
Images
Image Size Zoom Level
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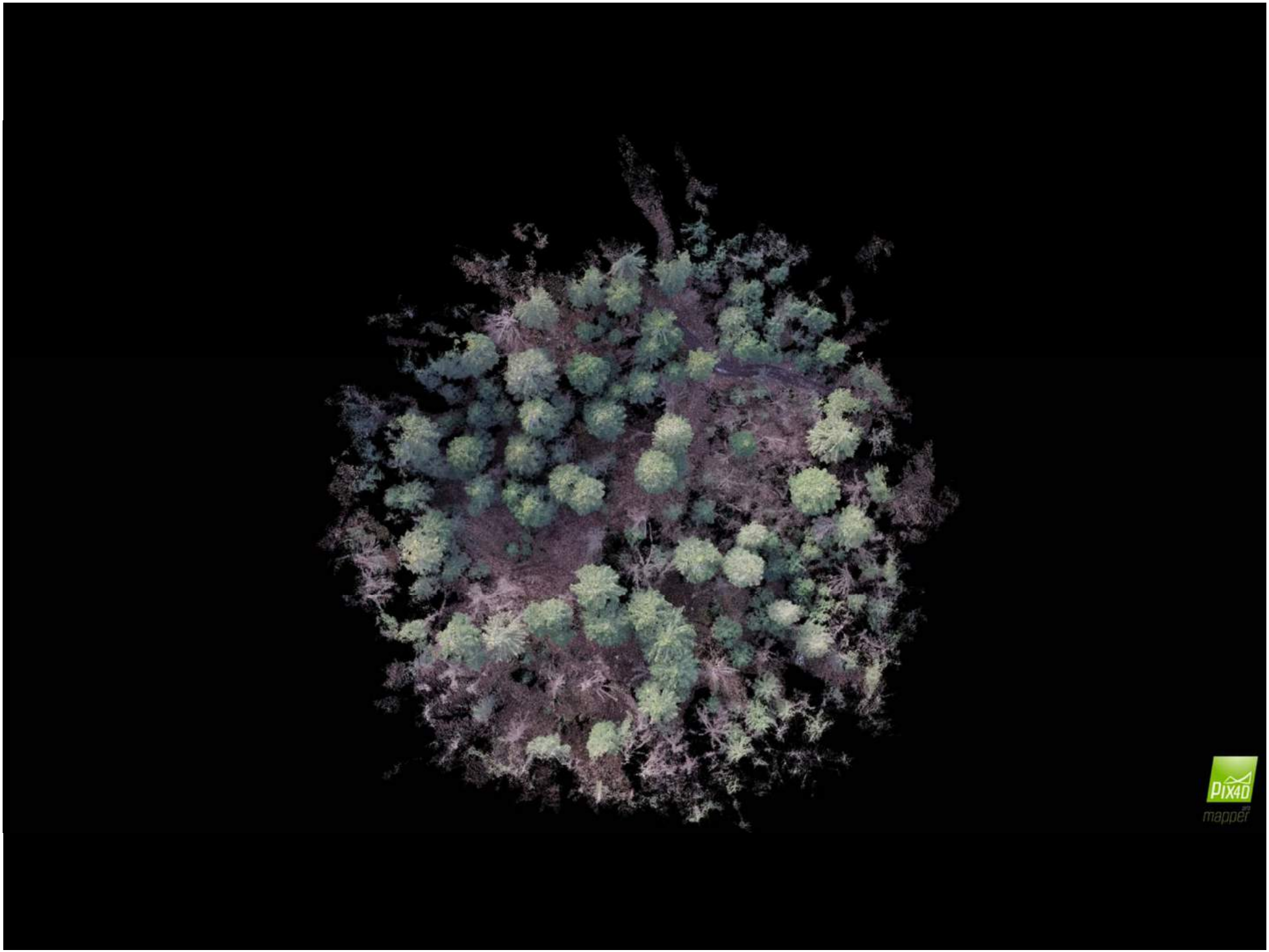
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