

SFM VR

Sustainable Forest Management through Virtual Reality

Using forest simulations
in sustainable forest management training



Training needs

- Forest district staff
 - Harvesting companies staff requirements
 - Technical staff
 - Workers
 - Forest management planning requirements
-
- **Training – raising awareness**

Technical silviculture

- Multi-functional forestry introduced in 1954 – **functional zoning system**
- **Mandatory forest management planning:** each forest plot has a function assigned – protection or production
 - 52% forests are assigned with regulating ecosystem services: water, soil, climate, recreation and for biodiversity protection
 - 4% of forests are strictly protected
 - Current efforts to integrate old-growth forests as strictly protected areas



Silvicultural principles



- **Close to nature, low intensity forest management**
- **Natural regeneration and natural types of forests**
- **High timber quality values based on long rotation age**
 - Long production cycles – rotation of 90-140 years (Picea, Fagus, Abies, Quercus)
 - Long regeneration periods (15-30 years)

Ecological sustainability of forestry

- **Natural forests** - preserving and restoring (natural) forests
- **Natural regeneration** – the main form of forest regeneration
- **Afforestation/reforestation of degraded lands** - reverse land degradation and rehabilitate unproductive land - *the national technical regulations stipulate that only species of trees or shrubs ecologically adapted to the conditions in which they are installed are used.*

Protected areas system

- 15 National Parks
- 13 Natural Parks
- Forest reserves
- Natura2000 sites

45% of forests

Sustainable forest management requirements

Ecological restrictions



Protected areas system – 45% of forests

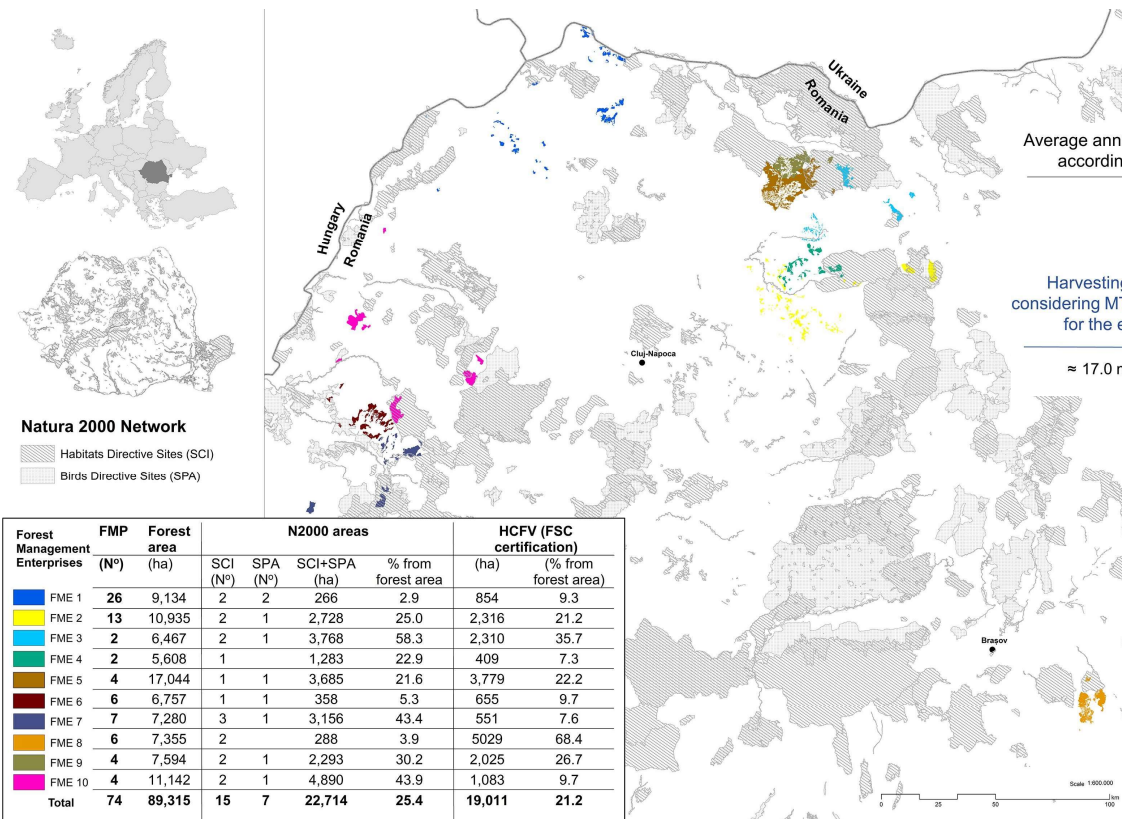


Voluntary restriction – forest certification

- Biodiversity trees
- Marginal habitats
- Protected species

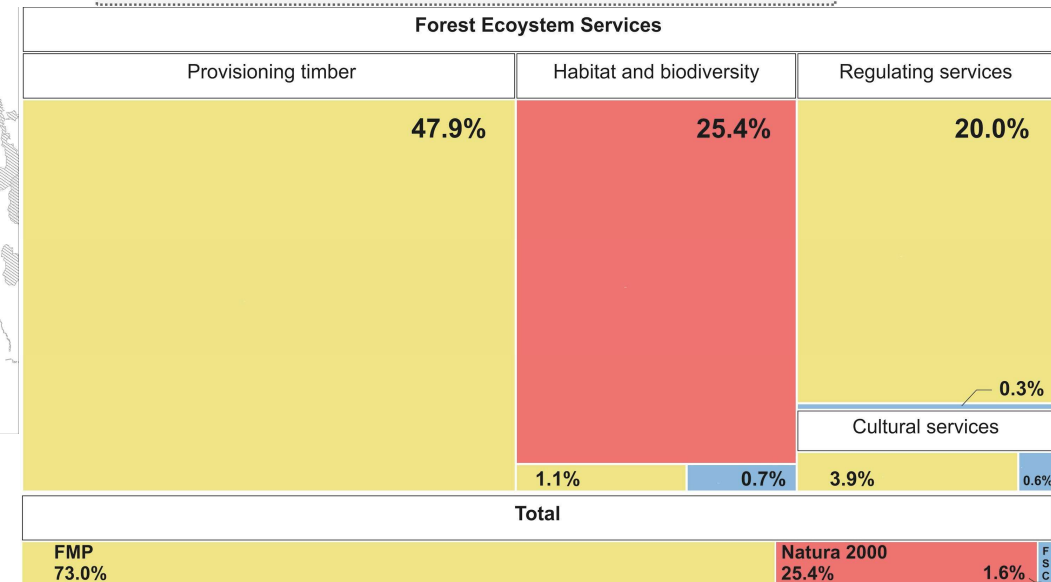
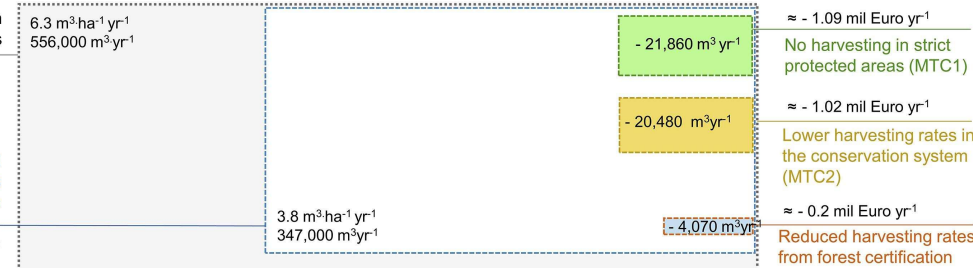


Ecological and management restrictions



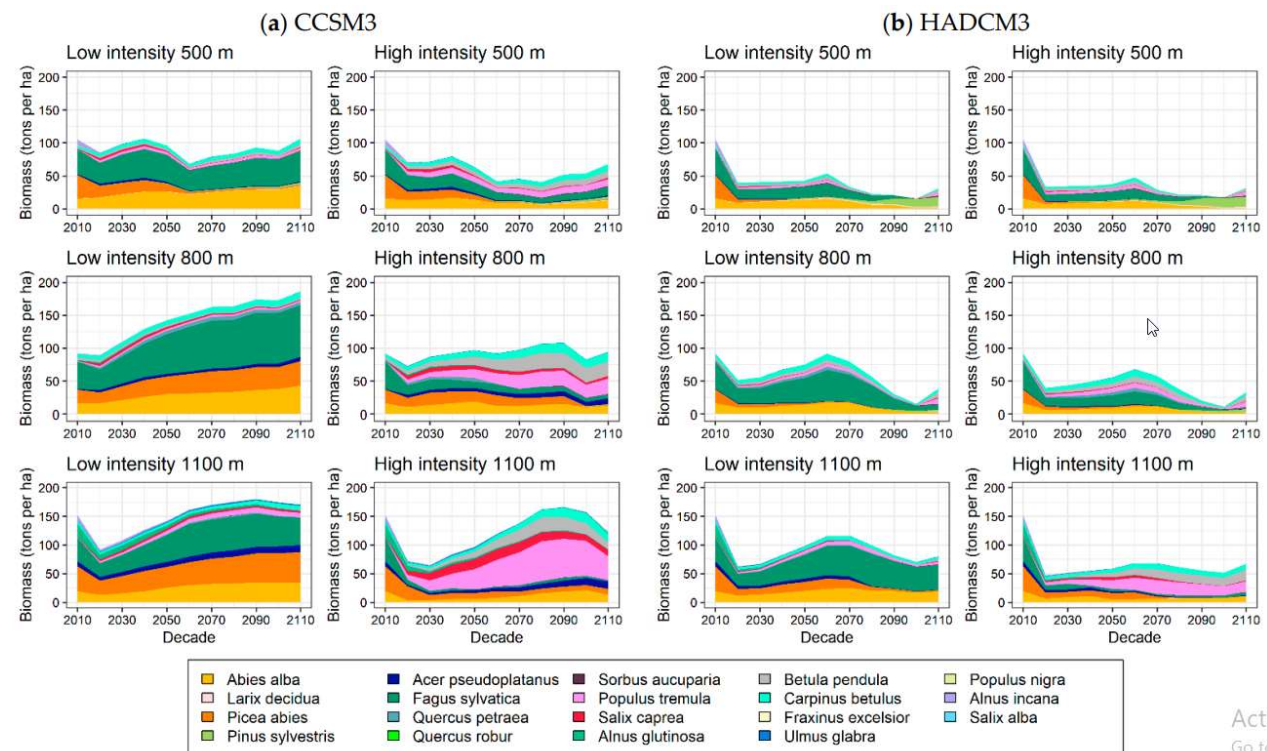
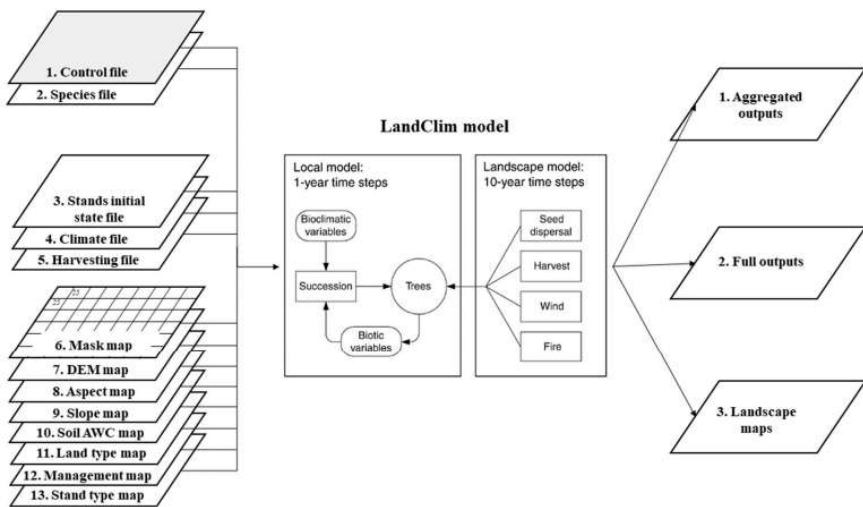
Average annual growth according to FMPs
 $6.3 \text{ m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$
 $556,000 \text{ m}^3 \text{ yr}^{-1}$

Harvesting potential considering MTC 6 rates for the entire area
 $\approx 17.0 \text{ mil Euro yr}^{-1}$



Nichiforel, L., Duduman, G., Scriban, RE, Popa, B., Barnoaiea, I., Drăgoi, M., 2021, Forest ecosystem services in Romania: Orchestrating regulatory and voluntary planning documents. Ecosystem Services, Volume 49

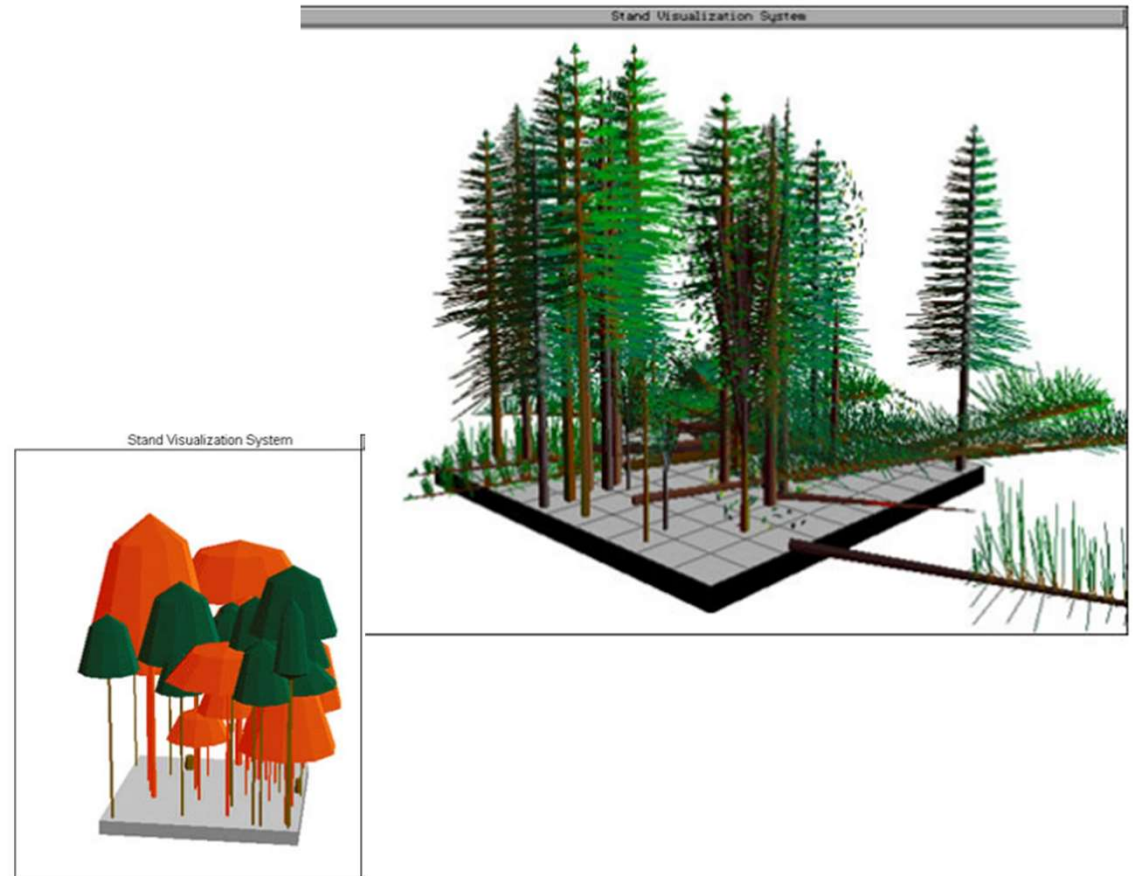
Forest modelling simulations – incorporating ecological restrictions and climate change



Cosofret, C. Duduman, G. Barnoaiea, I. Bouriaud, O. Management or Climate and Which One Has the Greatest Impact on Forest Soil's Protective Value? A Case Study in Romanian Mountains. Forests 2022, 13, 916.

Current teaching methods

- Simulators – mostly the computer simulations of tree or forest development under certain specific conditions (selecting the trees for cutting, evaluation of forest development after a certain period)



Simulations - SVS Stand Visualization System

Species: 202 Tree class: 99 Crown class: 99

Modulul de design al arborilor

Branch base: 0.00
 Branch increment angle: 67
 Uptilt at crown top: 2.8
 Uptilt at crown base: -2.4

branches: 390
 # whorls: 13
 High X: 0.83
 High Y: 0.57
 Low X: 0.98
 Low Y: 0.10

Stem color: 17
 Branch color: 19
 Foliage 1: 5
 Foliage 2: 18

Single leader form
 Multiple leader form
 Special object form
 Show wireframe

Redrau all

cr: 0.40 rad: 15 ht: 140

Load... Save... Add form... Modify form... Cancel Done

Stand Visualization System

Sistemul de marcare a arborilor

Marking Scenario 1... 'Mark' to stop

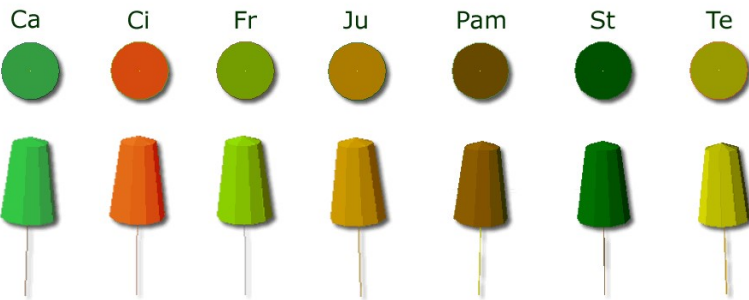
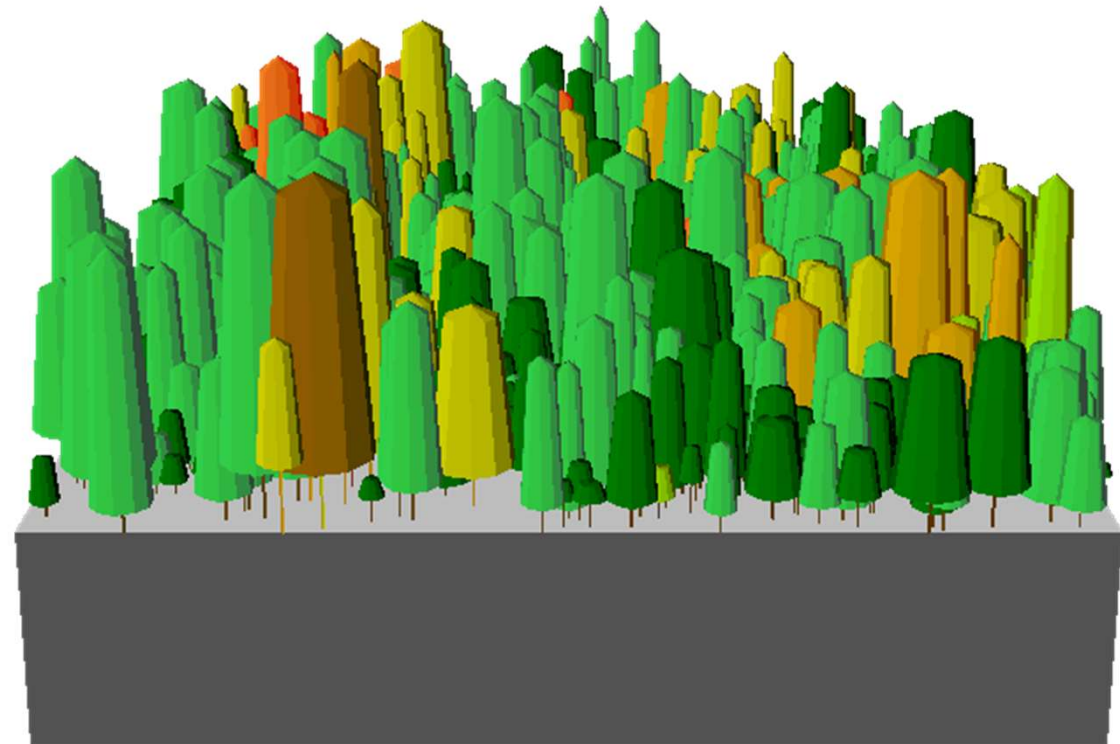
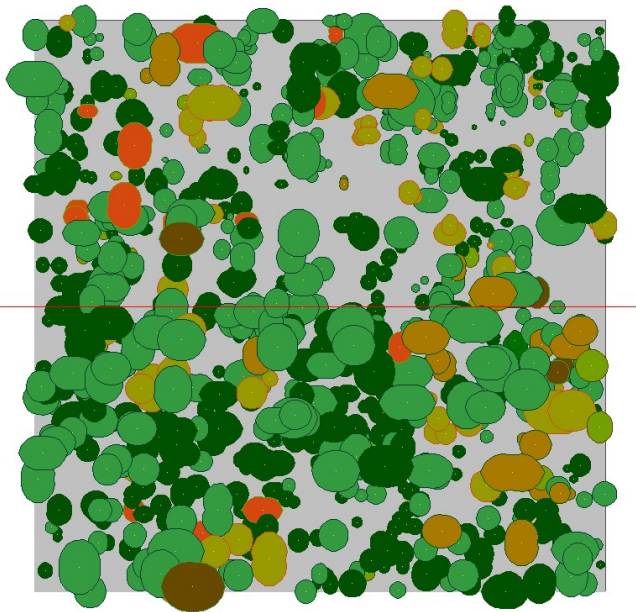
Tree MARKED for scenario 1

Species: 351
 Tree class: 99
 Crown class: 99
 Status: 1 (standing)
 Dbh: 15.00
 Height: 78.00
 Felling angle: 0.00
 Small end diameter: 0.00
 Crown size: 1 2 3 4
 radius: 9.8 9.8 9.8 9.8
 ratio: 0.50 0.50 0.50 0.50
 Scenarios: 1 2 3 4 5 6 7 8

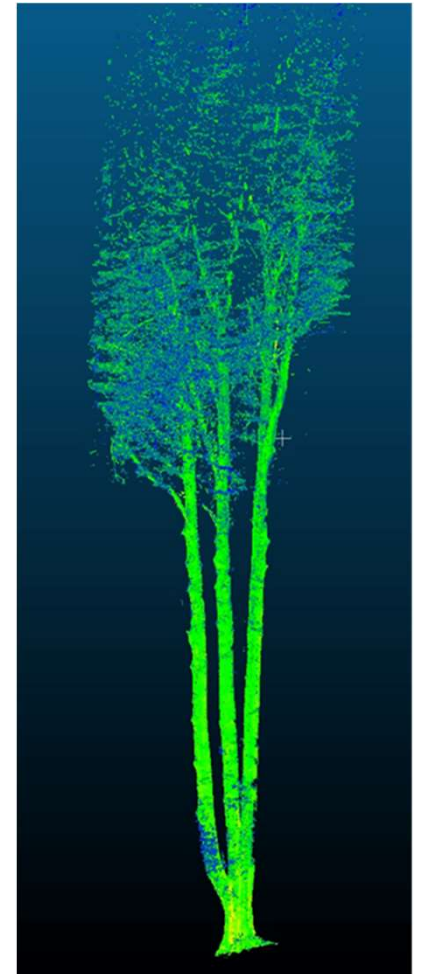
Head up Down Ground definition No trees
 Focus up Down Ground grid Stems only
 << Left Right >> Wireframe trees
 Closer Farther Solid trees
 Zoom In Zoom Out Realistic trees

Redrau all
 Open ground file Full-Screens: 1
 Tree designer Full-Screens: 3
 Default settings Tree list info
 Mark Treat Quit

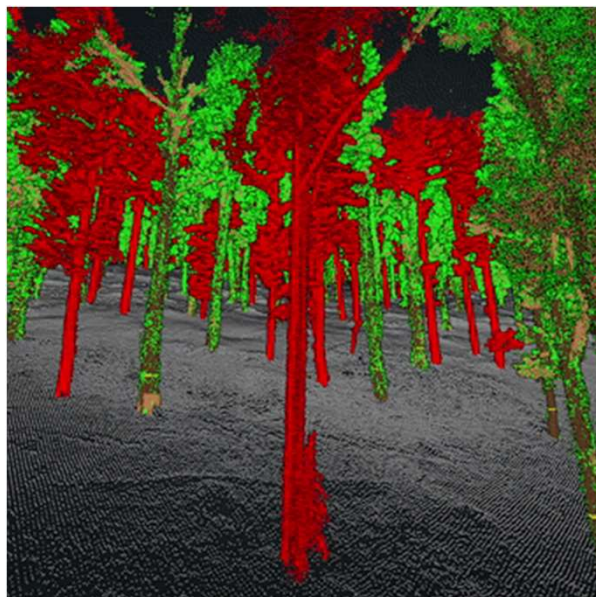
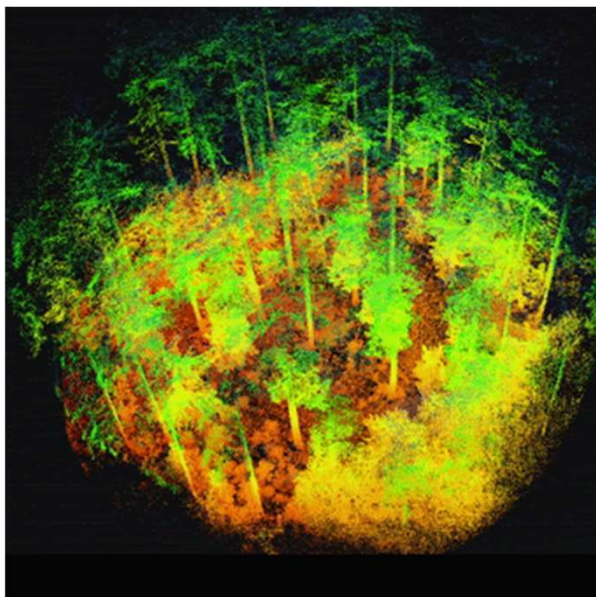
Simulations - SVS Stand Visualization System



Practicing the use of specific devices



Powered by Forest Design, VIRTILV is an innovative A.I. system based on terrestrial mobile lidar scanners and devices, meant to ensure true sustainable forest management.



**EXPLORATORY
INVENTORY**

**MANAGEMENT
INVENTORY**

**OPERATIONAL
INVENTORY**