Using city tree inventory data as a tool of planning, management and economic valuation of ecosystem services provided by urban trees

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Urban trees

- *Street and park trees,*

trees in yards, trees in built environment

- *Trees owned and managed by the city*

➢ *Trees that need input from the city*

Finnish i-Tree project

- *Cities of Turku and Helsinki*
- *Luke*
- *University of Helsinki*

Helsinki
Helsingfors

TURKU
ÅBO

i-Tree

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Ecosystem services of urban trees

- Bind dust and gaseous air pollutants
- Use water, alleviate infiltration and improve stormwater management
- Reduce noice
- Bind CO_2 and release O_2
- Affect microclimate; alleviate heat island effect
- Give shadow, reduce UV-radiation
- Increase biodiversity
- Improve well-being and health by having various recreational and social effects
- Cultural and landscape values
- Economic benefits on housing prices

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Do we need trees in this city? Can we afford them?

Amount and value of ecosystem services

- How much do our trees provide ecosystem services?
- What they are worth of?

Structure and cost of tree population

- What kind of trees and how many do we have now?
- How much does it then cost to plant and take care of our trees?

Planning and management

- Are there threats for our trees and their ecosystem services?
- How can we avoid them?
- What kind of trees and how many should we have in the future?

Goals of the project

To describe

- the structure of urban tree population in the city
- the economic value of some ecosystem services of urban trees
  - ✓ dust and gaseous air pollution binding
  - ✓ stormwater management
  - ✓ CO_2 binding

To give tools for planning of sustainable city tree population that

- ➢ Provides ecosystem services in the future
- ➢ And is resistant
- ➢ and resilient in the face of new pests, diseases and climate change

i-Tree – a tool for modelling some ecosystem services

- Tool for calculating the amount and value of some ecosystem services of city trees, and to describe the city tree population

- Does not take into account all ecosystem services, eg. recreational, health and cultural values

- Developed by USDA Forest Service, David Nowak et al.
- 1st version released in 2006, has been developed for 25 years
- Versions to USA, Canada, UK and Australia
- European version will be released in 2018
- All modules are not applicable outside of USA

Ecosystem services of urban trees modelled with i-Tree Eco Module

i-Tree Eco provides data on the structure, function and benefits of urban trees, including:

Ecosystem services

- Pollution removal and value as avoided health care costs
- Carbon storage, sequestration, and value
- Avoided runoff and value as avoided treatment cost
- Volatile organic compound emissions
- Oxygen production
- Ultraviolet (UV) effects

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Structure of urban tree population modelled with i-Tree Eco Module

i-Tree Eco provides data on the structure, function and benefits of urban trees, including:

Structure

- Number of trees
- Species composition
- Leaf area and biomass
- Canopy cover
- Species importance values

Forecasting and management

- Tree planting inputs
- Annual mortality adjustments
- Cost benefit analysis

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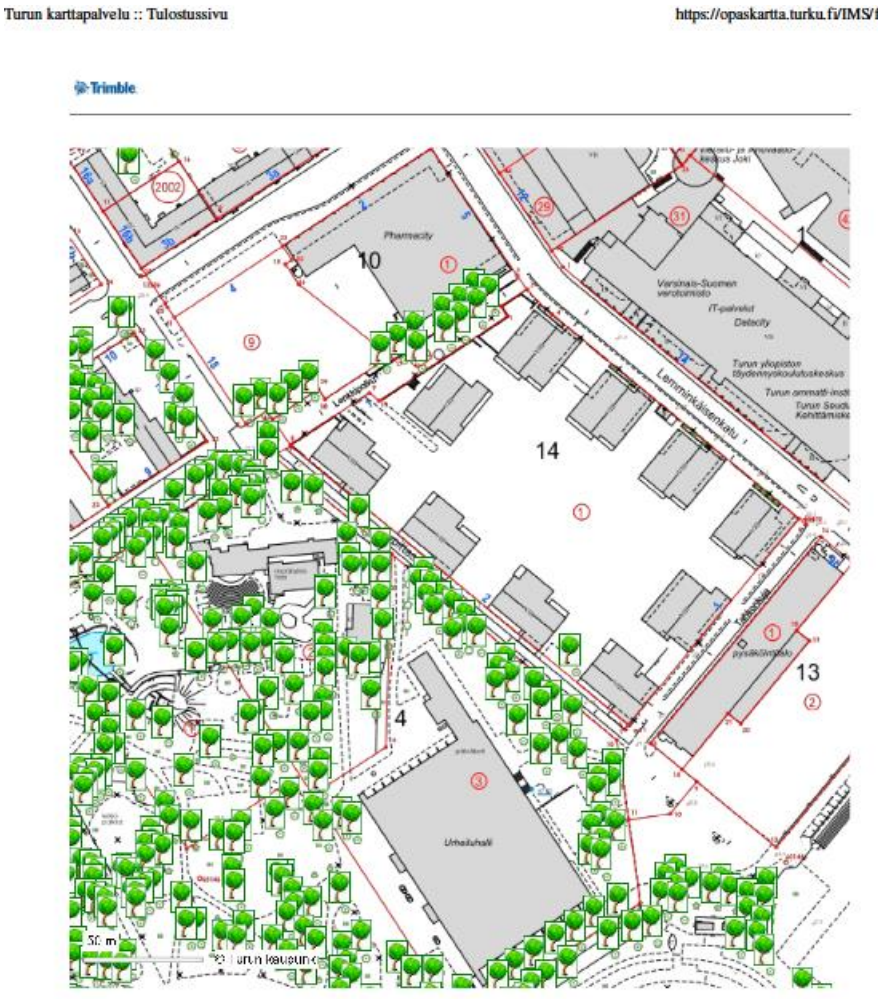
Data needed for modelling with i-Tree

1) Single tree inventory data	• **Available in the cities of Turku and Helsinki**
2) Inventory of random research plots	• **Will be studied in Turku and Helsinki 2018**
3) Tree inventory of a limited area, like a park or cemetary	• **Eg. Park of Kupittaa in Turku**
Weather and air pollution data	• From the nearest weather stations and measurement points
Coefficients	• Eg. cost of CO_2-ton, cost of stormwater treatment

Urban Tree Databases in Turku and Helsinki

- Created as a tool for management and planning of green infra
- Embedded in the GIS-software with city infrastructure



Tree Register in Turku

- Trimble Locus

Available for viewing in guide maps of Turku:

- Tree species in Finnish and Latin

https://www.turku.fi/turku-tieto/kartat-ja-paikkatieto/opaskartta

- ➢ Pick Maastokartta
- ➢ Zoom +

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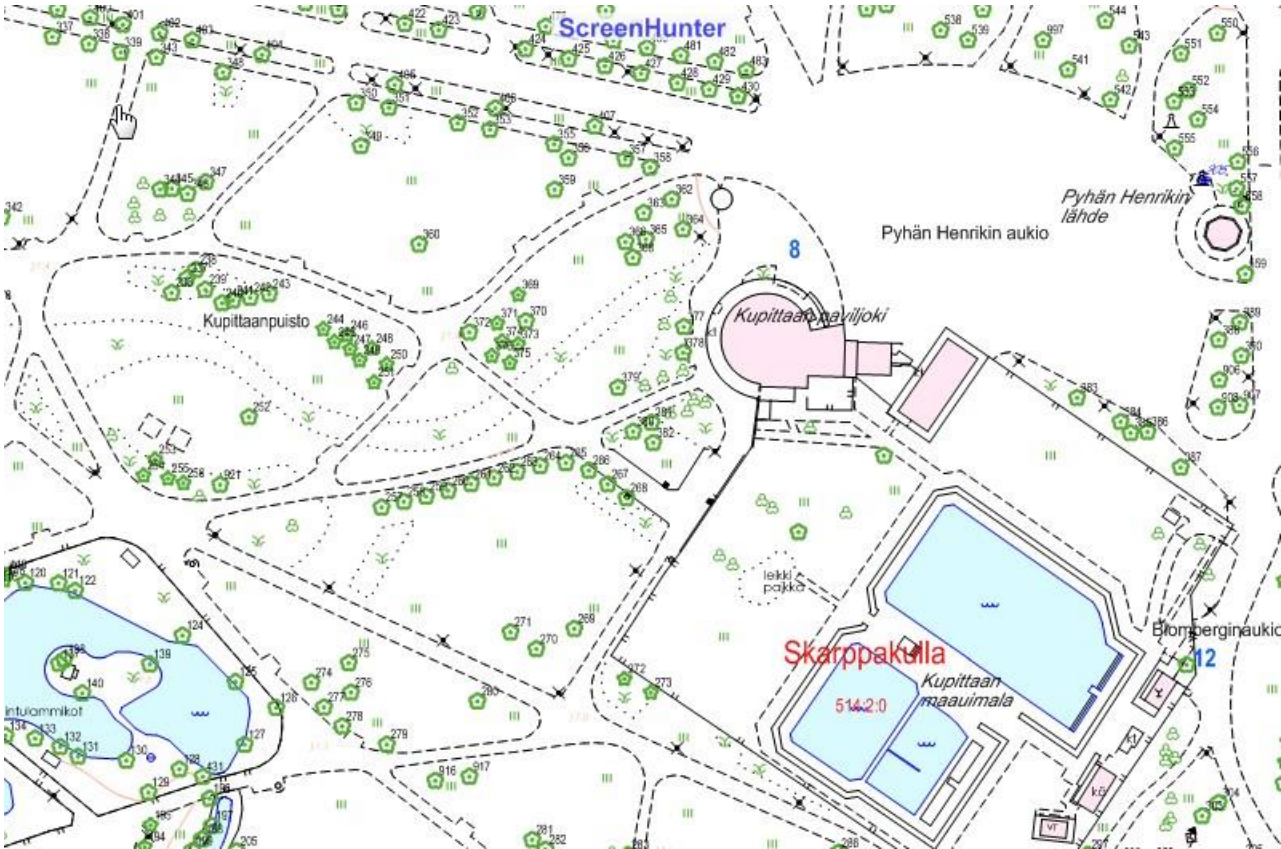
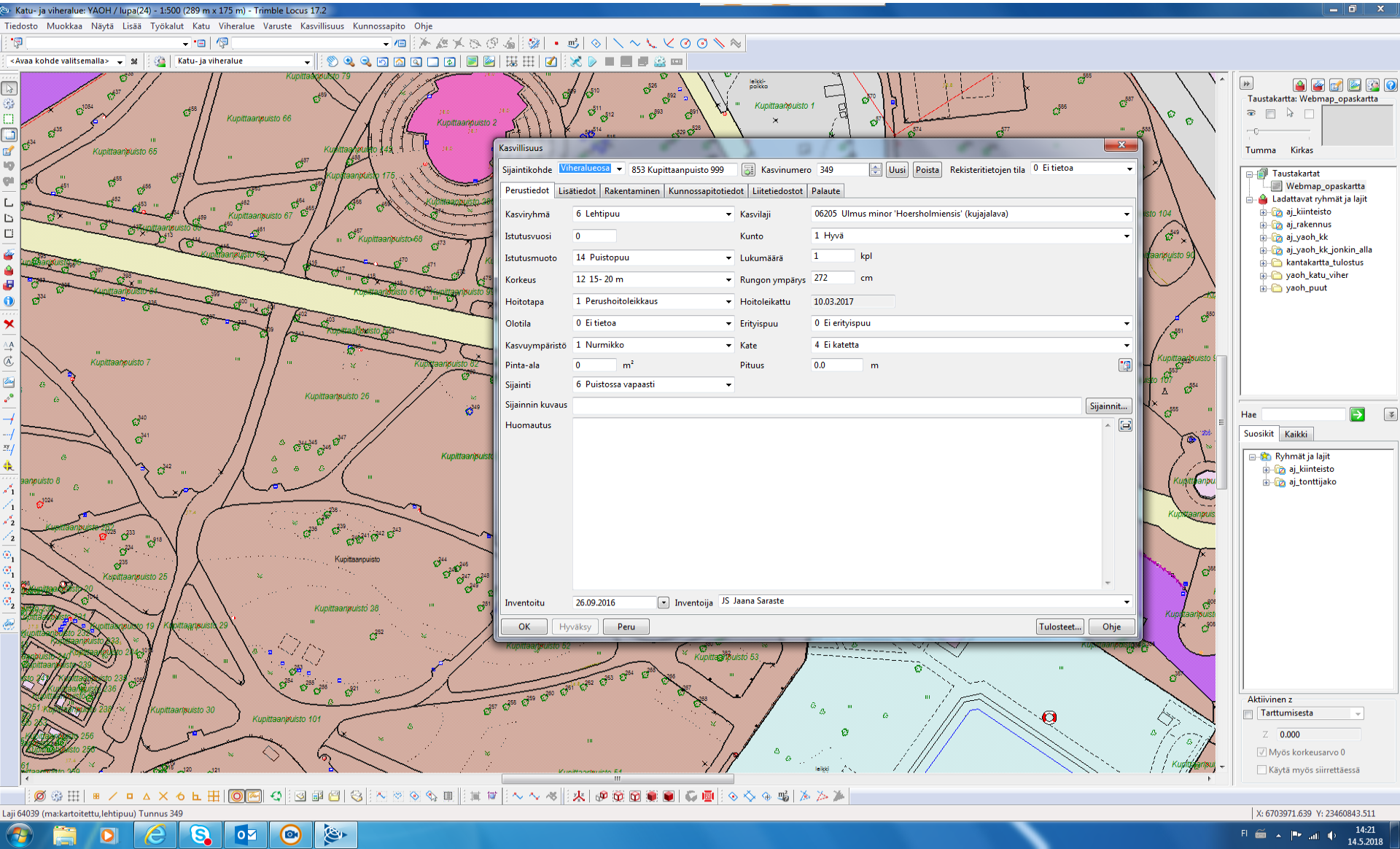
Urban Tree Database in Turku

- Includes 33 000 trees in the green areas of the city
- Trees owned and managed by the city
- Data collection started in 2007
- Cycle of updating 6-8 years, risk trees every 1-3 years
- Tree measurements and condition assessments made by arborists

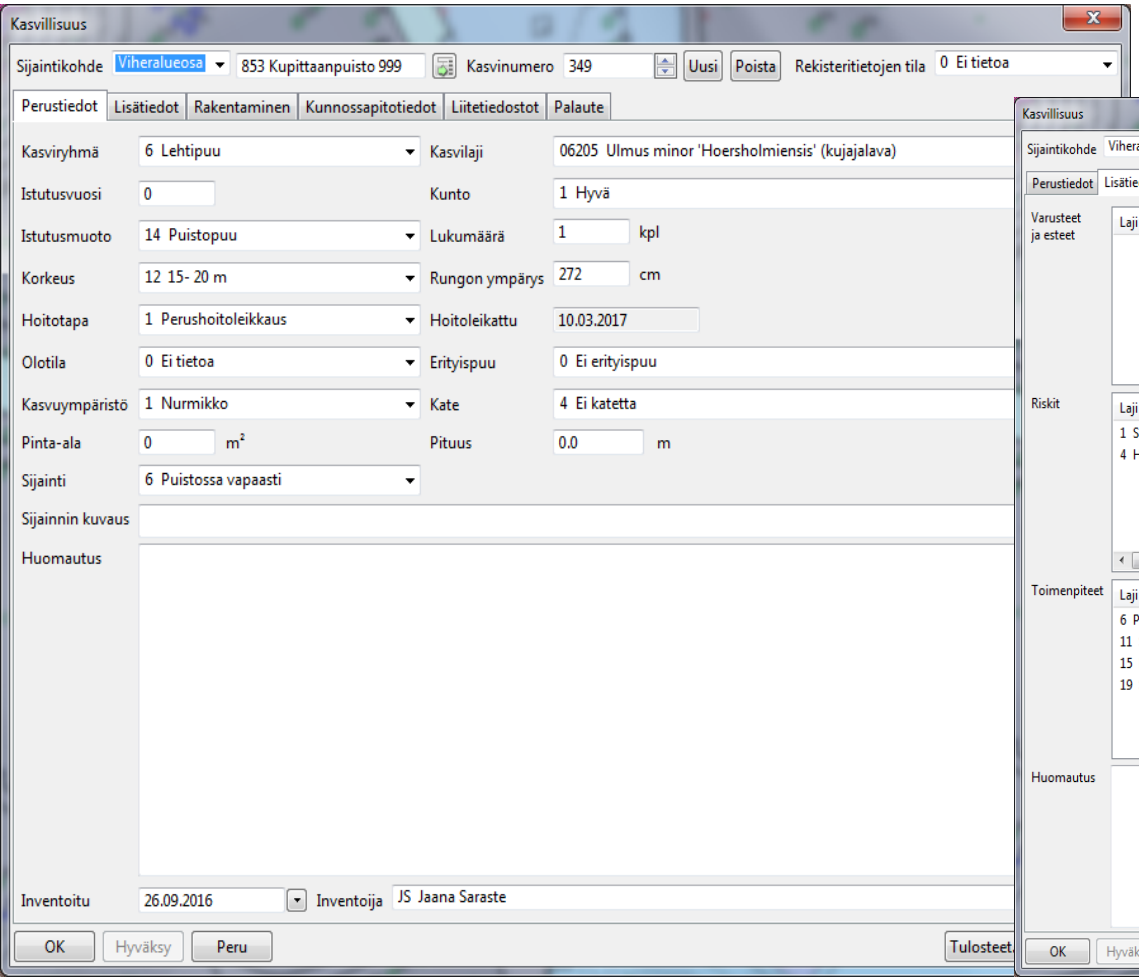


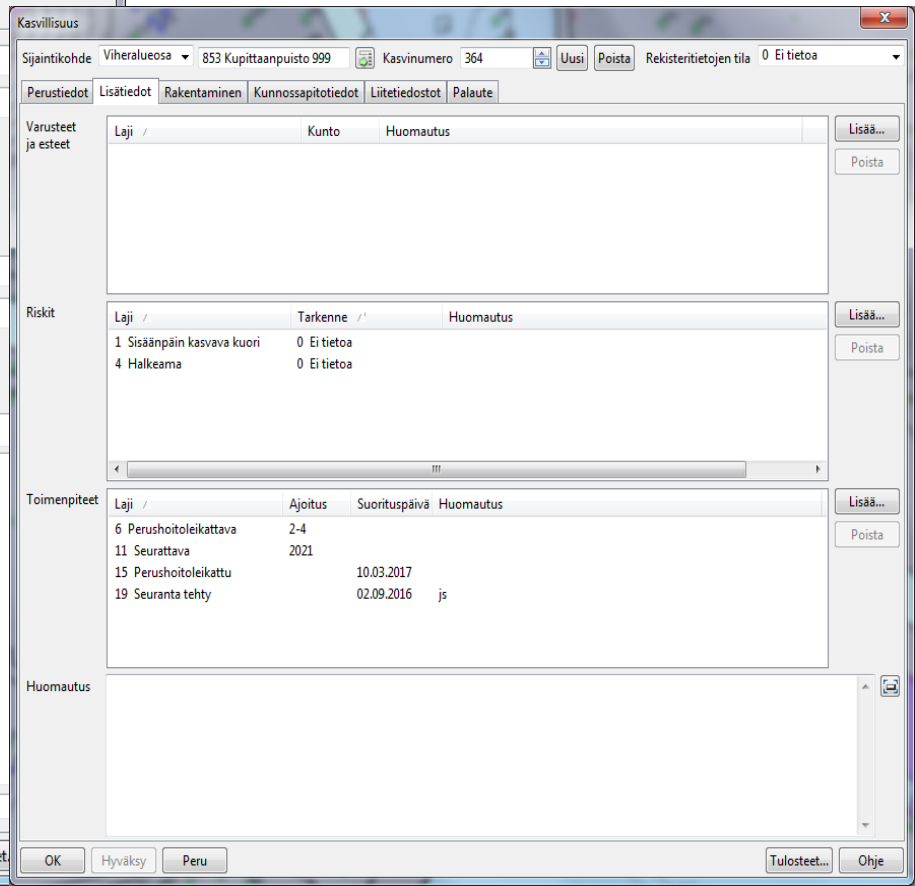
- Species (Finnish/Latin)
- Diameter at breast height (DBH 1.3 m)
- Height
- Condition 1-4
- Street/park tree

- Growing site info
- Mulching
- Equipment
- Lamp-posts, power lines etc. nearby



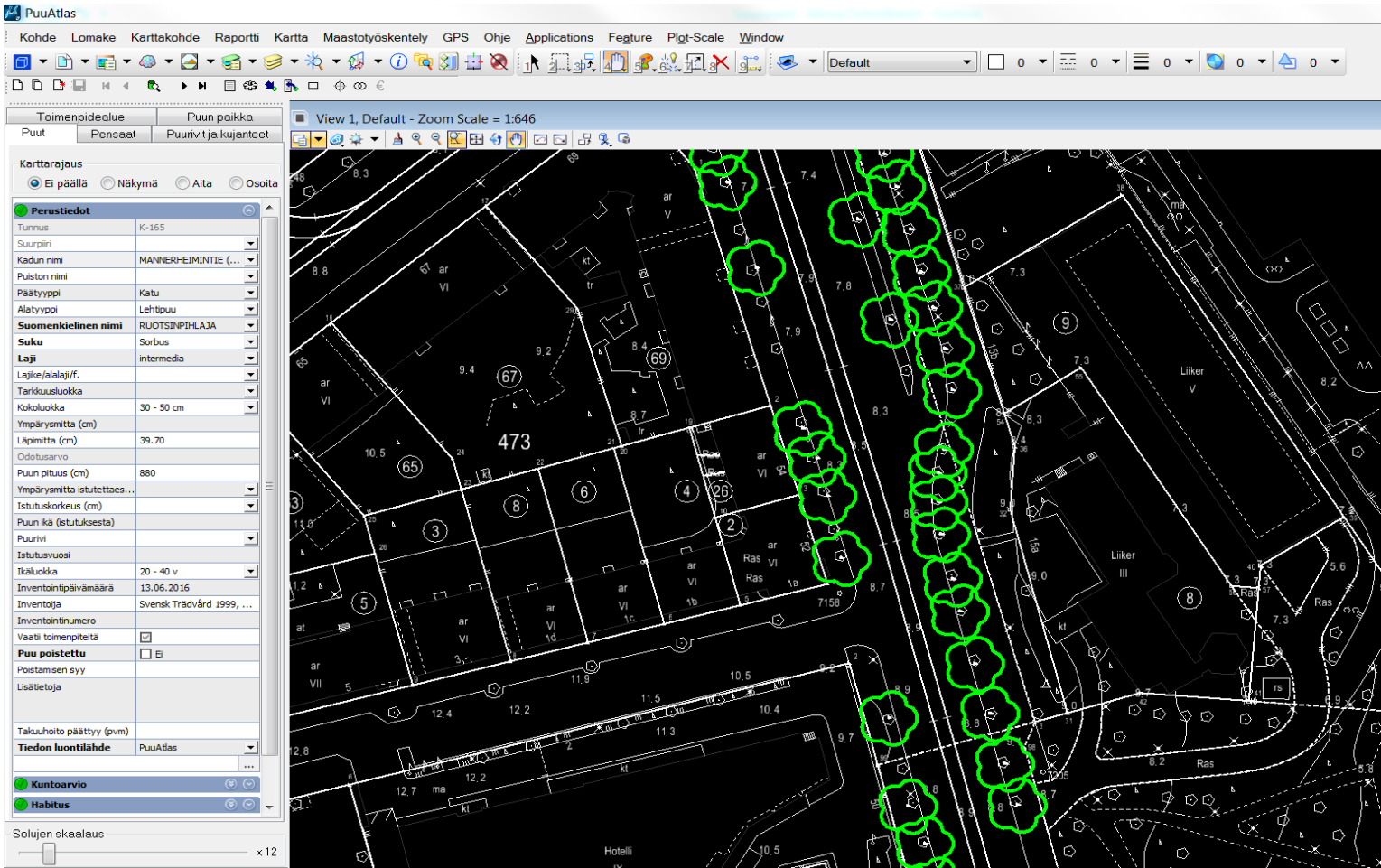
- Tree assessment, like risks, decay, decaying fungi, cracks, obliquity
- Maintenance so far
- Future needs of maintenance
- New plantings: plant species, size, pot quality, nursery, origin





Urban Tree Database in Helsinki

- PuuAtlas software
- Includes 48 300 trees in the green areas of the city
- Street trees 26 000, park trees 21 000
- Inventories started in the beginning of 21st century
- No planned cycle of updating, risk trees assessed every 3rd year



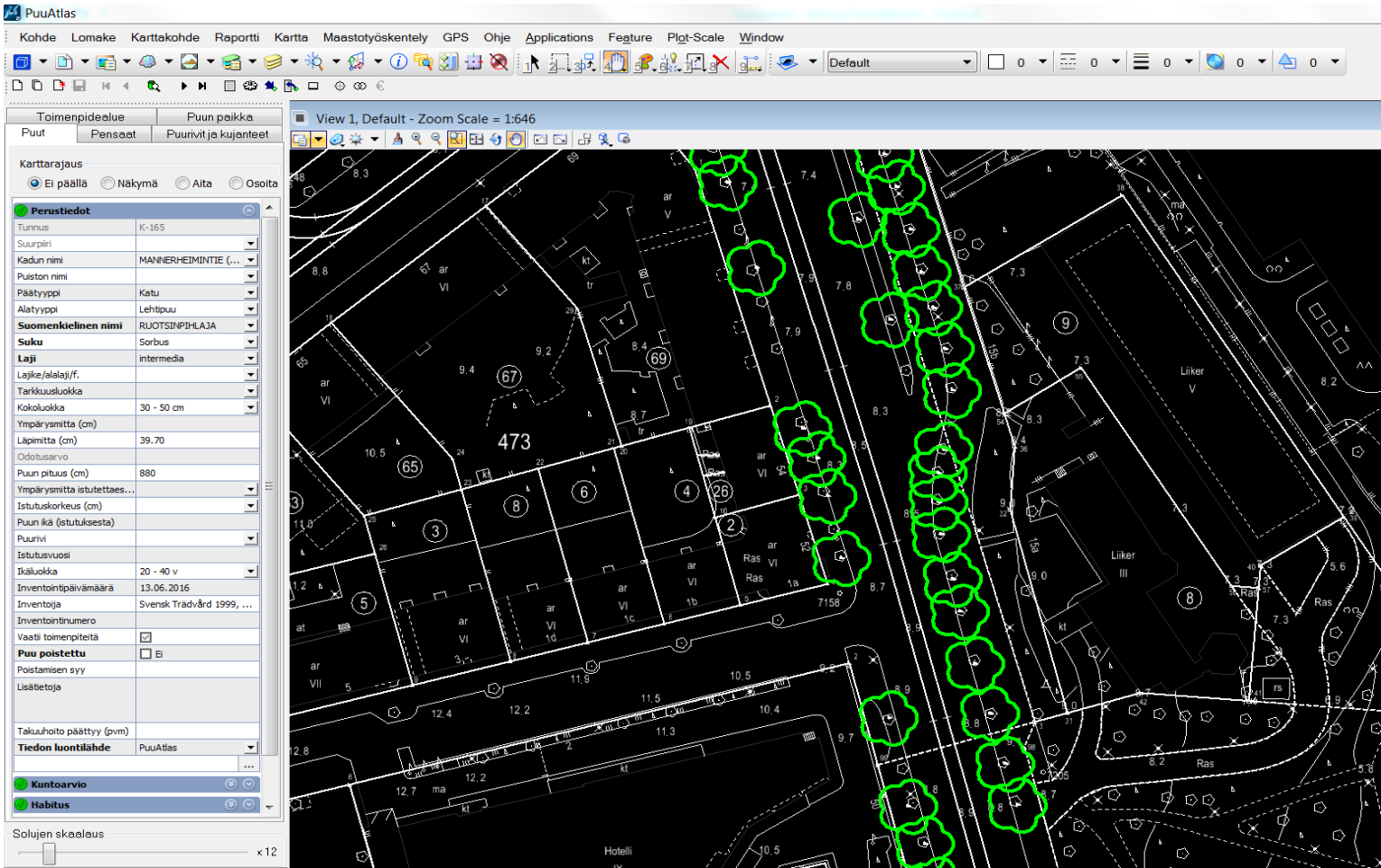
Urban Tree Database in Helsinki

- In addition, tree inventory data obtained by laser scanning

Topi Tanhuanpää et al., University of Helsinki

Abstract #10, session 5.

'Producing tree maps for the park areas in Helsinki'



Data needed for modelling with i-Tree

1) Single tree inventory data	• **Available in the cities of Turku and Helsinki**
2) Inventory of random research plots	• **Will be studied in Turku and Helsinki 2018** • **r = 11.3 m, n = min. 90/city**
3) Tree inventory of a limited area, like a park or cemetary	• **Eg. Park of Kupittaa in Turku**
Weather and air pollution data	• From the nearest weather stations and measurement points
Coefficients	• Eg. cost of CO_2-ton, cost of stormwater treatment

Inventory of random research plots
Tree data

- Location
- Height
- DBH 1.3 m
- Crown width in two directions
- Height of the crown base
- % of canopy missing
- Crown condition, % of dieback
- Crown light exposure, 1-5
- Canopy cover, %
- Distance to the nearest buildings

Leaf area, leaf biomass, tree biomass → **Carbon storage** → **Carbon sequastration** → **Air pollution removal** → **Avoided runoff** → **VOC emissions**

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Inventory of random research plots
Shrub layer, other characteristics

- Species
- Volume
- Cover-%

- Land use category
- Ground cover
- Plantable space, %

Shrubs, Ground cover → **Carbon sequastration** → **Air pollution removal** → **Avoided runoff**

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Finnish i-Tree project in co-operation with the Nordic i-Tree project

Nordic i-Tree project coordinated by SLU, Sweden

- Coordinator Johanna Deak Sjöman
- Project built by Johan Östberg
- Project leader Thomas Randrup
- Post-graduate student Blaz Klobucar

In co-operation:

- Kenton Rogers, Treeconomy, UK
  - ➢ Workshops in Sweden
- David Nowak, USDA Forest Service

Finnish i-Tree project has been build in Luke in the frames of **Urban Building with Wood and Green Infrastructure** -project

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Nordic project partners

In Sweden

SLU, Tukholma, Malmö, Hamlstad, Eskilstuna, Umea, Hassleholm, Lulea, Ystad, Uppsala, Kristianstad, Boras, Borlange Energi, Sveskakyrkan, arborist companies, housing companies

In Norway

- David Barton, Norwegian Institute for Nature Research (NINA)
- Ingjerd Solfjeld, Norwegian University of Life Sciences
- Oslo

In Denmark

- Oliver Bühler, Anders Busse Nielsen, Susanne Ogstrup, Institut for Geovidenskab og Naturforvaltning
- Copenhagen

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The Finnish i-Tree Project

Coordinated by Luke

Project leader Eeva-Maria Tuhkanen

Researcher Sirkka Juhanoja, Prof. Erkki Verkasalo

The city of Turku: Aki Männistö

The city of Helsinki: Minna Terho, Juha Raisio, Katriina Arrakoski

The University of Helsinki: PhD student Miia Mänttäri

Anu Riikonen, Topi Tanhuanpää

Other cities?

The effect of tree species selection on ecosystem services of urban trees

- What are the factors that have led to the current tree population in Turku and Helsinki?
  - Cultural and historical factors
  - Development of city structure
  - Practical reasons, eg. growing conditions, availability of plant material
  - Planning guidelines

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The effect of tree species selection on ecosystem services of urban trees

- What is the impact of tree species diversity in cities on ecosystem services?
  - Is diversity needed?
- What is the impact of tree species diversity on other species groups, like pollinators?
- What is the impact of tree diversity on resistance and resilience of tree population and provision of ecosystem services?

Thank you!

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