FORUM OF YOUNG GEOINFORMATICIANS 2014

8th YEAR OF PhD STUDENT SCIENTIFIC CONFERENCE

FORUM OF YOUNG GEOINFORMATICIANS

TECHNICAL UNIVERSITY IN ZVOLEN

Mapping the ground level light regime of forest stands using terrestrial laser scanning

Gábor Brolly – Géza Király – Attila Eredics

University of West Hungary, Faculty of Forestry. Sopron, Hungary

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Introduction

- Natural forest regeneration
  - Opening gaps in the upper canopy layer
  - Providing sunlight at ground level for seedlings (young trees)

- Promotion of natural regeneration through artificial opening of gaps (regeneration cutting)
  - Control over the spatial distribution of light
  - Gap size is based on experience and subjective decisions

- Questions:
  1. What is the influence of the gap light on environmental factors?
  2. What is the response of vegetation for the gap light?

  What is the spatial distribution of gap light at ground level?

Photo: www.taegrt.hu

Objective

Creating a simulation, that includes:

– Structure of mature trees

– Relief

– Geographic position

– Sun position

… and results in a detailed map of

– Potential

– Light levels

– At ground level available for seedlings

Terrestrial laser scanning

Study site
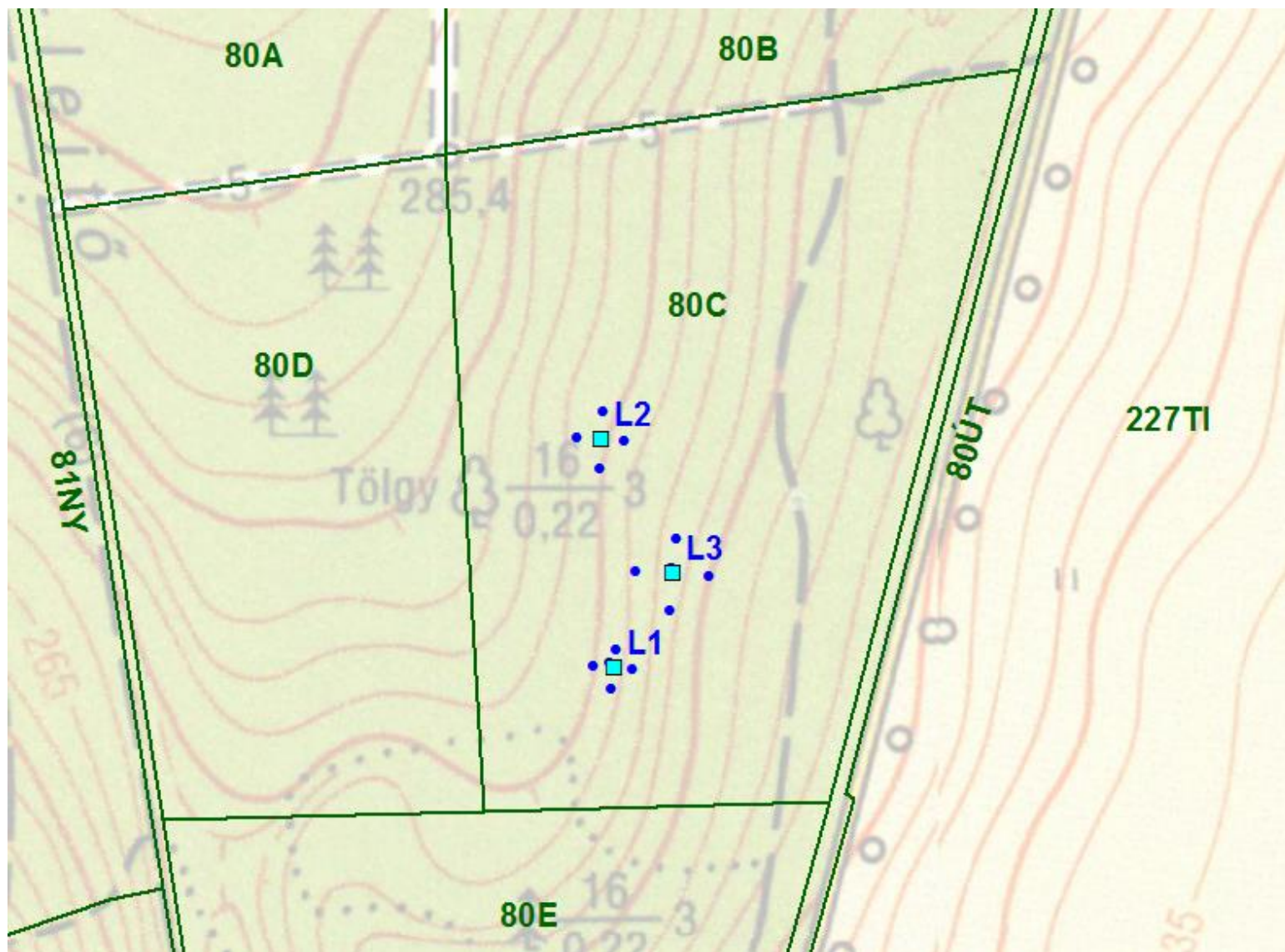
1. Terrestrial laser scanning

- 11.04.2013 (Leaf-less)
- Leica Scan Station 10
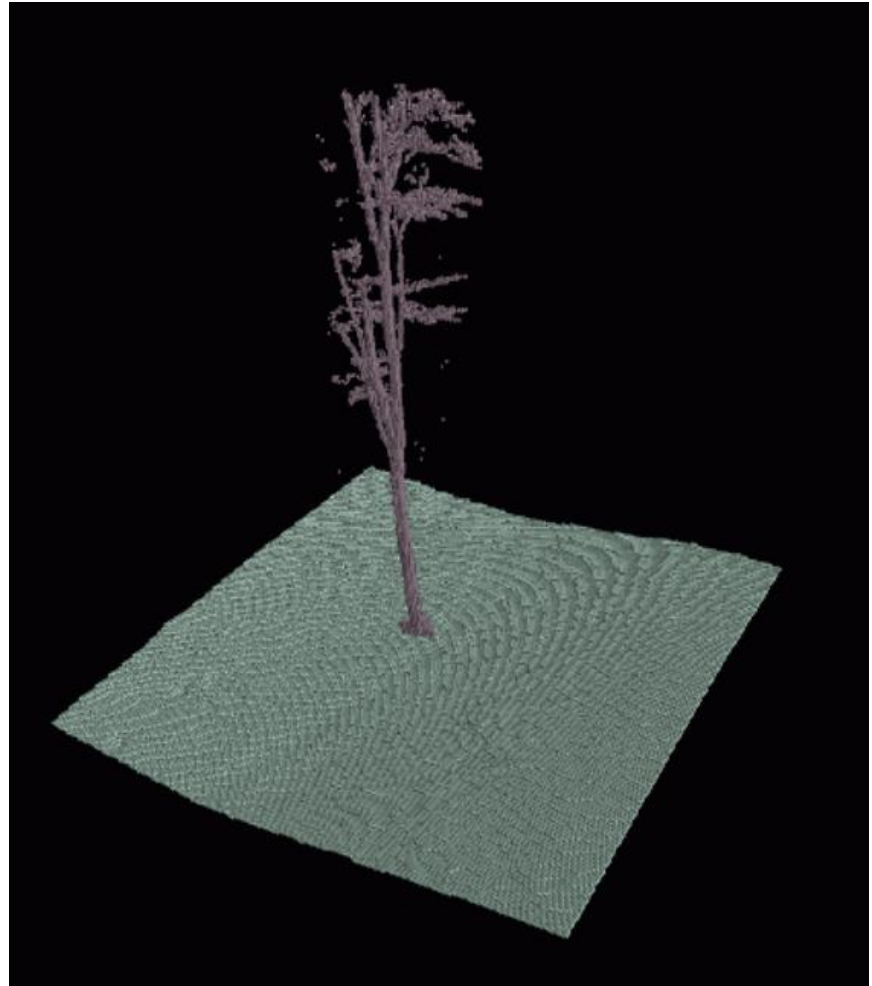- UWH, FGI
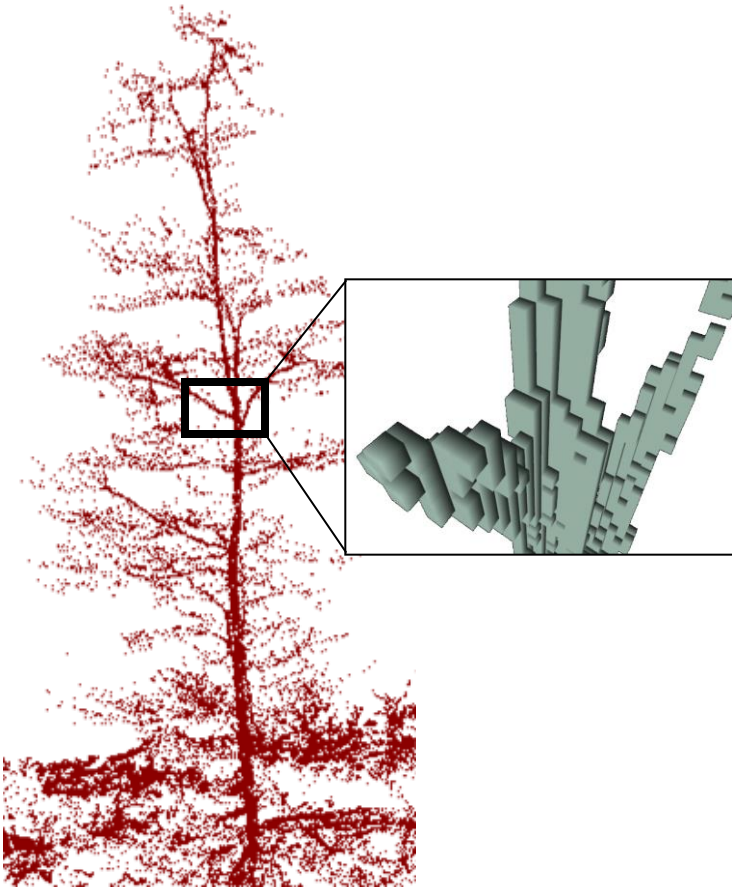- Green laser (λ=532 nm)
- 50 KHz
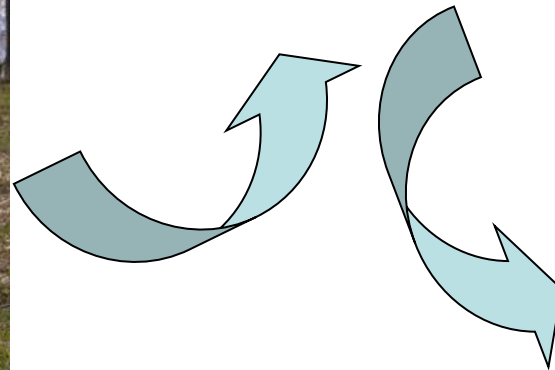
Tree map

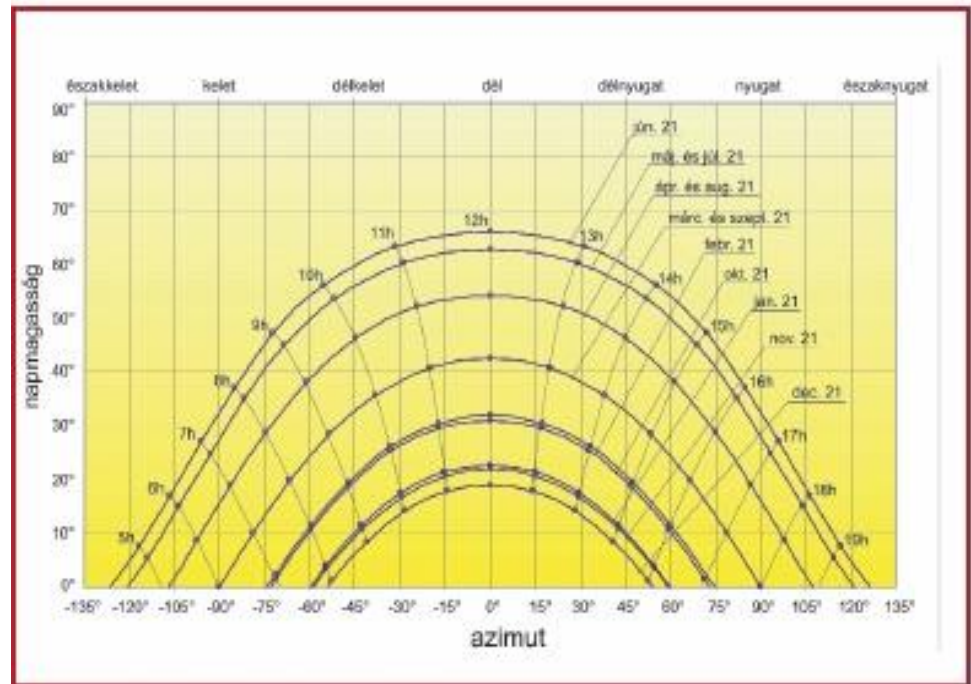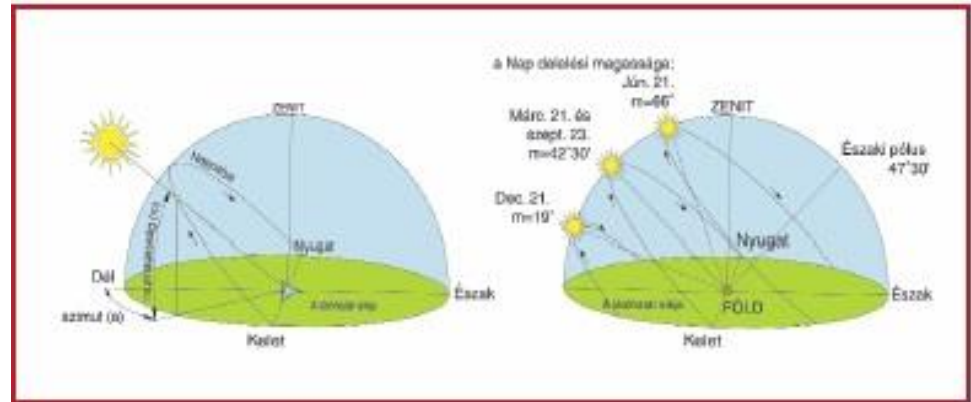Digital Terrain Model (DTM)

Gap boundaries (digitization)

2. Creation of voxel space

3. Calculation of Sun direction
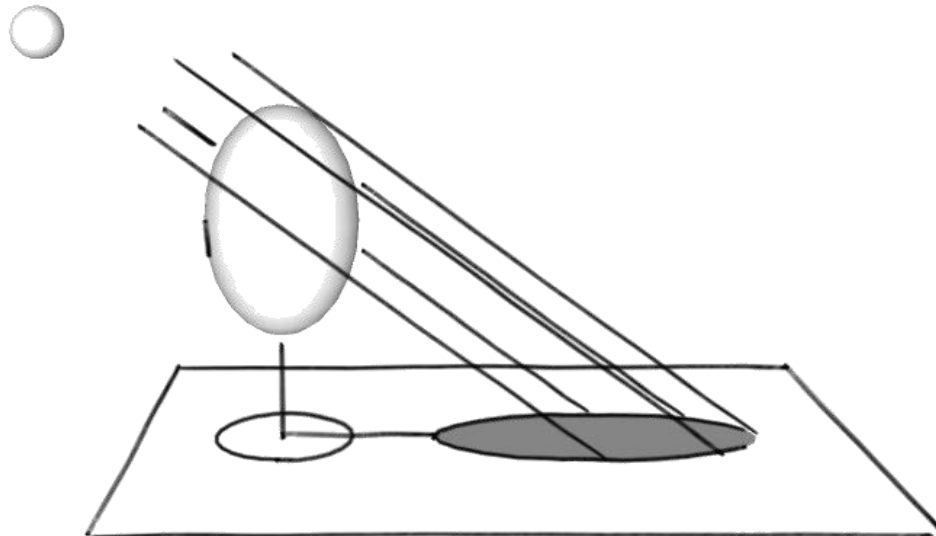
Solar equation of Sun's path:

1. Apparent daily movement
   1. East → West
   2. Sunrise / Sunset
2. Apparent yearly movement
   1. Altitude of midday
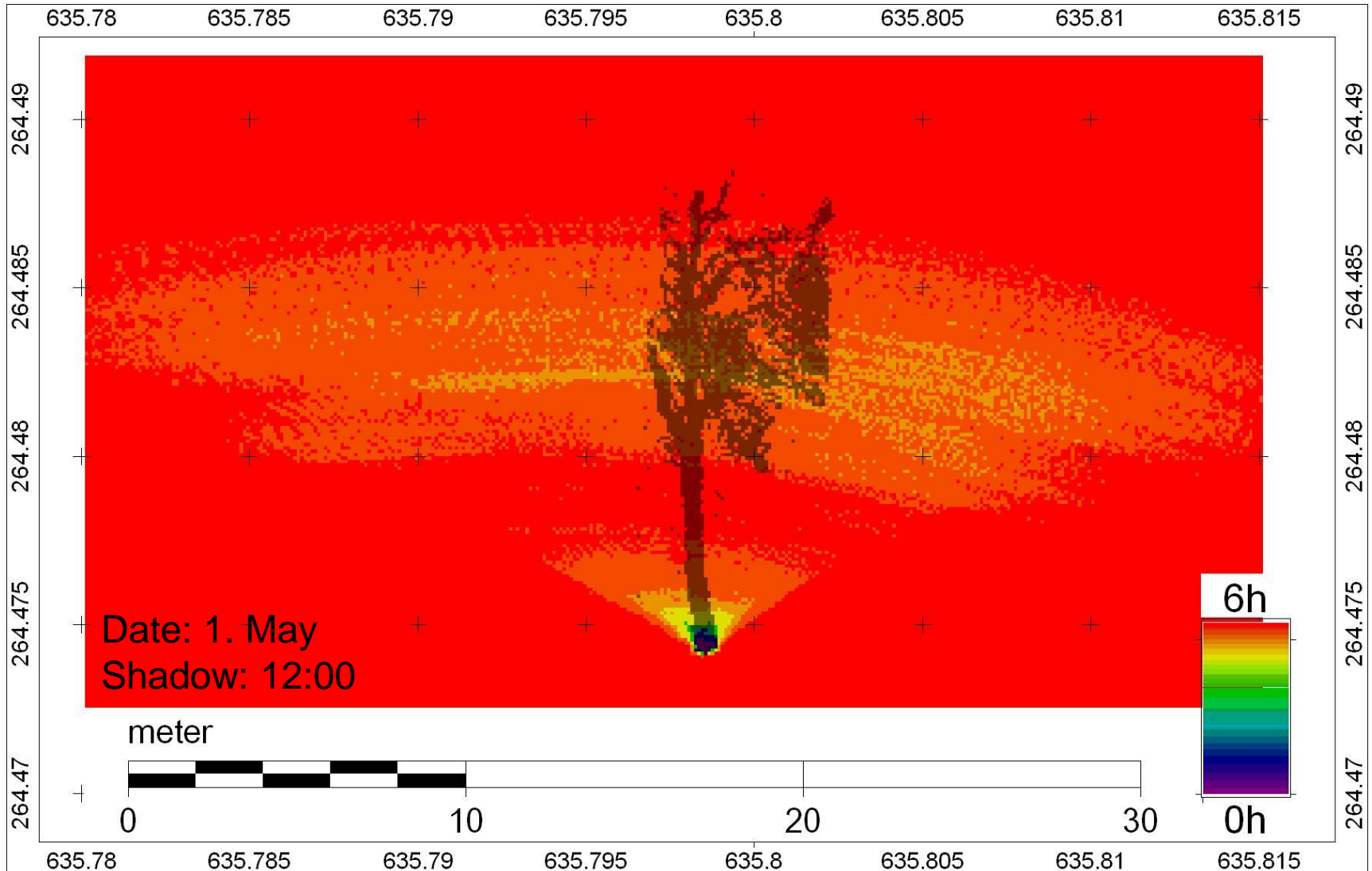   2. Azimuth of Sunset / Sunrise
3. Latitude

Ábra: www.primaklimatechnika.hu
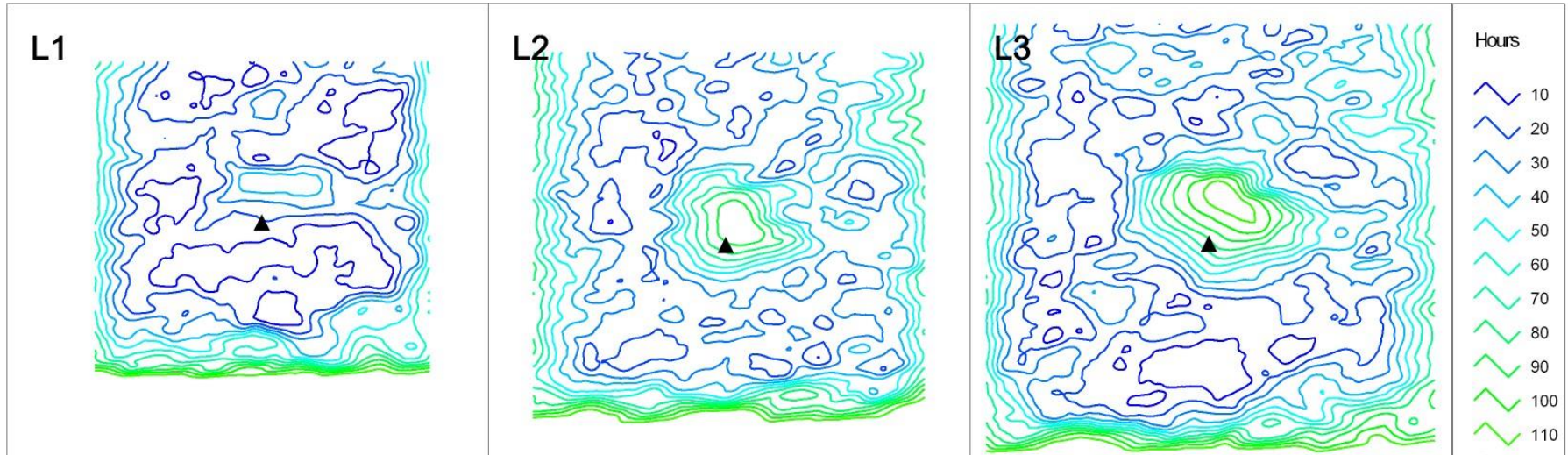
4. Modelling of sun beams

1. Tracing of sun beams in the voxel space

    •   *Voxels composing trees are opaque*

    •   *Spatial resolution: 10 cm*

2. Specify which ground cells are hit by sun beams

3. Summing up sun hits for each cell

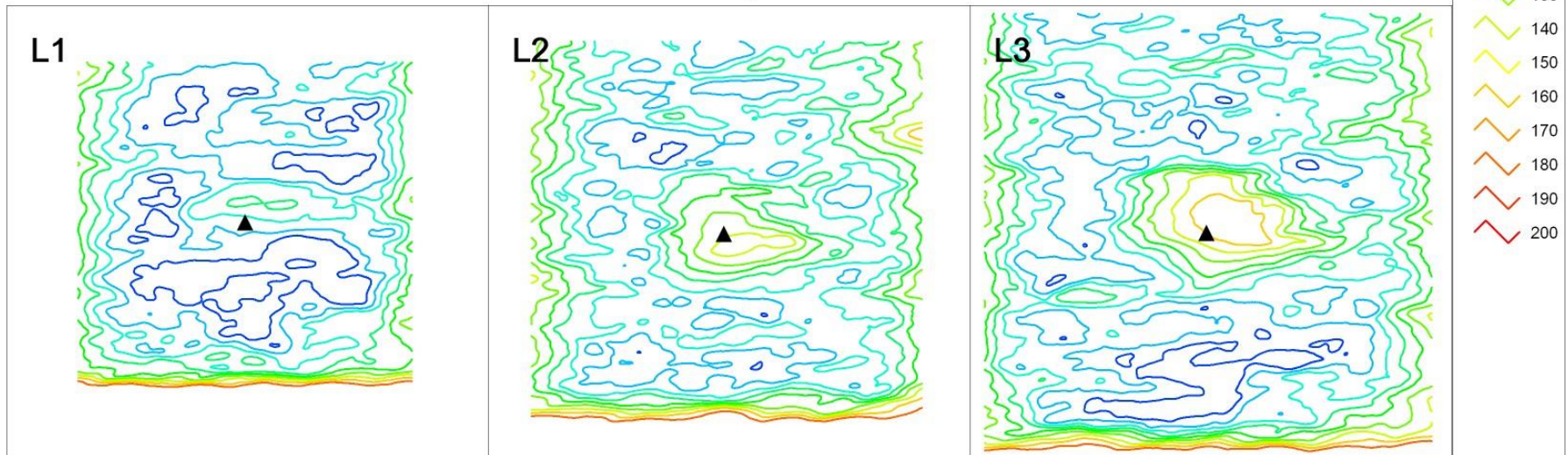   •   *Temporal resolution: 5 minutes*

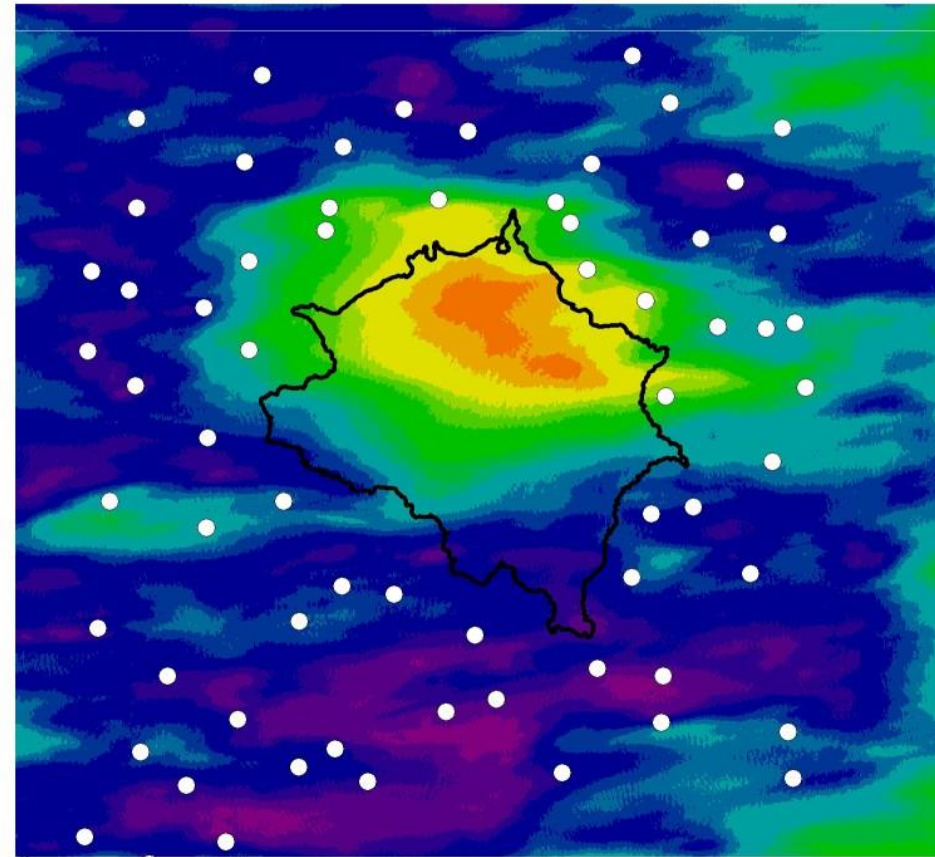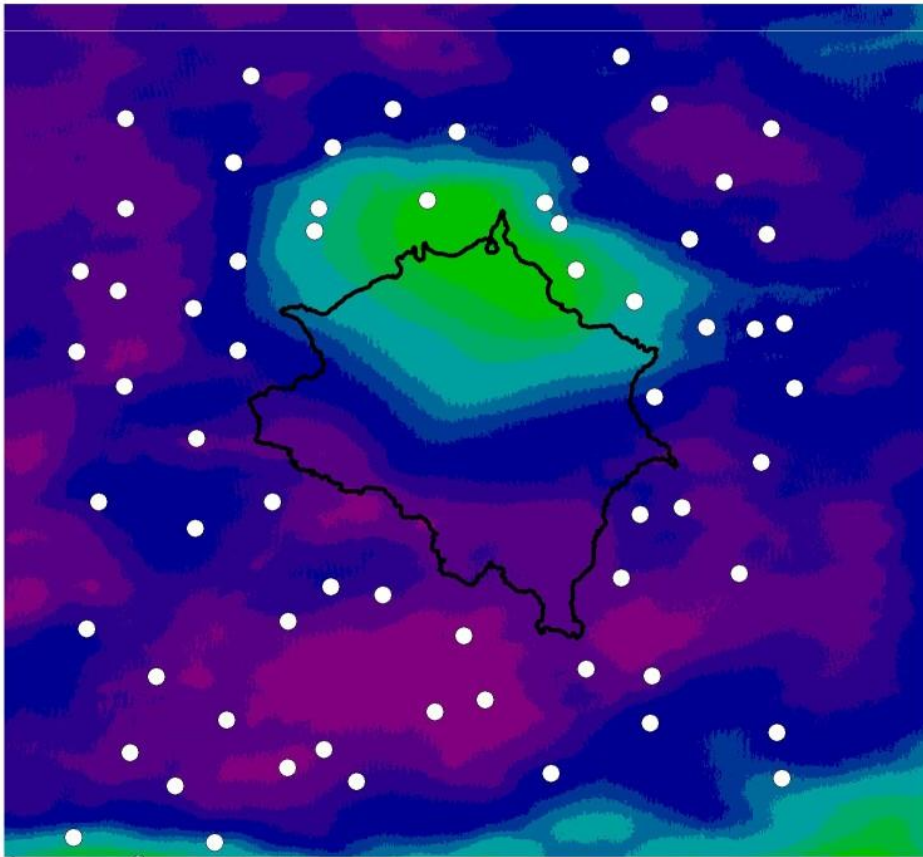# Daily light absorption on the ground modified by a single tree

April

L1   L2   L3

July

L1   L2   L3

Hours
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200

Meters
0   50

Gap boundaries and light absorption

L3 April

L3 July

Meters

0   50

0 ▰ 200 hours

Conclusion and outlook

- Conclusion
  - Transition zone (horizontal equivalent to stand height)
    → Minimum gap size
  - Vertical projection of the gap differs from the illuminated area
    → Sample design for ecologic investigations
- Critical points of the model
  - Potential direct sunlit
  - Model space (resolution, 100% opacity)
  - Leaf-less state of the forest
- Future plans
  - Calibration with radiometric field measurements
    → mapping of the energy from the incident radiation
  - Simulating the effects of thinning scenarios
  - Integration of ALS data

Thanks for your attention!

gbrolly@emk.nyme.hu