Toolbox for mapping of bioenergy on vast areas

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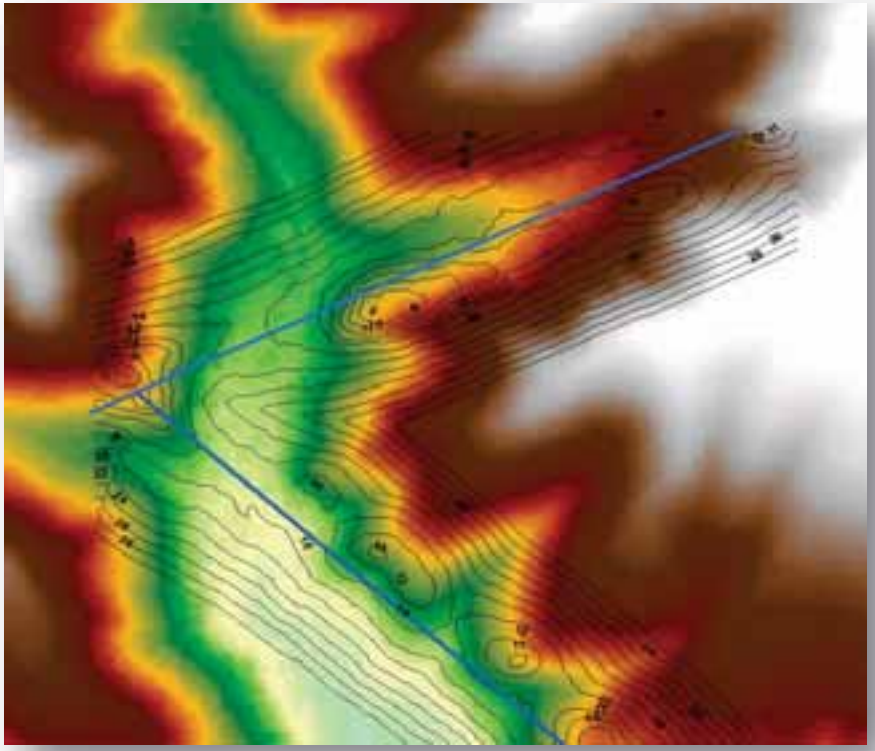
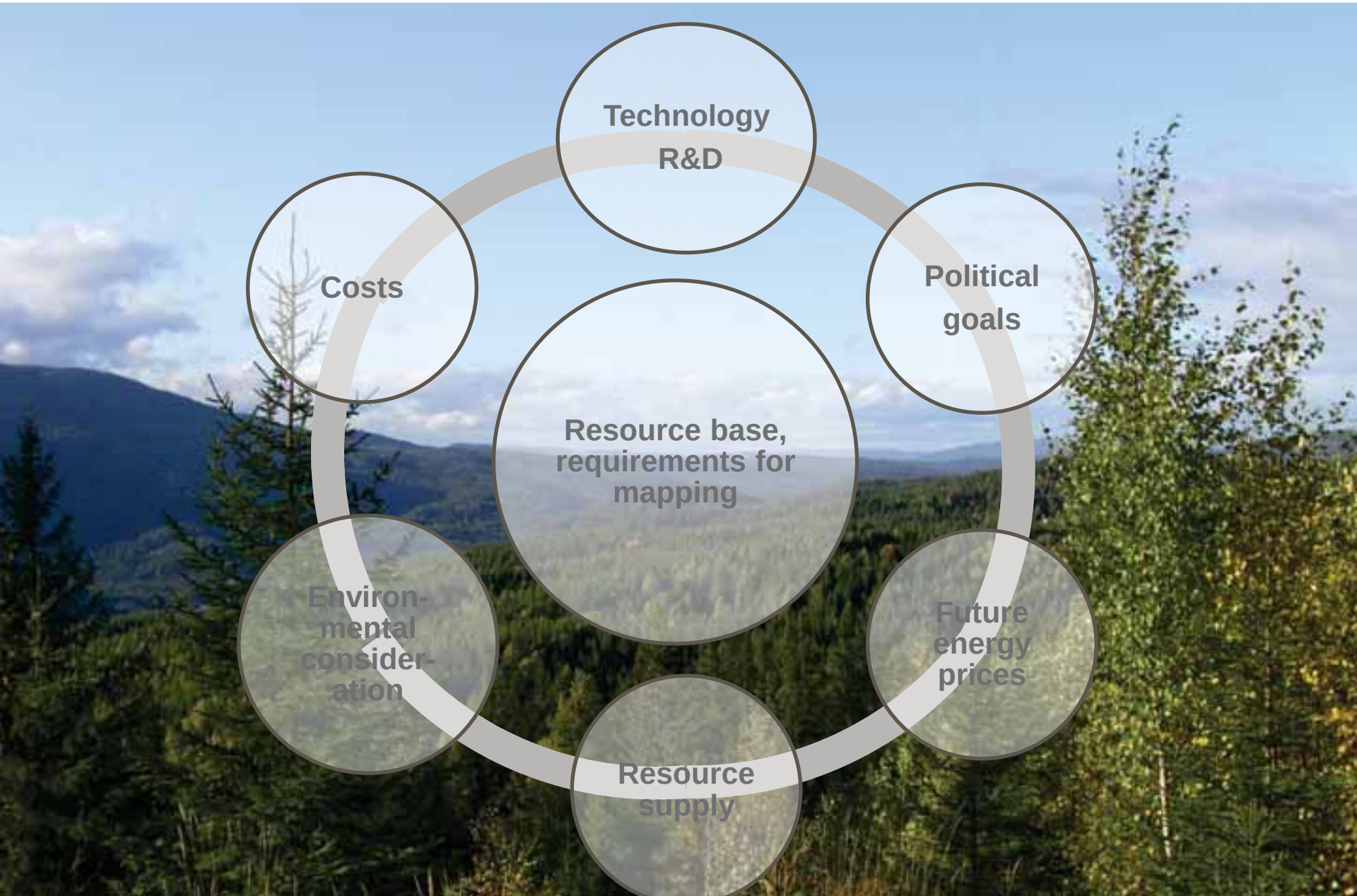
Agenda

- Bioenergy
  - The concept
- Forest resources
  - What is the potential?
- Geographical data
  - Digital base map
  - LiDAR point cloud
- Mapping of bioenergy
  - GIS Tools
  - Product examples




Technology
R&D
Political
goals
Future
energy
prices
Resource
supply
Environ-
mental
consider-
ation
Costs
Resource base,
requirements for
mapping

Bioenergy in a perspective

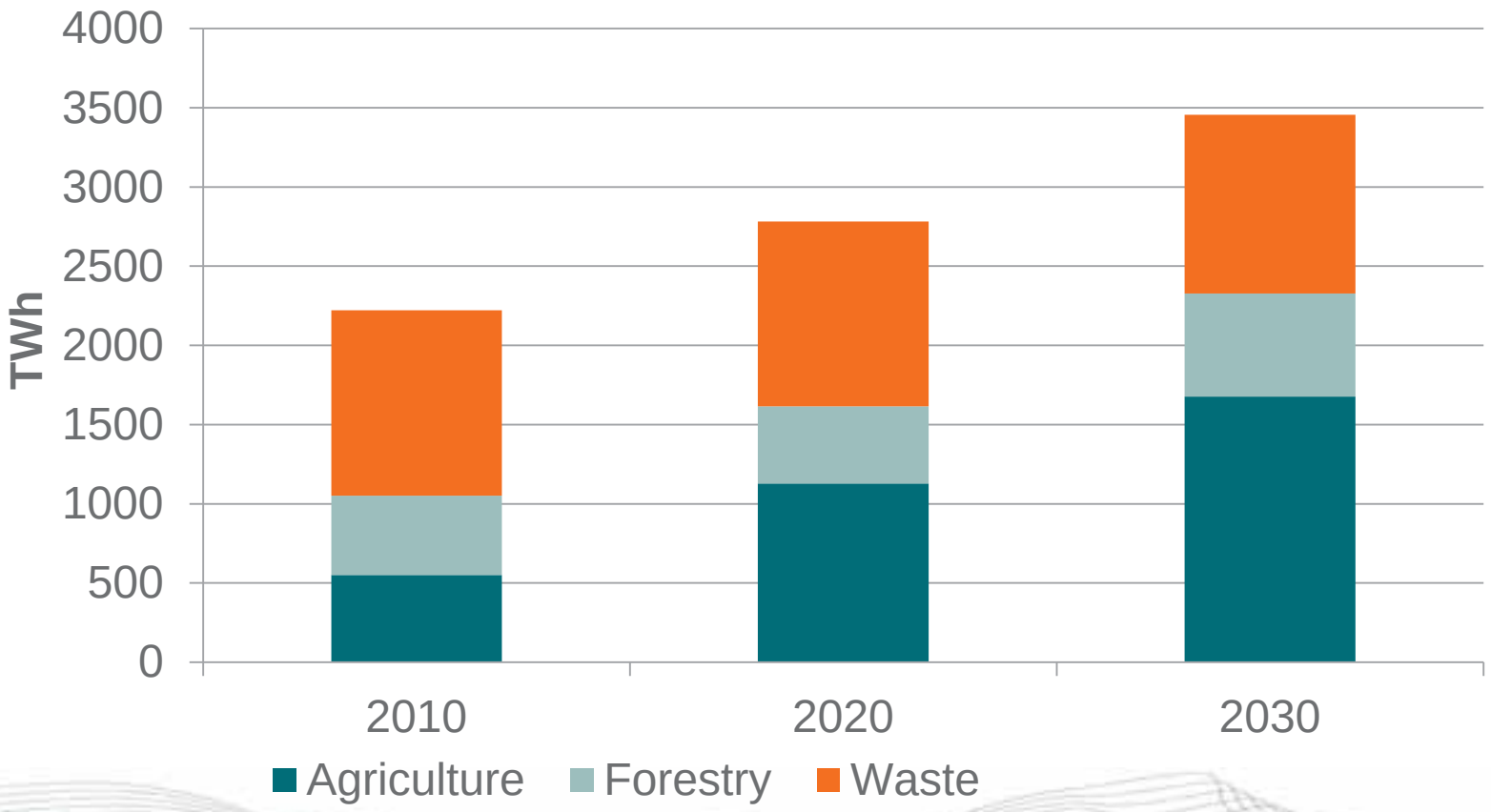
- Bioenergy is three times larger than hydropower in Europe
- 86% of biomass energy is for heating
- Increased trade with biomass (biofuel, pellets, chips)
- EU target: 20 % of total energy consumption from renewable sources by 2020.

Use of bioenergy today

(of total energy consumption)

- Norway 8 %
- Denmark 15 %
- Sweden 22 %
- Finland 20 %

Potential for bioenergy in Europe (EU-25)

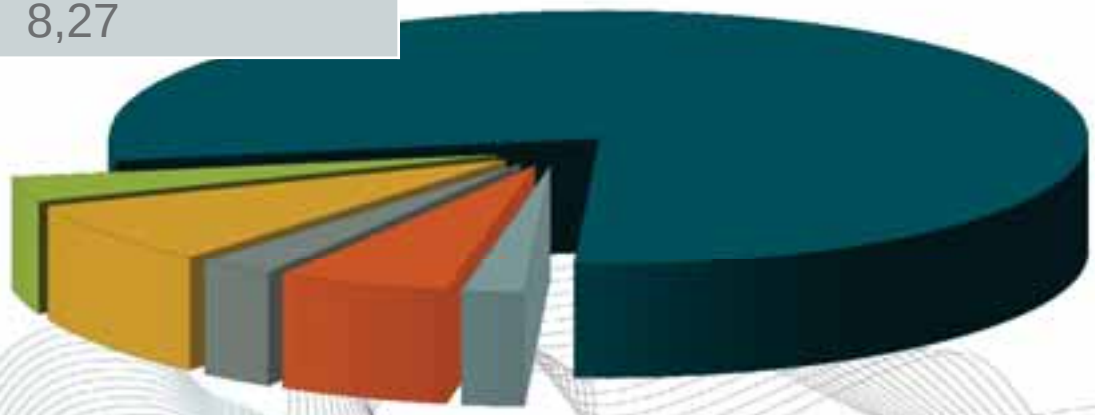


Source: EEA 2006

Bioenergy by land-use classes in Norway

Land use	Potential annual energy production (TWh)
Forest area (branches and treetops)	6,50
Cottage area	0,17
Agricultural area	0,47
Power lines	0,21
Roadsides, Railroads	0,66
Developed areas	0,26
	8,27

Source: Bergseng et al. (2012)

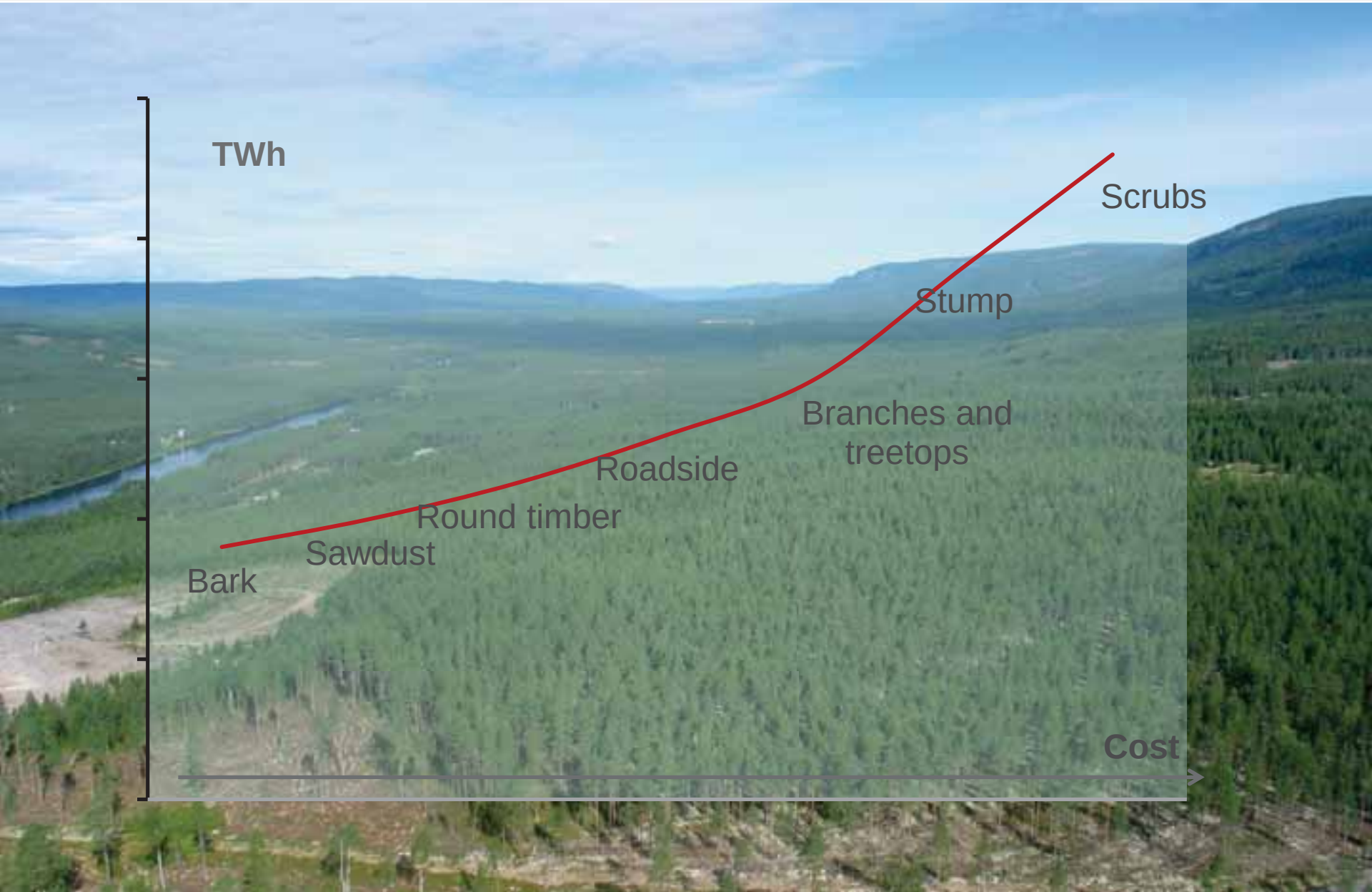


How to map and analyze?

Remote Sensing Techniques for mapping bioenergy

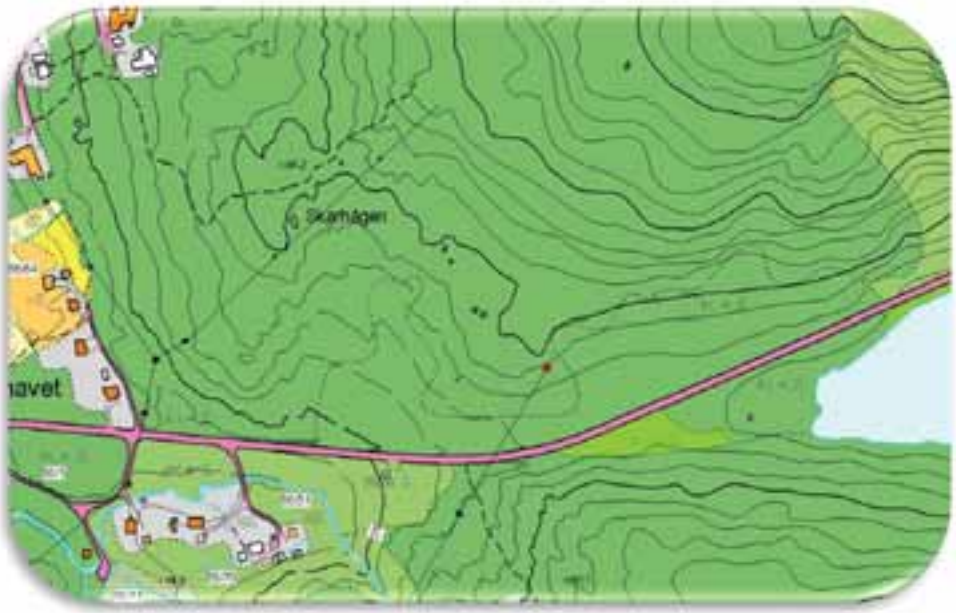
- Find forest areas with high density and standing volume
- Find stands with a large proportion of species with high energy class
- Calculate the amount of ”bioenergy-wood” (branches and tops)
- Use DTM-models to find were it is economical and biological sustainable to harvest
- Include other type of land use than forestry:
  - Abandoned agricultural land
  - Boarder zones of agricultural land
  - Ditches and wetlands
  - Along forest roads, power-lines, railroad etc.
  - Other vegetated area

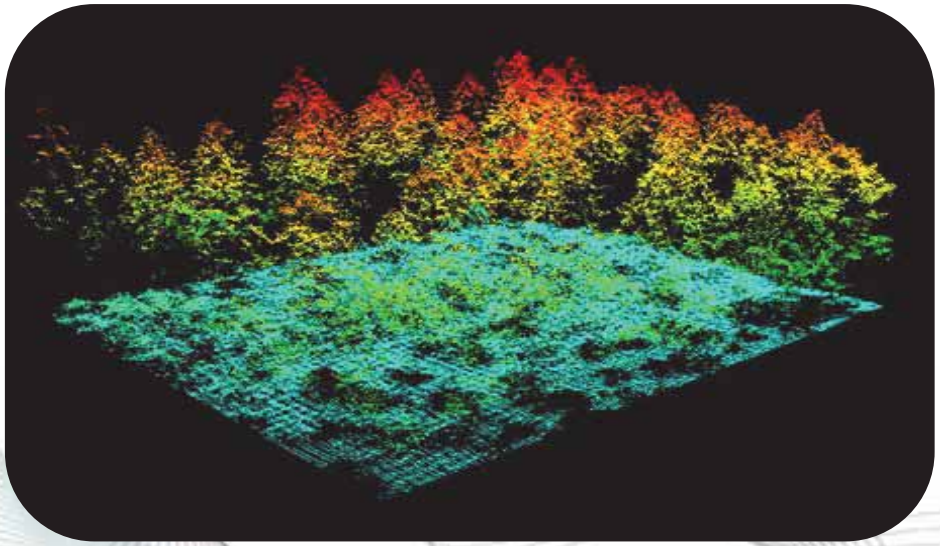
Cost for bioenergy from forestry



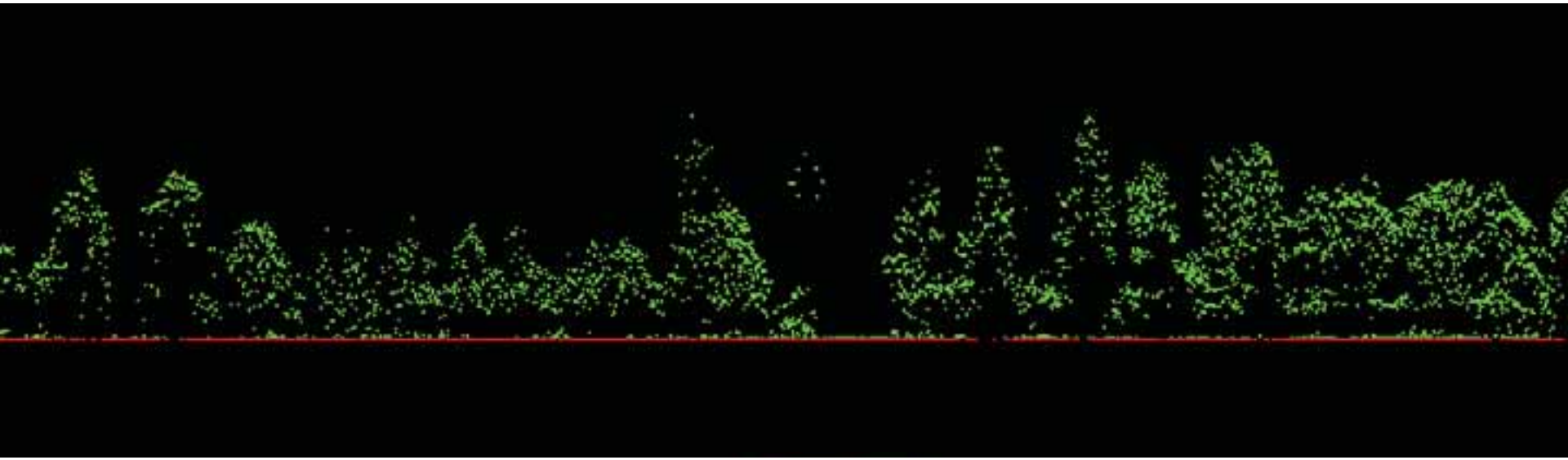
Geographical base data

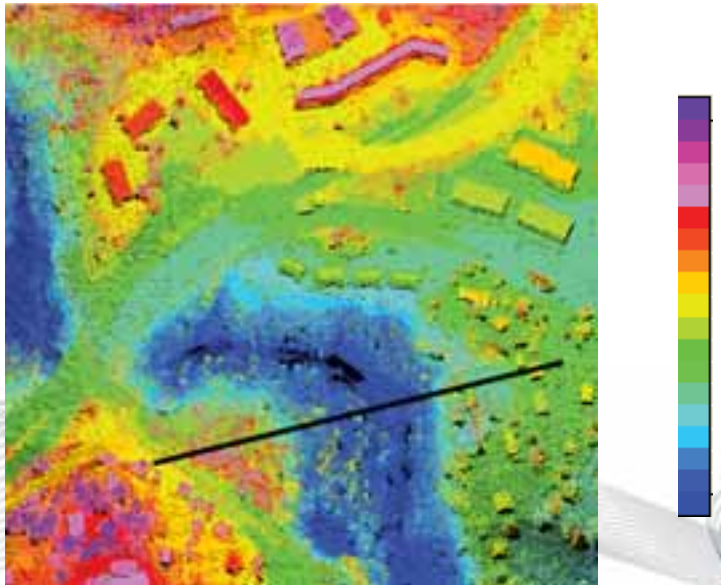
- Digital Base Map
  - Property borders
  - DEM
  - Roads etc
  - Water
  - Land use class
  - Protected areas
  - Cultural remains in forest
  - ……
- LIDAR point cloud (x,y,z)





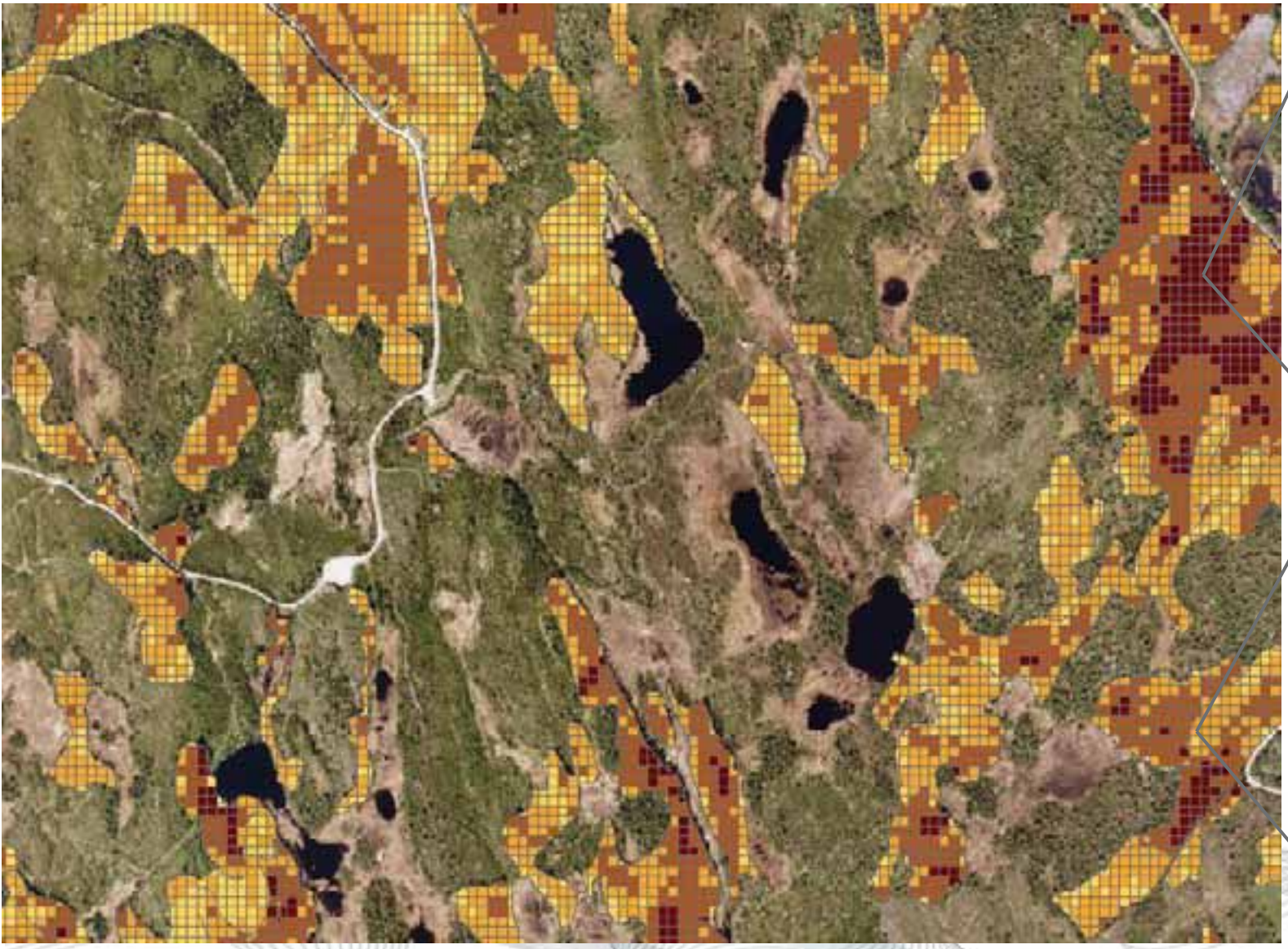
LIDAR data - Transformation of heights

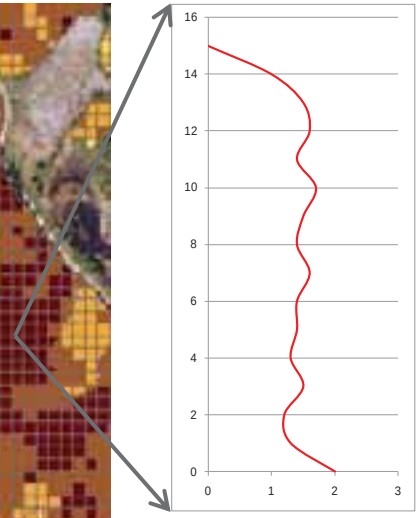


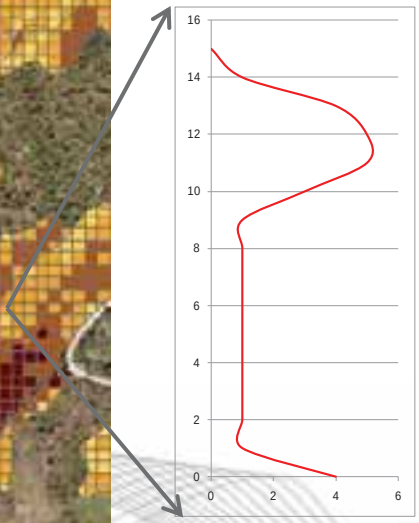


Height above ground

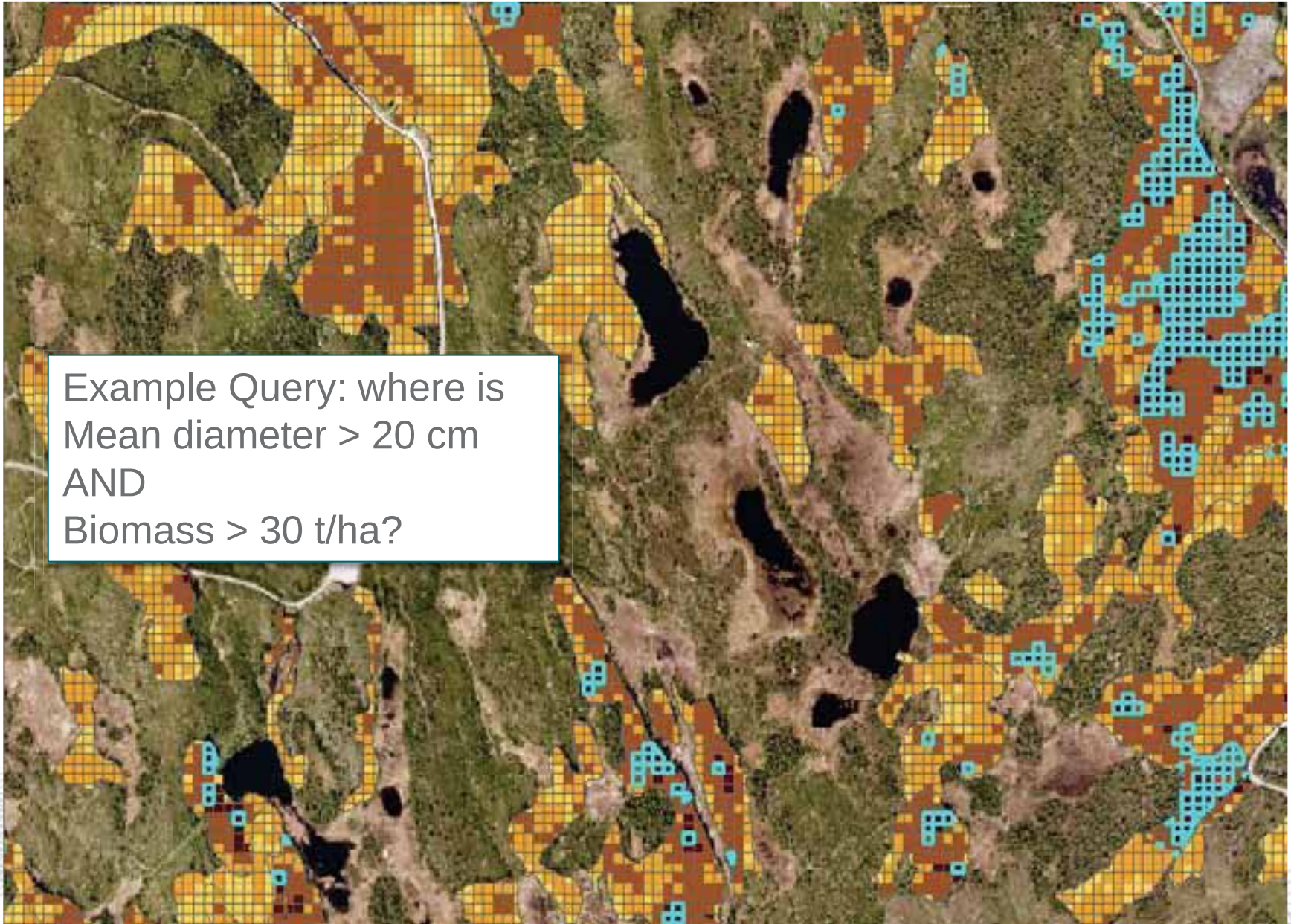
Density index calculation – results:



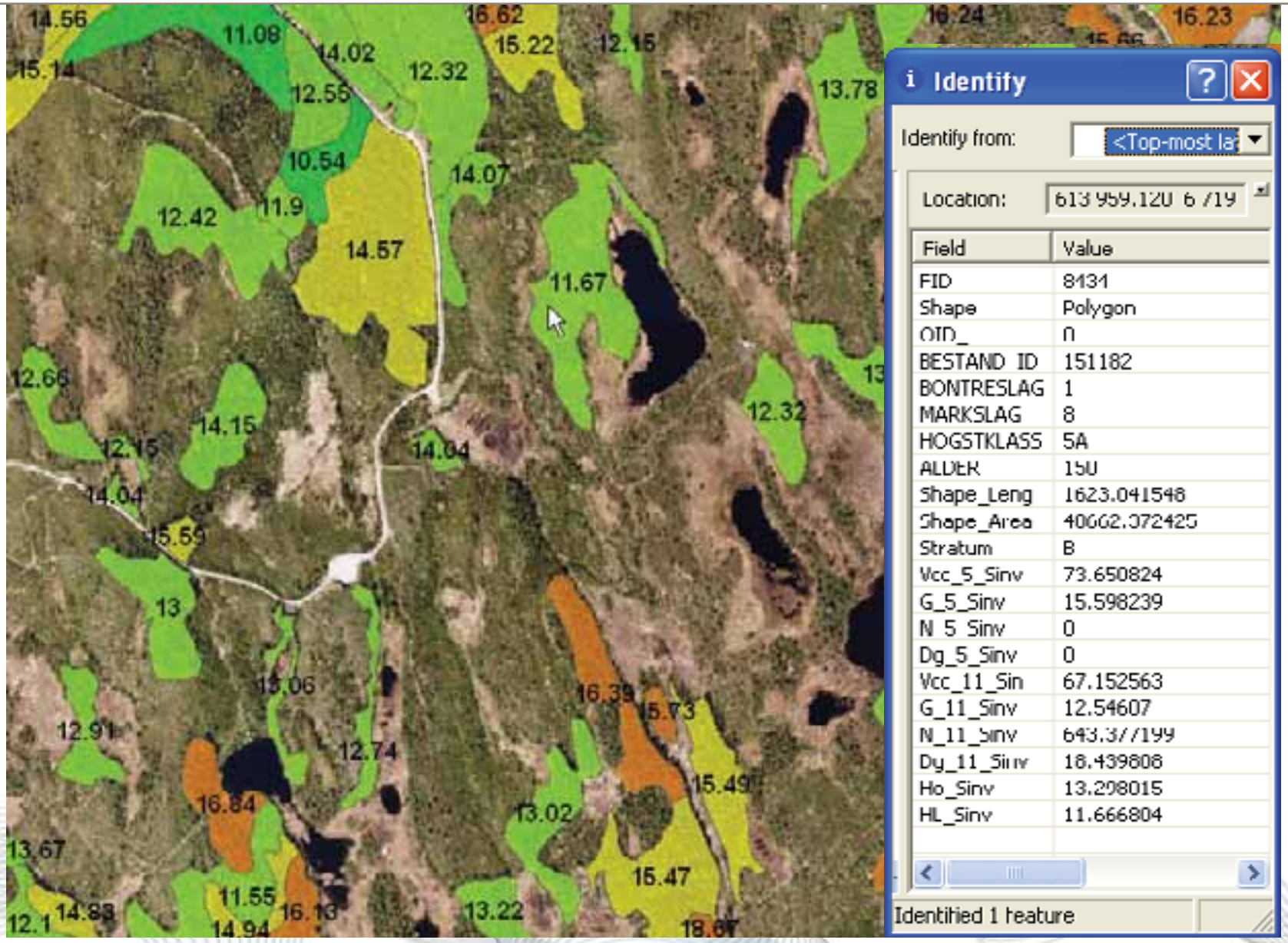




Results per grid cell - query



Result per forest compartment



Segmentation of biomass along power-lines

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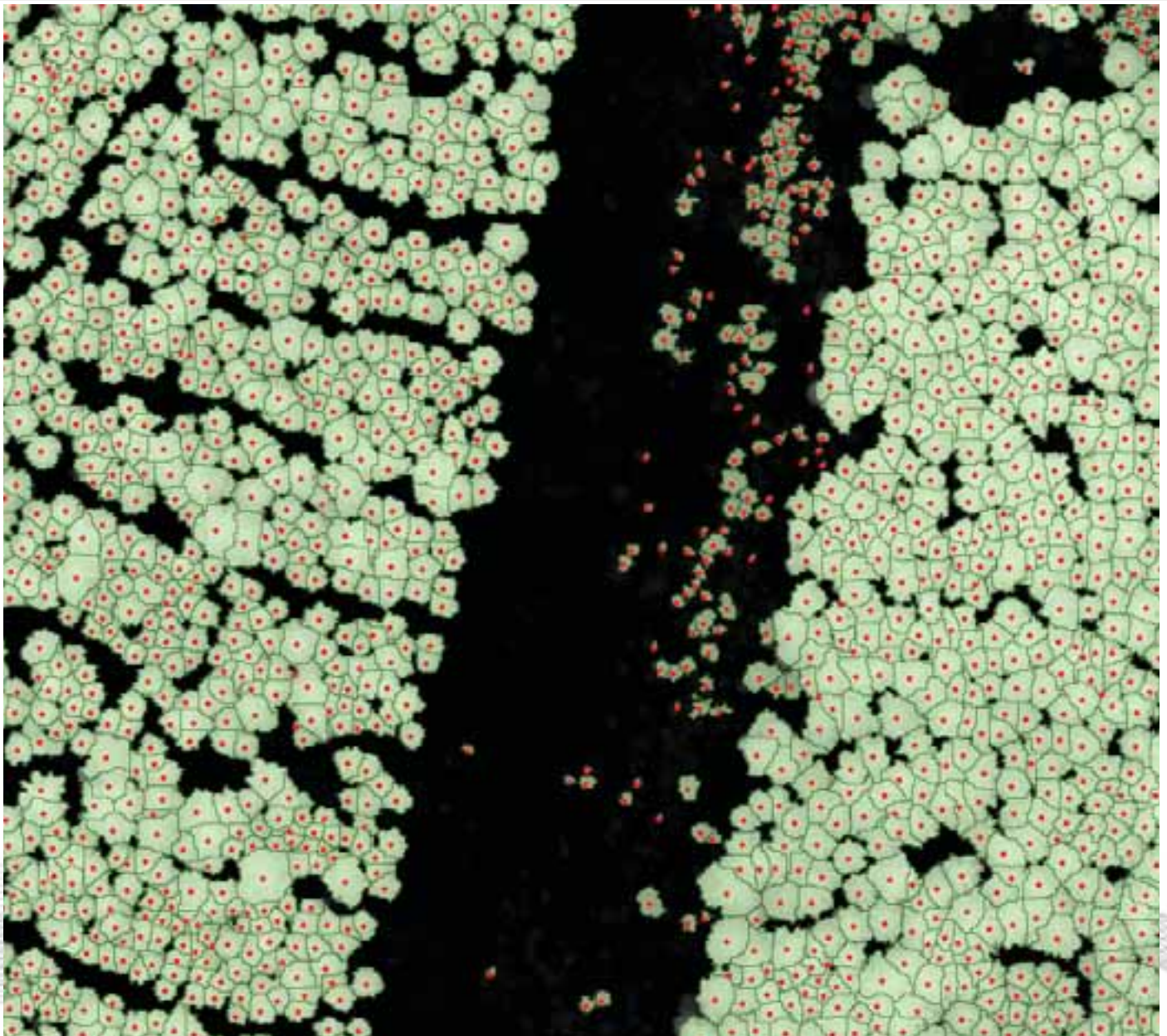
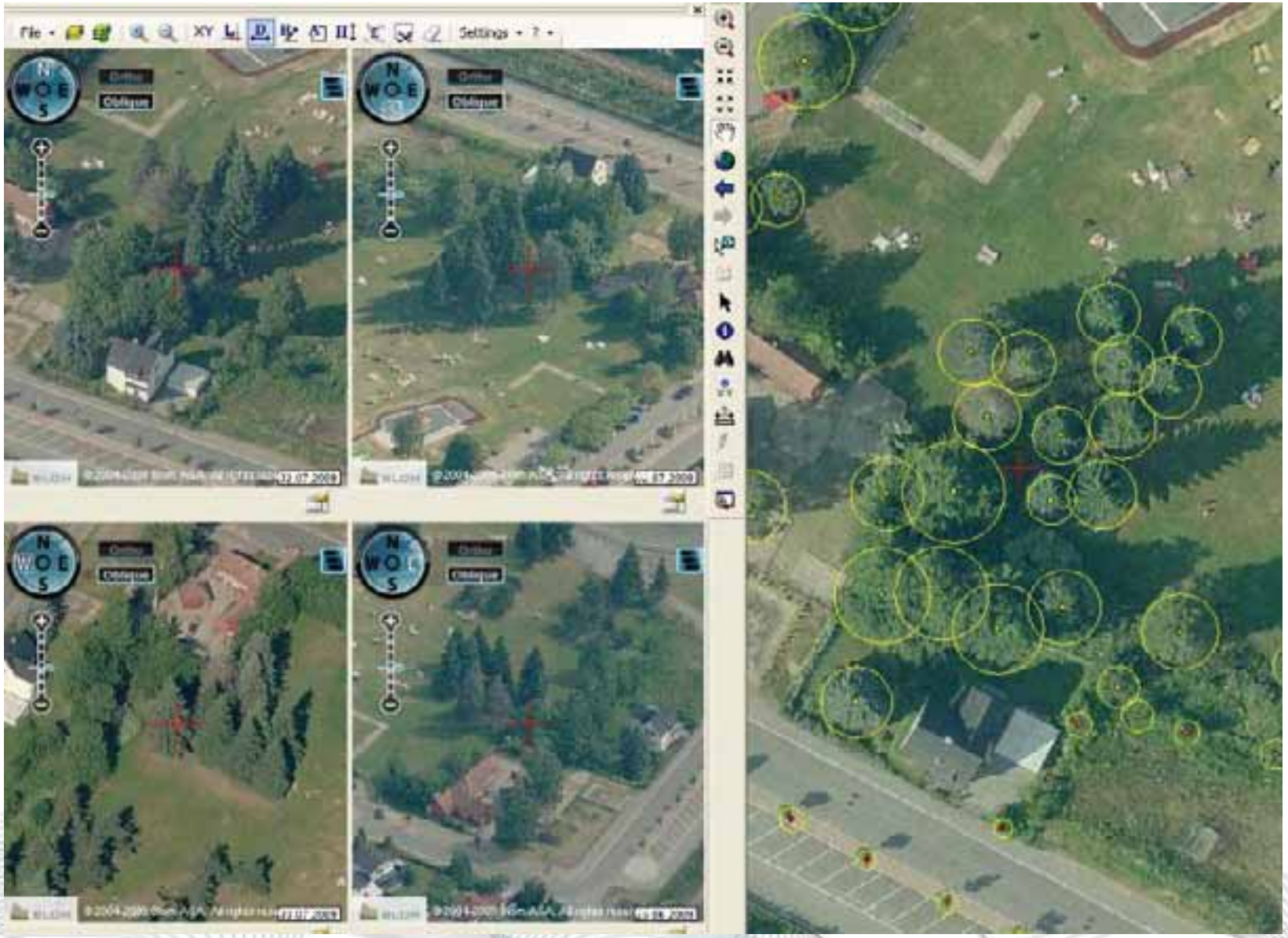


Biomass in urban areas

Using oblique images + LiDAR data



Toolbox for bioenergy mapping

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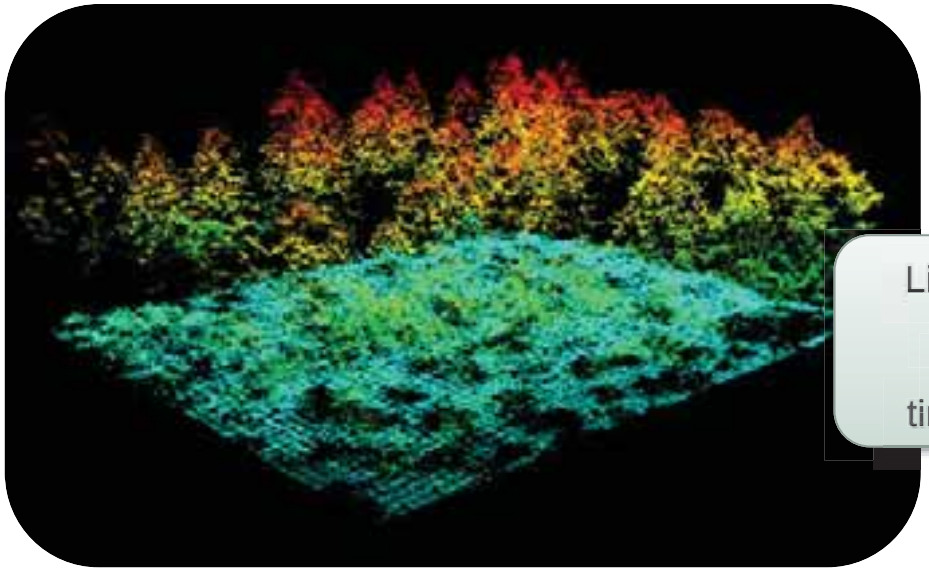

Airborne LiDAR data

Filtering and classification

Create DTM

Create DSM

Segmentation & classification

Variables for classification

Variables for estimation

Linking laser data from different times/individ

Linking field data and laser data

Single tree or groups of trees variables

Stand attributes

Geo database ArcGIS

Internet services Geocortex

Toolbox: Bio-energy Management Plan

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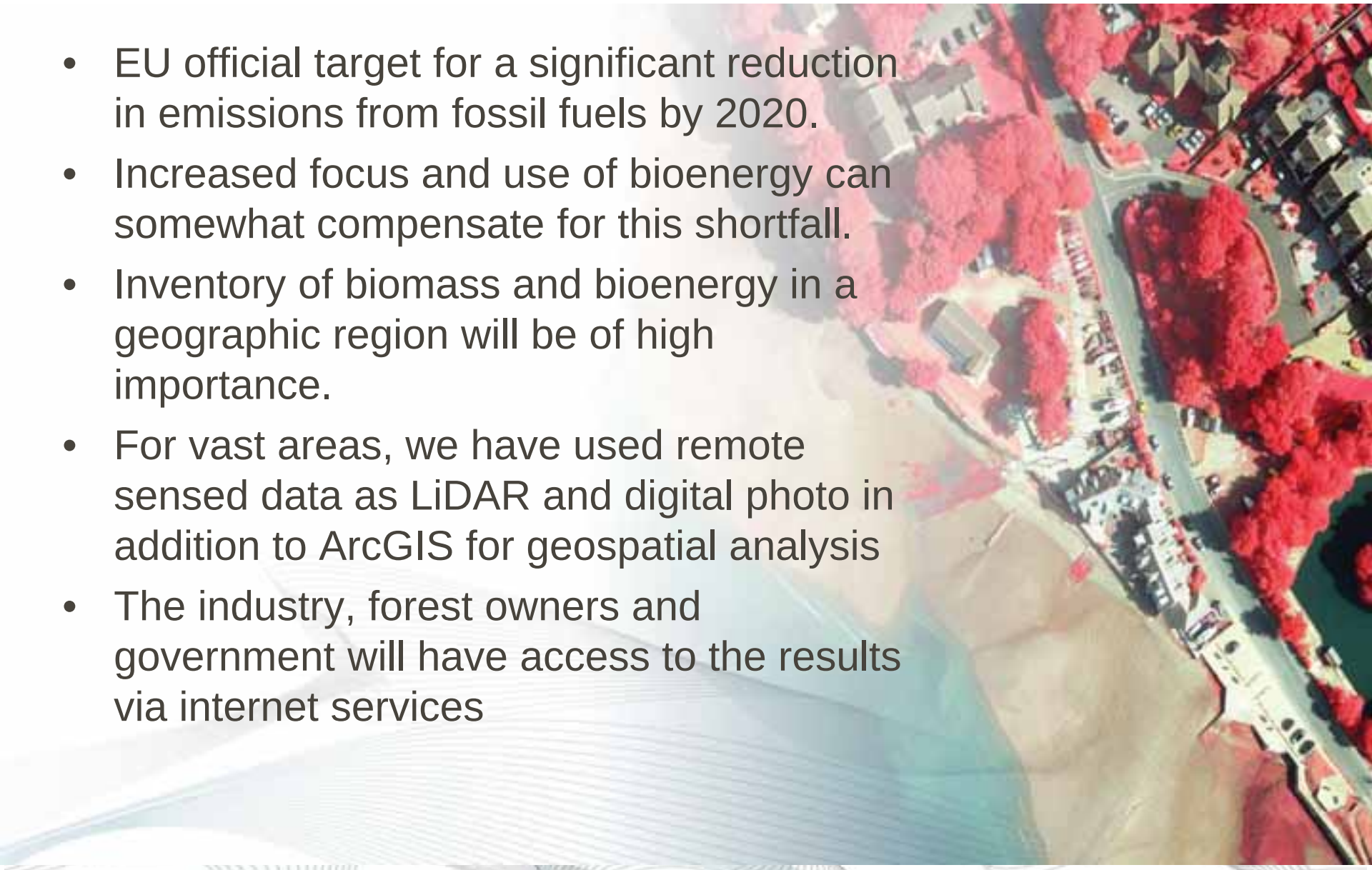
Map-figure	Areal, m^2	Species. S-P-B	Heights, class	Density, class	Type	Energy-class	Biomass, dry substance, t/ha	Energy, MWh/ha	Gross quantity of energy, kWh
1	15	10-0-0	10	12	Road-side	A	22,1	88	132
2	120	0-5-5	5	10	Ditch	A	20,2	80	960
3	250	0-0-10	7	5	FMA	C	41,5	160	4000
4	10	1-0-9	2	3	Moor	D	10,1	40	40
5	250	8-2-0	20	15	FMA	C	70,5	280	7000

Summary

- EU official target for a significant reduction in emissions from fossil fuels by 2020.
- Increased focus and use of bioenergy can somewhat compensate for this shortfall.
- Inventory of biomass and bioenergy in a geographic region will be of high importance.
- For vast areas, we have used remote sensed data as LiDAR and digital photo in addition to ArcGIS for geospatial analysis
- The industry, forest owners and government will have access to the results via internet services