

Forest monitoring – landscape scale at the single tree level

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Forest Research Institute*

Plan



Introduction

Single tree detection - STD

Data integration

Deriving knowledge about the forest from RS data

Conclusions



Zdj. K. Pilch

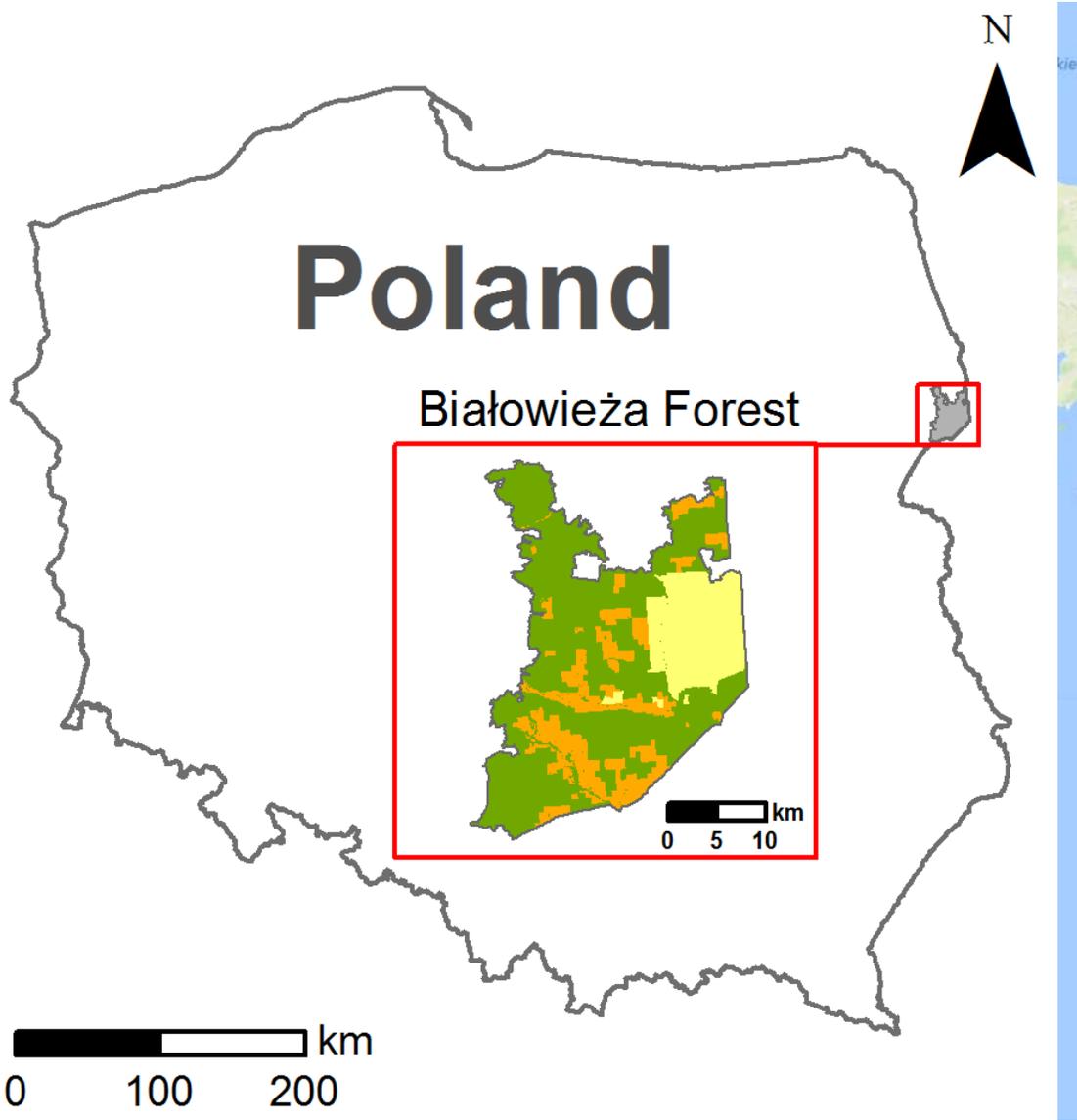
Introduction

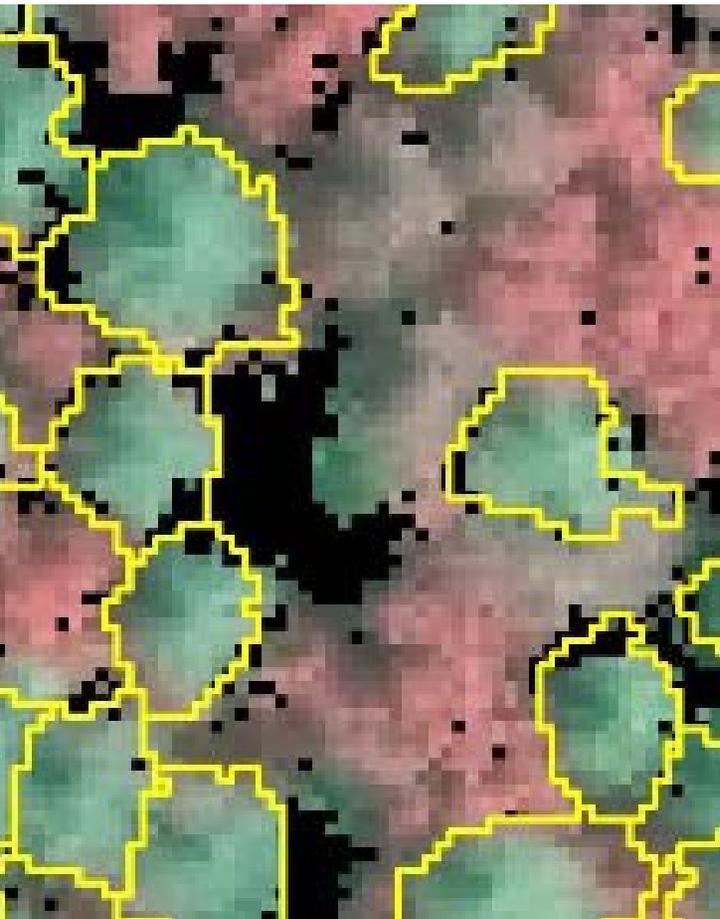
Project aim



*The aim of the project is to develop and apply a **monitoring** method of a large forest area with the use of RS data.*

Białowieża Forest

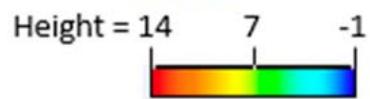
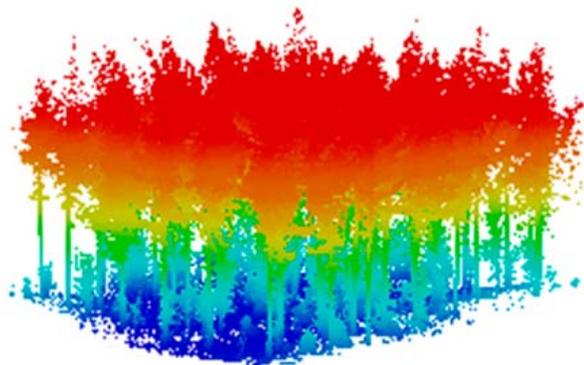




Single tree detection

STD

STD – ALS point cloud



(a)

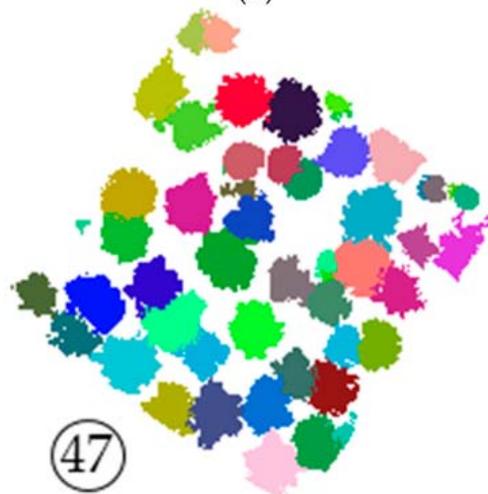


- - detected tree trunk points ○ - ground points
- - the other points

(b)

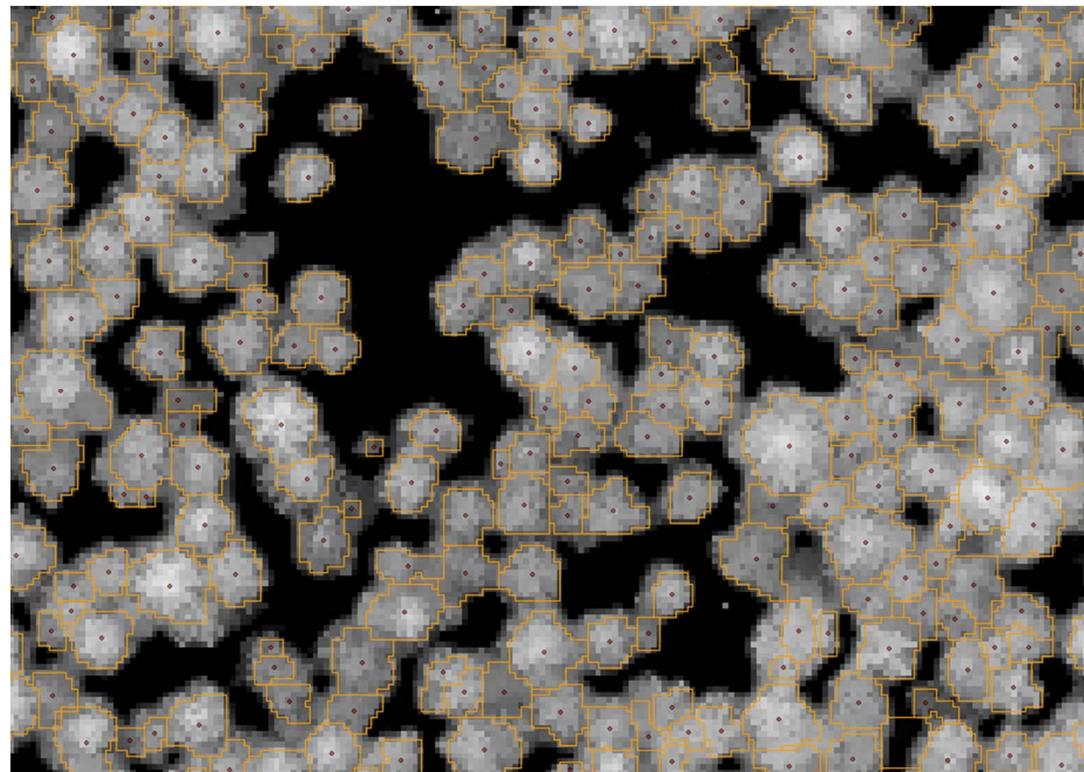
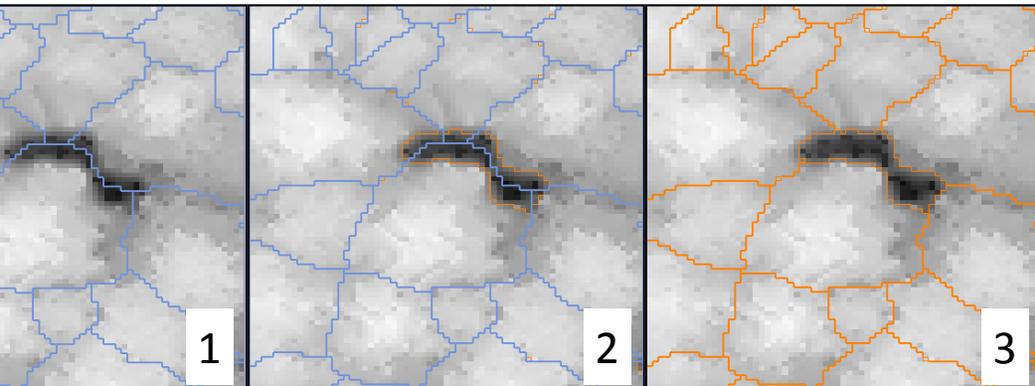


(c)

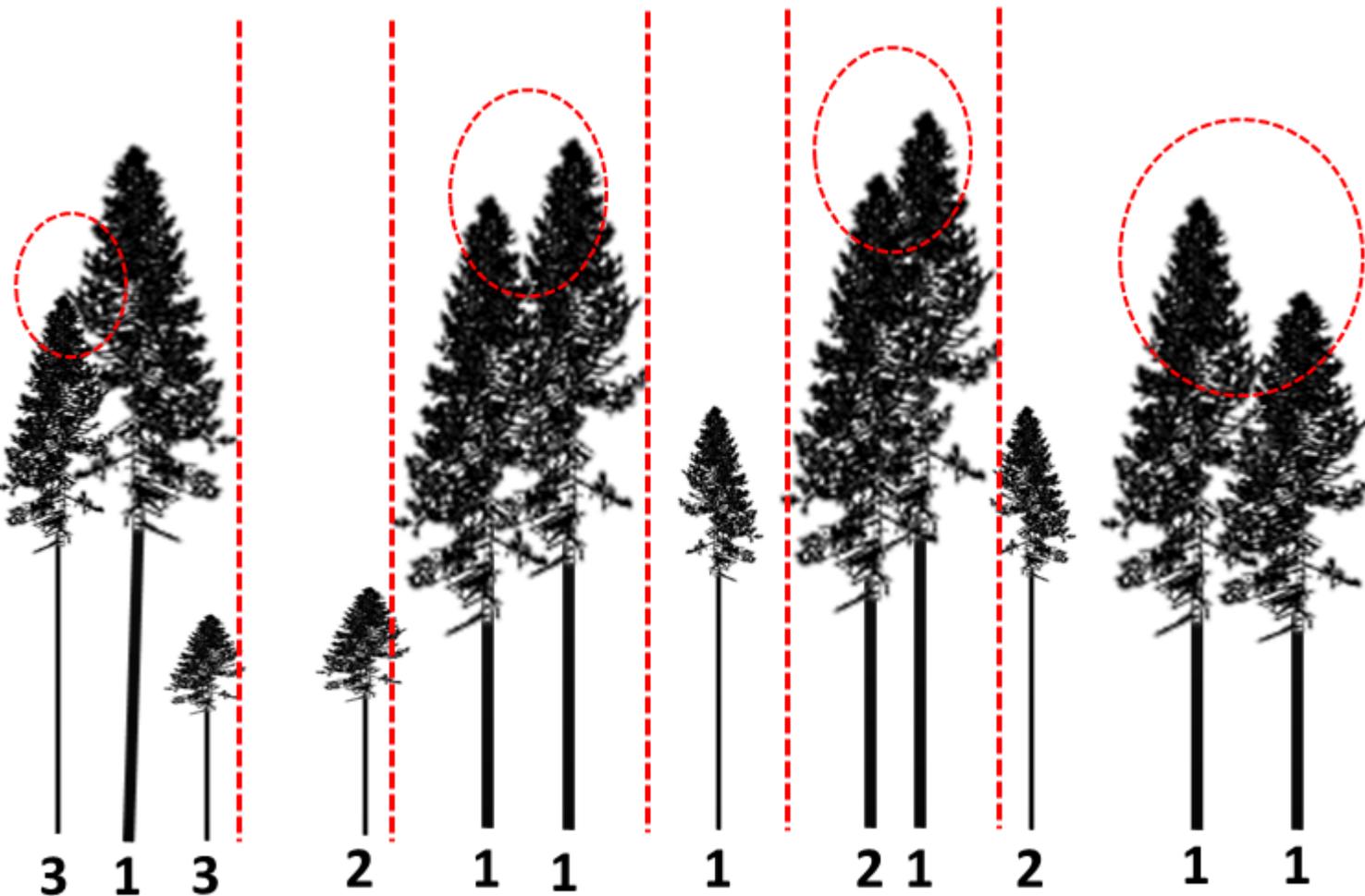


(d)

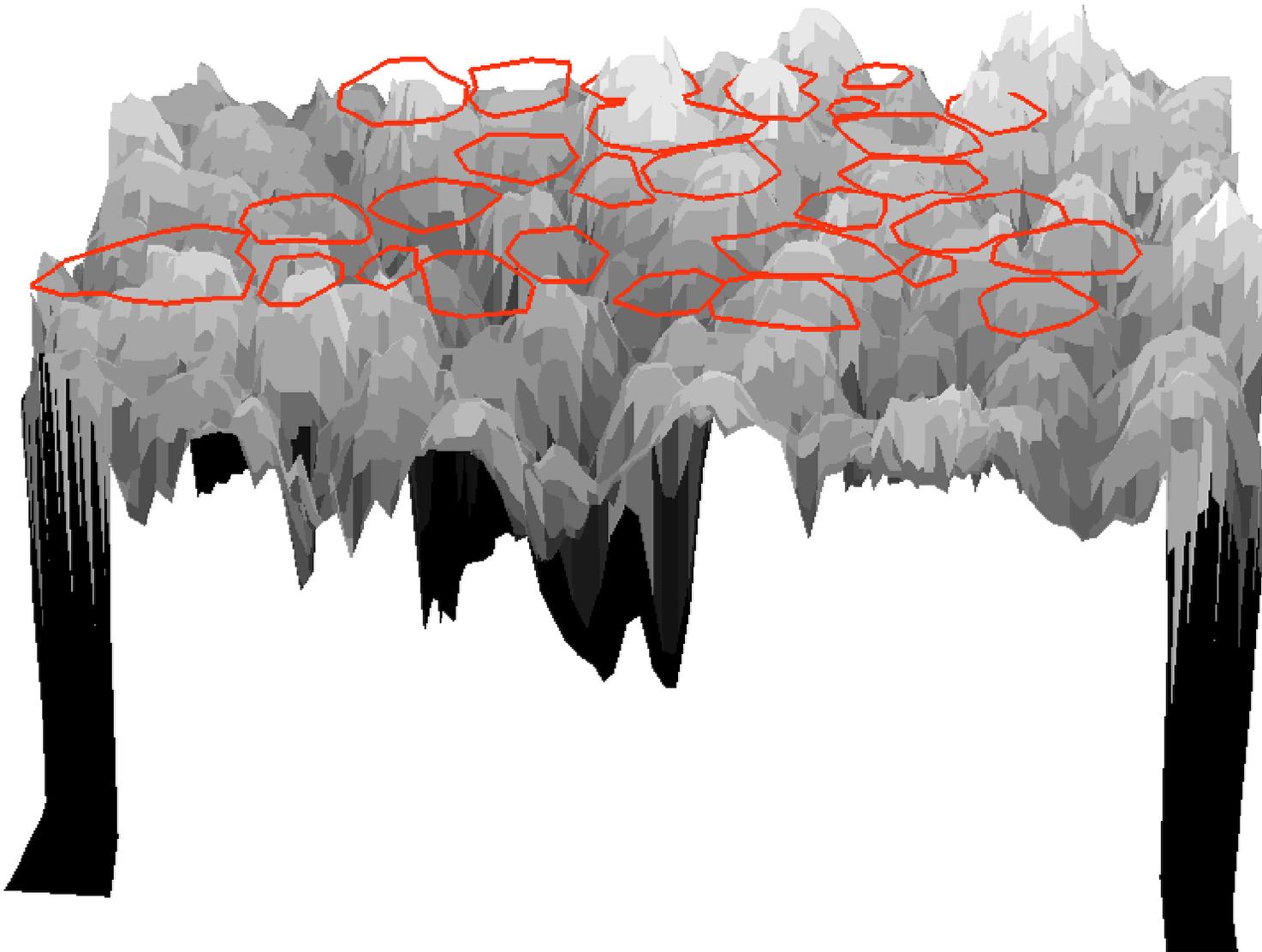
STD – Canopy Height Model (CHM)



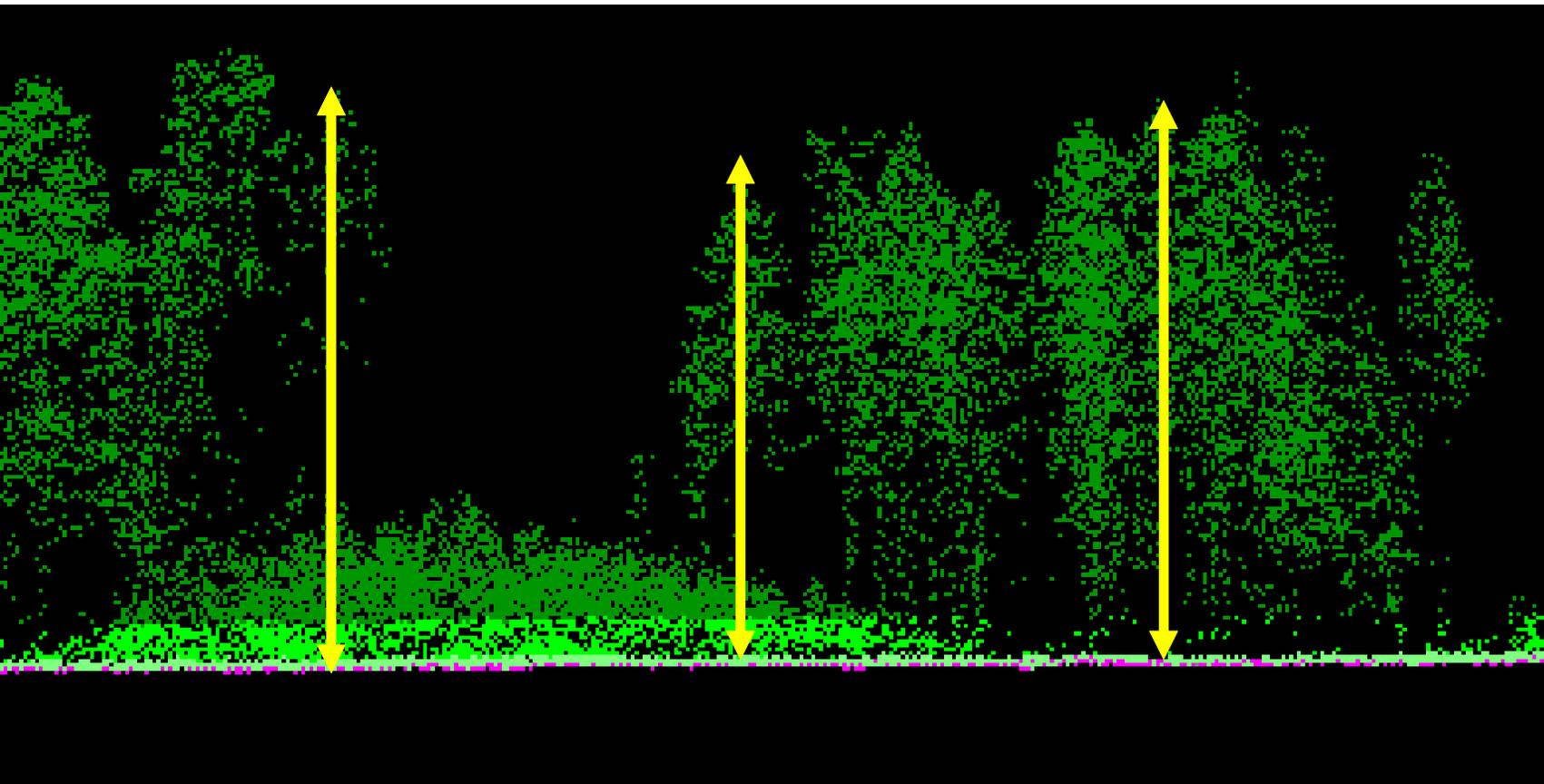
STD – limitations



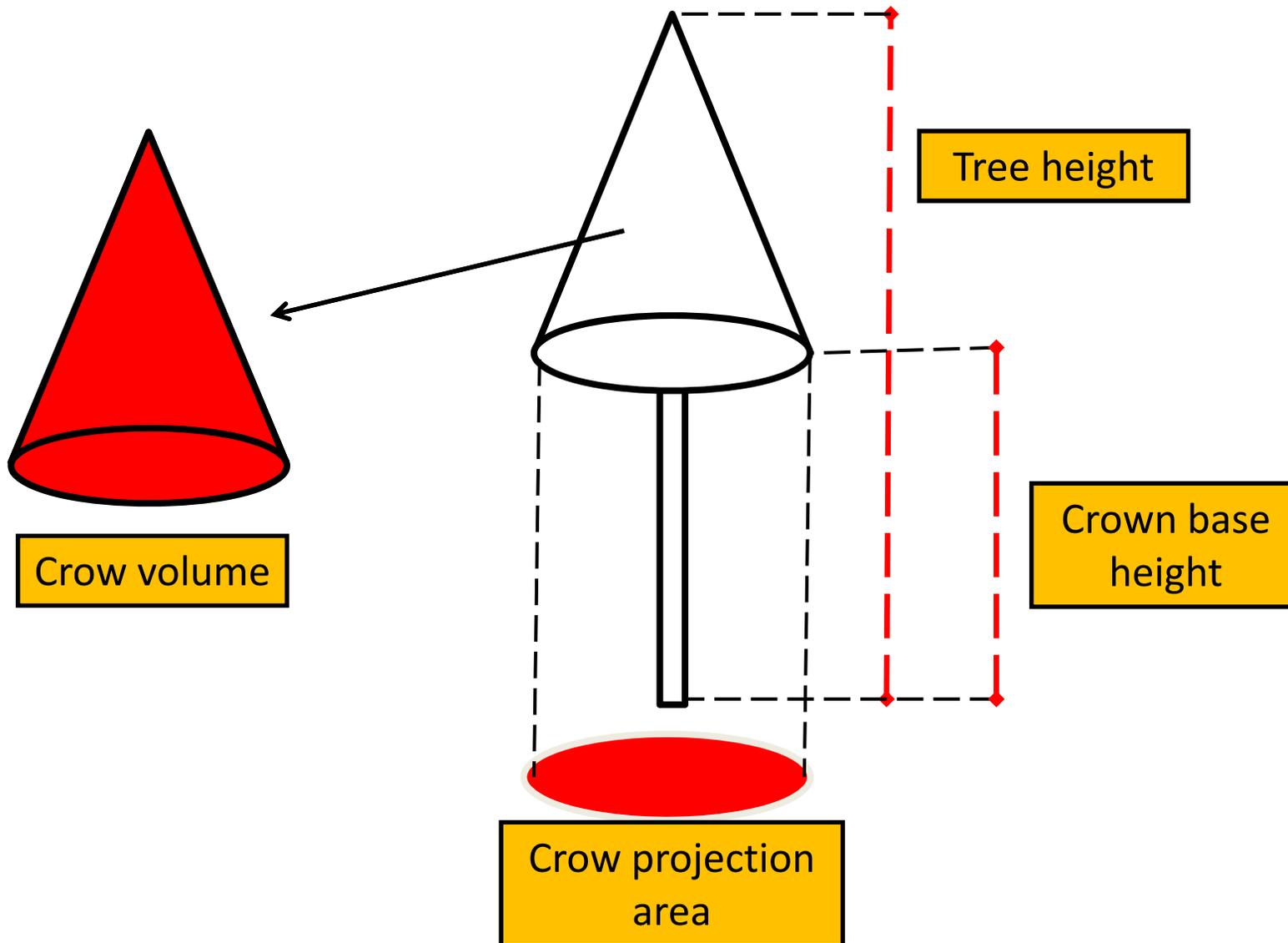
STD – Canopy Height Model (CHM)



ALS – tree height



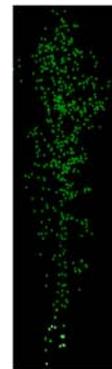
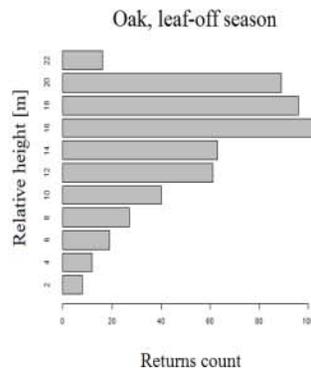
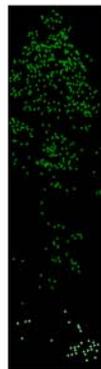
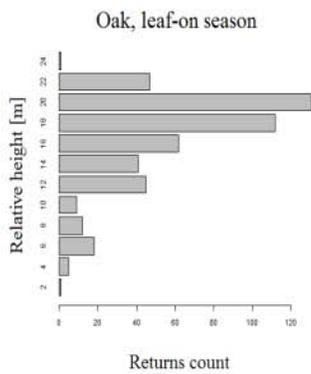
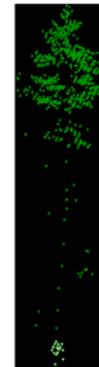
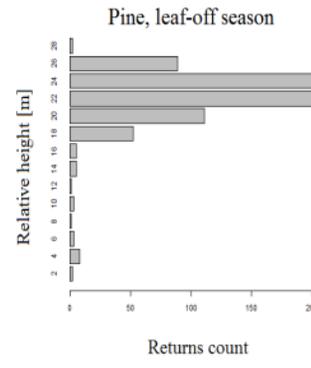
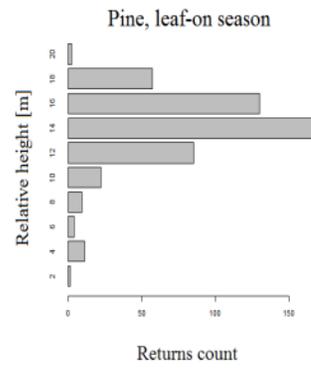
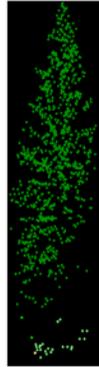
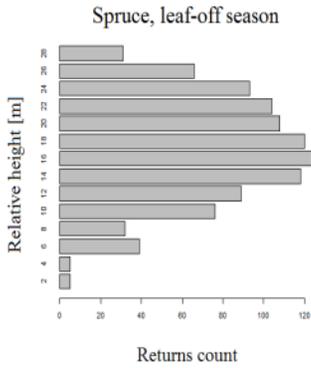
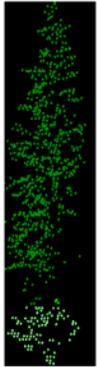
Single tree parameters

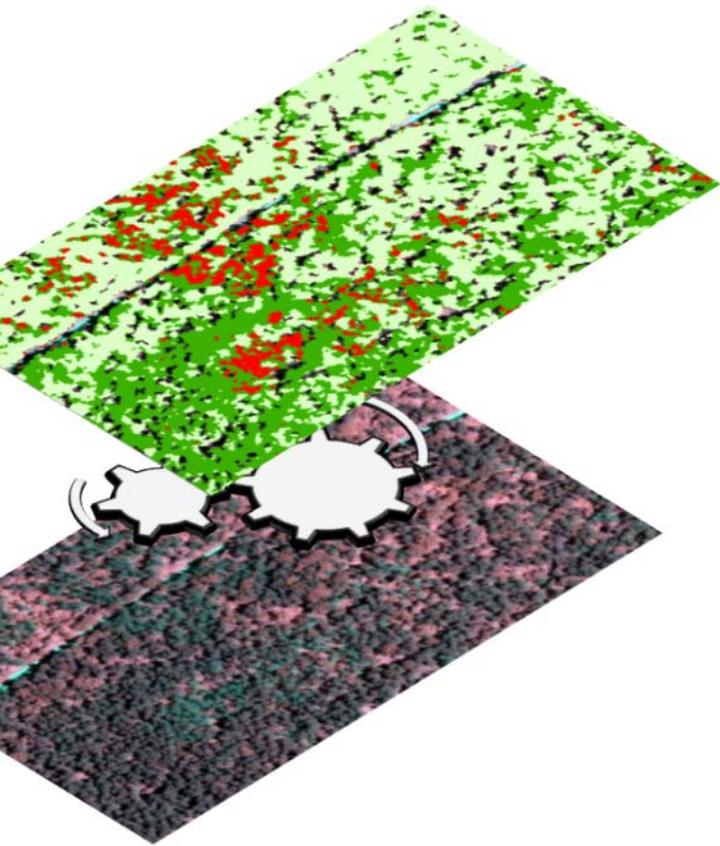


Single tree classification



on season
Returns count





Data integration



ALS data

Hyper-spectral data

Multi-spectral data

20 TB off data

MLN of objects in
single shp layer

Sample plots

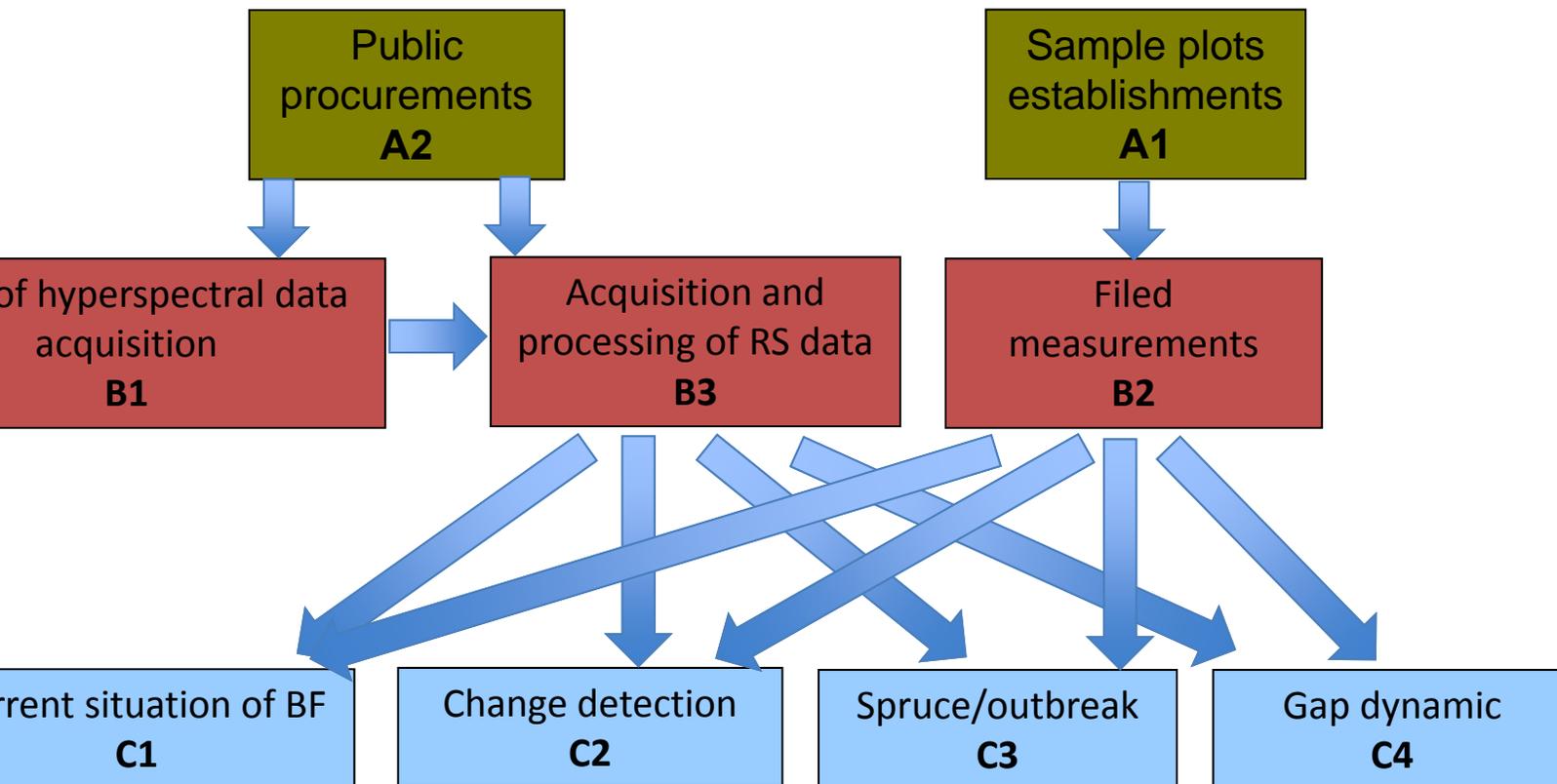
Dendrometers

Dead trees

Dendrochronological data

TLS data

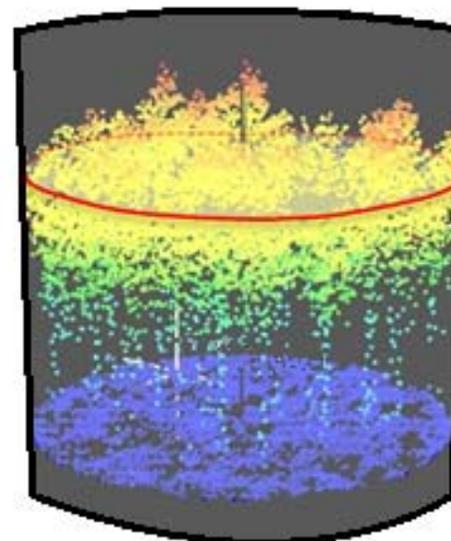
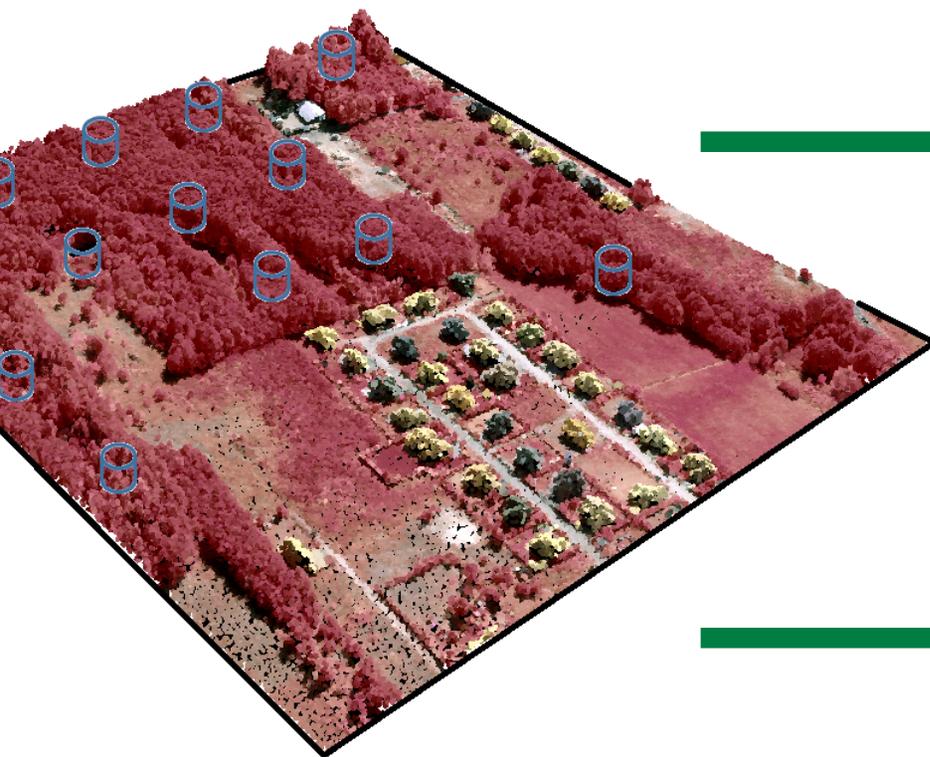
Meteorological data



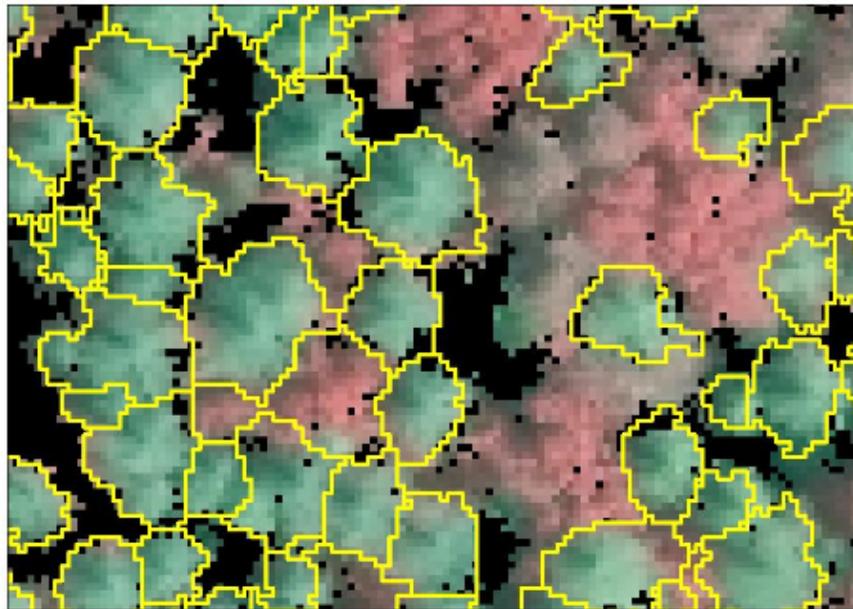
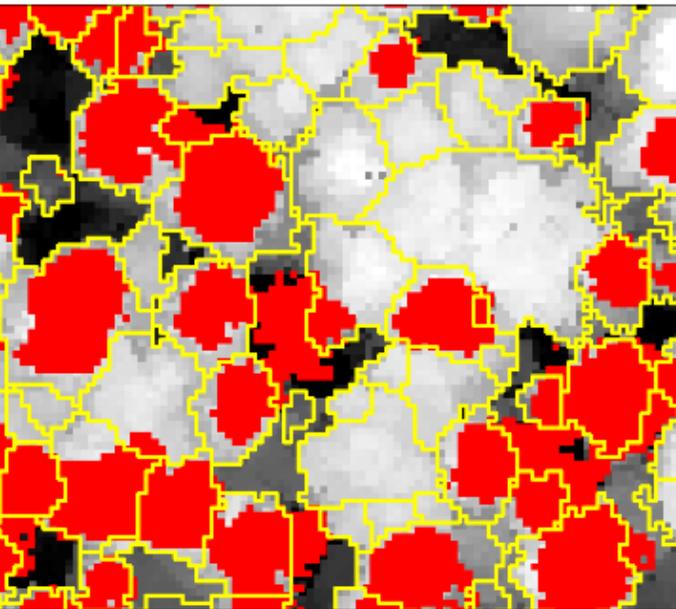


1. Field and aboveground data
2. Various RS data – similar time of acquisitions
3. Time series of one RS data
4. Time series of various RS data
5. Different results of single data set processing

1. Filed + aerial/spaceborne data



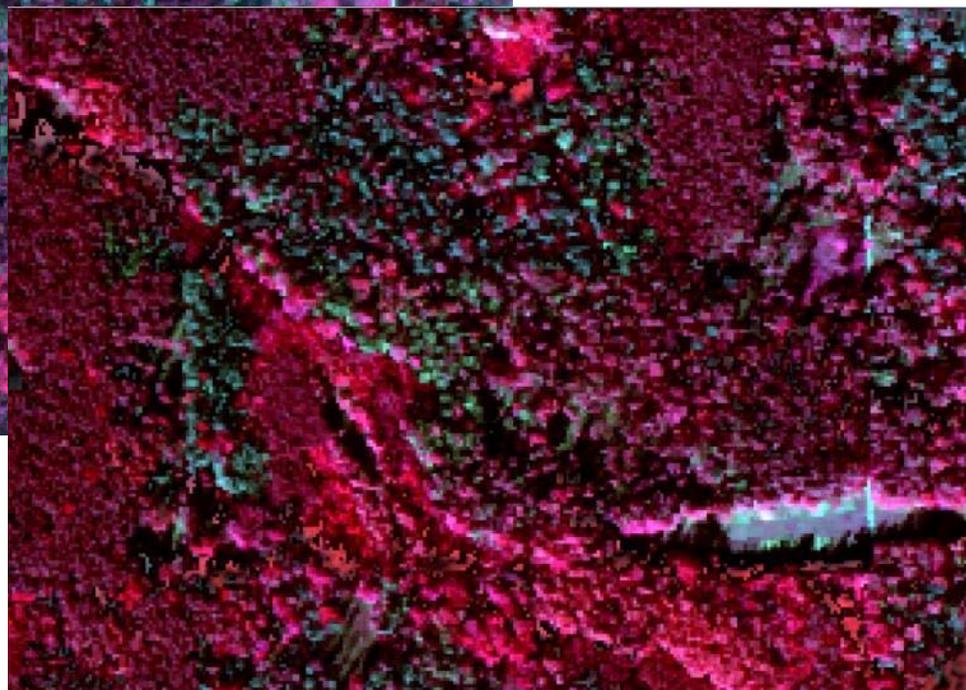
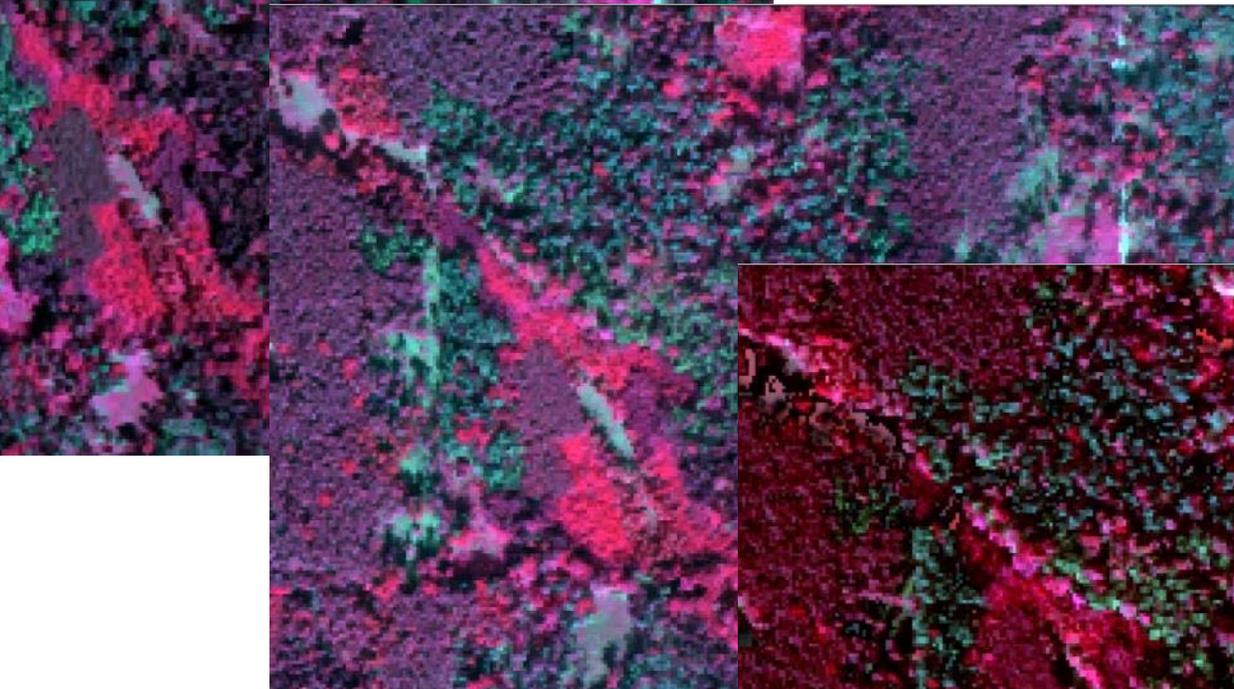
2. ALS + spectra data



3. Time series of one RS data



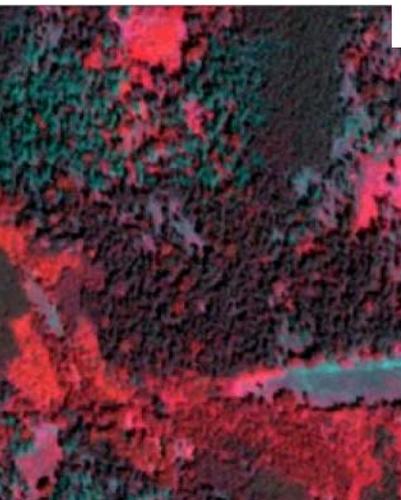
1, 2, 3 Hiperspectral



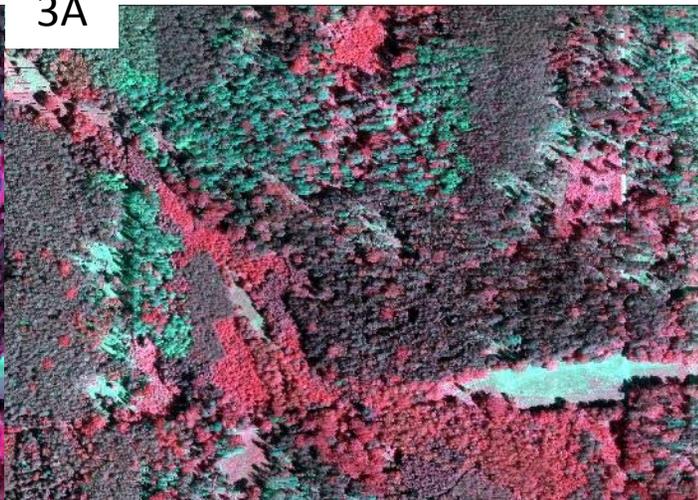
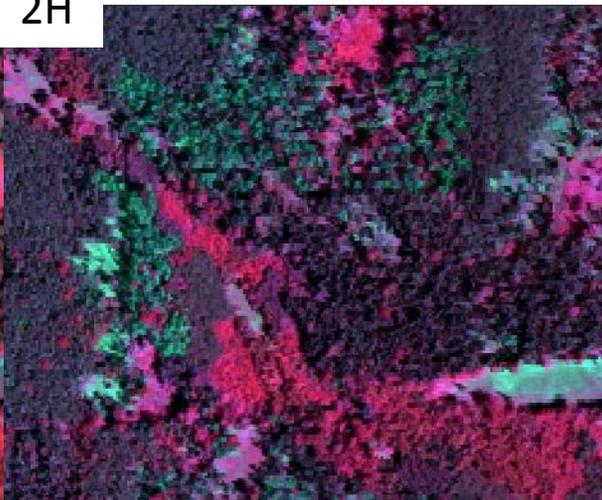
4. Time series of various RS data



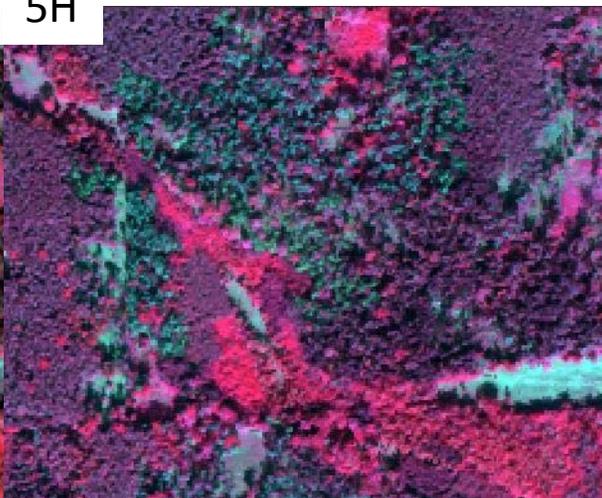
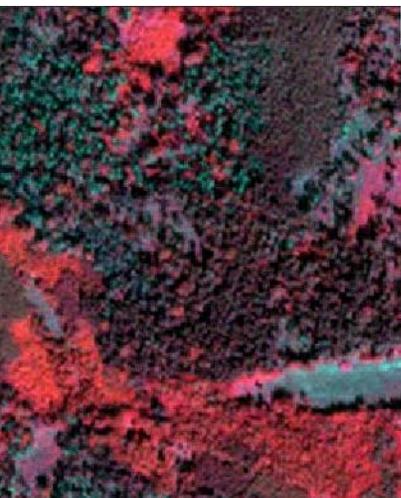
2H



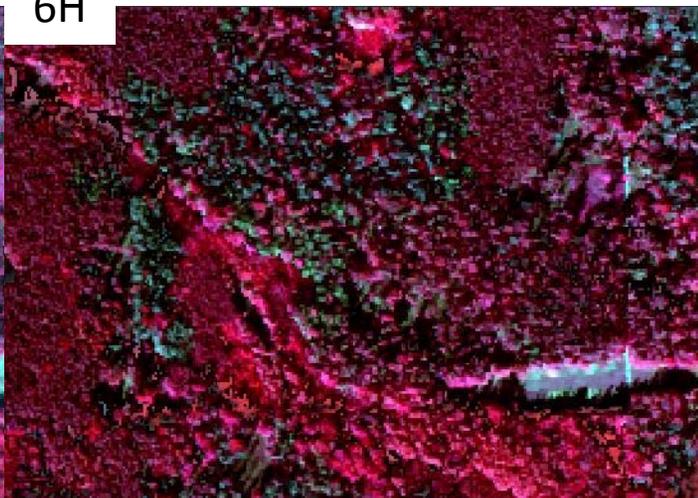
3A



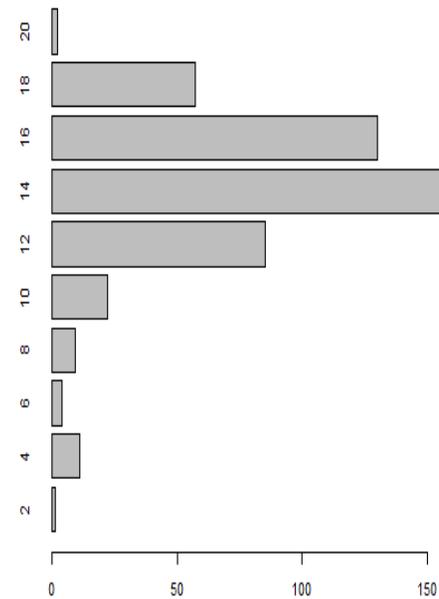
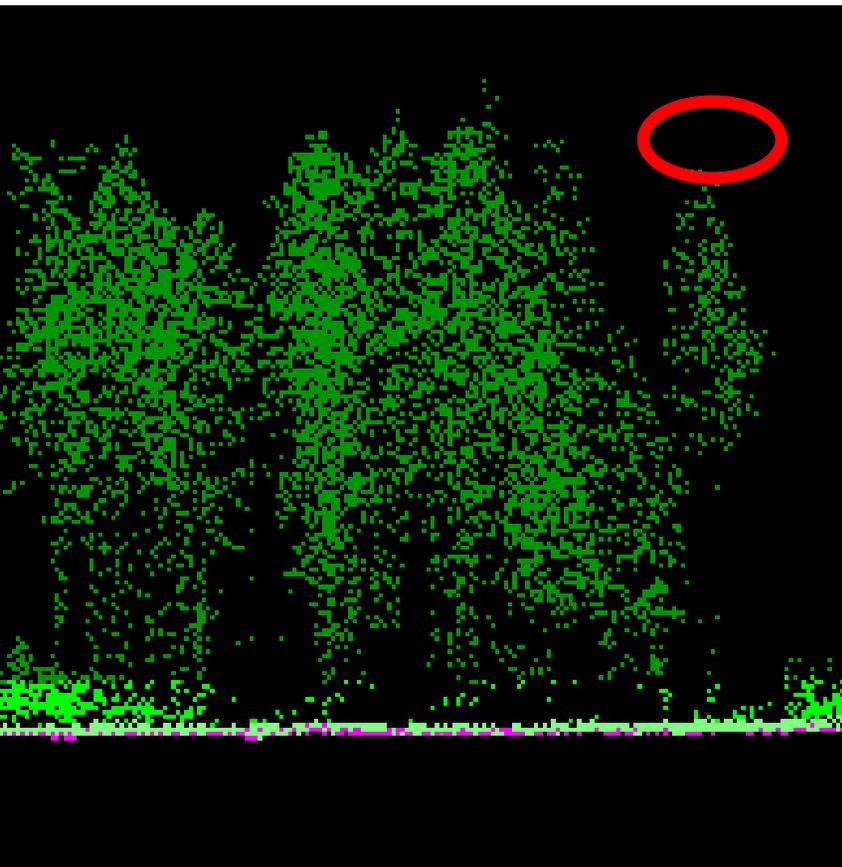
5H

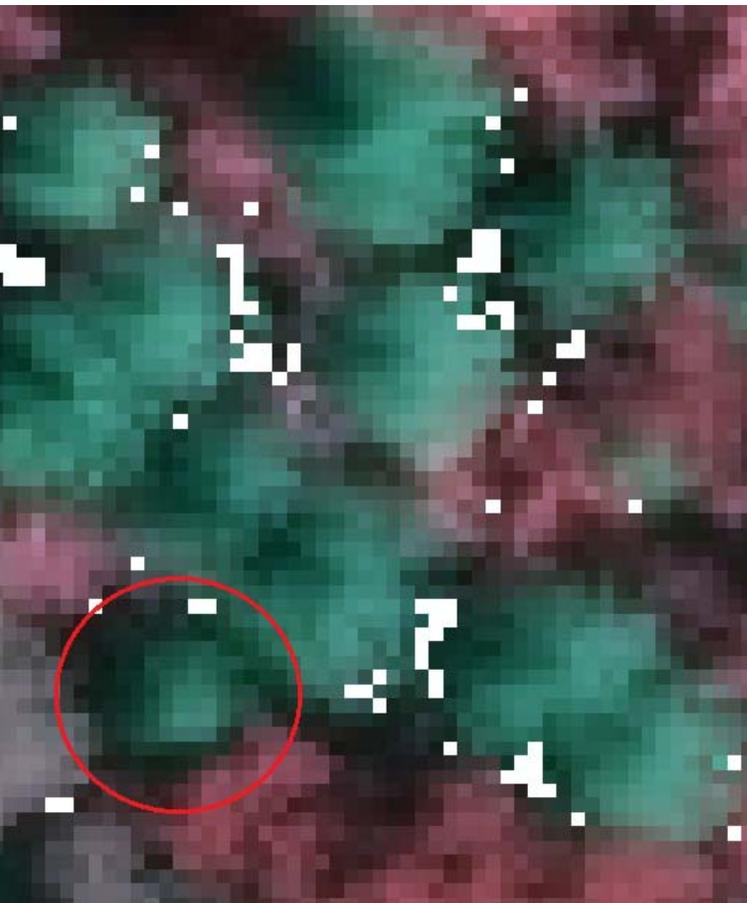


6H

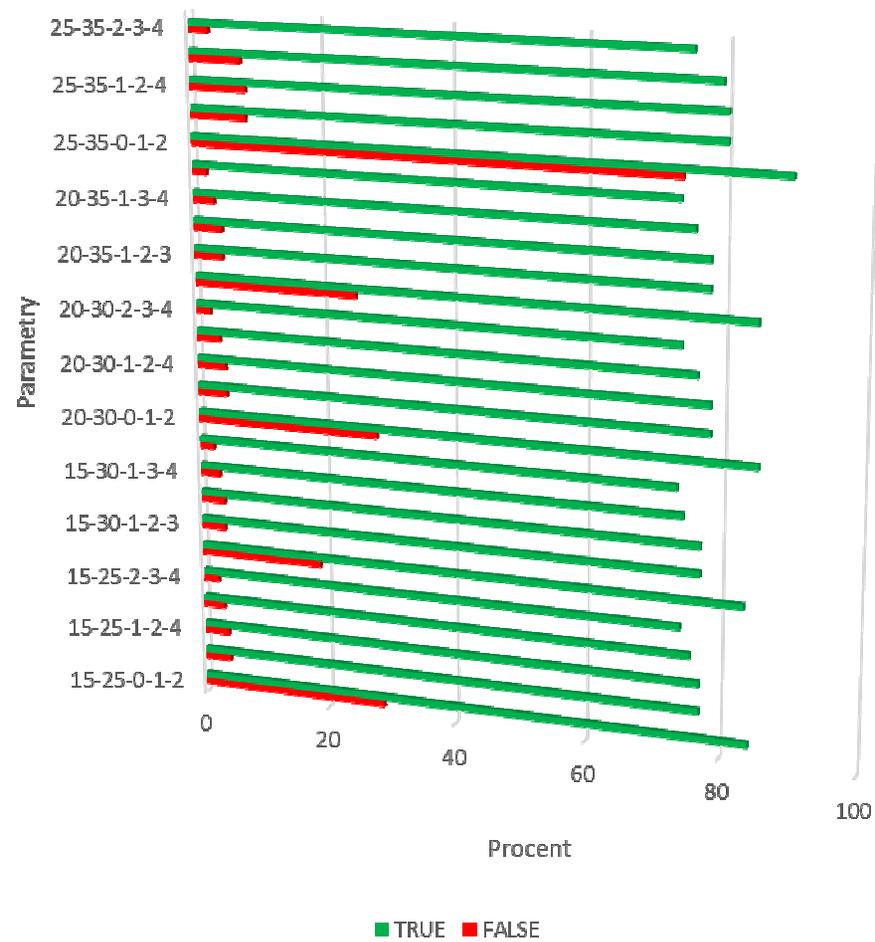
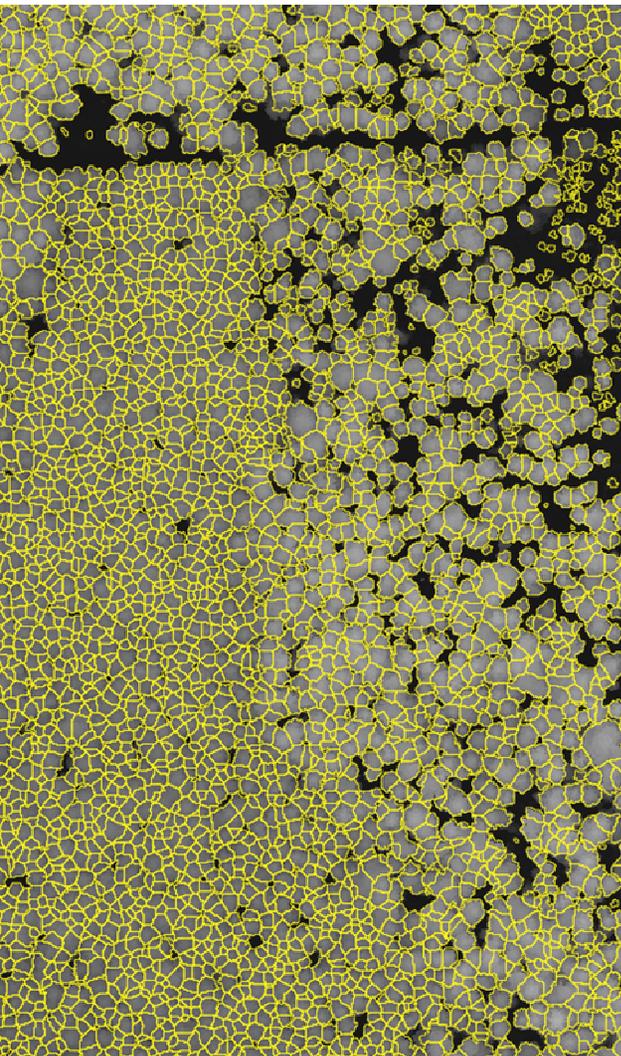


5. ALS – STD + point cloud analysis

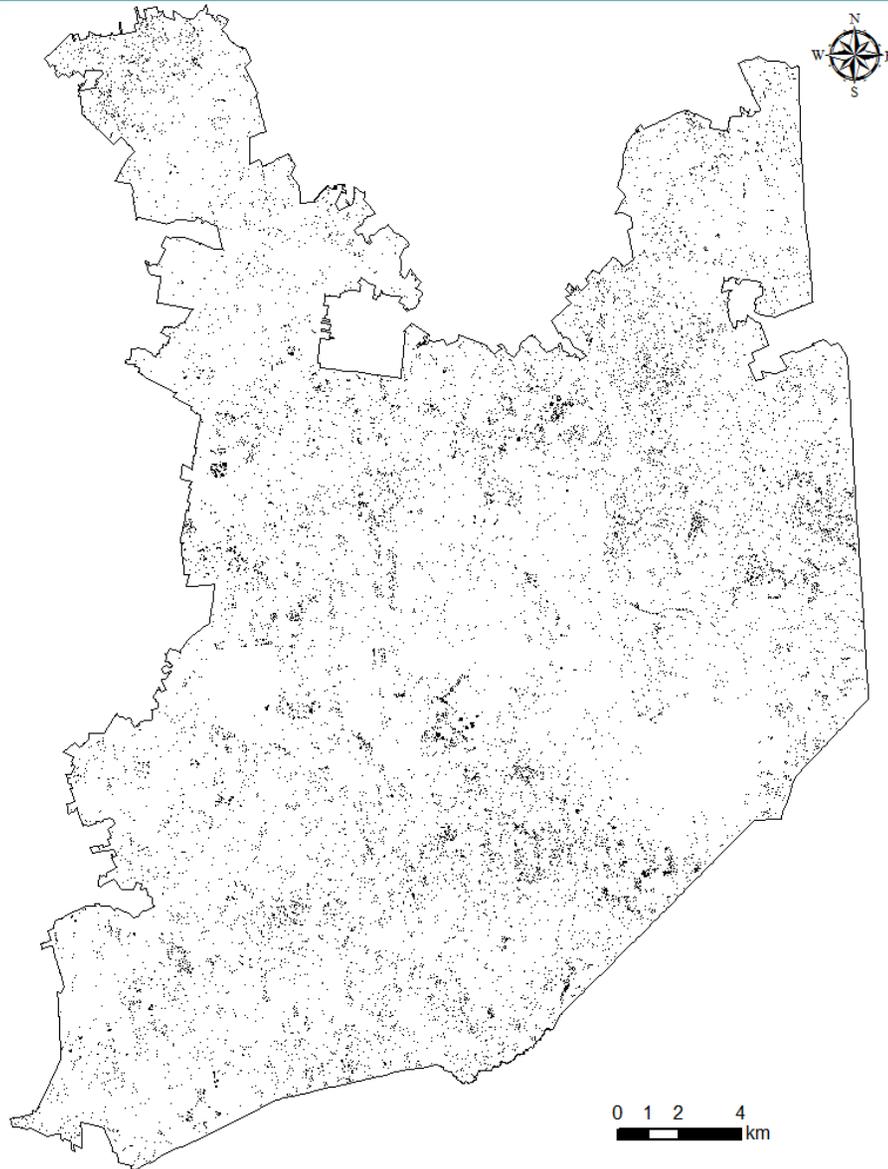




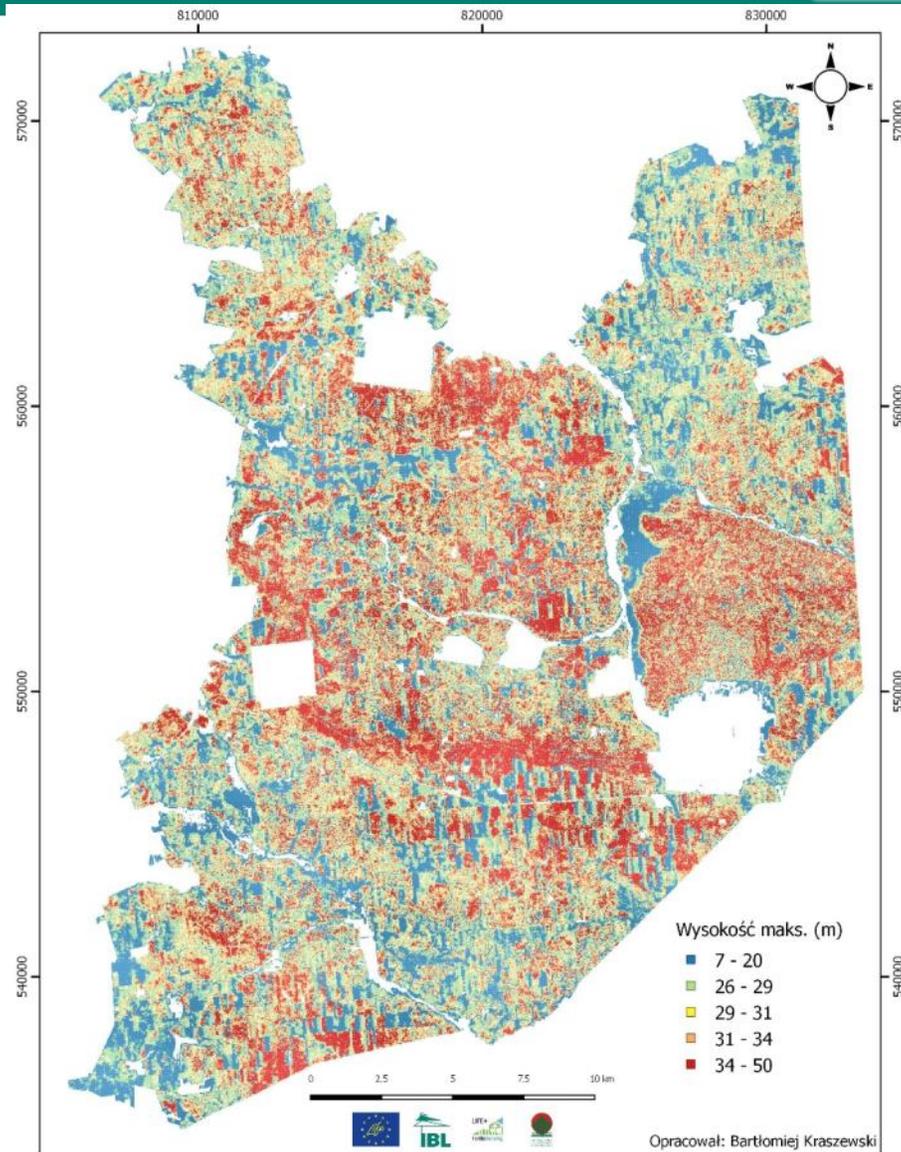
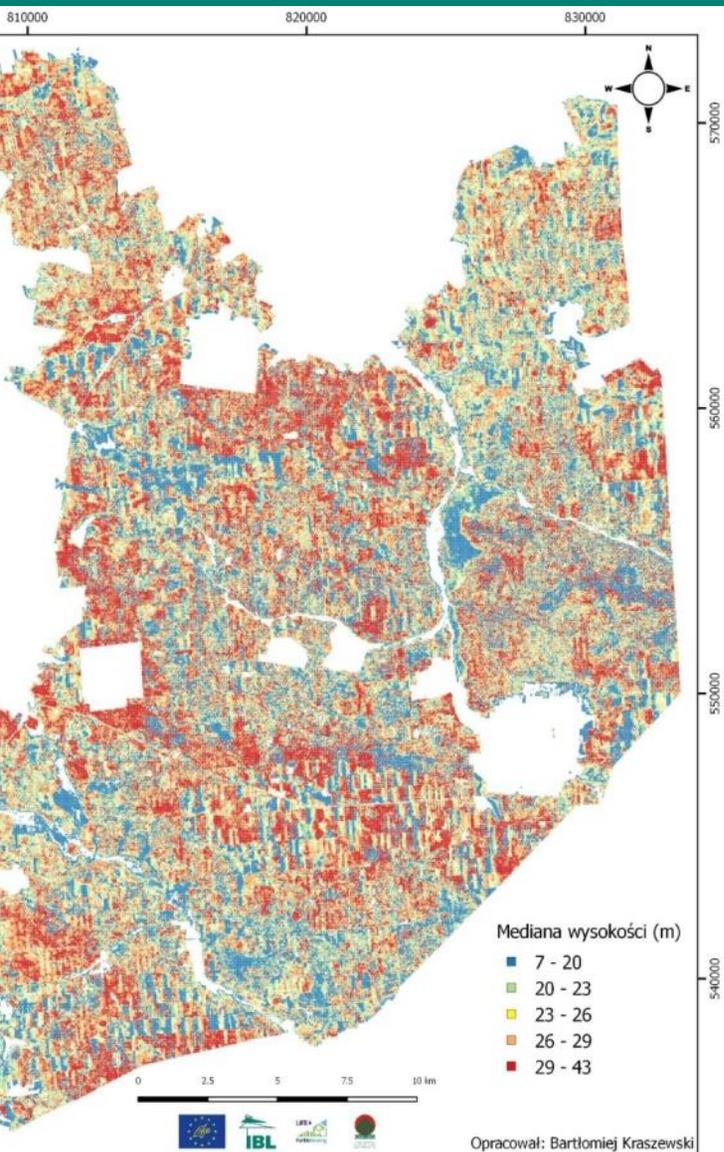
Gaining knowledge about the forest from RS data



Gap detection

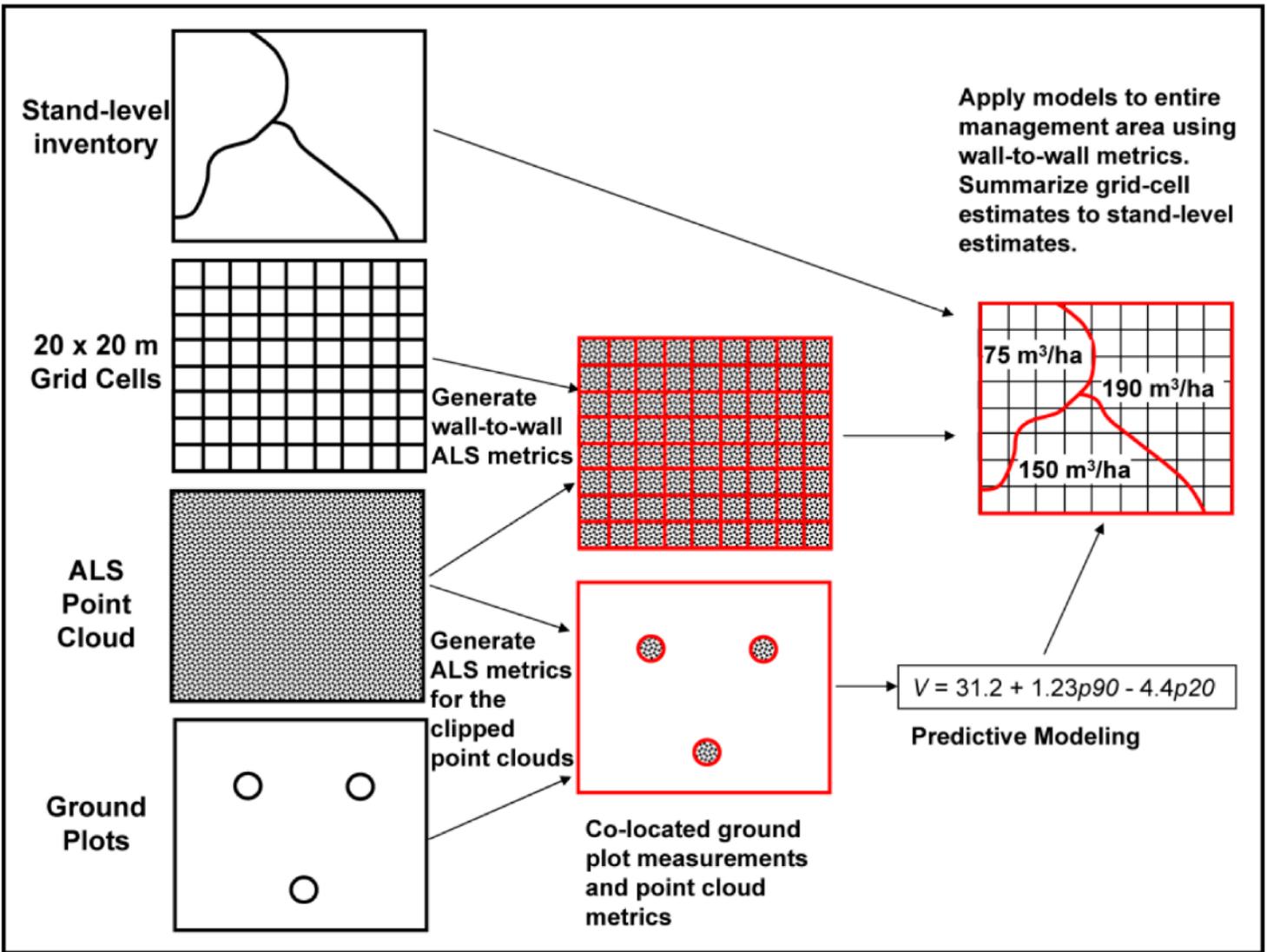


Tree height





ALS Growing Stock Volume (GSV)



White et al. 2013

ALS STD results at the sample level



Number;

Mean height;

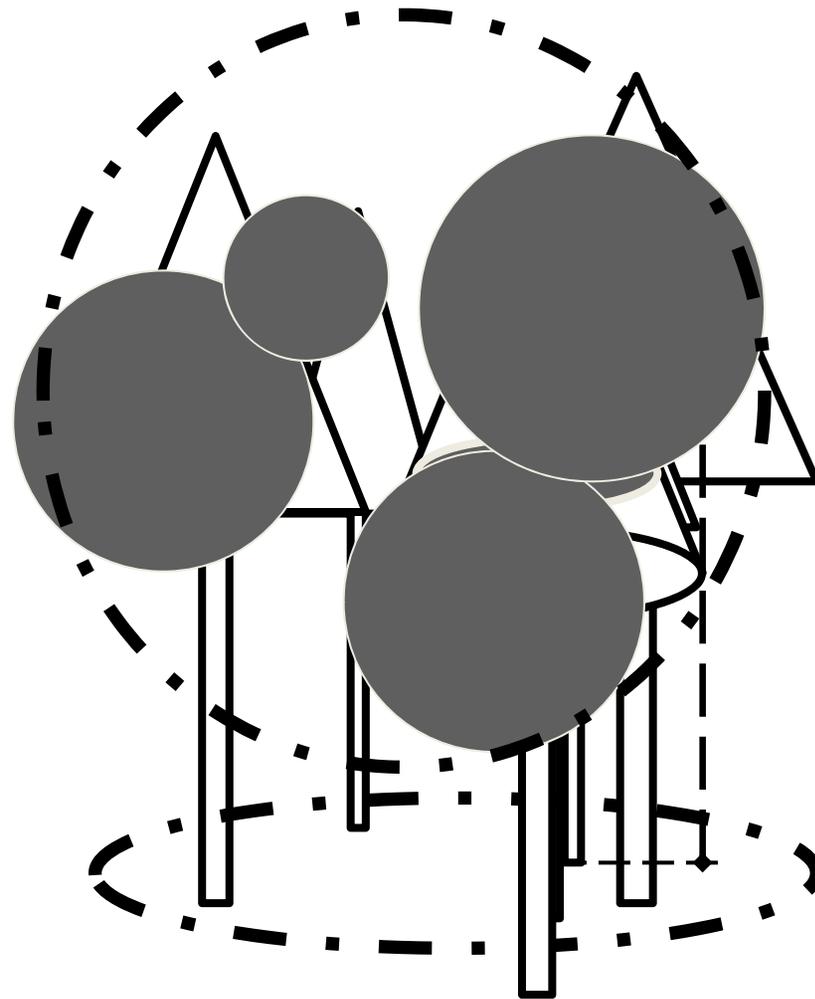
Top height;

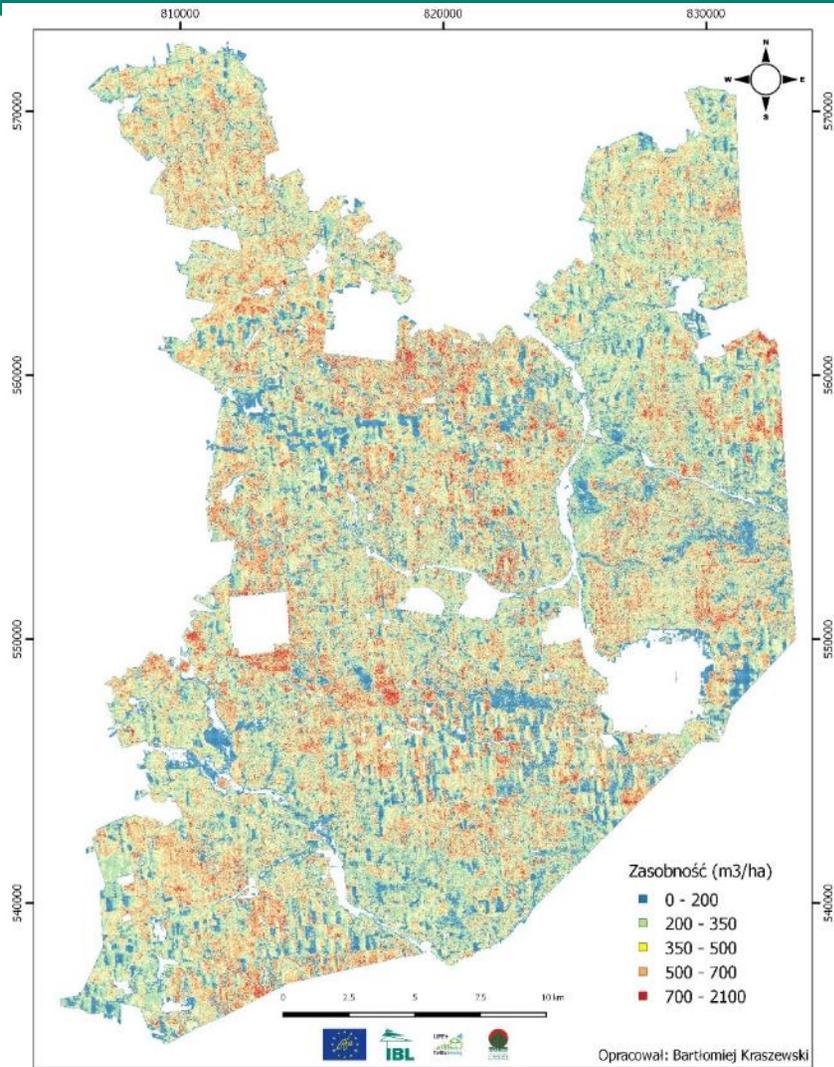
Sum of heights;

Sum of crowns projection

area;

Sum of crowns volume.





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 KRS: 0000384171

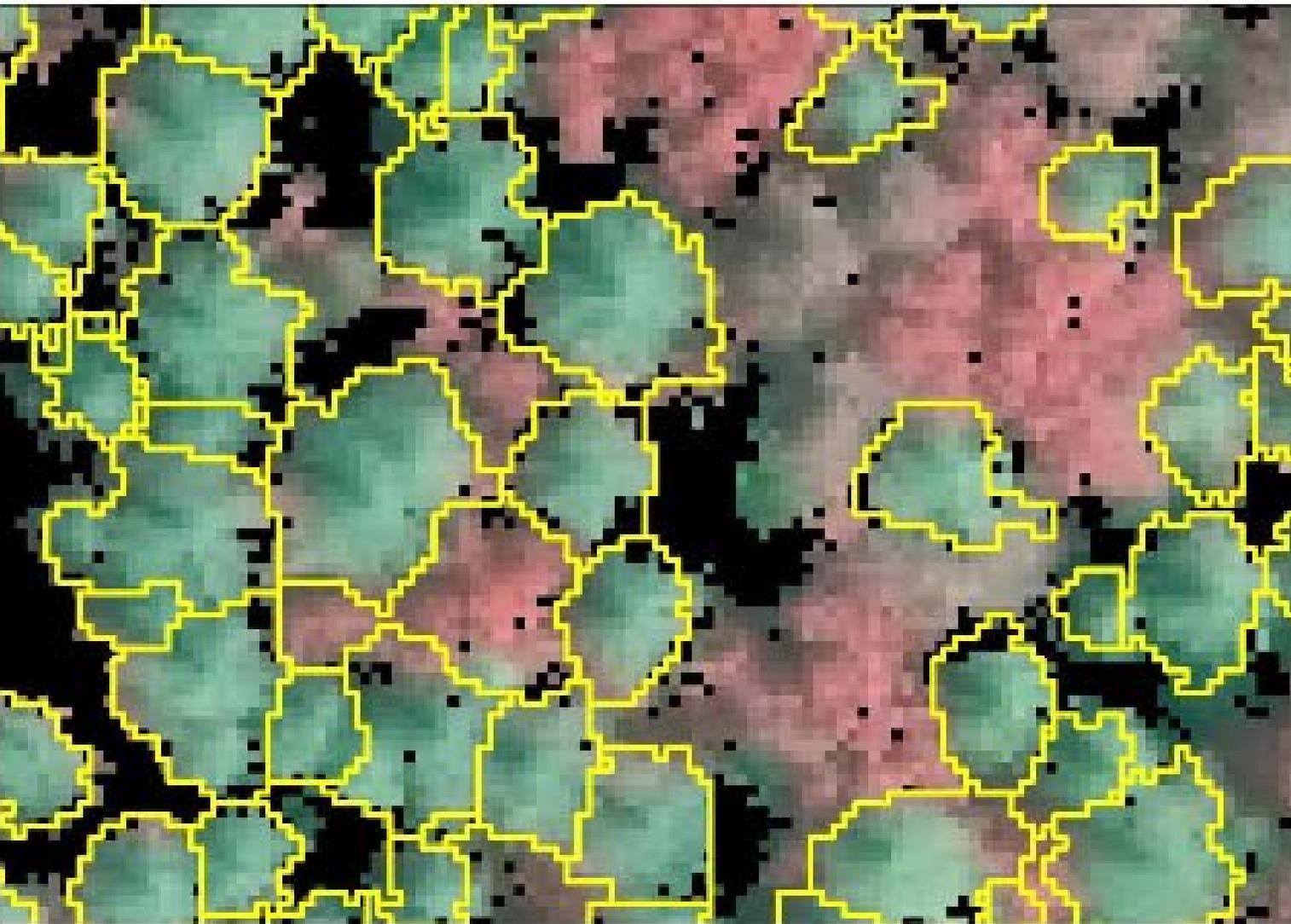
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 e-mail: biuro@ibl.gov.pl



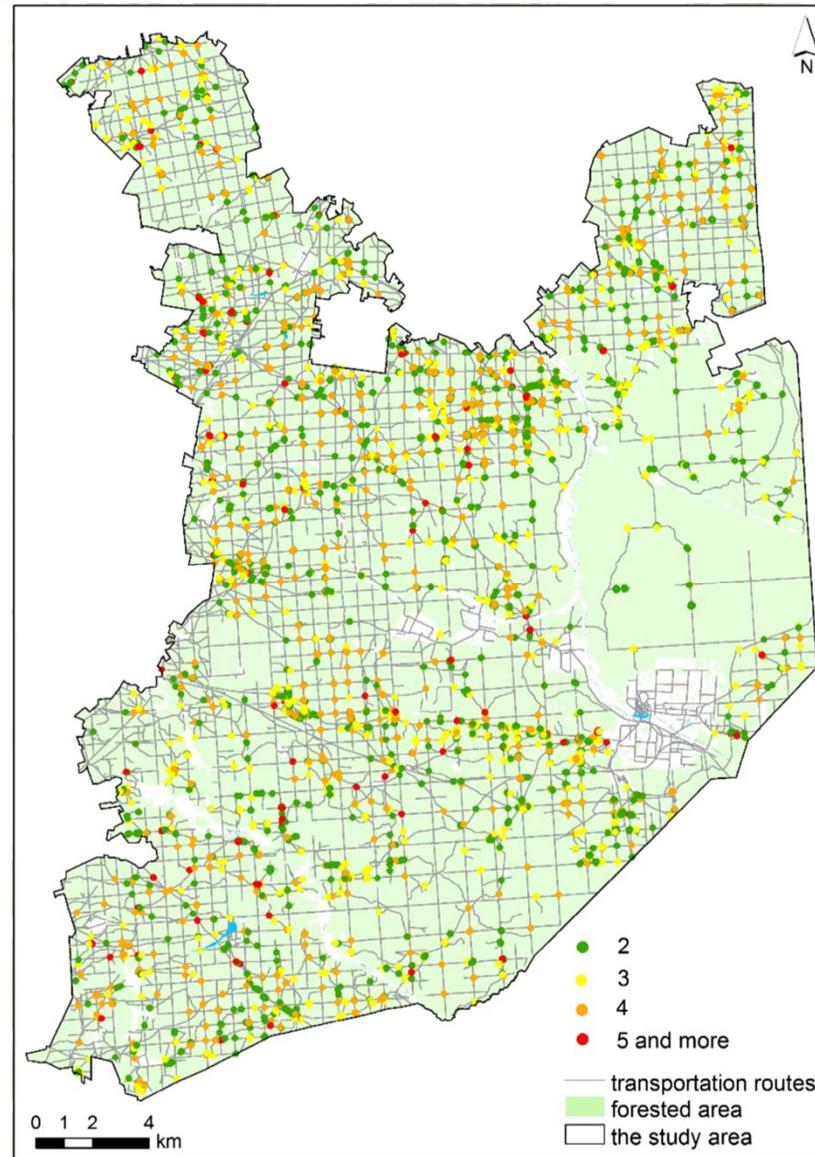
Instytut Leśnictwa i Wodnictwa jest jednostką organizacyjną Państwowego Instytutu Badawczego w Państwowym Systemie Służby Leśniczej, powołanej przez rozporządzenie z dnia 10 października 1978 r. (Dziennik Urzędowy Rzeczypospolitej Polskiej - Dziennik Urzędowy Komisji Europejskiej, L 275, 1978, 10042).

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Data integration



Assessment of risk posed by dead trees

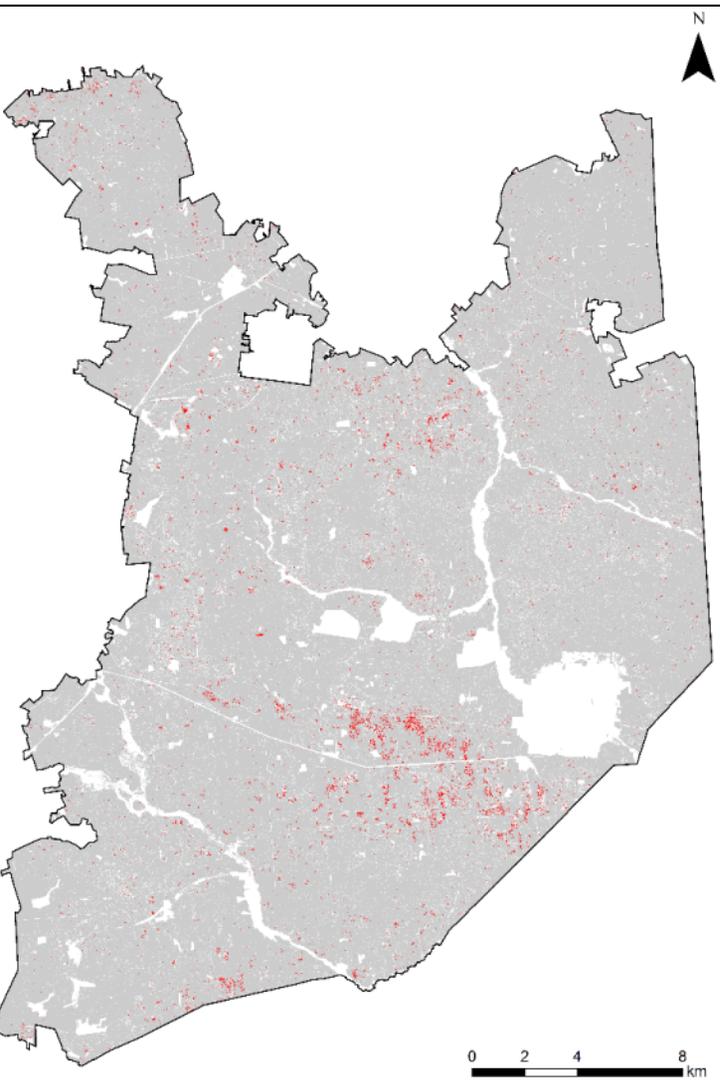


Kraszewski B., Milecarek M., Piasecka Ż. 2017. Inventory of trees in the surroundings of communication routes – The use of remote sensing to potential risk assessments. *Forest Ecology and Management*, 402: 76-91. <https://doi.org/10.1016/j.foreco.2017.07.018>

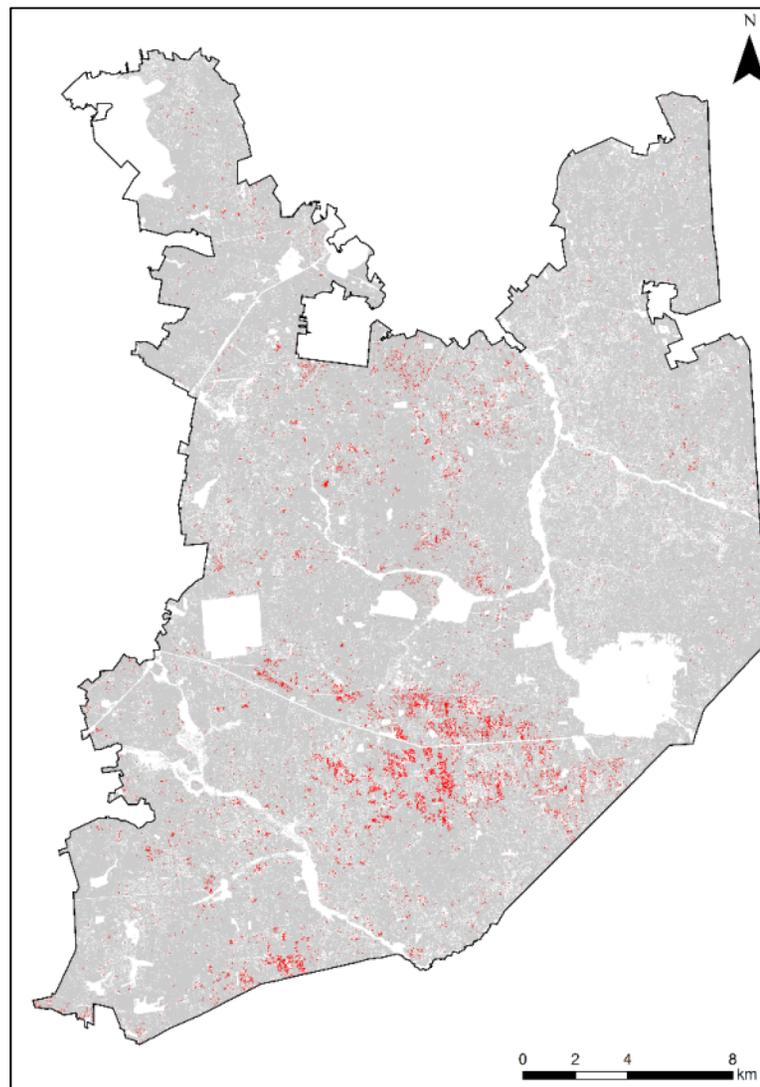
Satellite



August 2015



August 2016



June 2015

August 2015

October 2015



Data integration



- ALS
- hyper
- satellite

A H S H S H S S S S S S S H S S S S S S H A S



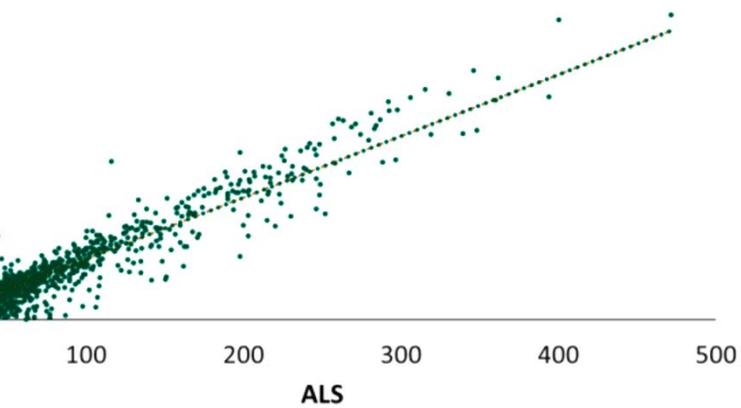
5

2019

Data integration

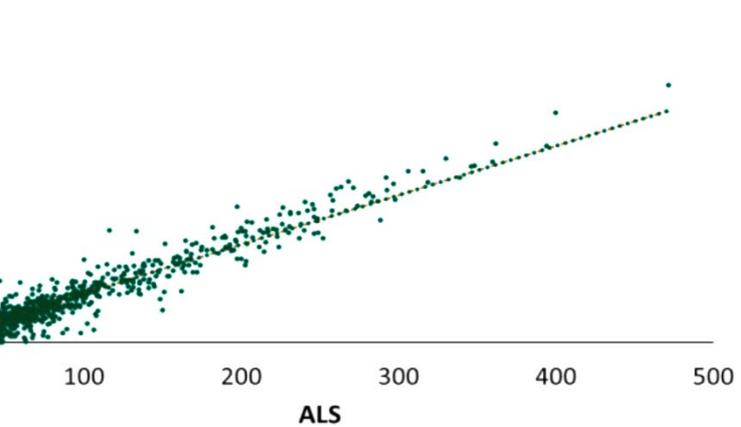


$r = 0.96$

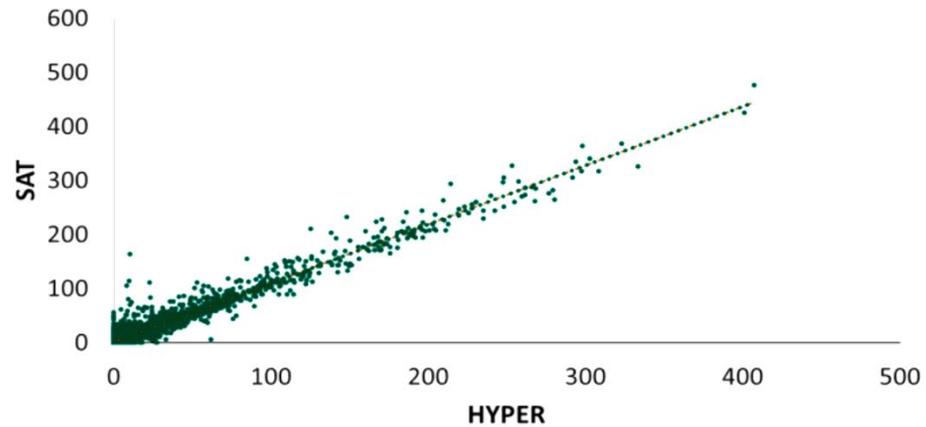


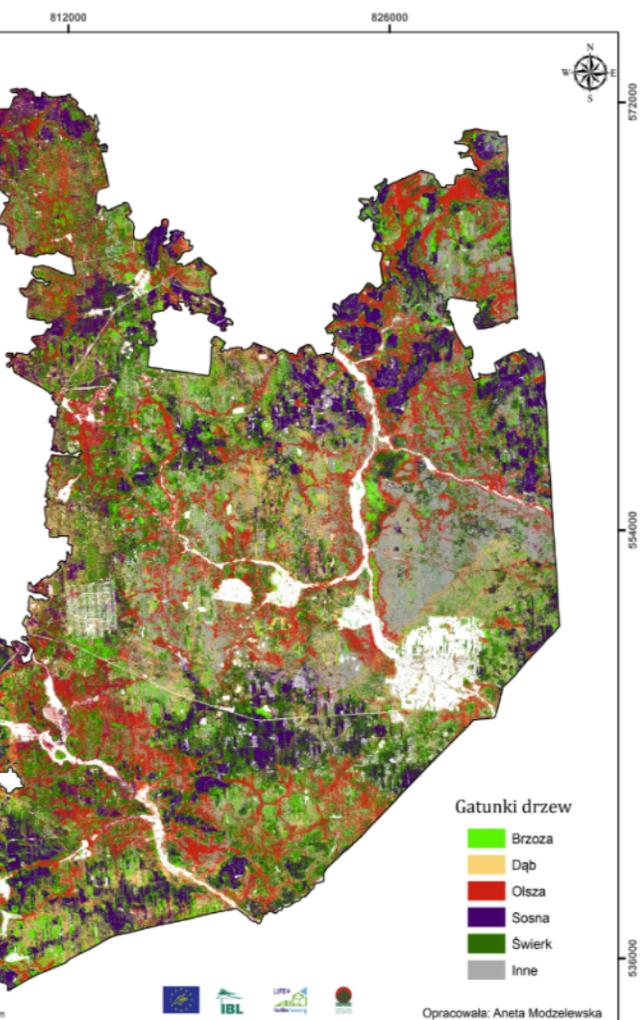
Volume of dead standing trees in forest stands from 3 data sources

$r = 0.95$



$r = 0.98$





Conclusions

Conclusions



Scale of analysis (minimum mapping unit)

Coreferencing of existing data (science vs practice)

Terrestrial vs spaceborne systems

Move from data acquisition to information delivery

Re-definition (re-definition?) – new view from above the forest

Reference data?



work was supported by the:

Project LIFE+ ForBioSensing PL “Comprehensive monitoring of stand dynamics in the Białowieża Forest”, as supported by remote sensing techniques. The Project has been co-funded by Life Plus (contract number LIFE13 ENV/PL/000048) and Poland’s National Fund for Environmental Protection and Water Management (contract number 485/2014/WN10/OP-NM-LF/D).

Project no 670424: „Preparation of data for the projects under the GLOBBIOMASS project forest biomass map for the periods 2005, 2010 and 2015.”



Thank you



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