Evaluation of forest function using GIS data generated by LiDAR data （UC644）

15th July 2014

ASIA AIR SURVEY
Katsumasa OONO

Back Ground & purpose

- In Japan, the Regional Forest Plan is planed every five year.
- Forest evaluation(zoning) is important for emphasizing public function of forest in the regional forest plan.
- Forest evaluation method using airborne LiDAR is developed.

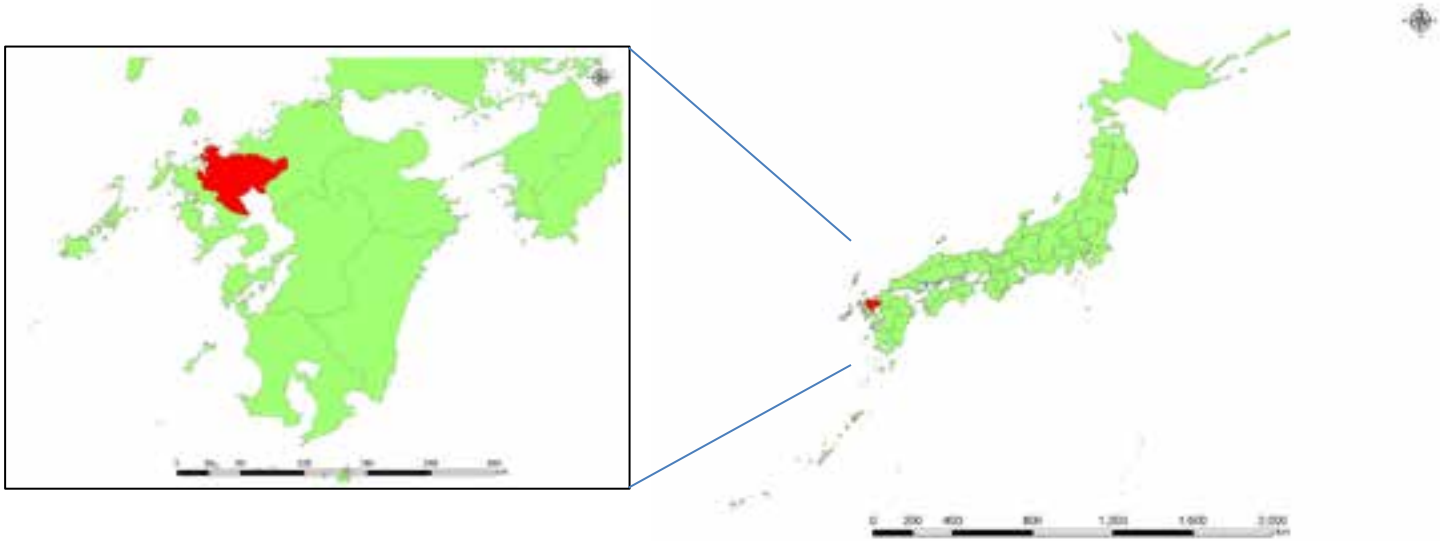
(Forest area represents 68% of land area in Japan.
Planted conifer represents 40% of forest area.)

Aims & objectives of this project

- Airborne LiDAR measurement
- Analyses of geography information and forest resource
- Preparation of GIS database
- Classification of forest function

Airborne LiDAR

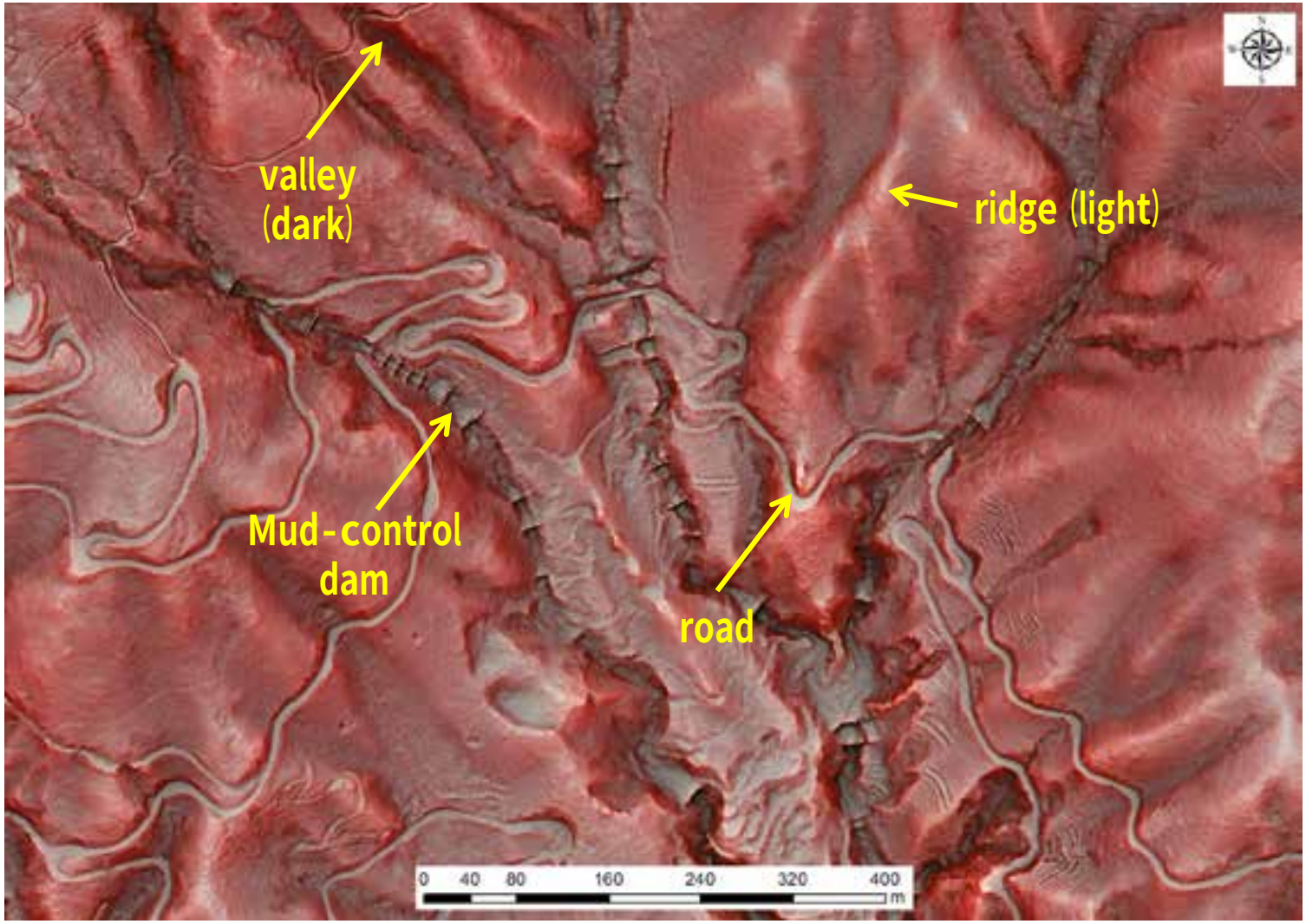
- From Sep to Nov in 2011
- Shot density: 4 points/m^2
- Total flight course: 1,107
- Total flight area: 180,000 ha



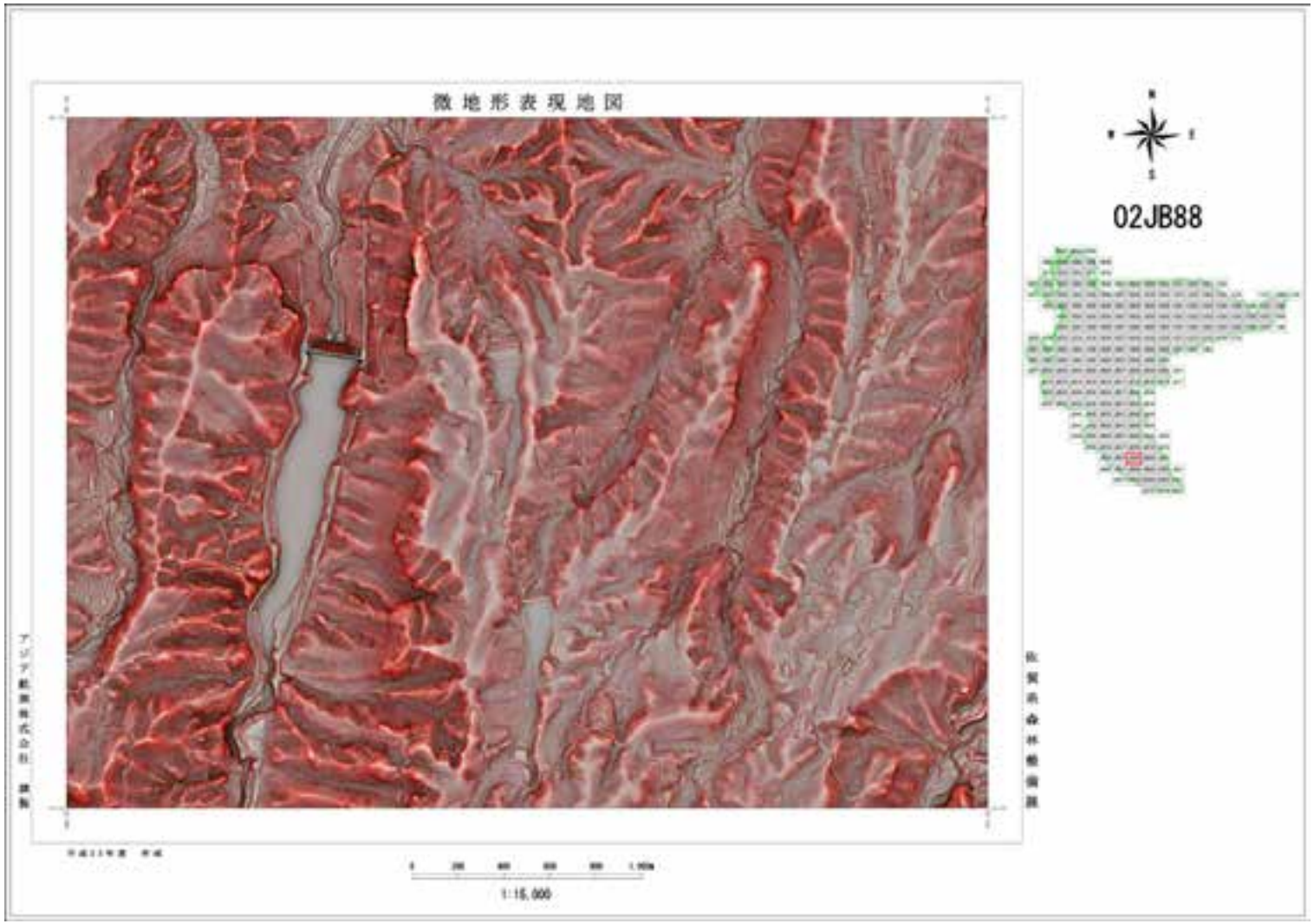
Preparation of geography information

- Red Relief Image Map (1/15,000)
- road (width 2m and over)
- Position of mud-control dam
- Forest base map (1/5,000、1/15,000)
- Ortho photo (1/15,000)
- Slope map (1/15,000)

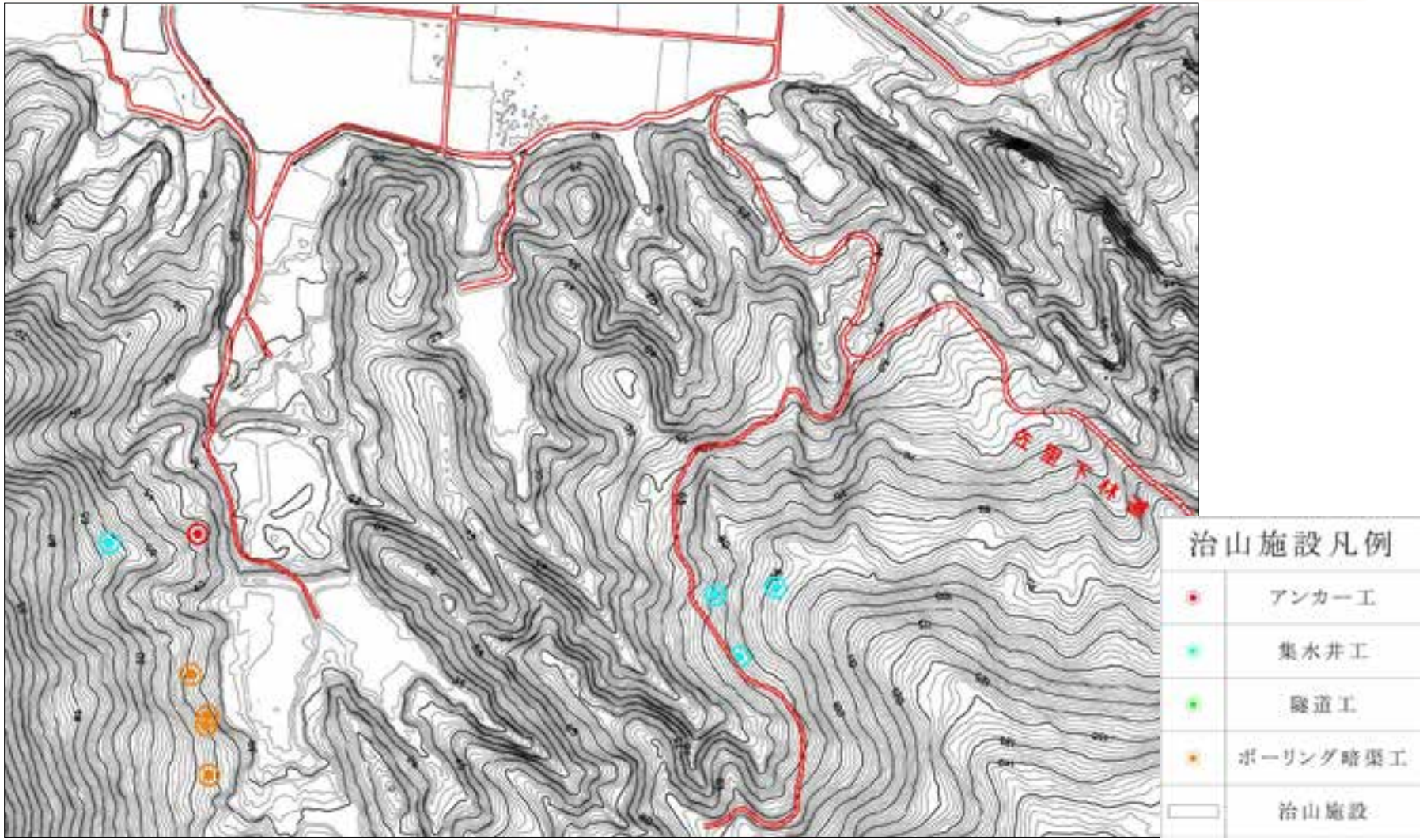
Example of Red Relief Image Map



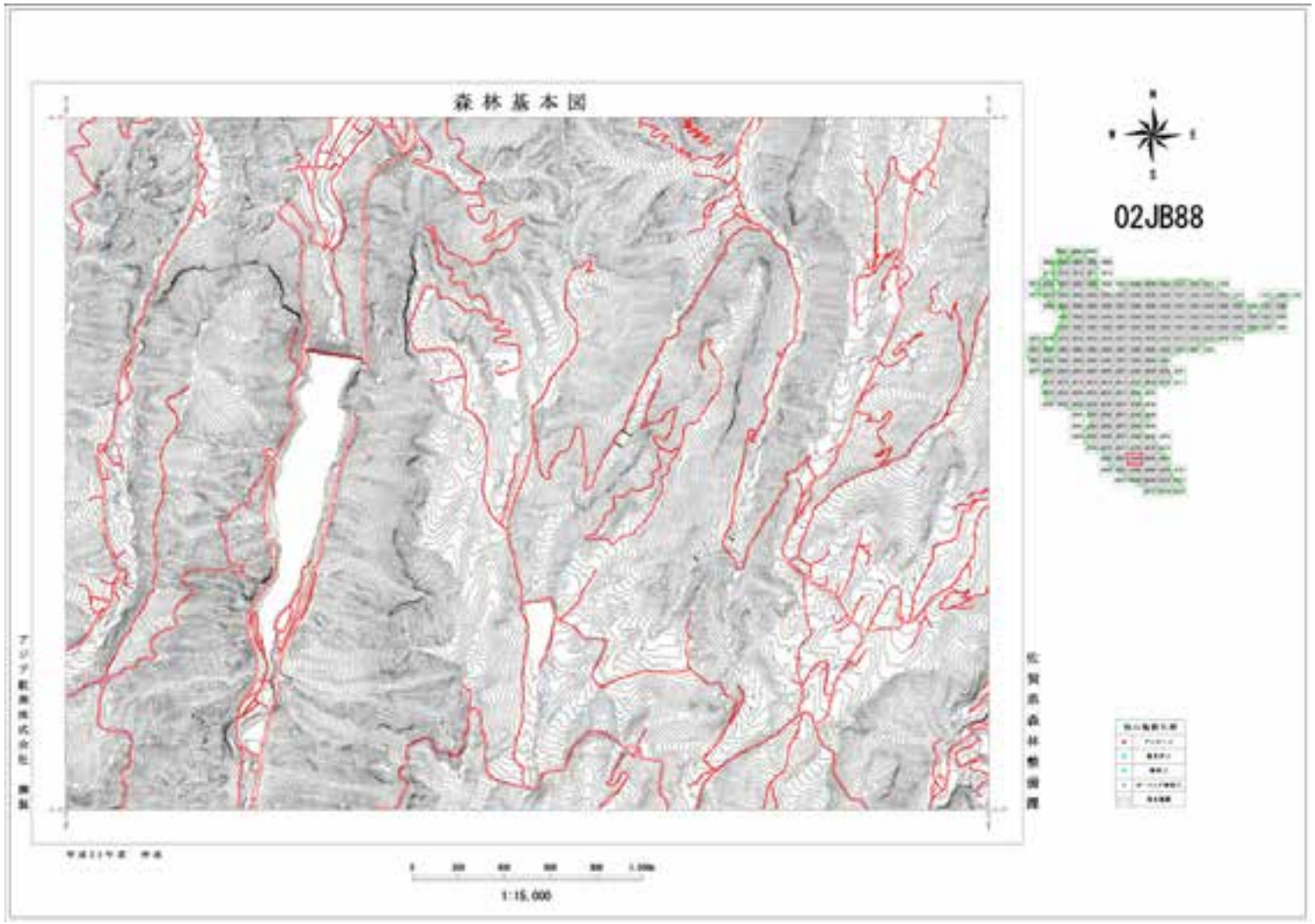
Preparation of Red Relief Image Map



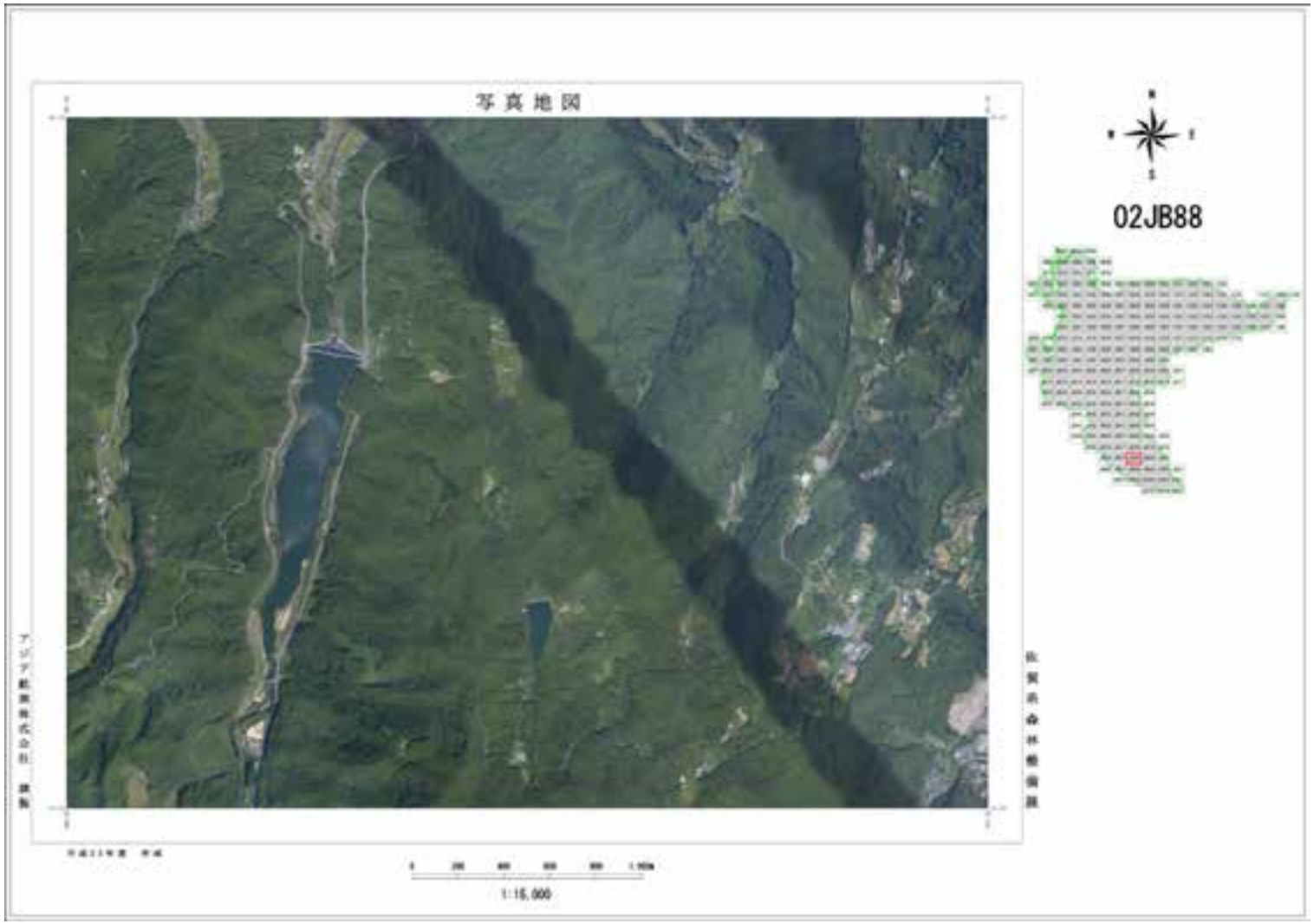
Example of forest base map



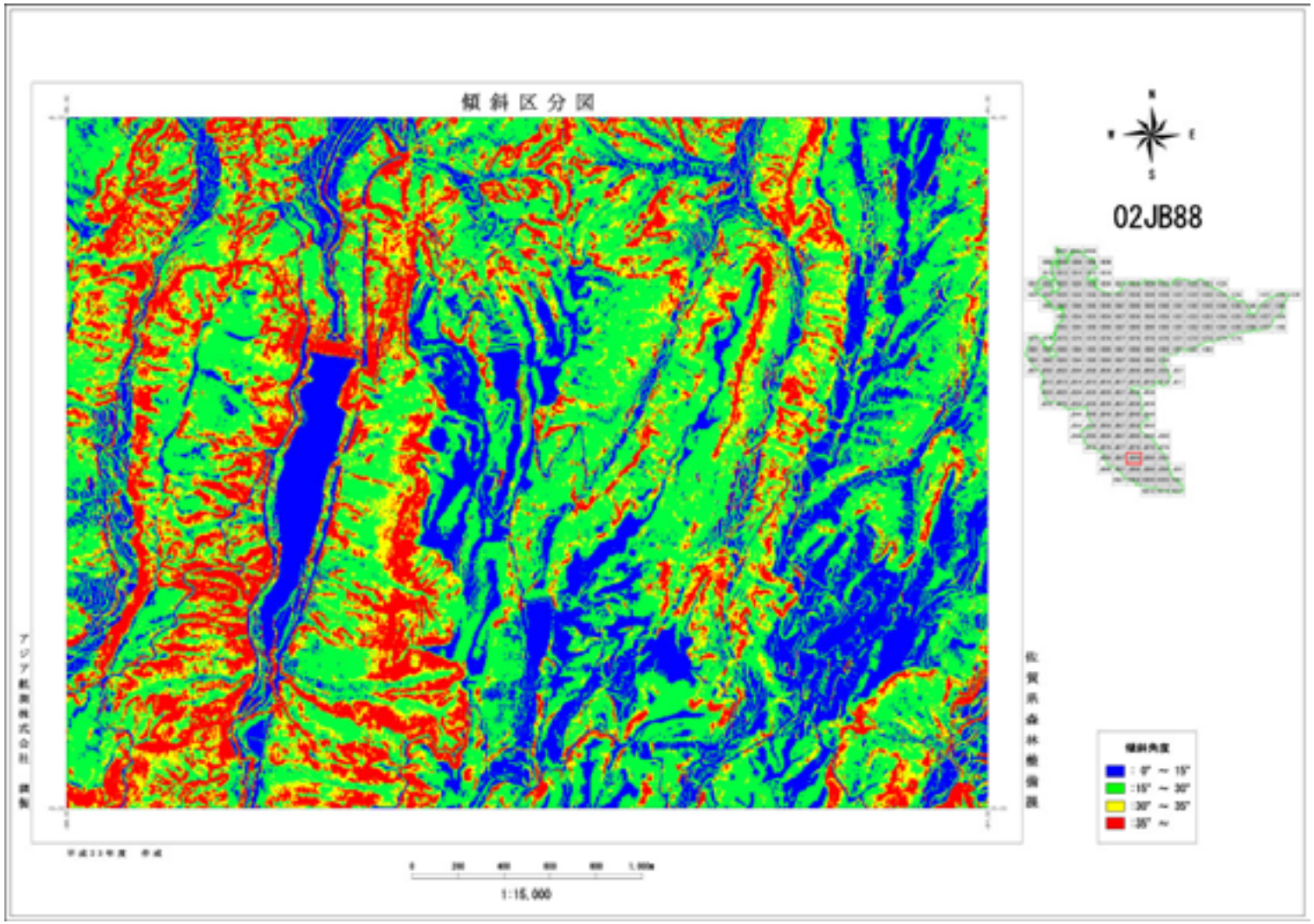
Preparation of forest base map



Preparation of ortho photo



Preparation of slope map



- LiDAR analysis for forest information

Forest type map using LiDAR data

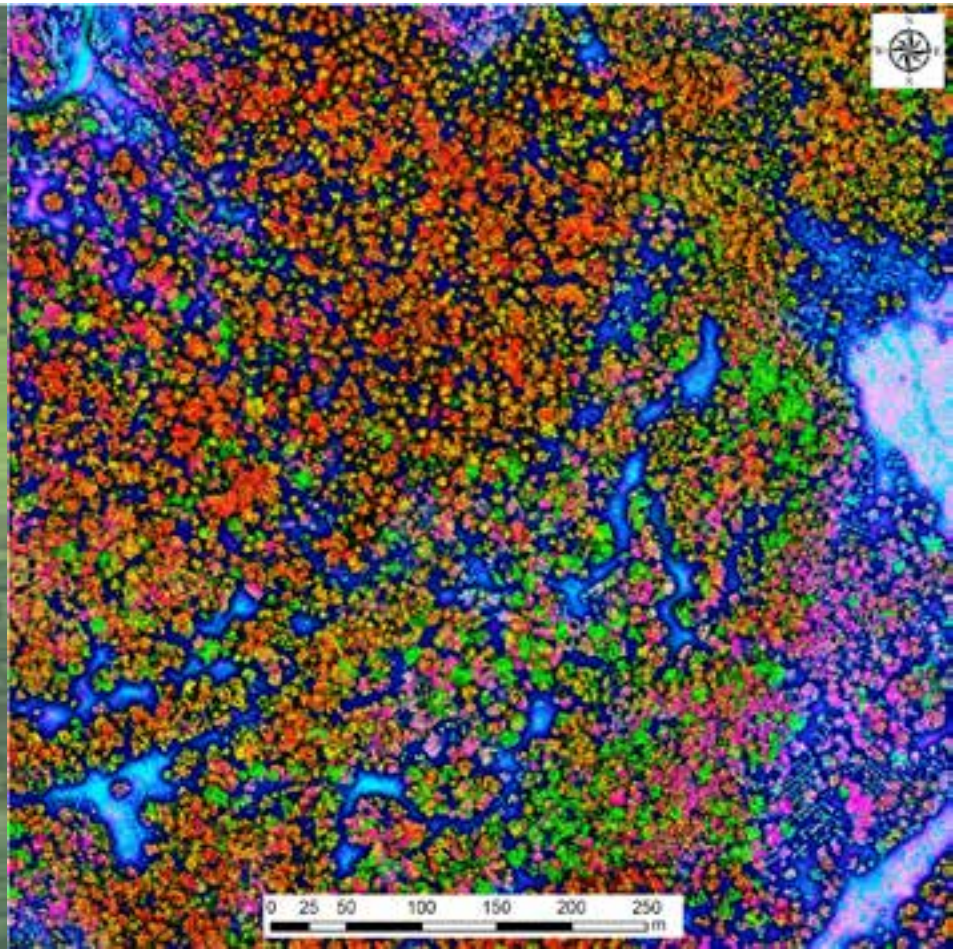
- Classification of vegetation is conducted by visual interpretation of aerial photographs and ortho photos.
- There are disadvantages on ortho photos.
  - ① There are some parts that difficult to interpret due to the ground form and shades.
  - ② Interpretation is often difficult for joint parts of photos and photos with high gradient.
  - ③ there can be uneven color tone due to light conditions and limb darkening

solution

- The Laser Forest Type Image(LaFTIm) was generated by combining three kinds of LiDAR derived imagery

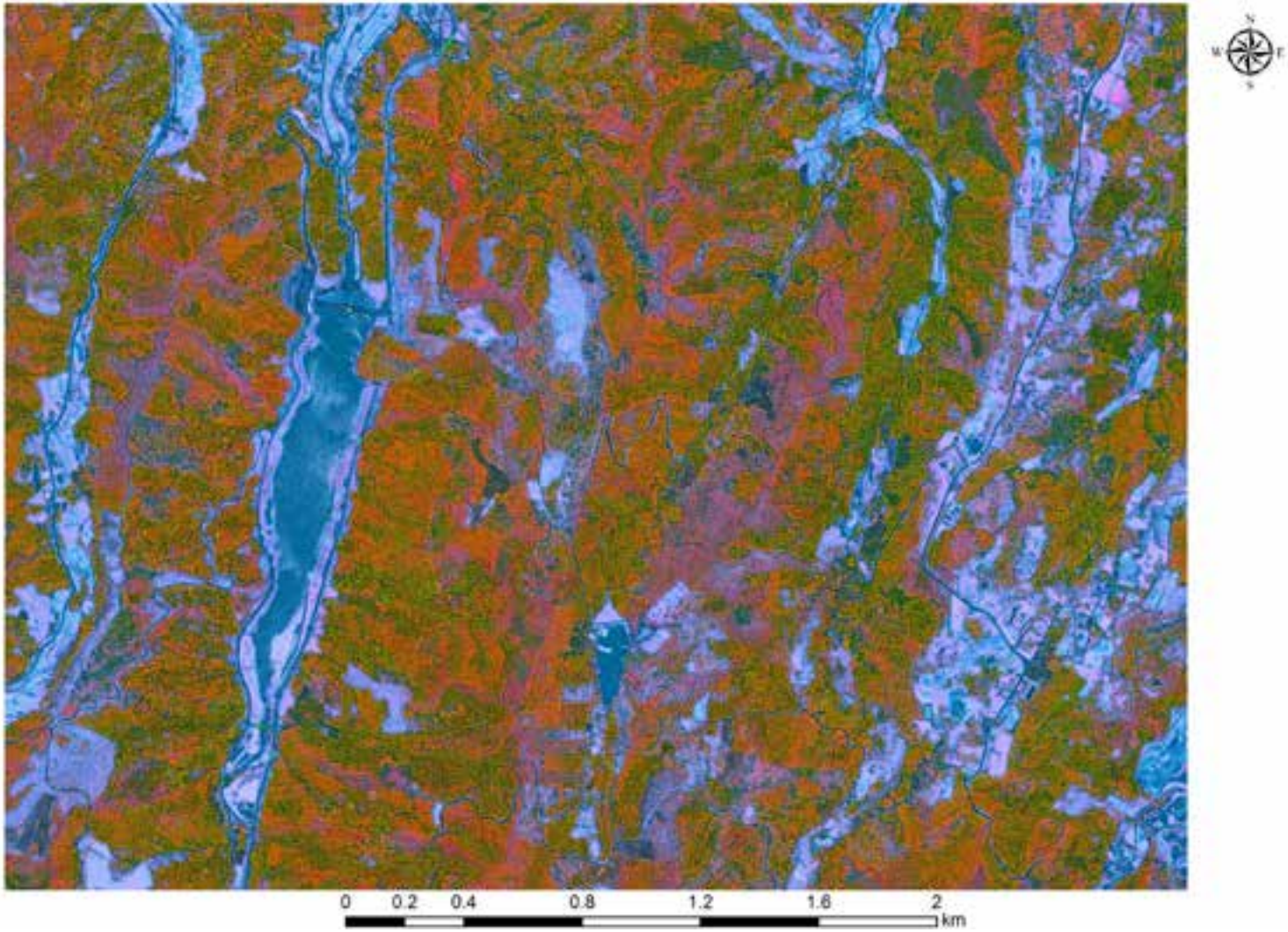
Generate process of LaFTIm

Ortho photo

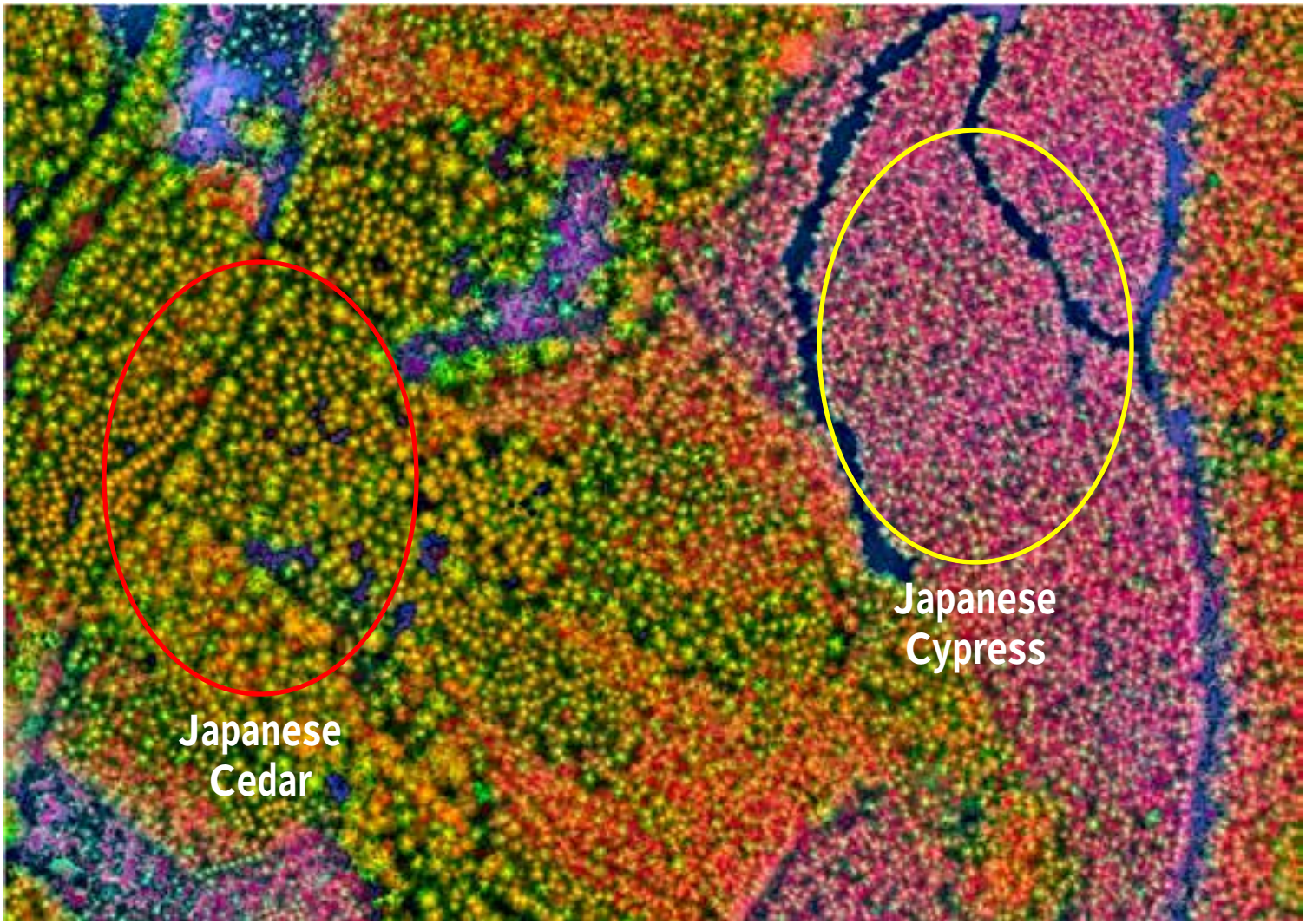


Laser Forest Type Image

Feature of LaFTIm 1



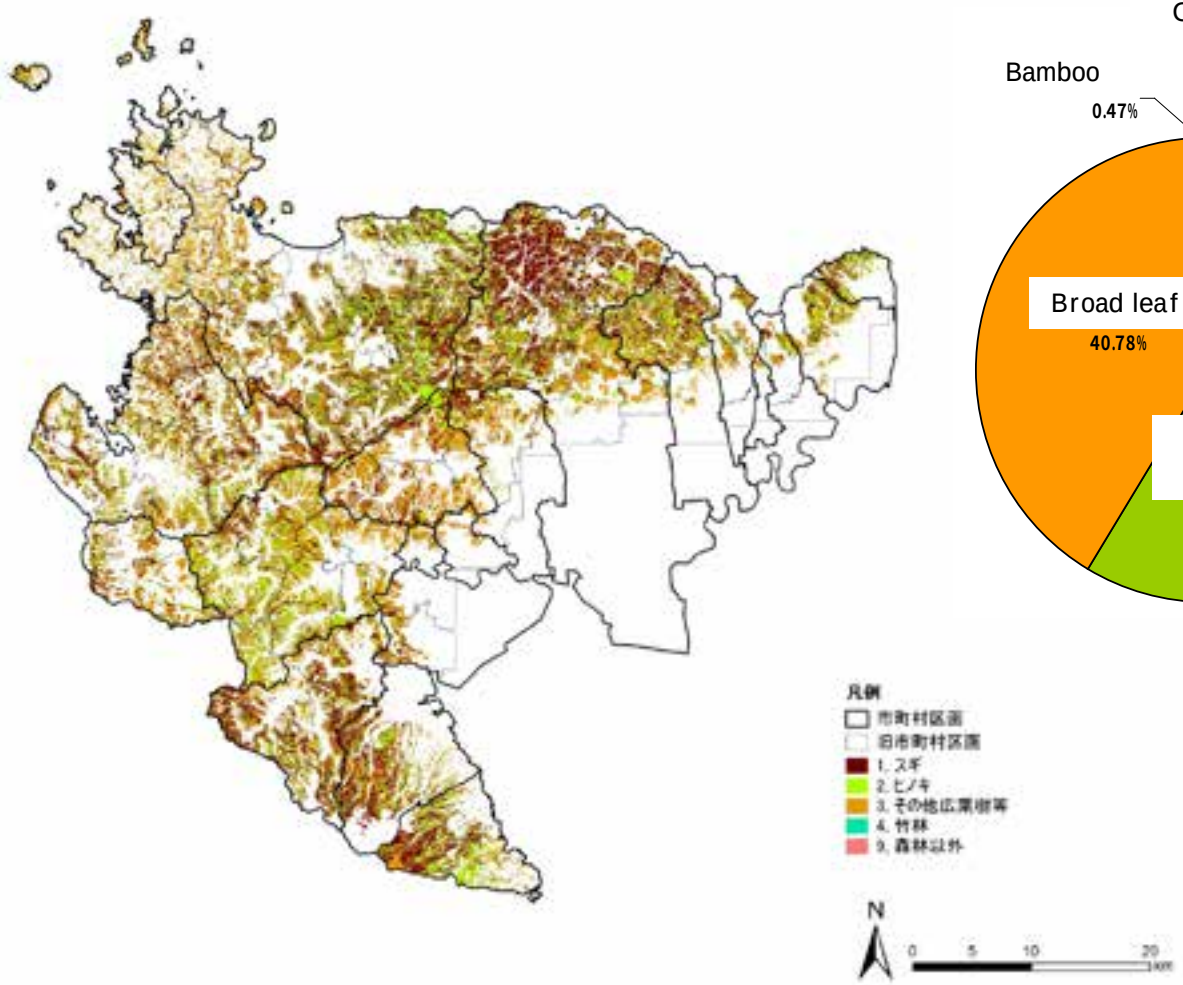
Feature of LaFTIm 2

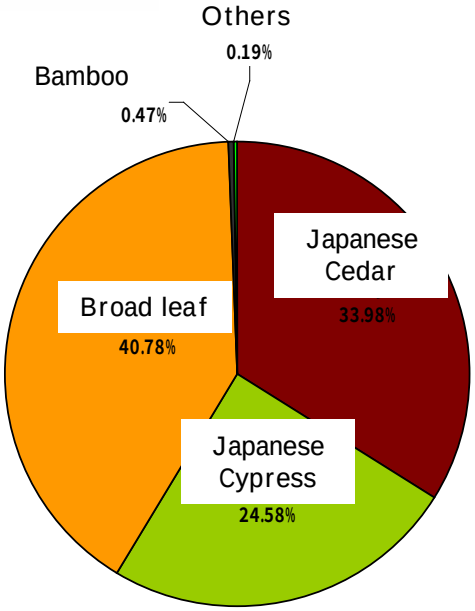


Japanese Cedar & Japanese Cypress

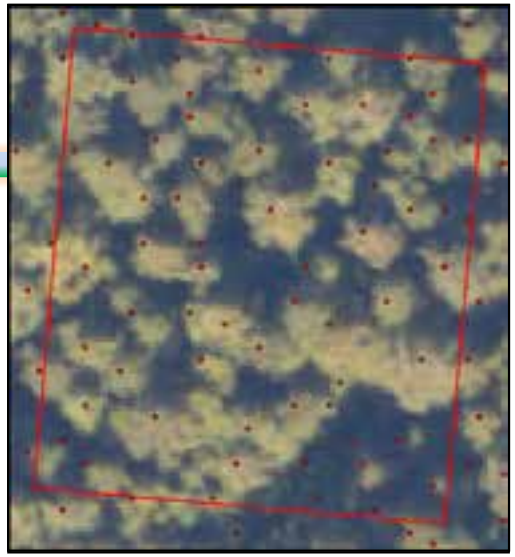
Left: Japanese Cedar　　Right: Japanese Cypress

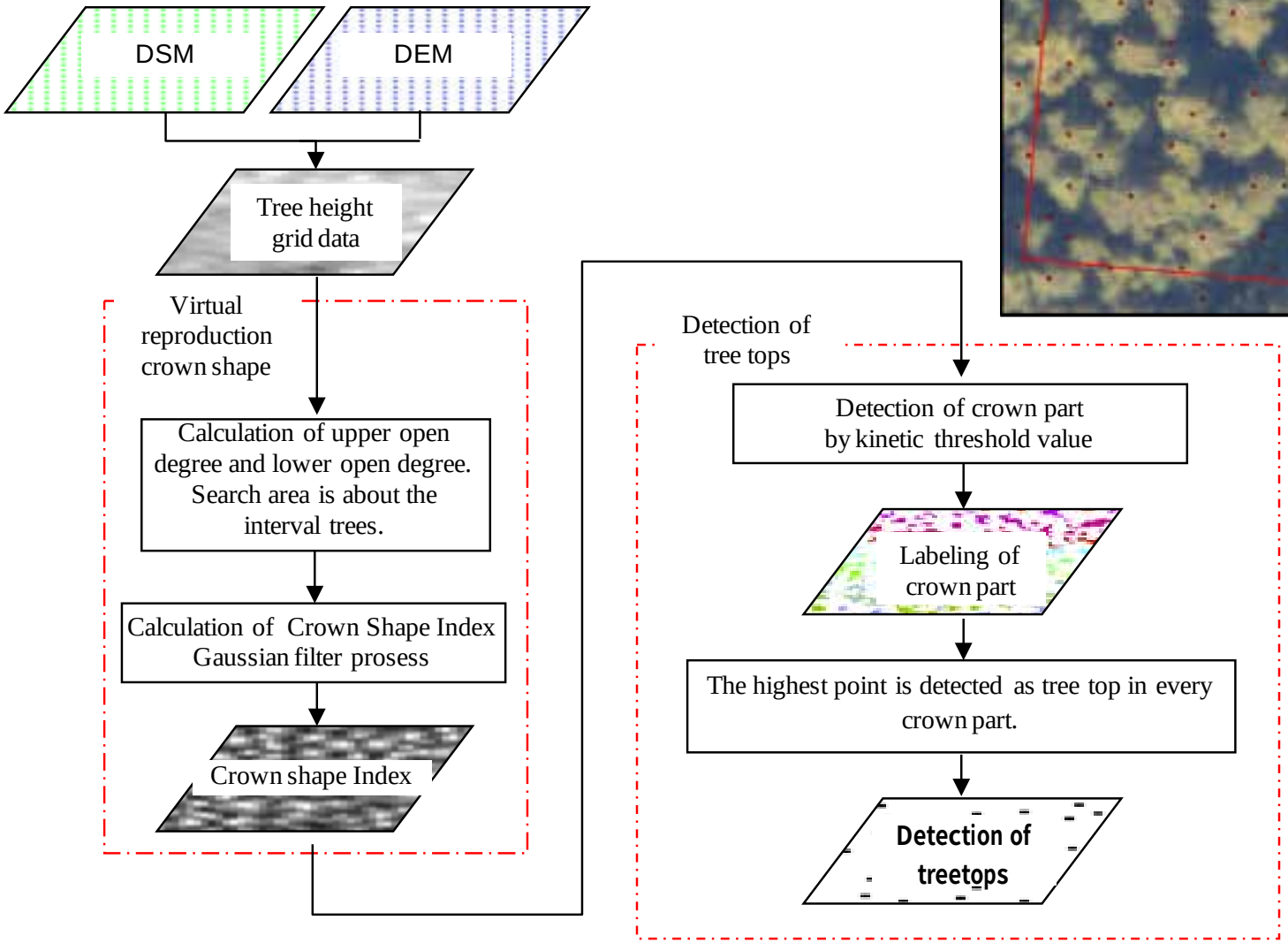
Results of visual interpretation



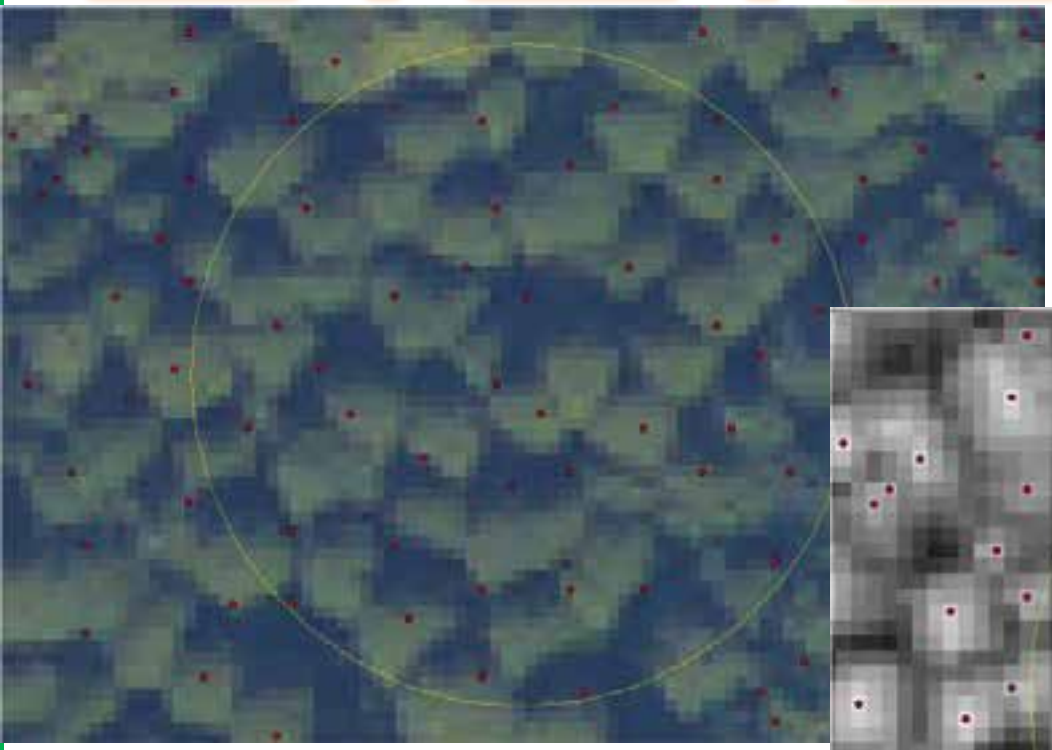


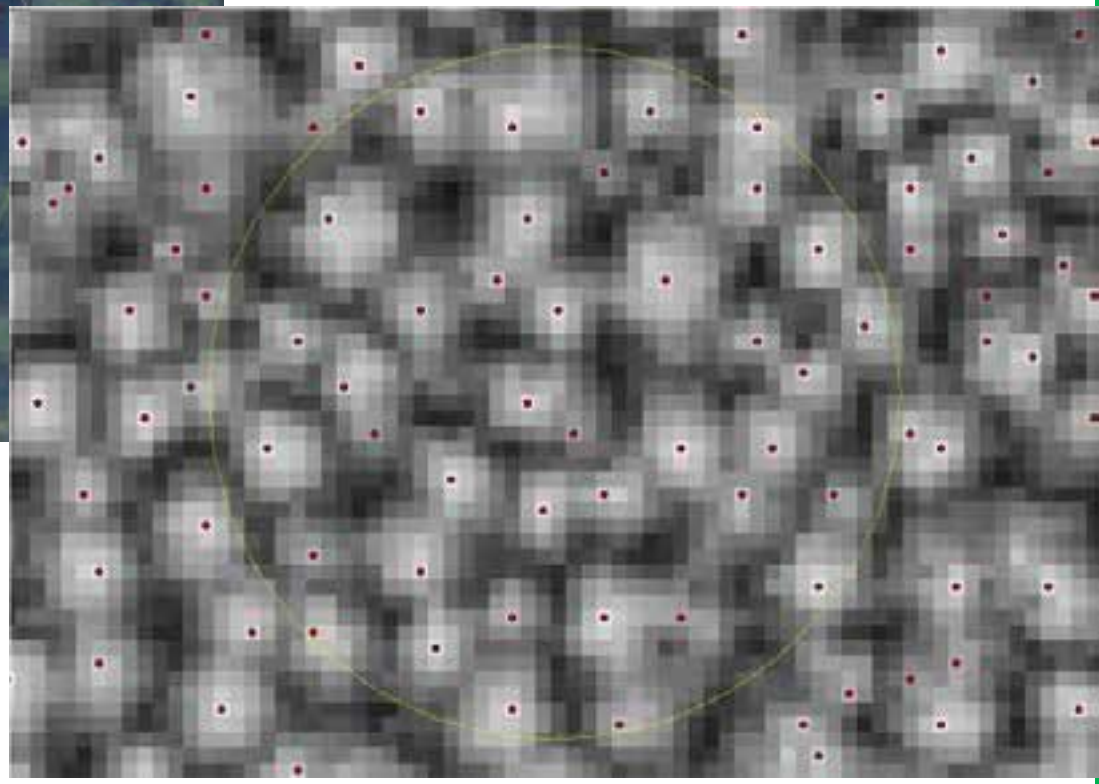
Stand density





Samples of treetop detection

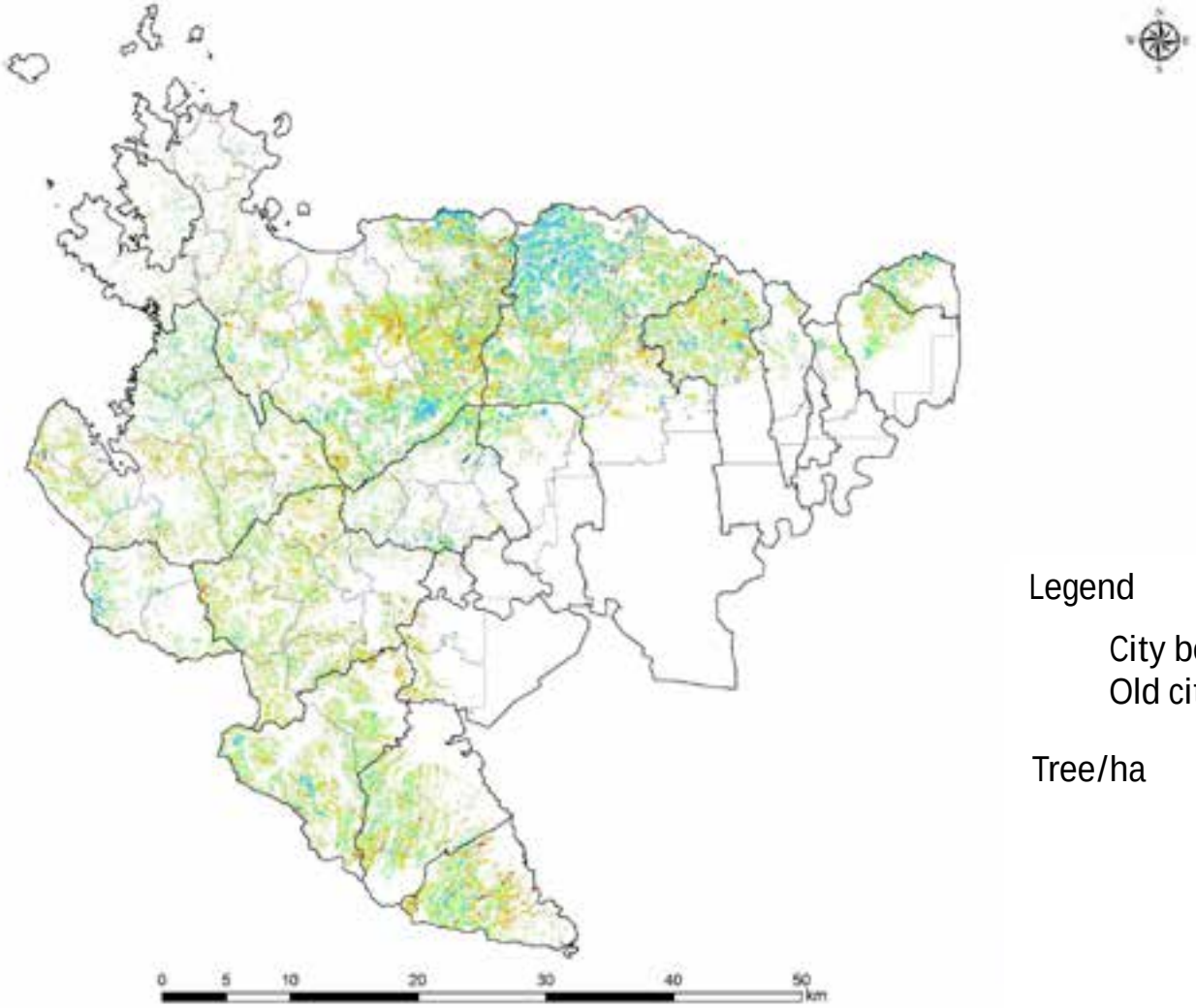




Preparation of forest information for GIS database

- “Compartment” is used for forest management base unit in Japan.
- Each compartment has sub-compartments which have same type of forest and the area of sub-compartments is around 2-3ha.
- Each sub-compartment was given forest information derived from LiDAR data.

Stand density map

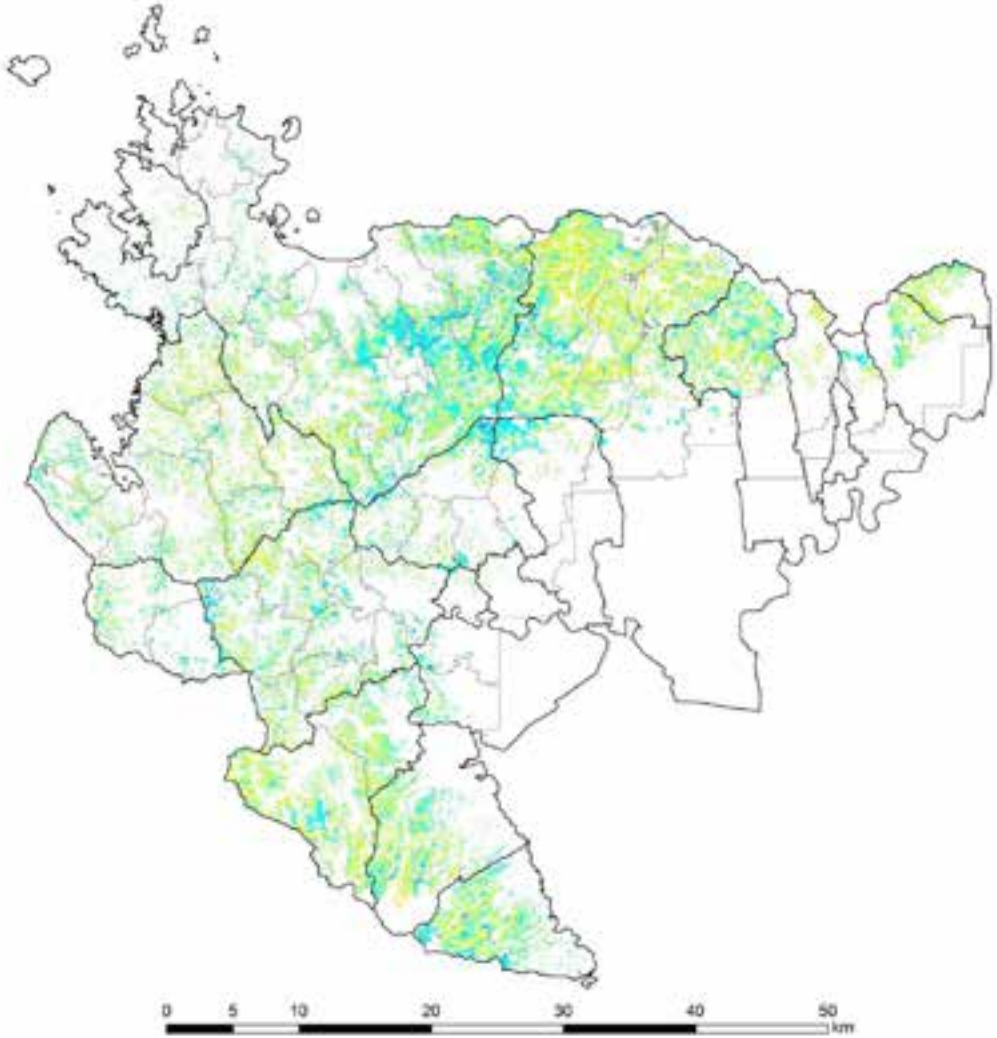


Legend

City boundary
Old city boundary

Tree/ha

Tree height map



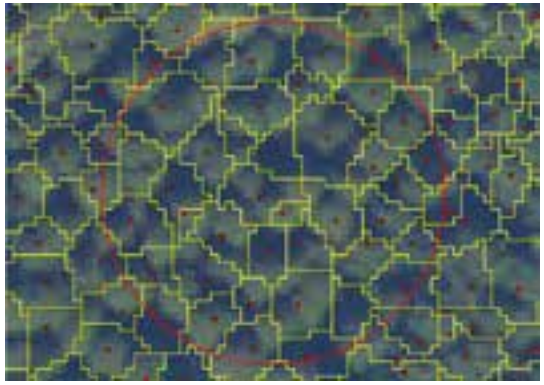
Legend

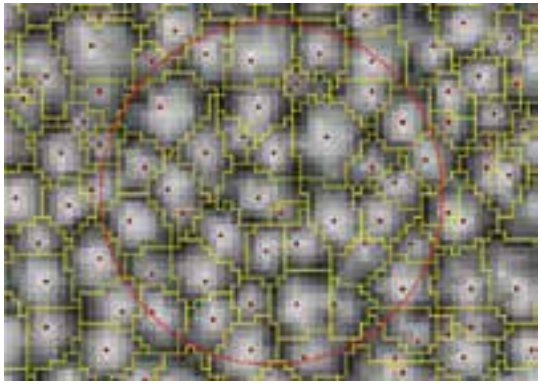
City boundary
Old city boundary

Tree height (m)

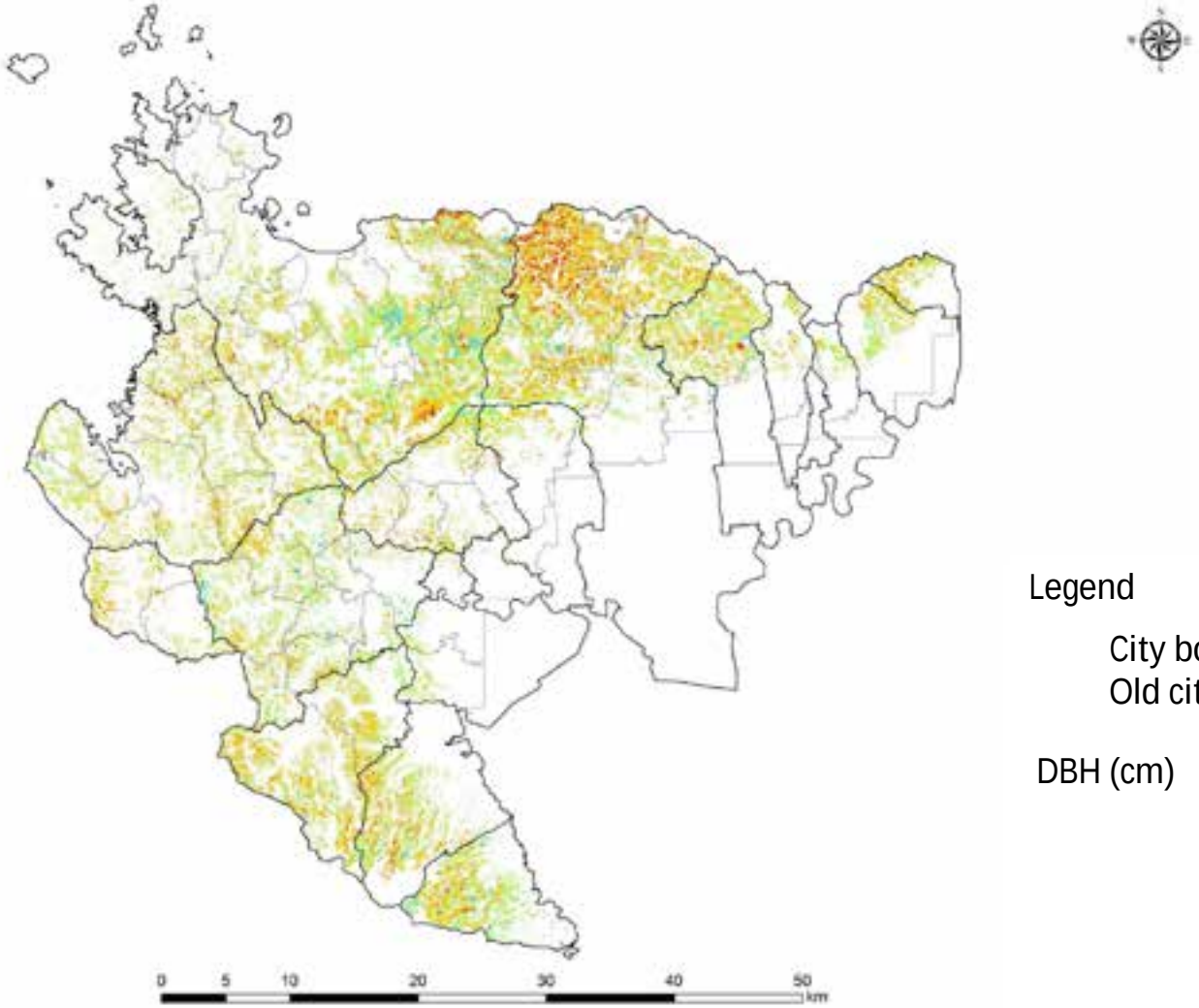
Estimation of DBH

- DBH is estimated from Crown area which is described by water shed algorism.
- A correlation equation is taken using a relation of average DBH (field survey) and Crown area.





DBH map

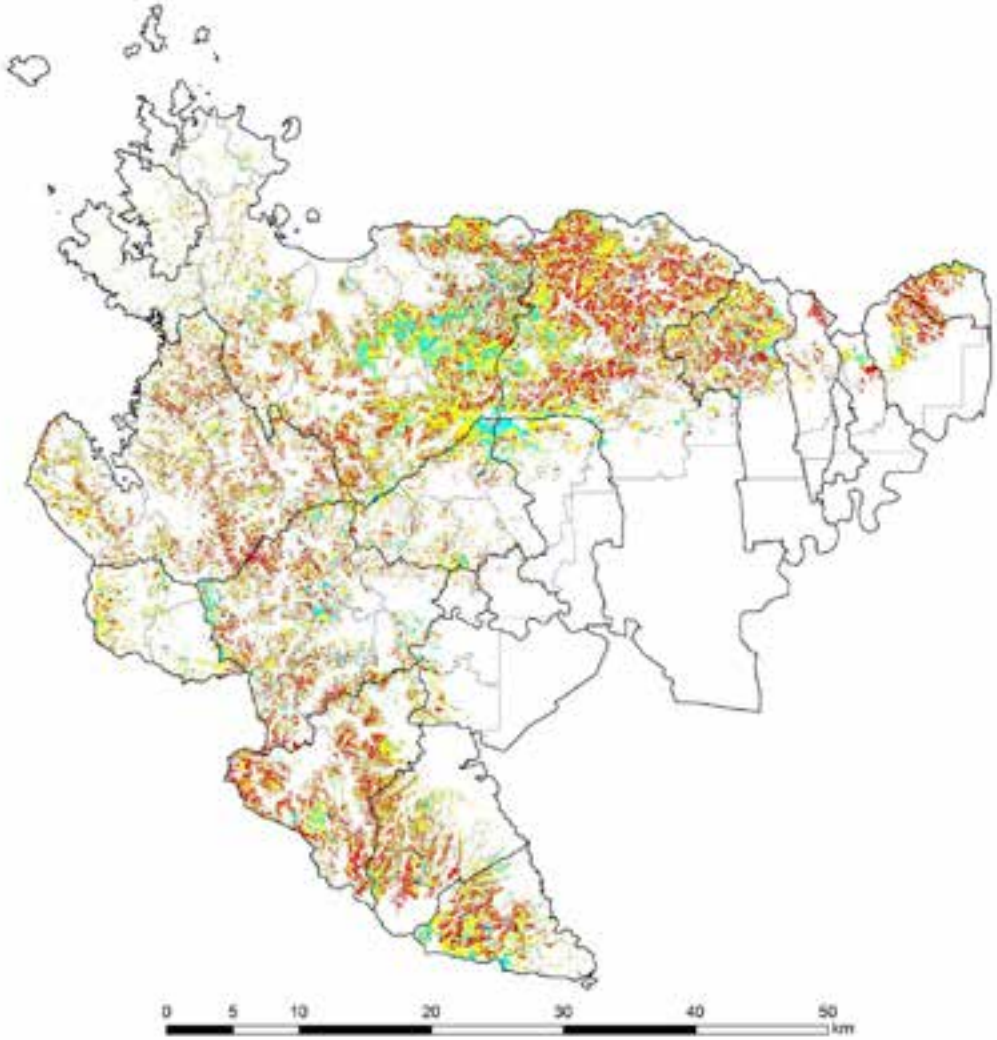


Legend

City boundary
Old city boundary

DBH (cm)

Stem volume map

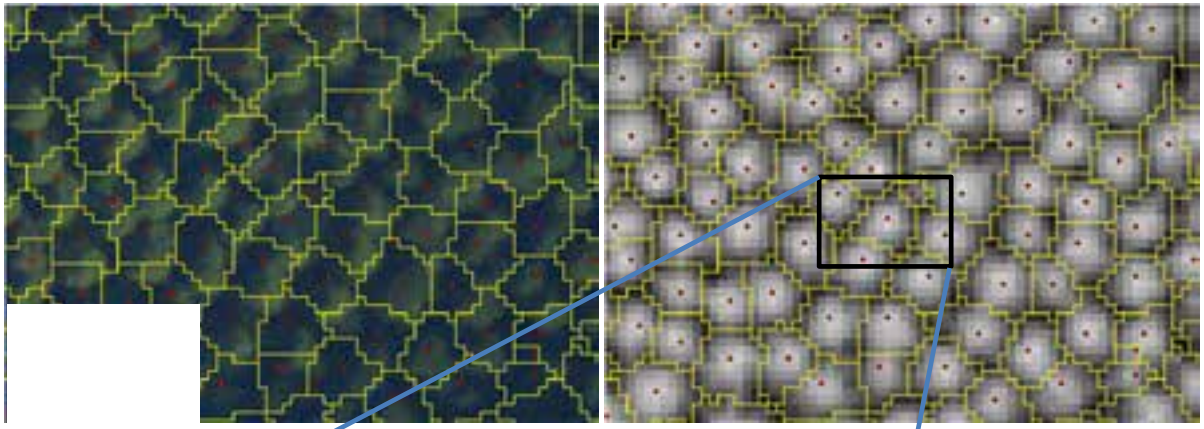


Legend

City boundary
Old city boundary
Stem volume
(m^3/ha)

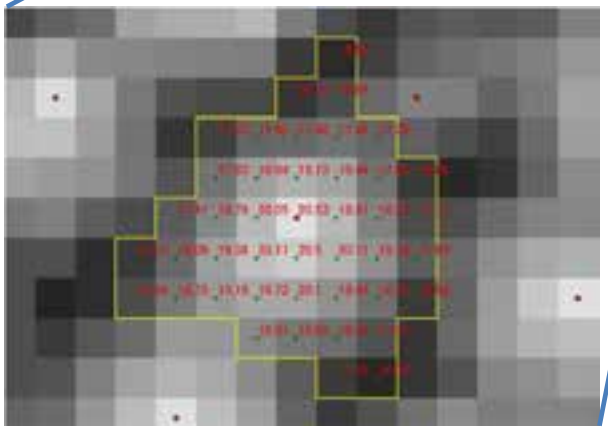
Estimation of crown length ratio

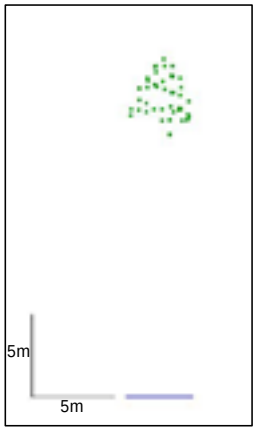
- LiDAR measure sunny crown length.



$$Cp = (H\max - H\min) / H\max$$

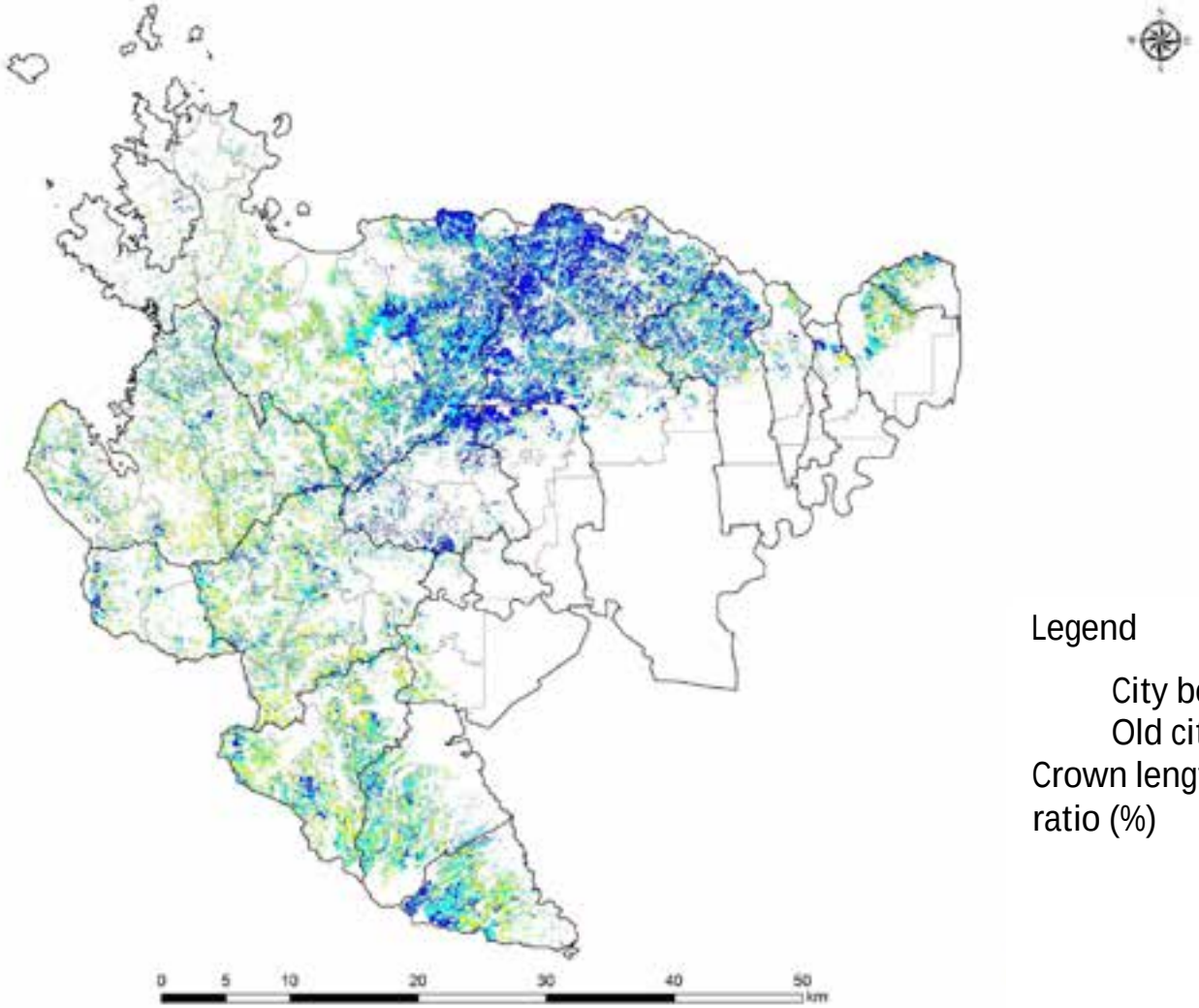
Cp：crown length ratio
H max：maximum tree crown height in a crown area
H min：minimum tree crown height in a crown area





断面図

Crown length ratio map



Legend

City boundary
Old city boundary
Crown length ratio (%)

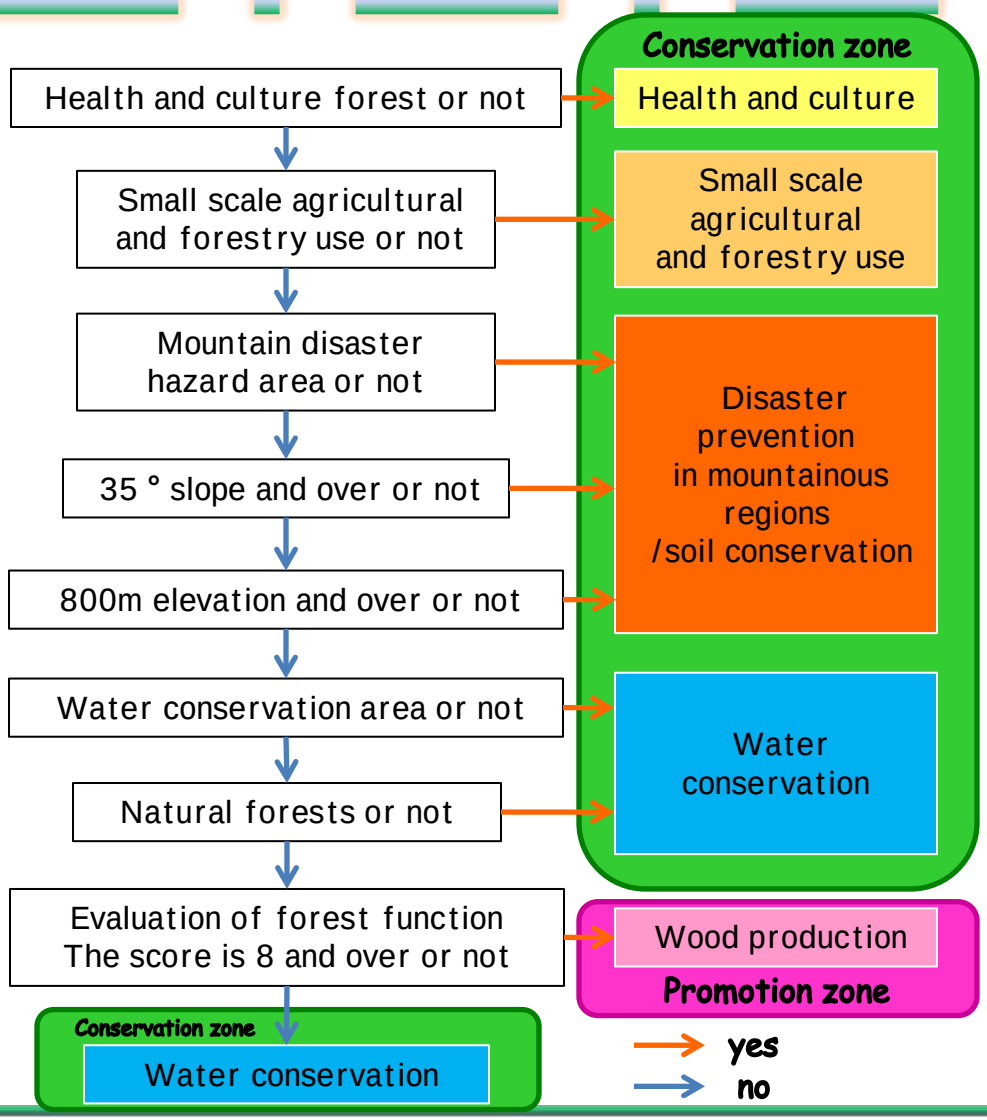
Accuracy of LiDAR analysis

- These forest information have more than 80-90% accuracy compared with 250 field survey points data.

Forest function and Zoning

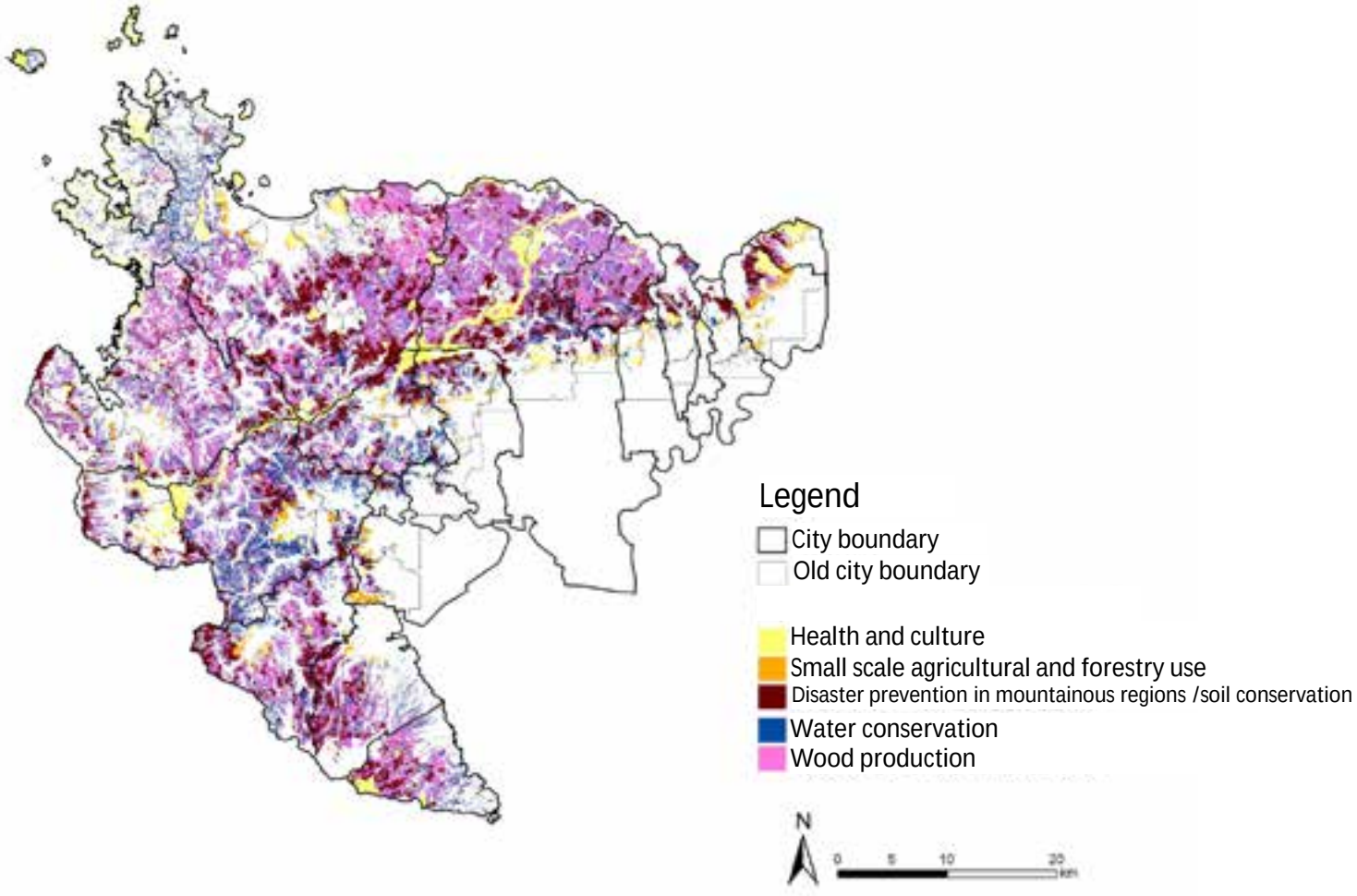
Forest function	Example	Zone
Health and culture	Parks and historic sites like castles for recreation	Forest conservation zone
Small scale agricultural and forestry use	Private forests that stand close to houses, or the border zone or area between mountain foothills and arable flat land	
Disaster prevention in mountainous regions /soil conservation	Forests on steep slopes	
Water conservation	Riparian forests and upper forests of dams	
Wood production	Plantation forests and conifer forests	Forest promotion zone

Flow of zoning

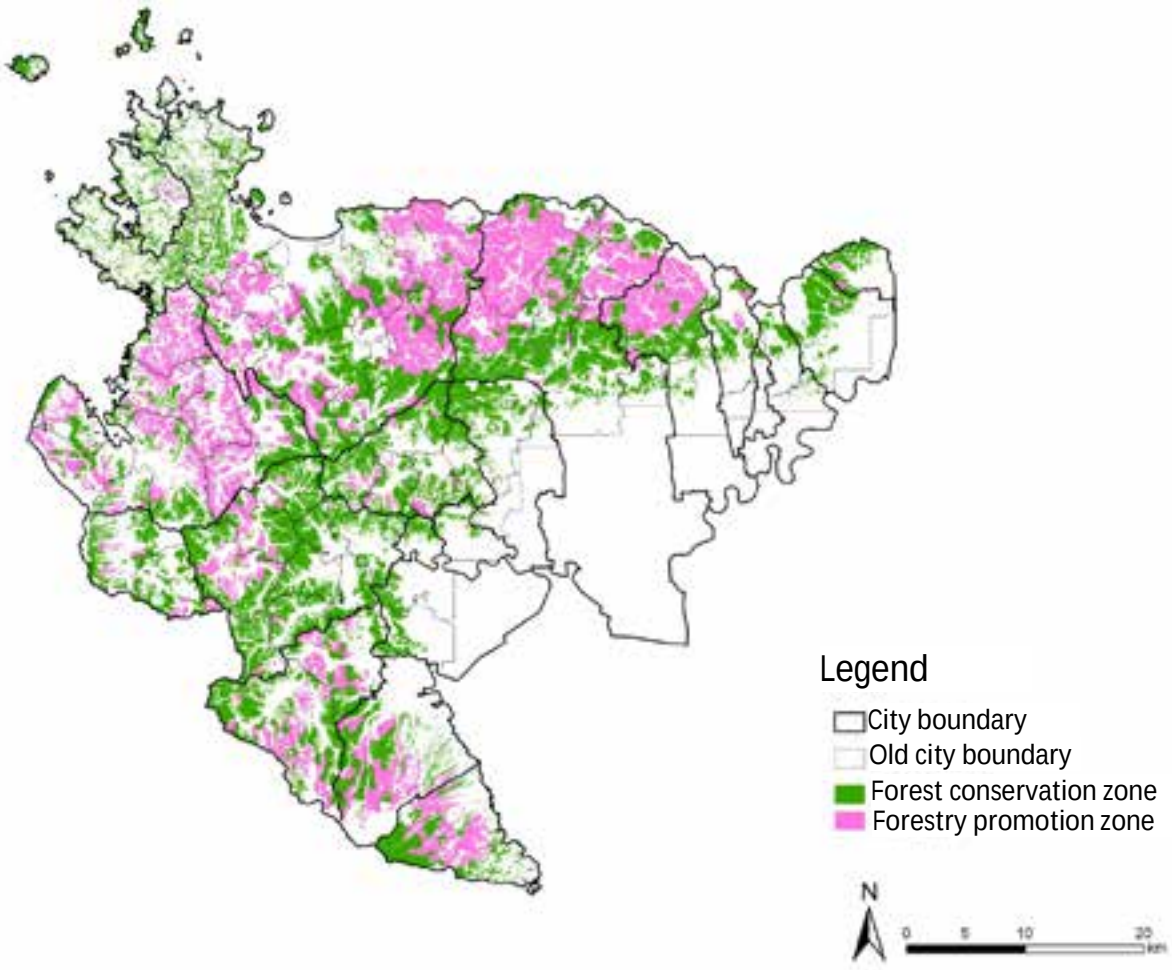


Evaluation categories	3 points	2 points	1 point	0 point
Slope	~ 15°	15~30 °	30~35 °	35 ° ~
Elevation	-	-	~ 800m	800m ~
distance from roads	~ 50m	50~100m	100~200m	200m ~
Site quality	1	2	3	-
Stem volume	500m^3 ~	300~500m^3	100~300m^3	~ 100m^3
Crown length ratio	30~	20~30	10~20	~ 10

Results of classification of forest function



Results of zoning



Advantages of GIS data for forest management

- Data management in an integrated fashion.
- You can access all data.
- Ordering of priority about management

  (Conservation or promotion forest has different purpose.)
- Grasping easily total area and distribution maps of target forest