



Application of *WorldView 2* satellite images in estimation damage to forest stands caused by major natural disasters

Primjena *WorldView 2* satelitskih snimaka za procjenu šteta na šumskim sastojinama uzrokovanih velikim prirodnim nepogodama

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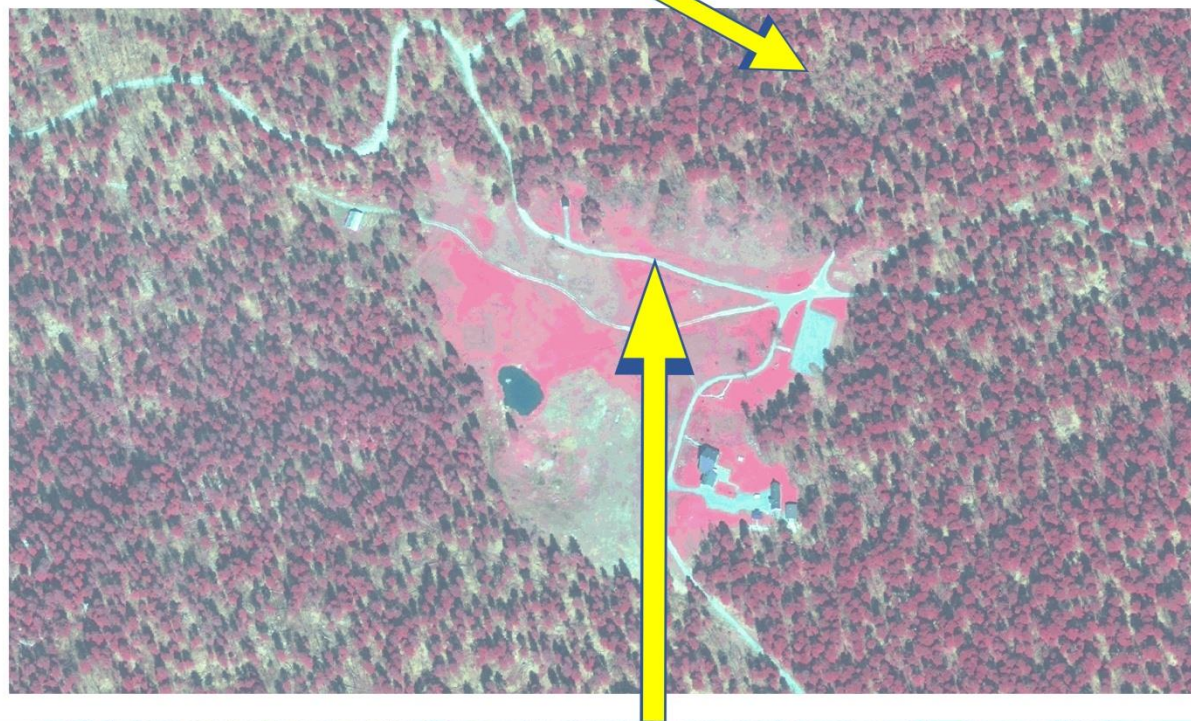
- more frequent natural disasters (ice storm, snow storm, wind break, floods, fires etc.) affected by forest ecosystems
- in the shortest time needed to inspect the situation on the terrain
- priority positioning of stands - vitality and productivity at an optimal level
- primary task - determining spatial distribution and intensity of damage
- determining the state of the forest, degree of damage (overturned, broken, bent, or leaning trees)
- include larger areas - reduced or completely disabled access

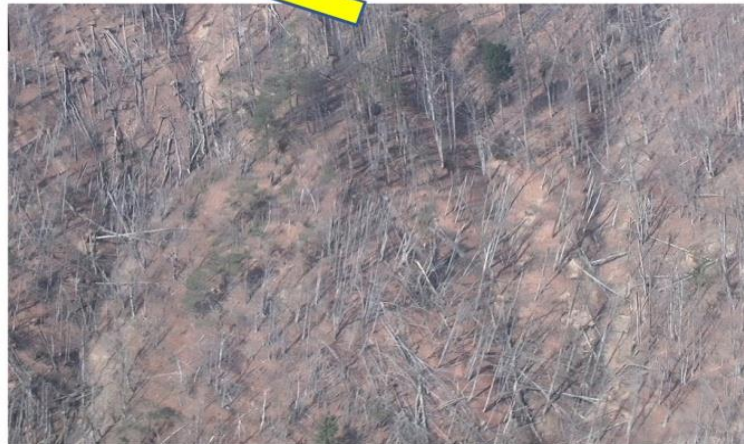
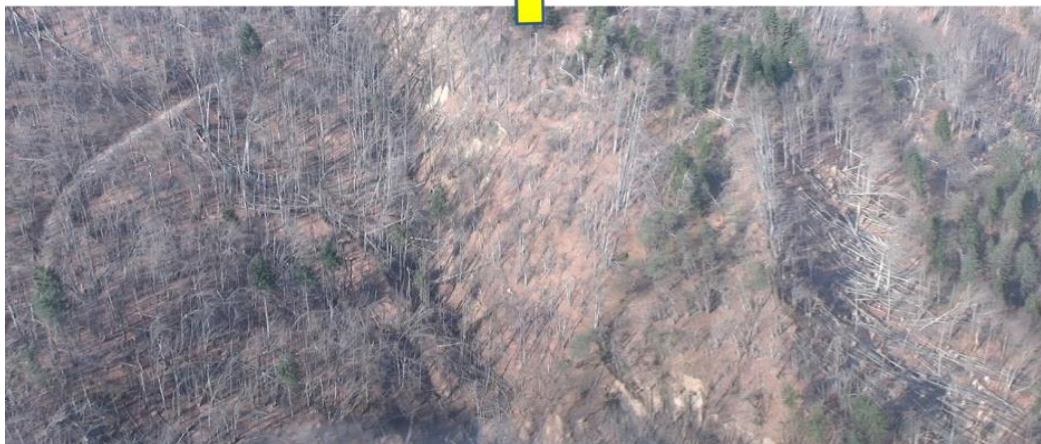


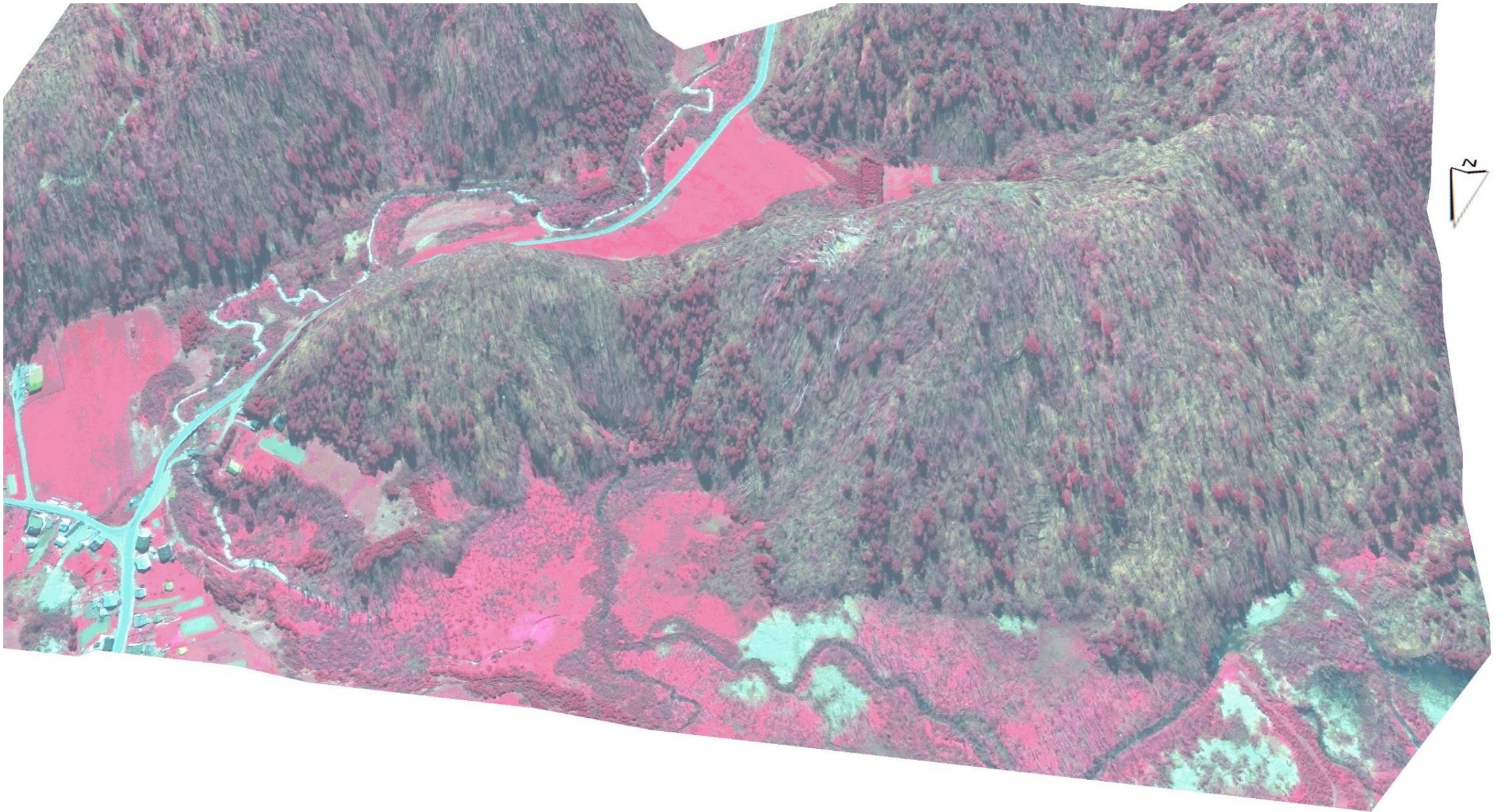
- **field research** - a large number of experts, high costs and extended time frame for terrestrial inventory on large areas
- **remote sensing methods** - extremely fast and reliable method of determining spatial coverage (scale / intensity), surface distribution of damage, terrain characteristics (altitude, slope, exposure)
- **objective mapping of forest damage** (database), thematic map of spatial distribution of damage, digital relief model (DRM) and digital orthophoto (DOP) of the investigated area, and GIS analysis of environmental factors
- **reducing the intensity of the field survey and the consequent reduction of costs**
- **establishing GIS** - all the collected data on the investigated area - in one place, in a form that is comparable to each other - possibilities of analysis



- Gorski Kotar - satellite image of high spatial resolution - WorldView2 (230 km²), 8 spectral bands
- creating DRM and infrared DOP (composite 8, 5, 3)
- visual and digital assessment of forest damage, mapping large areas
- interpretation and delineation of strata
- separate surfaces, considering the intensity of the damage, are categorized according to the degree of utilization of the wood mass
- category of damage to stands - all trees with the upper third of the crown damaged by more than 50%
- category devastation stands - the proportion of destroyed trees more than 70%



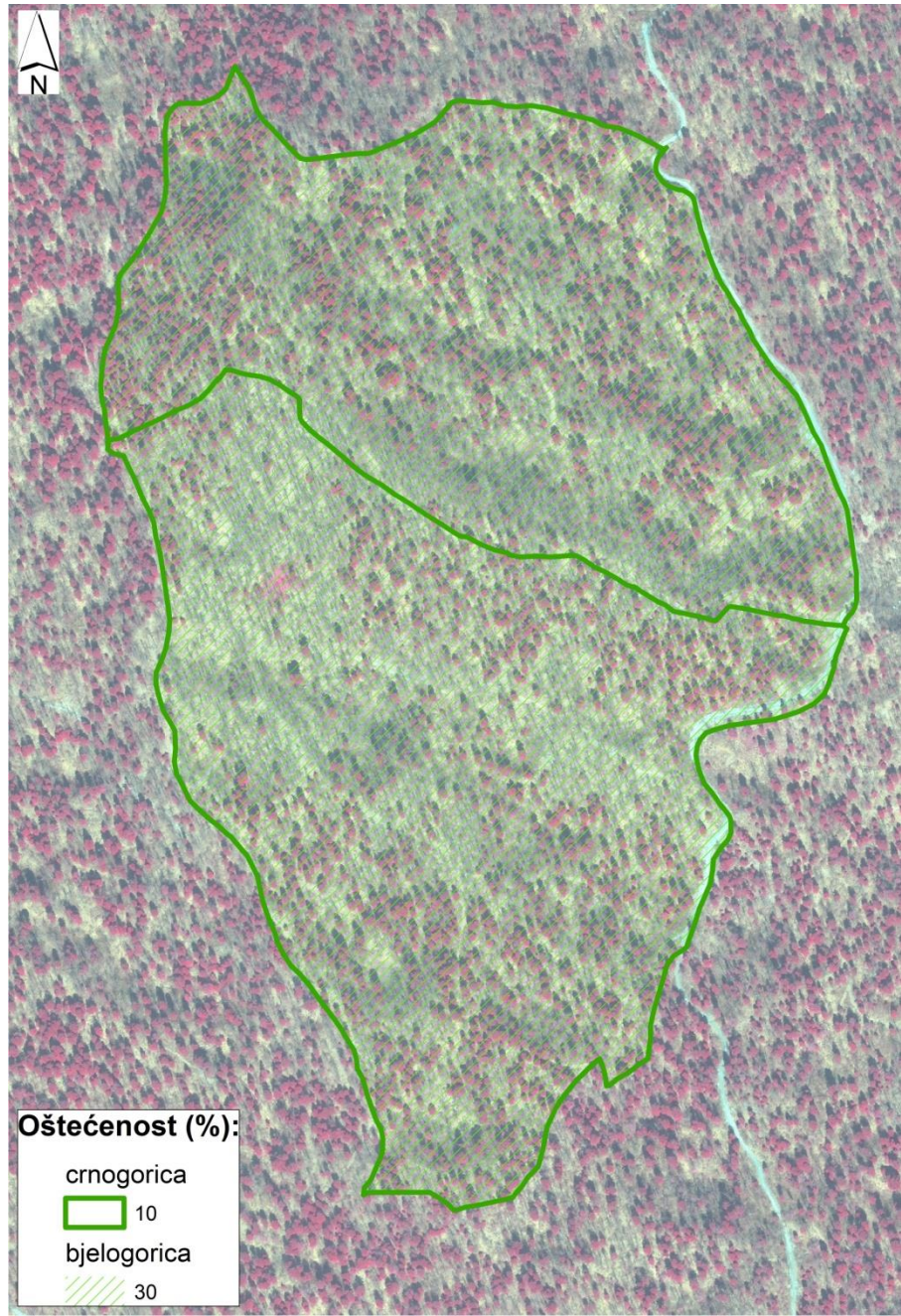


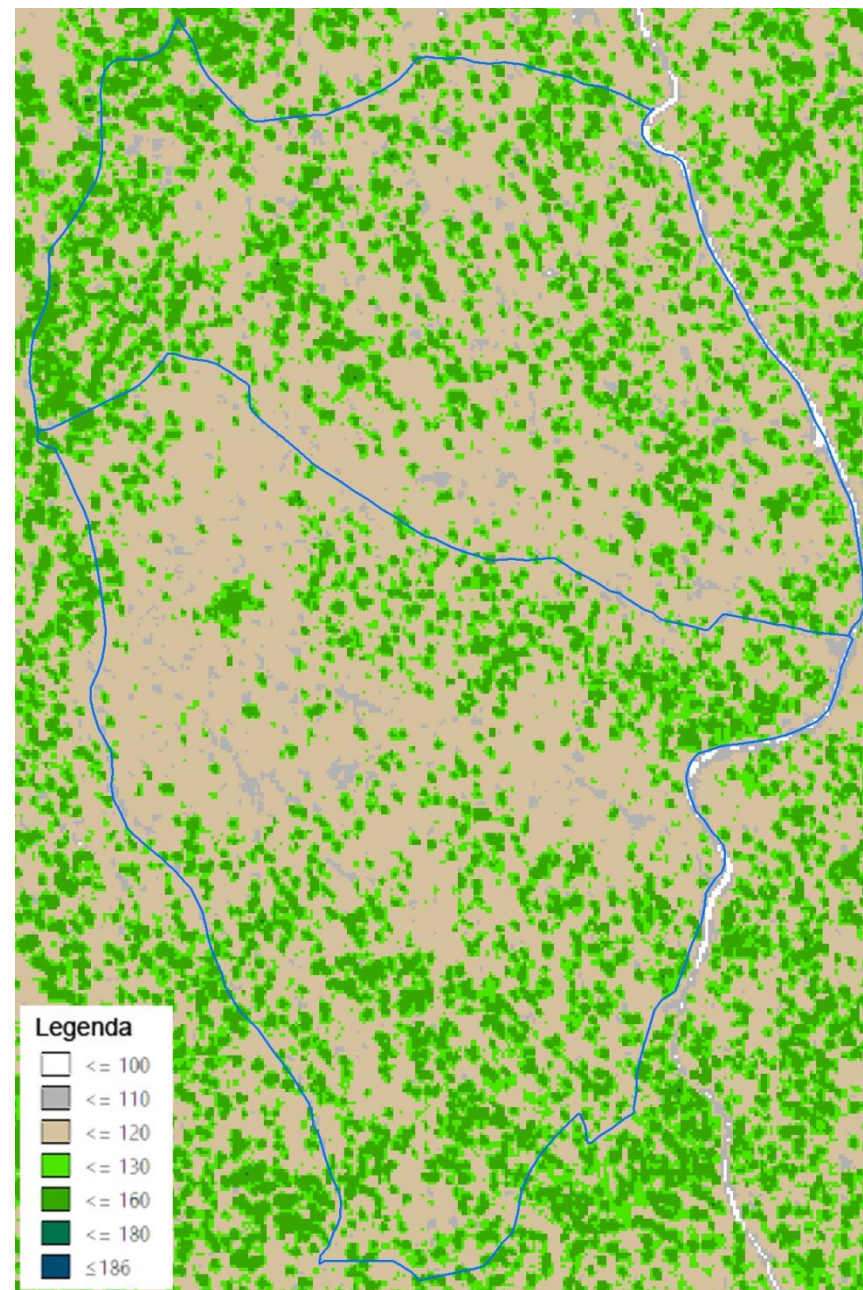
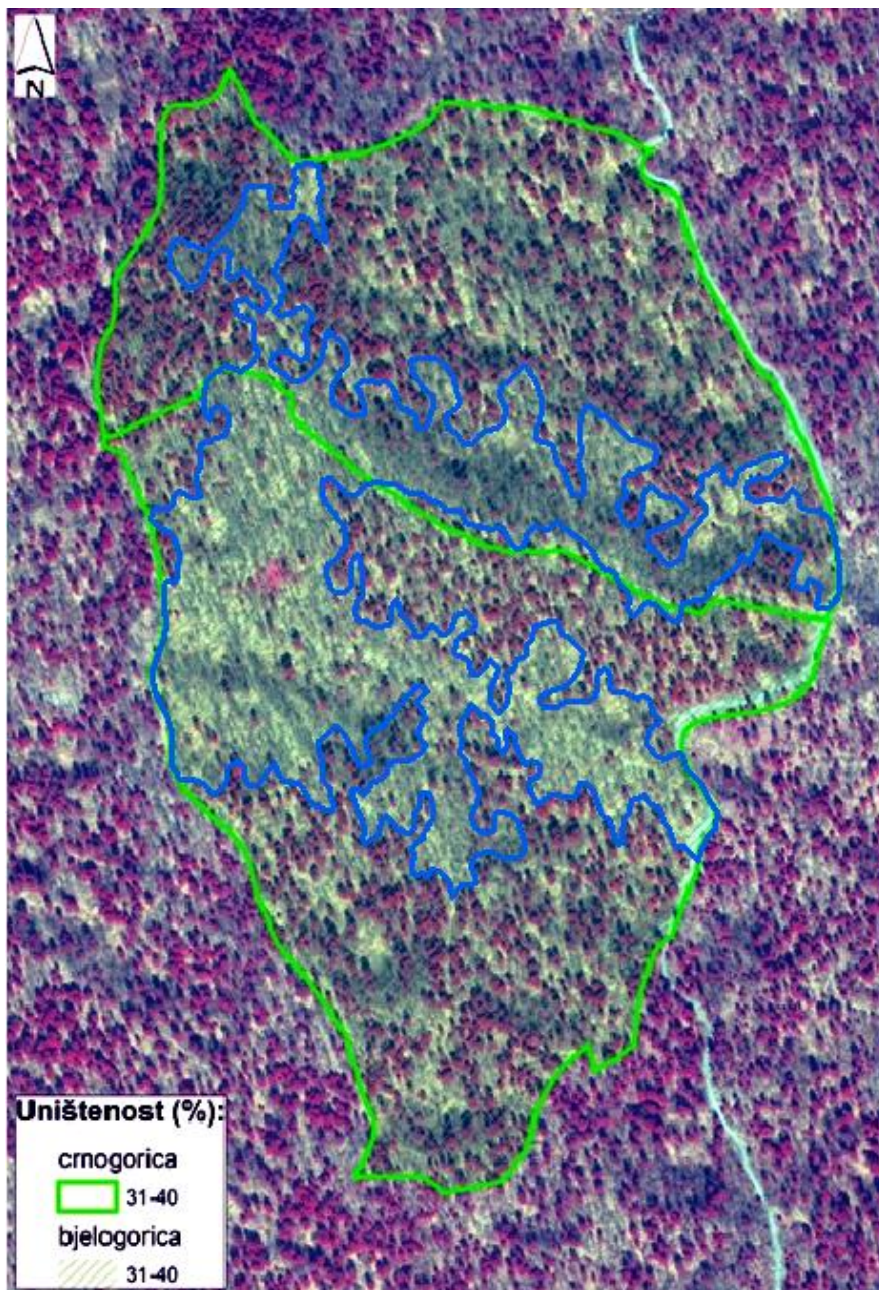




- visual interpretation - photointerpreter experience, assessment of damage degree individual tree species
- rapid assessment of the condition in the large area - digital interpretation - NDVI Index (Normalized Difference Vegetation Index)
- interpretation of satellite images determined the surface distribution, the state of the forest (scale / intensity), terrain characteristics (altitude, slope, exposure), and their possible impact on the state of the forest.

Comparison of raster (clip from satellite image) and vector layers (thematic map field estimated damage / devastation)







- introduction DRM as one of the layers in GIS significantly enhances spatial analysis - impact distinguishing different site parameters on the occurrence of forest damage
- overlapping thematic layers damage of forest stands (vector model) with raster terrain model, slope and exposure - new layers - relationships of factors relief and claims incurred





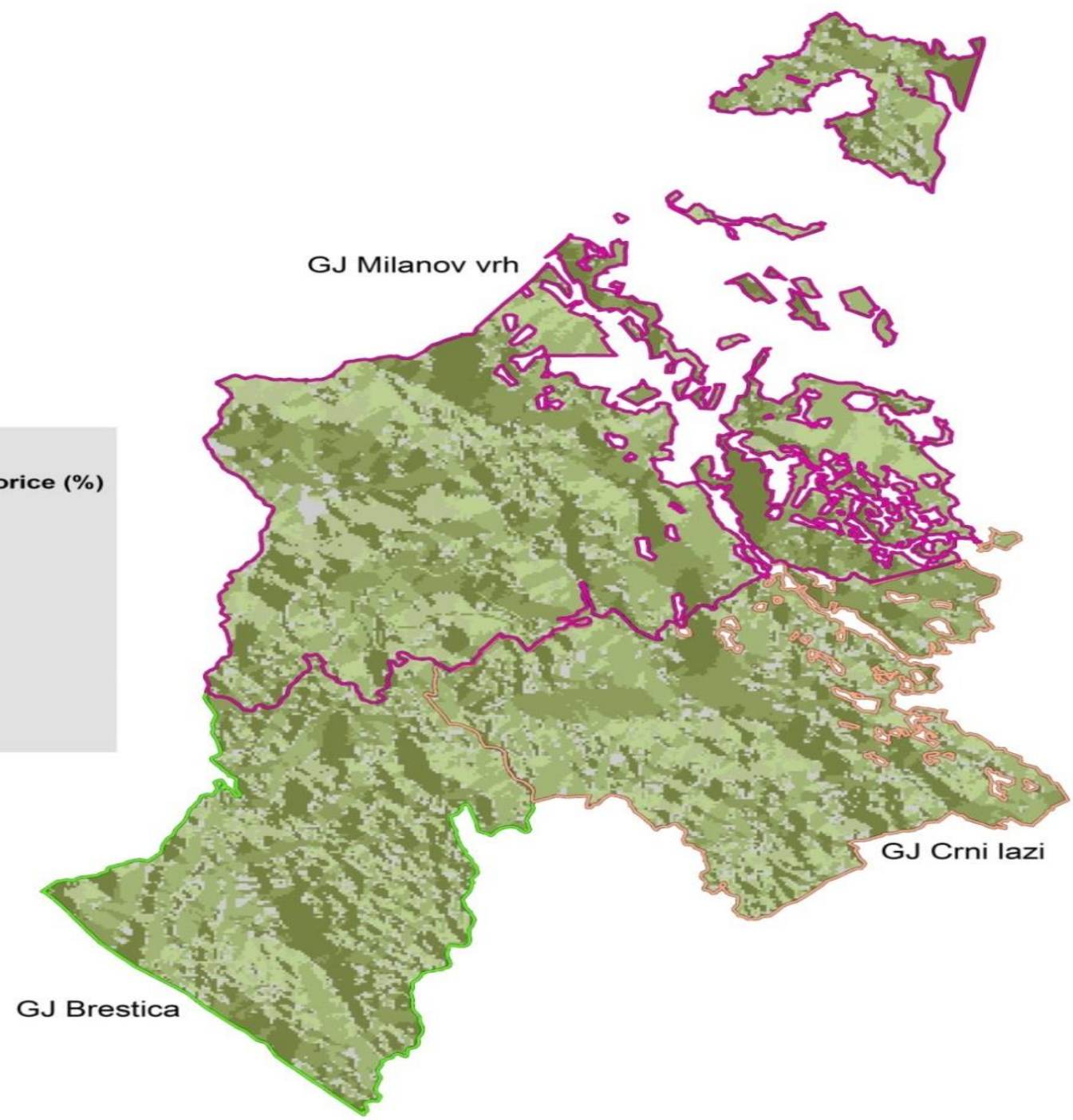
Legenda:

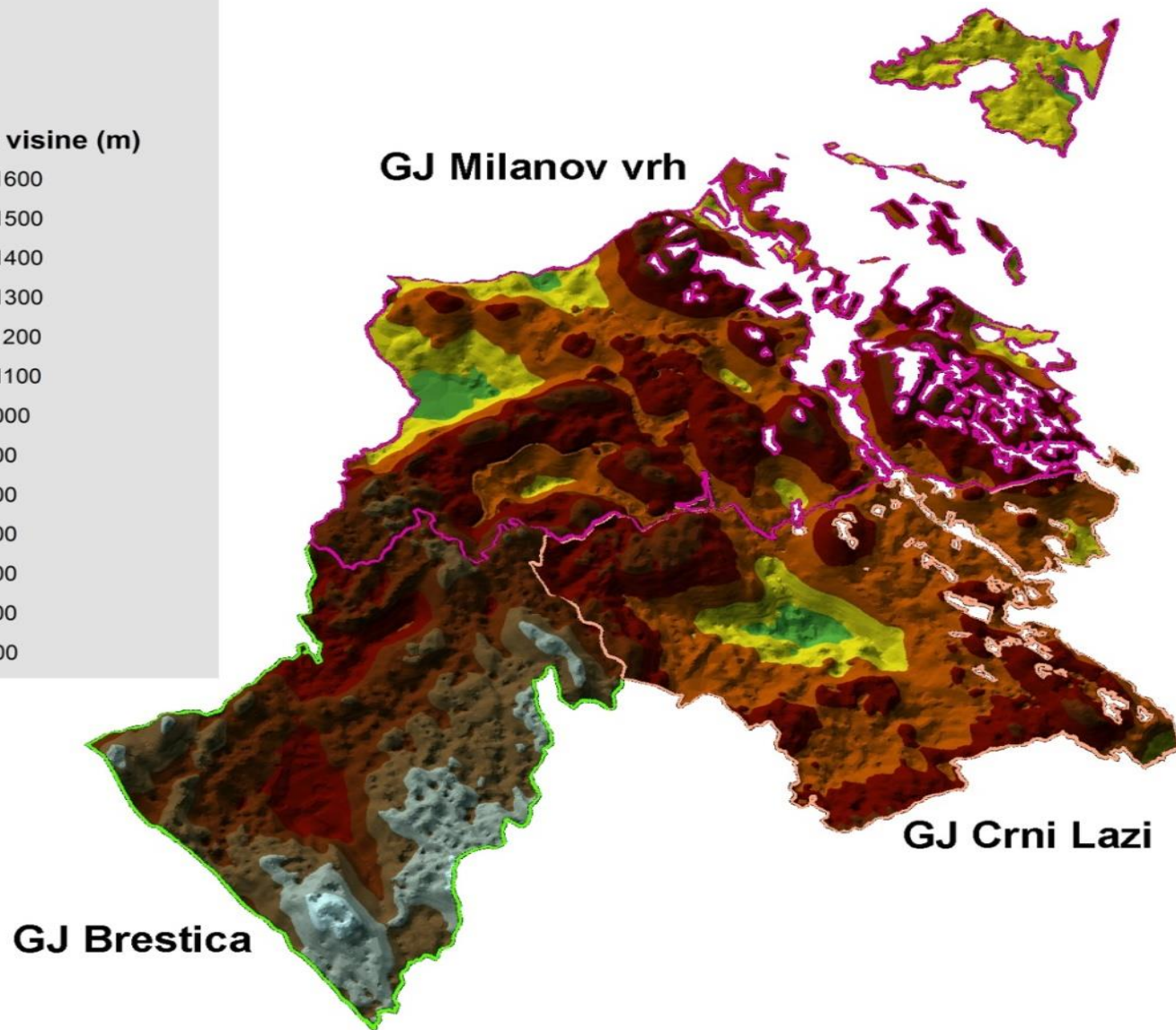
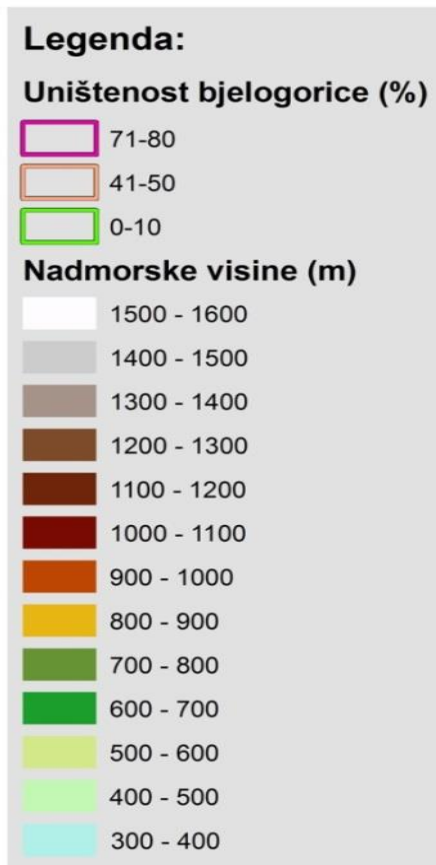
Uništenost bjelogorice (%)

- 71-80
- 41-50
- 0-10

Izloženost

- ravno
- sjever
- istok
- jug
- zapad







Legenda:

Uništenost bjelogorice (%)

71-80

41-50

0-10

Nagibi (stupnjevi)

0 - 5

5,1 - 10

10,1 - 15

15,1 - 20

20,1 - 25

25,1 - 30

30,1 - 35

35,1 - 40

40,1 - 45

45,1 - 50

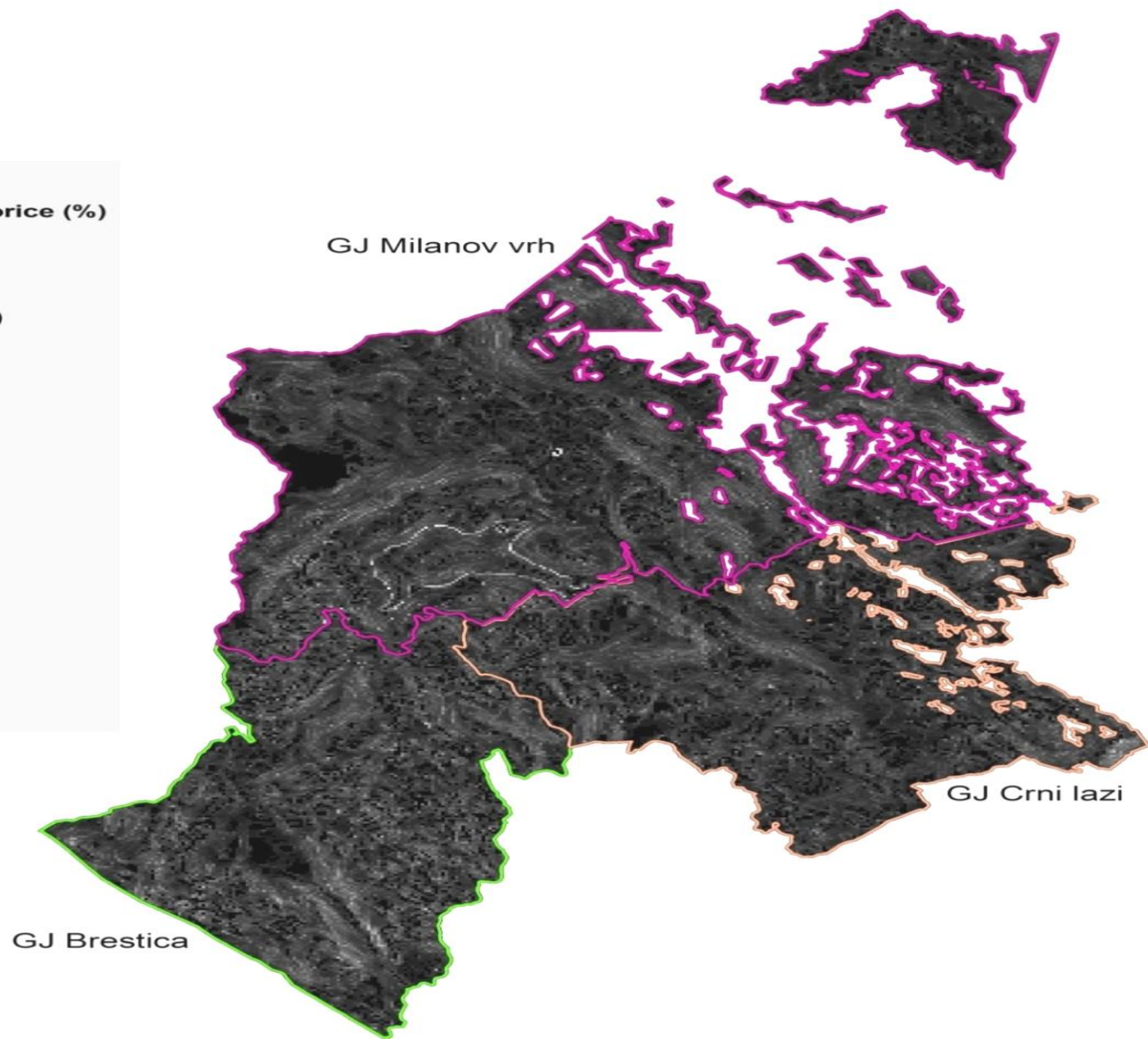
50,1 - 55

55,1 - 60

60,1 - 65

65,1 - 70

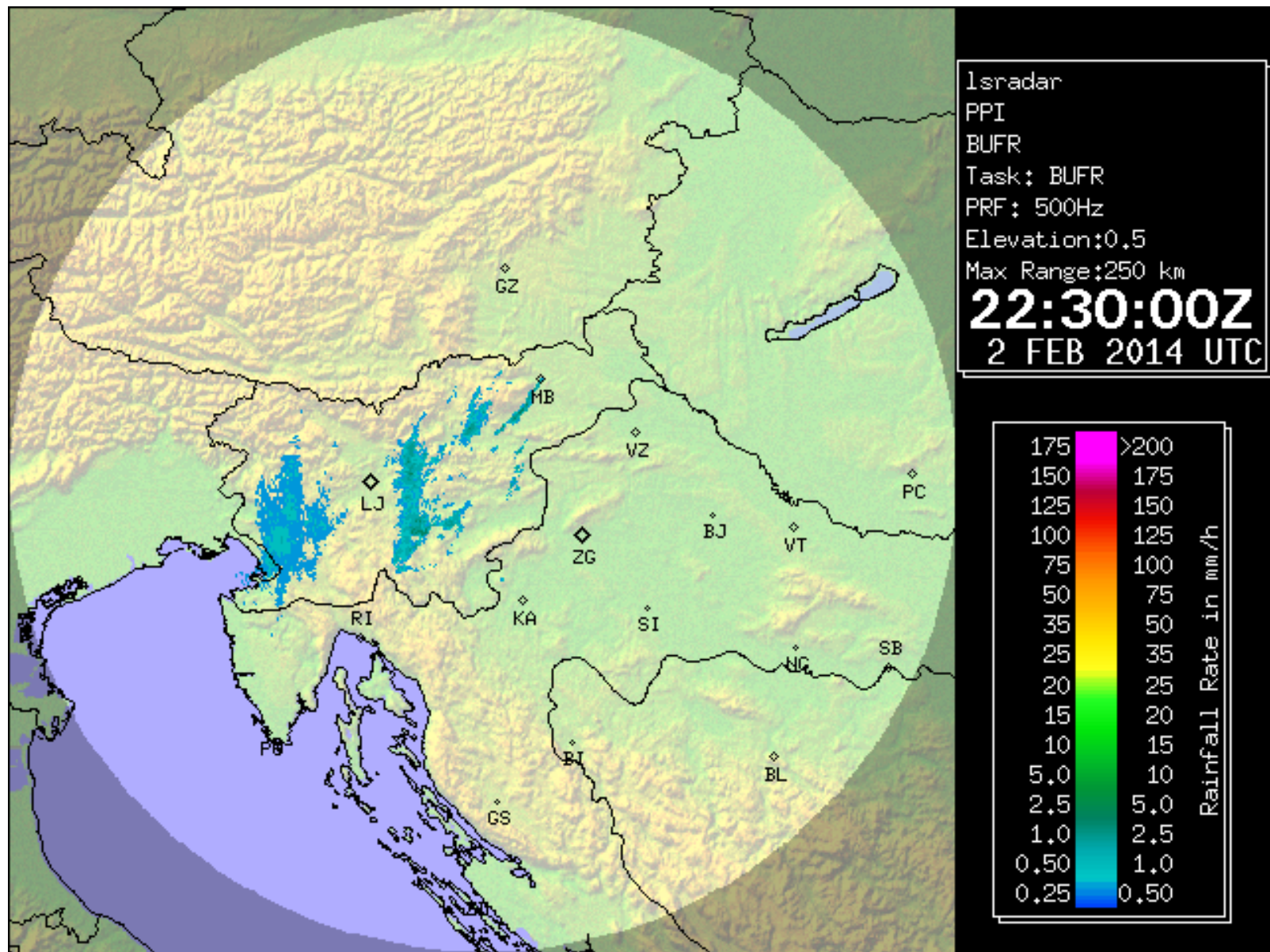
70,1 - 75





- results of the analysis layers spatial distribution of devastation stands and exposure - damage are greatest in the northern and northwestern exposures
- the results of the analysis (devastation of deciduous and coniferous trees) - the greatest damage stands of deciduous trees at altitudes of 800-1100 m, and that the damage to a minimum in altitudes above 1100 m, which can be explained by temperature inversion
- before the implementation of a method to estimate the damage caused by bad weather based on relevant available data are analyzed meteorological data that preceded and led to the bad weather and the impact on the extent and type of damage caused
 - in a layer above the 1000 and 1400 meters altitude
 - very pronounced temperature inversions
 - no conditions for the formation of cold rain in this area!

1. – 2. FEB 2014.



Ivana Čavlina Tomašević, DHMZ



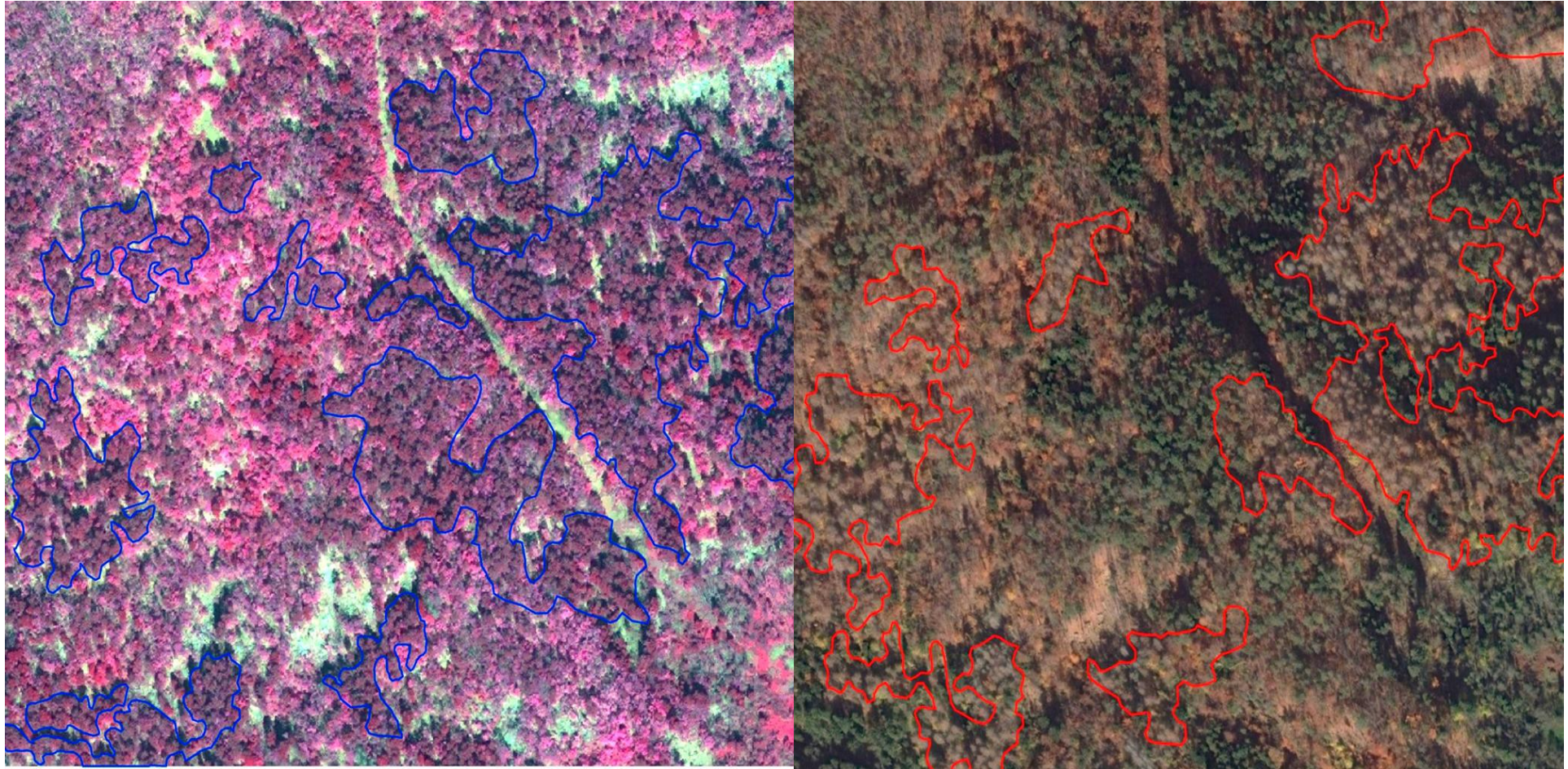
Conclusion:

- importance RS - size inventoried areas, inaccessibility of the terrain and the time spent
- define the area and intensity of damage, habitat characteristics
- primarily refers to the type of soil, its predispose to erosion, damage humus as the main catalyst for the absorption of rain water and prevent erosion
- significant role of DRM as layer in GIS in implementation of spatial analysis in study of forest condition, especially in determining of damages by natural disasters and habitat factors on large areas



- the current state of forests (inventory) and implementation of spatial analysis in GIS in the determination of damage from natural disasters and habitat factors, and point to the future directions of multidisciplinary research
- for the interpretation of the observed phenomena it is necessary to include meteorological parameters for modelling
- images remain a permanent documentation of the present state, necessary for monitoring success and the course of rehabilitation or base (current status) for monitoring the situation after re-recording (2, 5 or 10 years) - monitoring

Prediction attacks spruce scribe - the possibilities for application of remote sensing with forecasts graduation and spread attacks spruce scribe



Precision spatial detection predisposed spruce trees provides fast and effective intervention by forestry experts in the field - methodological innovation in the first step to combat bark beetle - early detection and prediction



THANK YOU FOR ATTENTION!