



*13th International Conference
GEOHERITAGE, GEOINFORMATION AND CARTOGRAPHY*

GIS Mapping of Croatian Landform Diversity Using the Geomorphons Approach

*Matjaž ŠTANFEL, Dražen TUTIĆ
University of Zagreb, Faculty of Geodesy
mastanfel@geof.hr, dtutic@geof.hr*

SELCE, SEPTEMBER 7-9, 2017

Geomorphons

A pattern recognition approach to classification and mapping of landforms

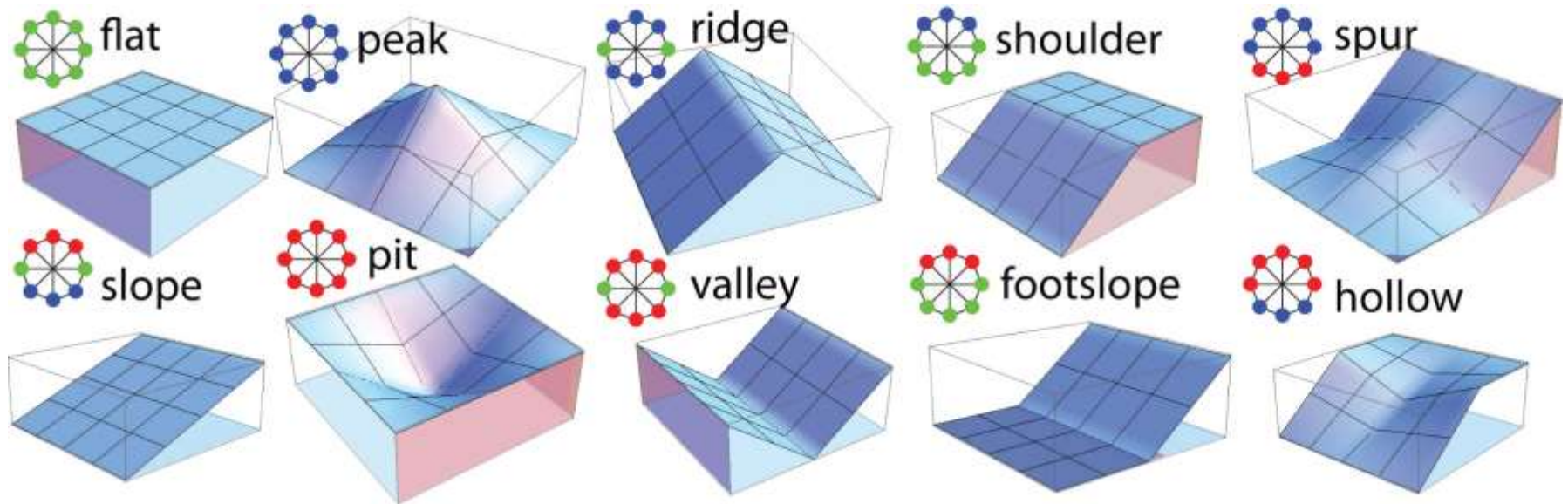


Figure: Symbolic 3D morphologies and their corresponding geomorphons for the 10 most common landform elements (Jasiewicz et al., 2013)

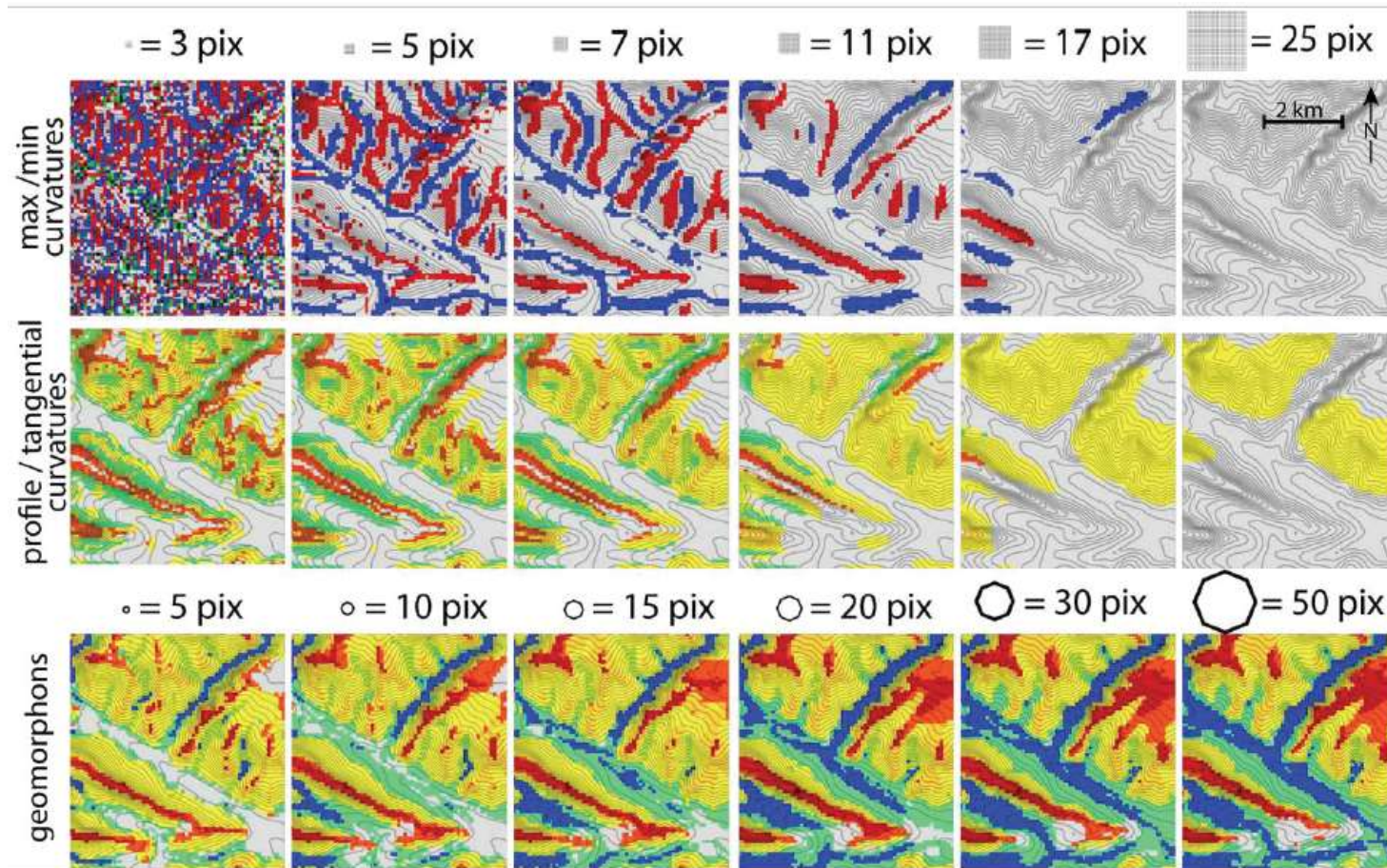
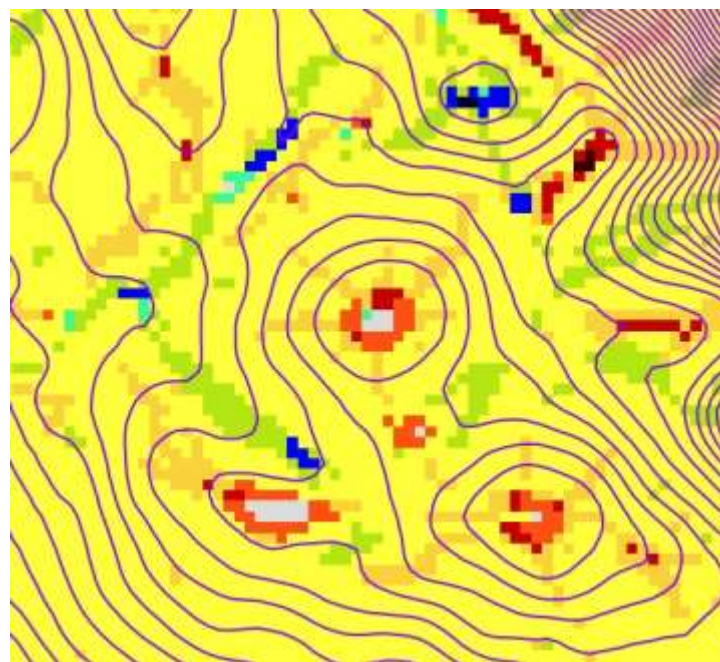
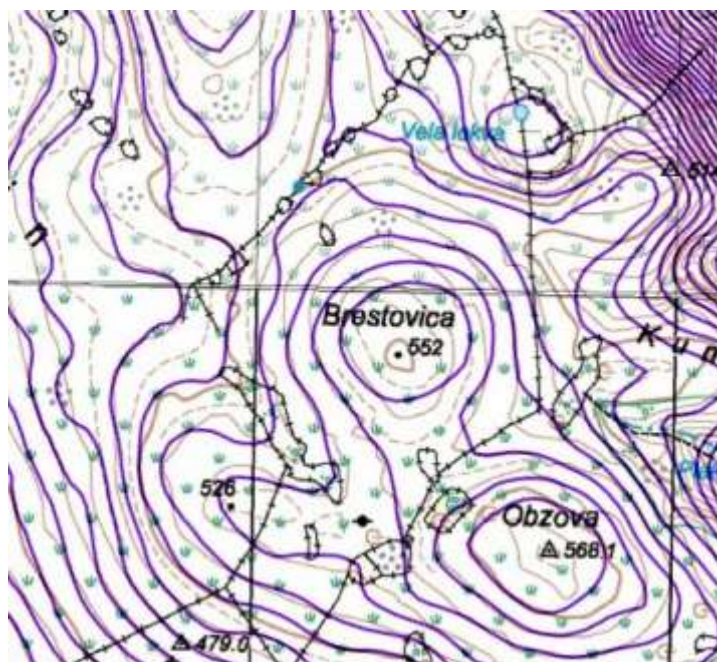


Figure: Dependence of geomorphometric map on lookup distance L (geomorphons) and window size (differential geometry)

EU-DEM analysis

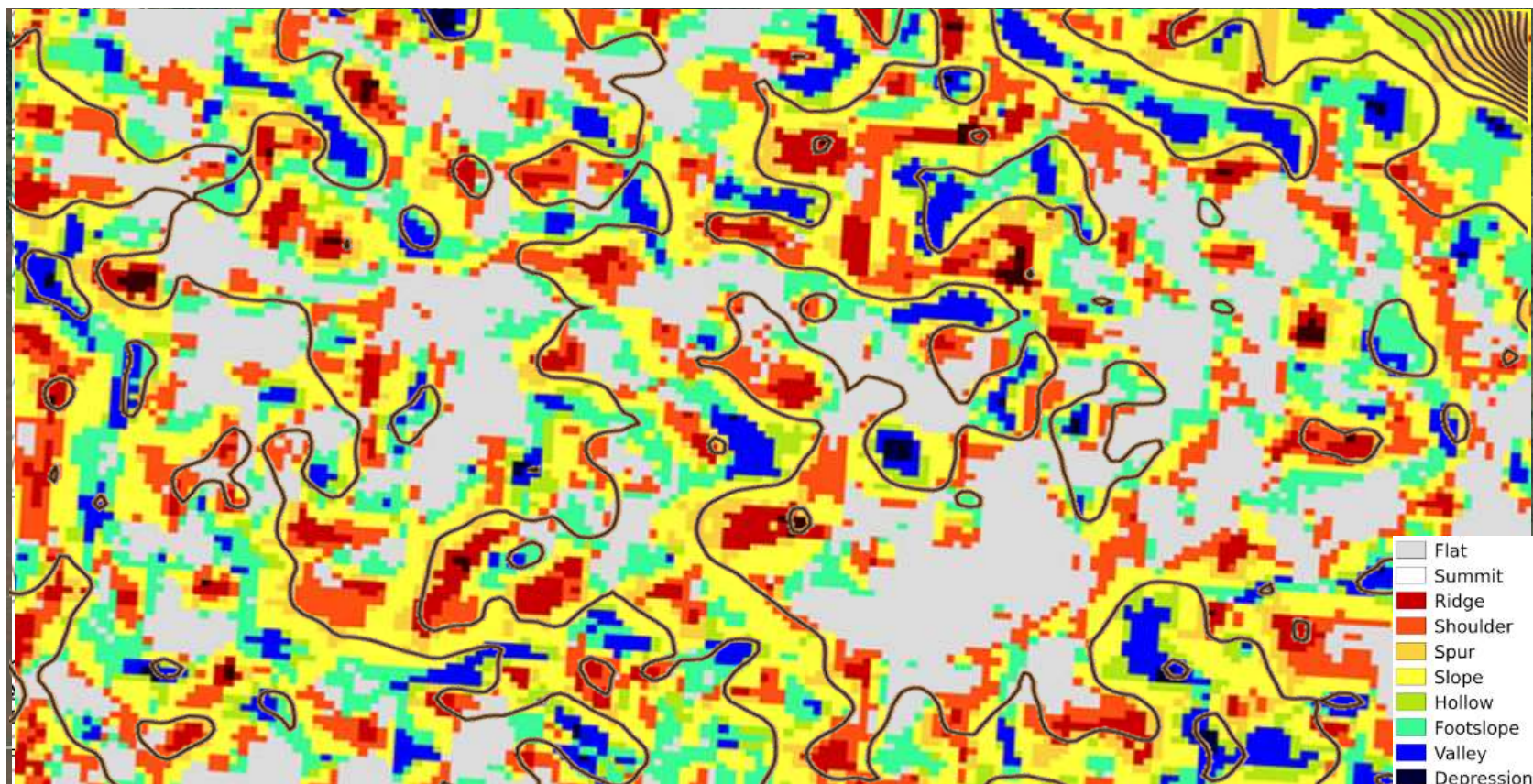
25m resolution Digital Surface Model – analysis of data adequacy for this research
on hilly area without vegetation



- Flat
- Summit
- Ridge
- Shoulder
- Spur
- Slope
- Hollow
- Footslope
- Valley
- Depression

EU-DEM analysis

25m resolution Digital Surface Model – analysis of data adequacy for this research
on flat area with vegetation



EU-DEM analysis

Conclusion

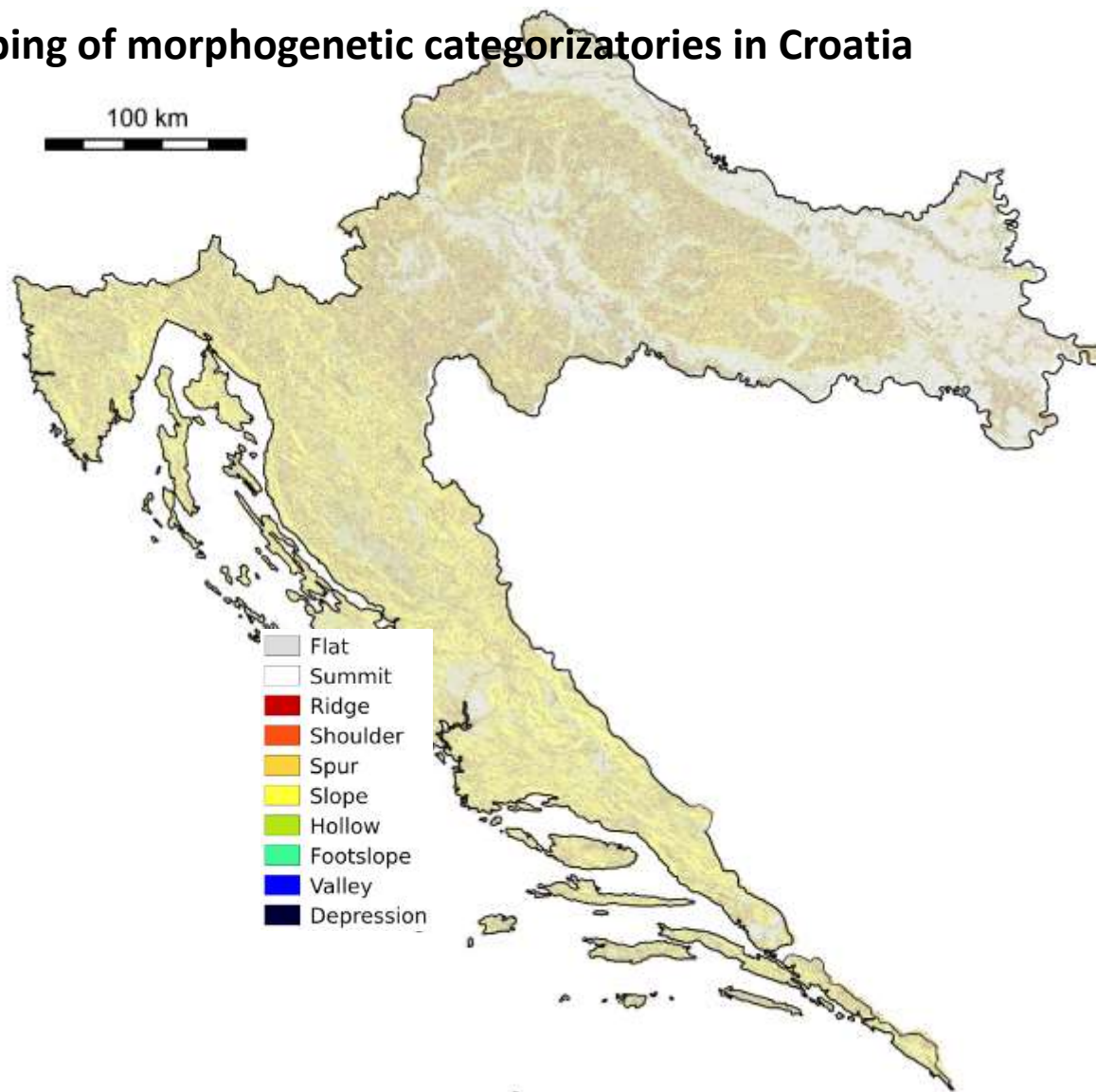
- Very good correlation with contours of national topographic map 1 : 25 000 in steep areas without vegetation.
- Unable to detect small depressions (dolines), especially in forested area.
- Outliers in larger urban areas (Zagreb) – not relevant for this research.
- The analysis was carried out on the total of 56,538 sq. km.
- 375m lookup distance, flatness = $0,7^\circ$ selected for this research

Morphogenetic categorization of Croatia



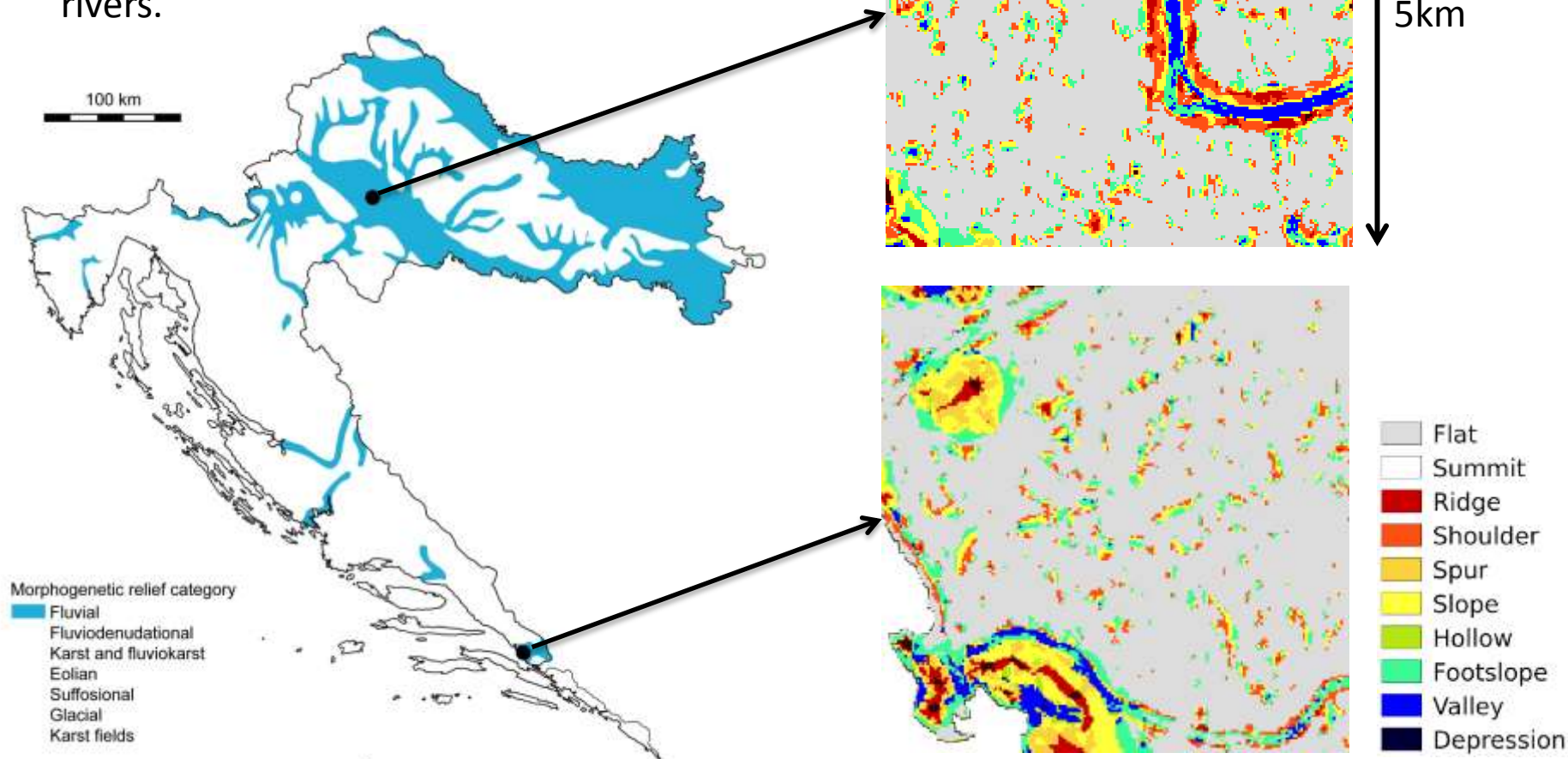
Source: Bognar, A., (1996): Croatia—the land and natural features. *GeoJournal*, 38(4), 407-416.

Geomorphon mapping of morphogenetic categorizatories in Croatia



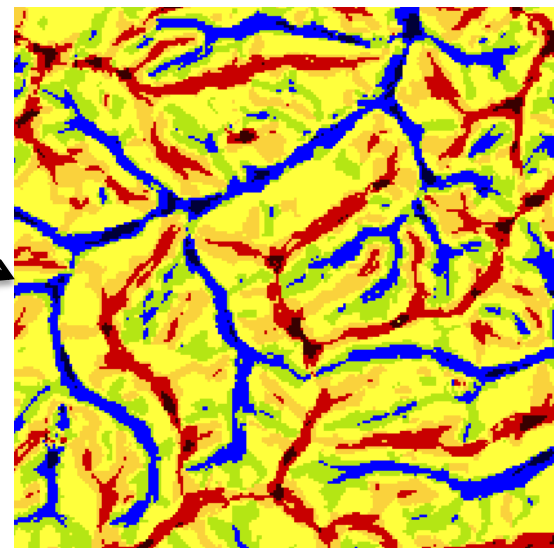
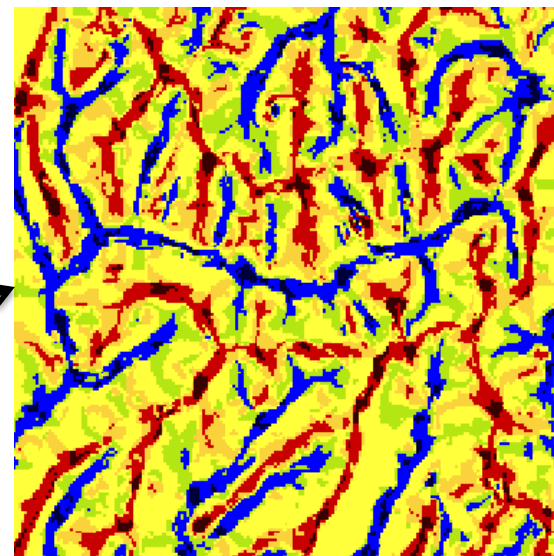
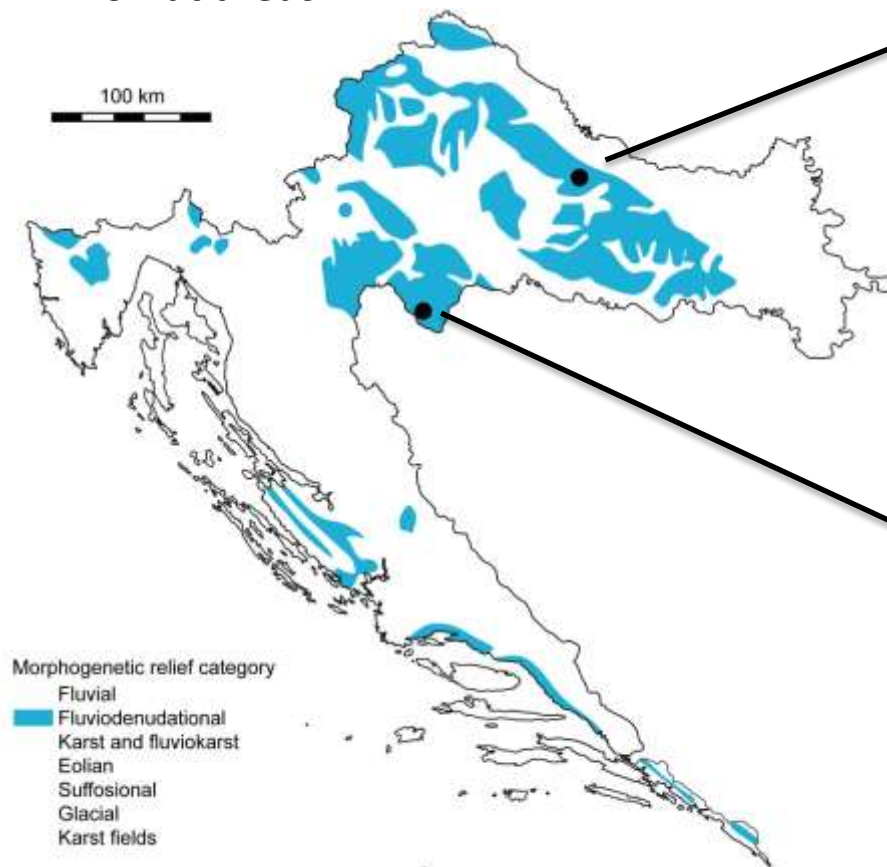
Geomorphon mapping of fluvial landforms

- Dominant flat areas – the most fertile soil type in Croatia often being cultivated.
- Plains with meander valleys – representing rivers.



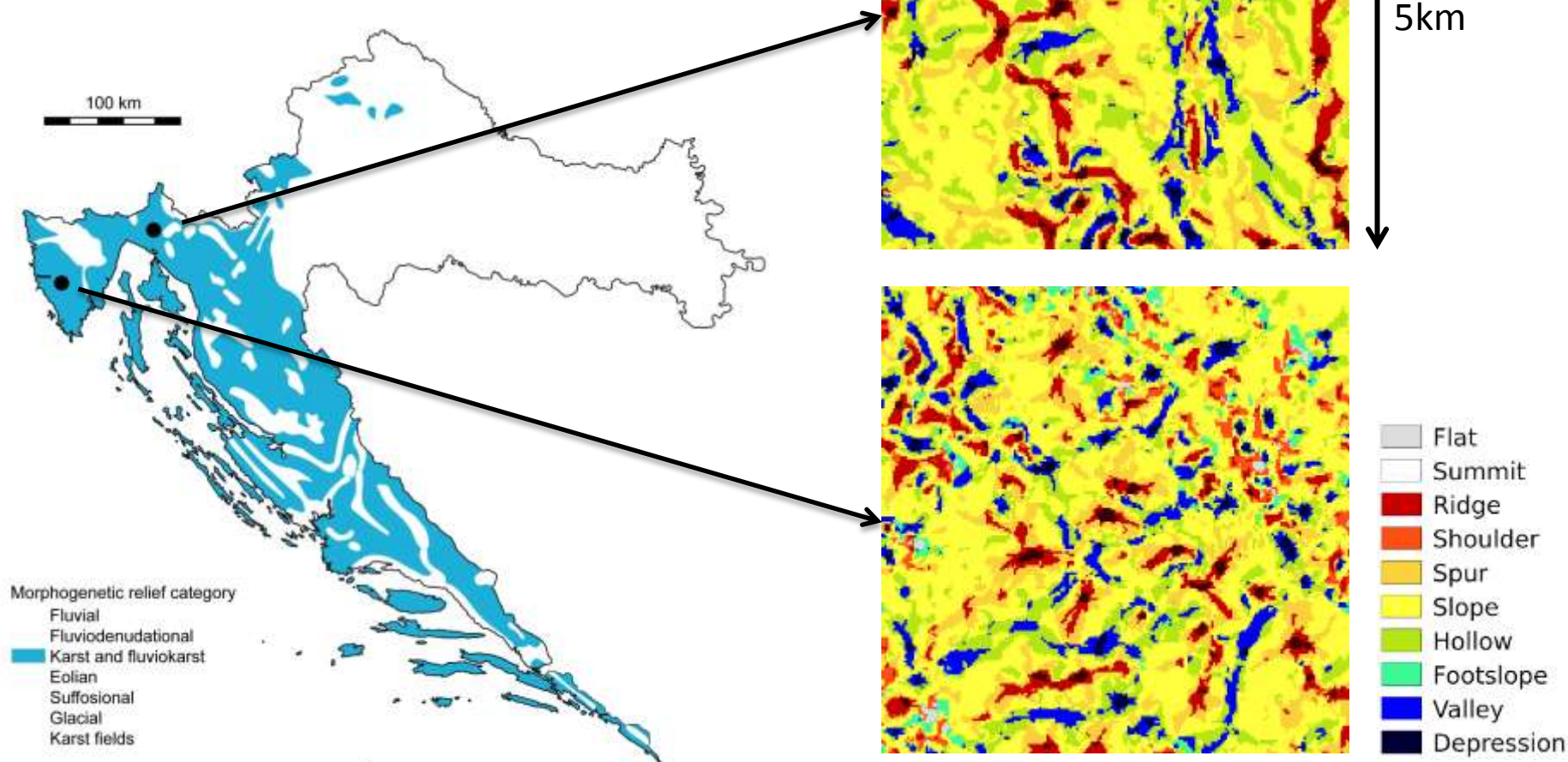
Geomorphon mapping of fluviodenudational landforms

- Interweaving of valleys and ridges – in Croatia mainly forested.
- No flat areas.



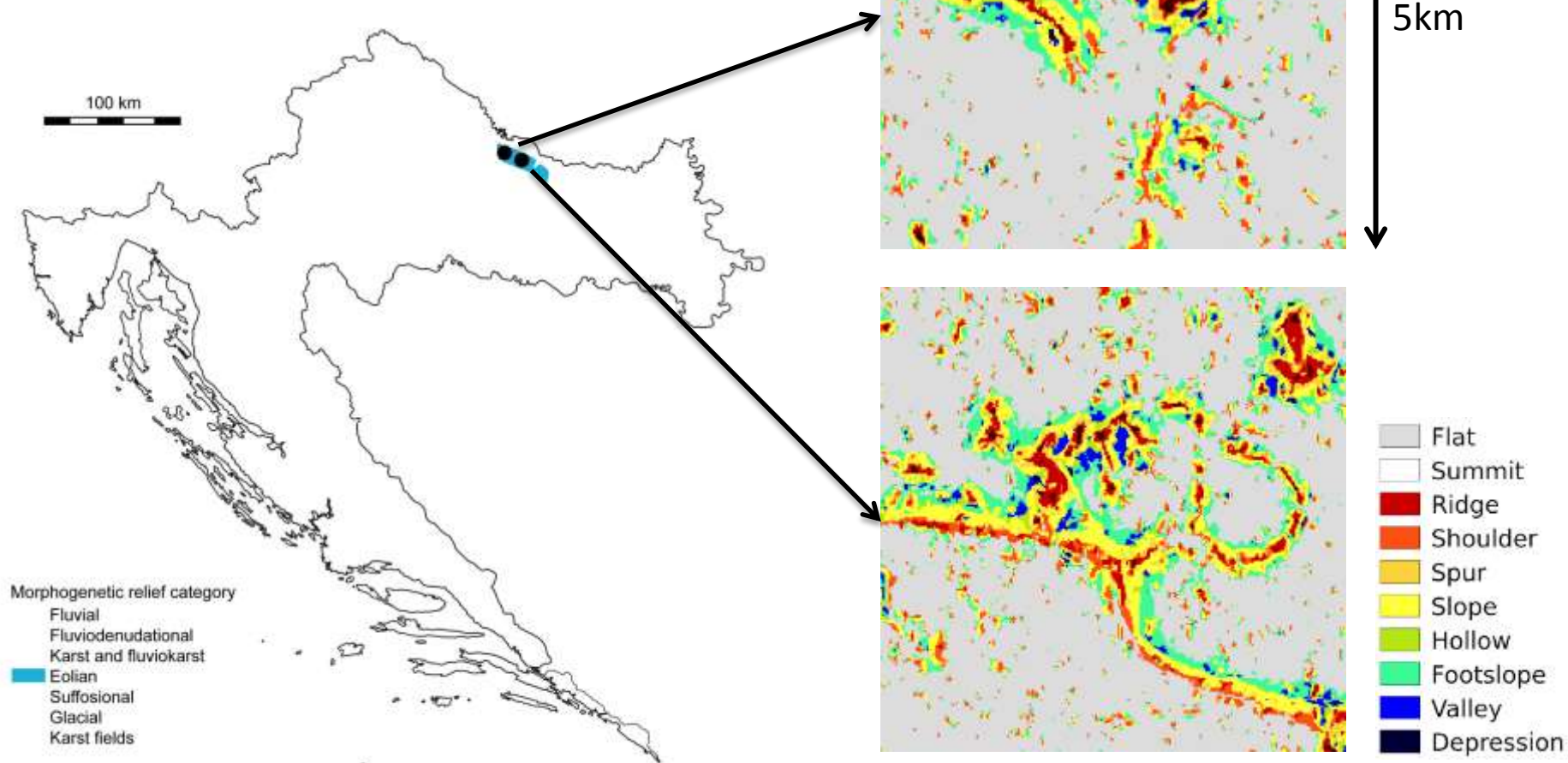
Geomorphon mapping of karst and fluviokarst landforms

- Most widespread landform in Croatia.
- Variety of form sizes. Larger slope areas.



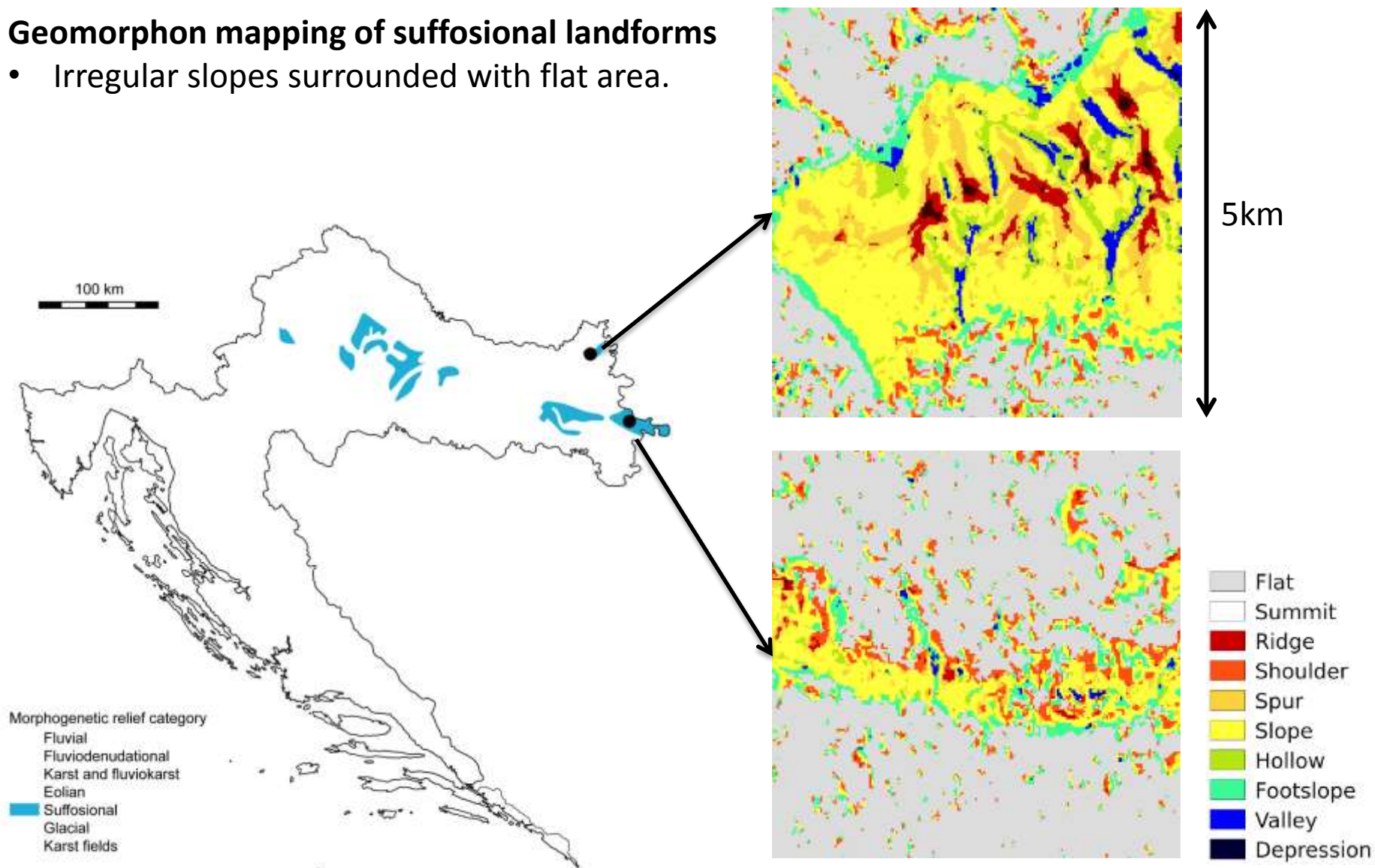
Geomorphon mapping of eolian landforms

- Flat areas with smaller landforms.



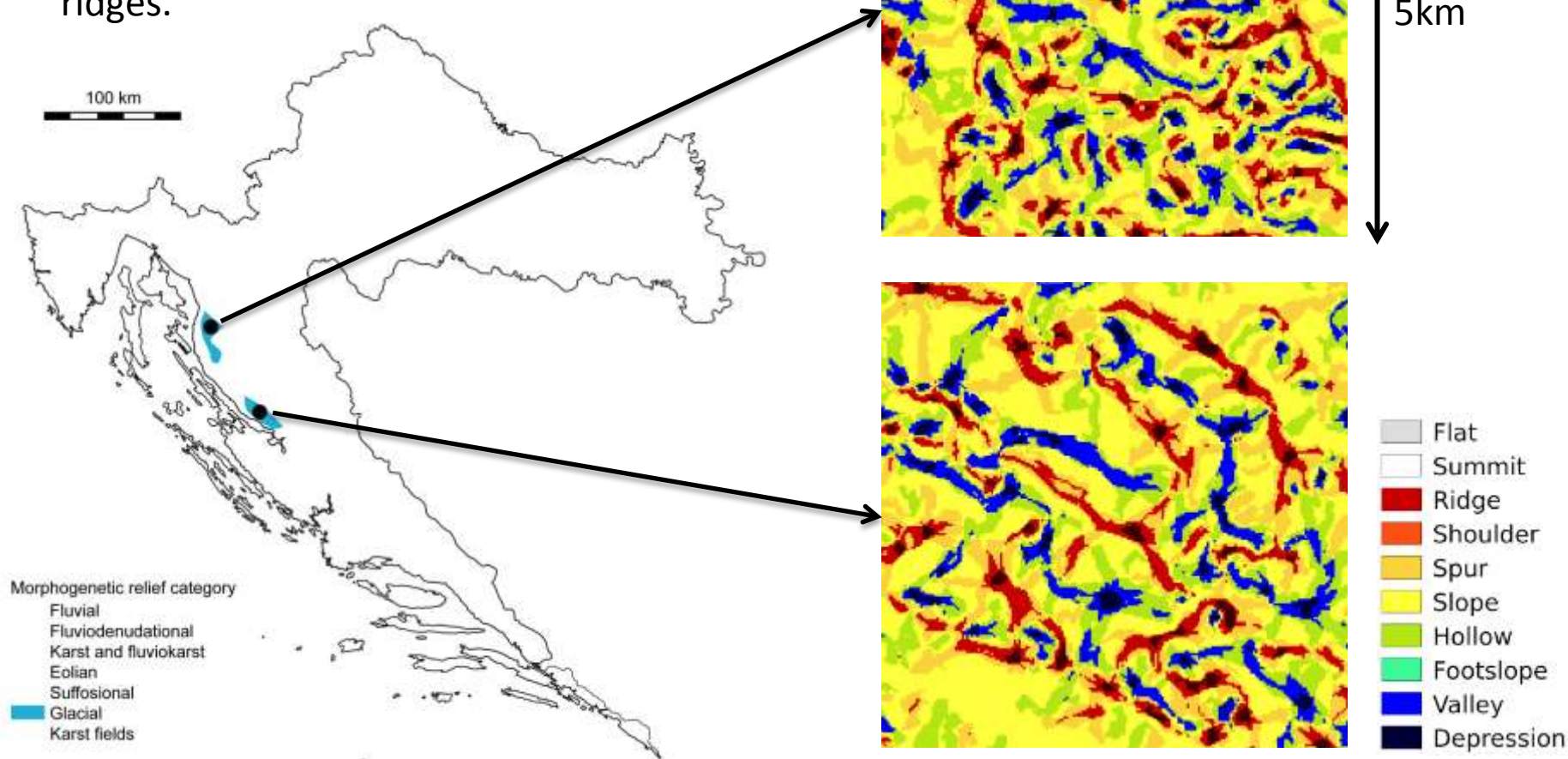
Geomorphon mapping of suffosional landforms

- Irregular slopes surrounded with flat area.



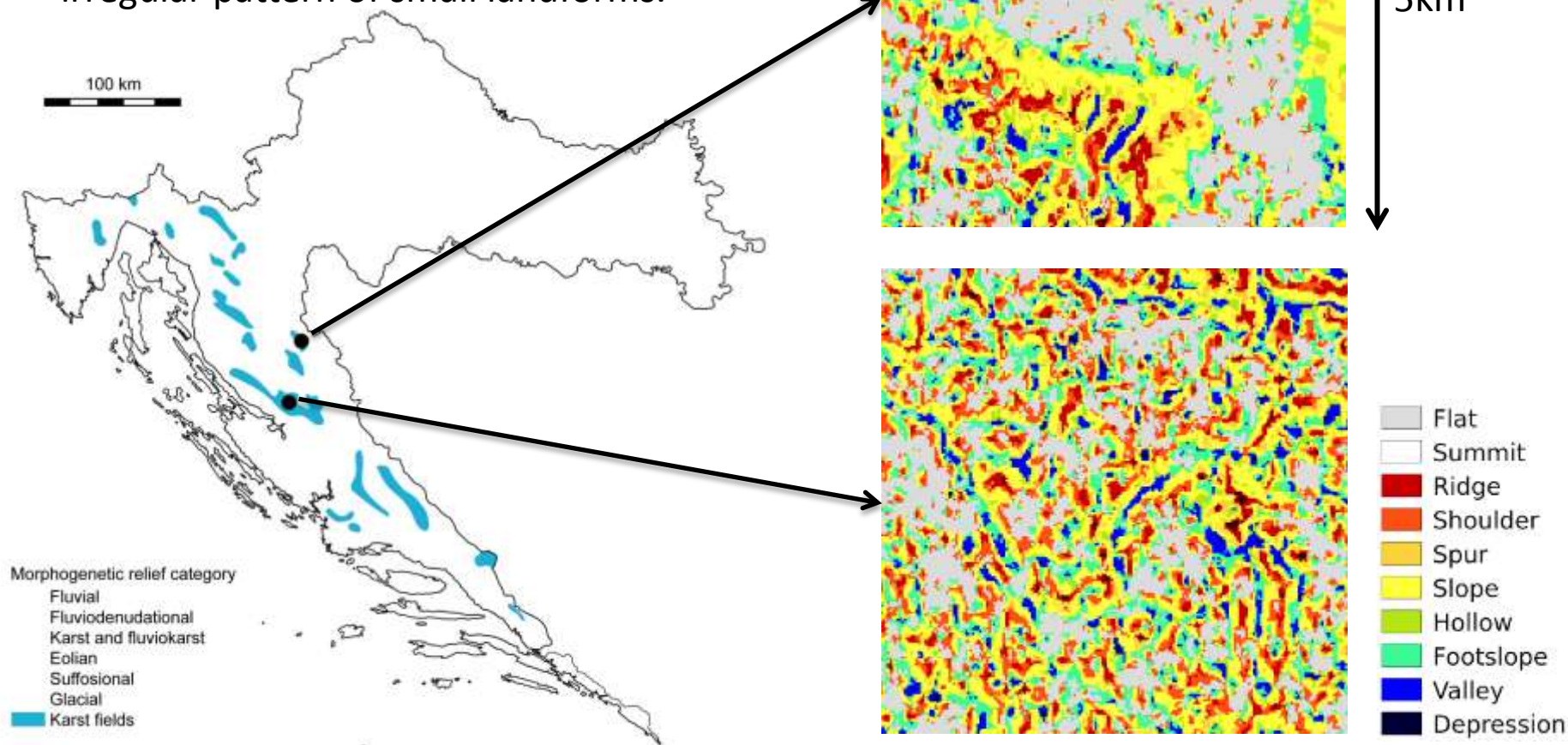
Geomorphon mapping of glacial landforms

- Traces of the Pleistocene glaciation (moraines, fluvial deposits, cirques, etc.).
- Net-like geomorphon structure of valleys and ridges.



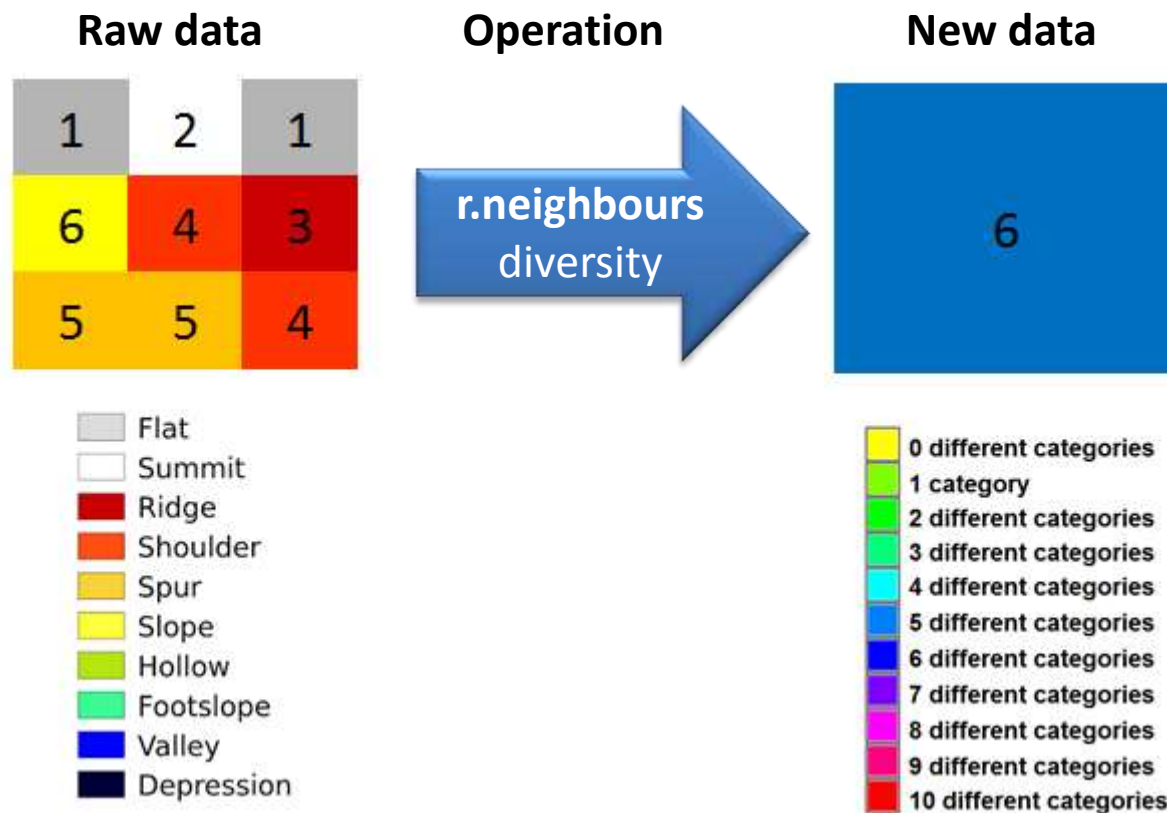
Geomorphon mapping of karst fields landforms

- Karst fields are unique features on Global level.
- Flat areas surrounded by mountains with irregular pattern of small landforms.



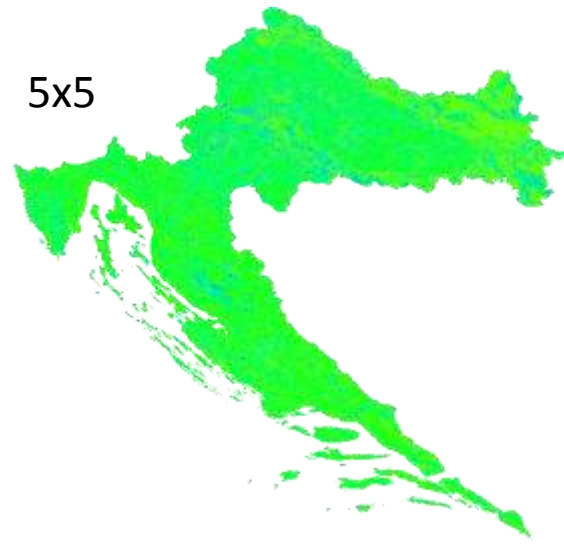
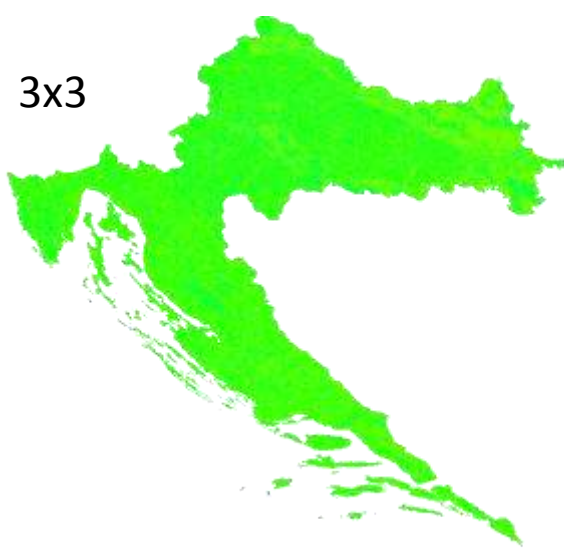
Geomorphon landform diversity map - *r.neighbours*

- Analysis of Croatian geomorphon diversity



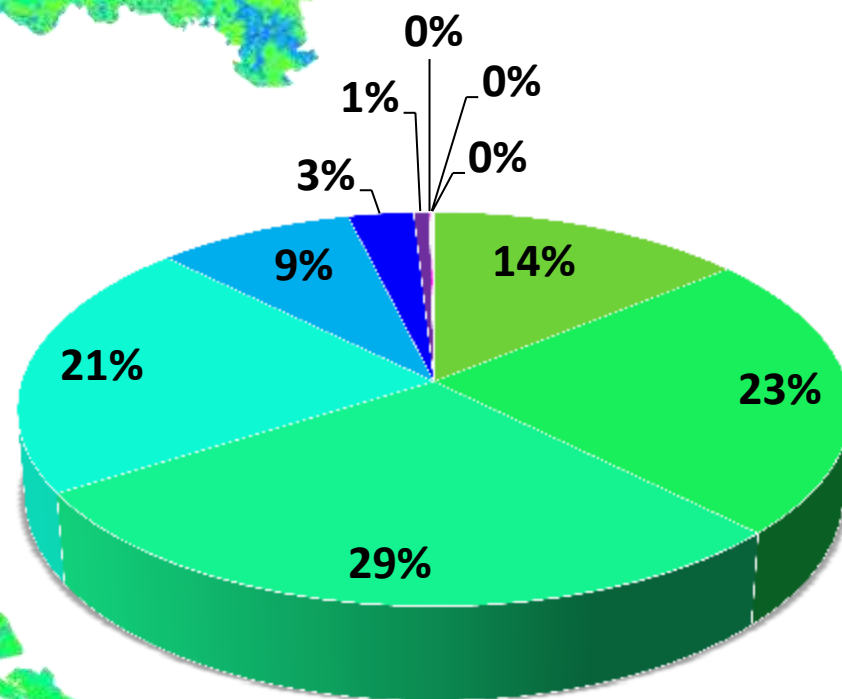
Geomorphon landform diversity map - *r.neighbors*

- Comparison of different matrix size.
- 3x3 matrix is too small to detect diversity
- 5x5 matrix can detect up to 7 different categories for Croatian area but there is almost no area with very high geomorphon diversity.
- 7x7 matrix can detect geomorphon diversity on wider range thus recognise very detailed areas with 10 different categories (less than 0,01% of Croatia).

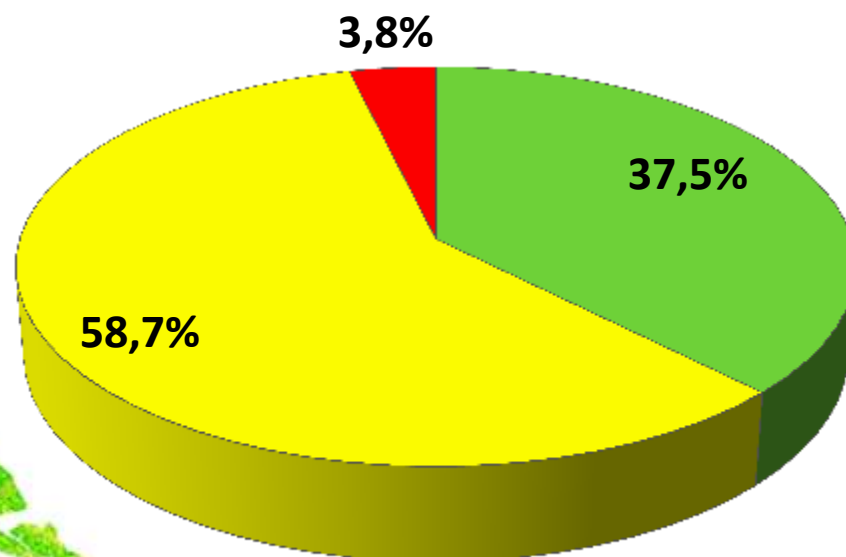
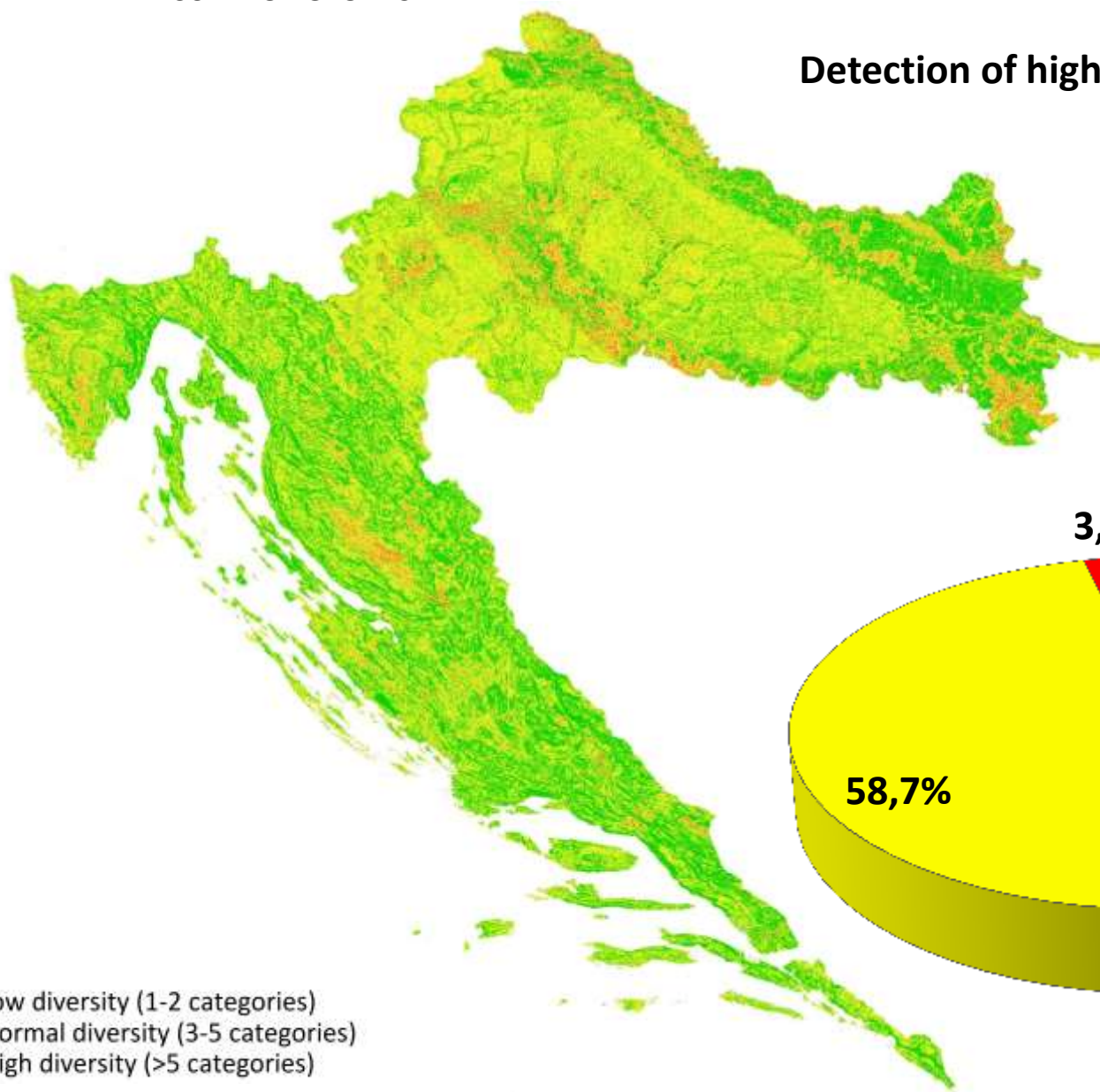




Diversity of Croatian geomorphons

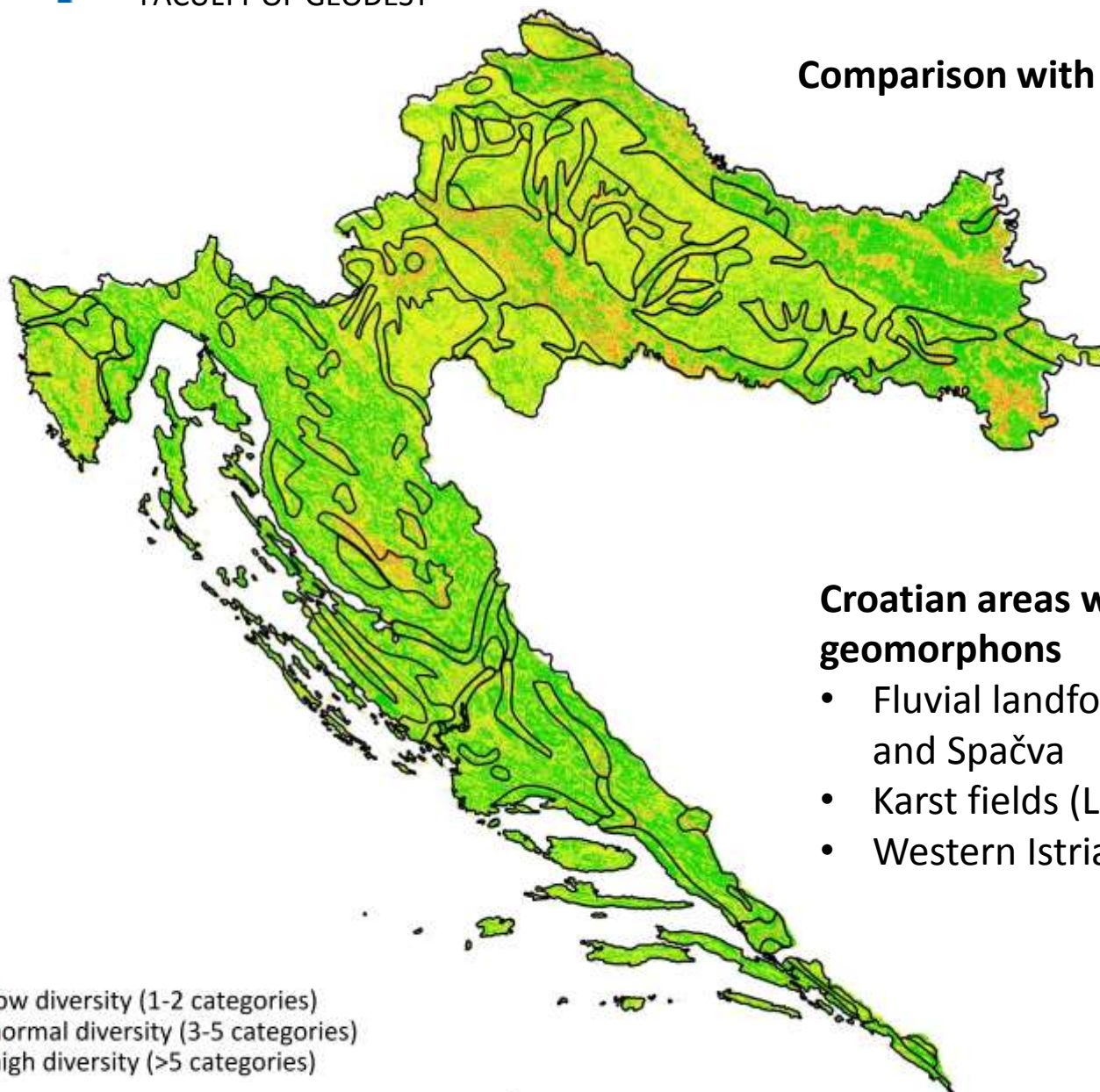


Detection of highest geomorphon diversity



 low diversity (1-2 categories)
 normal diversity (3-5 categories)
 high diversity (>5 categories)

Comparison with morphogenetic borders



Croatian areas with highest diversity of geomorphons

- Fluvial landforms around Lonjsko polje and Spačva
- Karst fields (Ličko polje)
- Western Istrian peninsula.

low diversity (1-2 categories)
normal diversity (3-5 categories)
high diversity (>5 categories)

Research conclusion and further recommendations

- Parameters for creation of geomorphon map depend on authors.
- Nevertheless of contained height related errors in dataset, generated landform maps may be of use for geomorphological research.
- Data quality assessment is important for result interpretation – especially in karst fields and flat fluvial forested areas.
- Landform diversity is correlated with morphogenetic relief category.



*13th International Conference
GEOHERITAGE, GEOINFORMATION AND CARTOGRAPHY*

THANK YOU FOR ATTENTION