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Geomorphometric characteristics of the high mountains in North Macedonia

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OBJECTIVES AND METHODS

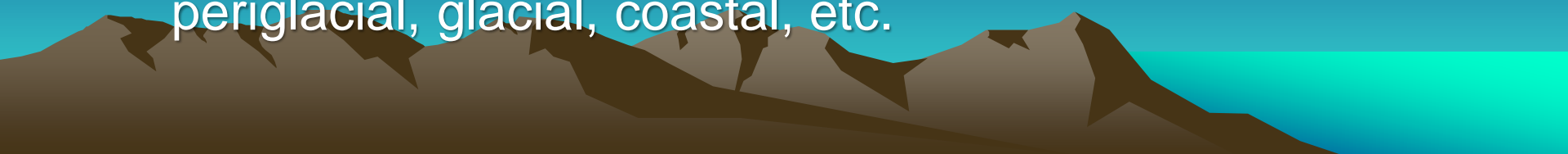
- To analyze morphometric characteristics of the high mountains (above 2000 m) in North Macedonia, their similarities and differences;
- To classify high mountains in Macedonia according to the main morphometric elements;
- To understand correlation between structural basis of the mountains and its morphometry;
- For the geomorphometry analysis of the mountains, 15-m DEM (based on 5-m ARECNM/Agency of Real Estate and Cadaster of North Macedonia) is used;
- On the end, morphometric classification of the high mountains is made.

BASIC FACTS ABOUT THE RELIEF IN NORTH MACEDONIA

- Country area: 25 713 km²
- Average altitude 830 m (among the highest in Europe)
- Average slope 15.5° (among the steepest in Europe)
- 38 mountains; 13 higher than 2000 m
- 5 mountains higher than 2500 m
- Hilly-mountain area: 79%
- High mountain area: 29.3%

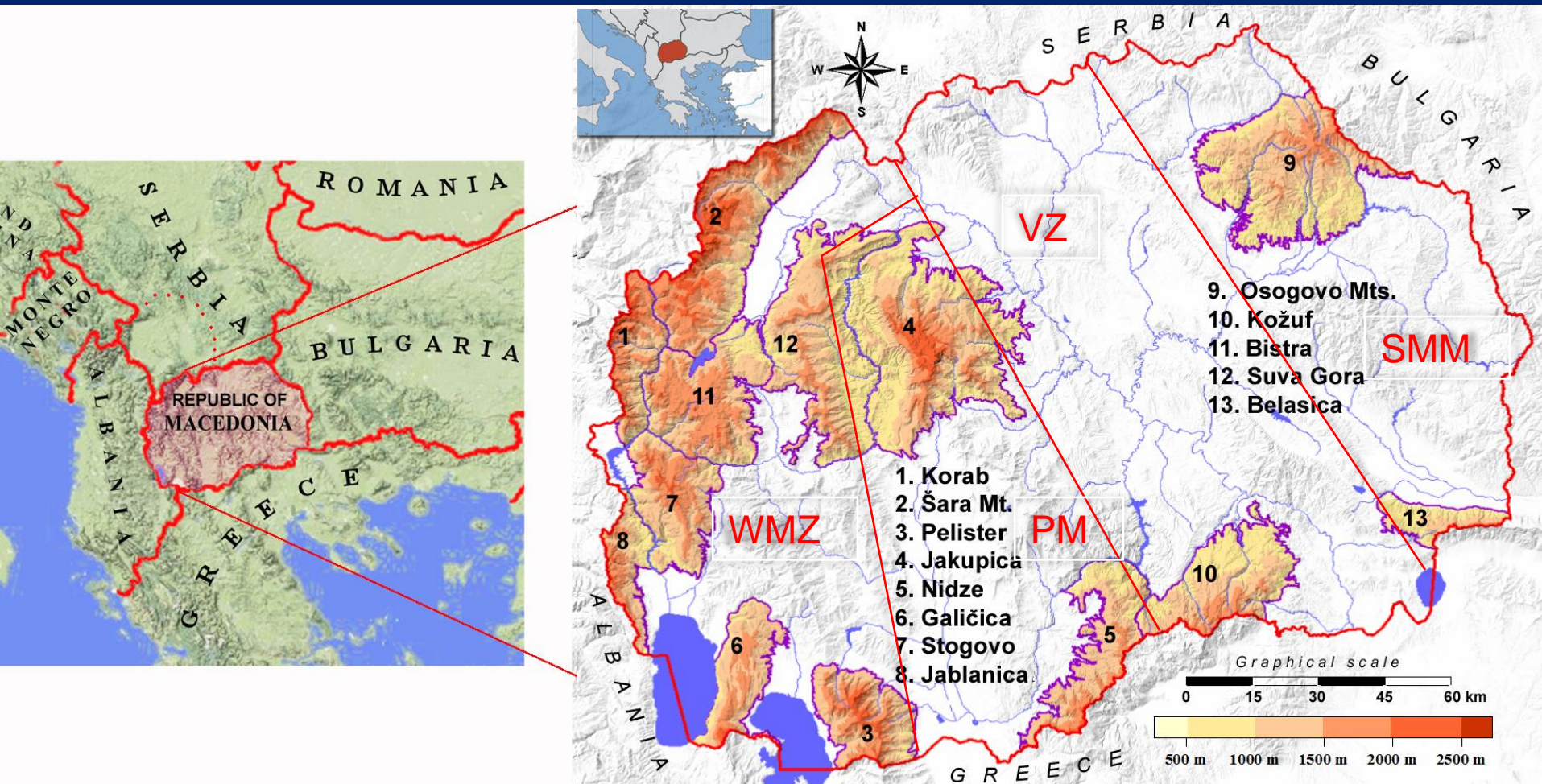


BASIC FACTS ABOUT HIGH MOUNTAINS IN NORTH MACEDONIA

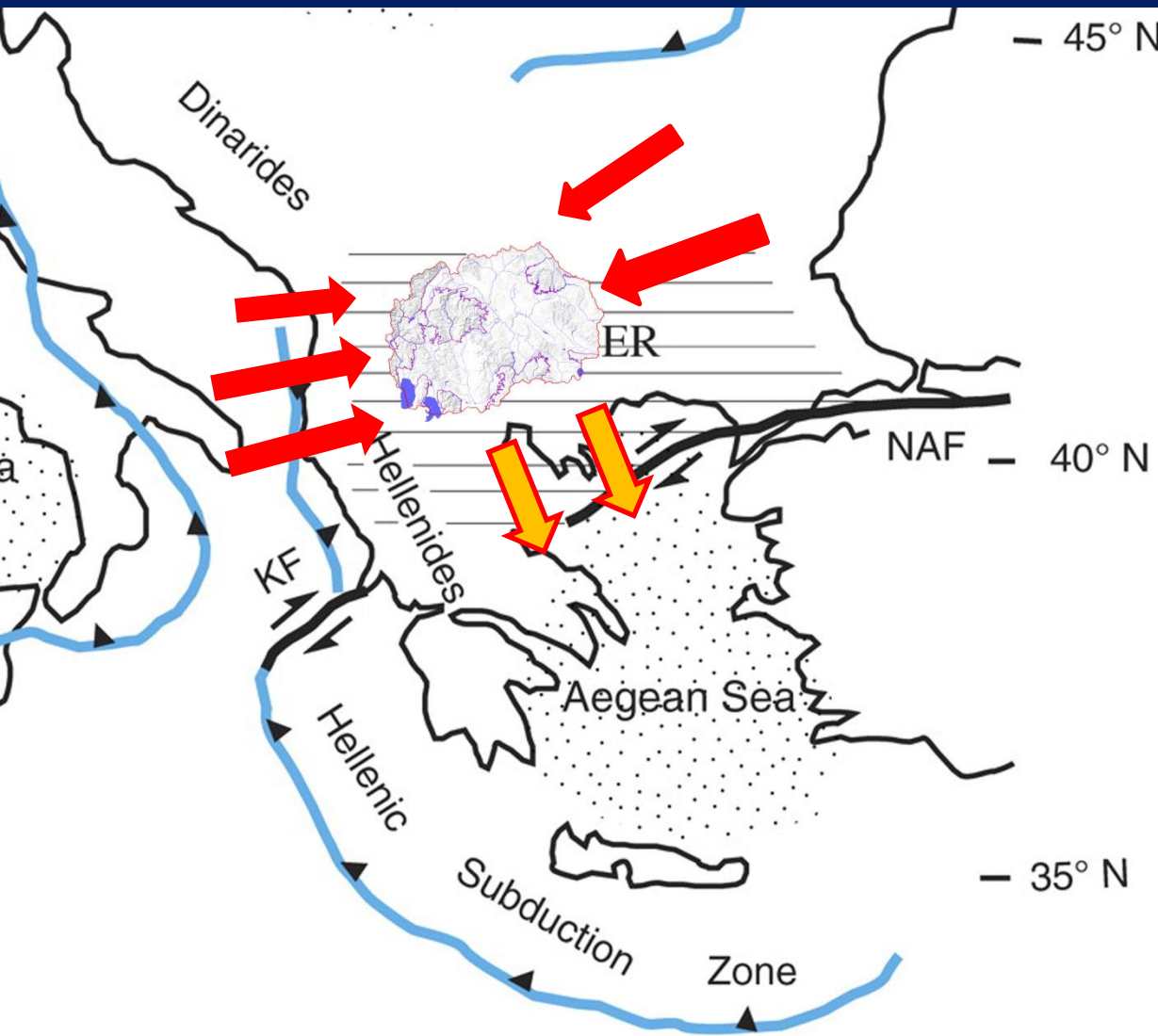
- Nationally, high mountains are defined as a mountains higher than 2000 m.
 - 11 high mountains in west/central part in the country built in schists, marbles and limestones (with karst, glacial, fluvial landscape...).
 - 2 high mountains in the east part of the country built in gneiss, mica-schists, igneous rocks (fluvial, palaeovolcanic, denudation landscape...).
 - On high mountains there are about 200 peaks above 2000 m.
 - Very reach geodiversity: geologic, tectonic, fluvial, karst, periglacial, glacial, coastal, etc.
- 

LOCATION OF HIGH MOUNTAINS IN NORTH MACEDONIA

Mostly in the west and central part of the country. Tectonically in West-Macedonian Zone and in Pelagonian Massif as a substructures of Dinarides-Helenides.

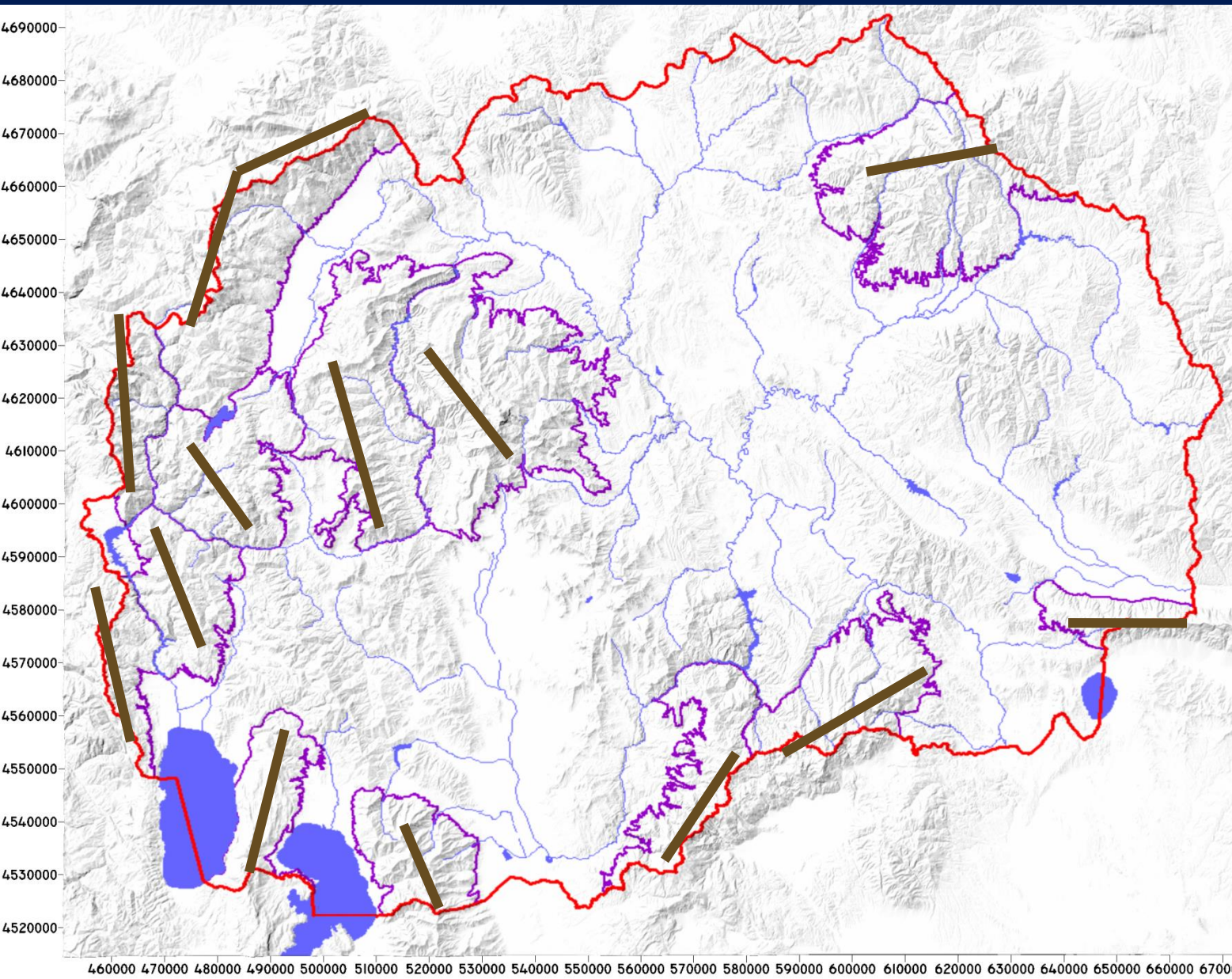


ABOUT HIGH MOUNTAIN GENESIS IN NORTH MACEDONIA



- Paleogene Cretaceous to Oligocene compression in east-west direction.
- Mountain range formation extended in NW-SE direction.
- Neogene and Quaternary north-south extension regime. Depression formation between mountains.

MOUNTAINS DIRECTION



NW-SE
(Dinaric)

E-W
(Exstensional)

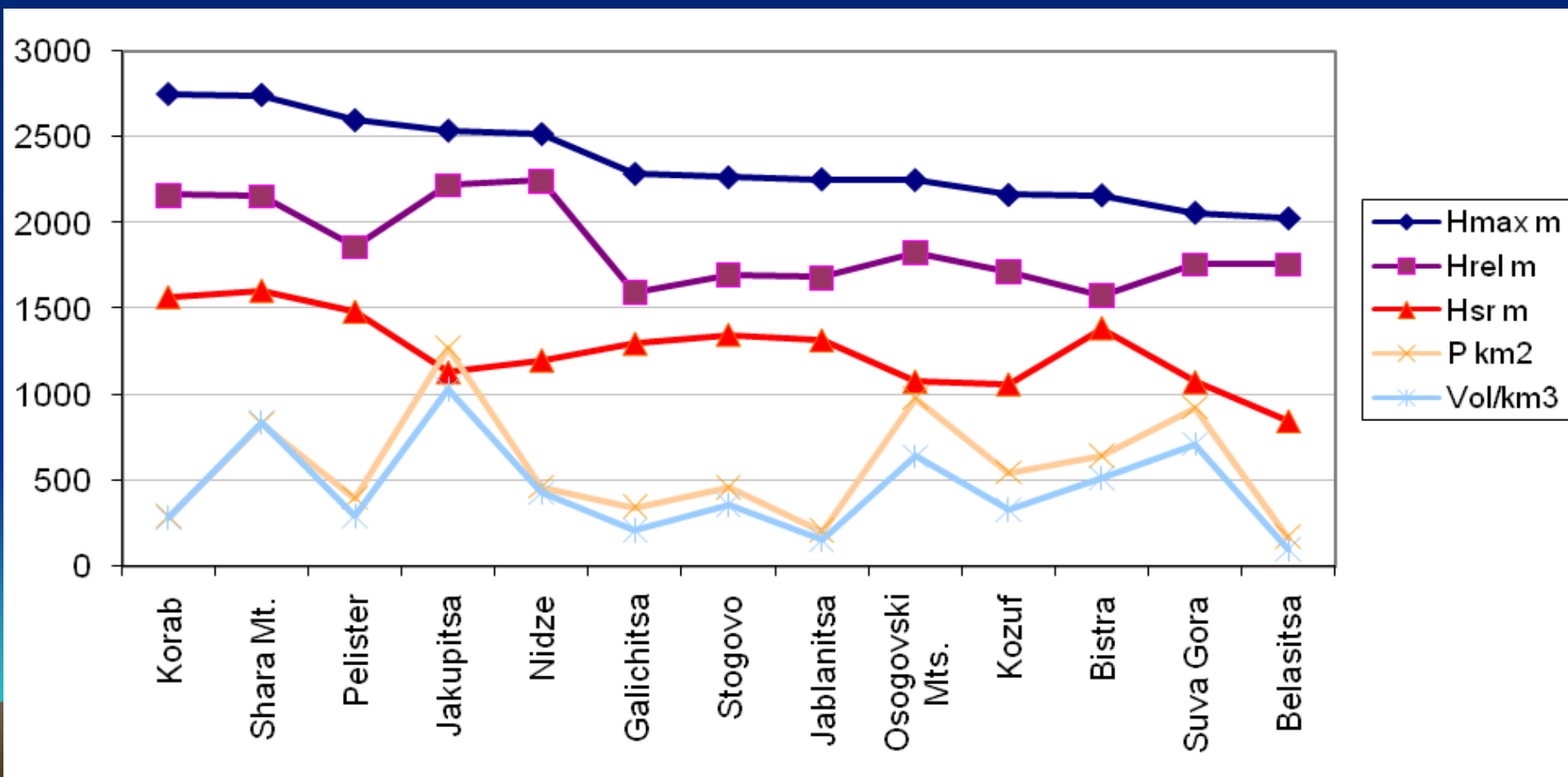
NE-SW
(Proextens.)

MORPHOMETRY OF THE HIGH MOUNTAINS IN NORTH MACEDONIA

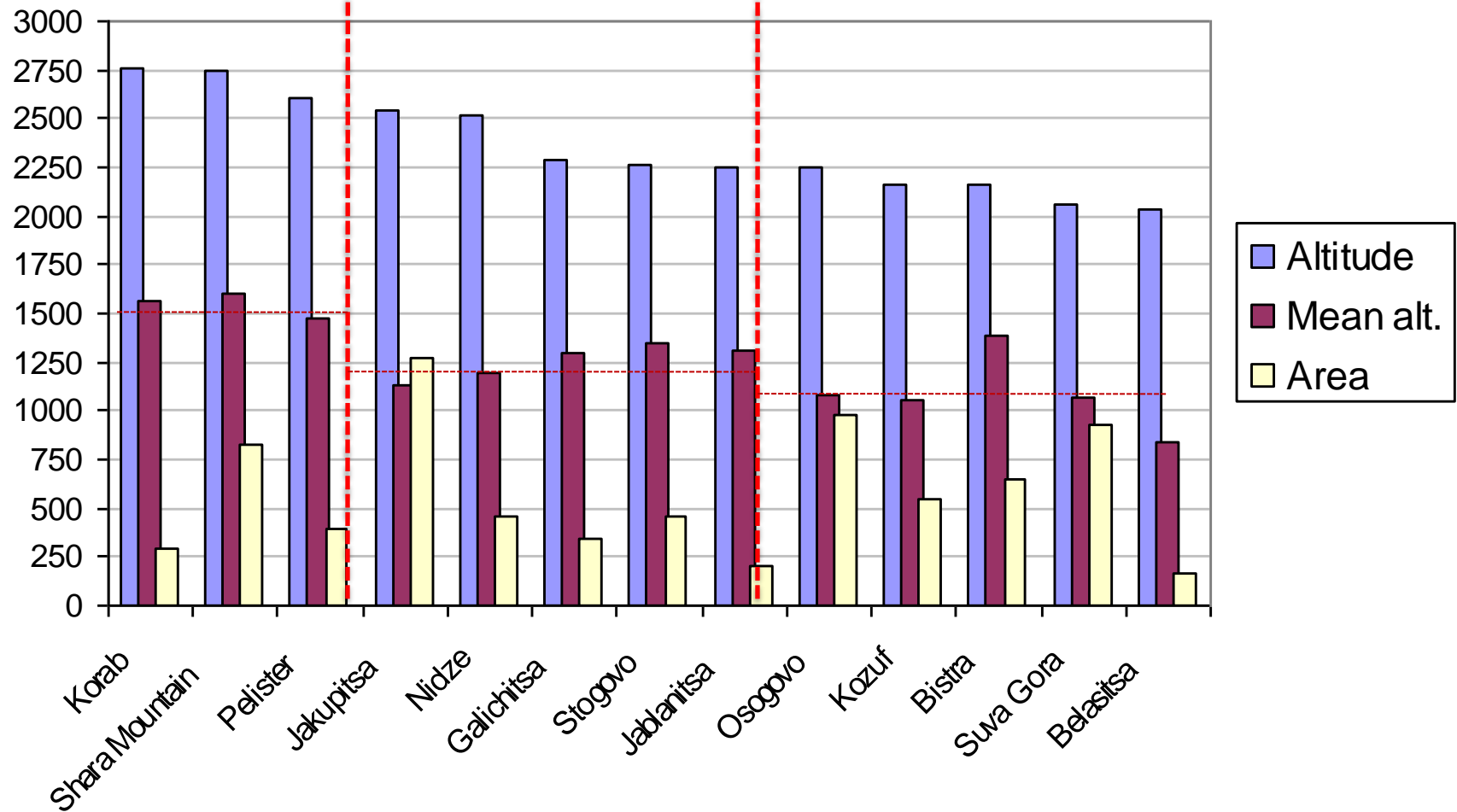
- 6 major morphometric parameters has analyzed:
 - Hypsometry;
 - Slope angle;
 - Length of slope (LS);
 - Slope curvature (planar and profile);
 - Aspects;
 - Vertical relief (terrain relief).

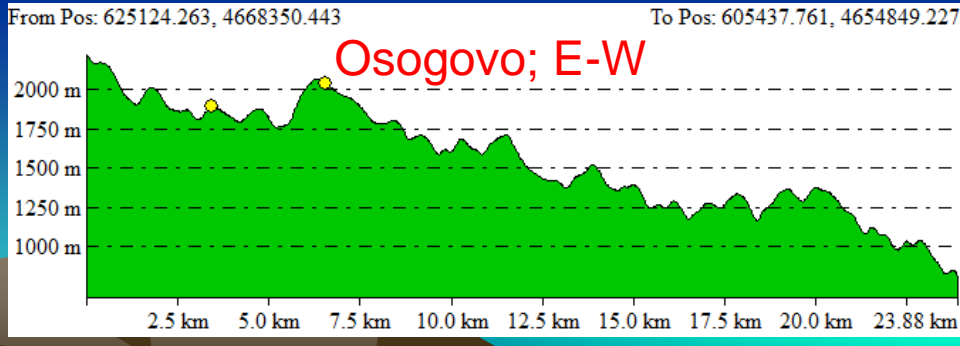
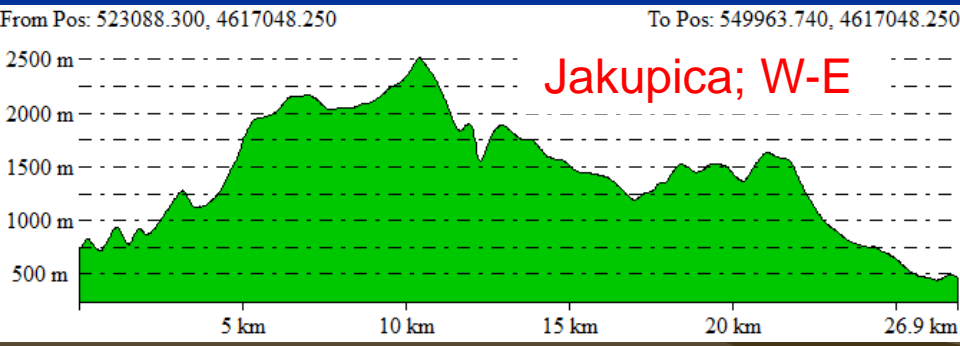
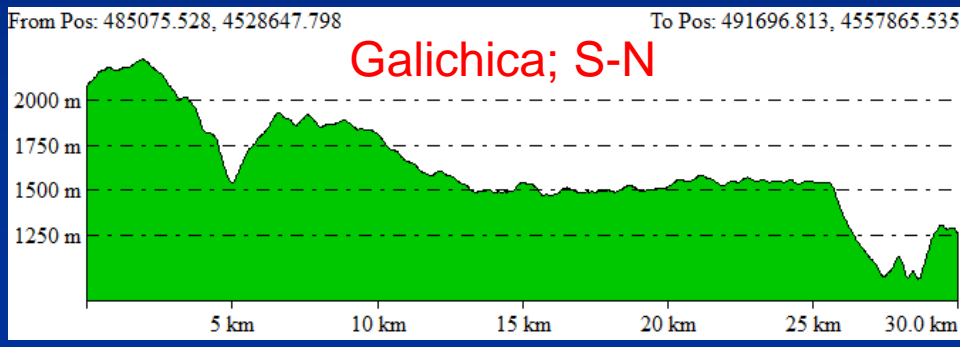
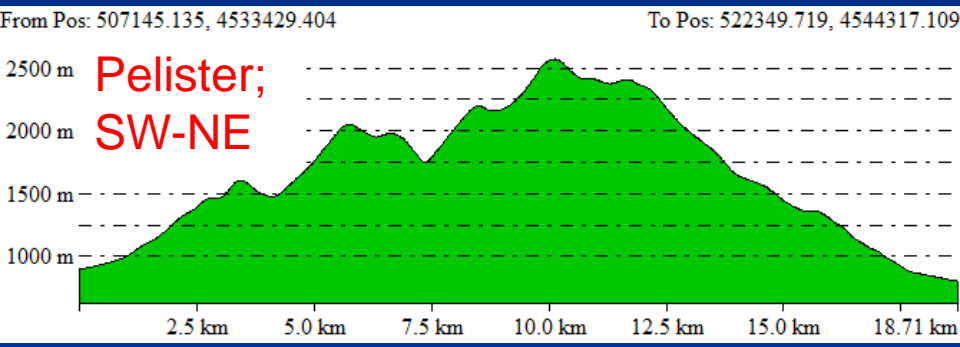
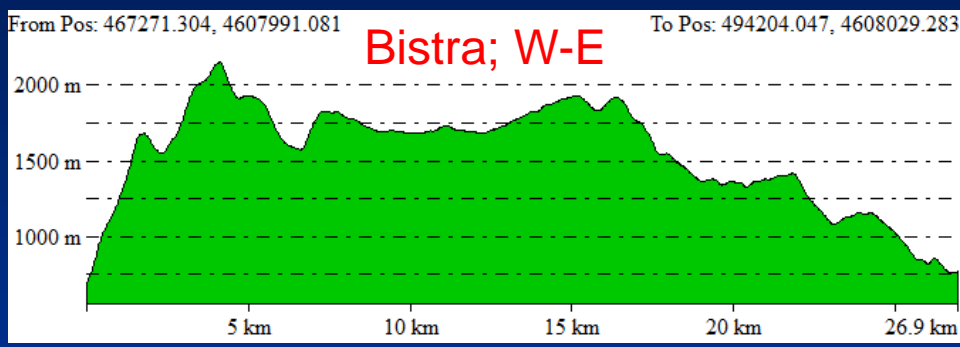
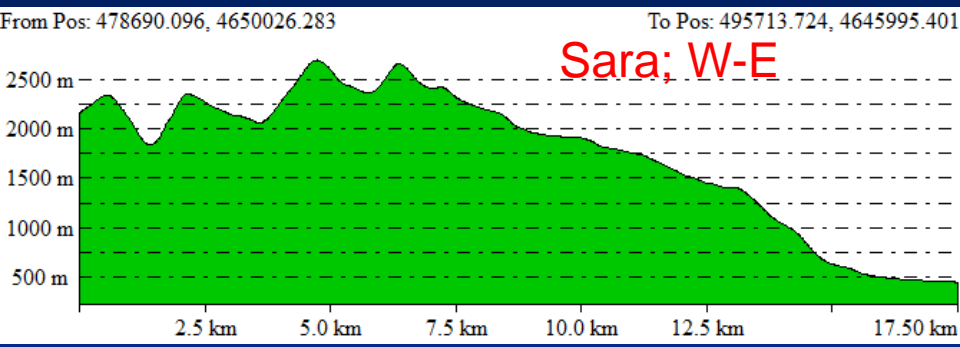
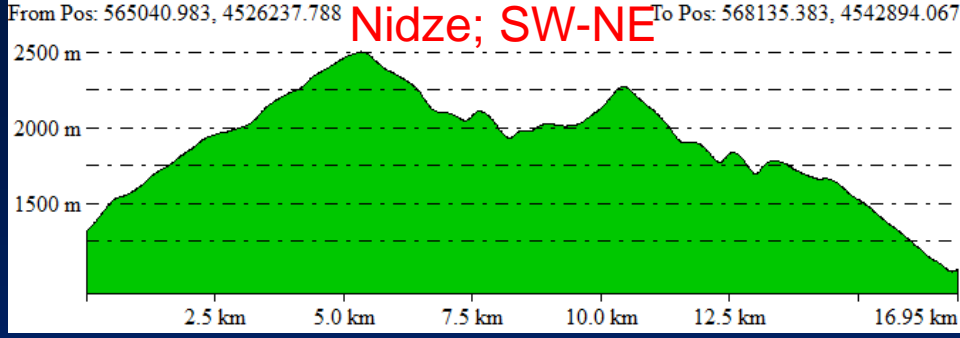
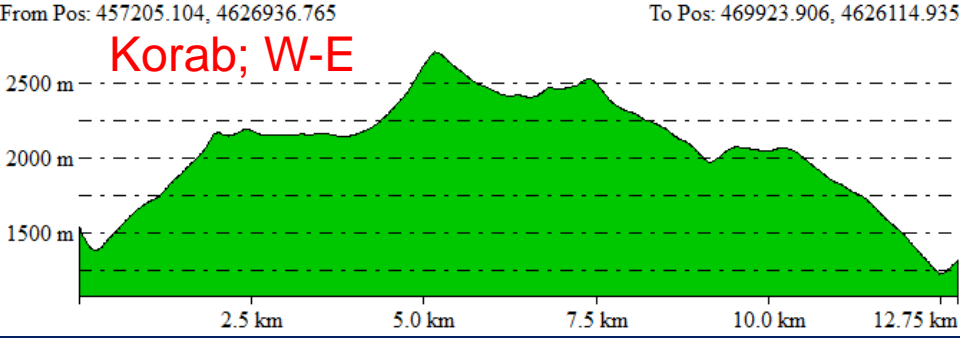


BASIC MORPHOMETRIC PARAMETERS FOR THE HIGH MOUNTAINS IN NORTH MACEDONIA: HYPSONOMETRY, AREA AND VOLUME



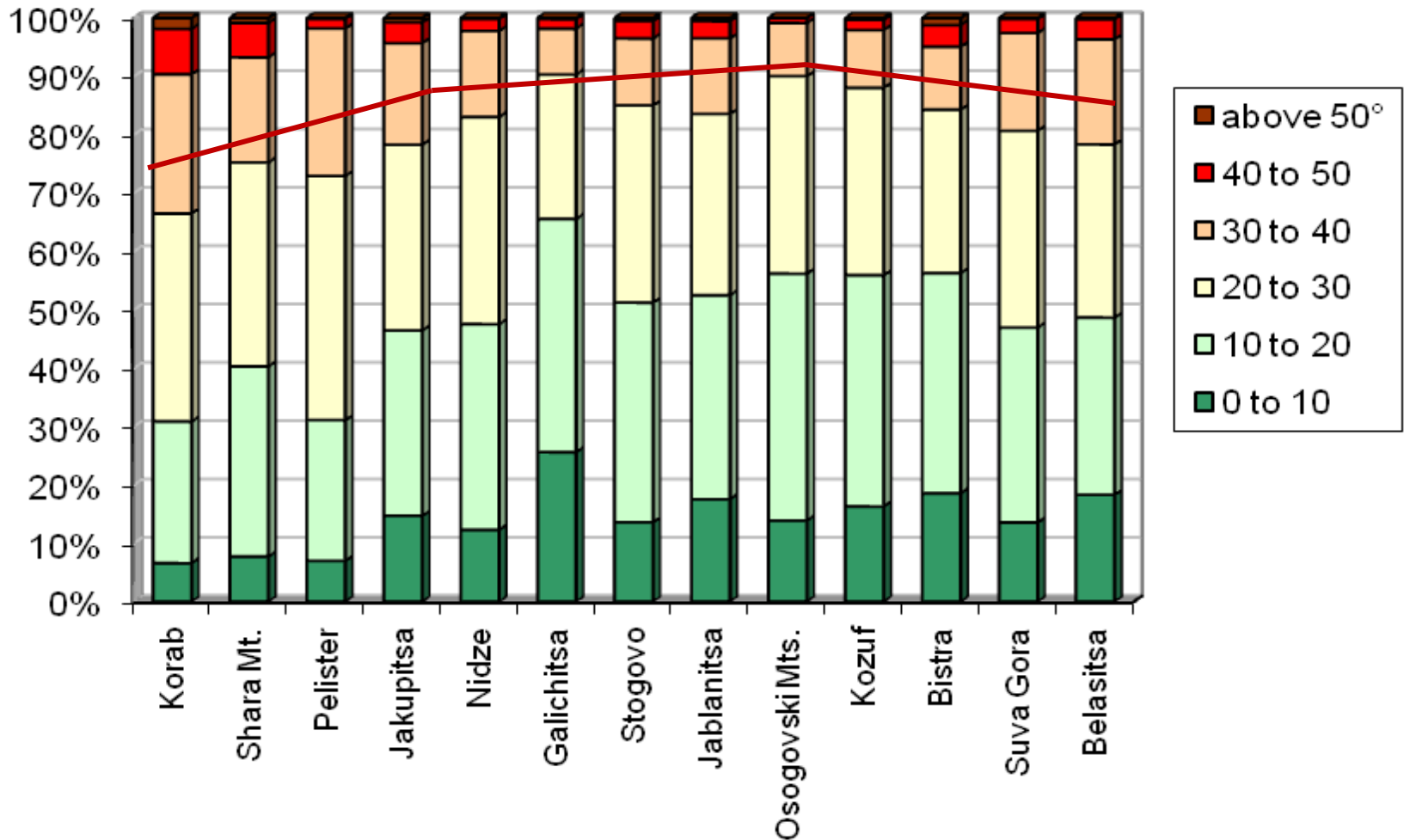
MAXIMAL, MEAN ALTITUDE AND AREA OF THE HIGH MOUNTAINS



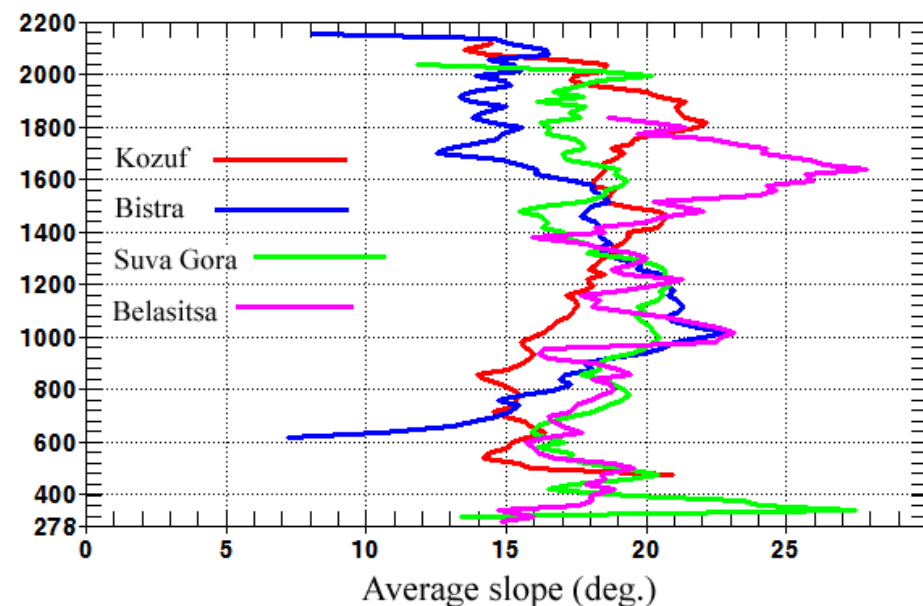
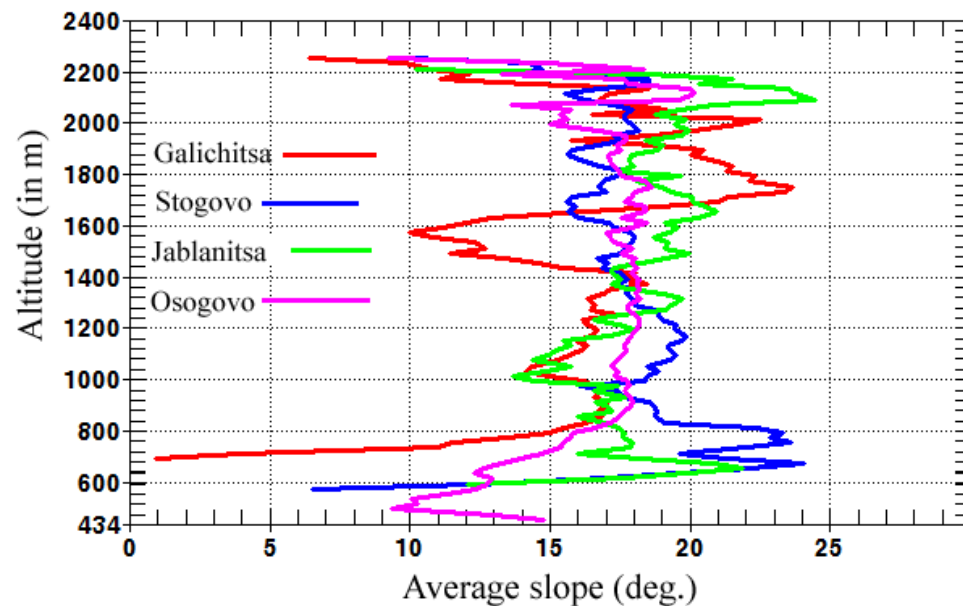
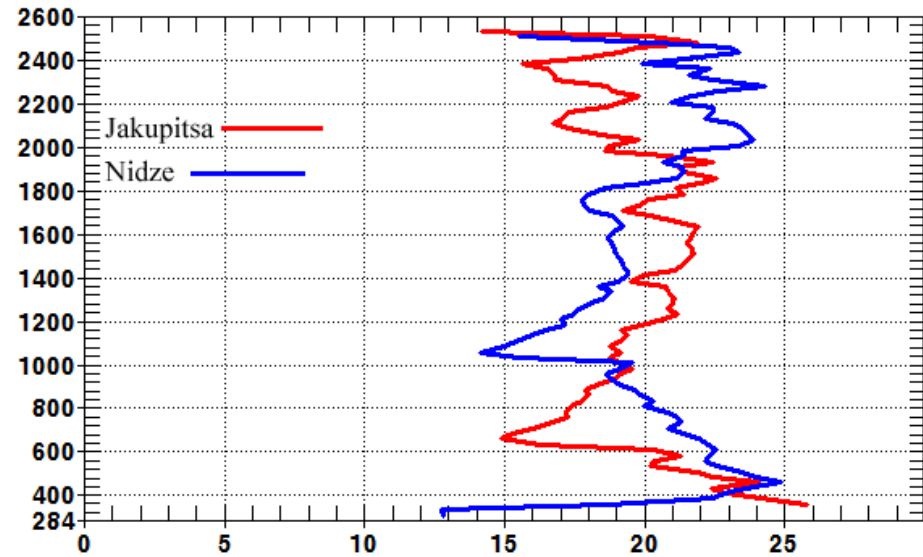
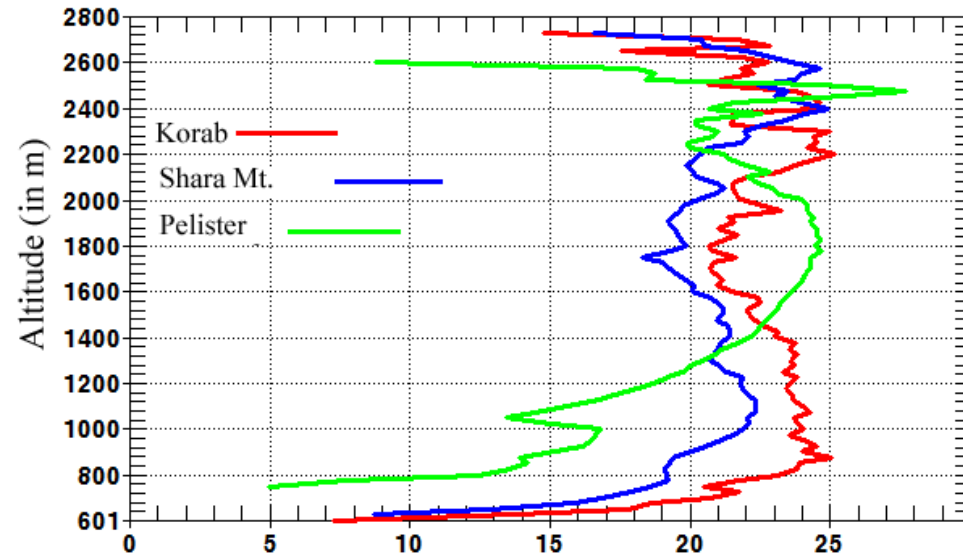


MOUNTAINS SLOPES

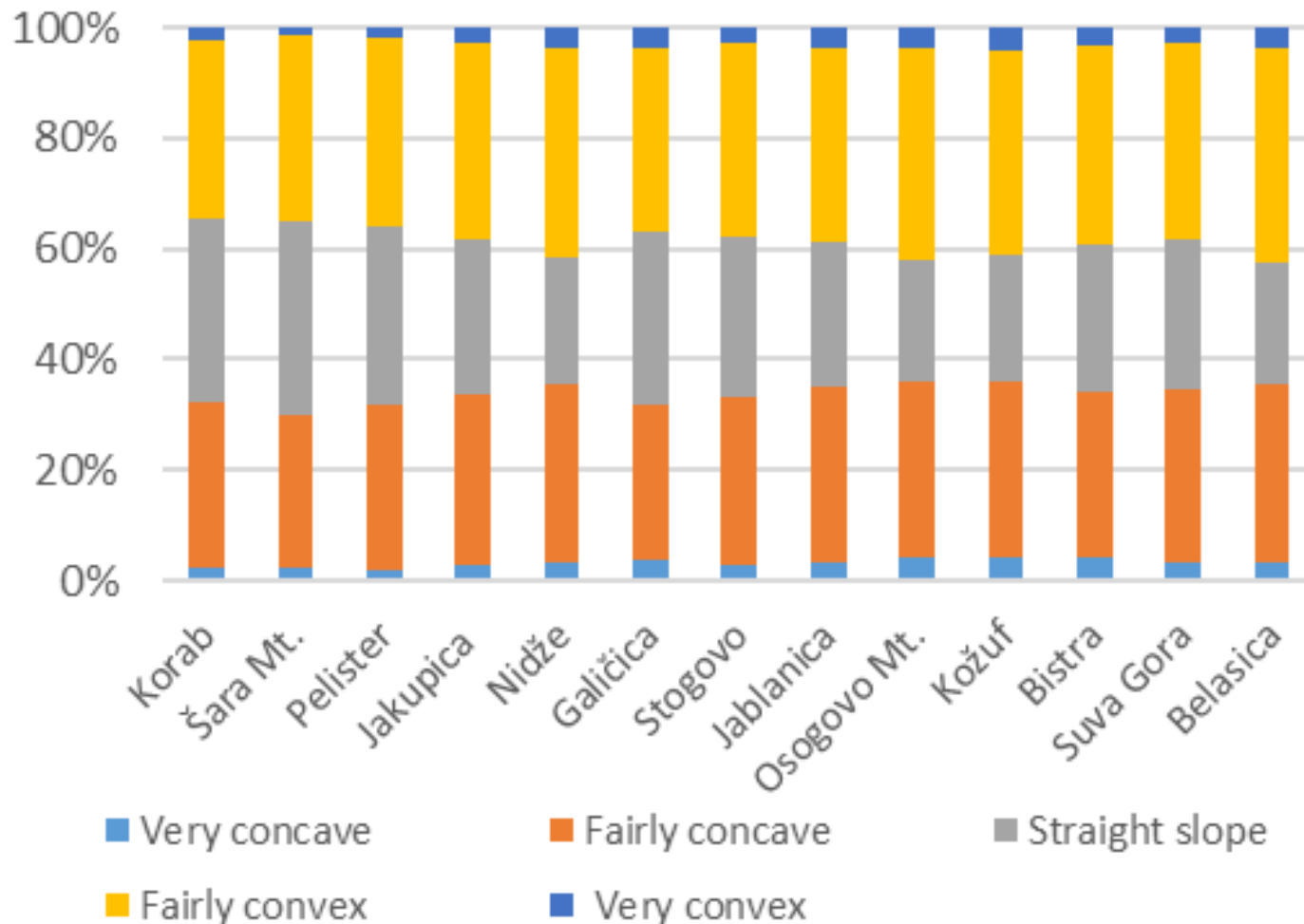
Average value: 20.9°



SLOPE WITH ALTITUDE

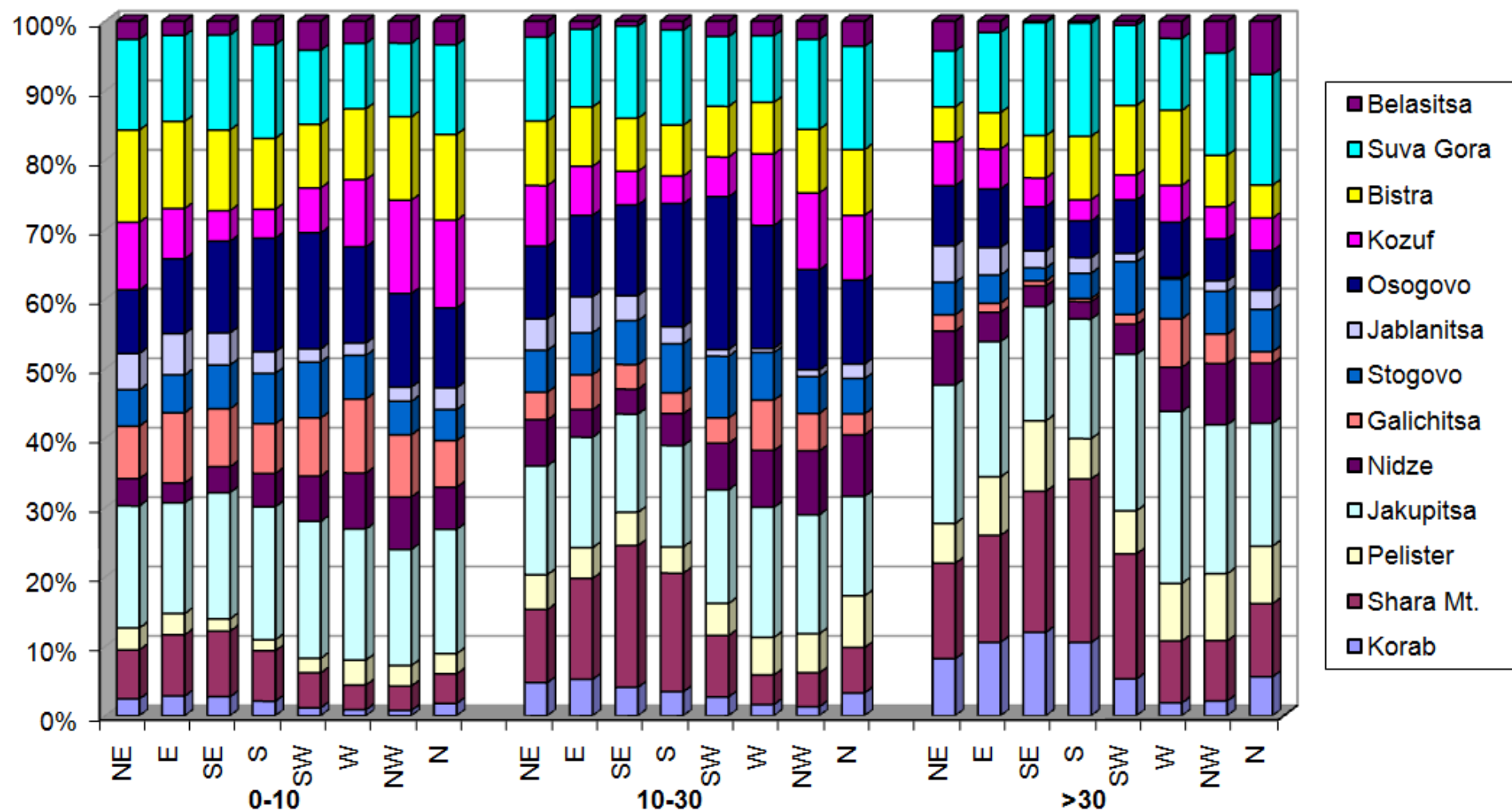


TERRAIN CURVATURE (CONVERGENCE INDEX) CLASSES OF THE HIGH MOUNTAINS IN NORTH MACEDONIA

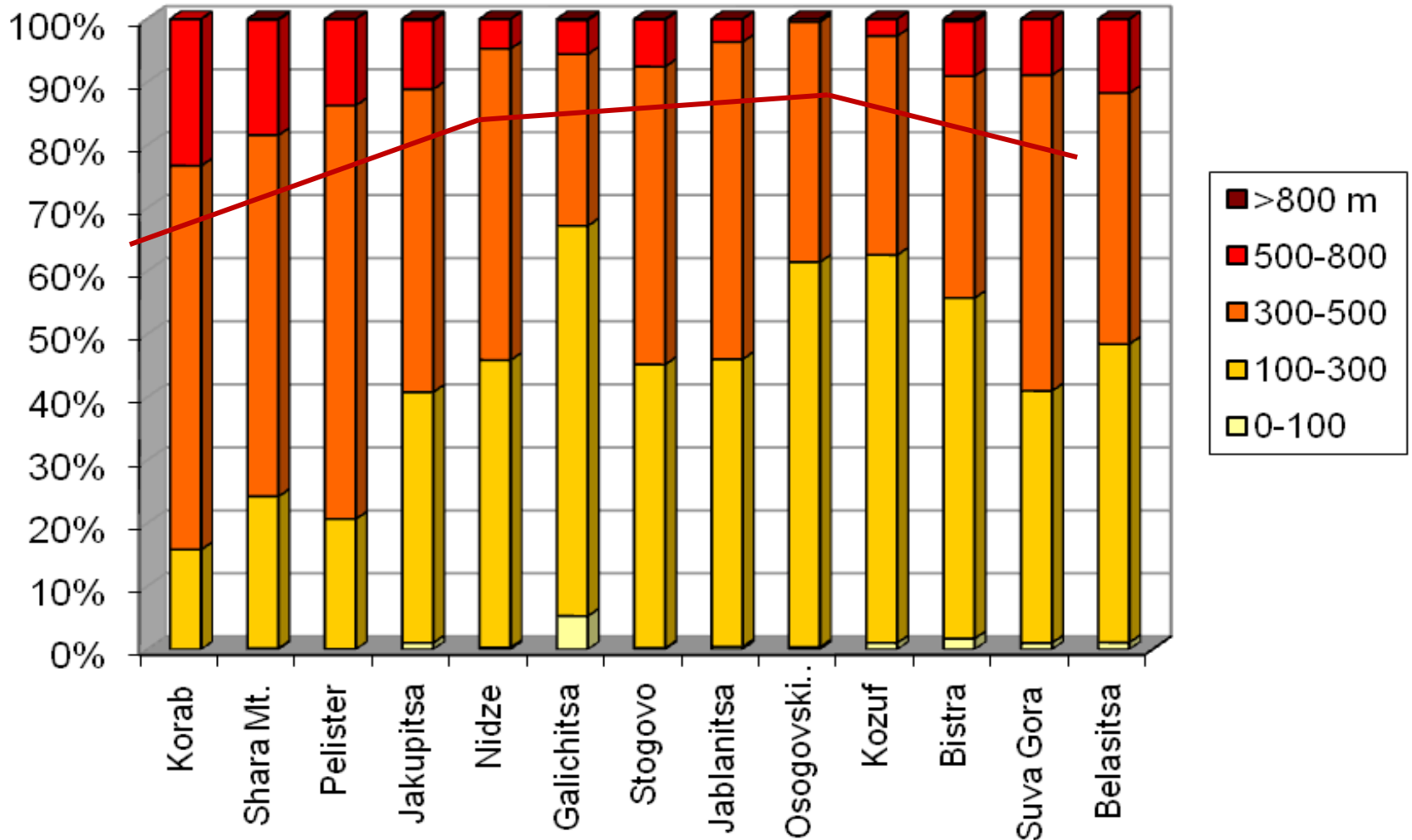


MOUNTAIN ASPECTS

Very different, but generally east-west aspects dominate on the mountains in the western part of the country (Dinaric) and north-south slopes on the mountains in the east part (Pre-Balkanic).



VERTICAL TERRAIN RELIEF IN M/KM²

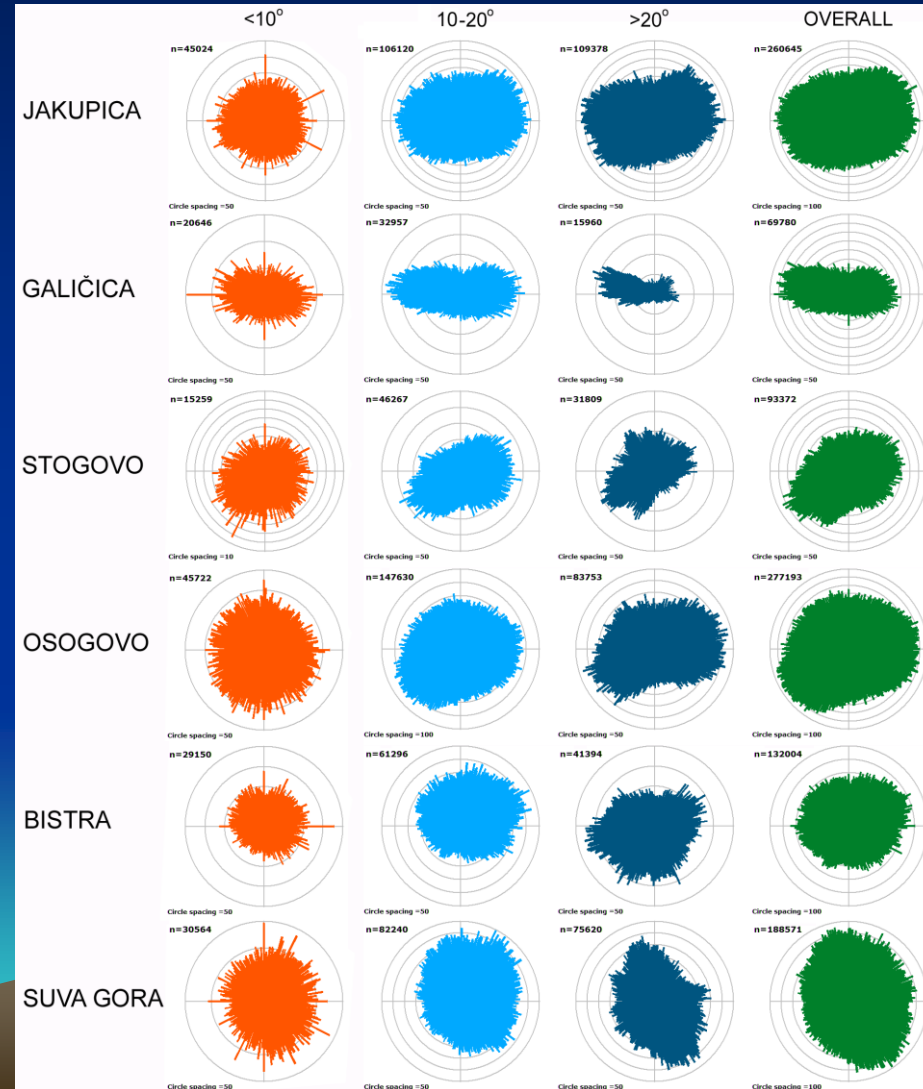


MORPHOMETRIC CLASSIFICATION ACCORDING TO THE HYPSONOMETRY, SLOPES, TERRAIN RELIEF AND VOLUME INDEX

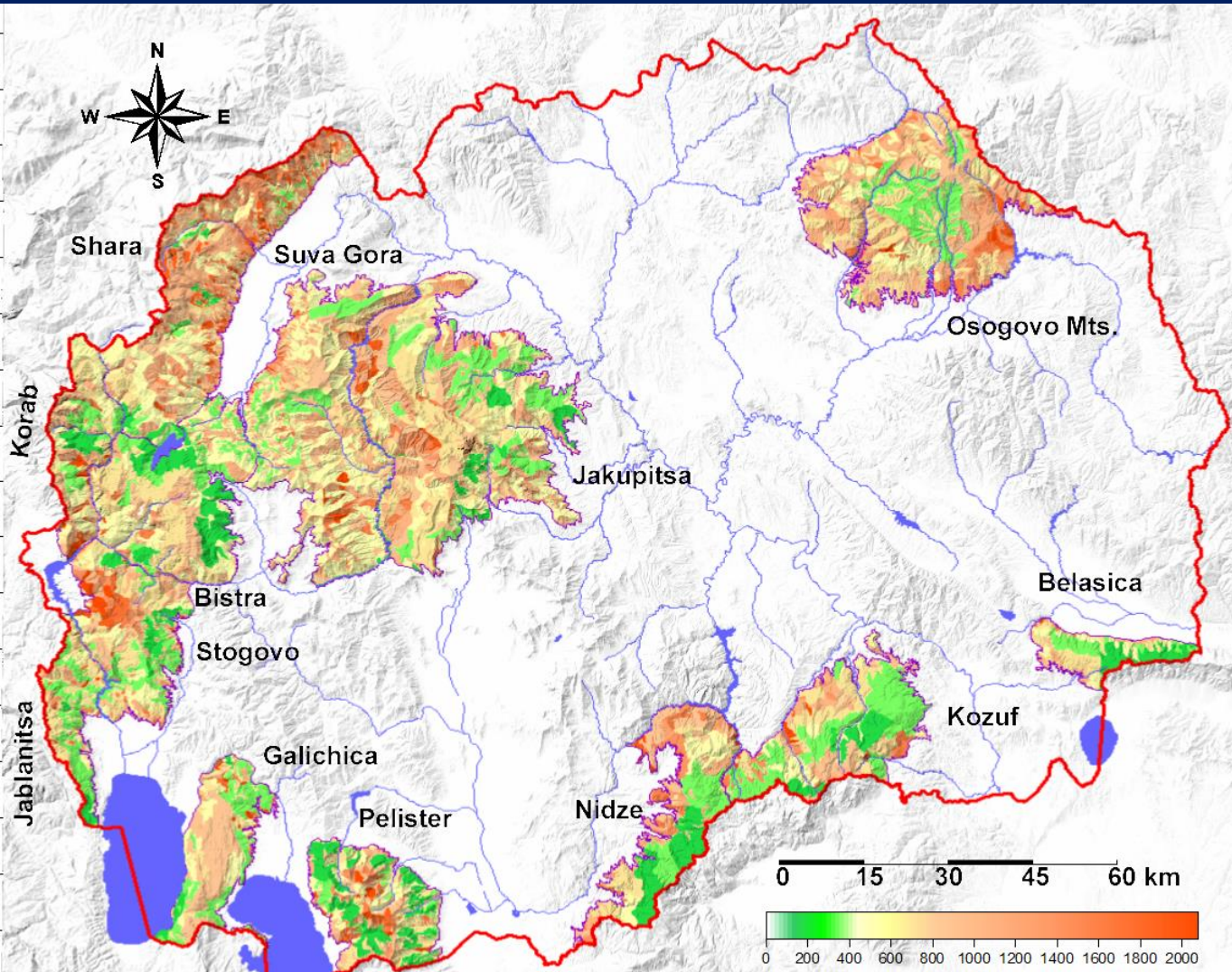
-cluster classification-

Class	Mountain	Hmax m	Hsr m	Slope°	TR m/km ²	iV/P
I	Korab	2753	1564,9	25,8	415,8	0,98
I	Sara Mountain	2748	1602,7	23,5	390,0	1,01
I	Pelister	2601	1480,3	24,1	386,8	0,74
II	Jakupica	2540	1127,2	21,6	340,9	0,81
II	Nidže	2520	1197,3	20,4	316,4	0,93
III	Galičica	2288	1294,3	17,0	269,7	0,60
II	Stogovo	2268	1345,8	20,4	327,2	0,78
II	Jablanica	2256	1314,2	20,0	315,4	0,74
III	Osogovo	2252	1074,8	19,1	278,5	0,65
III	Kožuf	2165	1058,5	19,2	282,4	0,61
III	Bistra	2163	1384,9	19,7	306,8	0,80
II	Suva Gora	2061	1070,7	21,1	333,0	0,77
II	Belasica*	2029	843,6	20,9	322,0	0,57

Aspects vs slopes for selected high mountains in North Macedonia



MORPHOMETRY AND EROSION INTENSITY



Below 1000 m,
790 m³/km²/y

Above 1000 m,
650 m³/km²/y


S sides, 840 m³/km²/y

N sides, 625 m³/km²/y

Under 10 degree, 590
m³/km²/y

From 20-40 degree,
910 m³/km²/y

CONCLUSION

- According to the analyzed parameters, the high mountains in North Macedonia in morphometric terms can be separated into three groups:
 - ✓ First group of very high, steep slope mountains: Korab, Šar Planina and Pelister,
 - ✓ Second group of moderate altitude, slope and relief: Jakupica*, Nidze, Stogovo, Jablanica, Suva Gora and Belasica;
 - ✓ Third group, lower, gentle sloped with large planation surfaces: Galichica, Osogovo, Kozuf and Bistra.
 - Morphometry and morphometric classification is close connected with morphostructural shape, genesis and evolution stage.
 - Morphometric type is changeable with time.
- 

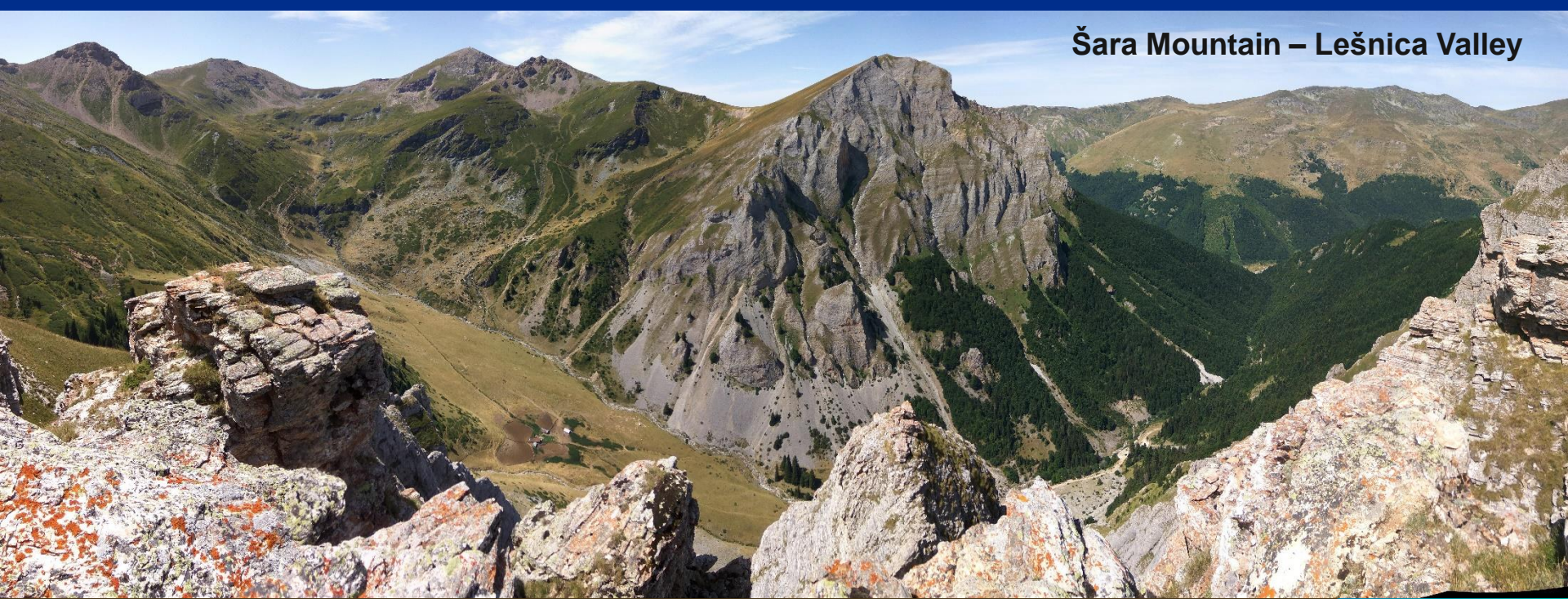
Korab Mountain-east slope



Korab Mountain-south ridge



Šara Mountain – Lešnica Valley



Jakupica-north side



Jakupica-south side



Pelister (Baba) Mt. -the peak



Pelister (Baba) Mt. - south part





Stogovo-highest ridge



Jablanica-Vevčani Lake



Osogovo-highest ridge



Bistra-west side



**THANK YOU FOR THE
ATTENTION!**

