

# Morphometric analysis of ice-wedge polygonal networks Adventdalen, Svalbard.

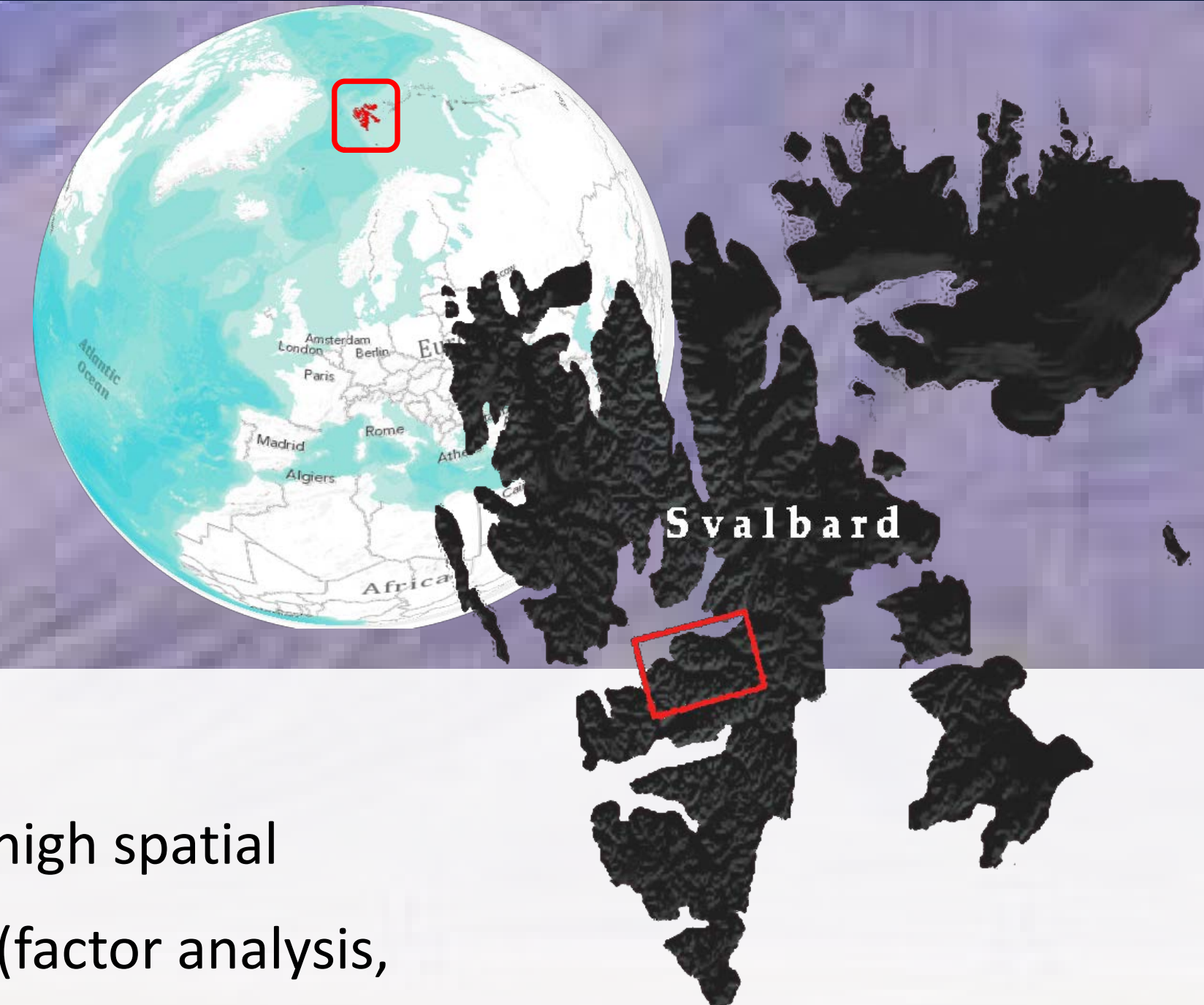


Miguel Cardoso <sup>(1,3)</sup>, Maura Lousada <sup>(2,3)</sup>, Gonçalo Vieira <sup>(1)</sup>, Pedro Pina <sup>(2)</sup>, Hanne H. Christiansen <sup>(3,4)</sup>

<sup>(1)</sup> Centro de Estudos Geográficos - IGOT, Universidade de Lisboa, Portugal, <sup>(2)</sup> Cerena/IST, Lisboa, Portugal, <sup>(3)</sup> UNIS, Longyearbyen, Norway, <sup>(4)</sup> CENPERM, Department of Geosciences and Natural Resource Management, University of Copenhagen, Denmark

## INTRODUCTION AND OBJECTIVES

Permafrost gives rise to a number of unique and complex landforms. Ice-wedge polygons are the most widespread, most visible, and most characteristic landform of lowland permafrost terrain formed by frost cracking and crack infill either by meltwater refreezing or by sands. The aim of this study is to understand if the environmental factors influences the dimensional variability of ice-wedge polygons in polygonal networks of the Adventdalen valley in Svalbard.

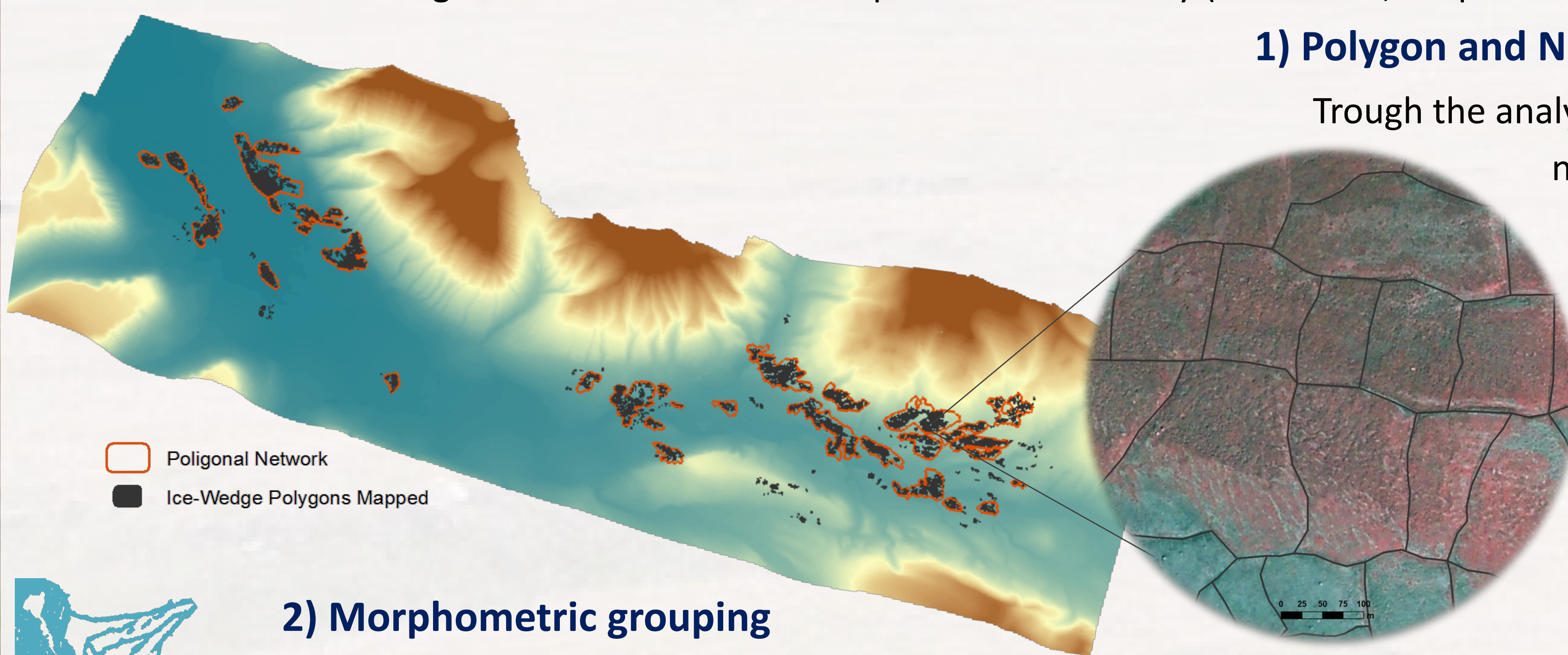


## METHODS:

Morphometric parameters of the polygonal network were calculated for more than 10,000 polygons identified in very-high spatial resolution remotely sensed images (four-bands RGB+NIR with 0.2 m/pixel of spatial resolution). Multivariate statistics (factor analysis, hierarchical classification and discriminant analysis) were used to describe the polygon's morphometric parameters, and to determine their relationship to local environmental controlling factors. Based on the morphometric similarity (dimension, shape and topology) 6 major groups of polygons were identified.

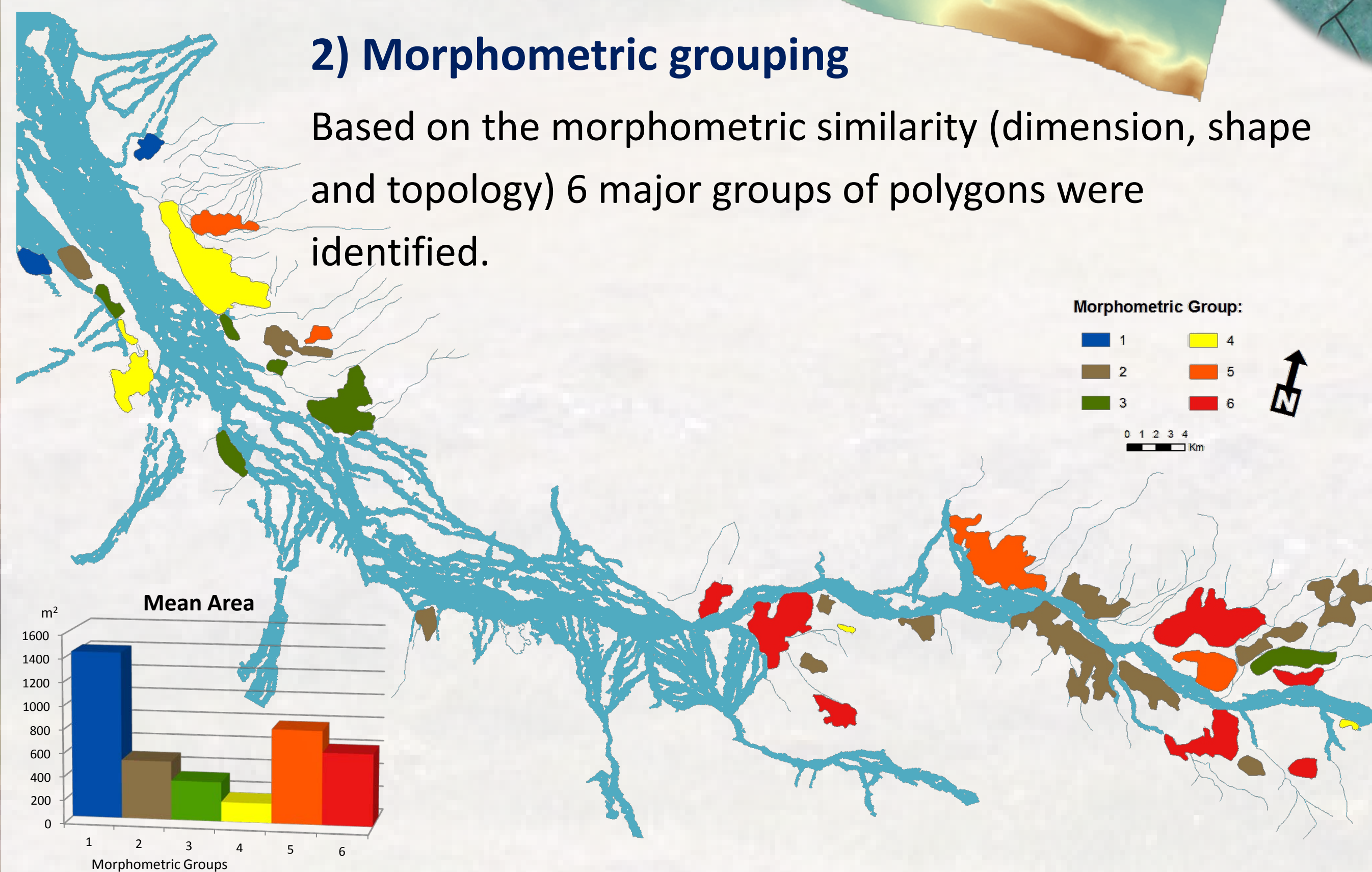
### 1) Polygon and Network Mapping

Trough the analysis of VHSRSI 10,000 polygons were mapped resulting 36 polygonal networks. Morphometric parameters were calculated for each of the polygons.



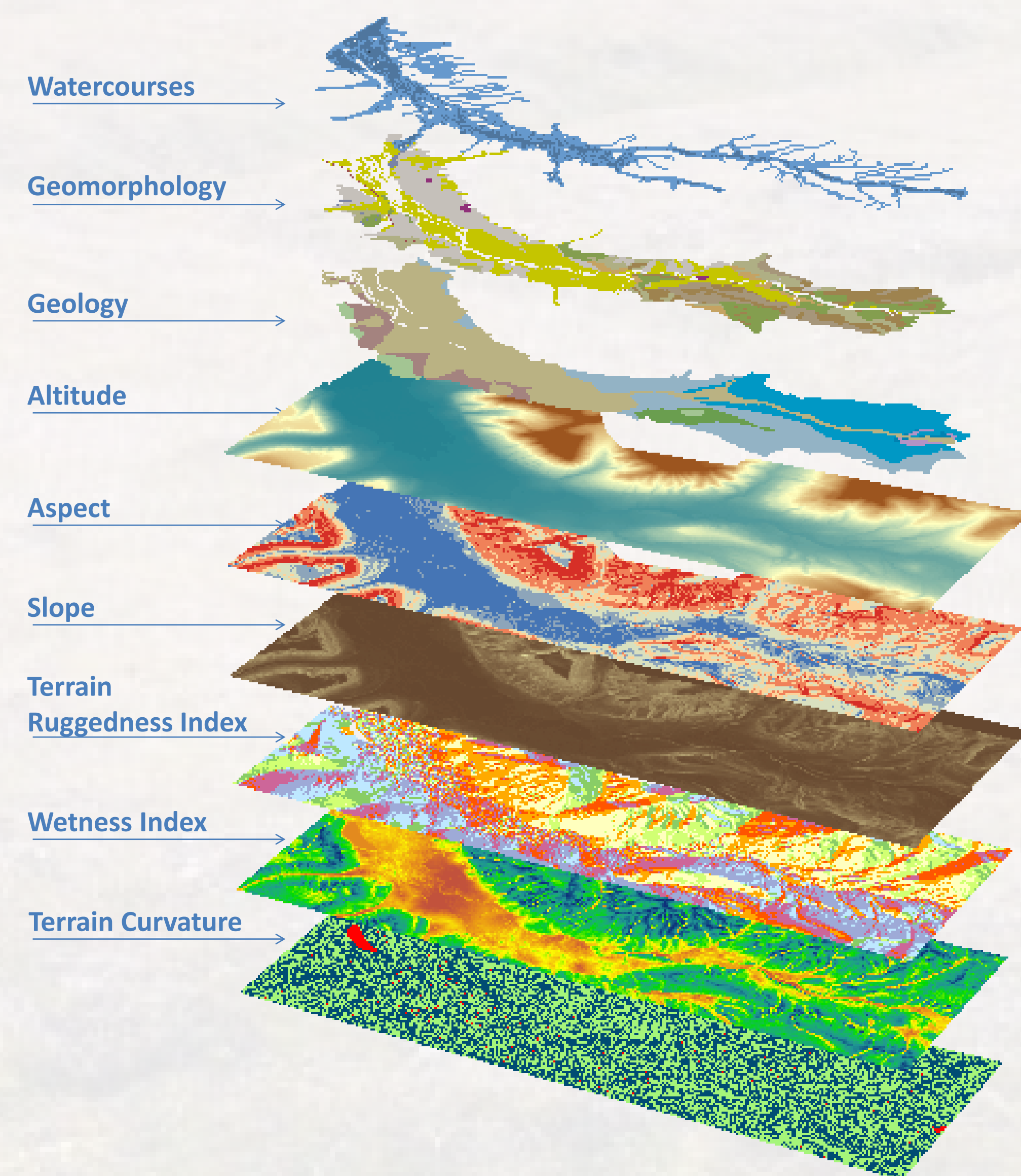
### 2) Morphometric grouping

Based on the morphometric similarity (dimension, shape and topology) 6 major groups of polygons were identified.



### 3) Environmental variables

In order to determine the relationship for each morphometric group and their polygons local environmental controlling factors where calculated by means of digitization of thematic cartography based on raster images and extraction of alphanumeric information matrix-based.

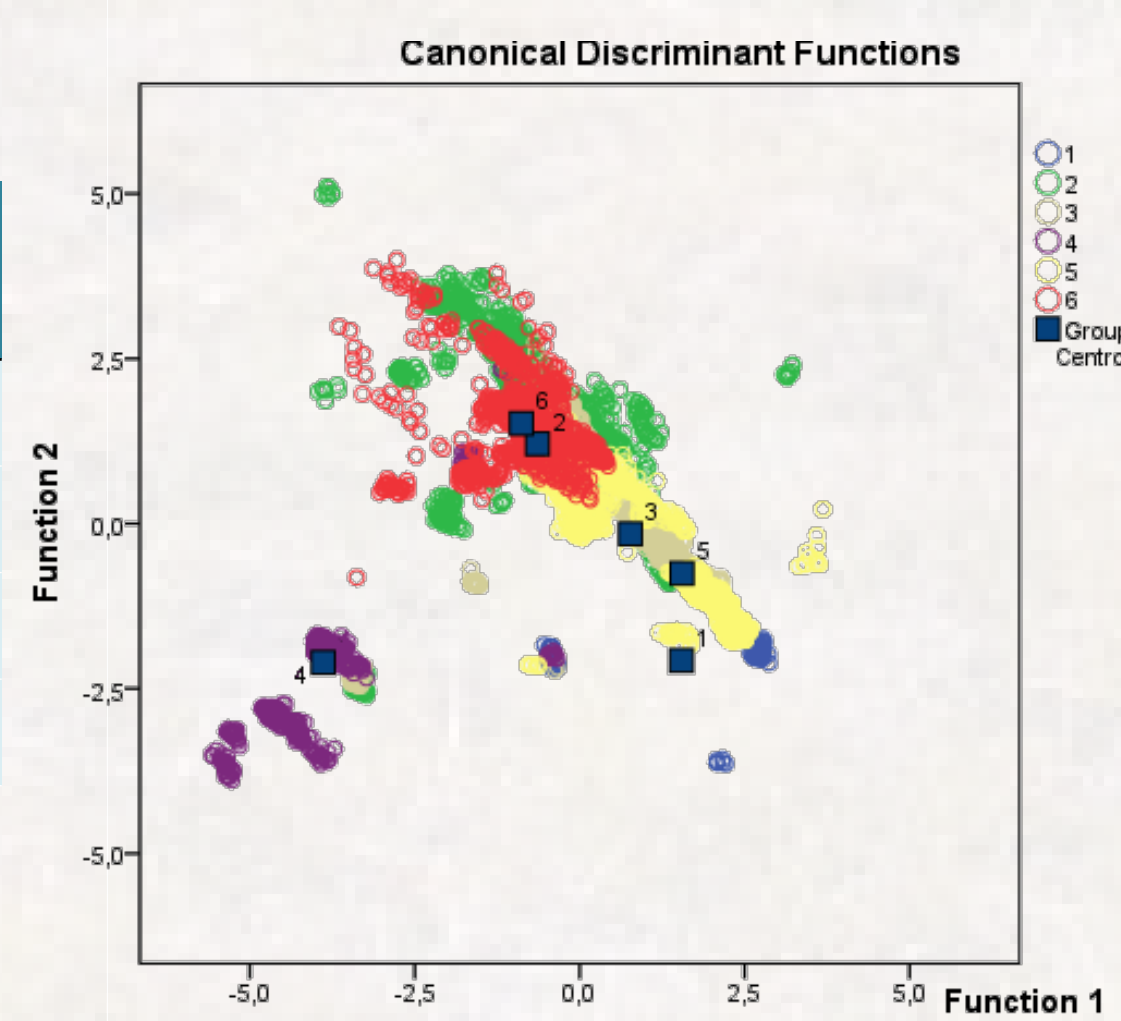


## RESULTS:

Discriminant Function	Eigen values	%	Standardized Canonical Discriminant Function Coefficients					
			Discriminant variables	Function 1	Function 2	Function 3	Function 4	Function 5
1	2,62	52,8	Geology: Agardhfjellet Formation	1,957	2,135	1,30	0,16	0,256
2	1,34	27,1	Geology: Fluvial and glaciifluvial deposits	0,207	1,924	3,864	0,773	-0,447
3	0,54	10,9	Distance to shore line	-0,957	0,952	3,755	-0,809	0,518
4	0,31	3,4	Geomorphology: Fluvial material, pre-recent	1,706	0,706	-0,181	-0,989	1,893
5	0,14	2,9						

Morphometric Groups	Predicted Groups						Total
	1	2	3	4	5	6	
1	90 (97,8%)	0	0	0	2 (2,2%)	0	92
2	0	1227 (60,5%)	156 (7,7%)	0	247 (12,2%)	398 (19,6%)	2028
3	0	45 (2,5%)	1529 (84,9%)	90 (5,0%)	93 (5,2%)	45 (2,5%)	1802
4	0	15 (1,6%)	0	817 (89,5%)	0	81 (8,9%)	913
5	0	102 (3,5%)	69 (2,3%)	0	2705 (91,5%)	79 (2,7%)	2955
6	0	84 (5,9%)	28 (2,0%)	0	0	1319 (92,2%)	1431

Correctly classified 83.4% of the original groups



## CONCLUSIONS:

- The spatial distribution of the 6 morphometric groups highlights a general morphometric zoning from west to east. The groups located in the western part of the valley have a greater asymmetry in polygon size, while in eastern areas a more uniform distribution of the mean polygon area and greater overall polygon sizes were found.
- This spatial zoning suggests a spatial control on polygon morphometry, probably controlled by geo-ecological variables, which may affect the growth and shape of polygons. Results from discriminant analysis show that geo-ecological factors contribute to successfully classifying 83,4% of the polygons within the 6 major morphometric groups. The most discriminant variables are the geological units Agardhfjellet Formation and Fluvial and glaciifluvial deposits, the geomorphological unit Fluvial material, pre-recent and the distance to the shore line.