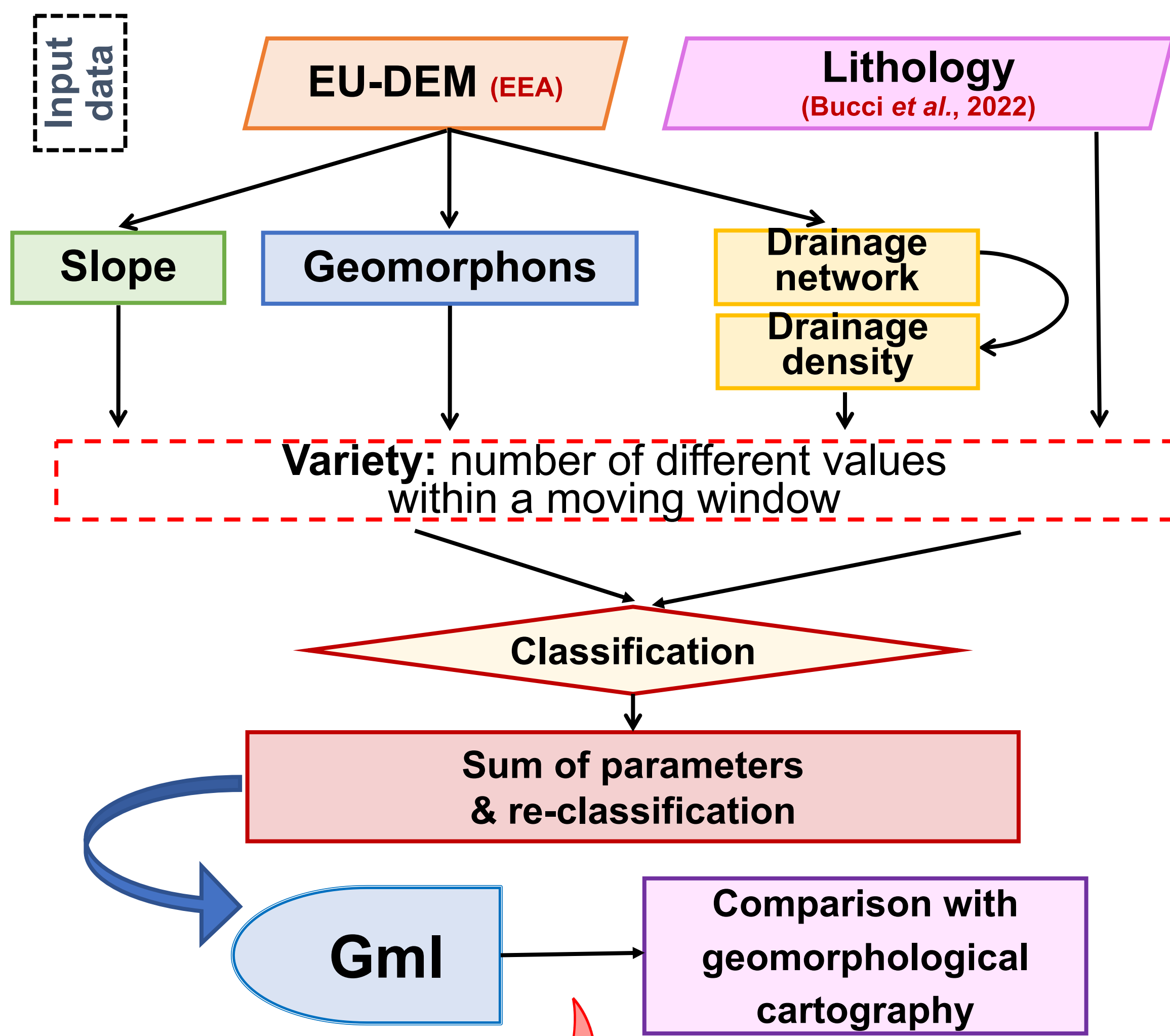


Quantitative methods to define the **geomorphodiversity**, the variety of landforms and surface features in a given area, are a promising approach in order to obtain an objective and reproducible working method, adopted by several scholars in a few different variants [1], [2]

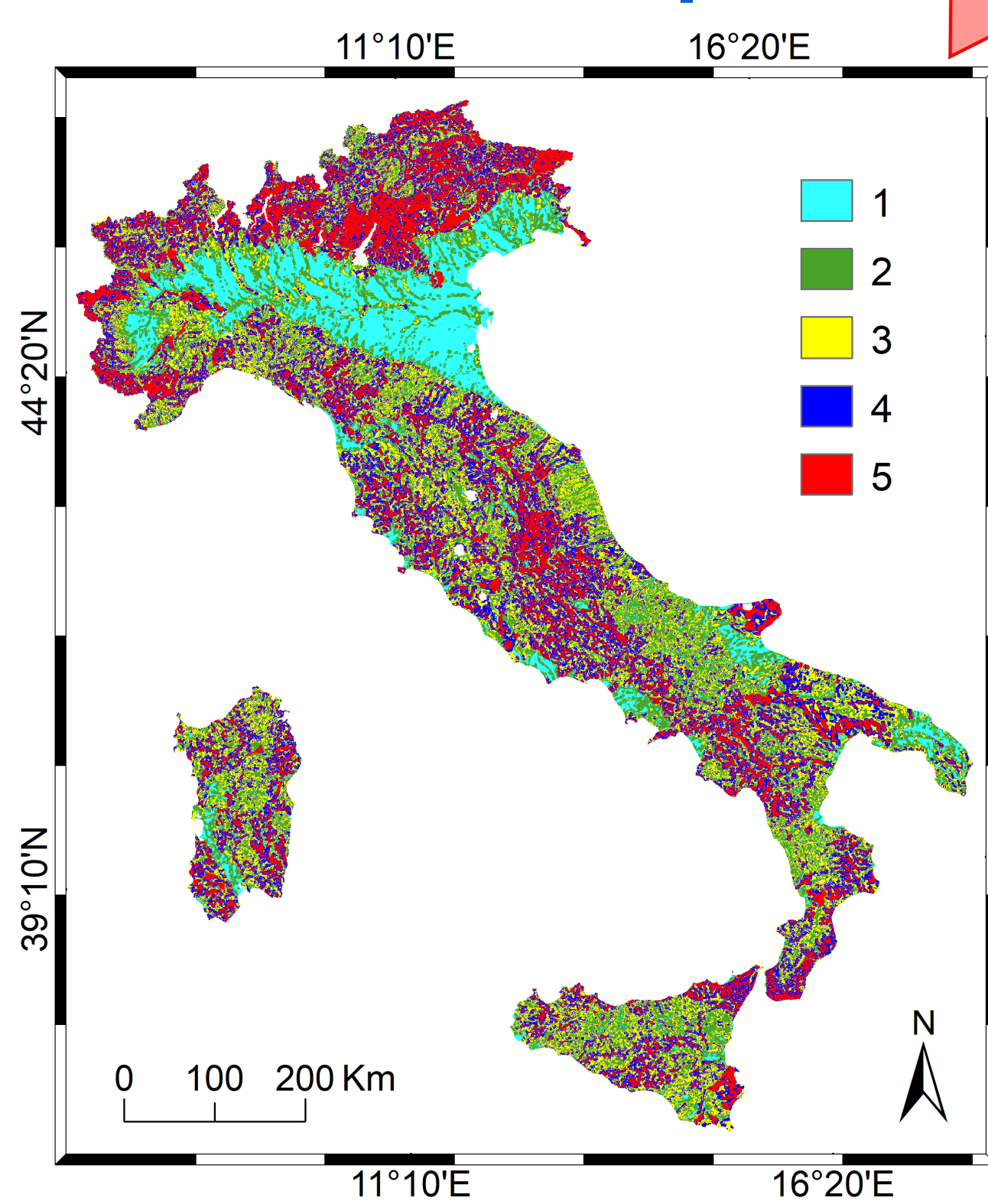
1 Starting point

This work starts from the Geomorphodiversity Index (Gmi) of Italy by Burnelli et al. (2023), [3] that considers four input parameters: lithology (geological factor), slope angle and landforms derived from geomorphons tool (topographic and geomorphological factors) and drainage density (as a corrective parameter for flat areas).

Method



Final map



For the Italian index all the input parameters have the same weight

More details

EGU24-15418
Monday, 15 Apr, 16:15–18:00 (CEST),
Display time Monday, 15 Apr, 14:00–18:00
Hall X1, X1.142

EGU24-20385
GM 5.5
Orals: Wed, 17 Apr | Room G1
09:15–09:25

2 Switzerland: physiographic arrangement



The physiographic map of Switzerland reflects the tectonic structure rather directly. The territory can be divided into 3 physiographic regions based on altitude and relief: The Alps (60% of the country's surface area), the Swiss Plateau (30%) and the Jura Mountains (10%).

3 Switzerland vs Italy

Switzerland was the first test area at national scale for the index developed by Burnelli et al. (2023). Compared to Italy, it exhibits less climatic and physiographic diversity. Initially, the calculations assumed equal weight for all input variables, resulting in an underestimation of the diversity of certain units, such as karst. The basics of the method are calculating the variety of the four input raster maps in GIS, with a moving window approach, casting them into five classes of variety, and combining them into a final, geomorphodiversity raster map. In addition to previous work, and taking into account the difference between Italy and Switzerland, we consider different weights for each partial variety map, when performing the combination into the final index. This allows extra flexibility in reproducing the diversity of landforms in the different geomorphological settings of Switzerland. The weights were selected based on the geomorphological characteristics of the primary processes in each physiographic unit.

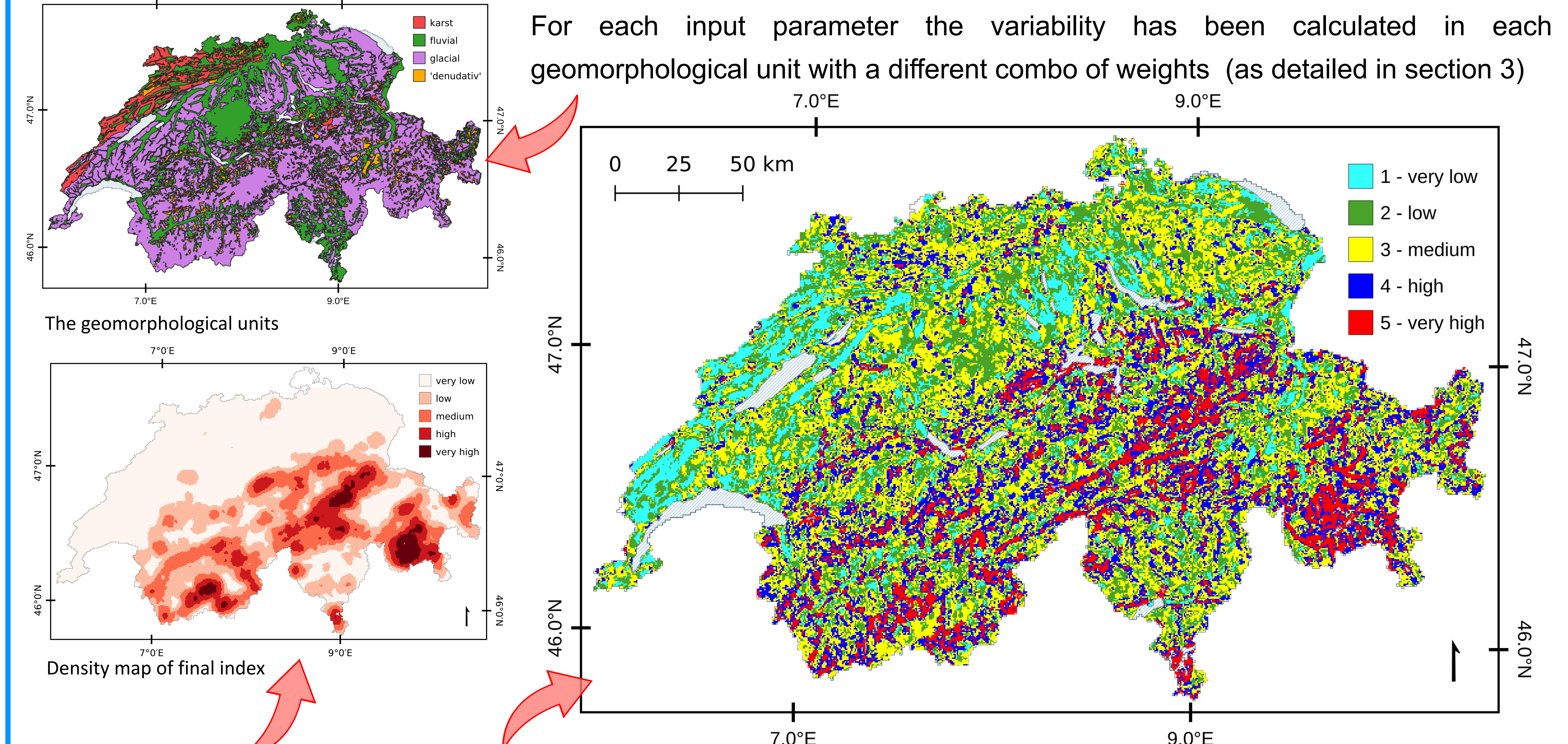
	Combo_1	Combo_2	Combo_3
Slope Angle	1	2	1
Drainage Dens	2	1	3
Geomorphons	3	3	2
Lithology	4	4	4

Value 1 minimum weight
Value 4 maximum weight

	KARST				FLUV				
	Gmi	Combo_1	Combo_2	Combo_3	Gmi	Combo_1	Combo_2	Combo_3	
val_1	2860	3188	2222	3654	val_1	3214	4245	3590	3358
val_2	3053	2978	3279	2732	val_2	10331	10957	10146	10682
val_3	2491	2119	2517	2033	val_3	17845	16101	10146	15005
val_4	890	939	1123	832	val_4	13250	12110	12633	14176
val_5	85	155	238	128	val_5	4779	6006	6185	6198

Number of cells for each geomorphological unit and for each of the three combo (see above)

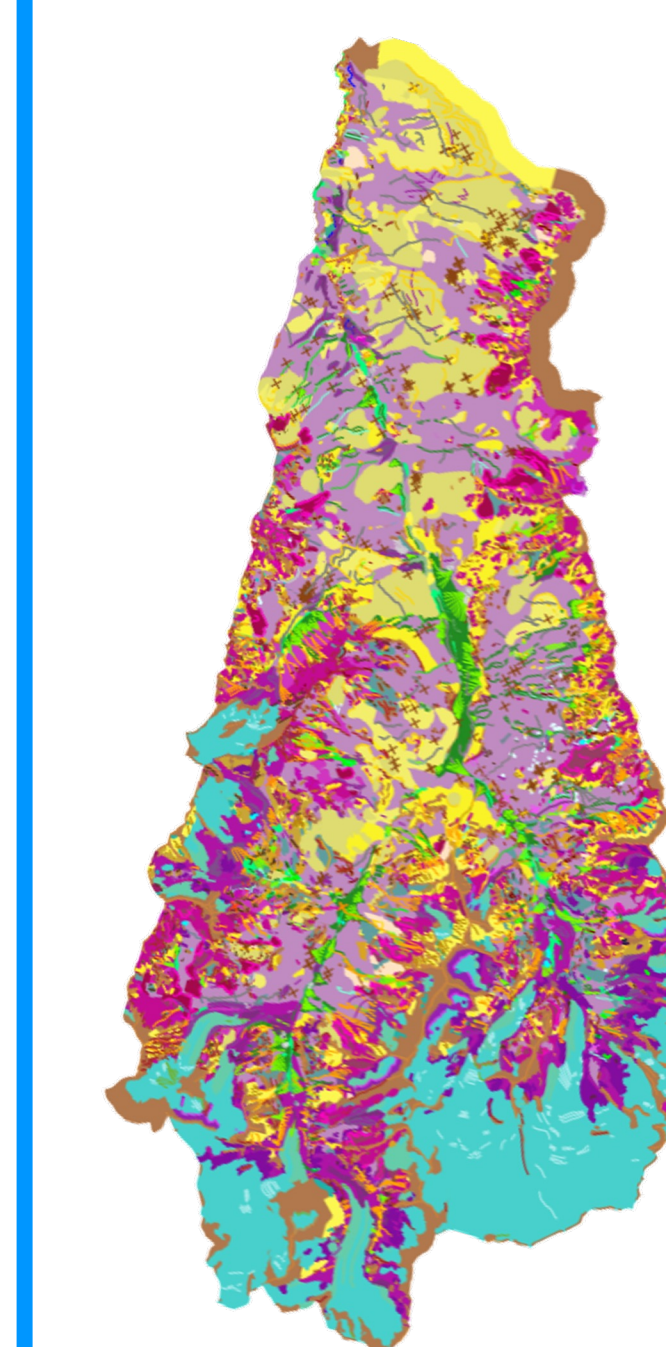
4 The Geomorphodiversity index of Switzerland



For each input parameter the variability has been calculated in each geomorphological unit with a different combo of weights (as detailed in section 3)

The density map and the final Geomorphodiversity Index map highlight a higher distribution of values in the southern part of the territory

5 Validation



The final step is a validation using a geomorphological map of Val d'Hérens, a side valley of the Rhone valley in the Swiss canton of Valais. This area exhibits a wide range of shapes and processes.

The validation is still a **work in progress**



References:

- [1] Zwoliński et al., Geoh Heritage (2018) <https://doi.org/10.1016/B978-0-12-809531-7.00002-2>
- [2] Melelli et al., Sci Tot Env (2017) <https://doi.org/10.1016/j.scitotenv.2017.01.101>
- [3] Burnelli et al., Earth Surf Proc Land (2023) <https://doi.org/10.1002/esp.5679>
- [4] Reynard et al Landscapes and Landforms of Switzerland (2021) https://doi.org/10.1007/978-3-030-43203-4_5
- [5] Lambiel Journal of Maps (2016) <https://doi.org/10.1080/17445647.2014.999135>



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Urgere Project website

<https://urgere-project.irpi.cnr.it/>