INTERNATIONAL ASSOCIATION OF GEOMORPHOLOGISTS (IAG)
REGIONAL CONFERENCE ON GEOMORPHOLOGY
16 – 18 September, 2025, Timisoara, Romania

Objective River Segmentation Based on Sinuosity and Confinement Indices: A Multi-Scale Geomorphological Approach with Applications to Sicilian Rivers

Claudio Mercurio[1*], Viviana Bellomo[1], Grazia Azzara[1], Christian Conoscenti[1], Edoardo Rotigliano[1]

[1]Dipartimento di Scienze della Terra e del Mare - Università degli Studi di Palermo, Palermo, Italia

* Correspondence to: Claudio Mercurio; claudio.mercurio@unipa.it

European States have transposed the Water Framework Directive (2000/60/EC), adapting it to their ecosystems and river morphologies. While the Directive allows flexibility in methodological choices, all Member States must subdivide watercourses into homogeneous sections, a key requirement for their characterisation and management. Nonetheless, the choice of scale of analysis can significantly affect river segmentation and characterization. This study proposes an approach based on the Sinuosity Index (SI) and the Confinement Index (CI), to achieve a more objective segmentation, consistent with morphological variations. The proposed method could serve as a rapid and valuable tool for river analysis at the European level, complementing existing methodologies across different Member States.

The SI values are computed every 50 m along the river using multiple spatial scales, ranging from 100 to 2000 m. Each SI value represents the sinuosity computed within a moving window, covering a distance equal to its size. This multi-scale analysis helps understanding sinuosity variations across different spatial scales and identifying the most representative scale by comparing and analysing SI distributions along the river profile. In addition, the method evaluates SI variation along the watercourse through graphical analysis, highlighting sinuosity changes and measuring the distance between consecutive meanders to quantify morphological variations along the analysed stretch.

Once the optimal SI window is determined, the selected value is integrated in a Python script that combines the SI with the Confinement Index (CI), also calculated every 50 m, considering the ratio between the width of the riverbed and the alluvial plain. By merging these two indices, this method enables an automatic segmentation of the river into morphologically consistent stretches, overcoming subjective approaches. At the end of the process, the segmentation of the river sections allows a combined classification, distinguishing Rectilinear (R), Sinuous (S) and Meandering (M) sections according to the SI and Confined (C), Semi-Confined (SC) and Unconfined (UC) sections according to the CI.

The method has been applied to several Sicilian rivers with different morphological characteristics, demonstrating its adaptability to these specific geographical contexts and its usefulness for geomorphological interpretation. In geographical contexts with wider meanders, it may be appropriate to increase the SI window size to better capture sinuosity variations. The results obtained show that the analysis scale significantly influences segmentation and the perception of river dynamics, underlining the importance of a well-considered selection of the SI calculation window for river characterisation and management studies. By integrating only parameters related to floodplain extent and fluvial morphology, this approach provides a fast and valuable tool for geomorphological analysis and river management, reducing subjectivity in river classification.

KEYWORDS River Segmentation, Sinuosity, Phyton, Sicilian river