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Fractal analysis and their applications in Geomorphology

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Fractal geometry methods offer a quantitative description of complex landscapes and can effectively elucidate the behavior of fluvial and coastal geomorphological systems. The bidimensional (2D) fractal geometry of a shoreline, obtainable with Koch's curve method, may be expressed by a fractional number between 1.1 and 1.4. In this case, the former shoreline is less rugged than the latter, which tends to a Peano's curve with a fractal dimension D = 2, that is a plan. These sizes, under initial analysis, may not supply direct information on the main processes responsible for modeling the coast. Actually, either erosion, sediment deposition, and tectonics could generate shapes with about the same fractal dimension, independently of their intensity, age, and time during which they acted, as a result of morphological convergence. From the results of research carried out along Mediterranean-type and Brazilian coastlands, it is possible to derive, from the fractal dimension, the primary and secondary processes behind modeling. Here distinguishing tectonic events from littoral dynamics, both responsible for coastal morphology and identifying which is predominant. Calculation and comparison of the 2D-fractal analysis over time along the selected littorals are useful for assessing sea storm impacts and tsunami flash remodeling, e.g., as a relationship between dimension and energy, and the post-event shoreline resilience time comparing the fractal dimensions before and after the main events related to the morphosedimentary features. The same principles can be applied to other geomorphological systems, such as dunes, river drainage networks, islands, and lagoons, representing an important tool for understanding and classifying these environments.