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Optimal Vertex Interval Determination for Efficient Shoreline Length Calculation

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Coastline extraction and decisions have important implications for efficient land management and national policy formulation. Therefore, shorelines should be determined in a reasonable manner, and consistent results should be produced for the same area. This must be calculated efficiently. For example, simple shoreline areas should be constructed using relatively large vertex intervals (point-to-point distances) for efficiency, while complex shoreline areas should be constructed using small vertex intervals, thus improving accuracy. In this study, we suggest an optimum vertex interval that can represent more than 99.7% (3σ) of the original shoreline data using a grid generated by applying a box-counting method. All coastline areas were gridded using 11 grid sizes. Generalization was performed on the shorelines contained within each grid, and the sum of the generalized shoreline lengths was calculated. As the grid size used increases, the shoreline will become more simplified, and the difference from the original data will increase. As the grid size decreases, the more precisely the shoreline will be represented, and the sum will be similar to the original value. As a result of regression analysis, using the sum of the generalized shoreline length, we could predict the vertex interval that would represent more than 99.7% (3σ) of the original data. For the experiment, three regions with distinct coastline characteristics were selected. The grid was generated by the box-counting method, a representative fractal technique, and the vertex interval was estimated. From this, the fractal dimension was then calculated. As a result of the experiment, it was confirmed that the area A had a vertex interval of 0.7m, and the areas B and C had vertex intervals of 1m. These optimal vertex interval values mean that when the coastline was reconstructed, it was the closest, efficient representation of the actual coastline. Furthermore, these interval values suggest that the area A has a more complex coastline, and therefore the coastline should be constructed with a smaller vertex interval than the other areas. Using fractal dimensions, we also found that the area B has a more complex coastline than the area C. Overall, we confirmed that the optimal vertex interval for the accurate and efficient construction of the shoreline is able to be calculated by the approach presented in this paper. This research is expected to contribute to efficient land management and national policy establishment and progress.