Coastal area classification using total suspended matter concentration

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Abstract Localities of various ocean physical features cause regional differences in sediment transport mechanisms. Hence, the regional analysis of the total suspended matter (TSM) in coastal zones helps to manage coastal areas. This work presents a new classification basis of the total suspended matter (TSM) sampling stations in coastal areas in South Korea using a newly introduced robust clustering protocol, iterative toroidal SOM-k-means, which reduced uncertainties in clustering analysis. Two location variables (longitude, latitude) and four concentrations (surface TSM in February and August, bottom TSM in February and August) in the 425 TSM sampling stations have been divided into six groups using iterative toroidal SOM-k-means. The systematic analysis showed that the surface sediment distribution, ocean currents, and tidal currents agree with the clustering results.

Keywords: total suspended matter, clustering, toroidal self-organizing map, k-means, coastal area.

Methods

- An iterative toroidal SOM-k-means is proposed to overcome the problems of the standard SOM and k-means clustering.
- The iterative toroidal SOM-k-means evaluates clustering validity using the Davies Bouldin Index (DBI).
- 425 total suspended matter (TSM) sampling stations in South Korean coastal areas were clustered using the suggested clustering method.

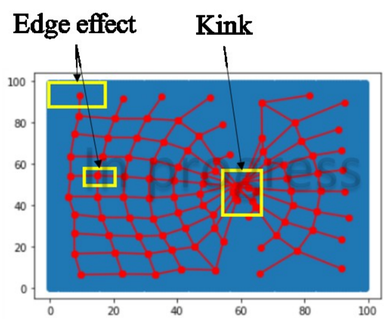

Figure 1: Problems of the standard SOM

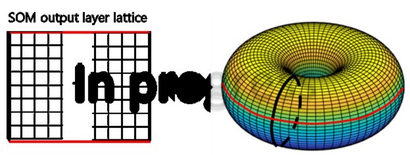

Figure 2: Conceptual diagram of the torus SOM grid mapping

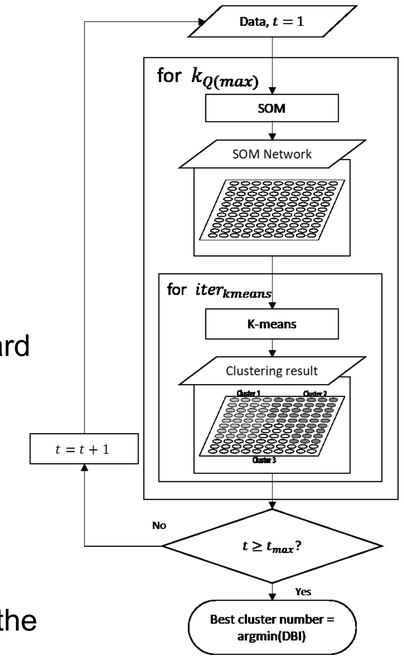

Figure 3: Flowchart of iterative toroidal SOM

Results

- The optimal number of clusters was 6, with the smallest DBI.
- The six clustered regions were compared with the sediment distribution map, ocean currents map, and tidal current map, respectively.
- The three physical property maps showed good agreement with the clustering result.

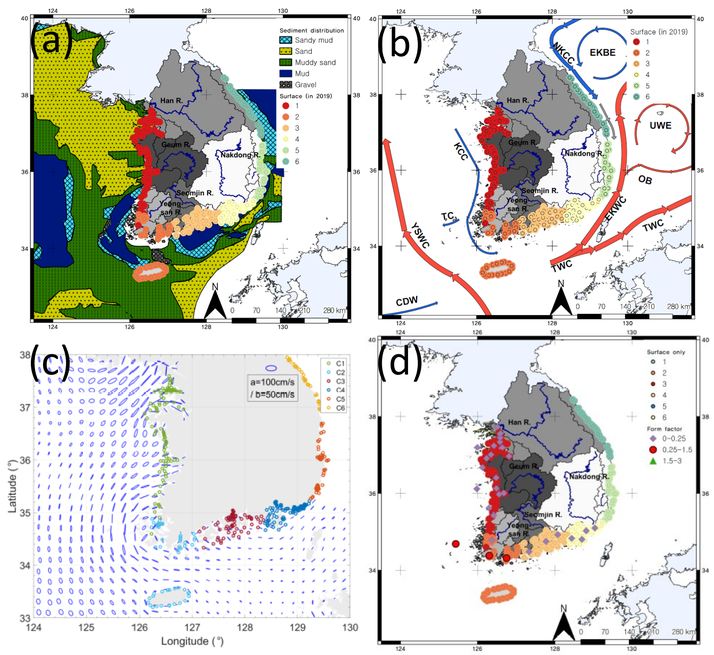

Figure 1: Physical features with clustering result; (a) sediment distribution map; (b) ocean currents map; (c) M2 tidal current map; (d) form factor map.

Conclusions

- The three physical property maps showed good agreements with the clustering result.
- Considering only the location and concentration variables can represent the spatial and seasonal physical patterns of TSM.
- The demonstrated regional classification result would be useful in the focusing study domain.

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