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Opinion Article

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An Updated Methodology for Preparation of Sediment Distribution Maps Using Conditional Strings in Arc GIS 10.X.

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Abstract

This paper proposes the most simplified, concise and accurate geostatistical method for the spatial representation of the surface sediment distribution. The methodology uses conditional strings in the raster calculator of Map Algebra using ArcGIS 10.x for preparing sediment distribution maps. This methodology is an updated version of USGS Arc Map Sediment Classification since the latter is a customized toolbar for Arc GIS 9.X. The conditional strings are derived from the ternary classification systems of Folk and Shepard. These strings are further updated for mapping hard bottom along with sediment types. For generating sediment distribution map in an area with natural or artificial barriers using conditional strings in ArcGIS 10.x is also discussed here. The 'SedTypes' freeware attached with the paper provides conditional strings that are compatible with Arc GIS 10.X series. The freeware also provides triangular plots of sediment classifications pertaining to gravel, sand and mud (GSM) and sand, silt and clay (SSC).

Keywords

Regionalized variable; Variogram; Variographic analysis; Anisotropy ;cross validation

Introduction

This methodology also has several advantages over the conventional discrete number method. The spatial distribution map of surficial sediments using conditional strings is more reliable and accurate as these maps are generated taking the weight percentages of sediment classes (gravel, sand, silt, clay etc) in the corresponding rasters. The methodology using conditional strings for preparing sediment distribution map and spatial representation of hard bottom along with sediments using sediment class data are the new attempts made by the authors. Further this methodology aids in generating first generation sediment distribution maps.

Seabed sediment mapping is important for a wide range of marine policies, planning and scientific issues. The need for very accurate sediment maps near coasts, and of medium-scale seabed maps on the continental shelf and the deep ocean is increasing. Around the world there has been considerable national and international investment in the collation and synthesis of sediment datasets. The sediment distribution map plays an important role in identifying the areas for anchoring, potential risk area, in the installation of pipelines that serves to define the safest route. The seabed mapping and distribution of sediments also helps in identifying ecologically distinct habitat and managing benthic environments.

Sediment distribution maps characterize the surface sediments and helps in understanding the sediment types. Geological and Geophysical proxies are used for mapping the seafloor which aids in generating the sediment distribution maps. Side scan sonar, Sub bottom profiling and Backscattering are the geophysical proxies used for seafloor mapping as large scale mapping techniques. Sea floor sediment sampling techniques using grab sampler and coring device provides the ground truth data which are the geological proxies used in seafloor mapping. There is a need for fit-for purpose maps for accurately depicting the types of seabed substrate and habitat and the properties of the seabed for the benefits of research, resource management, conservation and spatial planning. The different approaches used for preparing seabed substrate maps are manual interpretation, geostatistics, object-based image analysis and machine-learning techniques. The vast array of statistical learning techniques, including Supervised classification like Maximum Likelihood Estimation ,k-Nearest Neighbour various decision tree. Artificial Neural Networks and Bayesian Decision Rules . Seabed mapping studies that employed unsupervised classification have been presented by several authors. Seafloor sediment composition can be spatially predicted if the surface sediment composition (e.g. percentages of mud, sand and gravel) data are available.

Spatial prediction is the estimation of unknown quantities, based on sample data and assumptions regarding the form of the trend and its variance and spatial correlation. Spatial prediction of environmental properties can be achieved in various ways: Deterministic models such as inverse distance weighted, natural neighbour and nearest neighbour interpolation use observations of a target variable to calculate values at unsampled locations with mathematical functions. Such models use arbitrary or empirical model parameters and don't provide estimates of model error. Stochastic models, includes kriging and regression incorporate the concept of randomness and provide both estimations of a target variable and an associated error.

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