ABSTRACT

A new sediment texture map, based on the grain size data, is presented and classified into clay (0-2%), silty clay (2-25%), clay (25-75%), silt (75-100%). This map was developed applying the grain size data retrieved from satellites, including the MODIS data. In this study, the spatial variability of surficial sediment types on the Beaufort Sea shelf is analyzed using geostatistical methods and multi-parametric analysis. A new sediment texture map of the Beaufort Shelf was developed applying quality controlled ordinary and cross-ordinary kriging and cokriging. A new sediment texture map, based on the grain size maps, is provided according to commonly used grain size and sediment type classification systems. We describe an approach for a quality assessment of the surface estimations key parameters were evaluated. The average cross-validation errors equal almost zero in all cases. Cross-ordinary kriging provided superior interpolation results for silts, clays, and sands compared to ordinary kriging by using cross-validation maps and their corresponding variograms. The RMSSE can be observed to be improved by applying cokriging. Two main issues concerning the grain size datasets used in this study are obvious: the variability of the sampling design and the spatial extent of the data set. Especially in the shallow areas, as in the Mackenzie Bay, the sampling is not very dense. Local events could have been missed. Therefore, the procedure of cokriging and ordinary kriging greatly enhanced interpolation and mapping of the surficial sediment types on the Beaufort Shelf.

METHODS - Kriging and Standardization

Subsequent to data exploration, processing and analyzing characteristics, four single grids (clay, silt, sand, and gravel) were generated from grain size data by simple kriging and logging (Figure 3). Kriging also considered parameters that influence sediment texture such as bathymetry, slope, distance from the Mackenzie River and data anisotropy (directionality dependency). The kriging algorithm was quality controlled by cross-validation. For a detailed description please refer to Pesch et al. (2008). By subtracting each measured value from its estimated value an estimation or cross-validation error can be calculated resulting in an error estimation for the whole dataset:

- mean standard error (MSE) - the standardized average value of all cross-validation errors which at best should be 0;
- root mean square standard error (RMSE) – ratio of mean square standard error to the standard deviation (SD) of grain size distributions, which at best should equal 1;
- correlation coefficient after Spearman (C) - in case of ideal correlation the C should equal 1, if no such correlation exists the C should equal 0;
- predicted standard errors (PSEs) express a maximum deviation of kriged values and therefore help to evaluate the quality in those regions regarding the estimation results for a grain size range.

PSEs were used to define the extent of a reliable interpolation area.

RESULTS & CONCLUSIONS - Comparing ordinary kriging and cokriging

A new sediment texture map of the Beaufort Shelf was developed applying quality controlled ordinary and cross-ordinary kriging. Selected cell shows in the maps in Figure 5 containing the percentage of clay, silt, and sand according to Wentworth (1922) and was then applied to Shepard's (1955) classification system. The grain size-gravity was classified into 100% grid (class values = 100) as follows: grain size classification, range, size, and input (the Mackenzie River). Kriging described improved interpolation results for clay and sand as shown in Table 2. Ordinary kriging achieved better prediction accuracies for gravel and sand, therefore, used for generation of the final distribution. The RMSSE can be observed to be improved by applying cokriging. Two main issues concerning the grain size datasets used in this study are obvious: the variability of the sampling design and the spatial extent of the data set. Especially in the shallow areas, as in the Mackenzie Bay, the sampling is not very dense. Local events could have been missed. Therefore, the procedure of cokriging and ordinary kriging greatly enhanced interpolation and mapping of the surficial sediment types on the Beaufort Shelf.

QUALITY ASSESSMENT - I

To assess the quality of the surface estimations key parameters were evaluated. The average cross-validation errors equal almost zero in all cases. Kriging provided superior interpolation results for silts, clays, and sands compared to ordinary kriging by using cross-validation maps and their corresponding variograms. The RMSSE can be observed to be improved by applying cokriging.

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