Abstract

A Statistical Approach for Habitat Classification in Submarine Canyons

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Advances in technology have enabled numerous developments in deep-sea habitat mapping. As a result, a broad spectrum of data is increasingly being incorporated into seabed classification and many classification techniques have been proposed. Ideally, automated seabed classification for the deep sea is aiming for a statistically robust, objective and repeatable method, applicable at a variety of scales.

This paper presents a study from the upper Cascais and Lisbon-Setubal Canyons offshore Portugal, and will address 3 of the main objectives in automated seabed classification: 1) objective parameter selection, 2) data clustering and 3) determination of the optimal number of classes. Prior to parameter selection, it is important to ensure all spatial data integrations are carried out correctly. To achieve this, TOBI sidescan data of high image quality but with poor locational accuracy were reprocessed using synthetic imagery produced from multibeam bathymetry. Subsequently, abiotic terrain variables (bathymetry & derivates, sidescan imagery, sediment properties) were subjected to a statistical approach using the Akaike Information Criterion (AICc) and Principal Component Analysis (PCA) to select optimum parameters for habitat classification. Unsupervised fuzzy clustering was used for data clustering. Lastly, the optimal number of clusters was defined using Xie-Beni (XB) and Partition Coefficient and Exponential Separation (PCAES) index.

The proposed method gave promising results in these submarine canyons with high terrain variability. TOBI reprocessing successfully improved the sidescan sonar imagery registration onto the multibeam bathymetry. The habitat maps are groundtruthed and evaluated using cross validation. The percentage of correctly classified pixel yields a worthy result. Lastly, method comparisons are made between AICc and PCA for parameters selection and XB and PCAES for optimal number of clusters. A critical evaluation using SLOT analysis on the overall method is carried out to identify its strength, limitations, opportunities and threats.