Size, Composition and Spectral Response of Deposited Sediments in Mayagüez Bay

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Abstract

This project will help to determine if the suspended sediments in the Mayagüez Bay have different grain sizes, compositions and spectral responses. This question is very important because recent efforts to use remote sensing to study the water quality parameters in this Bay have found high spatial and temporal variability. Since suspended sediments are affecting the signal received by remote sensors, it is necessary to better understand their characteristics. During this time of the year (January to May) the main source of suspended sediments is the sea floor. Regular cold- fronts are responsible for strong waves, which produce large re-suspension of the sediments deposited in the bottom. Therefore, this study will collect samples from the bottom for the laboratory analyses. Eleven (11) stations will be visited along the Bay, from the Añasco to the Guanajibo Rivers. To determine the spectral response, the GER-1500 spectroradiometer, with a spectral range from 400 to 1050 nanometers and the HR-1024 spectroradiometer with a spectral range in the far infrared regions, will be used. For the grain size the sieve shaker is going to be used and for the mineral composition are the XRD tests. The expected results will also help to understand the dynamics of suspended sediments in Mayagüez Bay and provide recommendations for future application of remote sensing in this region.

Objectives

The main objective of this study is to determine the grain size, composition and spectral response of the bottom sediments along the Mayagüez Bay.

Introduction

Two distinctive seasons have been identified in the Mayagüez Bay (Gilbes et al., 1996), a dry season (January to May) and a rainy season (August to November). Each season has a large influence in the behavior and amount of sediments in the Bay. During the rainy season, river discharge controls the concentrations of suspended sediments. During the dry season a large amount of sediments are re-suspended due to strong waves (Fernando Gilbes, personal communication). Recurrent cold fronts that travel across the Caribbean region during winter produce such wave action. Since this research project will take place during this winter-spring semester, it will focus on the dynamics of re-suspended sediments from the bottom.

In this study case, sediments are re-suspended by the effect of the cold fronts. The re-suspension depends of the grain size, which controls the velocity of deposition (Calvin W. R. et al., 2003) (Figure1).

A front is the transition zone between two air masses of different temperatures and a cold front occurs when cold dry stable polar air is replacing warm and moist air (Donald, 2007). The repeated cycling of cold-front passages leads to positive feedback with transport onshore during both pre- and post-front conditions, and effective attenuation of wave energy over the muddy inner shelf inhibits erosion at the coast (Kineke et al., 2006).

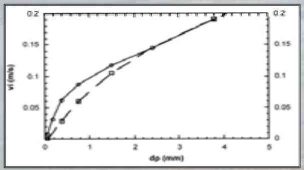

Figure 1: Velocity of deposition for the specific particle diameter (Calvin W. R. et al., 2003)

Study Area

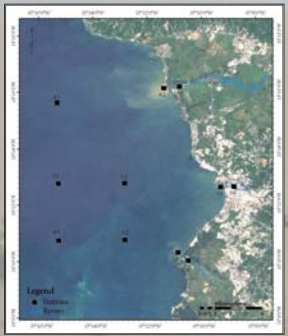

Figure 2: Study area and sampling stations (adapted from Hernández, 2008)

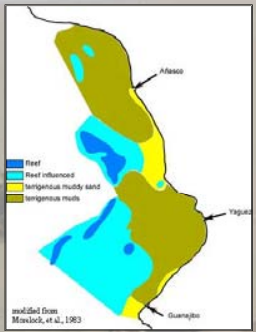

Figure 3: Facies of the Mayagüez Bay (Ramírez et al., 2003)

Methodology

Eleven (11) samples were taken along the Mayagüez Bay. Five of them were taken offshore and was used the NOAA's oceanographic cruise (Figures 4 & 5). The other six samples were taken along the coast of the Bay. Three on the mouth discharge of the rivers and the other three thirty (30)m away from the mouth.

Figure 4: NOAA's Oceanographic Cruise

Figure 5: Sampling with the bottom sediment grab

For the grain size, granulation process was used. The sieves and the sieve shaker did this. The sieves sizes utilized were 0.25, 1, 2.75, 3.50, 3.75 and 4 (Figure 6). For calculate the diameter of the grains in mm, the following formula was used (Table 1);

$$D = D_0 \times 2^{-\Phi};$$

Where D= diameter, D_0 =reference diameter (equal to 1 mm) and Φ is the sieve size.
Krumbein, W. C. and Sloss, L. L.(1963)

Φ	Mm
0.25	0.84
1	0.50
2.75	0.15
3.50	0.09
3.75	0.07
4	0.0625

Table 1: Sieves Sizes in Mm and Φ

Figure 6: Sieves Shaker

Future Work

To complete this research they are three other laboratory tests, XRD, terrigenous percent and reflectance. The XRD is going to be do to know the mineral composition of the samples. The terrigenous percent will be done by the difference of weight after the application of HCL at 10% and bleach. HCL for the carbonates and bleach for the organic matter. Finally the reflectance measures are going to be done with the GER-1500 and the HR-1024 spectroradiometers.

Results

Grande de Añasco River

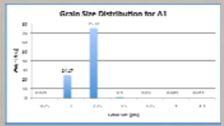

Figure 7a

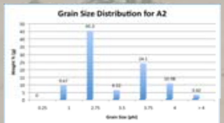

Figure 7b

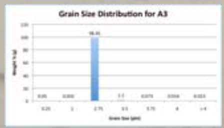

Figure 7c

Figure 7a, 7b, 7c: Grain sizes distribution for Grande de Añasco River. Sows from the offshore station (7a) to 30m in the channel of the River (7c). The dominant grain size along the three stations are grains of 0.15mm by diameter.

Yagüez River

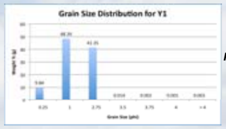

Figure 8a

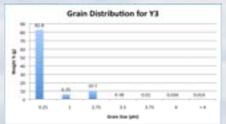

Figure 8b

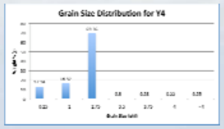

Figure 8c

Figure 8a, 8b, 8c: Shows the grain size distribution for the Yagüez River. The results illustrate that the dominant grain size along the Yagüez River is from 0.50 to 0.15 mm of diameter. Offshore to this river the dominant grain size is 0.15 mm of diameter.

Guanajibo River

Figure 9a

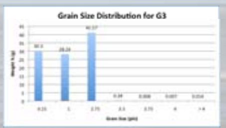

Figure 9b

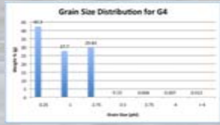

Figure 9c

Figure 9a, 9b, 9c: These figures shows the grain distribution along the Guanajibo River. Demonstrate that offshore (9a), the grain diameter most abundant is 0.84mm. On the mouth is 0.15 mm and 30m away is 0.84mm.

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