Comparison of Multispectral Imagery and Backscatter Classification for the Use of Nearshore Marine Habitat Mapping, Charleston, SC

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Introduction

Benthic habitat mapping is developing rapidly as acoustic technologies advance (Brown et al., 2002). The relationship between substrate and acoustics can help us understand more about benthic geologic and ecologic science applications. Fluxes in the environment, such as the topography and nutrient availability, can influence the distribution of marine habitats. Substrate is an important factor in determining habitat identity. Backscatter is a prominent tool in substrate mapping which is an important factor is determining habitat identity (Etnoyer et al., 2011 and 2015). This project aims to understand benthic habitats using backscatter and multispectral backscatter to understand whether these data types can help determine information about the substrate or habitat. Multispectral backscatter differs from traditional backscatter data in that multispectral allows for data collection at multiple frequencies, then each band is translated into a spectral file. Low frequencies penetrate through materials more because their wavelength is longer, meaning it is likely denser material, or hardbottom (Brown et al., 2017). Habitat mapping is important in helping to provide scientific data for informing environmental policy makers.

Study Area

This data was collected offshore from Charleston's main channel entrance, with depths ranging from 11.70 to 13.50 m (Figure 1). The area was chosen because it will be a probable site for the implementation of mitigation reefs by the United States Army Corps of Engineers.

Data

The data was collected by the US Army Corps of Engineers, Charleston District. The data was collected by an R2Sonic Multibeam. The data contains multifrequency multibeam and backscatter data that was collected at 200, 300 and 400 kHz. The data was collected over an area containing a range of material types as detailed in USACE's Post 45 reports.

Methods

- Hypack 2018 was used to process and clean the raw data that was used to create a base surface.
- FMGeocoder Toolbox (FMGT) was used to create a backscatter mosaic and three other mosaics (400, 300, 200 kHZ).
- Uncalibrated backscatter data collected at three different frequencies were combined as spectral bands into one mosaic using FMGT Composite Bands tool.
- The multispectral backscatter image was imported into Fledermaus and draped over the bathymetric surface.

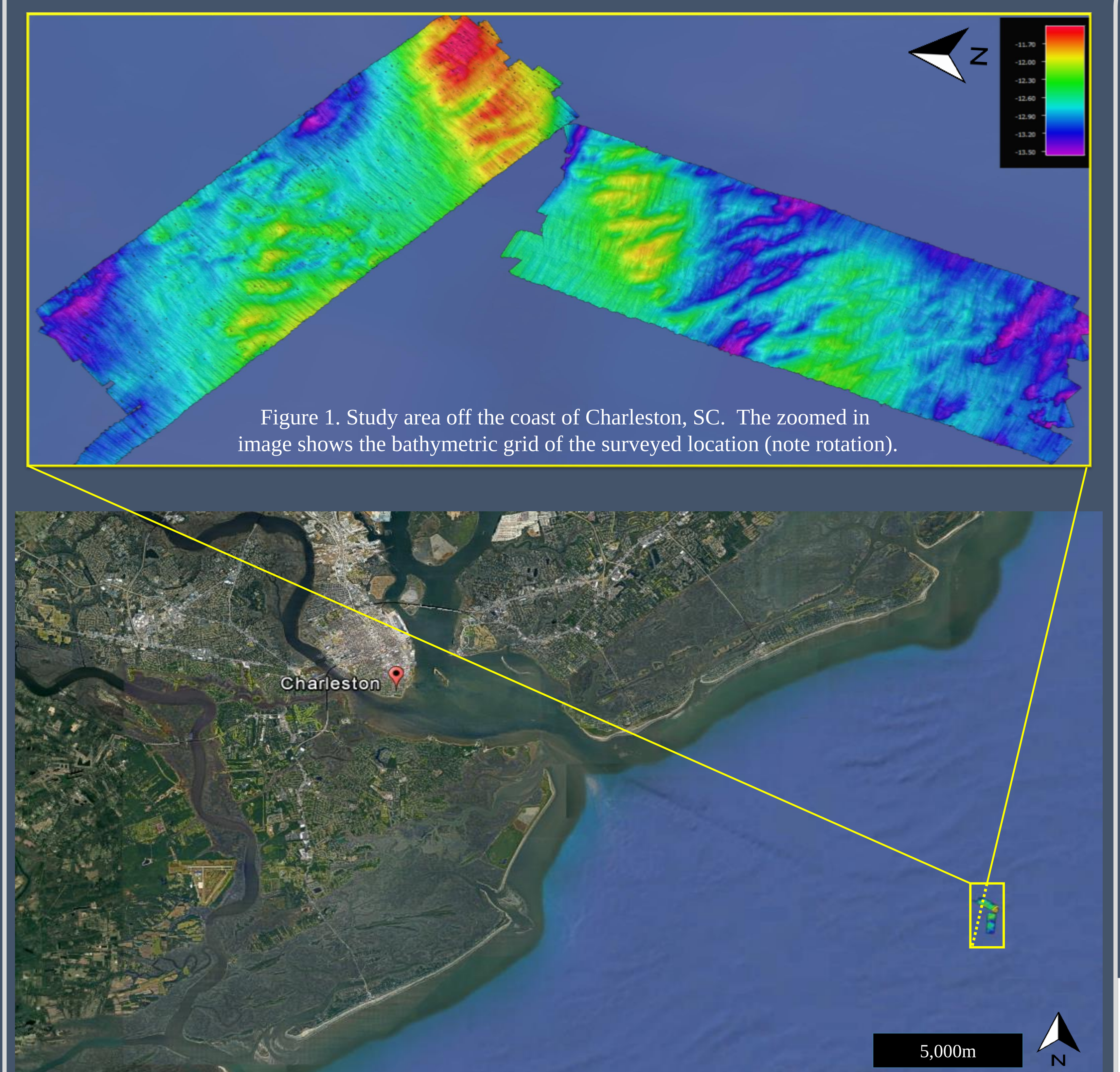

Figure 1. Study area off the coast of Charleston, SC. The zoomed in image shows the bathymetric grid of the surveyed location (note rotation).

Results

- The multispectral image (Figure 3c.) exhibits areas of high frequency in the lime green and low frequency areas in red/orange. The green areas represent a frequency of 200 kHz and the red/orange areas represent a frequency of 300 kHz.
- The backscatter mosaic (Figure 3b.) exhibits high backscatter intensity values in lighter grey (about 27.0-30.0 dB), while the lower backscatter intensity values are in dark grey (about 36.0-39.0 dB).
- The high frequency areas and low backscatter intensity areas, indicating less dense material, are found in both shallow and deep areas of this site. The assumed less dense material is prominent on the flat topped feature and the bulbous features, seen with the white X's on the bathymetric surface (Figure 3a.).

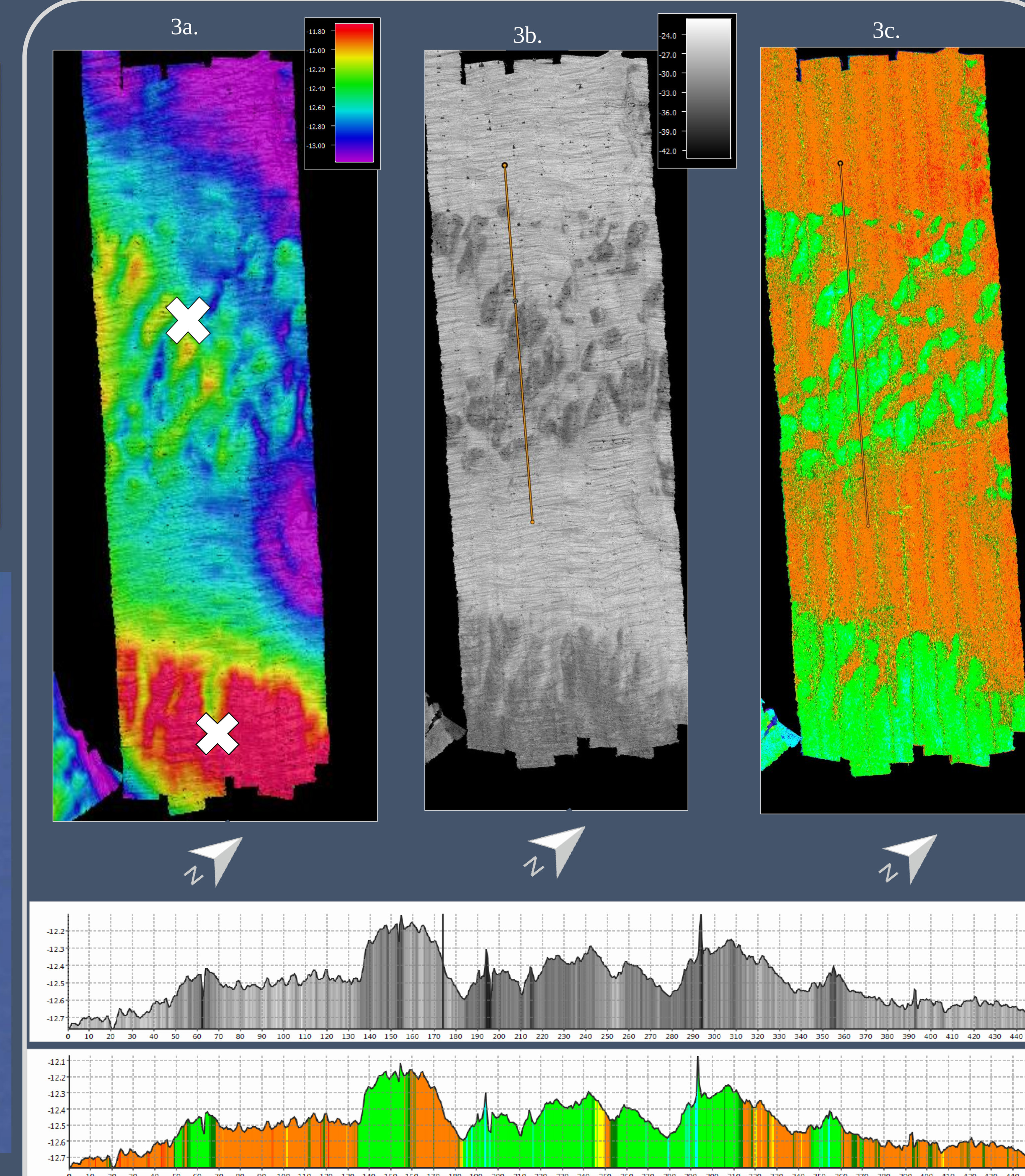

Figure 3. 3a. Bathymetric surface.
3b. Backscatter classification mosaic draped over the bathymetric surface.
3c. The multispectral backscatter image draped over the bathymetric surface.
(vertical exaggeration=18x)

Conclusion and Discussion of Current Applications

The multispectral and the single frequency backscatter intensity compare well. The methods of this study appear to be sufficient for classifying material boundaries. Based off of our understanding of the way that sonar interacts with high and low density materials, it is reasonable to conclude that the high backscatter intensity areas can be classified as higher density material while the lower backscatter intensity can be classified as lower density material. It is probable that the higher density material is hard bottom and the lower density material is soft bottom yet further ground-truth verification is needed to conclude that. Denser substrate locations likely indicative of hard bottom areas would be probable sites for marine habitats since marine invertebrates recruit more successfully on hard material. An ROV could be sent to these locations to test the reliability of these methods in finding deep sea coral habitats. Locating coral habitat is critical in order to protect these slow-growing organisms from threats such as trawling or coral mining. In this particular data set, the backscatter and multispectral mosaics follow the same trends, suggesting that there is no obvious benefit to using multispectral backscatter in place of singlebeam backscatter when searching for potential marine habitat sites.

Acknowledgements

This project was conducted as part of the College of Charleston BEAMS Program. We would like to thank College of Charleston's School of Mathematics for support, the Department of Geology and Environmental Geosciences, Fledermaus, FMGT, & Hypack for Academic Partnership, and Army Corps of Engineers for the collection of this bathymetric data.

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