A NONLINEAR MODEL FOR ROCKY SHORE BIOACOUSTIC SIGNATURE OFF CABO FRIO ISLAND

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INTRODUCTION

Different marine habitats have distinct acoustic signatures (Radford et al., 2014). These signatures are composed by anthropogenic, natural and biological sounds. In coastal zones, the acoustic signature has a stronger influence of benthic organisms that form the bioacoustic chorus (Butler et al., 2017), that we will term as the Rocky Shore Bioacoustic Signature (RSBS). However, RSBS patterns can be influenced by circadian and lunar cycles, wind, tide, temperature, luminosity and others. Yet, to better understand the influence of abiotic and biotic factors in the RSBS pattern it is very important to model, identify and quantify contributions of each these factors.

GOALS

Evaluating the relationship between RSBS and abiotic/biotic factors and to propose a nonlinear model for RSBS, based on data collected off Cabo Frio Island, Brazil.

MATERIAL AND METHODS

Study area sustains a unique environment due to strong upwelling occurrence and other hydrodynamic characteristics (Ferreira, 2003; Calado et al., 2018) (Figure 2).

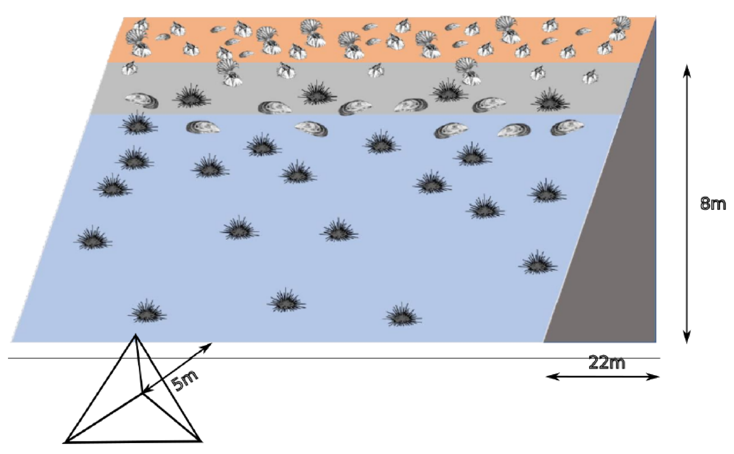

Figure 1 – Hydrophones relative position and some RSBS contributors.

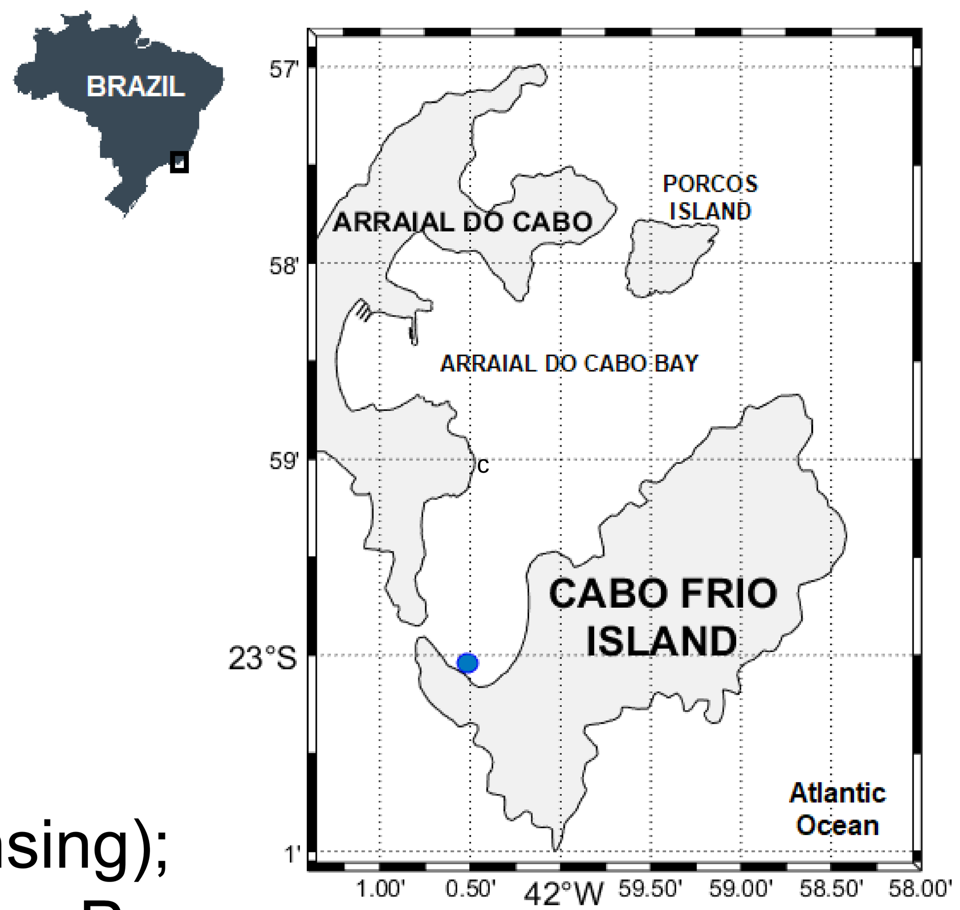

Figure 2 – Study area and acquisition system location (blue circle).

Acquisition system

- 1 regular tetraedron (1m);
- 4 hydrophones TP-1 (MarSensing);
- Sensitivity: -175 dB ref 1V/microPa;
- 24 bits, Fs of 52734 Hz;
- Duty cycle of 20%.
- Temperature (T) and luminosity (L): 1 each 10 min (Hobo pendant).

RSBS modelling (@ 82 days)

- Two frequency bands: B (1.5-8kHz) and C (8-24kHz);
- Meteorological dataset (INMET): [solar radiation (SR), wind speed (WS), rain(R)];
- Tide (TD);
- Spearman correlation;
- Nonlinear multiple regression.

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RSBS = a***T** + b*log(**SR**) + c***TD** + d***WS** + e***R** + k

RESULTS AND DISCUSSION

-**B/C** and **T** (corr +);
-**B/C** and **SR/L** (corr -);
-**SR** and **L** are dependent factors;
-**TD** and **T** correlation occur due to upwelling regime;

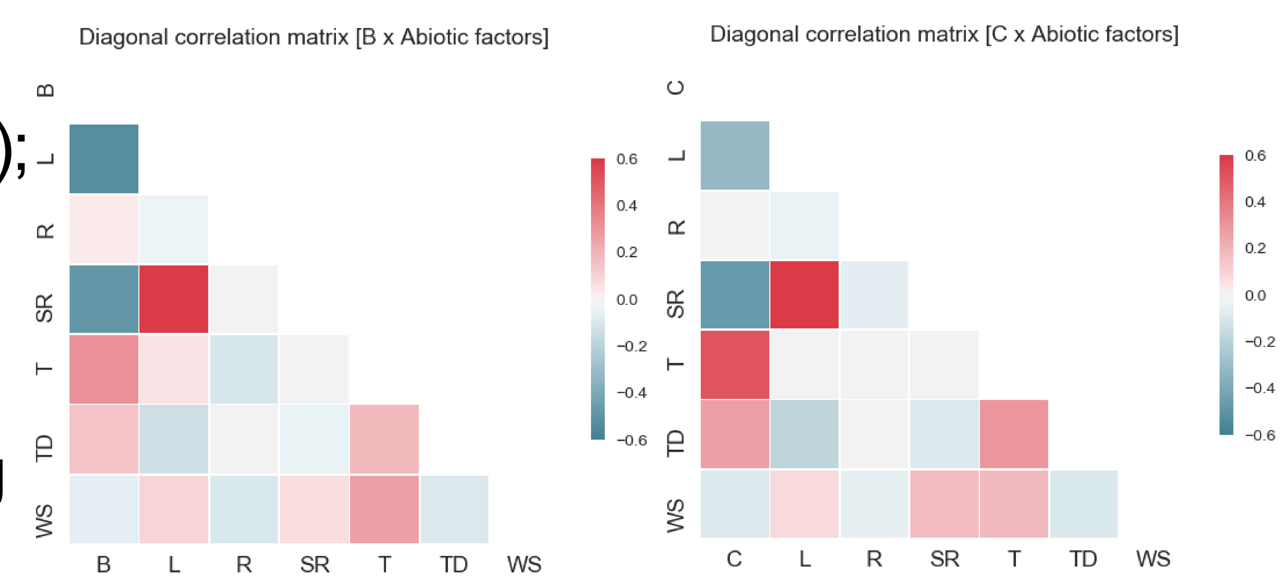

Figure 3 – Spearman correlation: band B (left) and C (right).

-**B/C** is more influenced by **T** and **SR**;

-**SR** influences more band **B** than **C**;

- Band **C** is more influenced by abiotic factors;

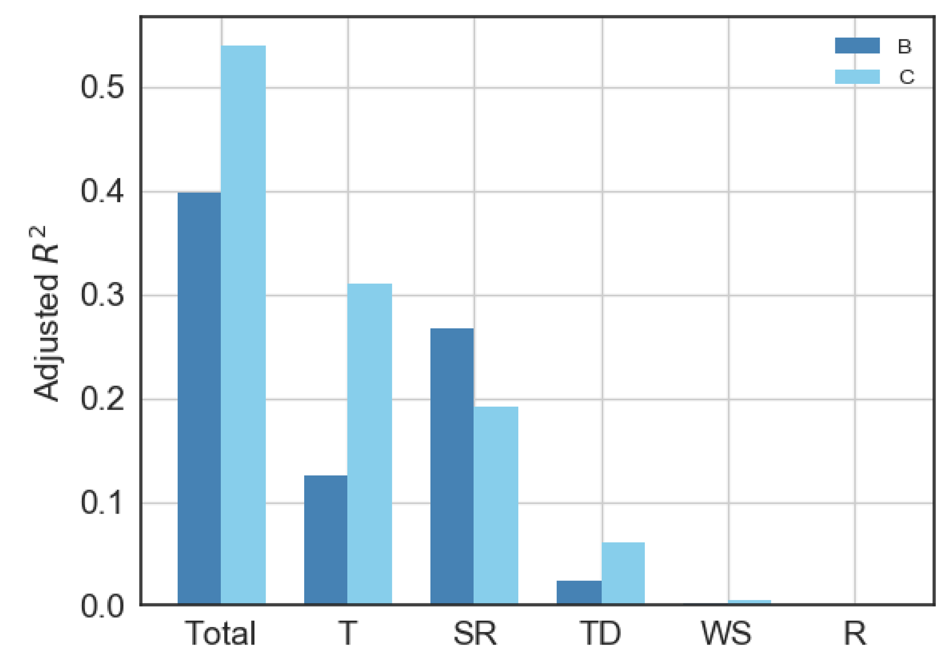

Figure 4 - RSBS explained variance by abiotic factors.

RSBS model

B = 0.2055***T** - 0.1996*log(**SR**) + 0.0640***TD** - 0.0282***WS** + 0.0293***R** + 73.3478

C = 0.2506***T** - 0.1220*log(**SR**) + 0.3182***TD** - 0.0640***WS** + 0.0323***R** + 61.5666

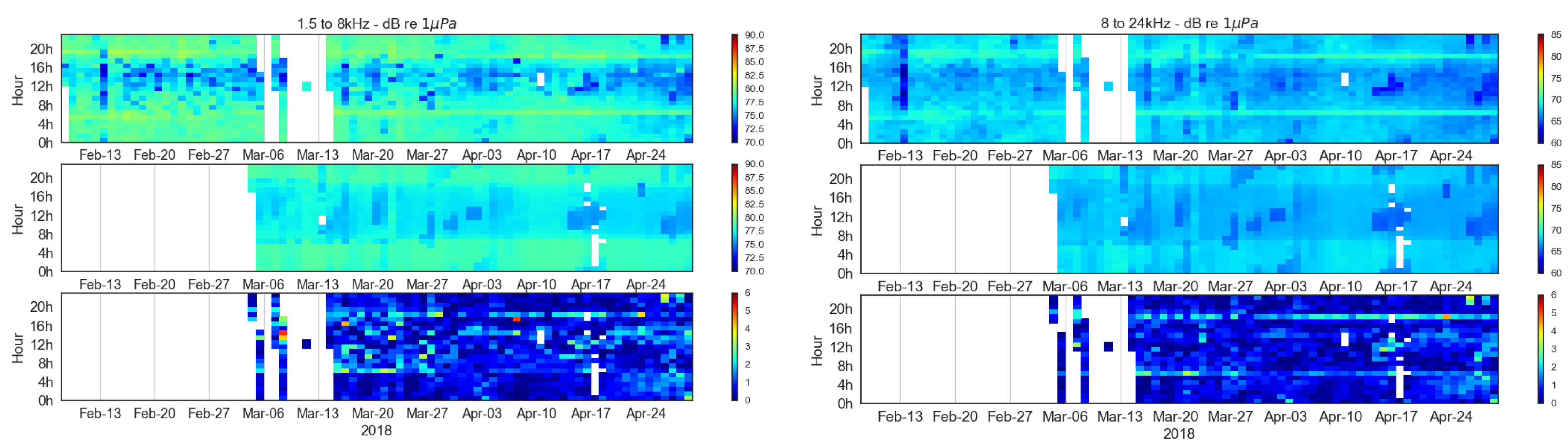

Figure 4 - RSBS data (top), RSBS model (center) and RSBS difference between data and mode (bottom): band B (left) and band C (right).

Regression analysis revealed that temperature and light (solar radiation) explain approximately [**B**: 40%, **C**: 50%] of the RSBS variance, while other abiotic factors explain just [**B**: 2.5%, **C**: 5%], approximately. Another important result was the nonlinear relationship between light (solar radiation) and RSBS.

CONCLUSIONS

This puts in evidence that the biorhythm can be one of the principal of contributors for RSBS, increasing in twilight. This model may help to understand RSBS pattern and its variations, and help for developing bioacoustic inversion applications as abiotic data measuring, population density of benthic organisms and marine health monitoring.

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