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Implications of Meteo-Oceanographic Events and Urbanized Watersheds in the Water Quality of Santa Catarina Island Bay (Brazil)

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Introduction

Nutrient runoff from anthropogenic activities are a major threat to coastal ecosystems worldwide, especially in the developing countries, due to the lack of effective management (Cloern, 2001). Santa Catarina Island Bay - SCIB (Fig. 2) has experienced an expressive urban and agricultural expansion in the last decades, without a corresponding improvement of the wastewater treatment systems. Furthermore, there is little government enthusiasm to deal with non-compliance with regulations and illegal dumping. Thus, the objective of this research is to investigate the mechanisms driving CNP (Carbon, Nitrogen and Phosphorus) biogeochemistry and eutrophication of SCIB, in order to understand its water quality and to improve the coastal management.

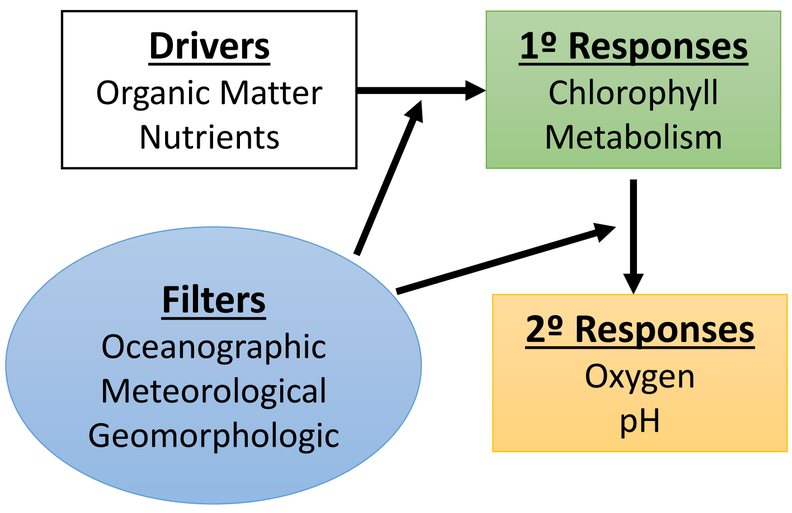


Figure 1. Conceptual model of coastal eutrophication. Magnitude of responses is proportional to drivers and filters. Adapted of Cloern (2001).

Study Site

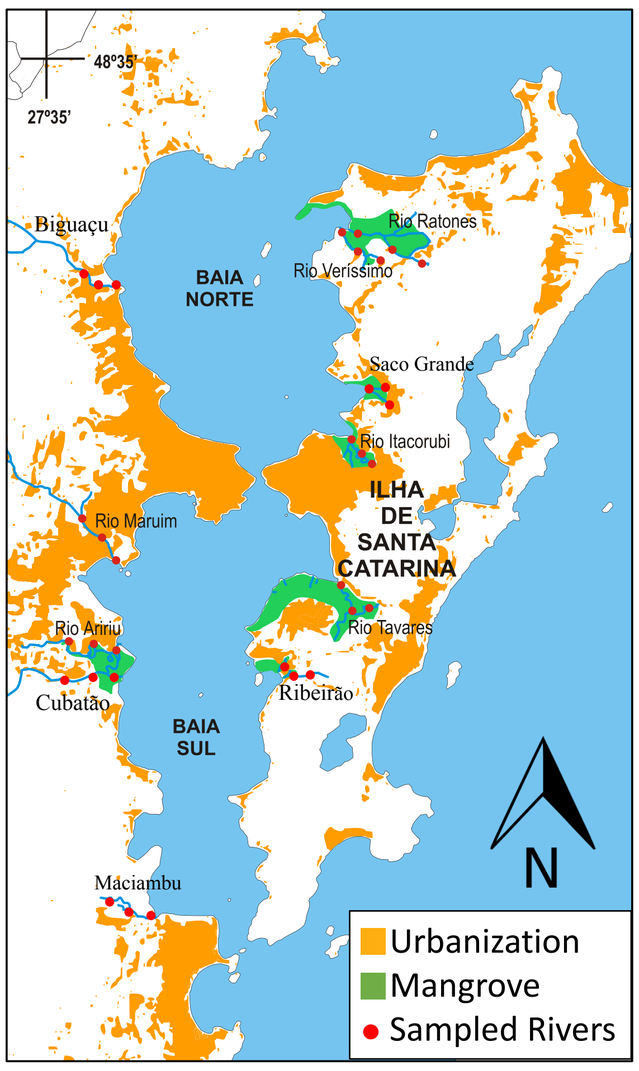


Figure 2. Map of SCIB and its watershed. Adapted of Pagliosa et al. 2006.

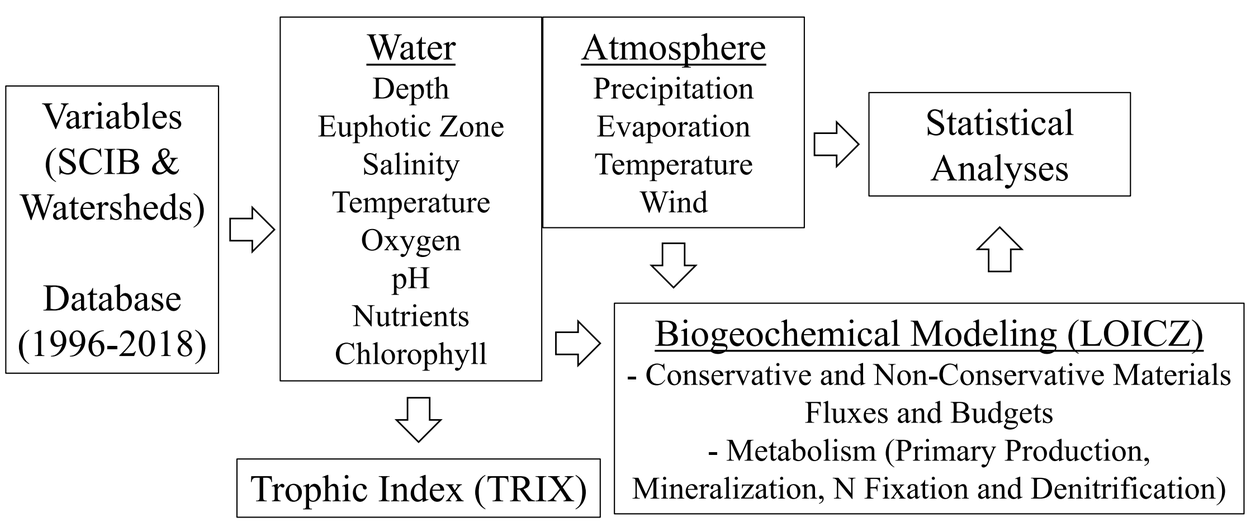
SCIB is located in the subtropical region of Brazil (Fig. 2), where high meteorological and oceanographic variability are observed (Fig. 3).

It is characterized as a coastal brackish water system, with an average depth of 4 m and 50 Km of length. The tidal regime is the semidiurnal, with daily amplitude less than 2 m.

There is a predominance of sandbanks in the south sector and muddy sediments in the north. SCIB watershed has a size of 1767 Km^2, where about 1.5 million of people live (IGBE).

Main economic activities in the bay are tourism and fisheries. In Brazil, 85% of oysters and mussels aquaculture are produced at SCIB, even though toxic algal bloom is frequently reported.

Methodology



Preliminary Results

Seasonal – Axis 1

- Explained by temperature (r = 0.84)
- Spring-Summer influenced by Brazil Current (Subtropical Shelf Water)
- Fall-Winter influenced by La Plata River Water

Spatial – Axis 2

- Explained by Salinity (r = -0.87)
- Waters in the inner bay rich in nutrients
- Shelf waters with higher concentrations of dissolved oxygen and salinity

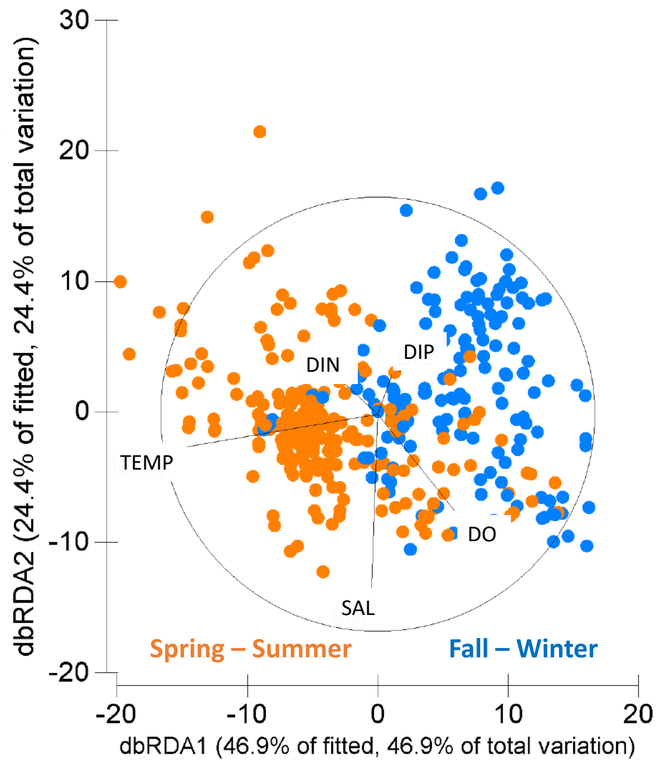


Figure 3. Distance-based redundancy analysis (dbRDA) performed on PRIMER 6 under Gower resemblance matrix. Variables analyzed: SALinity, TEMPerature, Dissolved Oxygen, Dissolved Inorganic Phosphorus and Dissolved Inorganic Nitrogen in the water column of SCIB. N=309. Years: 2005-2010.

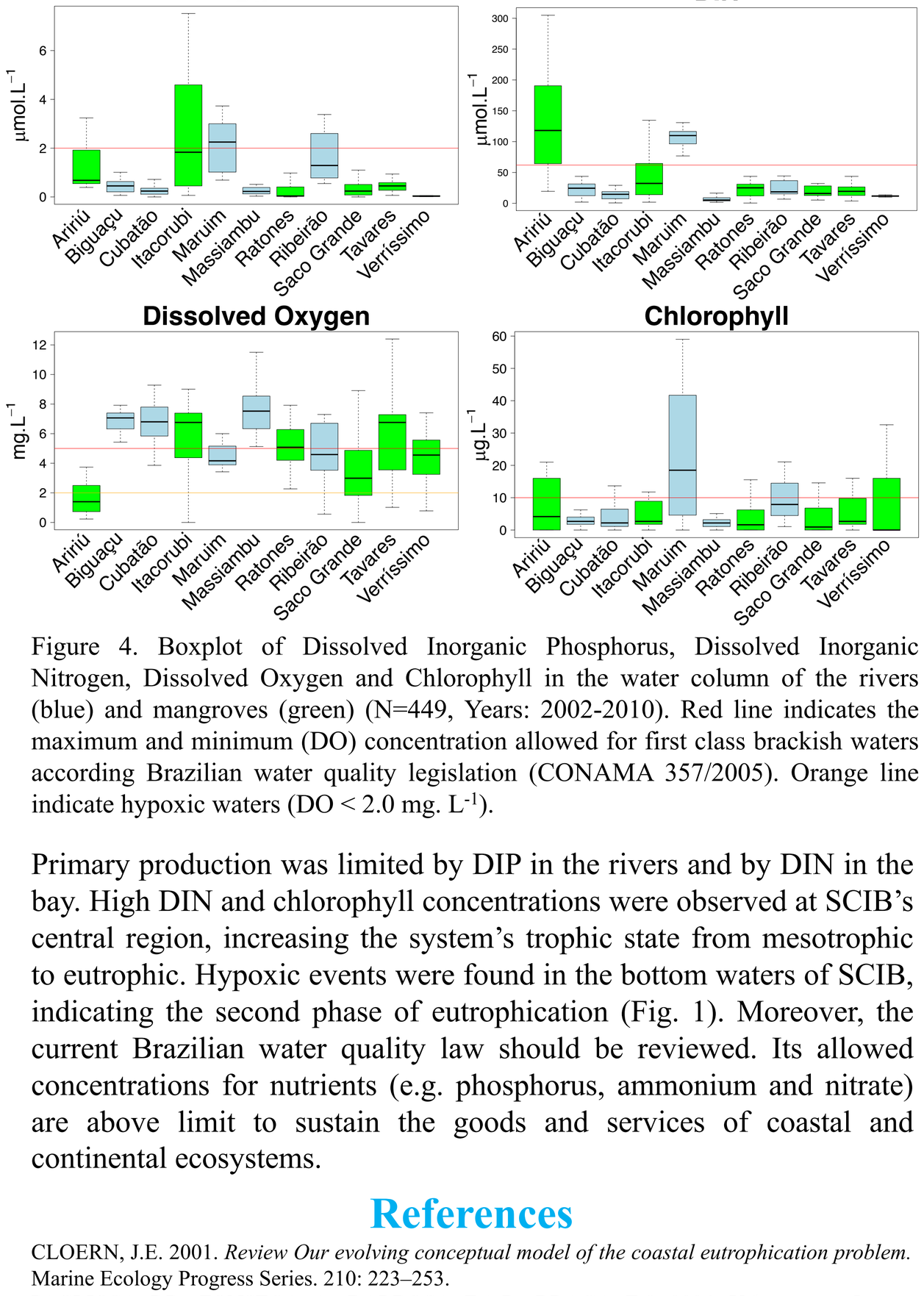


Figure 4. Boxplot of Dissolved Inorganic Phosphorus, Dissolved Inorganic Nitrogen, Dissolved Oxygen and Chlorophyll in the water column of the rivers (blue) and mangroves (green) (N=449, Years: 2002-2010). Red line indicates the maximum and minimum (DO) concentration allowed for first class brackish waters according Brazilian water quality legislation (CONAMA 357/2005). Orange line indicate hypoxic waters (DO < 2.0 mg. L^{-1}).

Primary production was limited by DIP in the rivers and by DIN in the bay. High DIN and chlorophyll concentrations were observed at SCIB's central region, increasing the system's trophic state from mesotrophic to eutrophic. Hypoxic events were found in the bottom waters of SCIB, indicating the second phase of eutrophication (Fig. 1). Moreover, the current Brazilian water quality law should be reviewed. Its allowed concentrations for nutrients (e.g. phosphorus, ammonium and nitrate) are above limit to sustain the goods and services of coastal and continental ecosystems.

References

CLOERN, J.E. 2001. *Review Our evolving conceptual model of the coastal eutrophication problem.* Marine Ecology Progress Series. 210: 223–253.

PAGLIOSA, P.R.; FONSECA, A.; BARBOSA, F.A.R.; BRAGA, E.S. 2006. *Urbanization Impact on Subtropical Estuaries: a Comparative Study of Water Properties in Urban Areas and in Protected Areas.* Journal of Coastal Research. SI (39): 731-735.