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Towards a time series in a tropical estuary: progress and perspectives in Colombia (South America).

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Abstract

TARENA goal is to understand biogeochemically in the Gulf of Urabá (GU) an estuary located in the southwest Caribbean Sea, Colombia (South America) one of most productive ecosystems and biodiverse in this nation. Historically, this estuary has been studied from the point of view of strategic ecosystems such as mangroves, seagrasses, reefs and others. Nevertheless, environmental monitoring since oceanography is incipient. Here, beginning in 2018 a sampling program nearly 40 locations, from brackish estuaries to offshore basins >100m depth, 80km of longitude along of estuary (North to South). Today, using a survey design and measuring variables multiple such as nutrients, algal bloom toxins, dissolved oxygen, pH, currents, microlayers, chlorophyll-a, biomass, diversity planktonic (phytoplancton, zooplanton and microbies), SST, salinity and density. In addition to these variables, here we will highlight some key findings and trends from the time serie. Conditions thermohalines showed that in the estuary density of water depends significantly on salinity and not on temperature and temperature warmer than the existing on the surface, probably due to differences in density between the water of the gulf and that of the Caribbean. Moreover, salt wedge was studied and results suggest that the progress of the Atrato and Leon rivers upstream outlet wedge depends on the climatic seasonal. Similarly, with the measurements in the area of the Atrato river and the middle part of the gulf, the theoretical potential energy was calculated by means of the salinity difference. Finally, TARENA expeditions has allowed us to know the diversity of a few explored area within the coastal ecosystems of Colombia, opportunities to join the collaboration in next years and upcoming challenges in other measurements such as tides, waves and the implementation of low-cost instrument launches to expand coverage in places still unexplored.
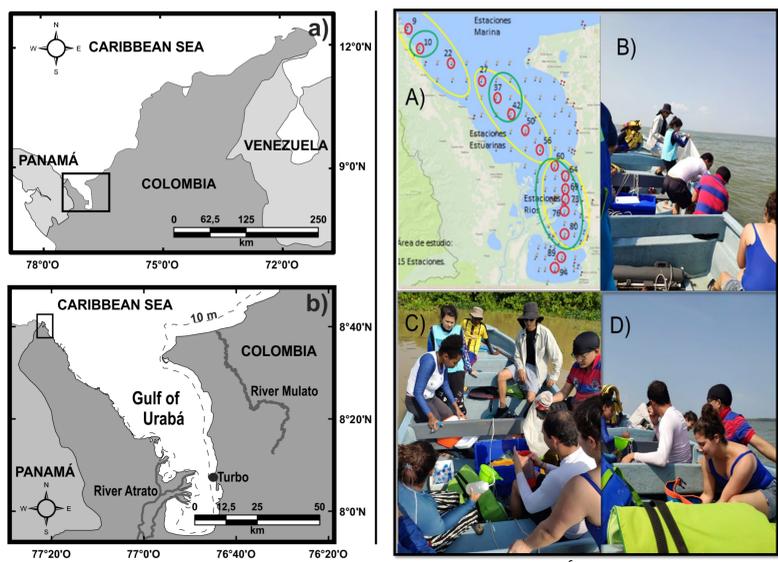
Results

Figure 1. Map showing the Gulf de Urabá (8.12 Lat N , 76.75 Long W) and TARENA Expedition in 80 km in length of North to South in the estuary.
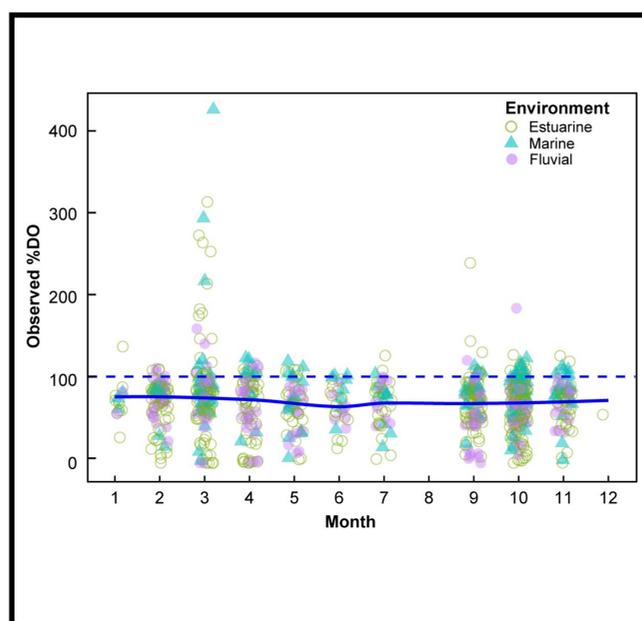

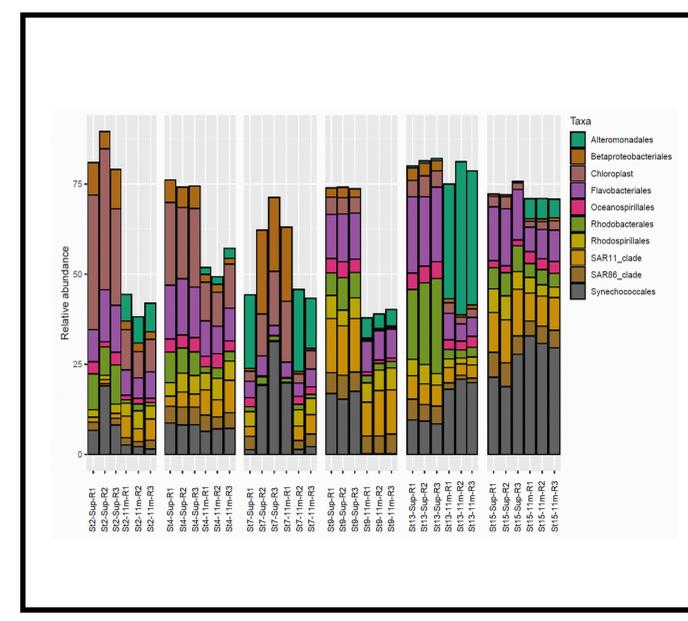**Figure 2. Dissolved oxygen saturation percentage over 10 years in three contrasting zones in the estuary.**

Figure 3. Microbial diversity along the estuary.
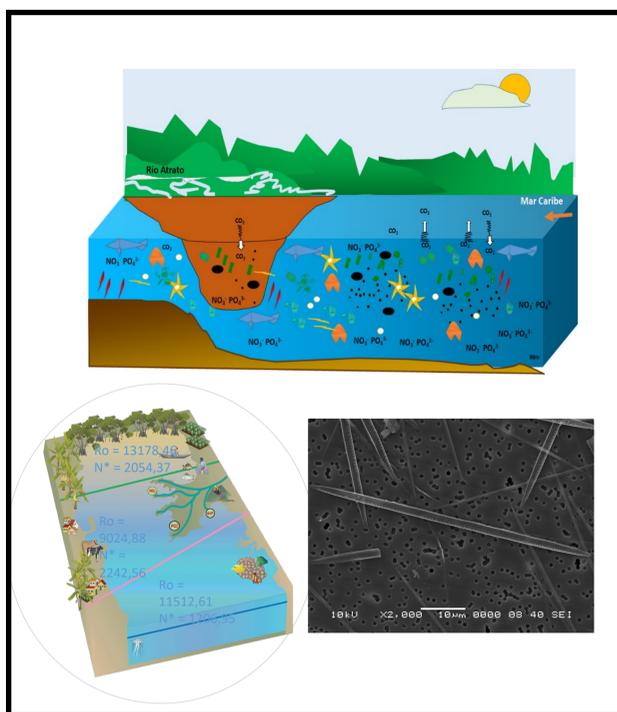

Figure 4. Conceptual maps of the functioning of the estuary and photography of toxic algae.
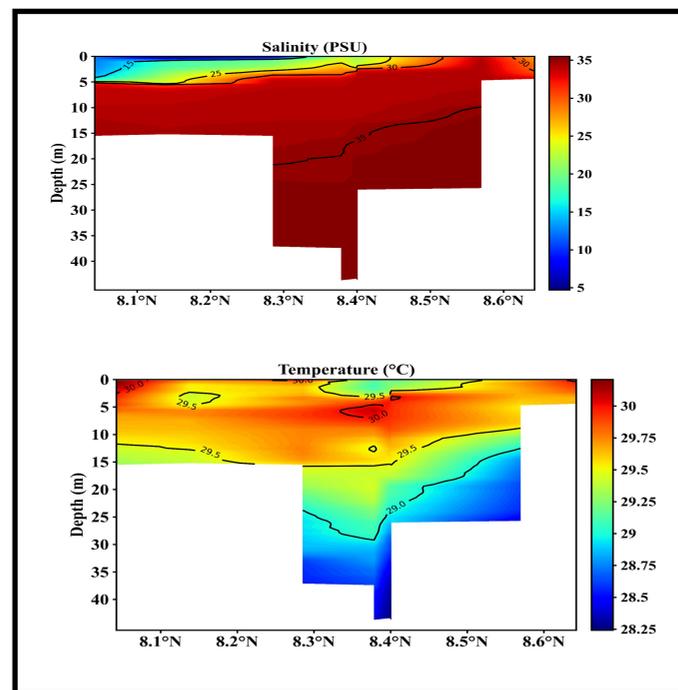

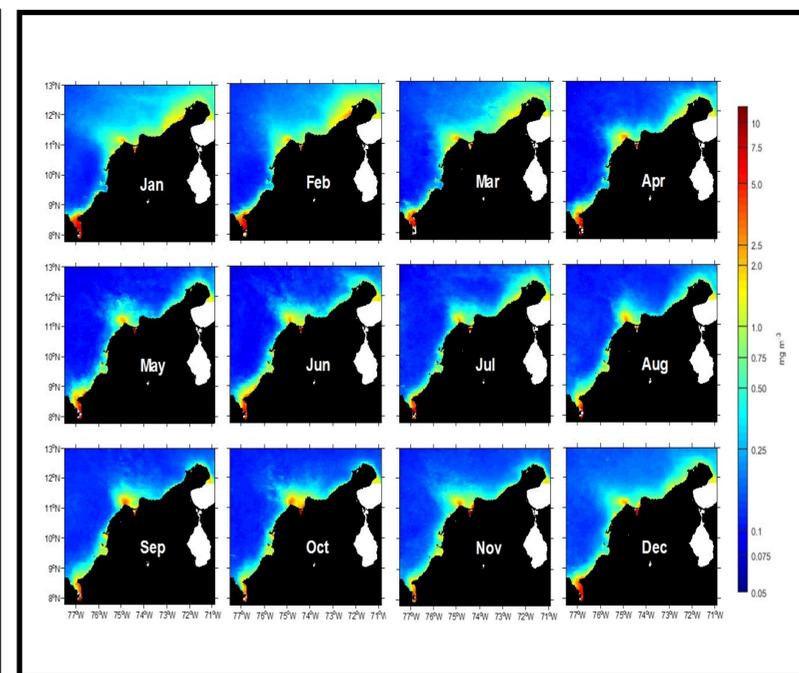**Figure 5. Vertical temperature and salinity profiles along the estuary.**

Figure 6. Time-series (13 years) annual average of Chlorophyll-a in the Colombian Caribbean. Note value in the gulf of Urabá.

Conclusions

1. High concentrations of chlorophyll-a in the Gulf of Urabá indicates that the delta is a mesotrophic area with high primary production. Local processes in the region such as the supply of nutrients from the Atrato River can withstand these high concentrations.

2. During 10 years of monitoring, hypoxia events were observed along the estuary. This deficit of oxygen can generate mass mortality of the local fisheries. However, the causes have not been documented.

3. Quality of water in the coastal areas of the eastern edge has been considered between the categorization of bad to regular, product of little treatment of wastewater and the excess of nutrients that reach the ecosystem.

4. The gulf presents toxic algae blooms causing the domoic acid potentially causing toxins. It can generate massive animal death. The toxic blooms are near the river with an abundance of pennate diatom Pseudo-nitzschia pseudodelicatissima.

Acknowledgment