Does climate drive changes in nutrient concentrations of mangrove sediments? A comparison between Basin and Fringe Forests in La Parguera, Puerto Rico

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Introduction

Low land use change characterizes La Parguera mangroves as relatively pristine (Sanders et al., 2014). However, in the past 60 years they have experienced a 1.7cm/yr sea level rise (SLR) vs. 9.7cm/yr in the past decade (Holgate et al., 2013; PSMSL, 2016). Studying their capabilities to abate the release of excessive nutrients into marine ecosystems will aid the understanding of mangrove sustainability with accelerating SLR and climate change.

Objectives

- Correlate changes in downcore sediment composition with precipitation and temperature records
- Study differences between fringe and basin forests in La Paguera

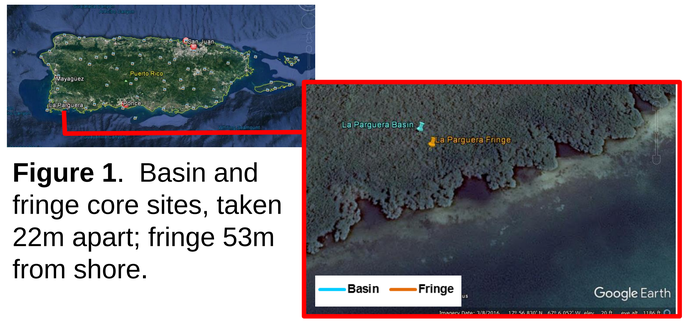


Figure 1. Basin and fringe core sites, taken 22m apart; fringe 53m from shore.

Southwest Coast of Puerto Rico

- Mangrove forests in southwest Puerto Rico are subject to low wave energy, low annual precipitation—30.23in from 1971-2010 vs 169.47in eastern coast (NOAA)—and low river runoff, in any.
- Fringe forests are subject to tidal flushing thus higher percent phosphorus would be expected compared to basin.
- Basin forests develop behind the fringe, at lower elevation thus are characterized by some inundation and higher salinity due to elevated air temperature (~27°C) and evaporation (Lugo & Cintrón, 1975).

Research Methodology

- Fringe and basin 50 cm deep soil cores were collected in La Parguera mangroves—sectioned into 2 cm intervals until 10 cm depth and then at 1 cm (Dr. Joseph Smoak).
- Intervals were processed for dry bulk density (DBD) and loss on ignition (LOI); homogenized samples went through total phosphorus colorimetry and a carbon and nitrogen elemental analyzer.
- Accretion rates will be determined via Lead-210 dating by Dr. Joseph Smoak.

Figure 2. Core sampling in La Parguera mangroves, top view of sediment sample and horizontal core sectioning.

Initial Results and 20th Century Climate Data

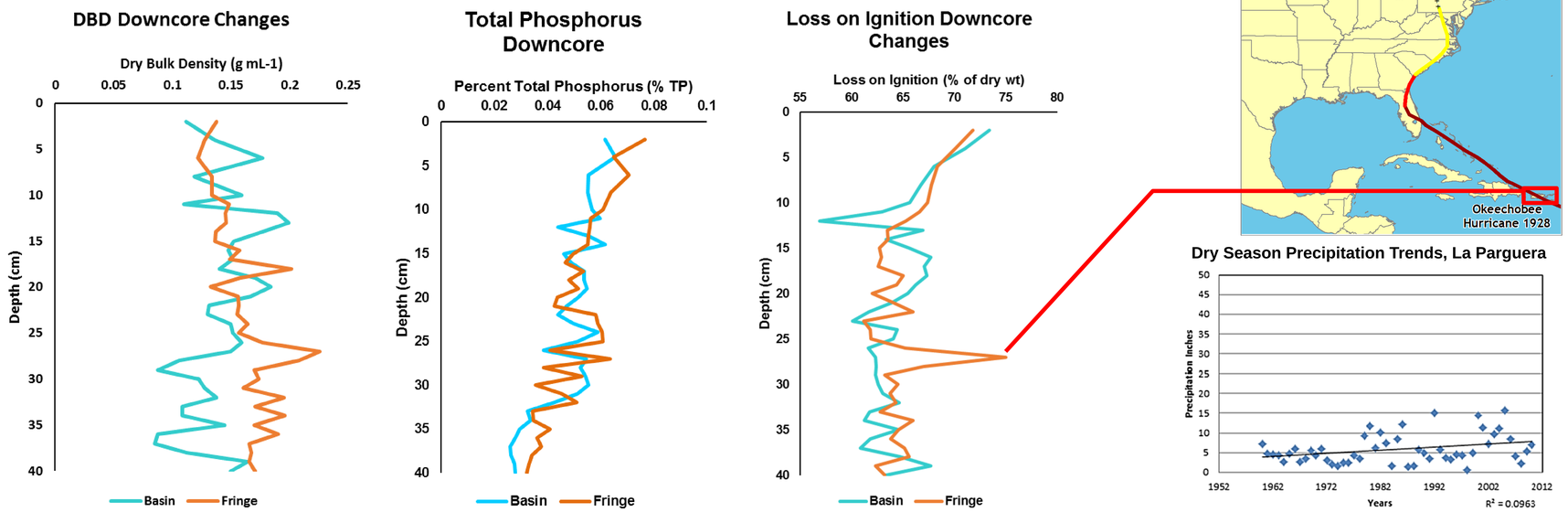
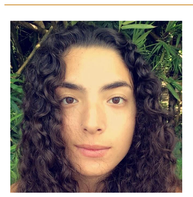


Figure 3. Results for dry bulk density, total phosphorus, and loss on ignition in basin and fringe core sites. Path of Hurricane San Felipe II (NOAA). Dry season precipitation trends for Isla Magueyes weather station in La Parguera (Ayala & Jose, 2012).

- Total phosphorus presented a slight increase over time in both core sites, which corresponds with a global increase in nutrient transport to oceans in the 20th century (Beusen et al., 2016). Based on 2.5-3.6 mm/yr accretion rates in the Florida Everglades, high LOI in the fringe could be associated to Hurricane San Felipe II in 1928 (Okeechobee).
- While increased precipitation leads to higher projected productivity (Lovelock et al., 2009), predicted drying trends for the Caribbean (Neelin et al., 2006) and increasing hurricanes (Bender et al., 2010) pose a problem for these mangrove forests. Climate change could lead to low mangrove productivity, lower accretion rates and greater impacts to mangrove sustainability, heightened further by sea-level rise.



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