SHORELINE CHANGES FROM 1986 TO 2010 ON PONTA NEGRA BEACH, NATAL / RN, NORTHEAST BRAZIL.

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Paper topic: Coastal risks and management, including climate changes.

1. Introduction

Many sandy beaches around the world are suffering erosion, natural process that has sometimes been intensified by inappropriate human actions in the coastal zone (Schlacher *et al.*, 2007). The tropical Atlantic coastal zone of Rio Grande do Norte State, extreme northeast Brazil, where Natal city is located, is a densely populated and urbanized coastal plain conurbation. The Ponta Negra Beach has become one of the most popular tourist destinations and so increased the real estate interests in the vicinity, forcing the municipality to initiatives such as the construction of the boulevard seaside with a 3.0 km boardwalk along the beach (Figure 1 a). Urbanization in the vicinity of the beach has developed intensely from the 80s and increased the population density from 2,490 to 4,800 people/km^2 between 1980 and 2010. Since then, many constructions were implemented and favored the occupation of the shore. Hotel chains have grown significantly since 90s due to large investments by European and Latin American companies, and much of these chains are in Ponta Negra Beach (Queiroz, 2010). Ponta Negra Beach suffered a sediment budget deficit in recent decades and this erosion is occurring in both area and volume scale factors (Busman; Amaro, 2012). This paper aimed the assessment of the long-term (interdecadal) coastline changes of Ponta Negra Beach between the years of 1986 and 2010, taking into account periods from 1986 to 1999 and 1999 to 2010.

2. Methodology

The Digital Shoreline Analysis System (DSAS; Thieler et al., 2009), an extension tool for ArcGIS® software developed by United States Geological Survey (USGS, http://woodshole.er.usgs.gov/project-pages/DSAS/), was used to determine the rate of change for the Ponta Negra Beach shoreline. A landward baseline was shaped encompassing most of actual shoreline and transects perpendicular to the baseline about 10 m apart intervals were created along the beach system. Two types of shoreline change rates were determined, the End Point Rate (EPR) that was calculated by defining the distance between the oldest and most recent shoreline in dataset and dividing it by the number of years between them, and Net Shoreline Movement (NSM) that reports the distance between the oldest and youngest shoreline features for each transect.

3. Results and Discussion

The shoreline evolution and the change rate on Ponta Negra Beach between 1986 and 1999 had an average advance rate of 0.3 m/year, representing almost 4.0 m in one decade, and the shoreline rate ranged from -2.1 to 3.3 m/year. However, between 1999 and 2010 there was an average retreat rate of 1.0 m/year, corresponding to nearly 11.1 m per decade, approximately. The shoreline rate ranged from -4.7 to 2.3 m/year. Therefore, results accumulated for years 1986 to 2010 revealed the largest accretion of 21.4 m and but the greater erosion was 30.5 m, with an average of -7.1 m. Largely in Ponta Negra Beach a depositional process had occurred until 1999, followed by intense erosive process further active until 2010 and more effective until present (figure 1 b, c).

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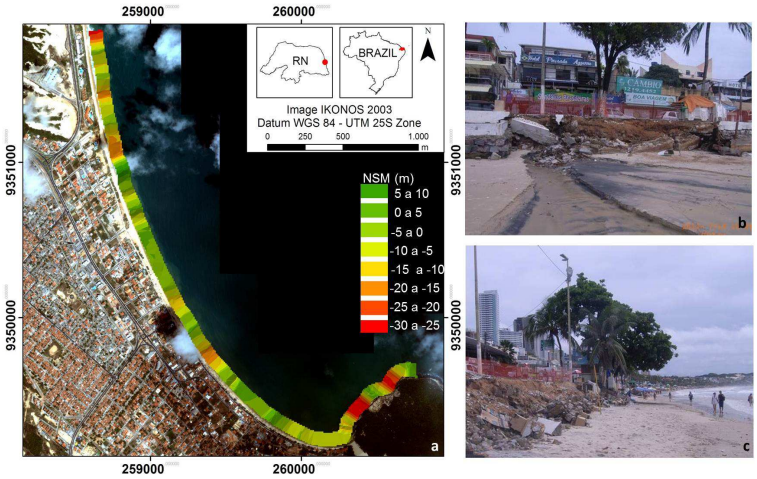

Figure 1. (a) Localization map of the study area classified with NSM rate; (b) Boardwalk of Ponta Negra Beach partially destroyed; (c) General view of eroded beach face.

In between 1986 and 1999, the general balance was accretionary of about 21,086 m^2 and from1999 to 2010, the areal balance was negative of 57,242 m^2. Finally, for the entire set of shoreline from 1 986 to 2010, there was a negative balance of 36,159 m^2. These results strongly suggest that Ponta Negra Beach is subject to strong erosive processes in recent decades. Nevertheless, appropriate sho reline change analysis requires a systematic understanding of the coastal processes that cause the c hange.

4. Conclusions

On the study area the average rates of the shoreline variations were negative, although there were episodes of sediment deposition in some beach segments probably related to seasonal concentration of sediments on movement alongshore, but strongly indicating a greater deficit in sedimentary cycles through time. The sediment transport, induced by the hydrodynamic conditions, affects beach morphology profile and the volume of eroded sand. In Ponta Negra Beach seaside infrastructures were constructed without previous comprehension of the coastal process and eventual hazards arising with regard to the interruption of exchange energy and sediments in the beach-dune system. Coastal zone is naturally dynamic and coastal processes do not recognize nor even respect limits imposed by public managers, mostly concerning deficient sedimentary cycles in urban waterfronts. DSAS tools proved to be suitable for the analysis of coastal evolution on this beach and applicable to management decisions in a longer-term.

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