A study of beach profile changes at selected beaches on the north coast of Puerto Rico (2009-2013).

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ABSTRACT
This study includes an evaluation of beach profile changes in selected beaches in the north coast of Puerto Rico from 2009-2013. Permanent profile stations were located on diverse geographic coastal scenarios as beaches: 1) protected by natural barriers 2) semi-protected by natural or man-made barriers, and 3) exposed to direct impact of waves and swells. Beach monitoring was done in monthly basis and/or during normal wave regime conditions and after occurrences of swells. Wave data (height, period and direction) and climatological data (cold fronts and storm occurrences) were acquired from published data bank from the Caribbean Coastal Ocean Observing System (CariCOOS) and weather chart published by the National Oceanographic and Atmospheric Administration (NOAA). Results showed continuous beach morphology changes from reflective to dissipative profiles, and vice versa, during the study period. Major beach profile changes were observed during the occurrence of swells generated by cold fronts arriving from the north Atlantic. These changes occurred mainly during the occurrence of swells approaching from north and northwest with wave periods ranging from 11 to 18 seconds.

OBJECTIVES
• Document a beach profile changes at selected beaches on the north coast of Puerto Rico (2009-2013).
• Identify possible relation between beach profile changes and wave climate.

STUDY SITE
The study is conducted in three beaches on the north coast of Puerto Rico. These are: 1) Tómbolo Beach located in Manati municipality; 2) Puerto Nuevo Beach at Vega Baja; and 3) Fortuna Beach at Luquillo municipality. Beach profiles are delineated by sand dunes, beachrock, eolianitas and marine terraces. In situ corals, seagrass and algal beds were observed along the narrow insular platform. Wave regime is high characterized by the presence of swell coming from North Atlantic and waves generated by tropical storm and cold front systems. Rivers were found near of beach sites in the study areas. These are: Río Grande de Manati, Río Cibuco and Río Espiritu Santo. Beach sediments are mixed terrigenous and biogenic in study sites.

METHODOLOGY
Beach profile lines were measured in monthly basis using a level and calibrated rod in permanent stations. The selection of these stations was based on the need of natural protection and/or exposure to the direct impact of seas and swells in the site. Data of significant wave heights, dominant period and direction were evaluated during study period from published data collected by the Caribbean Coastal Ocean Observing System (CariCOOS). Storm and cold front occurrence data were collected from databases published by National Atmospheric and Oceanographic Administration (NOAA). These variables were evaluated to identify possible relations of wave type producing beach profile changes in the site.

FINDINGS
1. Wider beaches were found in geographical areas protected by natural barriers as eolianitas and beachrock.
2. Major changes in beach profile (erosion or accretion) were found during the occurrence of swells during 2010 and 2012.
3. Swells affecting beach profile morphology (elevation) were related with the occurrence of cold fronts and extratropical systems during 2010 and 2012 (wave period range from 11 to 18 seconds and arriving from north and northwest direction).

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