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Wave and tidal level analysis, maritime climate change, navigation's strategy and impact on the costal defences – Study case of São Paulo State Coastline Harbour Areas (Brazil)

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São Paulo State Coastline Harbour Area concentrates around of 40% of Brazilian GNP, Santos Harbour is the America South Atlantic Hub Port and São Sebastião Oil Maritime Terminal is the most important oil and gas facility of PETROBRAS, the Brazilian National Petroleum Company. Santos Harbour had in the last decade increased rapidly the container handling rate, being the first in Latin America. In the last decade important oil and gas reserves were discovered in the Santos Oceanic Basin and São Paulo Coastline received a big demand for supplier ships harbours for the petroleum industry. Santos Metropolitan Region is one of the most important of Brazilian Coastline, also considering the turism. For that great economic growth scenario it is very important to have the main maritime hydrodynamics forcing processes, wave climate and tidal levels, well known, considering the sea hazards influence in ship operations. Since the hindcast just represents the deep water wave climate, to make time-series of the waves parameters in coastal waters, for evaluation of sea hazards and ship operations, it is necessary to take into acount the variations of those parameters in shallow waters with coastal instrumental data. Analysis of long term wave data-base (1957-2002) generated by a comparison between wave's data modeled by a "deep water model" (ERA40-ECMWF) and measured wave's data in the years 1982-1984 by a coastal buoy in Santos littoral (São Paulo State, Brazil) was made. Calibration coefficients according to angular sectors of wave's direction were obtained by the comparison of the instrument data with the modeled ones, and applied to the original scenarios. Validation checking procedures with instrumental measurements of storm surges made in other years than 1982-1984 shows high level of confidence. The analysis of the wave climate change on the extreme storm surge wave's conditions, selecting cases of Hs > 3,0 m, using that virtual data-base shows an increase in the Hs and Tp figures and also in the frequency of storm surge events in the last decades. According to that trend, the 50 year return period Hs and Tp were forecasted for the next 50 years, comparing the figures obtained from the 1957-2006 and 2007-2056 periods, from the point of view of the harbour and coastal structures purposes of navigation and coastal defences. Another set of sea state long term data was added to that analysis, is the tidal level variability (high tide, mean sea level and low tide). Considering the CDS (Santos Dock Company) datum, extreme LLW level, tidal variability for the last six decades (1944 - 2007) shows a consistent linear response in cm/century: 1. Overall period: rising rates for MSL (23.2), HHW (36.5) and LLW (41.8); 2. Period before 1969: 1.1, - 7.3 and 54.3; 3. Period after 1975: 40.9, 44.9 and 75.4. Considering the increasing sea hazards demonstrated, the high values of the facilities and infrastructures, it is necessary to evaluate the harbour and coastal defences to mitigate the risks of natural disasters. Some of them are highlighted as guidelines strategies suggested.