

Numerical assessment of tidal potential energy in the Brazilian Equatorial Shelf

Alessandro L. Aguiar ^{a,b,c,j}, Martinho Marta-Almeida ^{g,h}, Mauro Cirano ^{i,j}, Janini Pereira ^{d,f,j},
Letícia Cotrim da Cunha ^{b,c,e}

^a Departamento de Oceanografia Física e Meteorologia, Faculdade de Oceanografia,
Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil

^b Programa de Pós-graduação em Oceanografia, Faculdade de Oceanografia,
Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil

^c Rede Clima, Sub-rede Oceanos, Instituto Nacional de Pesquisas Espaciais, São José
dos Campos, Brazil

^d Programa de Pós-graduação em Geofísica, Instituto de Geociências, Universidade
Federal da Bahia, Salvador, Brazil

^e Rede Brasileira de Pesquisa em Acidificação dos Oceanos (BrOA), Universidade
Federal de Rio Grande, Rio Grande, Brazil

^f Departamento de Física da Terra e do Meio Ambiente, Instituto de Física, Universidade
Federal da Bahia, Salvador, Brazil

^g Centro Oceanográfico de A Coruña, Instituto Español de Oceanografía, A Coruña,
Spain

^h Centro Interdisciplinar de Investigação Marinha e Ambiental, Universidade do Porto,
Portugal

ⁱ Departamento de Meteorologia, Instituto de Geociências, Universidade Federal do Rio
de Janeiro, Rio de Janeiro, Brazil

^j Rede de Modelagem e Observação Oceanográfica (REMO), Brazil

Abstract

The Brazilian Equatorial Shelf (BES) is one among the macrotidal regions worldwide. This study used a high-resolution numerical configuration of the ocean model ROMS (Regional Ocean Modeling System) forced with realistic surface and lateral forcing, as well as with tides and river discharges. Tidal heights of more than 2 m were found in three regions in BES due to the large tidal amplification across the estuarine channels inside each region: Amazon, Pará, and Maranhão, and for a considerable time fraction. Heights between 4 and 5 m occurred with a frequency greater than 20%–30% in some regions. All hypothetical barrages proposed in this study were capable of an annual power production, in two-way mode, higher than La Rance (533 GWh year⁻¹, two-way operation, France) and Sihwa (553 GWh year⁻¹, flood-only operation, South Korea), except one with the same production as Sihwa barrage. The installation effort was evaluated using the Gibrat ratio, the ratio between the length of the barrage and its annual energy production. Among the proposed barrages, the most efficient ones have an annual power generation greater than 1500 GWh year⁻¹ and a Gibrat ratios between 1.17 and 3.26, much lower than the Gibrat ratio of Sihwa tidal barrage.