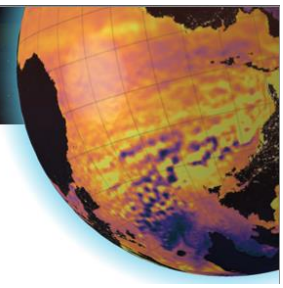
Development of a Coastal Forecast System for the Guanabara Bay - Rio de Janeiro – Brazil

The Physical Oceanography Laboratory - LOF/COPPE, the Brazilian Coastal Monitoring System (SiMCosta), and Deltares are collaborating to develop a 3D hydrodynamic coastal forecast system for the Guanabara Bay (GB) in Rio de Janeiro. GB is a significant coastal embayment in Brazil, supporting a variety of economic activities and experiencing intense marine traffic. Located in the greater Rio de Janeiro metropolitan area, the bay's margins are home to numerous communities, and sewage-related pollution is a major concern. In this context, an open-access coastal model will be valuable for providing environmental forecast information to the general public and navigation communities, as well as offering tools for ecological studies. The coastal model will have its oceanic boundaries forced by a regional ocean forecast system, hereafter referred to as LSE36-LOF/COPPE. The LSE36-LOF/COPPE is based on the Hybrid Coordinate Ocean Model – HYCOM and the T-SIS assimilation system, and effectively simulates oceanic subinertial processes, such as Coastal Trapped Waves (CTWs) and coastal upwelling/downwelling dynamics. CTWs have been observed to induce sea level variations as high as ~50 cm within GB, consistent with simulations from the oceanic model at the grid point nearest to the bay. At lower levels in the water column, a subsurface oceanic water mass known as South Atlantic Central Water (SACW) intrudes into GB, driven by upwelling/downwelling dynamics at shelf waters. The presence of this dense, cold, nutrient-rich water influences gravity currents, water renewal, and the ecological structure of the bay. Multi-parameter profiles, utilizing an AAQ-RINKO sonde, were conducted from 24 June 2022 to 04 June 2024. The SACW was observed on 6 out of 12 occasions, primarily between spring and early fall. During these 6 occasions, the LSE36-LOF/COPPE system also indicated the presence of SACW near the bay area, supporting the proposition that it is originated from the coastal upwelling dynamics. The coastal Delft3D FM model is currently under configuration. Initial testing involved setting up an oceanic open boundary with harmonic constituents from the TPXO9-atlas tidal model, showing good agreement between data and model results. Presently, preparations are underway for a 2D simulation incorporating LSE36-LOF/COPPE (which includes tides) at the boundaries. Future steps include integrating river discharges, wind forcing, and configuring the 3D coastal model with boundary conditions from the regional forecast system.

Fernando D.T. Barberini - Ocean Engineering Program - Federal University of Rio de Janeiro / Brazilian Coastal Monitoring System (SiMCosta); Afonso M. Paiva - Ocean



Engineering Program - Federal University of Rio de Janeiro; Mauro Cirano - Institute of Geosciences, Federal University of Rio de Janeiro (UFRJ) / Brazilian Coastal Monitoring System (SiMCosta); Ghada El Serafy - Deltares, Delft, The Netherlands / TU Delft, Applied Mathematics; Luana F. Bueno - Ocean Engineering Program - Federal University of Rio de Janeiro / Fugro; Ana Carine R. Lara - Ocean Engineering Program - Federal University of Rio de Janeiro; Aron. F.C. Nunes - Ocean Engineering Program - Federal University of Rio de Janeiro; Mariela Gabioux - Ocean Engineering Program - Federal University of Rio de Janeiro; Bruno P. Siqueira - Vortex Mundus; Gabriel M. Motta - Rio de Janeiro State University / Brazilian Coastal Monitoring System (SiMCosta); Yago Carlo - Rio de Janeiro State University / Brazilian Coastal Monitoring System (SiMCosta); Tayanne P. Ferreira - Ocean Engineering Program - Federal University of Rio de Janeiro; Francisco L.P. de Moraes - Ocean Engineering Program - Federal University of Rio de Janeiro; Ana Caroline V. Lemos - Ocean Engineering Program - Federal University of Rio de Janeiro; Manuel N. Zau - Ocean Engineering Program - Federal University of Rio de Janeiro;