ABSTRACT

Numerical Modeling of Physical Oceanographic Features of the Southeast Palisadoes Coastal Shelf of Jamaica (WI)

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The objective of the study was to shed some light on the possible mechanisms influencing circulation on the Palisadoes Shelf of Jamaica (WI) and provide quantitative, model-based, descriptions of physical oceanographic features of the Palisadoes Shelf. The two-part study included, (i) a detailed, descriptive, account of physical oceanographic features on the Shelf (based upon current meter, tidal, wind and hydrographic field data), and (ii) a numerical modeling study of current patterns, sea surface elevations, coastal upwelling/downwelling and hydrography on the Shelf.

The employed numerical model was an adapted version of the three-dimensional, time-dependent, Blumberg-Mellor, Princeton Ocean Model (POM). The predictions and the performance of the Palisadoes Shelf-adapted model were validated through correlation analyses between "model-predicted" and "observed" current meter data. Achieved adjusted R-square values, of approximately 0.30 - 0.45, were considered indicative of good (and acceptable) correlations. Based upon, (i) the results of the model validation exercise, (ii) the fact that the model's predictions coincide with what is expected theoretically, and (iii) apparent synergy between the model's predictions and observed current speeds reported by independent authors/sources, it was concluded that POM does a good job at simulating current-generating mechanisms, current patterns and "free surface" variations on the Shelf.

Final conclusions were, (i) the Palisadoes Shelf is a poorly stratified, well-mixed, homogenous waterbody, (ii) Shelf circulation is mainly tidally- and wind-driven, and (iii) the presence and location of a barrier reef, cays and shoals have significant influences on horizontal currents, vertical currents and "free surface" variations. Overall, Shelf circulation is a varying, often complex, 3-D phenomenon; with opposing undercurrents, eddy currents and coastal jets. A 3-D hydrodynamic numerical model is therefore required for a proper discretisation, simulation and study of Shelf oceanography.

Keywords: numerical model; numerical methods; Princeton Ocean Model; model validation; physical oceanography; currents; tidal currents; wind-driven circulation; nearshore processes; ocean circulation; Jamaica; Palisadoes Shelf; Narinesingh.