

# Hydrodynamic Numerical Modelling Of Maputo Bay (Msc. Thesis)

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## Abstract:

The aim of this work was to understand by using a numerical model, the main characteristics of the Maputo Bay hydrodynamics; and furthermore to assess the hydrodynamics implications on the different processes that can occur in the Bay.

The study was initiated with a description of the hydrodynamical characteristics of Maputo Bay, through the analysis of vertical profiles of salinity and temperature, time series of the components of tide currents and water elevation. The wind intensity and river runoff patterns were also studied. Analysis of temperature and salinity profiles have revealed that the Maputo Bay can be considered vertically homogeneous; however, when floods occur or when there is high intensity of precipitation on summer season, a horizontal stratification of salinity and temperature in Maputo Bay was observed. The tides were identified as the main forcing on the Maputo Bay hydrodynamics. The general patterns of other forcing (winds and river discharges) were also identified.

Through the characteristics of the Bay (vertically homogeneous), and the process that is intended to be understood (long wave propagation), a bi-dimensional numerical model SYMS/S2D was chosen as the best to perform this study. Afterwards, the model was calibrated by comparison of observed and simulated time series of tide elevation, the horizontal and the vertical components of tidal currents. Results of calibration have shown that the model reproduces with accuracy the wave propagation in the Bay. The hydrodynamic study allows the determination of the form number (type of tide); the amplitude and phase of the main constituents, as well as, the influence of non-periodic forces on the Bay hydrodynamics, through the determination of residual currents.

The results of the hydrodynamic model have shown that in the Maputo Bay, the tide is essentially semi-diurnal, and that the main semi-diurnal constituents,  $M_2$  and  $S_2$ , represented almost 90% of the total astronomical tides. In most part of the Bay, the tidal wave has exhibited a characteristic that lies between a standing and a progressive wave. Was also noticed by the results of the Eulerian residual circulation, that the influences of rivers, winds and bathymetry on non-periodic forces were very important on long-term processes. A Lagrangian module was also coupled to the hydrodynamic model, to assess the evolution of dispersion processes of passive particles in the Bay. The results of the Lagrangian module have shown that for time scales superior than a tidal cycle, the mixing and dispersion processes are more important in the central part of the Bay and in the Estuário Espírito Santo zone, respectively; in other

zones these values are actually insignificant. The range of flushing time in the Estuário Espírito Santo zone lied between on day (on the mouth of the estuary)