HYDRODYNAMIC MODELLING OF TRINCOMALEE BAY

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Introduction

Trincomalee bay which spreads over an area of 6000 *ha* can be described as one of the best natural harbours in the world. The bay consists of Coddiyar bay, Shell bay, Thambalagamu bay and inner harbour. Mahaweli, the largest river in Sri Lanka is the major river inflow to the bay. More than half of the population of Trincomalee district lives around the bay. In addition, the port and various industries located near to the bay highlights the economic importance of the area. A larger portion of the Thambalagamuwa bay area is dominated by mangroves. Large deposits of shell are also found in the bay area, allowing high potential for ecotourism. Therefore, it is very important that the Trincomalee bay and its surrounding ecosystem be maintained in a sustainable manner despite rapid development activities taking place in this area. In this regard, use of mathematical models is very effective in analyzing large scale coastal water bodies. In this study, a three-dimensional mathematical model - *ELCOM* software package - is used to study the behaviour of water body in Trincomalee bay in terms of hydrodynamics and also to simulate salinity and temperature distribution within the bay.

Model Set-Up, Calibration and Verification

Since Trincomalee bay is a very large, deep and complex water body, a large amount of data needs to be collected. Bathymetry of the bay, Mahaweli river discharge and tidal fluctuations to be used as boundary conditions, initial condition & other data were collected for the whole year of 2005. Several trial runs were carried out to justify that the data collected for the study are acceptable and also to justify that the software is working properly. Next, the model was calibrated using the salinity and temperature data measured by CTD (Conductivity Temperature Depth) profiler. The salinity and temperature profiles in the surface layers obtained from the field measurements were compared with those obtained from model runs. By changing the drag coefficient, the differences between the measured and simulated salinity and temperature in the surface layers were minimized. After the model had been calibrated, it was verified using a completely independent data set collected from the same bay. Then the model was used to simulate the salinity and temperature distribution of the bay. Model results were obtained for January, February, March and April for the year 2005.

Results and Discussion

The current patterns in the surface layer of the bay at the end of a high tide and beginning of a low tide were compared (Figure 1). According to the current patterns it can be seen that the river water is flowing outward along the southern bank, near the entrance to

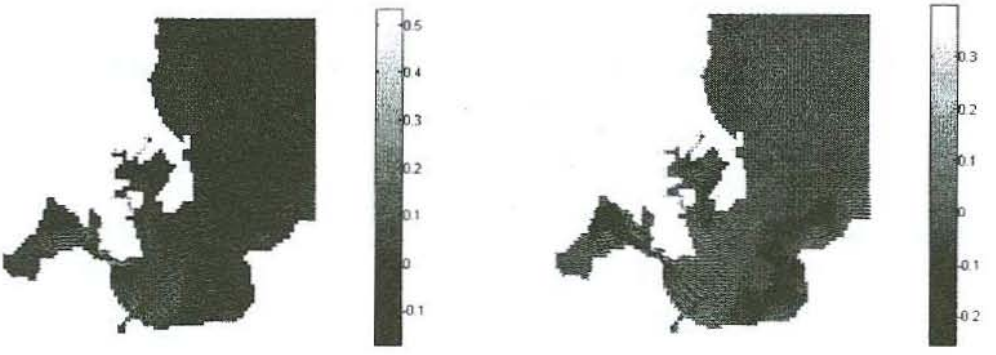

Figure 1. Current patterns of the surface layer (velocities are in *m/s*)

the Thambalagamuwa bay indicating complex current patterns.

Surface Salinity distribution in Trincomalee bay during high river discharge (500 m^3s^{-1}), moderate discharge (200 m^3s^{-1}) and low discharge (50 m^3s^{-1}) were compared in Figure 2. The results show that the surface salinity distribution of the Trincomalee bay is highly influenced by the discharge from the Mahaweli River. Lowest salinity levels are confined to south bank of the bay. This further confirms that the river water flows outward along the southern bank.

The temperature distribution in the water body of Trincomalee bay has also been simulated using *ELCOM* Model. Any significant variation of surface temperature distribution of the bay due to ocean tides and river discharges has not been identified. However, the temperature distribution of the surface layer during day and night time was apparent as indicated in Figure 3. Also the surface temperature in deep areas is comparatively lower than that in shallow areas. However the temperature at Thambalagamuwa bay is comparatively low although it is not a deep area. This could be partly attributed to the fact that river discharge flows through this part of the bay resulting continuous mixing.

Conclusions

A three dimensional mathematical model (*ELCOM*) has been applied to Trincomalee bay to simulate the

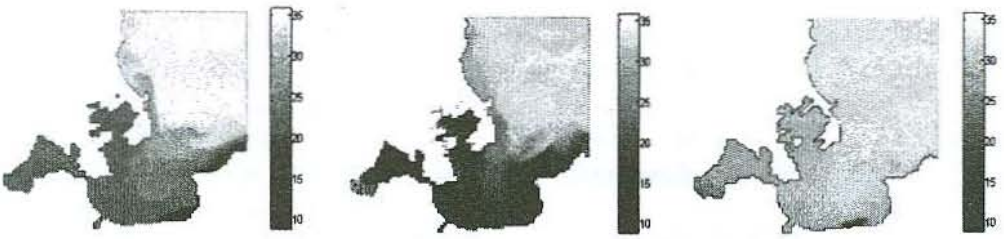

Figure 2: Surface salinity distribution (*ppt*) during period of high, moderate & low river discharge

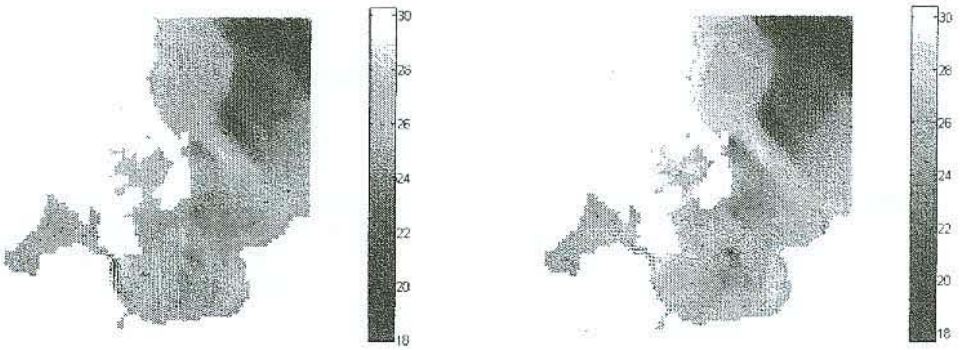

Figure 3: Distribution of surface temperature in the bay at day & night time (^0C)

distribution of currents, salinity and temperature in the bay due to upstream river discharge and tidal fluctuations in the ocean. The model has been calibrated and verified using the salinity and temperature data measured at different locations of the bay. Complex current patterns are simulated near the entrance to the Thambalagamuwa bay. In addition, the current patterns and salinity distribution of the surface layer simulated by the model indicate that the river discharge coming into the bay takes a path through Thambalagamuwa bay.

The surface salinity distribution simulated by the model appears to be reasonable and is highly influenced by the river discharge of the Mahaweli. The model is also capable of simulating spatial and temporal distribution of temperature in the surface layer. The effect of river flow and ocean tides on surface temperature distribution appears to be insignificant. The results presented here are based on the simulations carried out for a short period due to high computational time required for the model simulations. However, if model simulations are performed over a long period using high speed computers, seasonal variations of hydrodynamic parameters, salinity and temperature could be predicted. In addition, these model results can be given to other modules of *ELCOM* package to simulate biological and chemical processes in the bay.

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