Numerical Model Study of Hydrodynamic and Related Process in Shallow Seas and Coastal Inlets in Sri Lanka

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Abstract

There is a vast variety of coastal water bodies are located along the Sri Lanka coastline and which are subjected to both natural and anthropogenic influences. This paper presents wide range of numerical model application in coastal inlets and shallow seas around Sri Lanka. The depth averaged tidal model and 3-D hydrodynamic Estuary Lake Computer Model (ELCOM) were used for this purpose. The primary focus is on the application of numerical models to these coastal systems to describe the impotency of oceanographic and hydrodynamic processes for environmental assessment problems.

Tides and estuarine circulation interact with the local topography of estuaries and lagoons. The inlet configurations are particularly important. Narrow inlets and/or long and shallow lagoons like Negombo, Chilaw, Rekawa, Mundal, Koggala lead to reduce water exchange but also to reduced tidal amplitudes and strong dissipation of tidal energy, known as tidal choking. The degree of mixing and water exchange however, differs a lot from one lagoon to another due to different topography.

The major dynamic effect of freshwater supply into the lagoon is through set up of a small sea level slope towards the ocean, the magnitude of which depends on the freshwater flux and also on the friction or resistance caused by e.g. the tides. The flushing time in Negombo Lagoon is only few days (less than 04 days) during high discharge (100 m^3s^{-1}) whiles it is few weeks (exceeds more than 15 days) during low discharge, similar results can be observed from Chilaw, Koggala Lagoons etc. On the other hand, river discharge strongly influences salinities and sea levels in these lagoons. Combination of river discharge and seasonal seal levels in the open ocean influences on saltwater intrusions along the rivers, in Kelani River, saltwater intrudes more than 15 km upstream during low discharge periods particularly when the open ocean mean sea level is high period, January-February. Although lagoons are shallow, the circulation is also affected by the density differences produced by the salinity contrast between freshwater and oceanic water particularly in the inlet regions of Negombo and Chilaw Lagoons, in the case of inverse estuaries like Puttalam Lagoon, where evaporation dominates and circulation is reversed.

Wind may modify the circulation and become an important force occasionally in larger lagoons like Puttalam and Jaffna particularly during monsoon periods, but different in the open ocean and it is not commonly responsible for a mean circulation over extended periods of time. In Palk Strait, which is a shallow sea area located between Sri Lanka and India, water exchange and flushing is dominated by monsoon winds and sea level differences between Bay of Bengal and Palk Strait. The numerical model simulations on pollutants dispersion in the lagoons and dispersion of sediments due to dredging of shipping canal through Gulf of Mannar/Palk Strait are also presented.