Abstract

The ever-increasing economical and environmental considerations of coastal zones have provoked further studies of the variety of coastal processes such as coastal erosion, deposition and sediment transportation. The proposed study aims to trial a cost-effective modelling approach to derive a reasonably accurate sediment budget along the Southwest coast of Sri Lanka. In data poor environments, such as commonly found in developing countries, numerical modelling is a promising method to derive a qualitative regional sediment budget, and to identify the environmental forcing/human interventions that govern the sediment budget.

The study showed that the application of transport model is considered to be essential for quantifying the transport components of the sediment budget and the associated erosion and deposition volumes. The computed sediment transport rates at the cell boundaries have significant influence on the sediment budget of the cell. Moreover, the volumetric changes due to erosion and accretion in the defined coastal cells are compared with the corresponding transport gradient explained in terms of computed net transport rates with uncertainties. This is an encouraging result but it is substantial to verify the model results by field measurements.

Bathymetry and wave data are the dominant factors for determining sediment transport thus the sediment budget. Through literature review, an appropriate survey has been executed for collecting data and information. Moreover, collected data pertaining to wave (ERA Interim) was validated by ORCA (met Ocean data Transformations, Classification and Analysis) developed by Deltares. For the wave transformation, Delft3D-WAVE model was applied, forced by offshore wave/wind with spatially varying boundary conditions.

Along the coastline eighteen coastal cells have been distinguished based on the classification of bays, rives, head lands and human intervention etc. The numerical simulation model UNIBEST-LT was used to estimate long shore transport rates and related morphodynamics of beach profiles. The net yearly-averaged long term and short term long shore transport rates at the cells boundaries are computed and schematized with the LT-module separately for a number of defined Dean Profiles along the coast. As a nodal point of net sediment transport is observed in the coastal stretch between Dodanduwa and Hikkaduwa, north of the nodal point the net sediment transport is directed northward and south of that point the sediment transport is south-eastward directed. Long-term and short-term erosion/deposition volumes were calculated by extracted coastlines from historical aerial photographs of 1956, 2005 and 2014. Coastal recession due to sea level rise is considered as well.

The overall sediment budget was computed as yearly average for long-term (1956-2005) and short-term period (2005-2014). The larger scale sediment budget has assessed by considering the volumetric changes due to erosion and accretion and computed sand transport rates with the possible source/sink terms (nourishment, mining, dredging and river flux) under the hypothesis of conceptual sediment budget could balanced.

Finally, recommendations for future research are given to improve the accuracy of sand budget computations in poor data environment.

Key words: sediment transport, sediment budget, coastal cell, nodal point, Delft3D-WAVE, UNIBEST-LT