

Evaluation of salt water intrusion in the Kuantan Estuary with the application of a 1-D analytical salt intrusion model integrating the predictive equations for dispersion and Van der Burgh's coefficients

J.I.A. Gisen^{1,2}, A.A.F. Ahmad Tajudin², W. Abd. Rahman¹

¹ Faculty of Civil Engineering and Earth Resources, ² Centre for Earth Resources Research and Management (CERRM), Universiti Malaysia Pahang, 26300 Gambang, Pahang, Malaysia.

*Corresponding author: isabella@ump.edu.my

Abstract

Salt water intrusion in the Kuantan Estuary has become crucial due to the extreme El-Nino event that occurred from the end of year 2015 to early 2016. This phenomena has caused water supply disruption in the area as the sea water has reached the water abstraction station at Kobat. Conducting detailed salt intrusion study will require substantial field surveys and it is time consuming. Hence, this study adopted a predictive measure to simulate the longitudinal salinity distribution in the Kuantan Estuary using a 1-D analytical salt intrusion model integrated with an empirically derived predictive equations for the dispersion and Van Der Burgh coefficients. The performance of the predictive model was evaluated by comparing the calibrated salinity curve against the measured data obtained from the previous study in 1977. From the analysis, the result in Figure 1 indicates that the performance of the predictive model is nearly equivalent to the study in 1977 with the root-mean squared error of 1.59 ppt and 1.57 ppt, respectively. The Nash–Sutcliffe efficiency coefficients of 0.95 are obtained for both methods. However, for the salinity at 8000 m (from mouth) onwards, the predictive model shows a significantly high efficiency with the Nash–Sutcliffe efficiency coefficients of 0.99 compare to 0.92 from the previous study. The root-mean squared error is as low as 0.38 ppt. Hence, it is proven that the empirically derived predictive model is applicable in predicting the longitudinal salinity distribution in the Kuantan Estuary.

Key words: saline intrusion, brackish water, Kuantan Estuary, tide, predictive model

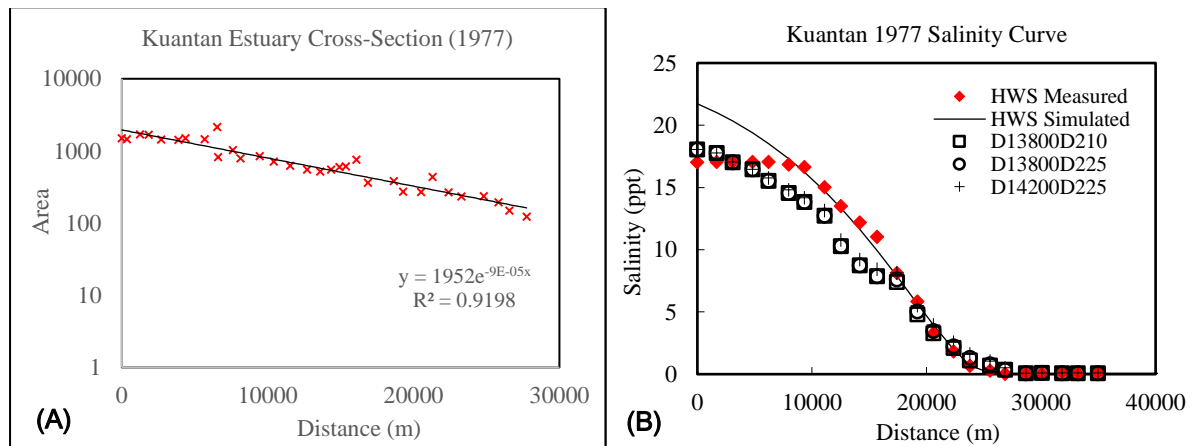


Fig. 1. A) Cross-sectional area of the Kuantan Estuary in year 1977 which is presented in an exponential function. B) Comparison between the simulated longitudinal salinity distributions in the Kuantan Estuary in reference to the measurement data taken in 1977. Symbols represent: (♦) data, (—) simulation with the predictive model, (□) previous study simulation with $D = 13800$, $D = 210$, (○) previous study simulation with $D = 13800$, $D = 225$, and previous study simulation with $D = 14200$, $D = 225$.