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A MATHEMATICAL MODELLING THROUGH CHAOTIC APPROACH TO FORECAST THE SEA LEVEL IN PENANG

(Pemodelan Matematik Melalui Pendekatan Kalut bagi Meramal Paras Laut di Pulau Pinang)

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ABSTRACT

Forecasting of sea level is significant since a rising sea level can cause erosion, flood, and inundation. Prediction of the behaviour of a future sea level is crucial for coastal engineering, geodetic applications, navigation, coastal ecosystems, and recreational activities along with observation and prediction of the changes in fisheries and marine environments also coastal fortifications. The data examined is a time series of sea levels recorded hourly in a high-risk area at Penang tidal gauge station. The chaotic approach technique was used to analyze the observed time series data which was divided into two steps: phase space reconstruction and prediction. The purpose of the study comprises to discover the existence of chaotic nature through the phase space reconstruction process and the Cao method. A local linear approach has been used for prediction purposes. The findings indicated that the coefficient of correlation value among the data observed and data predicted was .9356. The result implies the Malaysian sea level of time series can be predicted using the local linear approximation method. These findings are anticipated to support agencies in particular the Department of Survey and Mapping Malaysia (JUPEM) to organize improved management of the sea level.

Keywords: Cao method; chaotic approach; local linear approximation method; phase space approach; sea-level prediction

ABSTRAK

Peramalan paras laut adalah signifikan kerana kenaikan paras laut boleh menyebabkan hakisan, banjir, dan penggenangan air. Peramalan paras laut pada masa hadapan juga sangat penting untuk kejuruteraan pantai, aplikasi geodesi, navigasi , ekosistem pantai dan kegiatan rekreasi juga bagi tujuan pemerhatian dan peramalan perubahan perikanan di persekitaran laut dan pantai. Kajian ini menggunakan data siri masa paras laut yang dicerap mengikut jam di kawasan berisiko tinggi yang terdapat di stesen pasang surut, Pulau Pinang. Data siri masa yang dicerap dianalisis menggunakan kaedah pendekatan kalut yang membabitkan dua proses iaitu pembinaan semula ruang fasa dan proses peramalan. Tujuan kajian adalah untuk mengesan kehadiran dinamik kalut menggunakan proses pembinaan semula ruang fasa dan kaedah Cao. Kaedah penghampiran linear setempat pula digunakan untuk tujuan peramalan. Hasil kajian menunjukkan nilai pekali korelasi antara data yang diperhatikan dan data yang diramalkan ialah .9356. Keputusan membuktikan bahawa data siri masa paras laut Malaysia dapat diramalkan menggunakan kaedah penghampiran linear setempat. Dapatan ini diharapkan dapat membantu agensi-agensi khususnya Jabatan Ukur dan Pemetaan Malaysia (JUPEM) dalam pengurusan paras laut.

Kata kunci: kaedah Cao; pendekatan kalut; penghampiran linear setempat; pembinaan semula ruang fasa; peramalan paras laut

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