ON THE APPLICATION OF DATA ASSIMILATION IN REGIONAL COASTAL MODELS

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On the Application of Data Assimilation in Regional Coastal Models

DISSERTATION
Submitted in fulfilment of the requirements of
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and of the Academic Board of the International Institute for Infrastructural,
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by

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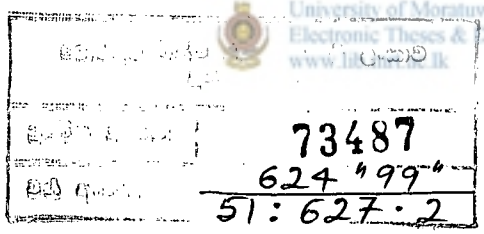

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ABSTRACT

Data assimilation is a methodology which can optimise the extraction of reliable information from observations and combine it with, or assimilate it in, numerical models. The development of both the observation techniques and the numerical models (associated with the increase in computer speed and memory) has made of data assimilation a very important and attractive field within oceanography, meteorology and engineering.

This work deals with the integration and further development of existing computationally efficient data assimilation techniques for large scale regional coastal models. Two suboptimal schemes of the Kalman filter are described. The first scheme is a reduced rank square root (RRSQRT) approximation of the extended Kalman filter, which approximates the error covariance matrix by one of a lower rank. The second is the ensemble Kalman filter (EnKF), which calculates the error statistics using a Monte Carlo method. Both techniques can approximate the results obtained from the Kalman filter but at a much lower cost.

The performance of these methods is compared in a twin test using a two-dimensional shallow water equation model. The performance of the RRSQRT filter for forecasting and hindcasting has been tested in the standard two-dimensional model and in a special version that computes the shallow water equations in areas of different resolution (nesting). The final part of this work presents the initial tests of the implementation of the RRSQRT in a three-dimensional model.

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