AOGS 2005

Prediction of Shallow Water Waves with Data Assimilation

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The wave model SWAN (Simulating Waves Nearshore), used for wave prediction in shallow waters, has been significantly improved by application of specially developed error-correction scheme in this study. An accurate wave prediction depends on various factors such as wind fields, boundary conditions, initial conditions, and the quality of the wave model used. The wind-induced error and numerical limitations are the major sources of inaccuracy of SWAN. Error correction is an effective data assimilation method for real-time updating of model results by combining observation data and the numerical model outputs. In this study, an error correction scheme is designed to forecast and correct wind-induced model errors generated by SWAN. The scheme consists of three successive processes: (1) model errors forecast by local models, (2) model errors distribution by a local weighted regression model, and (3) model errors correction by superimposing the estimated model errors on the original SWAN outputs. Genetic Algorithm is used to construct the optimal local weighted regression models. This methodology has been applied along with SWAN to the Malacca Straits to improve the wave predictions for the whole computation domain. Results show the effectiveness of the error correction scheme in the improvement of the wave prediction in shallow waters.

Keywords: SWAN model; Wave prediction; Data assimilation; Error correction; Local model; Genetic algorithm