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福建省风暴潮漫堤预警辅助决策模式研究

The Study of Storm Surge Overbank Warning Assistant Decision Model for Fujian Province

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摘　要

本文为解决由于台风路径预报偏差而可能带来的风暴潮预警漏报、误报问题，提出一种基于假想台风增水数据库的风暴潮增水快速预报算法和基于台风路径预报概率圆的风暴潮集合预报、预警模式。首先建立了福建沿海风暴潮数值模型，并利用多年来的福建沿海实测潮位资料对该模型进行了检验，进而运用该模型研究了福建沿海风暴潮增水对台风参数改变的响应以及福建沿海风暴潮－天文潮非线性耦合效应。在此基础上研究建立了基于风暴潮增水数据库的查算方法，结合台风路径"概率圆"预报思路，提出了基于台风路径预报概率信息系统建立了福建省风暴潮漫堤预警辅助决策系统，为防灾减灾提供辅助决策支持。该系统已于2008年台风季节开始投入业务化试用。本文还利用台风预报个例对该系统的预报有效性作了初步检验。本文在研究中形成的主要结论有：

（1）模型检验结果显示本文建立的模型对福建沿海风暴潮的模拟是比较成功的，平均绝对误差（MAE）为21.2 cm，模拟结果与实测结果变化基本一致。

（2）在预报的台风参数的可能变化幅度范围内，前期台风主要特征参数对后期增水的影响较小。台风登陆前6小时的近中心最大风速、前12小时的中心移动速度和中心移动方向，对后期增水的影响的数值实验获得的最大绝对差值分别为4.4%、1.9%、1.2%，均远小于一般的风暴潮后报误差。

（3）福建沿海风暴潮－天文潮非线性耦合总水位与线性叠加总水位的差值曲线（耦差），接近于一条半日潮周期的正弦曲线，振幅约为10 cm量级，其谷值出现在天文潮波峰前后处，峰值出现在天文潮波谷前后处。

（4）基于风暴潮增水数据库的查算方法与模型直接计算结果基本一致，差距小于一般数值模型的计算误差，是可行的；该查算法在个人计算机上不到2分钟可完成基于台风路径预报概率圆多达2700多条路径的风暴潮增水集合预报，实现对福建沿岸37个万亩海堤的漫堤预警。

福建沿海；风暴潮；集合预报；漫堤预警

Abstract

Storm surge warning could be failure and misdeclared when the typhoon track forecasting deviate from the real track. A storm-surge computation method based on surge database and also an ensemble prediction model based on probability circle of typhoon track forecasting were studied to solute the problem. First of all, a one-way nested coupled storm surge numerical model was established and used to simulate the storm surges induced by 31 typhoon landfalls along the Fujian coast. The results were satisfactory and so numerical experiments were then performed to study the variability of storm surges induced by the cyclone parameters and which were different from those 6/12 hours before landing. Another numerical experiment was also performed to study the nonlinear interaction between storm surge and tide. According to the results of these numerical experiments, the storm-surge computation method based on surge database and the ensemble prediction model based on probability circle of typhoon track forecasting were studied and used to establish the Storm Surge Overbank Warning Assistant Decision Model for Fujian Province. And then the visual Storm Surge Overbank Warning Assistant Decision System for Fujian Province was established base on GIS. The system had been used since 2008 and verified with predication case. The main conclusions are as follows:

(1) Simulation verification demonstrated that the model was successful in the computations of storm surges along the Fujian coast. The mean absolute error (MAE) is 21.2 cm, and the simulated results were coincident to the observed trends.

(2) The experiments demonstrated that these main typhoon parameters, which varied in their possible ranges when they were forecast, induced little effect on storm surges when typhoon landing. The former parameters such as the maximum wind speed was 6 hours before typhoon landing, typhoon velocity and

typhoon track were 12 hours before typhoon landing, The major absolute discrepant were 4.4%, 1.9%, 1.2% respectively, far smaller than the error of general storm surge prediction.

(3) The curve of the discrepant of the nonlinear and linear interaction between storm surge and tide approached to sinusoid with a half-day period. The amplitude was around 10 cm, and the valley value tended to appear before or after the peak phase of tide, inversely the peak value tended to appear before or after the valley phase of tide.

(4) Simulation verification demonstrate that the storm-surge computation method based on surge database has good performances in the computations of storm surges, with a small discrepant to the storm surge model results. And the ensemble prediction model based on probability circle of typhoon track forecasting used in the system could calculate almost 2700 typhoons in 1~2 minutes. And then the system could warn the 37 important seawalls along the Fujian coast.

Keywords: Fujian coast;storm surge;ensemble prediction;overbank warning

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