PROGNOSTIC EQUATION BASED ON ARTIFICIAL NEURAL NETWORK FOR QUANTITATIVE RAINFALL FORECAST USING NUMERICAL WEATHER PREDICTION MODEL PRODUCTS

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AHMAD KAMIL AMINUDDIN

NOVEMBER 2012

Contents

2. Letter of Offer (Research Grant)

UNIVERSITI TEKNOLOGi MARA

PEMENANG ^ ^
Anugerah Kualiti *iW* m
P«rdana Mentori L, *L^J*
2008 V R *

Surat Kami 600-RMI/ST/DANA 5/3/Dst (47/2010)
Tarikh 21 September 2010

Prof. Madya Dr Wardah Tahir
Fakulti Kejuruteraan Awam
Unlversiti Teknologi MARA
40450 SHAH ALAM

Y. Bhg. Prof./Tuan/Puan

KELULUSAN PERMOHONAN DANA KECEMERLANGAN 08/2010

T p . .	Prognostic Equation Based on Artificial Neural Network for Quantitative
I ajuK KrojeK	Rainfall Forecast Using Numerical Weather Prediction Model Products
Kod Projek	600-RMI/ST/DANA 5/3/Dst (47/2010)
Kategori Projek	Kategori G (2010)
Tempoh	01 Oktober 2010 - 30 September 2012 (24 bulan)
Jumlah Peruntukan	RM 9,500.00
Ketua Projek	Prof. Madya Dr Wardah Tahir

Dengan hormatnya perkara di atas adalah dirujuk.

2 Sukacita dimaklumkan pihak Universiti telah meluluskan cadangan penyelidikan Y Bhg Prof./tuan/puan untuk membiayai projek penyelidikan di bawah Dana Kecemerlangan UiTM.

3 Bagi pihak Universiti kami mengucapkan tahniah kepada Y. Bhg. Prof./tuan/puan kerana kejayaan ini dan seterusnya diharapkan berjaya menyiapkan projek ini dengan cemerlang.

4 Peruntukan kewangan akan disalurkan melalui tiga (3) peringkat berdasarkan kepada laporan kemajuan serta kewangan yang mencapai perbelanjaan lebih kurang 50% dari peruntukan yang diterima.

Peringkat Pertama	20%
Peringkat Kedua	40%
Peringkat Ketiga	40%

5 Untuk tujuan mengemaskini, pihak Y. Bhg. Prof./tuan/puan adalah diminta untuk melengkapkan semula kertas cadangan penyelidikan sekiranya perlu, mengisi borang setuju terima projek penyelidikan dan menyusun perancangan semula bajet yang baru seperti yang diluluskan. Sila lihat lampiran bagi tatacara tambahan untuk pengurusan projek.

Sekian, harap maklum.

"SELAMAT MENJALANKAN PENYELIDIKAN DENGAN JAYANYA"

Yang^benar

MUSTAFAR KAMAL HAMZAH
Ketua/Penyelidikan (Sains dan Teknologi)

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Penotong Pentadbtrar Fa* Unit Kvwangan Zon 1 ~>

5. Report

5.1 Proposed Executive Summary

Precipitation is a main component of the hydrological cycle and important parameters for water resources management, agriculture and flood protection. As rainfall is one of the most difficult variable to forecast due to the multi-scale nature of the atmospheric processes which leads to its development and inherent variablity of precipitation over space and time, the prediction of rainfall in our country needs to be improved continuously. This research focuses on the mathematical modelling for'quantitative rainfall forecasting using the numerical weather prediction (NWP) model products based on the Fifth Generation Penn State/NCAR Mesoscale (MM5) and the Weather Research and Forecasting (WRF) model that currently run at the Malaysian Meteorological Department (MMD). The highest domain resolution of 4km will be used in this study after a few studies have found that increasing resolution has resulted in improved model simulations and predictions of atmospheric phenomena (Weisman et al.,1997; Bernadet et al.,2000; Nielsen-Gammon and Strack 2000; Roebber et al.,2002; A.Fernandez-Ferrero et al.,2009). Therefore, the most relevant NWP model products that consists of atmospheric variables for rainfall forecasting will be identified. A number of raingauge stations around Peninsular of Malaysia will be selected within year of 2006 until 2009 in order to validate the effectiveness of previously recorded hourly rainfall values with the NWP model products for rainfall forecasting specifically on the flash flood and monsoon flood events. The correlations and multiple regression analysis will be carried out to make sure only highly correlated NWP model products with rainfall forecasting will be selected to combine with the satellite images for canonical correlation and neural networks. The aim of this study is to produce a new model of precipitation based on NWP model products for rainfall prediction with a 3 hours lead times. Successful of this research will lead to a better flood forecasting model by coupling the meteorological and hydrological model.

5.2 Enhanced Executive Summary

In Malaysia, there are two types of flood that normally occur namely, monsoon flood and flash flood. Floods associated with the monsoonal rainfall events are common occurrences on the eastern coast of Peninsular Malaysia during the northeast monsoon season. Every year tropical monsoon storms result in severe flooding and causes enormous economic damage, social disruption, and sometimes loss of lives. Extreme monsoon storm weather phenomenon is the most destructive natural disaster afflicting Malaysia with respect to the cost, damages to properties and the area of extent (Keizrul and Chong, 2002). Given the sparseness of ground based observations, missing records and uneven distribution of the existing raingauge network, there is no adequate and timely information about rainfall pattern in Malaysia. An alternative source of quantitative precipitation information is from the Numerical Weather Prediction (NWP) model products. However, the accuracy of quantitative precipitation forecast produced by the Malaysian Meteorological Department (MMD) is still lacking even though significant progress has been made on the technical aspects (Low, 2006) . The study examined the effectiveness of two high resolution Numerical Weather Prediction (NWP) models namely the Fifth Generation Penn State/NCAR Mesoscale (MM5) and Weather Research and Forecasting (WRF) in predicting Quantitative Precipitation Forecast (QPF) over a tropical region. In this study, Kelantan River Basin has been selected as the case study to evaluate the performance and accuracy of precipitation forecast produced by the NWP models for monsoon flood events in the catchment area. Hourly and daily total rainfall data in year 2009 had been analysed. The rainfall events were further classified into low, moderate and heavy rainfall by using Drainage and Irrigation Department (DID) Malaysia standard. The performance and accuracy of the NWP model outputs against rainfall amount was verified using Root Mean Square Error (RMSE) and correlation (r). Notably, the statistical verification shows that there is quite strong correlation for 24 hourly rainfall forecast and the RMSE values are smaller for short range forecast (hourly up to 24 hourly). It is also noted that the longer the rainfall forecast duration, the higher probability of detection (POD) and the lesser probability of the false alarm ratio (FAR).