Forecasting Model for Extreme Rainfall using Artificial Neural Network

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Abstract (English)

Successive days of rainfall are known to cause flood. The forecasting of daily rainfall helps to estimate the occurrences of rainfall and number of wet days, while with a maximum of five consecutive days of rainfall, the magnitude of rainfall within a specified period can predict what may signify rainfall extremes. In this study, data mining and back propagation neural network (BPNN) have been established in developing the extreme rainfall forecasting models. Four forecasting models were developed to forecast the maximum five consecutive days of rainfall amount (PX5D) of the next month. The models only use the extreme rainfall indices outlined by STARDEX as predictors in forecasting. The first developed model uses six extreme rainfall indices in forecasting, the second model uses the values of the PX5D index of a three-month delay, the third model uses the previous six-month PX5D values, while the fourth model was developed to forecast the PX5D using the values of the same index of a twelve-month delay. It was found that when using the six extreme rainfall core indices, the forecasting error was the lowest. A regression model has been developed using the six extreme rainfall indices to compare the performance measurements with the BPNN model that uses the same indices.

Abstrak (Bahasa Malaysia)

Hujan berterusan diketahui menyebabkan banjir. Ramalan hujan harian membantu untuk anggaran kejadian hujan dan bilangan hari basah, manakala dengan maksimum lima hari berturut-turut hujan, magnitud hujan dalam tempoh yang dinyatakan boleh diramal yang mungkin menandakan keterlaluan hujan. Dalam kajian ini, pengumpulan data dan rangkaian neural rambatan balik (BPNN) telah dikenal pasti berpotensi dalam pembangunan model peramalan hujan melampau. Empat model ramalan telah dibangunkan bagi meramal jumlah hujan maksimum lima hari berturut-turut (PX5D) bagi bulan berikutnya. Model-model berkenaan hanya menggunakan indeks hujan melampau seperti yang ditetapkan oleh STARDEX sebagai peramal. Model pertama yang dibangunkan menggunakan enam indeks hujan melampau dalam peramalan, model kedua menggunakan nilai indeks PX5D bagi tiga bulan sebelumnya, model ketiga menggunakan nilai indeks PX5D enam bulan sebelumnya, manakala model keempat dibangunkan untuk meramal PX5D menggunakan nilai indeks yang sama bagi 12 bulan sebelumnya. Kajian mendapati apabila menggunakan enam indeks teras hujan melampau, ralat bagi peramalan adalah paling rendah. Model regresi telah dibangunkan menggunakan enam indeks hujan melampau untuk dibandingkan dengan prestasi model BPNN yang menggunakan indeks yang sama.

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Chapter One
Introduction

1.1 Background

Rainfall is one of the main sources of water for the hydrological cycle, and causes a serious impact to water source, rain related activities and the environment. In case the rainfall of one location significantly deviates from the regular condition, this can be considered that the event will be less likely to occur. Currently, it is most common to appoint a percentile value as a threshold. The values above this threshold are considered extreme values, which are the values (event) that are not likely to happen (Gu et al., 2010).

Malaysia's climate has the following characteristic features: copious rainfall, high humidity and uniform temperature. Winds are generally light. Located in the equatorial area, even with periods of severe drought, it is a high rarity to have a full day without clouds. On the other hand, it is also rare to have completely no sunshine for a stretch of a few days except during the northeast monsoon seasons (MET Malaysia, 2013). Malaysia experiences rain almost all year long, and for some regions, it is heavier. With the average yearly rainfall, Peninsular Malaysia receives around 2,440mm, while Sarawak and Sabah receive 3,830mm and 2630mm respectively (Hazenberg et al., 2011). The West Coast of the Peninsular is exposed to convective and localized storms caused by the intermonsoon seasons. Convective storms are extremely variable in space and time and can lead to very intensive rainfall rates that produce floods. The extreme flood event that happened between December 2006 and January 2007

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