

**STATISTICAL PRECIPITATION VARIABILITY CHANGES UNDER  
CLIMATE CHANGE SCENARIOS SIMULATIONS USING A  
STATISTICAL DOWNSCALING MODEL (SDSM)**

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**Dedication**

*Dedicated to my Family and my Friends*

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## ABSTRACT

The climate impact studies in hydrology often rely on climate change information at fine spatial resolution. However, General Circulation Models (GCMs), which are among the most advanced tools for estimating future climate change scenarios, operate on a coarse scale. Therefore the output from a GCM has to be downscaled to obtain the information relevant to hydrologic studies. The results presented in this thesis have indicated that it is feasible to link large-scale atmospheric variables by GCM simulations from Hadley Centre 3rd generation (HadCM3) outputs with daily precipitation at a local site. Statistical Downscaling Model (SDSM) was applied using three set of data; daily precipitation data for the period 1961-1990 corresponding to Endau rainfall (Station no. 2536168) and Muar (Station no. 2228016) located in Johor at the Southern region of Peninsular Malaysia; The observed daily data of large-scale predictor variables derived from the National Centre for Environmental Prediction (NCEP) and GCM simulations from Hadley Centre 3rd generation (HadCM3). The HadCM3 data from 1961 to 2099 were extracted for 30-year time slices. The result clearly shows increasing increment of daily mean precipitation of most of the months within a year in comparison to current 1961-1990 to future projections 2020's, 2050's and 2080's considering SRES A2 and B2 scenarios developed by the Intergovernmental Panel on Climate Change (IPCC). Frequency analysis techniques were carried out using the observed annual daily maximum precipitation for period 1961-1990 and downscaled future periods 2020's, 2050's and 2080's. Therefore, it does appear that SDSM can be considered as a bench mark model to interpret the impact of climate change.

## ABSTRAK

Kajian-kajian kesan iklim dalam hidrologi selalu bergantung pada maklumat perubahan iklim di resolusi ruang yang baik. Bagaimanapun, General Circulation Models (GCMs) yang wujud di kalangan paling maju peralatan menganggarkan akan datang senario-senario perubahan iklim, menjalankan pembedahan terhadap satu skala yang kasar. Oleh itu, keluaran daripada GCM perlu dikecilkan untuk mendapatkan maklumat yang relevan untuk kajian-kajian hidrologi. Hasil-hasil tesis ini telah menunjukkan adalah munasabah untuk menghubungkan pembolehubah atmosferik berskala besar oleh simulasi GCM daripada Hadley Centre 3<sup>rd</sup> Generation (HadCM3) pengeluaran dengan presipitasi tempatan. Statistical Downscaling Model (SDSM) digunakan 3 set data ; presipitasi harian dari 1961 – 1990 merujuk kepada curahan hujan Endau (No. Stesen 2536168) dan Muar (No. Stesen 2228016) yang terletak di Johor, Selatan Semenanjung Malaysia ; Diperhatikan data harian yang di cerap daripada peramal skala besar dari National Centre for Enviromental Prediction (NCEP) dan simulasi GCM dari Hadley Centre 3<sup>rd</sup> Generation (HadCM3). Data HadCM3 daripada tahun 1961 untuk 2099 adalah di ekstrak untuk 30 kepingan masa. Hasil menunjukkan dengan jelas pertambahan presipitasi purata harian bagi kebanyakan bulan dalam tahun semasa dijangkakan teknik analisis frekuensi dijalankan digunakan presipitasi cerapan harian tahun maksimum bagi jangka masa 1961-1990 dan diunjurkan masa depan 2020's, 2050's, 2080's. Oleh itu, di dapati SDSM boleh dipertimbangkan sebagai model tanda aras untuk menilai impak perubahan cuaca.