IDENTIFICATION OF MINIMUM DATA DURATION FOR MONTHLY WATER BALANCE MODEL CALIBRATION

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Degree of Master of Science

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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M.A.D.N. Ariyasena Date

The above candidate has carried out research for the Master's thesis under my supervision.

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Professor N.T.S. Wijesekera Date

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ABSTRACT

Water scarcity which arose with the growth of population, industrialization, urbanization and climate change, emphasizes the importance of water resources planning and management. Hydrologic modelling for water management in many disciplines has a history dating back to 1940's. Monthly models are commonly used for water resources planning and management because in practice, monthly time step is the choice for planning activities. Water balance models are popular water resources estimation tools which ensure the mass balance in watersheds. Reliability of the model simulations depends upon the nature of the data. Erroneous input can create unrealistic results. Therefore data quality is an important factor to be considered when dealing with data length. Further it is important that the data be representative of the watershed processes. However by using the longest available data, most researchers had attempted to achieve representativeness. In this aspect information contained in the data and careful extraction is important. Literature review shows that the data length selection for monthly water resources models vary between 12 and 780 months and the reasons for selection is mostly individual preference. This lack of a rationale poses a question on model reliability and creates a problem when utilizing public funds for water and associated infrastructure management. The present work is a critical evaluation of appropriate data length for the calibration of a monthly water balance model. In this effort, model calibration and verification has been carried out by considering various data length scenario. Ellagawa watershed in Kalu Ganga river basin of Sri Lanka over the period from 1977 to 2017 was modelled to identify the appropriate data duration for optimization of a two parameter monthly water balance model to contribute towards sustainable water management, planning and design.

Initially a detailed review of available guidelines and research findings to identify the best data duration option available for water managers to calibrate and verify a monthly streamflow estimation model for sustainable water resources management was carried out. Then a two parameter monthly water balance model was used to simulate streamflow of Ellagawa watershed using different data lengths. Considering the total data duration with 42 years of monthly resolution, the model was calibrated over the period from 1983 – 2017 for data duration options 10, 15, 20, 25 and 30 years. Model outputs were verified with the 7 year observed dataset from 1976 to 1983. Using a conceptual multi objective evaluation combining hydrograph, flow duration and water balance difference the observed and computed streamflow were results compared to obtain the most suitable data duration option. Existing literature and guidelines recommend various data durations as data period for modelling. Considering the time of exceedance, the recommended median of less frequent longest length is 24 years, same of less frequent short length is 6 years and the median of most used data length is 10 years for monthly data. Out of 315 case study catchments in literature, which were identified as work on monthly data resolution, 237 catchments were identified as the most used category. In the present work analysis of water balance model calibration and verification results for data

durations from 10 to 30 years, identified that consistent results can be achieved with longer data lengths. Multi objective evaluation of the water balance modelling results showed that a threshold data duration of 20 years is the threshold for reliable optimization of a hydrologic model. At this threshold data length the mean values of respective model parameters c and Sc for Ellagawa watershed of Kalu river basin are 0.80 and 605.42. In case of 20 years the average overall Mean Ratio Absolute Error values varied between 0.1643–0.2189 for calibration and 0.2981–0.3039 for verification. This study also concluded that data consistency is important to obtain reliable results and Double Mass Curve with a regression method can be successfully used as a tool for data rectification.

KEYWORDS: Data duration, Parameter Optimization, Monthly Water Balance Model, Data Rectification

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