Enhancing Urban Flood Prediction Accuracy with Physics-Informed Neural Networks:

A Case Study in Real-Time Rainfall Data Integration

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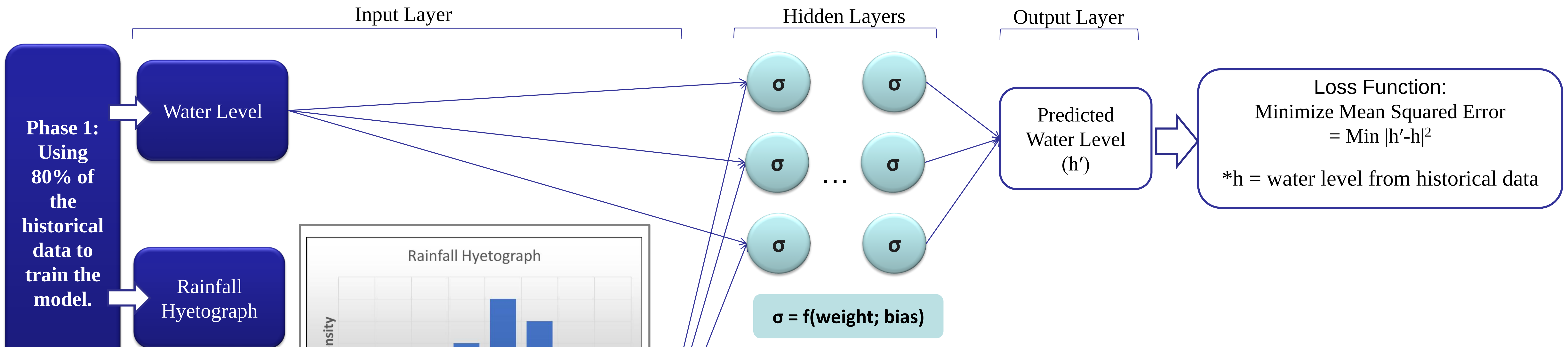
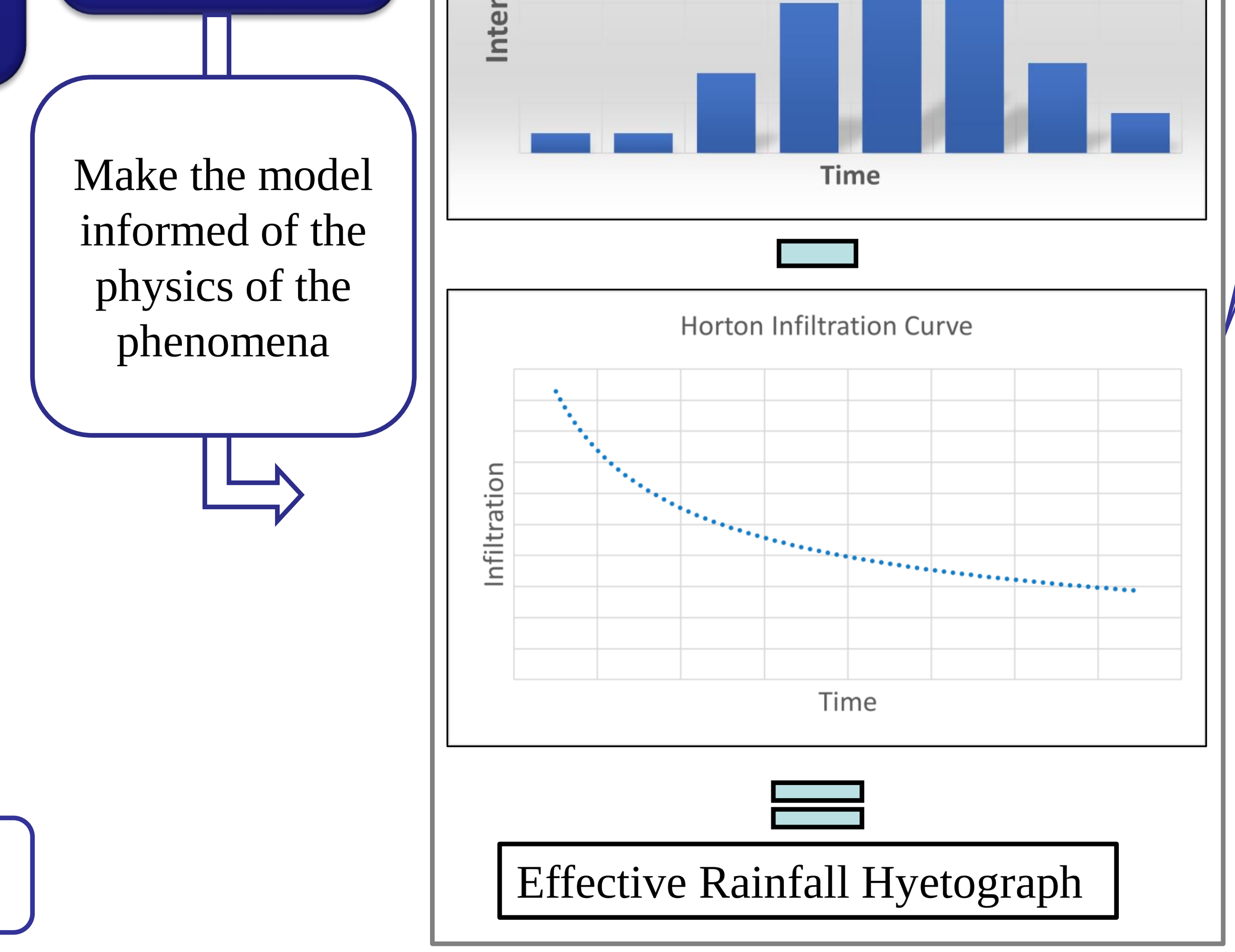
Introduction

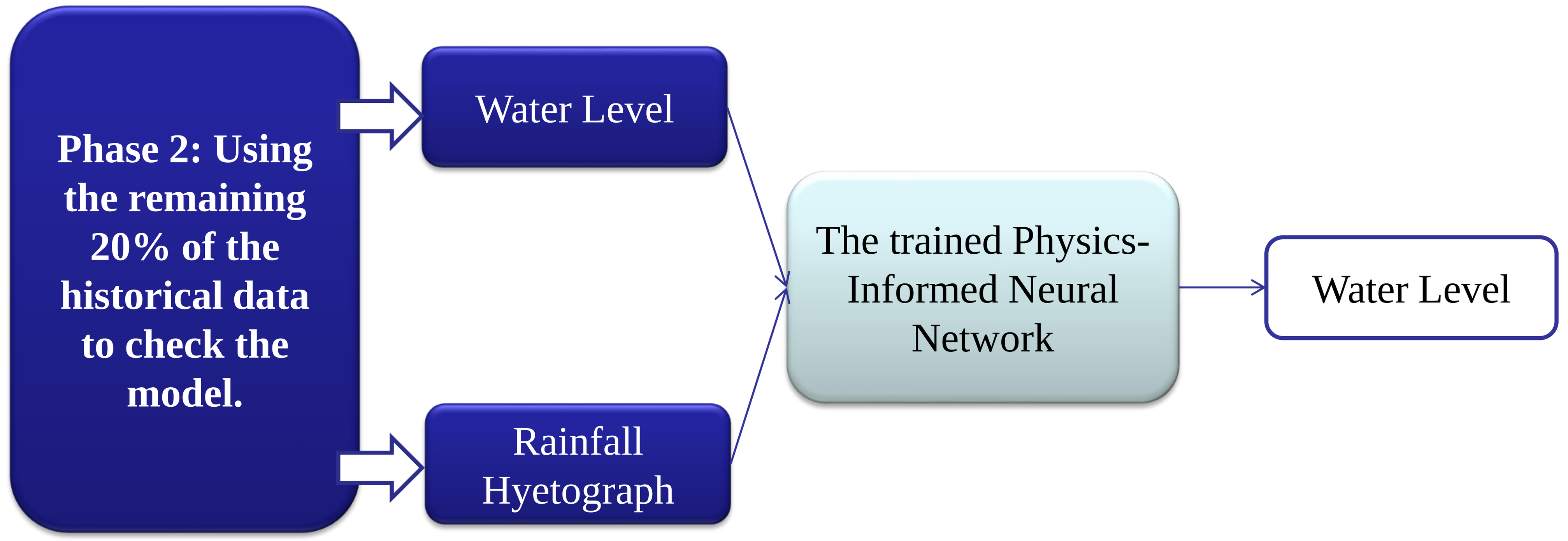
- Urban flooding presents significant socio-economic challenges in cities, emphasising the need for effective flood forecasting [1].
- Due to data scarcity and the necessity to account for real-time variable factors, Machine/Deep Learning (ML/DL) techniques are emerging as preferred solutions [2].
- These methods offer an advantage over slow, yet accurate, calibrated numerical models by handling limitations more efficiently [3].

Aim and Objectives

- This study aims to develop a PINN model to detect flood events at specific points in an urban drainage system during rainfall.
- The model employs the Horton equation applied to the rainfall hyetograph (both time-dependent) to process real-time data.
- This input allows the model to predict water level rises at certain points in the channel, identifying potential flooding.







Research Strategy

- A notable DL technique, the Physics-Informed Neural Network (PINN), integrates physics understanding into the modelling process.
- This approach enables the model to incorporate physical principles into its inputs, enhancing its predictive capabilities despite limited data availability.
- The structure of PINN layers varies based on the problem's nature. Within the hidden layers, hyperparameters such as weights and biases are adjusted during the training phase to minimise the loss function, which is generally defined by the Mean Squared Error (MSE) - a measure of the squared difference between outputs and target values [4].

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