IMPROVING FLOOD FORECASTING SKILL USING REMOTE SENSING DATA: RAINFALL ESTIMATION

Ashley Wright, Stefania Grimaldi, Yuan Li, Jeffrey Walker, Valentijn Pauwels

Monash University, Department of Civil Engineering, Clayton, VIC 3800

THIS PROJECT AIMS TO USE HYDROLOGIC MODELS AND DATA ASSIMILATION THEORY TO ESTIMATE CATCHMENT WIDE RAINFALL .

Numerical precipitation forecasts need to be improved to make them useful for flood forecasting. Retrieving catchment-wide rainfall distributions from model inversion (Kirchner 2009) will provide important information that can be used to add value to numerical rainfall forecasts.

INTRODUCTION

Floods are among the most common natural disasters in Australia, and cost the economy on average $377M per year. The 2010-2011 Brisbane floods alone resulted in 35 confirmed deaths and $2.38 billion in economic damage.

Flood forecasting models are an essential tool in managing floods. Significant progress has been made in the improvement of these models. However, they are prone to significant errors, due to errors and uncertainties in the rainfall data and the model structure and parameters.

RESEARCH QUESTIONS

1. Is the Discrete Cosine Transform (DCT) or Discrete Wavelet Transform (DWT) more effective at reducing hydrological input data for rainfall estimation?
2. Can rainfall and model parameters be realistically estimated whilst simulating streamflow using model input data reduction techniques and parameter estimation algorithms?
3. If remotely sensed soil moisture is assimilated using the Ensemble Kalman Filter (EnKF) into 3 different rainfall runoff models, each forced by estimated rainfall, what insight does the analysis of filter (EnKF) innovations provide?

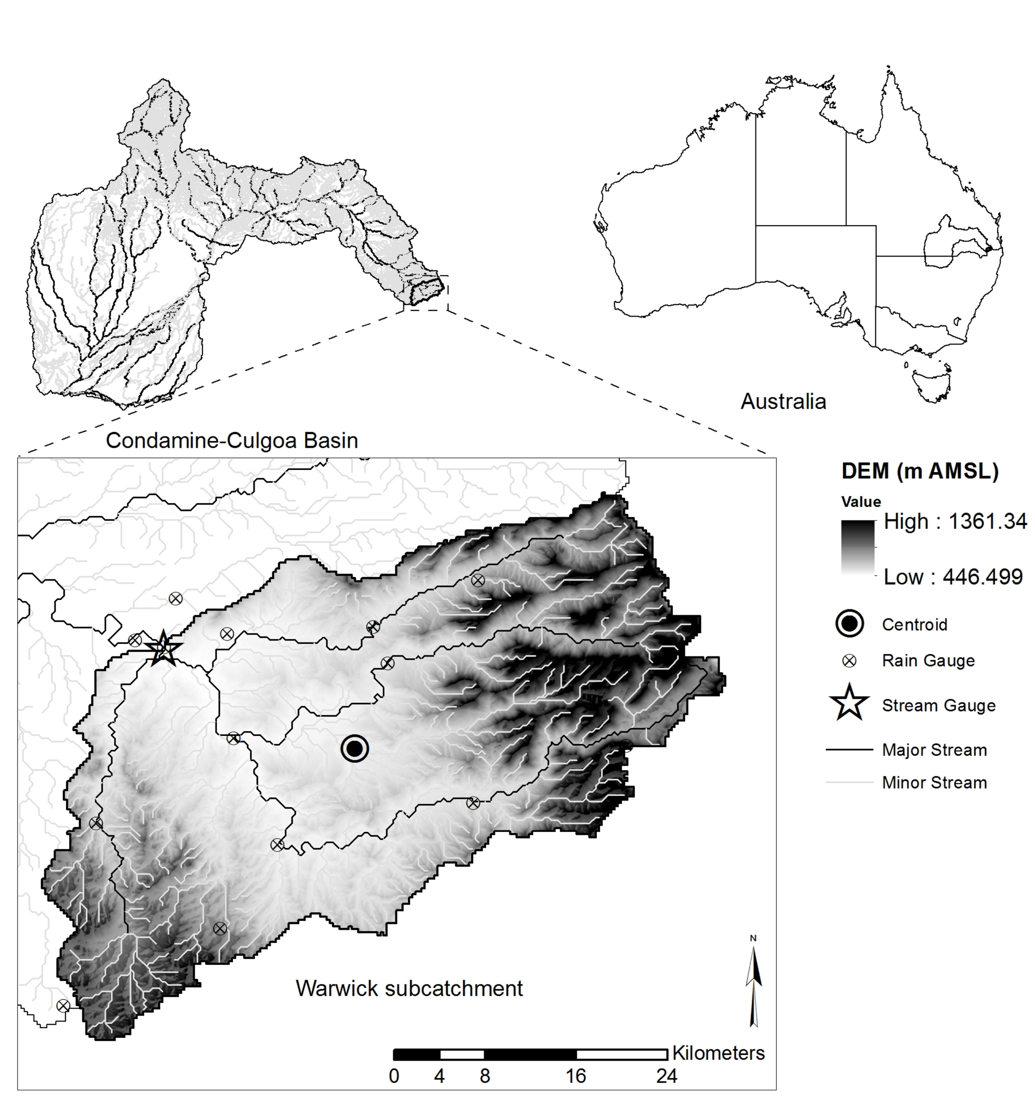

Figure 1: The Warwick study catchment.

SUMMARY OF FINDINGS

Task 1

Results demonstrate that the DWT is more suitable than the DCT to represent hydrological data series which are commonly influenced by transient events. Using the DWT as a hydrologic model input data reduction technique allows the modeler more flexible options.

Task 2

Findings of this task demonstrate that using a likelihood function that considers streamflow as well as input rainfall allows for the realistic estimation of temporal rainfall series and model parameter distributions. All of this is achieved whilst yielding superior streamflow simulations when compared to a traditional parameter estimation approach.

Task 3

Some models achieve better streamflow simulations with wetter or dryer rainfall estimates than those observed. Soil moisture can effectively be assimilated into the models, without CFD matching or exponential filtering, depending on their tendency to run wet or dry, and an analysis of the assimilation results provides insight in the quality of the rainfall retrievals.

REFERENCE

Kirchner,J.(2009), Catchments as simple dynamical systems: Catchment characterization, rainfall-runoff modeling, and doing hydrology backward, Water Resources Research, 45 (2), doi:10.1029/2008WR006912.

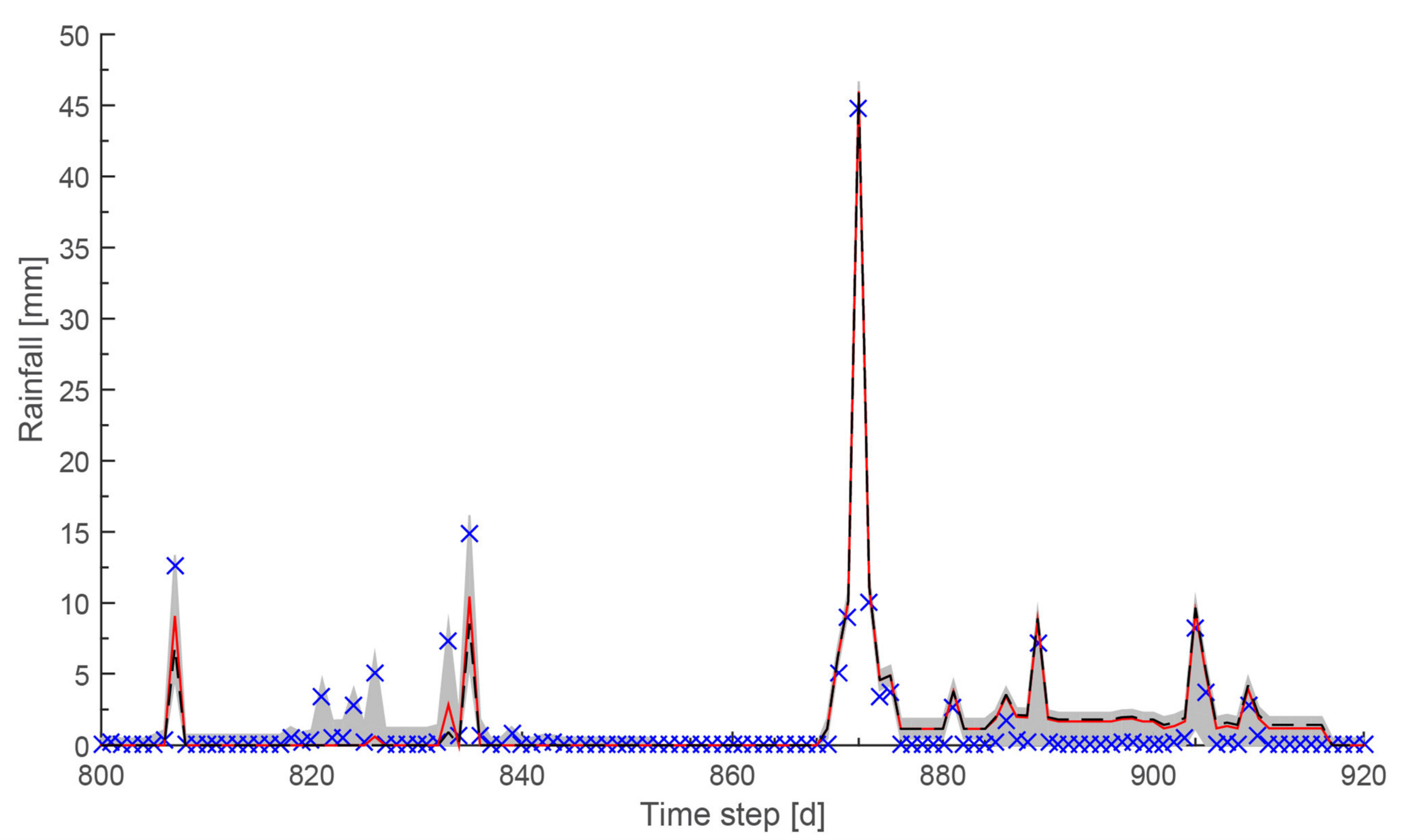

Figure 2: Rainfall estimations for the Warwick catchment, producing superior streamflow simulations. The crosses are the observed rainfall, red and black lines are the MAP and mean rainfall estimates, respectively. The grey shading represents the 5-95% uncertainty bounds.

END-USERS STATEMENTS

The remote sensing constrained hydrologic modelling capacity being developed will complement the current flood forecasting capabilities of the Bureau of Meteorology. ***– Soori Sooriyakumaran, Manager Flood Policy Unit, Bureau of Meteorology***

Australian Government Department of Industry, Innovation and Science | Business Cooperative Research Centres Programme

MONASH University Engineering

Australian Government Bureau of Meteorology

Australian Government Geoscience Australia

bnhcrc.com.au