



Frameworks for Evaluating and Improving
Simplified Hydrologic Models for Baseflow
and Rainfall-Runoff Estimation Using
Distributed Physical Models

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Table of Contents

Table of Contents.....	III
Abstract	VII
Statement of Originality	IX
Acknowledgements.....	XI
List of Figures	XIII
List of Tables.....	XVI
1 Introduction.....	1
1.1 Research background.....	1
1.2 Research aims	6
1.3 Organisation of thesis	9
2 Framework for assessing and improving the performance of recursive digital filters for baseflow estimation with application to the Lyne and Hollick filter (Paper 1)	11
2.1 Introduction.....	17
2.2 Generic framework for assessing and improving the performance of RDFs for baseflow estimation.....	21
2.2.1 Performance assessment.....	22
2.2.2 Performance improvement	23
2.3 Case study.....	25
2.3.1 Catchment characteristics and hydrological properties.....	25
2.3.2 Fully integrated SW/GW model.....	27
2.3.3 Digital filter	32
2.3.4 Error measure and optimization procedure	34
2.4 Results and discussion	36
2.4.1 Relationship between optimal filter parameters and soil properties	36
2.4.2 Relationship between filter performance and soil properties....	42
2.5 Summary and conclusions	47
2.6 Acknowledgements.....	49

3	Performance assessment and improvement of recursive digital baseflow filters for catchments with different physical characteristics and hydrological inputs (Paper 2).....	51
3.1	Introduction	57
3.2	Methodology	60
3.2.1	Selection of catchment characteristics and hydrological inputs.....	62
3.2.2	Fully integrated SW/GW model	69
3.2.3	RDFs	72
3.2.4	Calibration and performance assessment.....	75
3.2.5	Development of regression models.....	77
3.3	Results and discussion.....	79
3.3.1	Simulated streamflow and baseflow	79
3.3.2	Optimal filter parameters	83
3.3.3	Filter performance.....	88
3.3.4	Practical implications.....	93
3.4	Summary and conclusions.....	95
3.5	Acknowledgement.....	98
4	Assessment of the internal dynamics of the Australian Water Balance Model under different calibration regimes (Paper 3)	99
4.1	Introduction	105
4.2	Methodology	108
4.2.1	Catchment characteristics and hydrological inputs.....	109
4.2.2	Fully integrated SW/GW model	111
4.2.3	Australian Water Balance Model (AWBM)	112
4.2.4	Calibration of Australian Water Balance Model (AWBM)....	114
4.2.5	Evaluation of model performance.....	122
4.3	Results and discussion.....	122
4.4	Summary and conclusions.....	129
4.5	Acknowledgement.....	131
5	Conclusions	133
5.1	Research contributions	135
5.2	Publications	137
5.3	Research limitations	138
5.4	Recommendations for future work.....	139

References	141
Appendix A	155

Abstract

Hydrologic models are becoming increasingly important in the planning, design, operation and management of natural and engineered systems. However, development of such models is complicated by the fact that the underlying physical processes are extremely complex and that the observation and measurement of these processes are expensive and difficult. Consequently, simplified models are generally used in practice for purposes such as baseflow estimation and rainfall-runoff prediction. However, it is difficult to provide a rigorous assessment of how well such simplified models perform under a range of catchment characteristics (e.g. catchment area, soil type, slope) and hydrological inputs (e.g. rainfall, evaporation) and how well they are able to capture the underlying physical processes. In addition, without such assessments, it is difficult to change model structure and parameterization in order to improve the models' predictive capability and the ability to better represent physical processes.

In order to address these shortcomings, in this research, generic frameworks for (i) evaluating and improving recursive digital filters (RDFs) for baseflow estimation and (ii) evaluating the internal dynamic performance of conceptual rainfall runoff (CRR) models are developed and applied. The underlying premise of the frameworks is that fully integrated surface water/groundwater (SW/GW) models are able to provide the best possible approximation to the physical processes of water flow within catchments and can therefore be used as a benchmark against which the performance of these simplified models can be assessed for a variety of physical catchment characteristics and hydrological inputs.

The major research contributions are presented in three journal publications. These publications describe: 1) the development of frameworks to evaluate

and improve RDF performance for baseflow estimation based on catchment characteristics and hydrological inputs and their application to a single RDF under a limited number of catchment characteristics; 2) the application of the frameworks developed in the first paper to three RDFs under a larger range of catchment characteristics and hydrological inputs, as well as the development of regression equations for predicting RDF performance and optimal RDF parameters for improving RDF performance; and 3) the development and application of framework to evaluate the internal dynamic performance of one commonly used CRR model-Australian Water Balance Model (AWBM) under different calibration regimes under a larger range of catchment characteristics and hydrological inputs. Consequently, this research has developed a new way of evaluating and improving commonly used simplified hydrologic models for baseflow estimation and rainfall-runoff prediction.

Statement of Originality

I, *Li Li*, hereby declare that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution to Li Li and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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List of Figures

Figure 1.1 Specific research aims and their hierarchy, and linkage of research aims and publications	8
Figure 2.1 Schematic description of the framework for assessing the performance of RDFs for baseflow estimation	22
Figure 2.2 Schematic description of the framework for improving the performance of RDFs for baseflow estimation	24
Figure 2.3 Schematic representation of tilted V-catchment flow problem (refer to Panday and Huyakorn (2004))	26
Figure 2.4 Ten year daily rainfall data for Adelaide, South Australia, gauge number 23000.....	27
Figure 2.5 Catchment model for case study (modified version of the V-catchment in Panday and Huyakorn (2004)).....	30
Figure 2.6 Values of the optimal LH filter parameter with the error bars obtained from the linear estimates of uncertainty for sand (a), sandy loam (b), loam (c), loamy sand (d) and silt loam (e) with different soil properties	39
Figure 2.7 Simulated streamflow and baseflow for catchments with sand (a) and silt loam (b) with their mean values of K_s and porosity	40
Figure 2.8 Flow duration curves for catchments with sand and silt loam with their mean values of K_s and porosity.....	40
Figure 2.9 Impact of different values of LH filter parameter on baseflow for catchment with sand with minimum porosity	41
Figure 2.10 Relationship between the optimal LH filter parameter and K_s with the error bars obtained from the linear estimates of uncertainty for different soil properties	42
Figure 2.11 Comparison of baseflow calculated from the HGS model simulation and the LH filter with two different values of the filter	

List of Figures

parameter for sand with maximum K_s (a) and silt loam with minimum K_s (b).....	46
Figure 2.12 Flow duration curves for catchments with sand with maximum K_s , and silt loam with minimum K_s	46
Figure 3.1 Schematic representation of the adopted methodology	62
Figure 3.2 Schematic representation of tilted V-catchment flow problem (refer to Panday and Huyakorn (2004)).....	63
Figure 3.3 3D Catchment model (modified version of the V-catchment in Panday and Huyakorn (2004))	72
Figure 3.4 Scatter plot of BFI and Eckhart BFI_{max} filter parameter	84
Figure 3.5 Regression models for the prediction of optimal filter parameter values using input sets 2 and 4.....	87
Figure 3.6 Plot of cumulative distribution functions of E_f values for the different RDFs investigated	89
Figure 3.7 Regression models for the prediction of optimal filter performance (in terms of E_f) using input sets 2 and 4.....	92
Figure 3.8 Procedure for checking filter suitability and estimation of optimal filter parameter values.....	93
Figure 4.1 Schematic representation of steps in the proposed methodology	109
Figure 4.2 Schematic representation of tilted V-catchment flow problem (adopted from Panday and Huyakorn (2004))	110
Figure 4.3 An example of 3D catchment model for case study (adopted from Li et al. (2013b))	112
Figure 4.4 Structure of AWBM	114
Figure 4.5 Nonlinear regression models for the prediction of BFI and KBase	118
Figure 4.6 Performance of AWBMs for the different calibration methods investigated	126

Figure 4.7 Example of total-, base- and quick- flow hydrographs obtained for two distinct parameter sets obtained using Method 1 for one of the 66 catchments investigated..... 127

List of Tables

Table 2.1 Soil types and ranges and means (shown in brackets) of soil properties considered for model simulations (taken from Puhlmann et al. (2009)).....	26
Table 2.2 Optimal LH filter parameters and the linear estimates of uncertainty for sand, sandy loam, loam, loamy sand and silt loam with different soil properties.....	38
Table 2.3 Comparison of LH filter performance for the case where the optimal filter parameter was used and a filter parameter of 0.925 was used for sand, sandy loam, loam, loamy sand and silt loam with different K_s .	44
Table 3.1 Different physical catchment characteristics considered.....	66
Table 3.2 Different hydrological inputs considered	67
Table 3.3 Surface and subsurface parameters for the synthetic catchment model (refer to Partington et al. (2012))	71
Table 3.4 Different input sets considered for the development of all regression models	79
Table 3.5 Maximum, median and minimum daily streamflow, daily baseflow and BFI for the 66 records	82
Table 3.6 Maximum and minimum optimal values of filter parameters corresponding to high and low flows and the corresponding value of BFI (shown in brackets).....	84
Table 3.7 Predictive performance (CoE) of regression models for the prediction of optimal filter parameter values.....	85
Table 3.8 Performance of LH and Eckhardt/Boughton filters.....	89
Table 3.9 Predictive performance (CoE) of regression models for the prediction of optimal filter performance (in terms of E_f).....	90
Table 3.10 Percentage of correct prediction of good filter performance (i.e. $E_f \geq 0.5$) using the regression models.....	92

Table 4.1 Catchment characteristics considered (adopted from (Li et al., 2013b))	110
Table 4.2 Hydrological inputs considered (adopted from (Li et al., 2013b))	111
Table 4.3 AWBM parameter description and ranges	114
Table 4.4 Summary of calibration methods	120