BITS Pilani
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Rainfall-Runoff Modelling Using AWB Method

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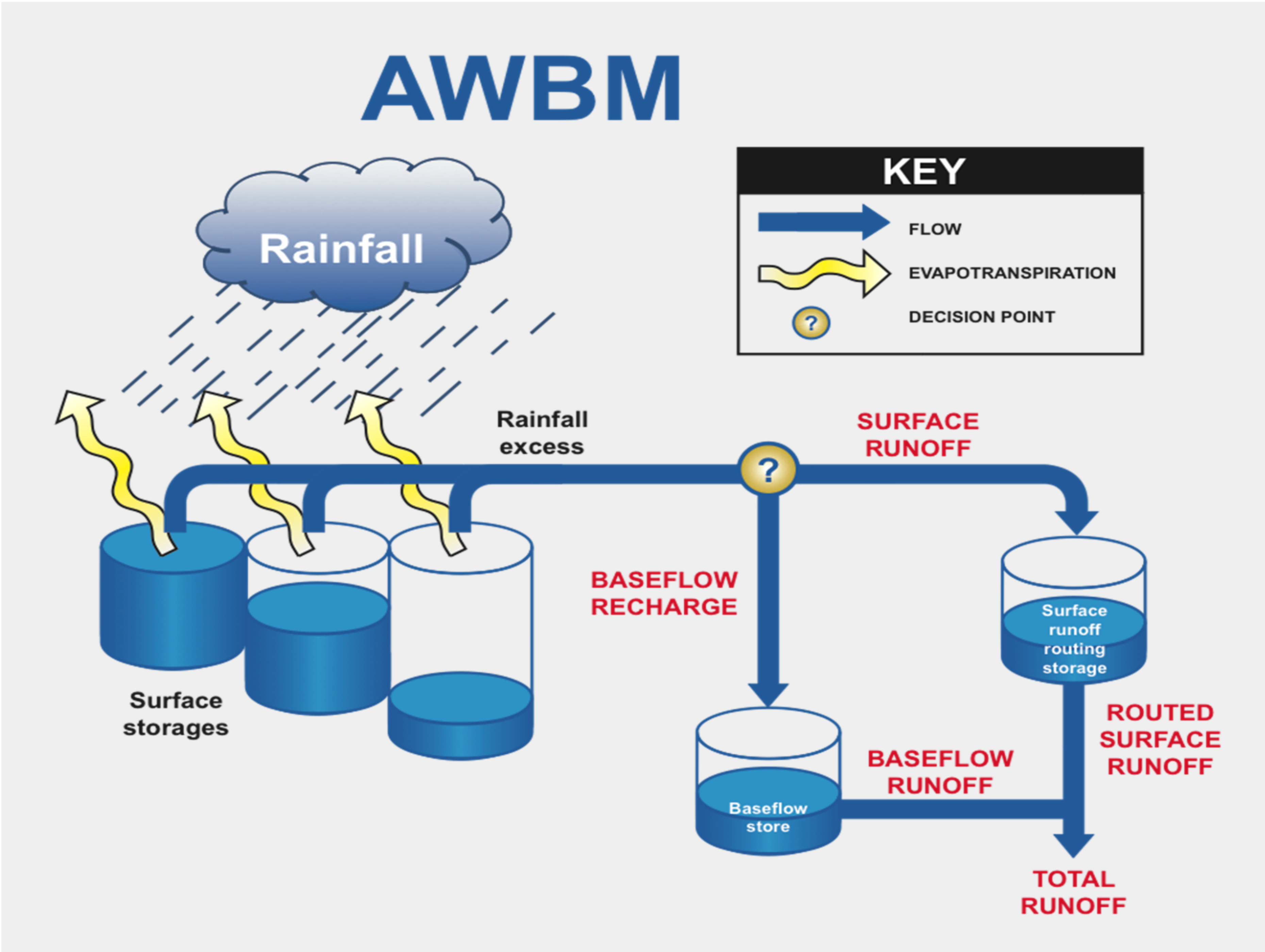
Australian Water Balance Model (AWBM)

- The Australian Water Balance Model (AWBM) is a catchment water balance model that relates daily rainfall and evapotranspiration to runoff, and calculates losses from rainfall for flood hydrograph modelling.
- The model contains five stores; three surface stores to simulate partial areas of runoff, a base flow store and a surface runoff routing store.
- WBM operates at the functional unit scale and at a daily time-step.
- The model can be applied at sub-daily intervals, provided the values of the recession values are appropriate to the chosen timestep.


AWBM
KEY
FLOW
EVAPOTRANSPIRATION
?
DECISION POINT
Rainfall
Rainfall excess
?
SURFACE RUNOFF
BASEFLOW RECHARGE
Surface storages
Surface runoff routing storage
ROUTED SURFACE RUNOFF
Baseflow store
BASEFLOW RUNOFF
TOTAL RUNOFF

STRUCTURE & PROCESS

- AWBM uses three surface stores (C1, C2 and C3) to simulate three partial areas (A1, A2 and A3) of runoff. The water balance of each surface store is calculated independently of the others.

- By default, the model calculates the moisture balance of each partial area at daily time-steps. At each time-step, rainfall is added to each of the three surface moisture stores and evapotranspiration is subtracted from each store. If the value of moisture in the store becomes negative, it is reset to zero, as the evapotranspiration demand is superior to the available moisture. If the value of moisture in the store exceeds the capacity of the store, the moisture in excess of the capacity becomes runoff and the store is reset to the capacity.

- The catchment area is divided into 3 subareas: A1, A2 and A3, each representing e.g. user defined land use or soil classifications as proportions of the area of the catchment. The sum of A1, A2 and A3 must be 1. Only A1 and A2 are set by the user and the remaining area proportion, A3, is calculated internally as A3 = 1 - (A1 + A2). Default area parameter values are:
  - A1 = 0.134
  - A2 = 0.433 and, therefore
  - A3 = 0.433
- If the user enters values of A1 and A2 that do not satisfy the constraint of adding up to less than 1, then the AWBM model will rescale these parameters to ensure that A1 + A2 + A3 = 1. These rescaled values are not reported to the user.

Part of total surface runoff becomes recharge of the base flow store. The fraction of the runoff used to recharge the base flow store is:

BFI runoff

where: BFI = base flow index, ie. the ratio of base flow to total flow in the stream flow

The remainder of the runoff, ie. ((1.0 - BFI*)* • runoff), becomes surface runoff.

The base flow store is depleted at the rate of (1.0 - K) • BS where:

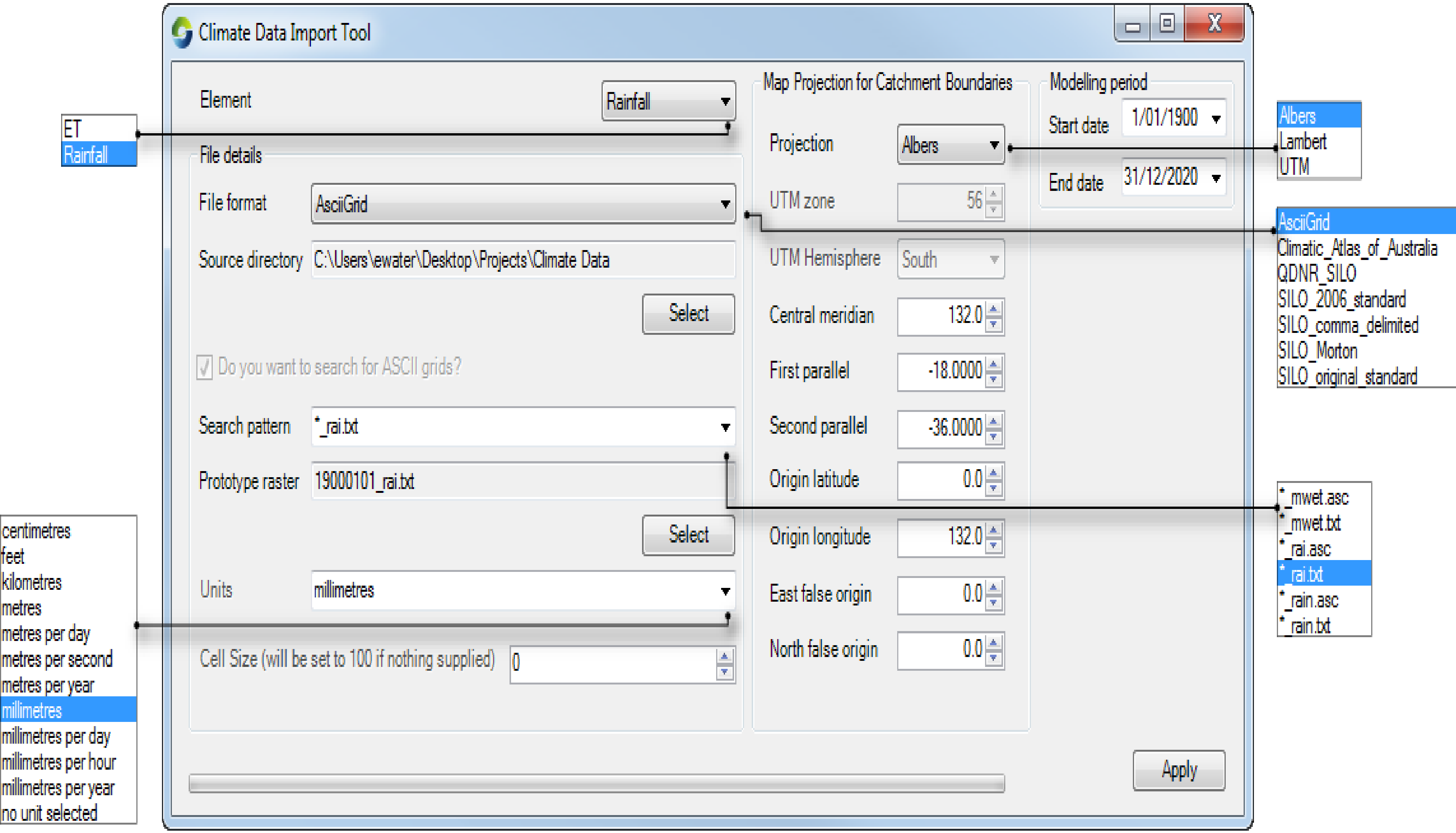
BS = the current moisture in the base flow store, and

K = the base flow recession constant of the time-step being used (typically daily).

The surface runoff can be routed through a store if required to simulate the delay of surface runoff reaching the outlet of a medium to large catchment. The surface runoff store acts in the same way as the base flow store, and is depleted at the rate of (1.0 - KS)•*SS*, where *SS* is the current moisture in the surface runoff store and *KS* is the surface runoff recession constant of the time-step being used.

INPUT DATA

- The model requires daily rainfall and potential evapotranspiration data (PET). As with other rainfall-runoff models in Source, the rainfall and PET data sets need to be continuous and overlapping.
- Daily rainfall data may be obtained from rain gauges as time series or from rainfall represented as a spatial layers, eg. rainfall grids per time step. Note that the time that rainfall data is collected may be important. Very often rainfall data is collected in the morning, the usual time is 9am, and may be more representative of the previous day's rainfall.
- Daily PET is an estimate of the spatially averaged areal potential evapotranspiration rate of the catchment being modelled. This estimate is subject to a number of climatic and land use/land cover variables. it may be estimated by applying a crop/land use factor to daily pan data or extracted directly from maps of calculated areal potential evapotranspiration data.


Climate Data Import Tool
Element
Rainfall
ET
Rainfall
File details
File format
AsciiGrid
Source directory
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Select
Do you want to search for ASCII grids?
Search pattern
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Prototype raster
19000101_rai.txt
Select
Units
millimetres
Cell Size (will be set to 100 if nothing supplied)
0
Map Projection for Catchment Boundaries
Projection
Albers
UTM zone
56
UTM Hemisphere
South
Central meridian
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First parallel
-18.0000
Second parallel
-36.0000
Origin latitude
0.0
Origin longitude
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East false origin
0.0
North false origin
0.0
Modelling period
Start date
1/01/1900
End date
31/12/2020
Apply
Albers
Lambert
UTM
AsciiGrid
Climatic_Atlas_of_Australia
QDNR_SILO
SILO_2006_standard
SILO_comma_delimited
SILO_Morton
SILO_original_standard
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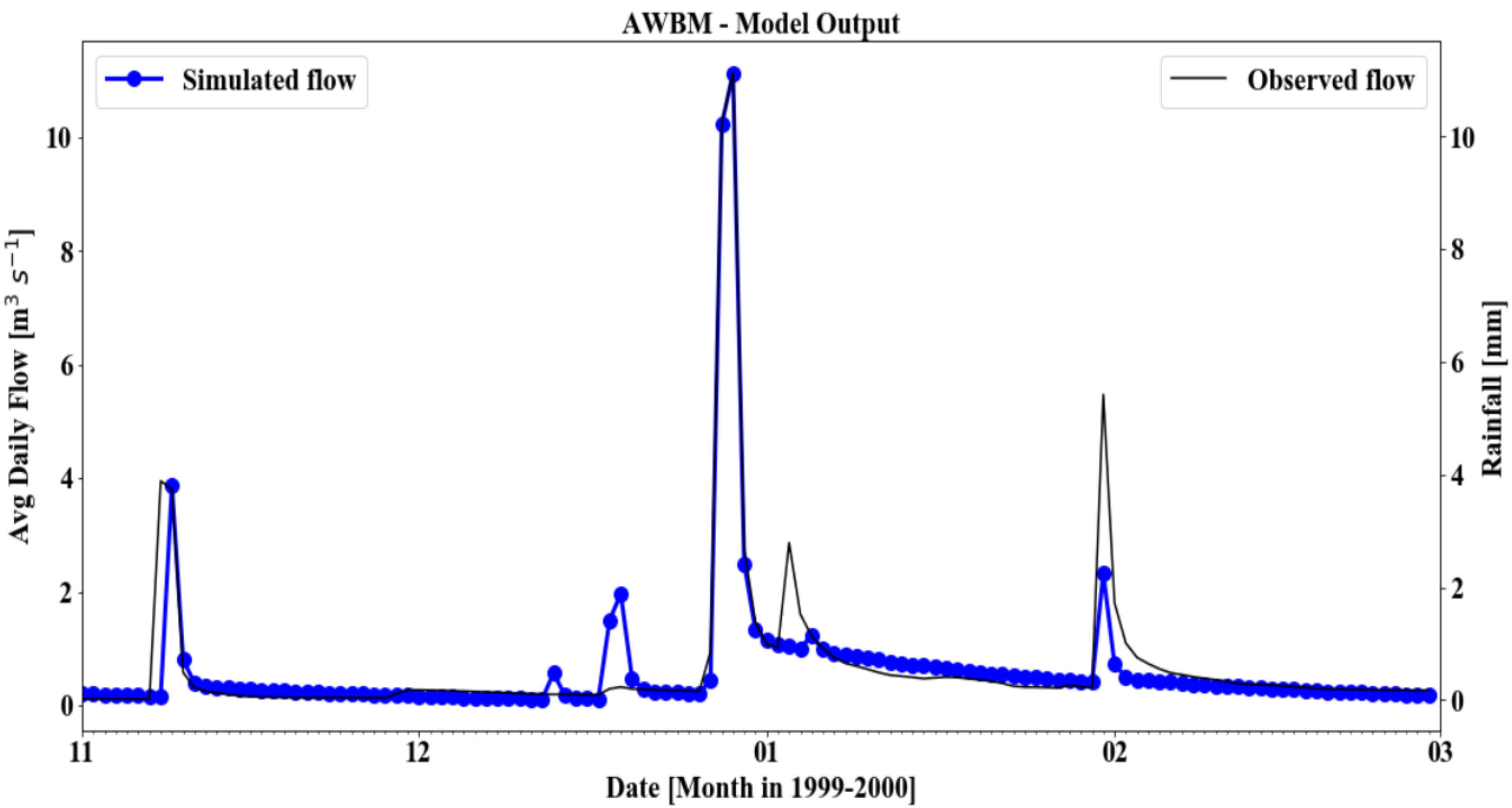
*_mwet.txt
*_rai.asc
*_rai.txt
*_rain.asc
*_rain.txt
centimetres
feet
kilometres
metres
metres per day
metres per second
metres per year
millimetres
millimetres per day
millimetres per hour
millimetres per year
no unit selected

PARAMETERS

Parameter	Description	Units	Default	Min	Max
A1	Partial area of surface store 1 (Proportion of the catchment)		0.134	0.000	1.000
A2	Partial area of surface store 2 (Proportion of the catchment)		0.433	0.000	1.000
BFI	Base flow index (proportion of excess runoff going into the base flow store)		0.35	0.000	1.000
C1	Capacity surface store 1	mm	7	0	50
C2	Capacity surface store 2	mm	70	0	200
C3	Capacity surface store 3	mm	150	0	500
K_{Base}	Base flow recession constant (proportion of moisture depth remaining per time-step)		0.95	0.000	1.000
K_{Surf}	Surface flow recession constant (proportion of moisture depth remaining per time-step)		0.35	0.000	1.000

OUTPUTS

Variable	Parameter	Frequency
Baseflowrecharge	Baseflow recharge in each time step	time step
Baseflowstore	Baseflow store contents in each time step	time step
Effectiverainfall	Effective rainfall at each time step	time step
Surfacerunoff	Surface runoff in current time step – before routing	time step


AWBM - Model Output
Simulated flow
Observed flow
Avg Daily Flow [m^3 s^{-1}]
Rainfall [mm]
Date [Month in 1999-2000]
11
12
01
02
03
0
2
4
6
8
10

THANK YOU