Cambodian Source Model

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Overview

- What is Source + demo
- Source + geographic data + demo
- Cambodian Source model + demo
- Source + Datacube

eWater Solutions

Not for profit, Australian Government owned organisation

Australian Government
Department of the Environment

MURRAY–DARLING BASIN AUTHORITY

Government of South Australia
Department of Environment, Water and Natural Resources

State Government Victoria
Department of Environment and Primary Industries

NSW GOVERNMENT
Department of Primary Industries
Office of Water

Queensland Government
Natural Resources and Mines

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eWater Solutions

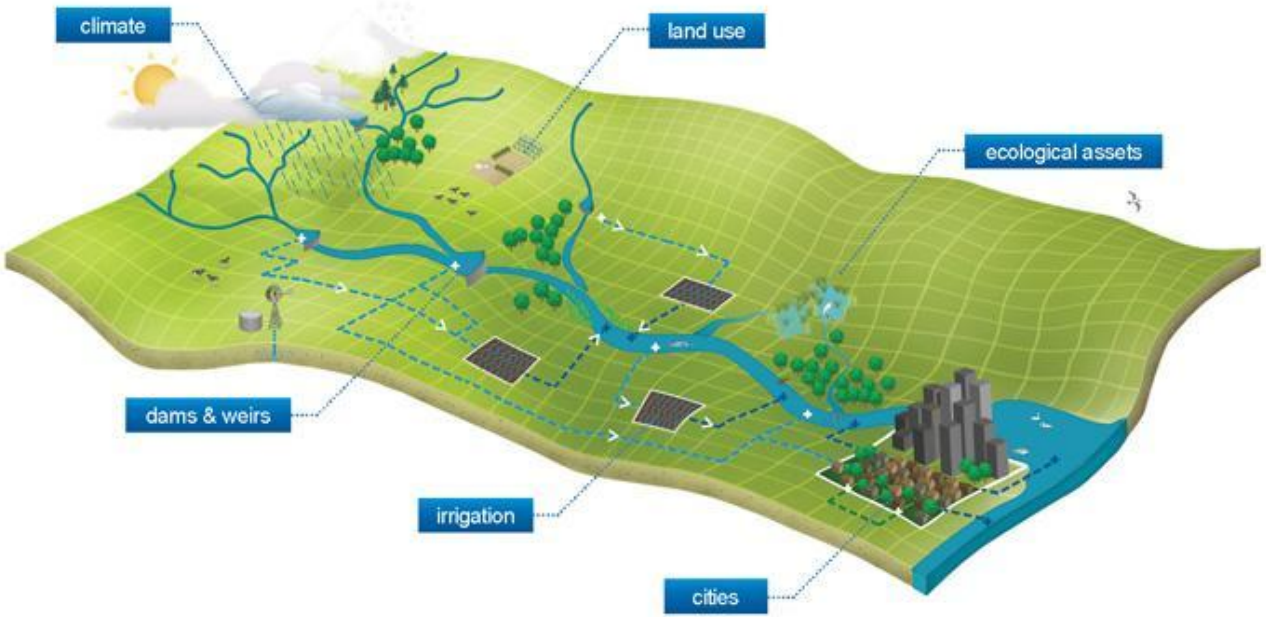
- Primary role to support the implementation and use of eWater Source
- Tools, technical support, capacity building
- ~30 staff – engineers, scientists, software developers, admin

What is Source?

eWater Source provides decision-support for water system planning and operations

A ‘catchment to estuary’ modelling capability:

- water quantity and quality
- ecosystem health
- Reservoirs and water use
- urban and rural catchments.



Allows implementation of complex policy & operational rules within the hydrological models

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Source Goals

To encourage **consistency** in application – community of practice

Transparent - documentation of algorithm and methods

Defensible - best practice modelling approaches

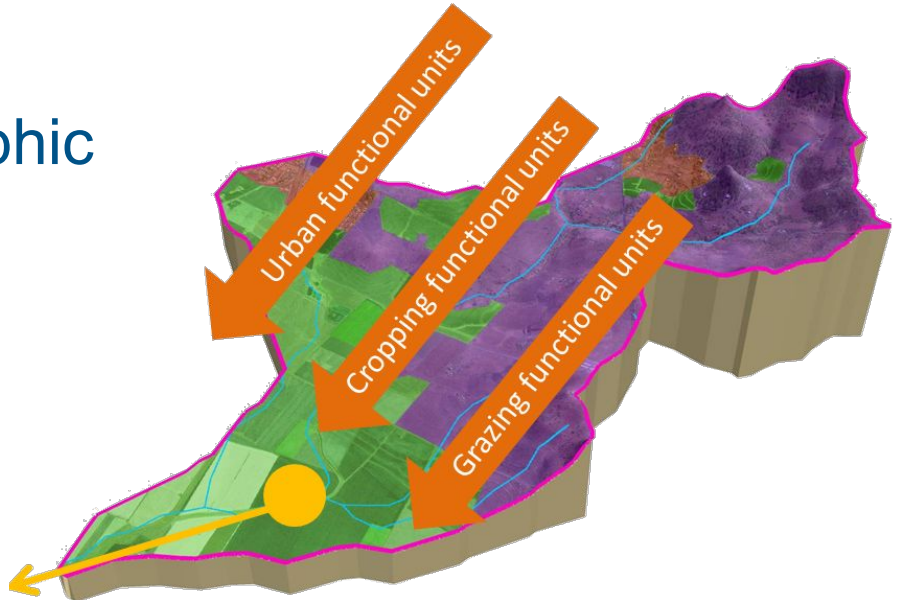
Robust - rigorous software development and testing process

Flexible - customisable for specific water management situations

Source Capabilities

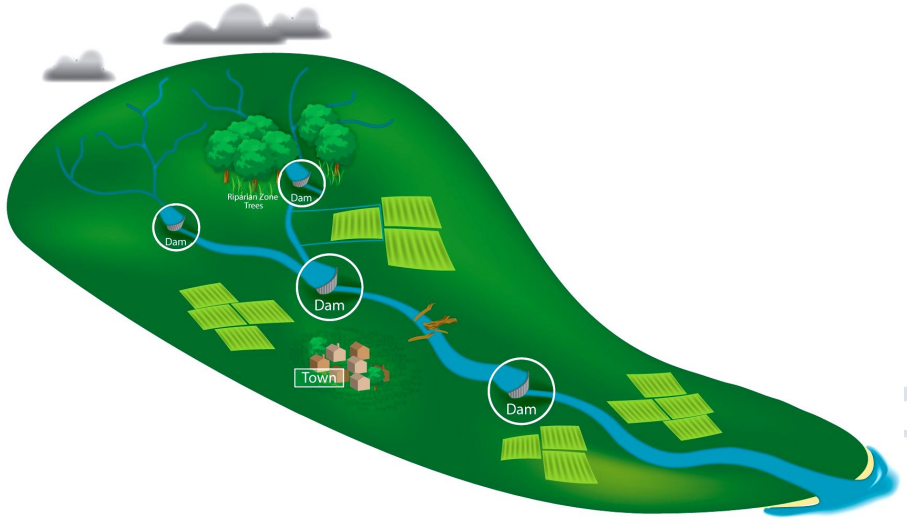
Catchment Processes (Geographic Scenarios only)

- Rainfall-runoff models
- Constituent generation and filtering



River or stream processes

- Routing – how water moves through a river
- Nodes for physical & management processes
- Constituent movement – lumped or marker



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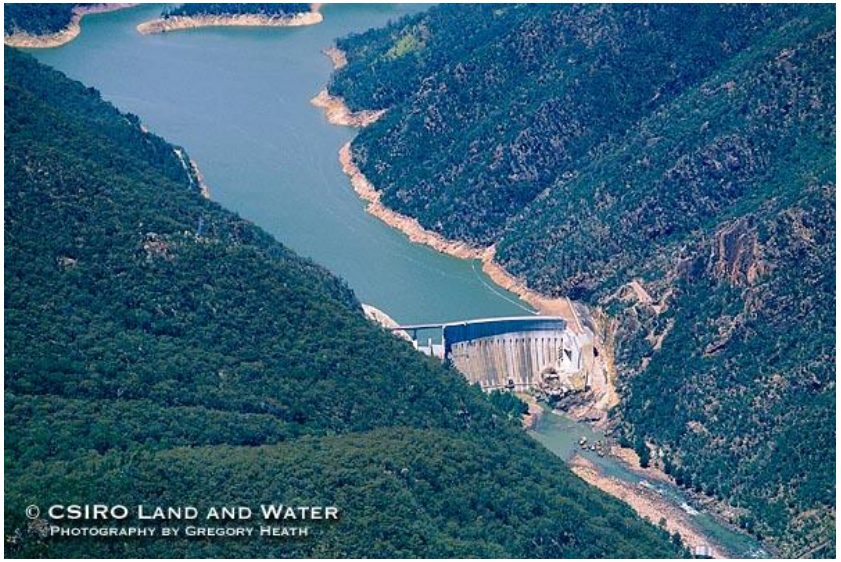
Source Capabilities – cont.

River regulation

- Reservoirs and storages
- Hydropower generation
- Operation to target levels

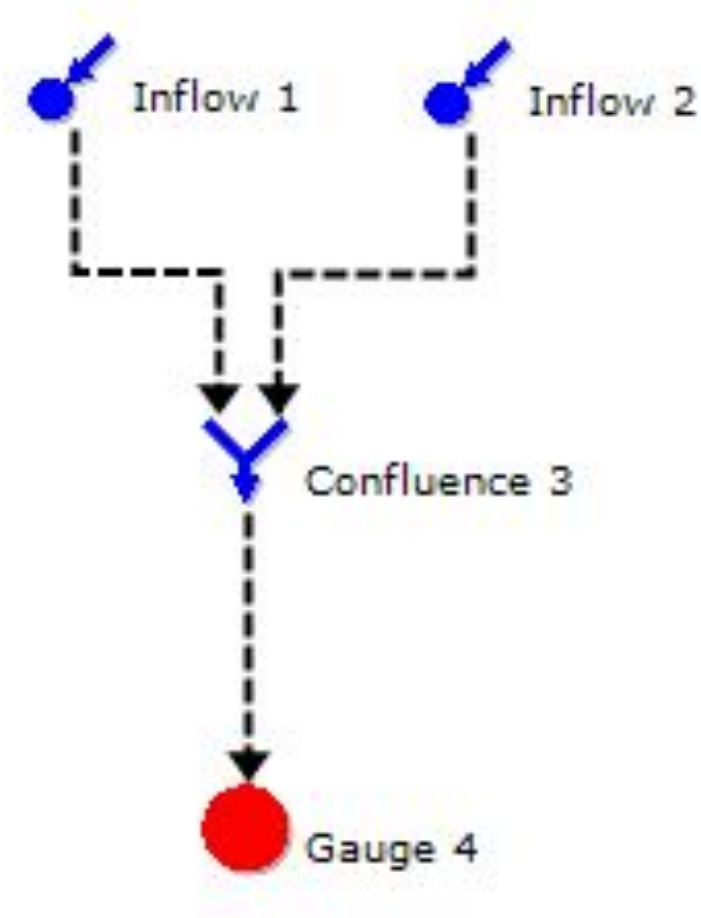


Water use and demand

- General purpose demand
  - E.g. Time series
- Tailored demand models for:
  - Environmental requirements
  - Crop requirements
  - Urban demand models

Source Conceptual Framework

- **Links** – model the transport water/constituents through the system
- **Nodes** - represent points where hydrologic processes occur and management rules are applied

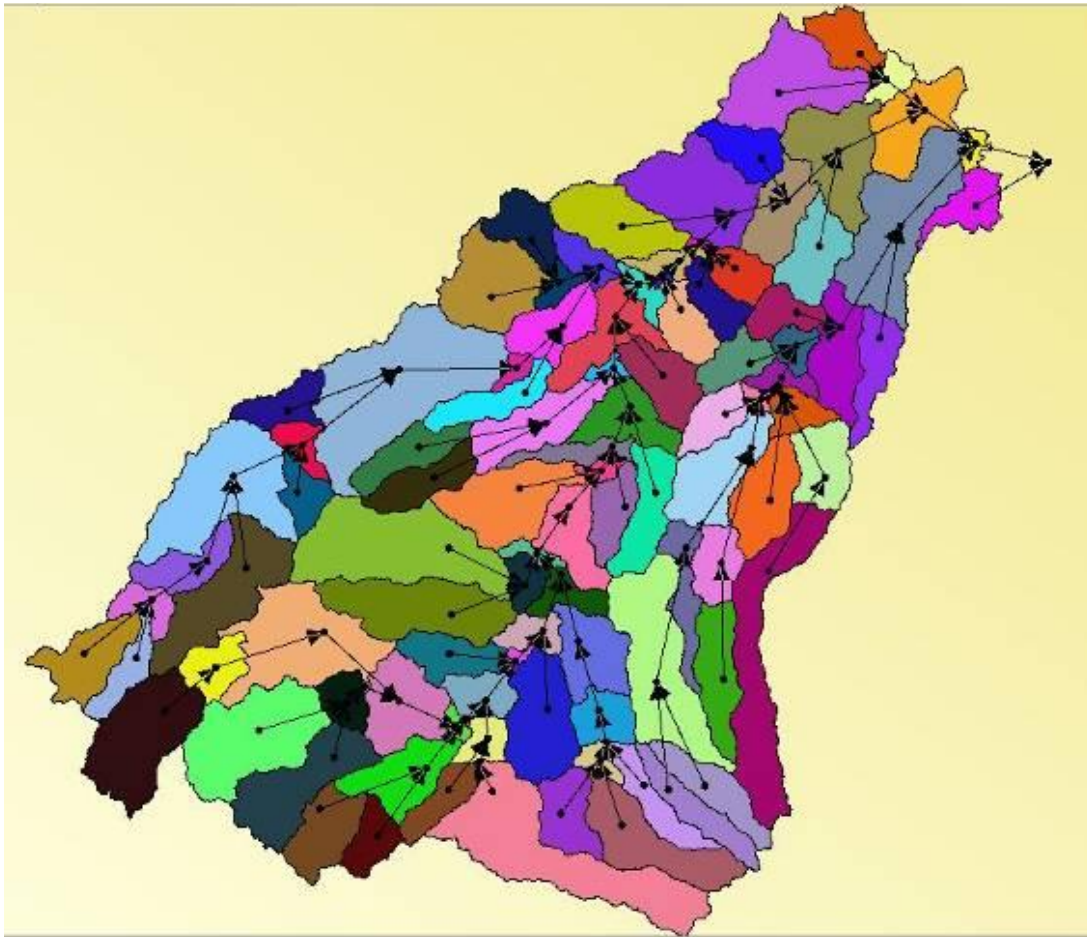


Creating Source Models

Two methods of creating Source models:

1. Creating catchments from spatial data

- Used for rainfall-runoff modelling
- Can add other network elements



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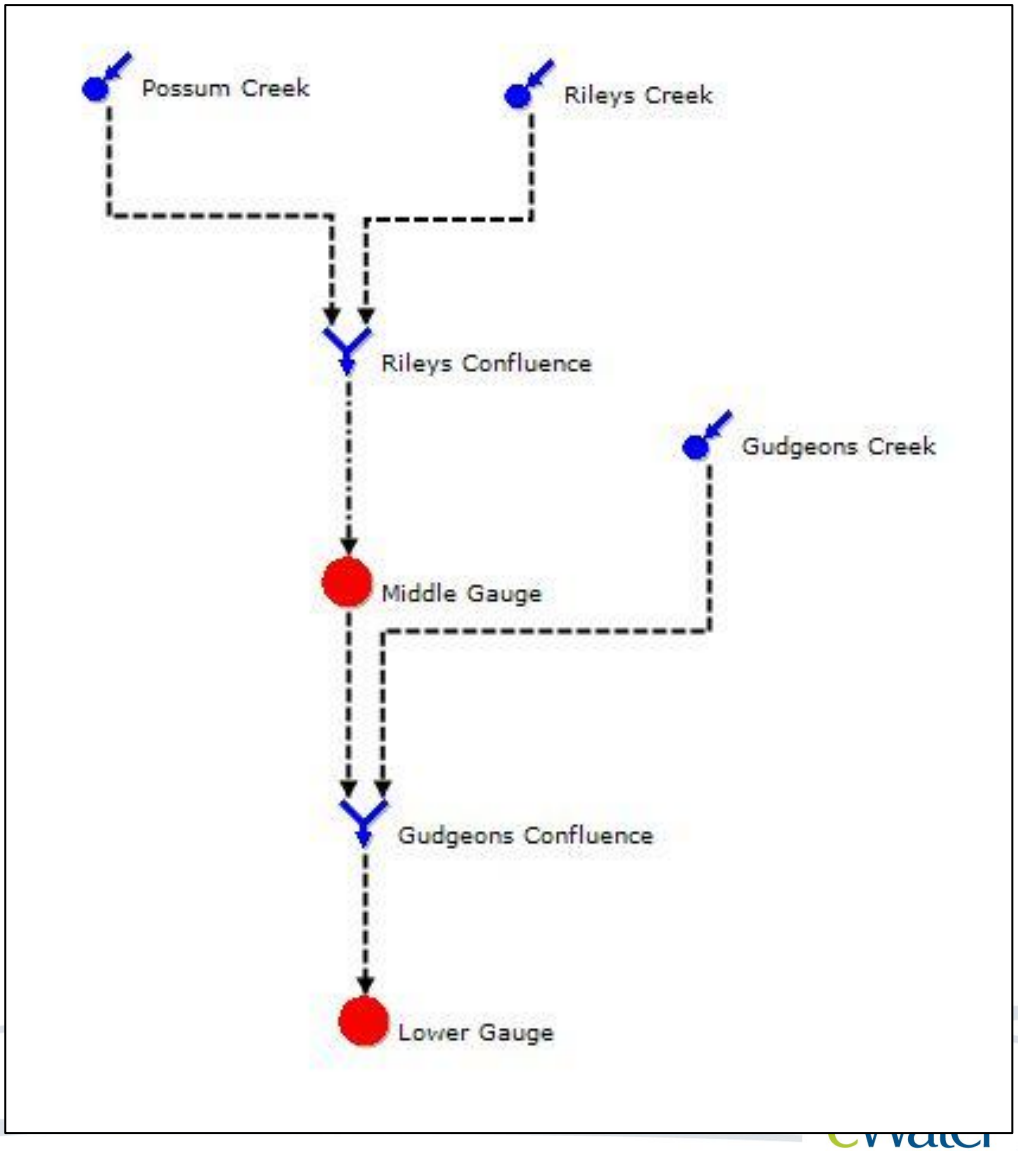
Creating Source Models - Continued

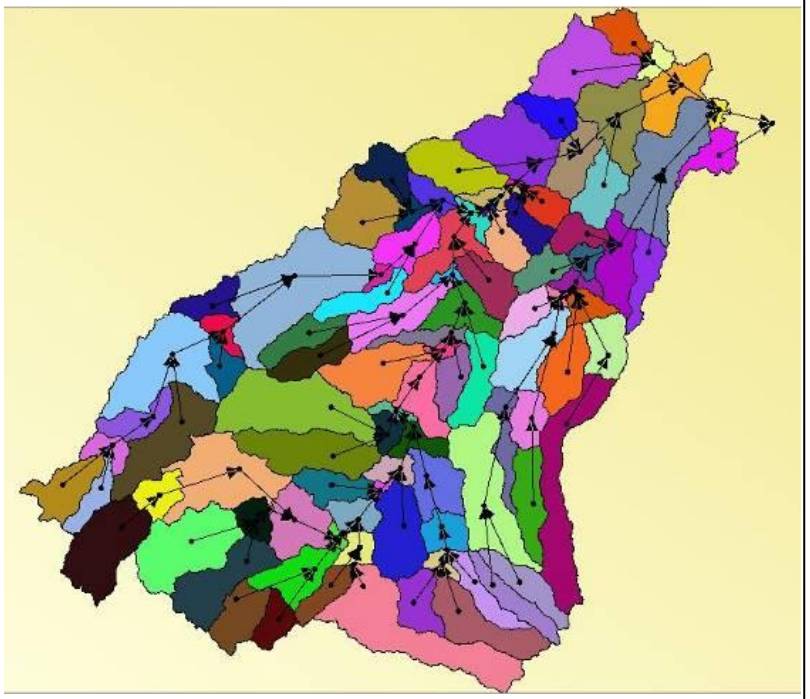
2. Draw the network manually

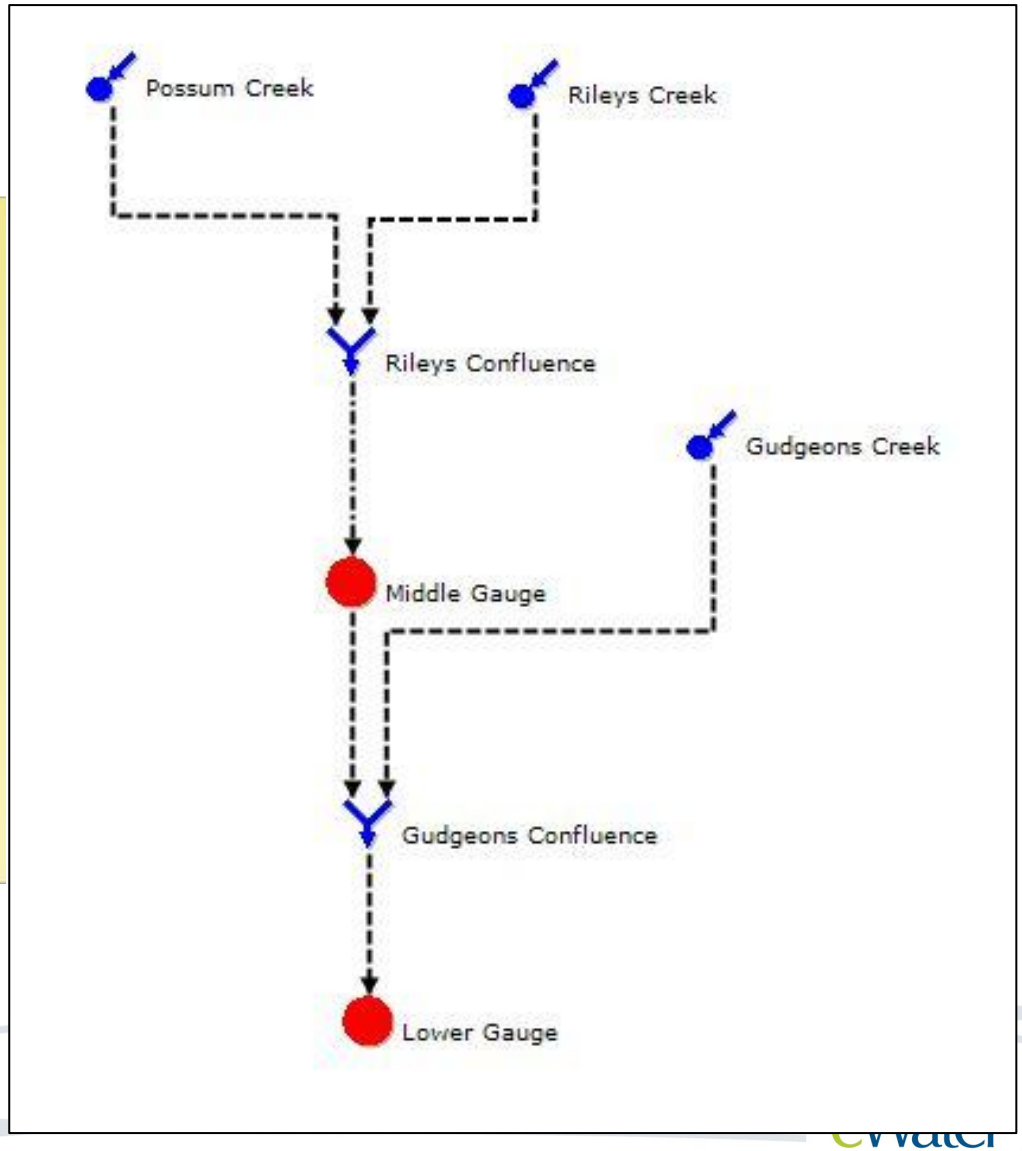
- Catchments are not created, so method cannot be used for rainfall-runoff modelling
- Typically used in regulated and urban systems



Creating Source Models - Continued

3. Scenarios can be linked





Regulated & Unregulated Systems

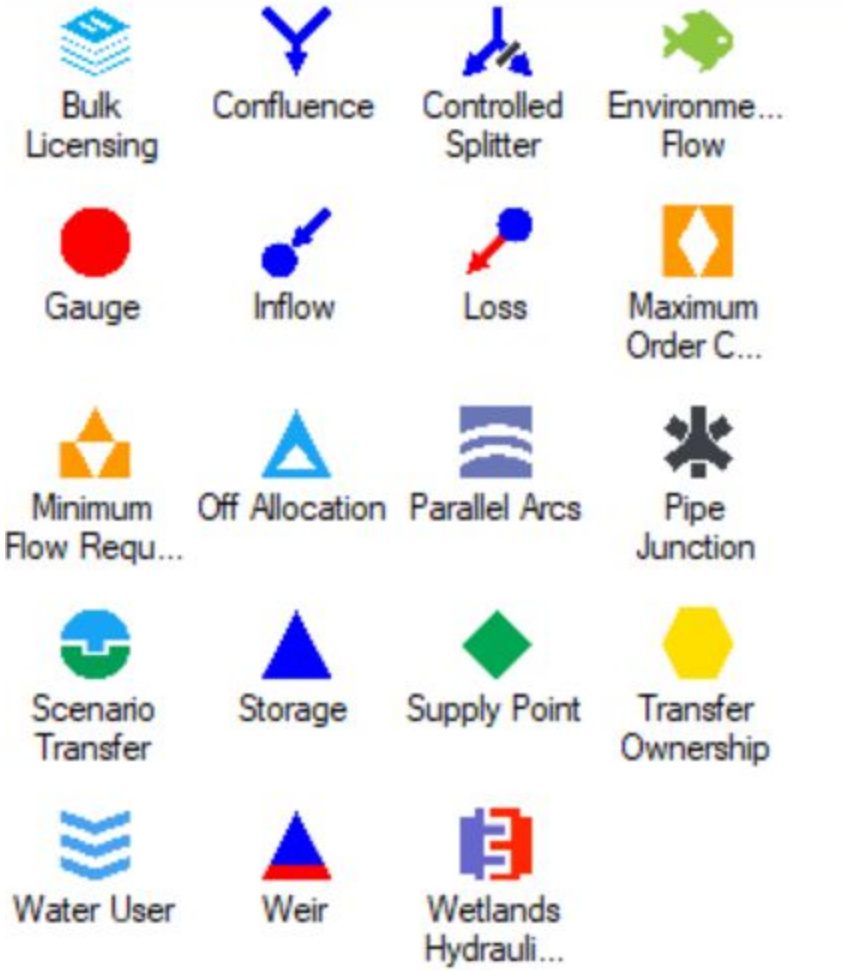
Unregulated system

- Natural flows
- Water users can take water opportunistically

Regulated system

- Water user or other feature that “orders” water
- Water is released on demand from storages

Modular Design



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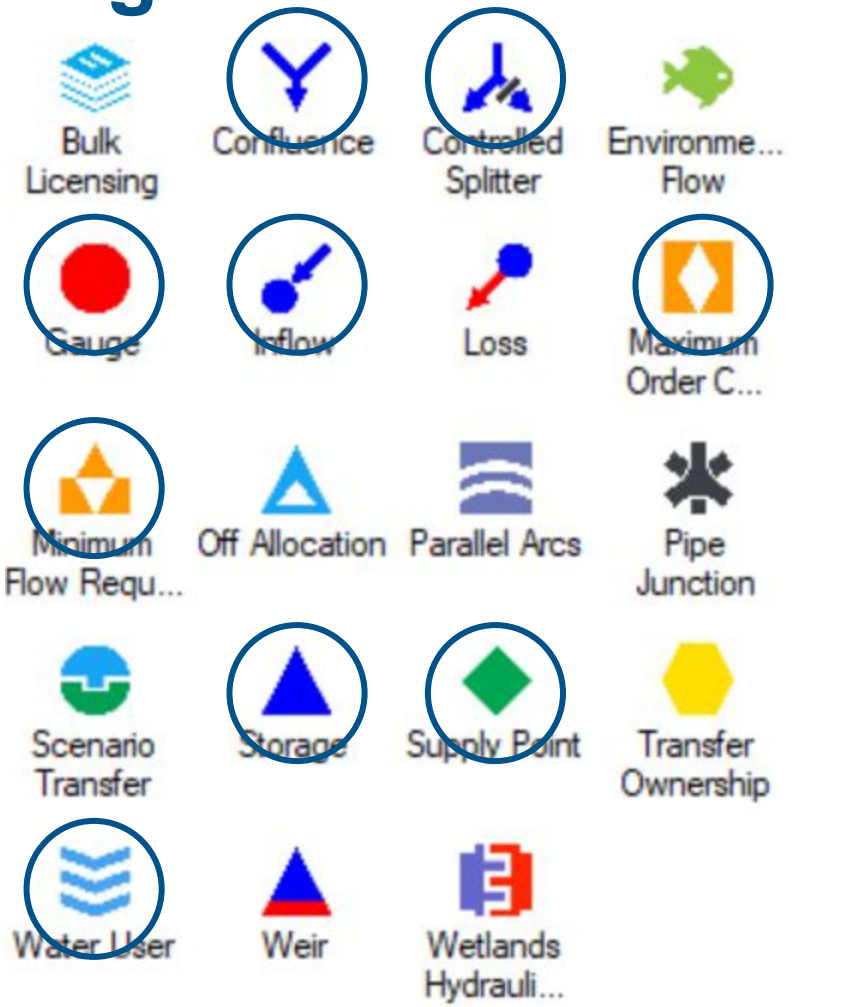
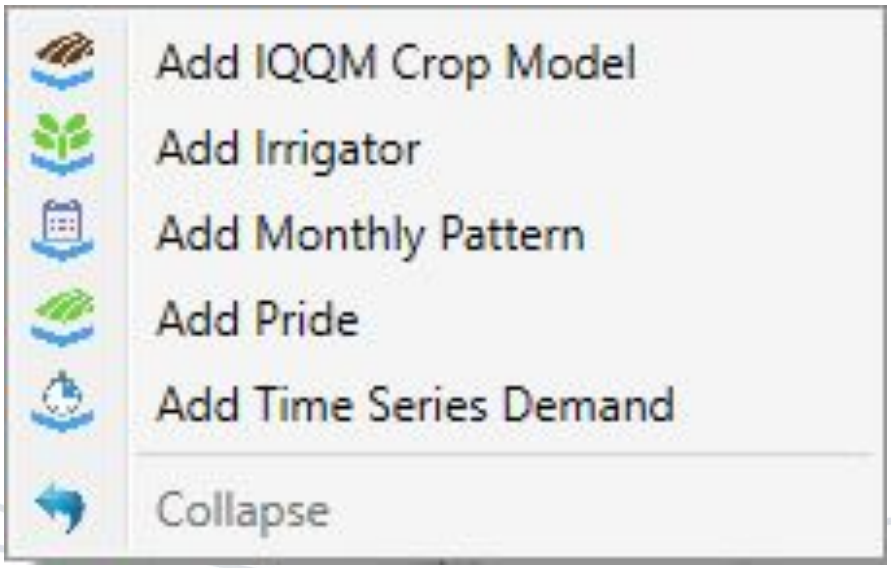
Modular Design

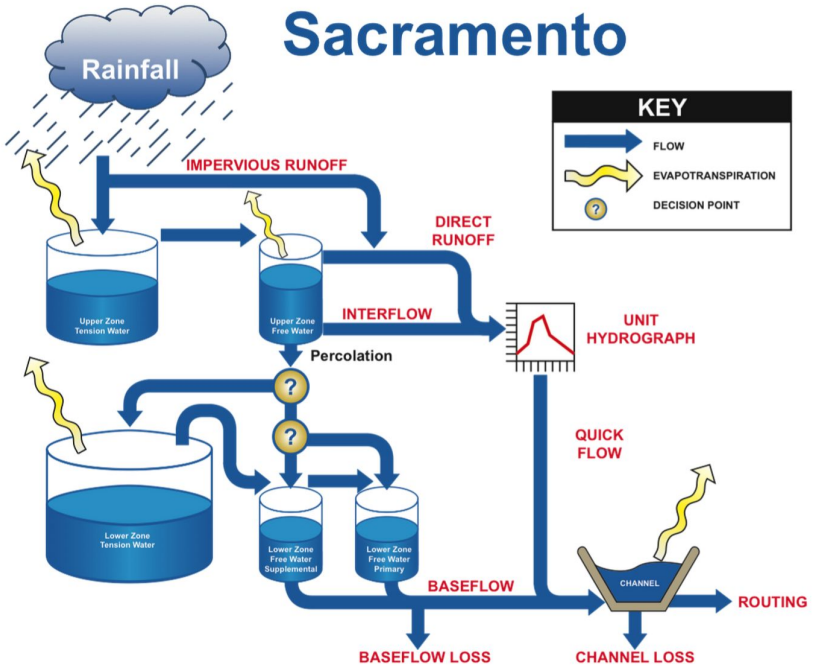


Modular Design

Most elements offer a range of alternative models at varying levels of complexity

- Water User Node – implements 5 different water user types
- 7 different rainfall runoff models



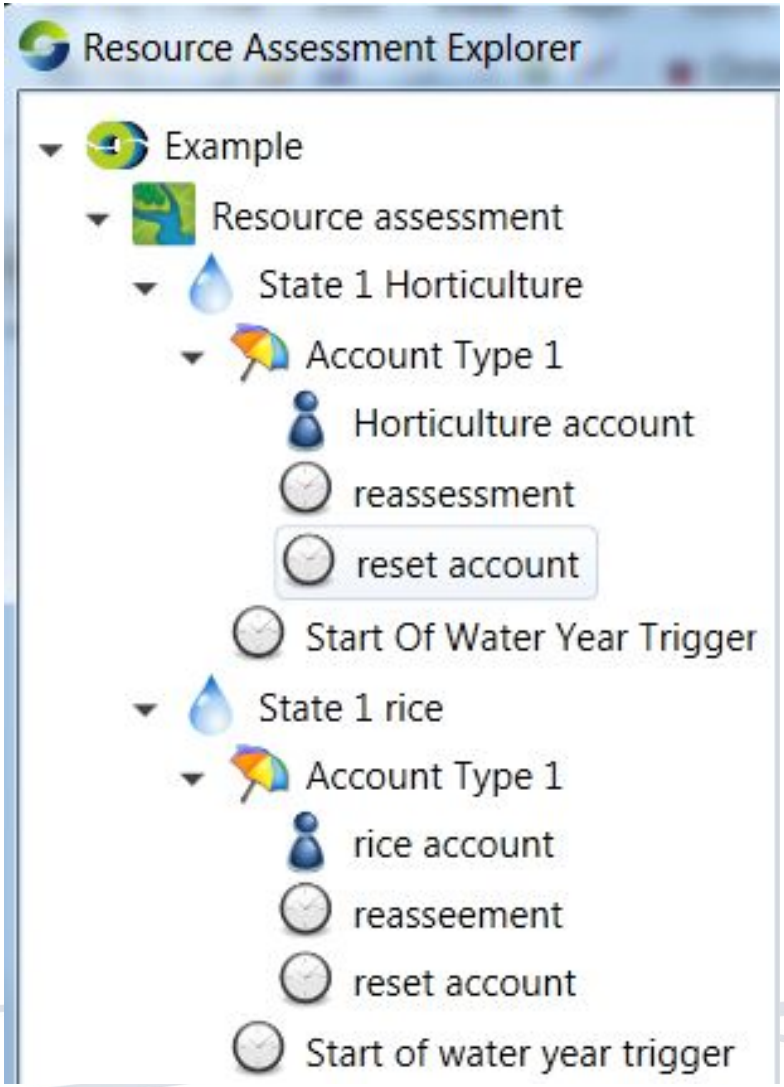


Water Access Rules

Option 1 Simple Rules: Use expression editor and the minimum flow requirement functionality to reflect flow, supply or storage priorities

Option 2 Share based on broad allocation of resources: Use the 'resource assessment' functionality to allocate available resources to different users e.g. on a seasonal basis

Option 3 Ownership: Track water ownership and assign owner priorities



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Tools for Customising Source

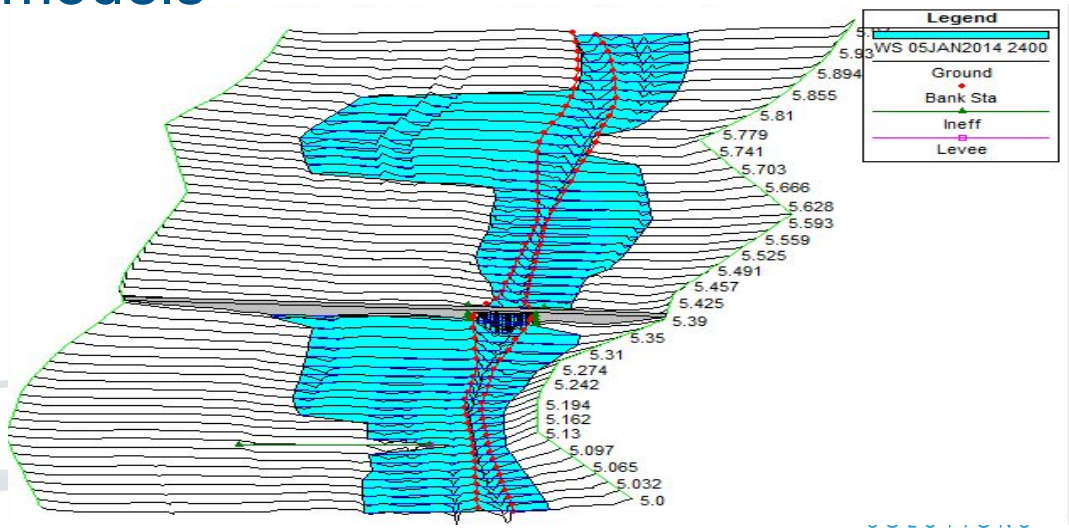
Functions – user-defined logic

- Define equations, operational rules, results analysis

```
300*sin((($now.dayofyear)/366*pi()))+50
```

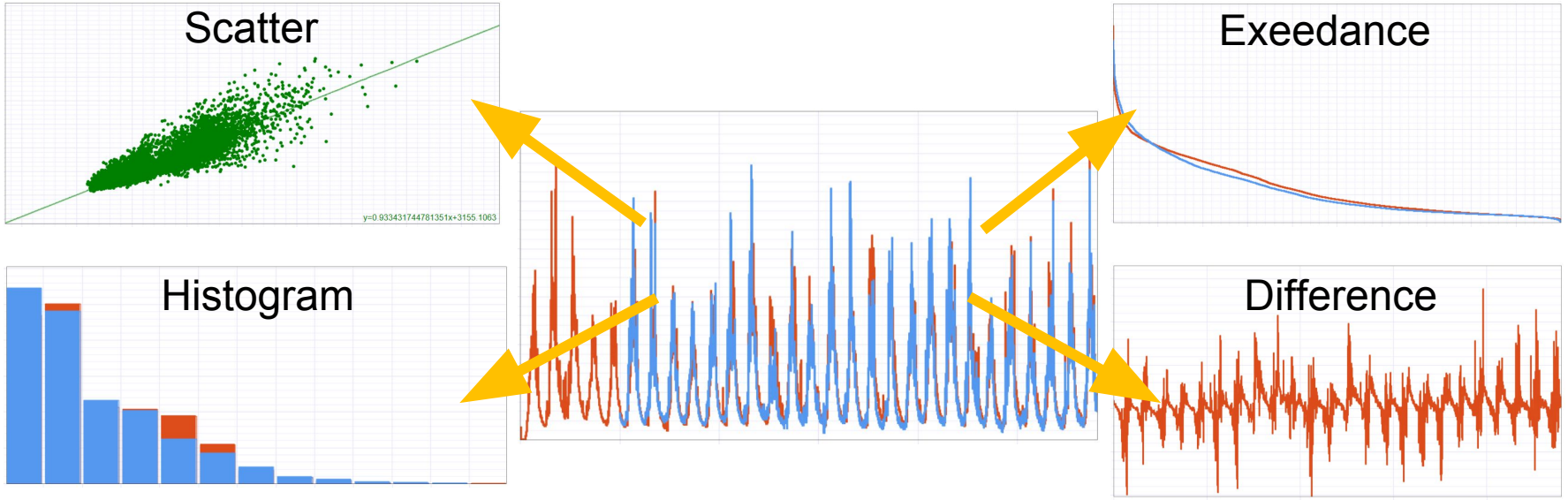
Plugins – extensions to the Source framework, e.g.:

- Custom rainfall-runoff models
- HEC-RAS



Tools for Optimisation and Analysis

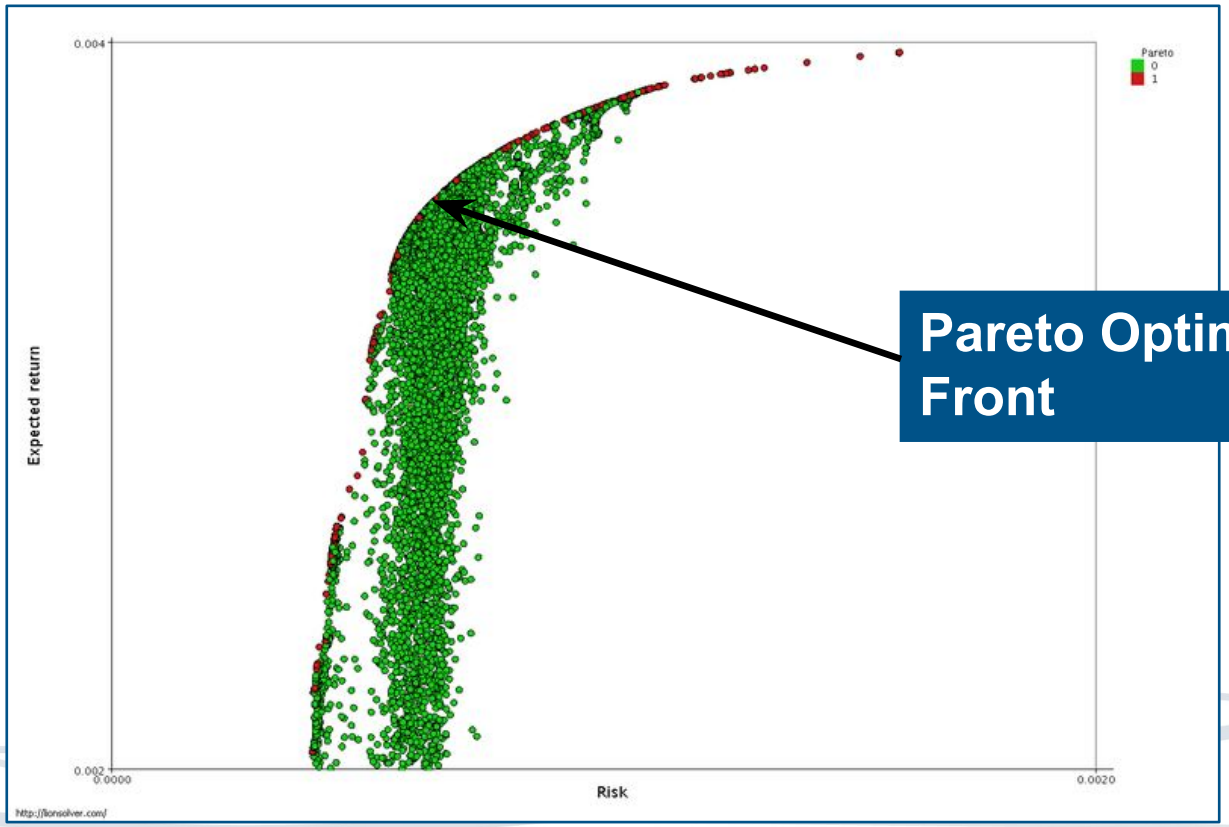
Time series graphing and analysis via the Results Manager



Tools for Optimisation & Analysis – cont.

Catchment calibration tool

Multi-objective optimisation (Insight) – evaluates trade-offs between competing objectives



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Tools for Automation, Integration & Performance

Command line interface

- Run and edit Source models via the command line
- Batch processing
- Allows integration with other systems

Tools for managing & editing large models

- Bulk configuration of model elements (Feature Editor), import & export settings

Performance

- Parallelisation, Source on the cloud

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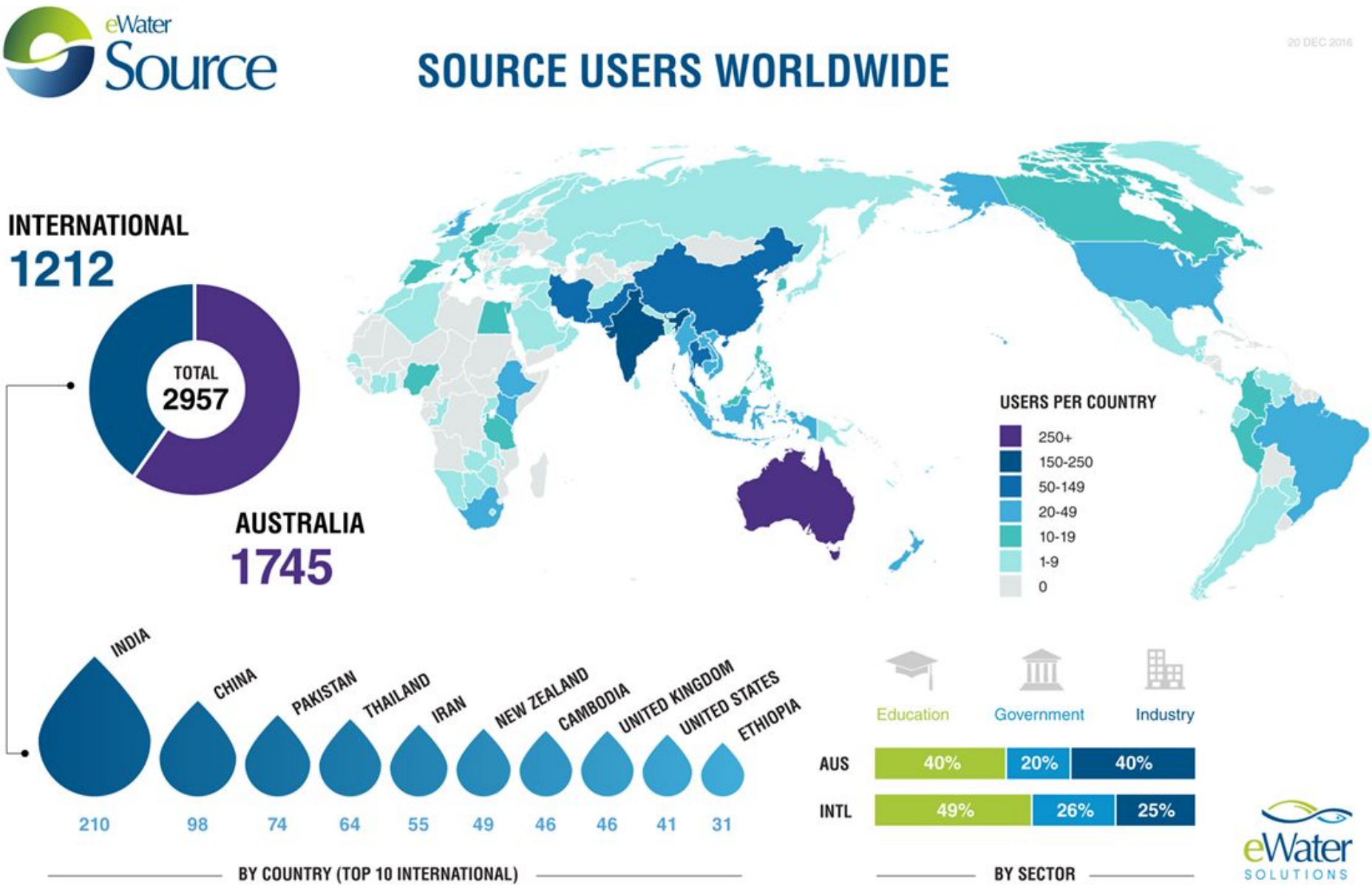
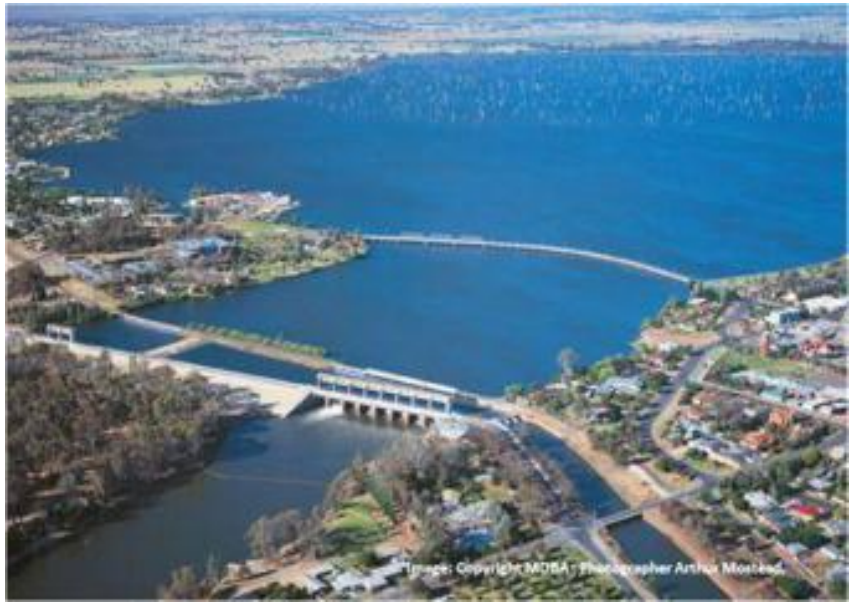
Source Applications



How is Source Used?

The River Murray

Murray-Darling Basin Authority (MDBA) responsible for management of the River Murray System, in collaboration with State jurisdictions



Sophisticated process involving daily data collection, analysis and decisions as well as planning many months in advance.

MDBA using Source to build river-system models to support both day-to-day operations and planning

The aim is to improve water management and delivery for agriculture, communities and the environment

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Great Barrier Reef (GBR)

Partners: QLD Gov, CSIRO, GBR Marine Park Authority

Declining water quality in the catchments near the GBR has been identified as a national priority and threat to the reef

Source catchment and water quality models used to:

- Identify pollutant sources
- Evaluate progress

Significant plugin development – Dynamic SedNet framework

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Mekong River Basin

The Mekong is a trans-boundary river in Southeast Asia

Rapidly growing economies and populations

Two Source projects:

- Procedures for Water Use Monitoring (PWUM)
- MRC Council Study

Procedures for Water Use Monitoring (PWUM)

Aim: ensure that the use of the water resource is reasonable and equitable across the Member Countries of the Mekong River Basin

Modelling to understand water availability and use

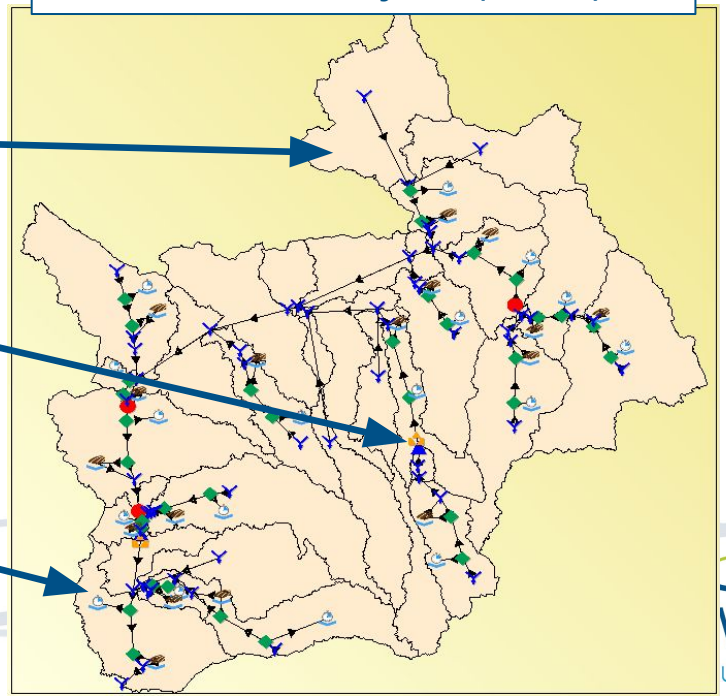
Source integrates:

Rainfall-runoff modelling

Storages & flow regulation

Water Users and demands
- Hydropower,
- Agricultural/ Urban,
- Environmental

Xedon Pilot Project (Laos)

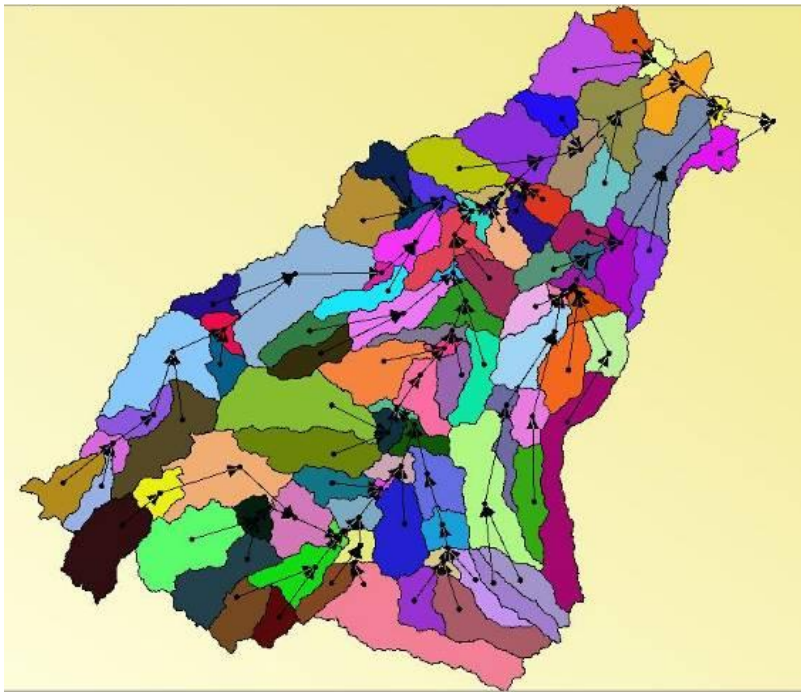


Demo

Source + Geographic Data: Rainfall runoff

Catchment models:

- Catchment boundaries
- Links between catchments
- Node types
- Functional units
- Climate data



Model Creation using Geographic data

- Generation via DEM:
  - Source calculates catchment boundaries and links automatically
  - some minor configuration allowed
- Generation via shapefiles:
  - need to provide your own:
    - catchment boundaries and links via shape files

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Model Creation using Geographic data

- Generation via DEM:
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  - need to provide your own:
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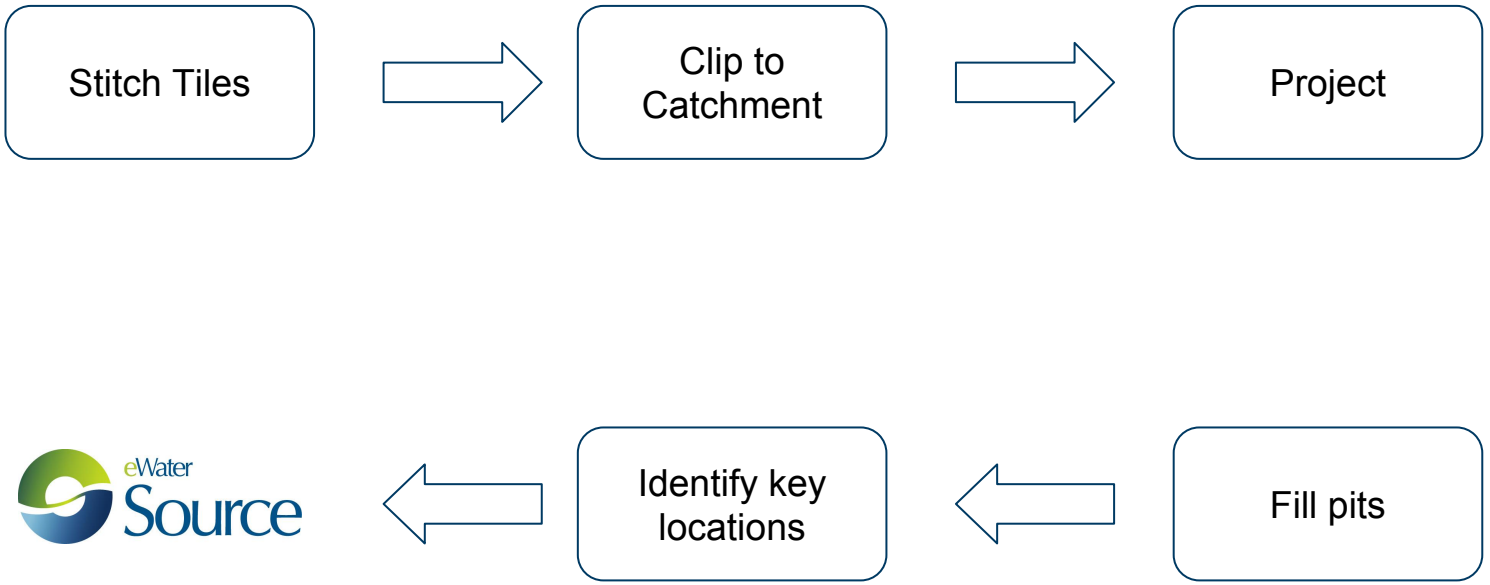
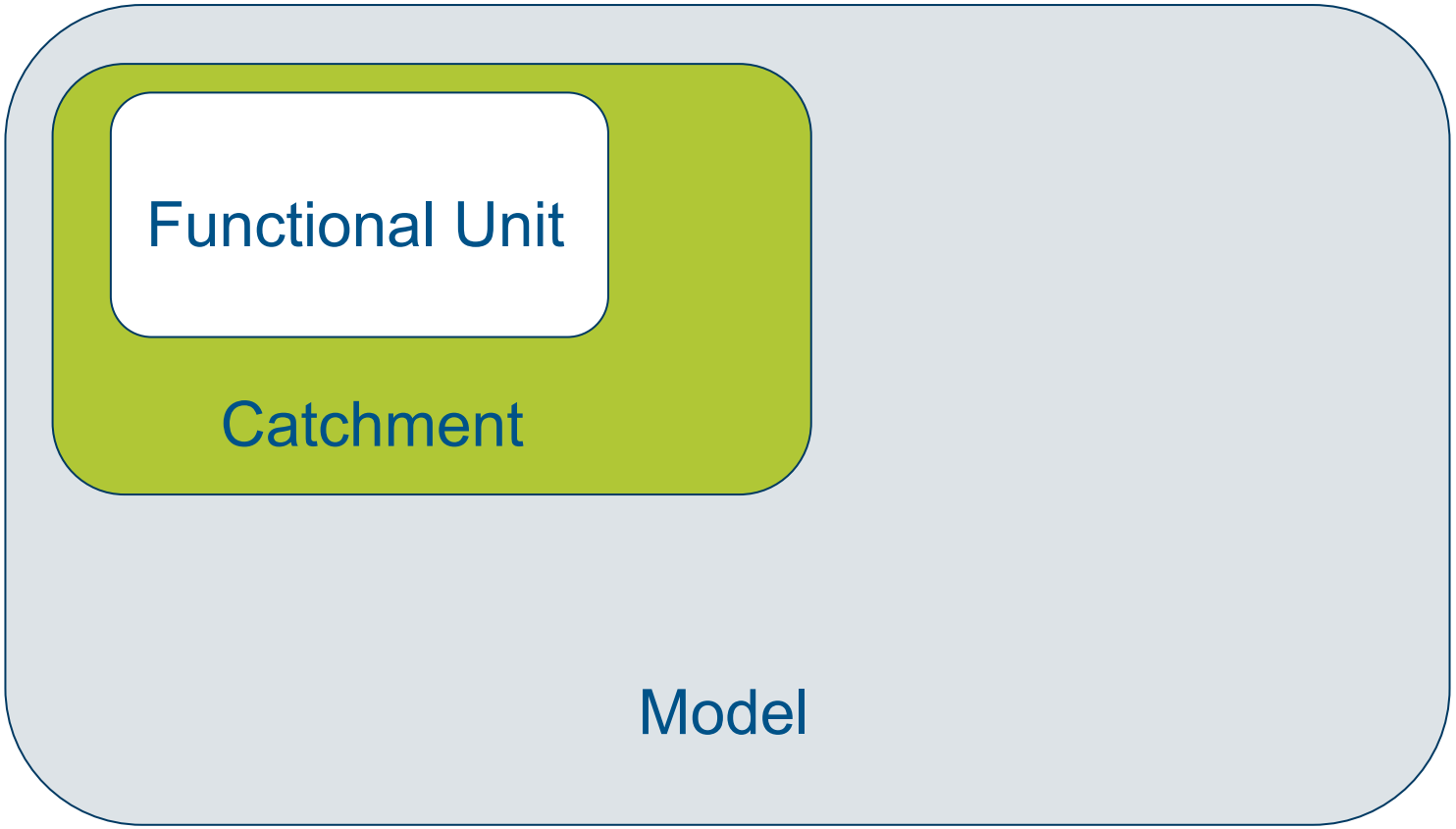
Data preprocessing

Both methods still require significant preprocessing



Functional Units



Functional Units (FU)

Functional units based on:

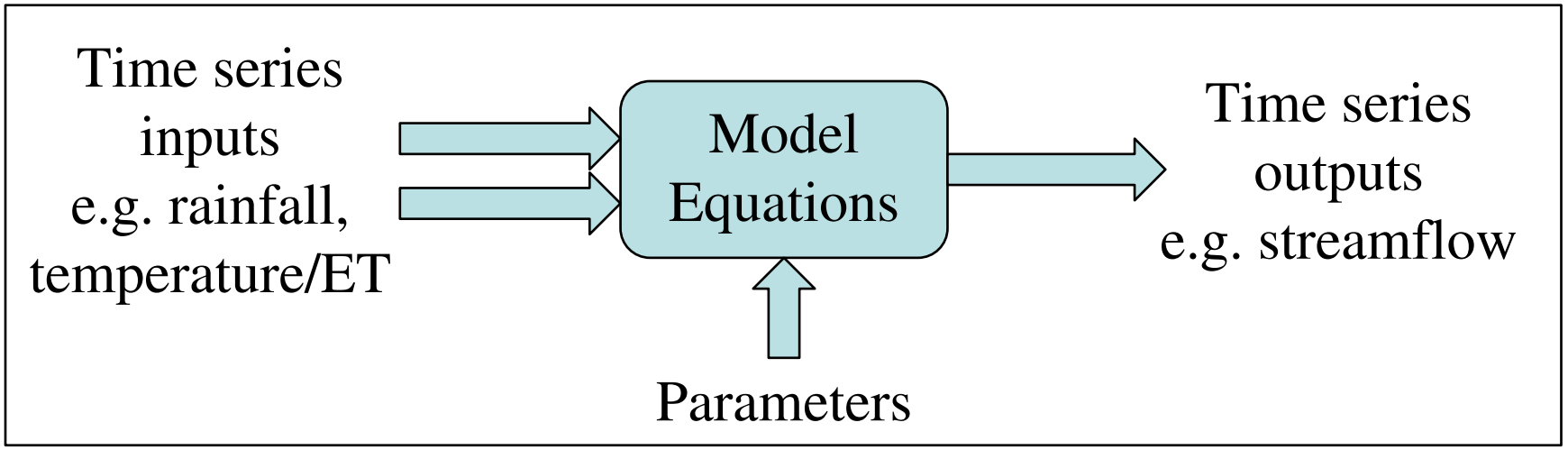
- Land use - forested, non-forested, snow
- Soil type - pervious, impervious
- Slope
- Climate

Functional Units (FU)

- Allows each catchment to have a different runoff response for each FU
- Each catchment has every functional unit and a configurable area
- Catchment functional unit areas can be defined using rasters

Rainfall-runoff Models

A rainfall-runoff model converts rainfall into surface runoff (streamflow)



Parameters are variables describing catchment characteristics

- e.g. hill slope, soil water capacity, temperature coefficients

(May be statistical or have physical significance)

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Rainfall-runoff Models in Source

Built-in models are metric/conceptual, spatially lumped, deterministic:

1. GR4J
2. Sacramento
3. IHACRES-CMD
4. SYMHYD
5. SMARG
6. Australian Water Balance Model (AWBM)
7. Simple Urban Runoff Model (SURM) – used for functional units with large cities or towns

Relatively easy to include custom rainfall-runoff models using plugins.

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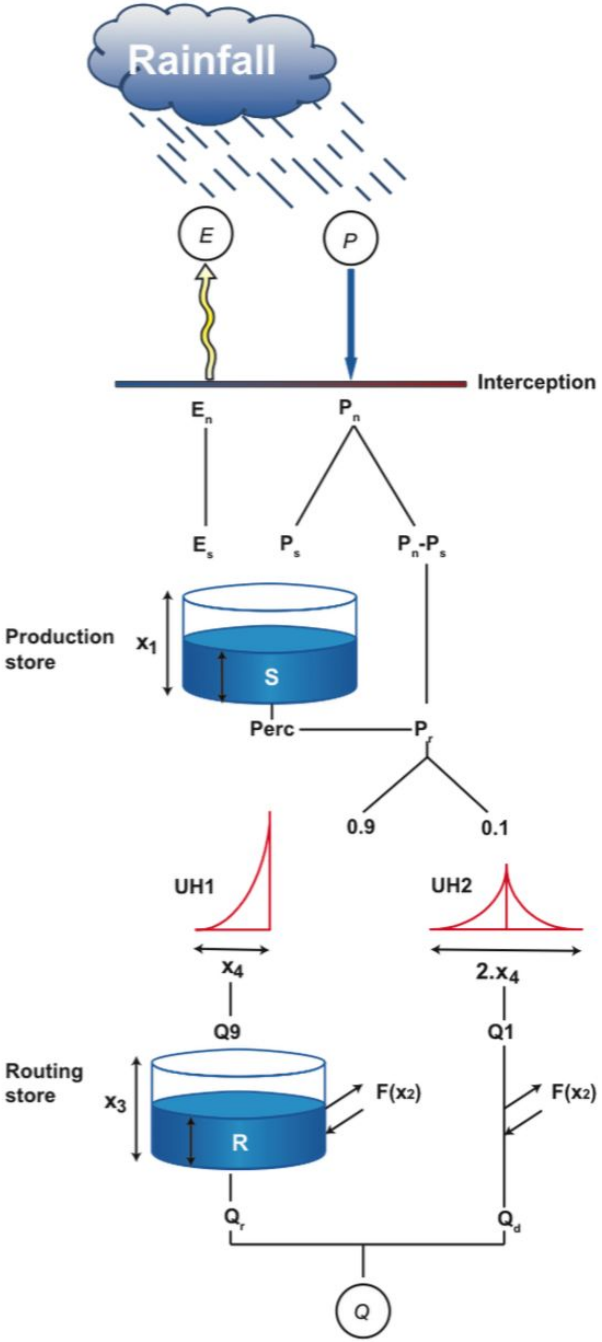
GR4J

Metric/empirical model, spatially lumped

2 soil moisture stores

4 parameters

(2 optional parameters for baseflow separation)



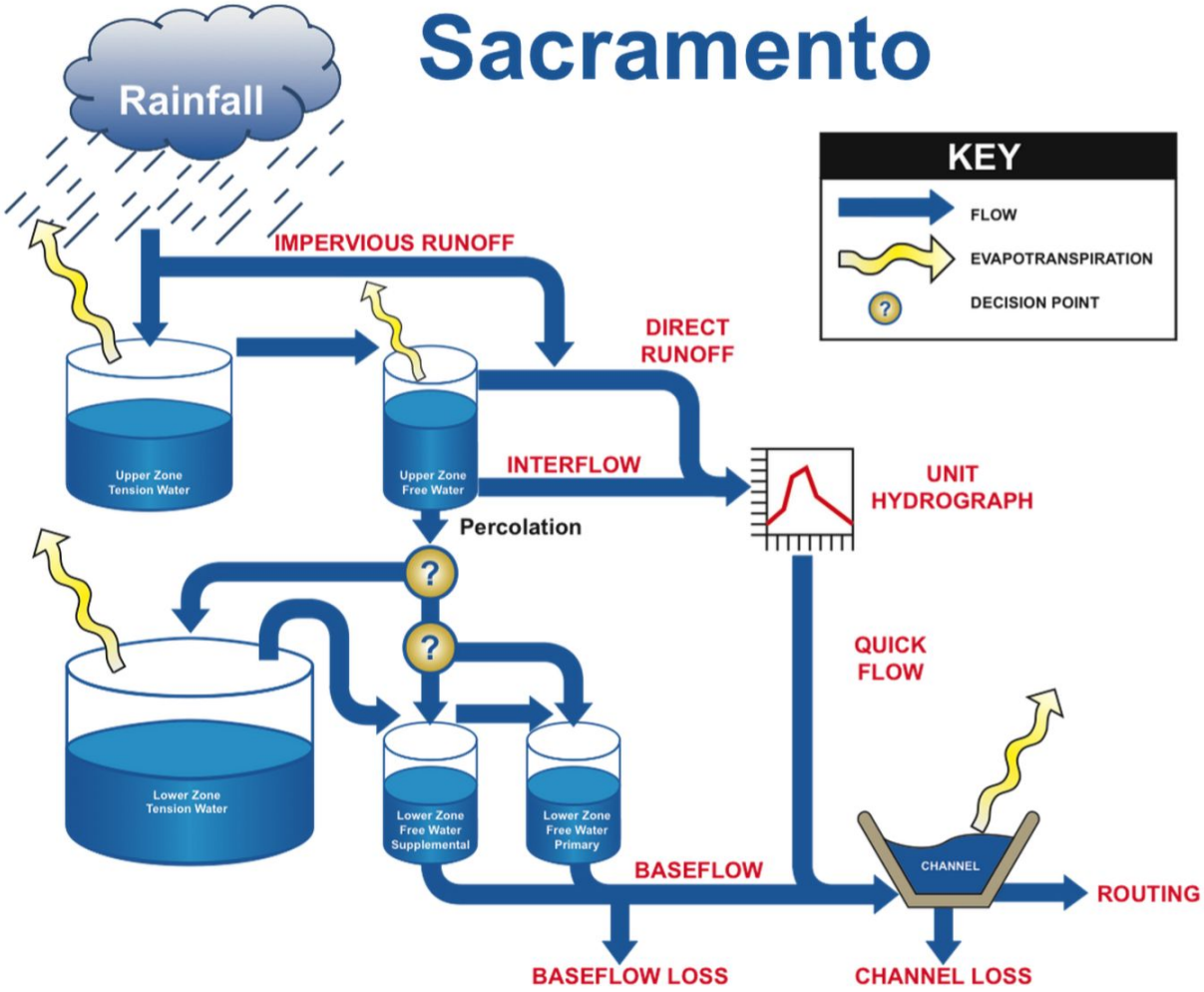
Sacramento

Conceptual, spatially lumped

5 soil moisture stores

22 parameters total:

- 17 water balance parameters
- 5 unit hydrograph (routing) parameters



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Demo

- Create model using DEM
- Create model using shapefiles
- assigning function units
- configuring rainfall runoff models

Cambodian Source Models

Model	1	2	3
Catchments	271	271	31
Function Units	7	1	1
Rainfall Runoff Model	GR4J	GR4J	GR4J/Sacramento
Possible Use cases	calibration and water balance analysis	model calibration and historical water balance analysis	future water balance forecast
Complexity	high	medium	low

Demo

Cambodian Source Models: Rainfall

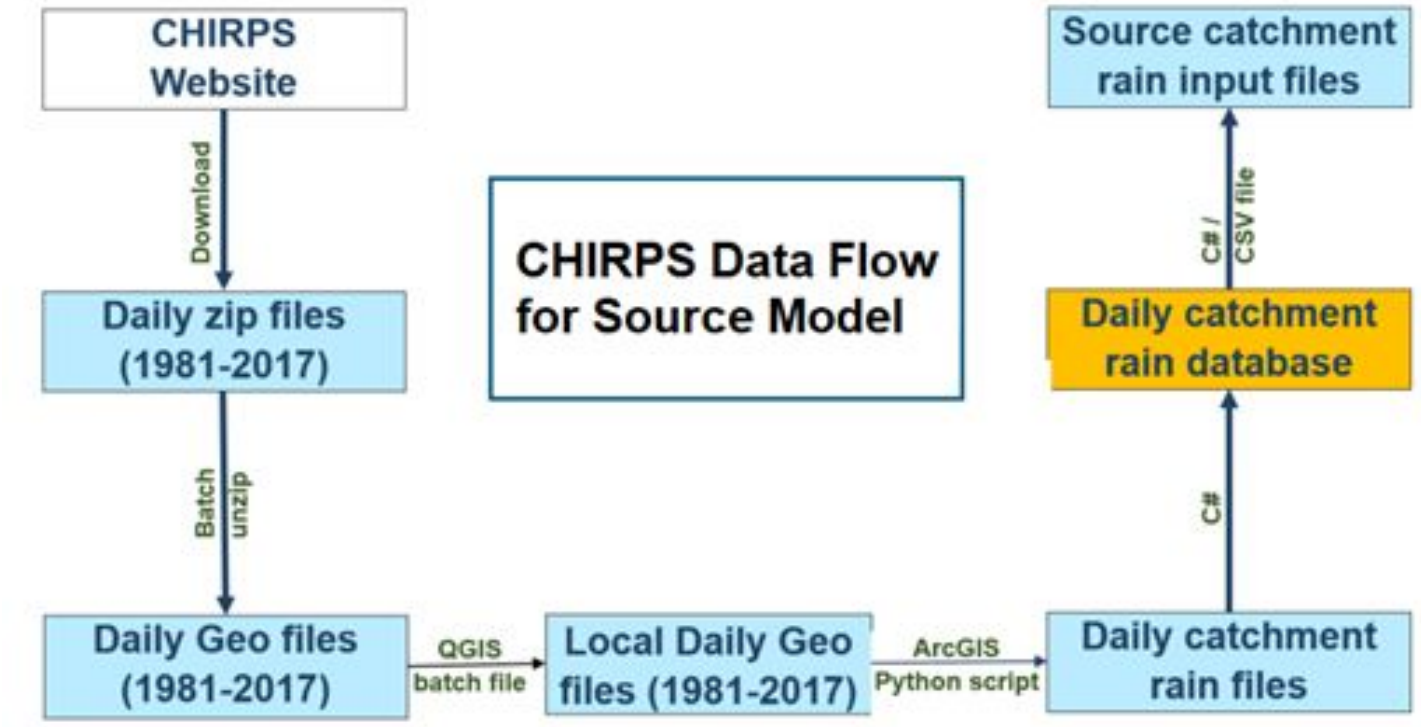
Two data sources

- Observed Data from Mekong River Commission (MRC), Mekong River Modelling(MRM) and World Meteorological Organization (WMO)
- CHIRPS satellite data

Observed rainfall data

- 61 stations
- 40 with data
- different periods
-

Cambodian Source Models: Rainfall



Bias corrected rainfall data

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Source + Datacube

Integration areas:

- Catchment generation
- Climate data
  - historic data
  - forecast data
-

Accessing Source

Source Public

- Free, publicly available release
- Limited to models with 20 nodes

Source Full

- Restricted access
- Full functionality, including advanced features not available in Source Public