



The Water Balance

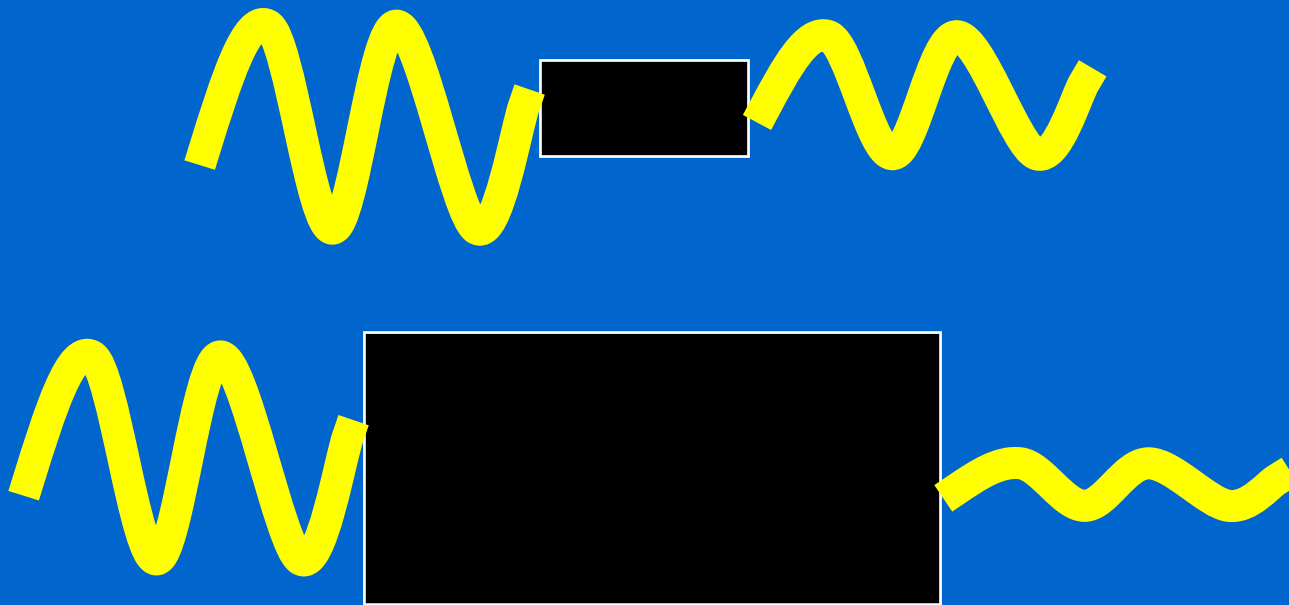


Overview

- The significance of storage
- Tonga roof catchment study
 - Introduction & DVD (Alena)
 - Analysis methods (Sarah)
- Practical exercise – Excel example

Storage in the hydrologic cycle

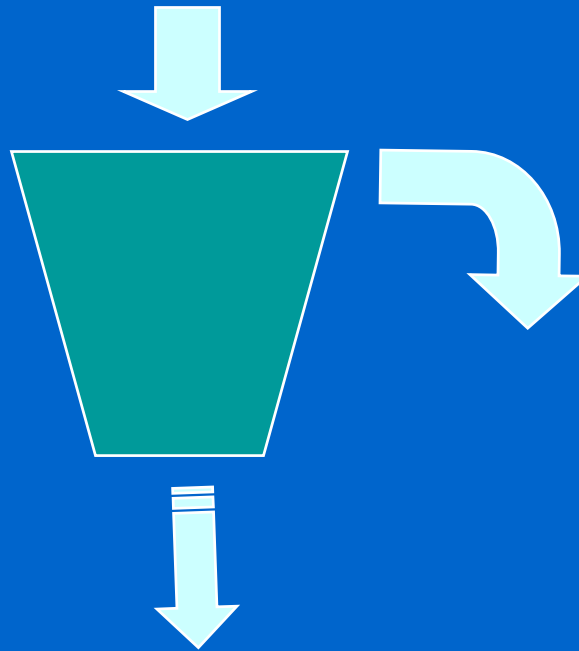
- $\text{Input} - \text{Output} = \text{Change in storage}$



Larger storage smooths outflow

A storage bucket

- Overflows when full
- Leaks faster when relatively full



An Excel bucket model

- Leakage is proportional to storage
- $\text{Storage} = \text{Previous storage} + \text{input} - \text{leakage}$
- Bucket overflows if storage exceeds capacity

Microsoft Excel - bucket.xls

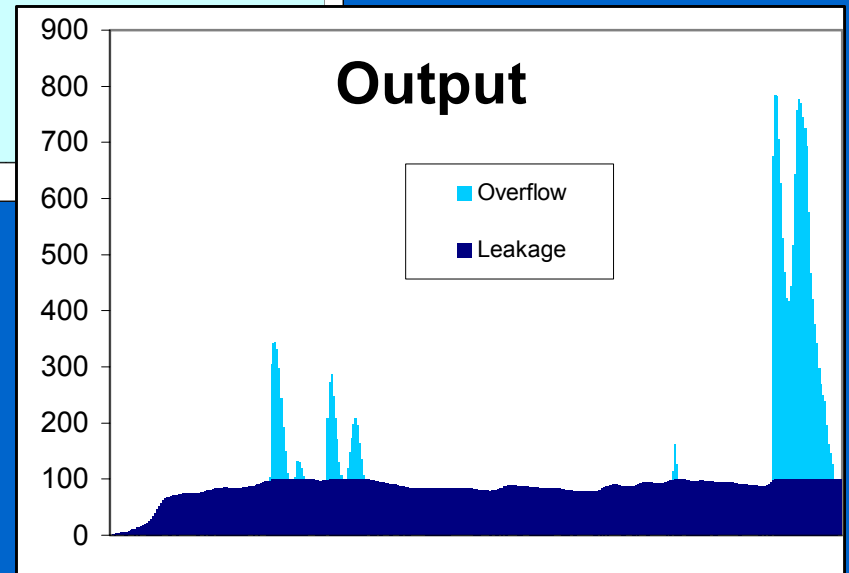
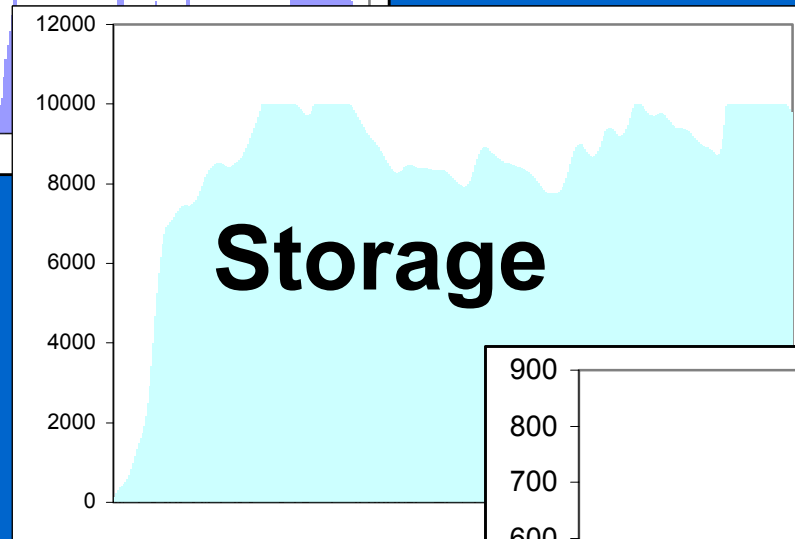
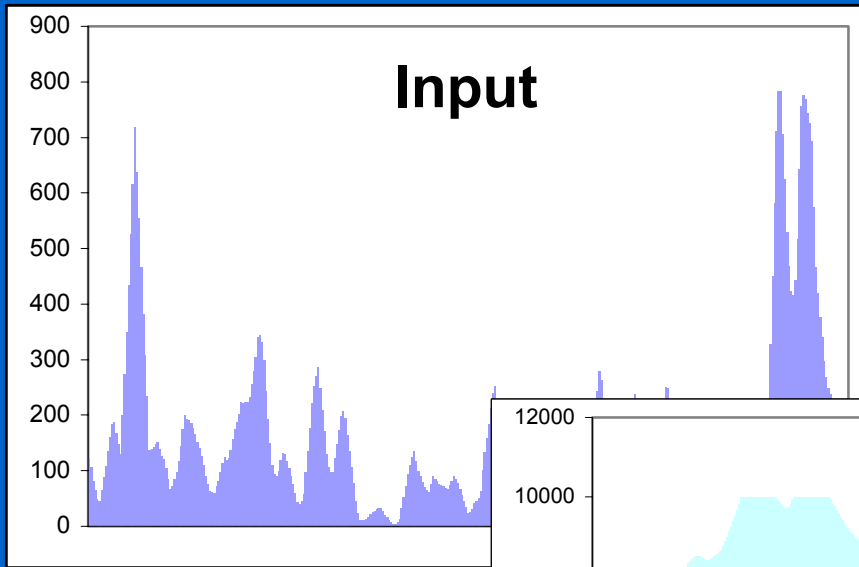
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Arial 10 B I U \$ % , +.0 .00 +.00

D3 = =IF(F2+B3-C3>0,F2+B3-C3,0)

	A	B	C	D	E	F	Formula
1	Date	Input	Leakage	S+I-L	Overflow	Storage	
2	1-Feb-95	123	0	123	0	123	
3	2-Feb-95	106	1	227	0	227	
4	3-Feb-95	80	2	305	0	305	
5	4-Feb-95	64	2	266	0	266	

Bucket.xls



Roof catchment design exercise

Tank Volume (litres)	60000.0									
Initial Tank Level	0.0									
House Size (m ²)	70.0									
Number of People	6.5									
Litre per person/day	50									
Runoff Coefficient	0.7									
Gutter Factor (1 = full)	0.5									
Rationing level	0.3	<i>(tank level below which rationing is carried out)</i>								
Rationing factor	0.5	<i>(percentage of full demand while rationing)</i>								
Length of record	1.83	<i>(years)</i>								
Satisfaction	82%	<i>(percentage of demand volume met)</i>								
Reliability	77%	<i>(percentage of days that demand is met)</i>								
Longest dry spell	13	<i>(maximum run of dry days)</i>								
Month-Yr	Rain (mm)	Runoff	Storage+ Runoff	Overflow	Storage after overflow	Demand	Storage - demand 0	Supply	Demand met	Run of dry days
1-Feb-95	1.8	44	44	0	44	162.5	0	44	0	1
2-Feb-95	17	417	417	0	417	162.5	254	163	1	0
3-Feb-95	0.6	15	269	0	269	162.5	106	163	1	0
4-Feb-95	2.2	54	160	0	160	162.5	0	160	0	1

Roof catchment design exercise

- Tank volume
- Initial tank level
- House size
- No. of people
- Per capita water use
- Runoff coefficient
- Gutter factor
- Rationing level
- Rationing factor
- Satisfaction
(% of demand vol met)
- Reliability
(% of days demand met)
- Longest dry spell
(Max. run of dry days)

Roof catchment design exercise

- What tank volume and house size is required to ensure that reliability is better than 90% and the longest dry spell is < 5 days?
- Assume that:
 - Initial tank level is 50% full
 - No. of people = 6
 - Per capita water use = 50 l/p/d
 - Runoff coefficient = 0.7
 - Gutter factor = 0.9
 - Rationing level = 0.0 (i.e. no rationing done)
- How would rationing change the requirements?

