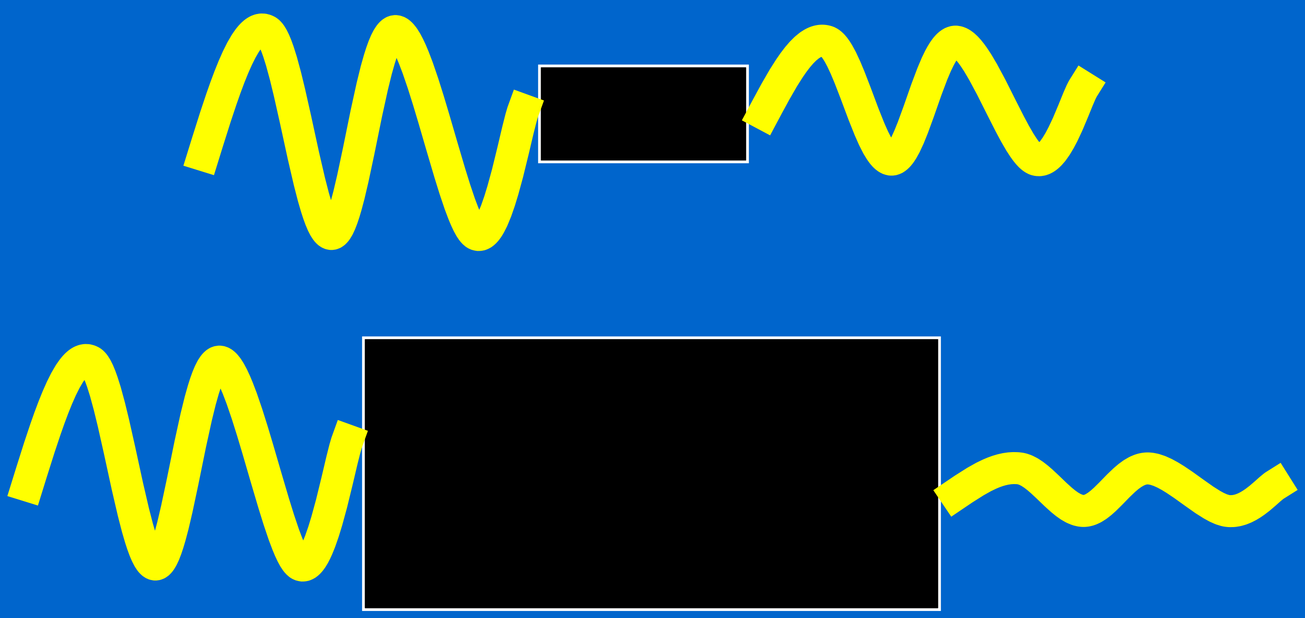
The Water Balance

Overview

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

Storage in the hydrologic cycle

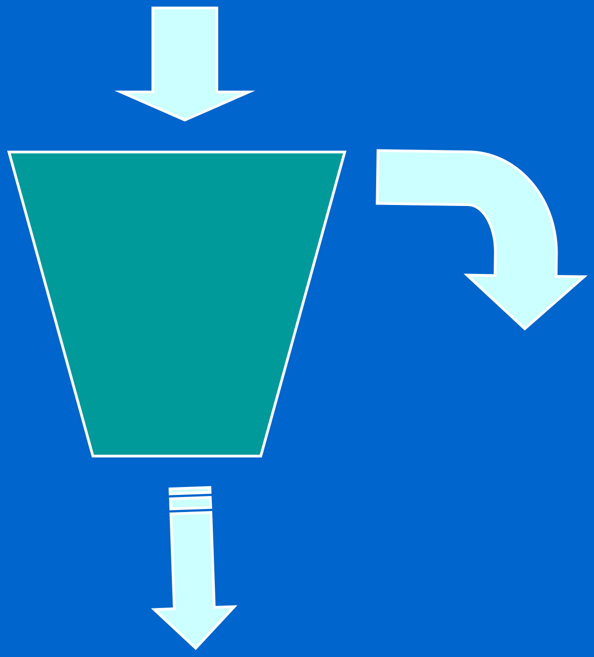
- Input – Output = Change in storage



Larger storage smooths outflow

A storage bucket

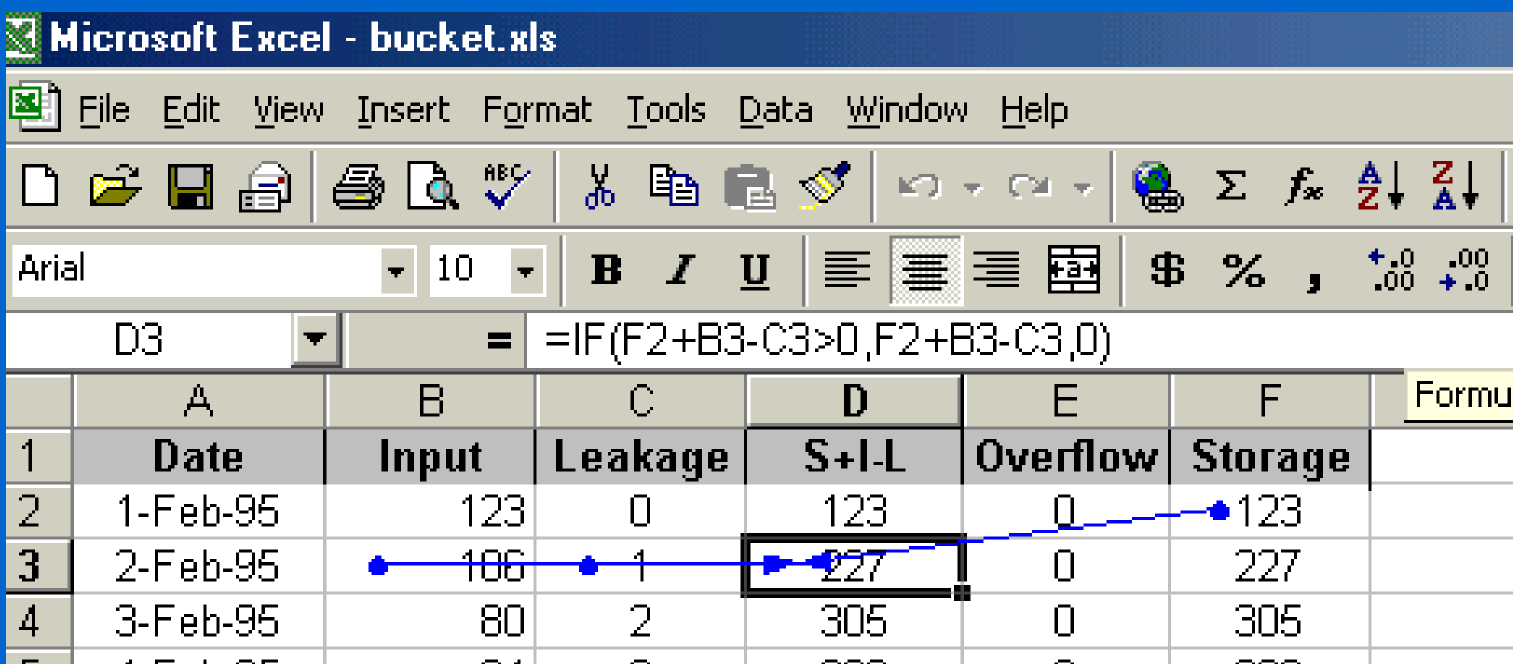
- Overflows when full
- Leaks faster when relatively full



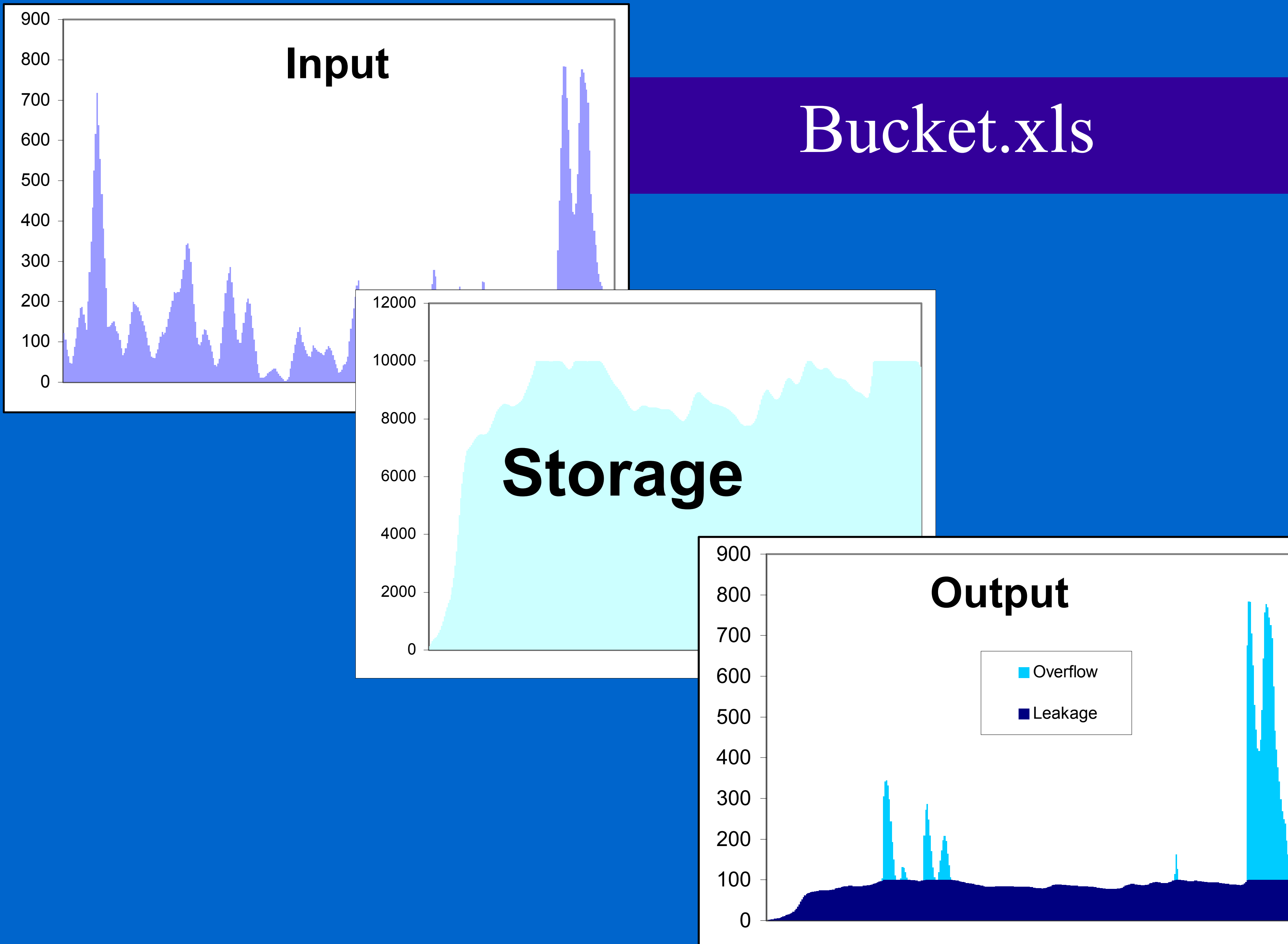
Bucket.xls

An Excel bucket model

- Leakage is proportional to storage
- Storage = Previous storage + input – leakage
- Bucket overflows if storage exceeds capacity



Bucket.xls


Input
900
800
700
600
500
400
300
200
100
0
Storage
12000
10000
8000
6000
4000
2000
0
Output
900
800
700
600
500
400
300
200
100
0
Overflow
Leakage

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	*(tank level below which rationing is carried out)*
Rationing factor	0.5	*(percentage of full demand while rationing)*
Length of record	1.83	*(years)*
Satisfaction	82%	*(percentage of demand volume met)*
Reliability	77%	*(percentage of days that demand is met)*
Longest dry spell	13	*(maximum run of dry days)*

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

VavauRainCalcsv4.xls

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

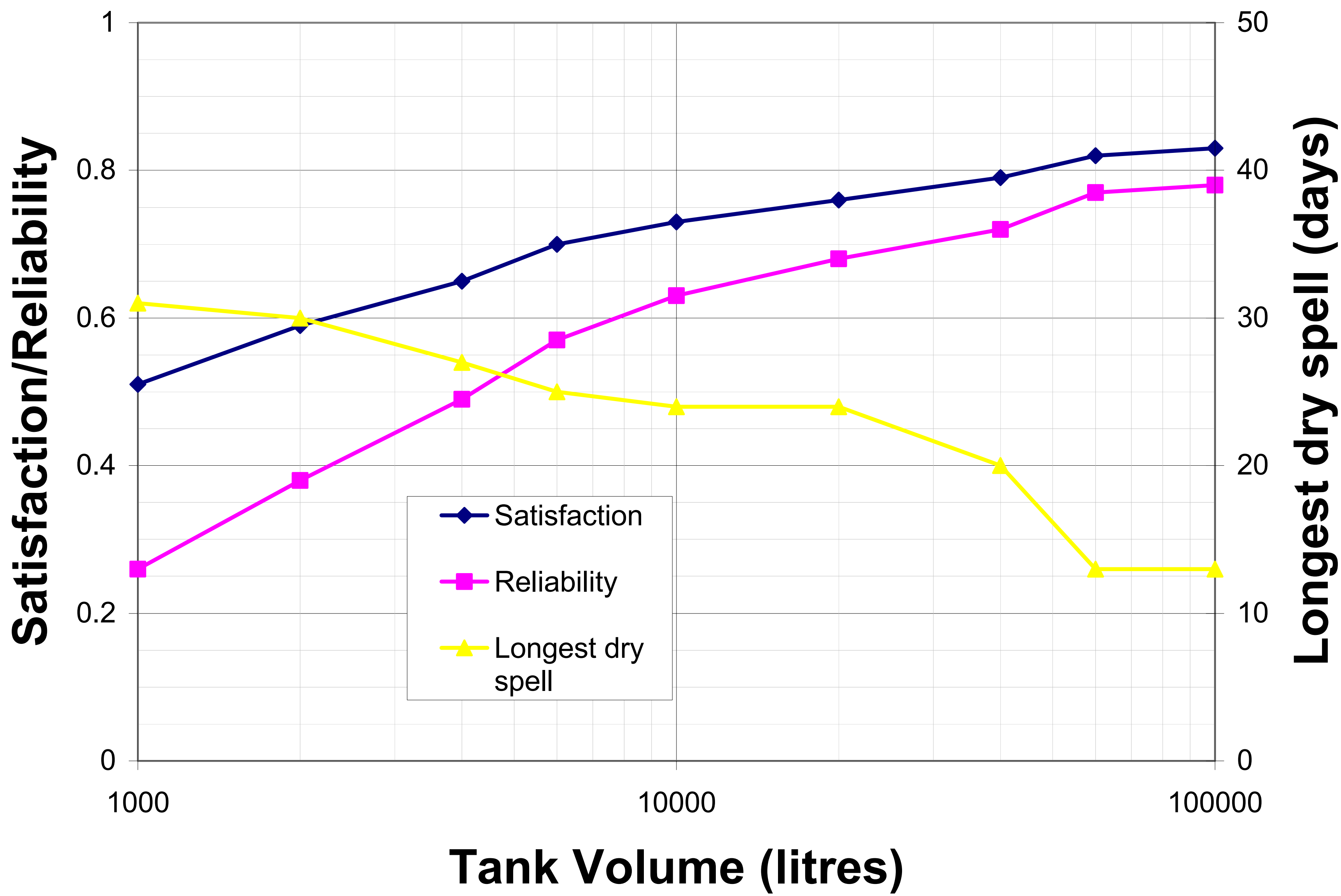
  (% of demand vol met)
- Reliability

  (% 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?



Satisfaction/Reliability
Longest dry spell (days)
Tank Volume (litres)
Satisfaction
Reliability
Longest dry spell
0
0.2
0.4
0.6
0.8
1
0
10
20
30
40
50
1000
10000
100000