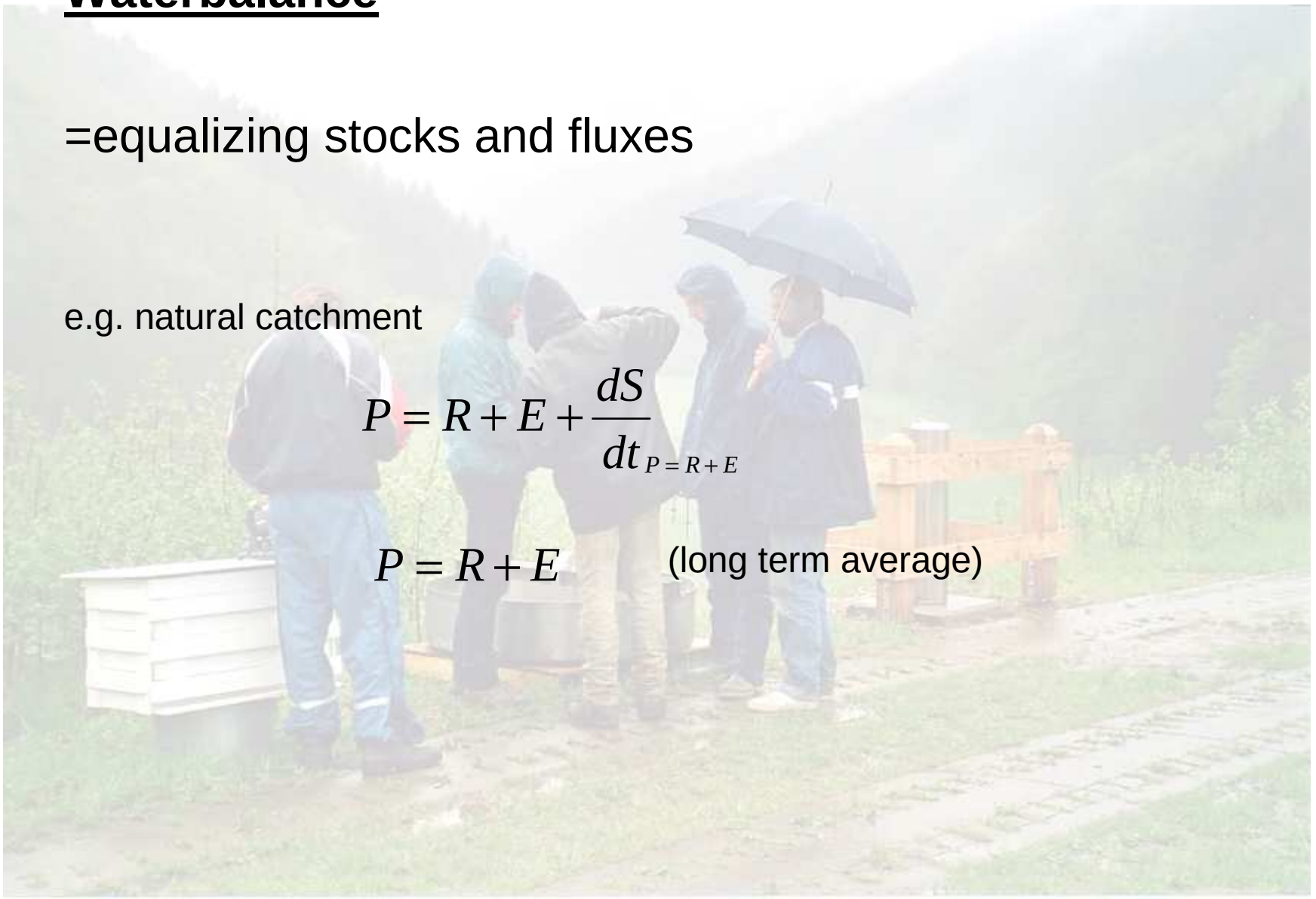
Why Monitoring

To determine components of a waterbalance

Why a Waterbalance

Assessment availability
Assess consequences changes

Waterbalance



=equalizing stocks and fluxes

e.g. natural catchment

$$P = R + E + \frac{dS}{dt}_{P=R+E}$$

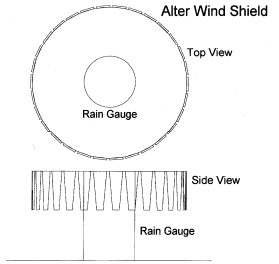
$$P = R + E$$ (long term average)

Precipitation measurements:

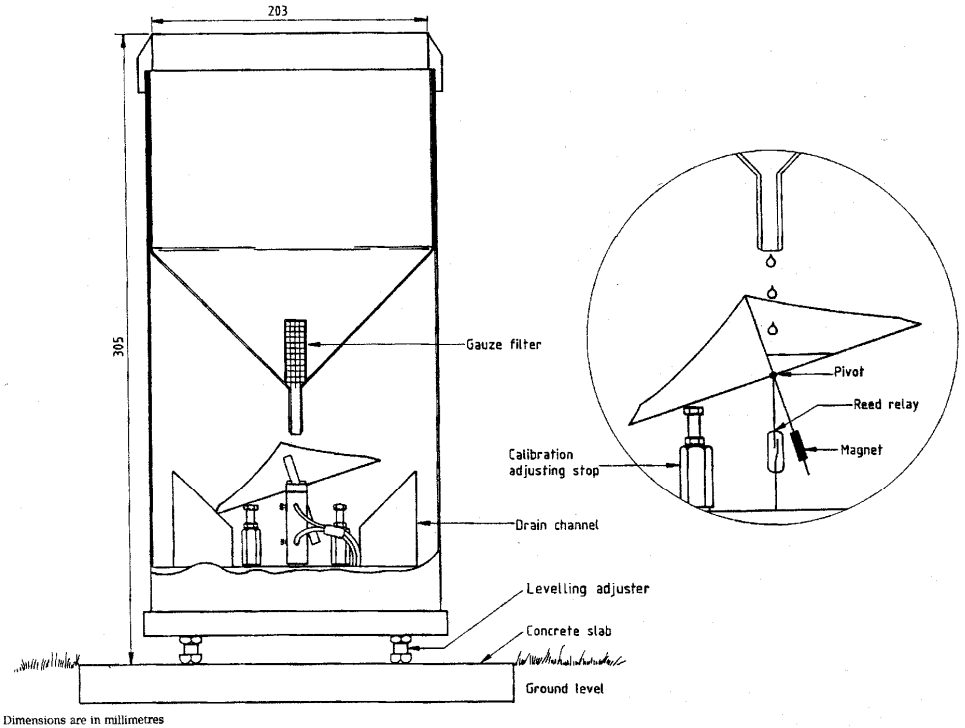
-Point measurements
- funnel
- tipping bucket
- tilting siphon
- optical raingauge
- heated raingauge

-Areal Integrated
- Radar
- Satelite

Screens



Funnel & Jar



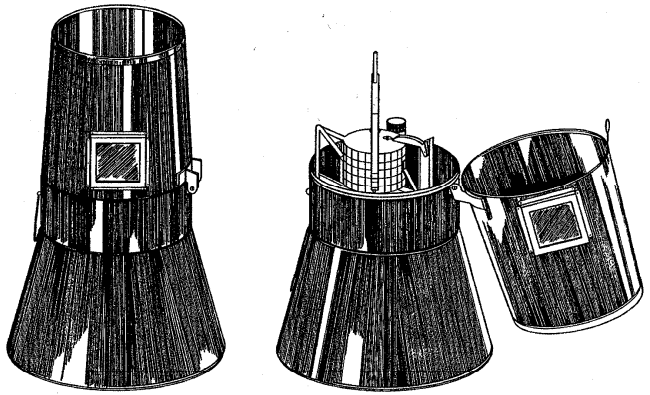
Tipping bucket

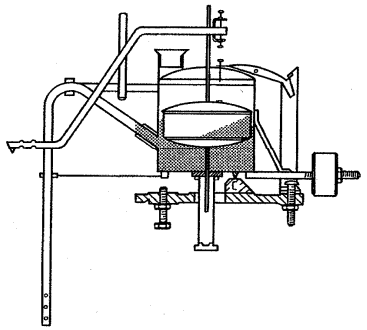
Example of a file from a tipping bucket raingauge

```
Date,Time,Rainfall (mm)
8/27/03,04:10:00 PM,0.6
8/27/03,04:11:00 PM,0.4
8/28/03,11:06:00 PM,0.2
8/28/03,11:27:00 PM,0.2
8/28/03,11:43:00 PM,0.2
8/28/03,11:55:00 PM,0.2
8/29/03,12:01:00 AM,0.2
8/29/03,12:06:00 AM,0.2
8/29/03,12:12:00 AM,0.2
8/29/03,12:18:00 AM,0.2
8/29/03,12:24:00 AM,0.2
8/29/03,12:30:00 AM,0.2
8/29/03,12:37:00 AM,0.2
8/29/03,12:44:00 AM,0.2
8/29/03,12:51:00 AM,0.2
8/29/03,12:58:00 AM,0.2
8/29/03,01:06:00 AM,0.2
8/29/03,01:14:00 AM,0.2
8/29/03,01:22:00 AM,0.2
8/29/03,01:31:00 AM,0.2
8/29/03,01:40:00 AM,0.2
8/29/03,01:50:00 AM,0.2
```

Note:
(mm) is accumulated rain
for the minute indicated
As multiple of 0.2 mm

Tilting siphon

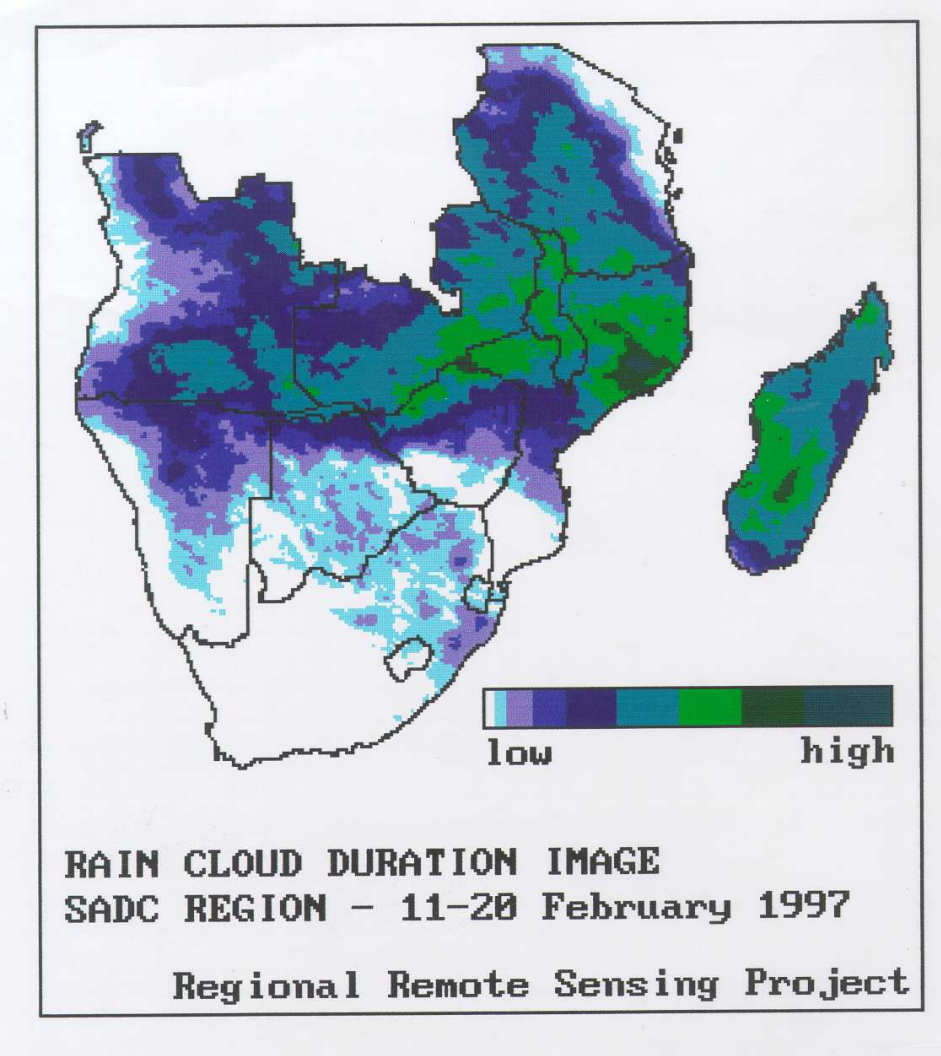




Areal Integrated Measurements

Radar:

Satelite



Remark: calibration required

Monitoring **Actual** Evaporation

= difficult

e.g. Penman = open water, reference or potential evaporation

therefore

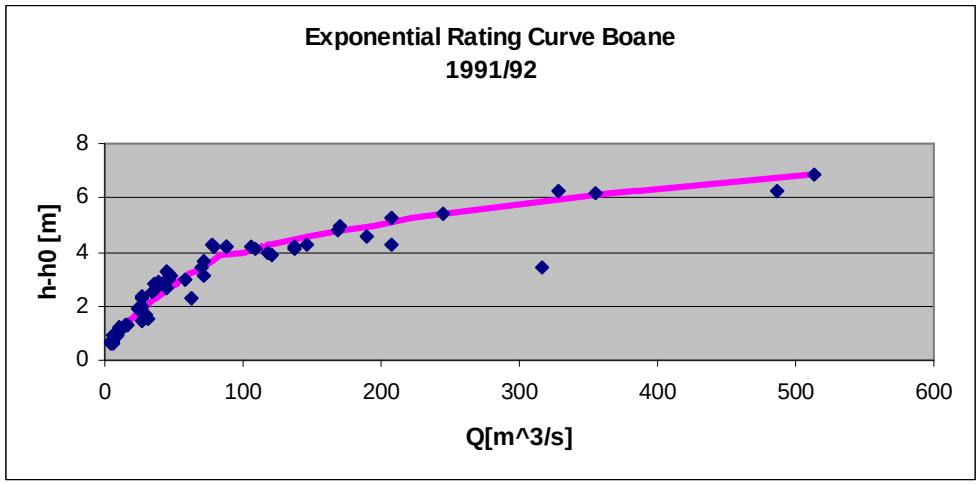
Monitoring Runoff

= important

Monitoring Runoff

continuous stage h and Q-h relation

- natural control: measure Q for Q-h relation



-discharge structure: Q from discharge formula

$$Q = \left(\frac{2}{3}\right)^{3/2} \cdot C_d \cdot b \cdot \sqrt{g} \cdot h^{3/2}$$