Hydrological Data and Measurements

CARIWIN Advanced Course in IWRM
September 17, 2007

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Session Overview

• Hydrological Measurements
  • Surface flows
  • Subsurface flows
• Break-out: Conducting watershed studies
  • Monitoring, Analysis, Data management, Modeling
• Report-back
  • Challenges in implementation
  • Lessons learnt
Sub-watershed Monitoring

- Field-level monitoring
- Instrumentation for surface and subsurface flows
- Flow and quality are essential to calculate loads

Water Flow Instruments

Water Quality & Climate Instruments
Flow measurements

• Generally continuous

• Based on the height/velocity of flow and the shape of the waterway

• Relationships can be established between the height of water and the flow (rating curve)
Discharge on the Y-axis Vs Height on the X-axis gives a rating curve from the Flume/Weir

Points represent sets of samples. Between 20 and 50 individual measurements were used.

A 2nd order curve fits the measured data.

Figure 3.1 Courbe des débits jaugés pour la station du ruisseau St-Esprit(1994)
Flow measurements

- Use of weirs/flumes to calculate discharge

- Gaging stations monitor water level using:
  - Floats
  - Pressure transducers
  - Ultrasonic sensors

- Velocity meters
  - Propeller
  - Doppler
Float and stilling mill

To measure discharge in a stream or channel, we usually measure the water level, and then use a known equation to calculate discharge.

The simplest technique is to use a float, installed in a stilling well, and record the movement of that float on a chart recorder.
Floats

To the left, is an example of ‘older’ chart recorders, which used paper charts on a drum.

To the right, is a ‘newer’ water level recorder. It uses the same old float, but records the data electronically.
Floats

A water level recorder being used in conjunction with a V-notch weir.

The float hangs on a metal tape, which is mounted on the wheel of the water level recorder.
Surface Runoff

- Runoff exits field through a flume

- Discharge is determined based on a rating curve specific for the flume type and dimensions

- The required input variable is height of water (stage)
Surface runoff flow measurements

To the right, we see an example of an “H” flume, being used to measure surface runoff. Note the ultrasonic sensor mounted directly over the flume, and to the right, located in a stilling well, is a pressure transducer.
Water level monitoring

Two types of pressure transducers. Both are submersible. The one on the right (with the attached cable) requires a datalogger to read the signal. The ‘Diver’ contains both the pressure transducer and the datalogger. It can simply be dropped down a well, and the data can be collected every 2-3 months, when the unit is pulled up.

Ultrasonic sensor
Ultrasonic Depth Sensor (SR50)

- The stage is primarily measured by a Campbell Scientific Ultrasonic sensor (SR50) installed directly above the flume.

- SR50’s are an acoustic digital sensor that measure the time between emission and return of an ultrasonic pulse.

- The ultrasonic beam is cone shaped and emits at an angle of 22°.
Ultrasonic sensor readings

Snowfall events

Partial snowmelt

Filtered Snow Accumulation (cm/hr)  Snow Depth (cm)
Pressure Transducer

• An alternative sensor for stage measurement is a submersible pressure transducer

• Shown: Campbell Scientific Keller-173
• Measures pressure above the bottom of the sensor and automatically converts that into a depth of water
• Automatically adjust pressure for temperature differences
• Used for surface water or ground water application
Pressure transducer readings

An example of a stage versus time graph. This was recorded using a pressure transducer. The total water level change (Y axis) is approximately 0.40 m or 40 cm. The resolution on the pressure transducer is 0.1 mm. So...you get a nice ‘smooth’ curve. In selecting the equipment for a particular site, you have to make sure that you have the desired level of precision, and you have to make sure that the sensors cover the ‘range’ of water levels.
Velocity measurements

Propeller velocity meter
Doppler velocity meters

Figure 7-4: Doppler Velocity Measurement

http://ehoskin.xplorex.com/?p2=/modules/hoskin/categoryproducts.jsp&parentld=6625
Water Flow: Subsurface Flows

- Subsurface drainage exits the field through tile drains
- Discharge is measured by an Endress and Hauser Prosonic flow meter
- **Alternative to the insertion flow meter**
- Measurements are logged by the datalogger
Climate Instruments

- Propeller based wind anemometer for measuring speed and direction
- Kipp and Zonen Silicon Pyranometer used to measure incoming solar radiation
- Vaisala RH and temperature probe – shown with a required radiation shield
Conducting watershed studies

• Do you see the need? Where and why?
• What are the challenges and constraints?
• Current level of instrumentation?
• Current level of data availability?
• How is the data collected and analyzed?
• How is the data stored and managed?
• Dissemination of information
Discussion

What are the steps needed to setup a hydrologic monitoring program in your country?
Thank you

Acknowledgements
Mark Eastman, Peter Enright and Nicolas Stämpfli
for photographs and content