

# Hydrological Observation in JAPAN

International Centre for Water Hazard and Risk Management, ICHARM  
Under the auspices of UNESCO  
Public Works Research Institute

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## Introduction

### Why Hydrological Observation ?

- River Planning  
“ Draft of dam, levee, etc.”
- River management  
“ Flood fighting, Drought management, etc.”
- Flood forecasting



They should be decided based on the characteristic of each countries' river.



It is necessary to observe the hydrological parameter like rainfall, water level, discharge, etc. surely.

# 1.0 Characteristics of Rivers in Japan

**Tone River Flooded**



**Tone River Not flooded**



## Introduction

### The Number of Hydrology Observation Station in Japan

	River bureau	Highway bureau	Met. Agency	Local-Governments	Water Corporation	Total
Radars	26		20			46
Rain	2348	1182	1275	4557	243	9605
Water Stage	2132			4042		6262
Others	1560	188	87	400	337	2572
Total	6066	1370	1382	8999	668	<b>18485</b>

# Rainfall Observation

Any form of water, such as rain, snow and hail, that falls from the atmosphere to the earth's surface is called precipitation. Precipitation can be broadly classified into rain and snow.

Rainfall Data is very important.

- Probable rainfall is basic data of river planning in Japan.
- Rainfall data is one of the input data for flood forecasting.



It is important to measure the rainfall surely and successively.

Two Types of rain gauge

- Self-recording rain gauge
- Rader rain gauge

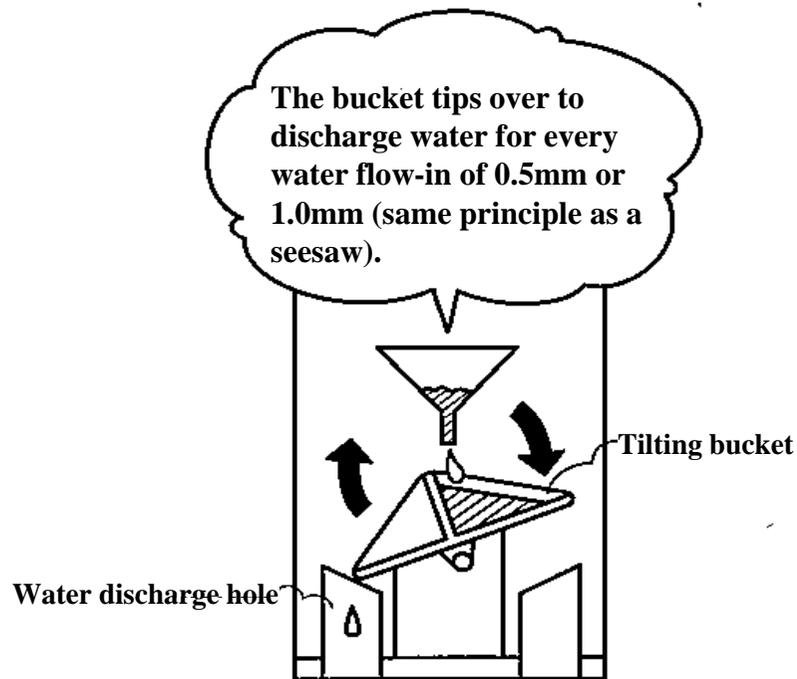


# Rainfall Observation

## Self-recording rain-gauge

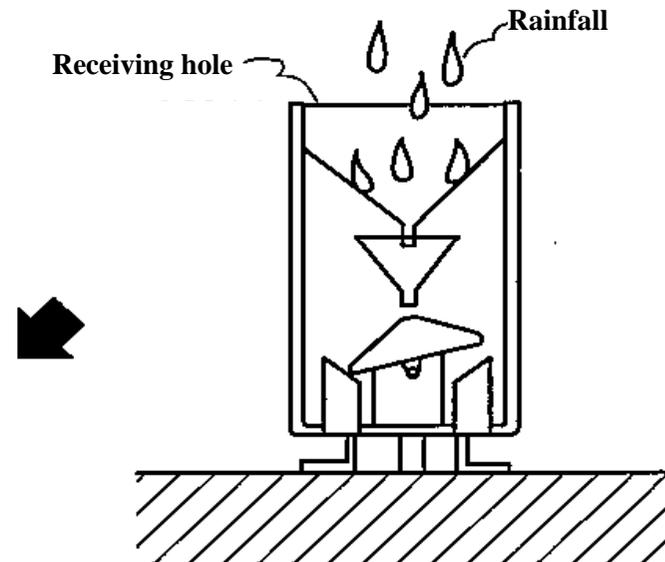
### ■ Tipping-bucket rain gage

There are gauges for 0.5mm and 1mm for tipping.  
Check which gauge to use beforehand



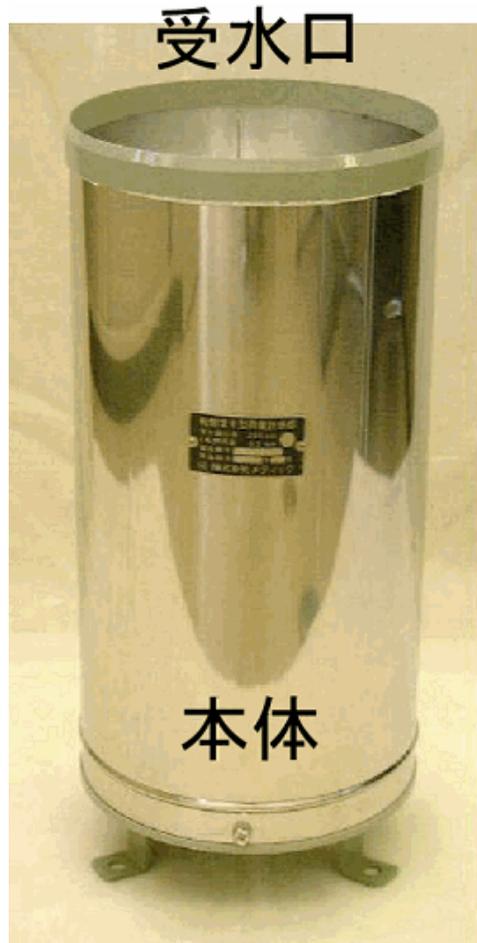
### 5 Year Calibration

According to the calibration by Met Office, the error shall be within  $\pm 3\%$  for 20mm/hr or above.  
(in case of 0.5mm gauge)

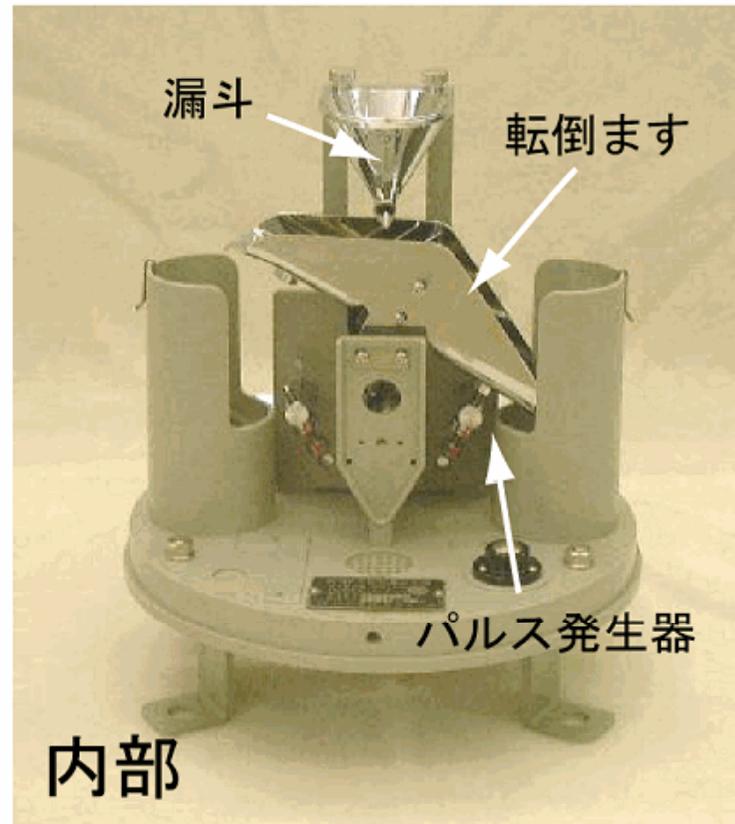


## Rainfall Observation

### Self-recording rain-gauge



Tipping-bucket rain gauge



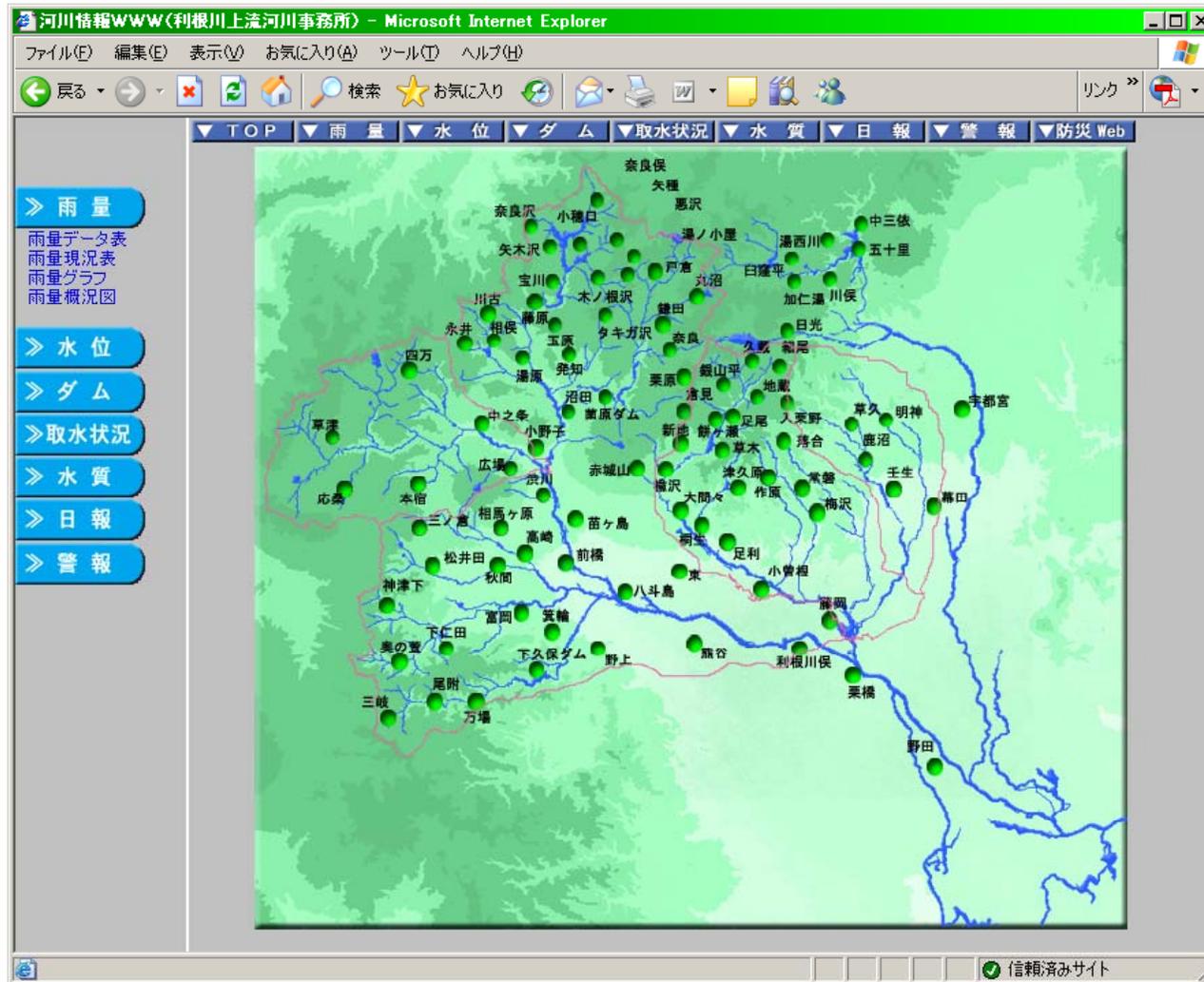
<http://www.cc.yamaguchi-u.ac.jp/>

Inside

# Rainfall Observation

# Self-recording rain-gauge

## ★Condition of rainfall gauge distribution in Upstream area of Tone River



Rainfall gauge stations should be distributed evenly throughout the river basin.

This figure shows the condition of rainfall gauge distribution in Upstream area of Tone River.

Over 80 stations in this basin.

(To ensure the required level of observation accuracy, there should be one rainfall gauge station for about every 50 km<sup>2</sup>.)

# Rainfall Observation

# Self-recording rain-gauge



# Rainfall Observation

## Self-recording rain-gauge



*Some rain gauges are removed during snow season.*



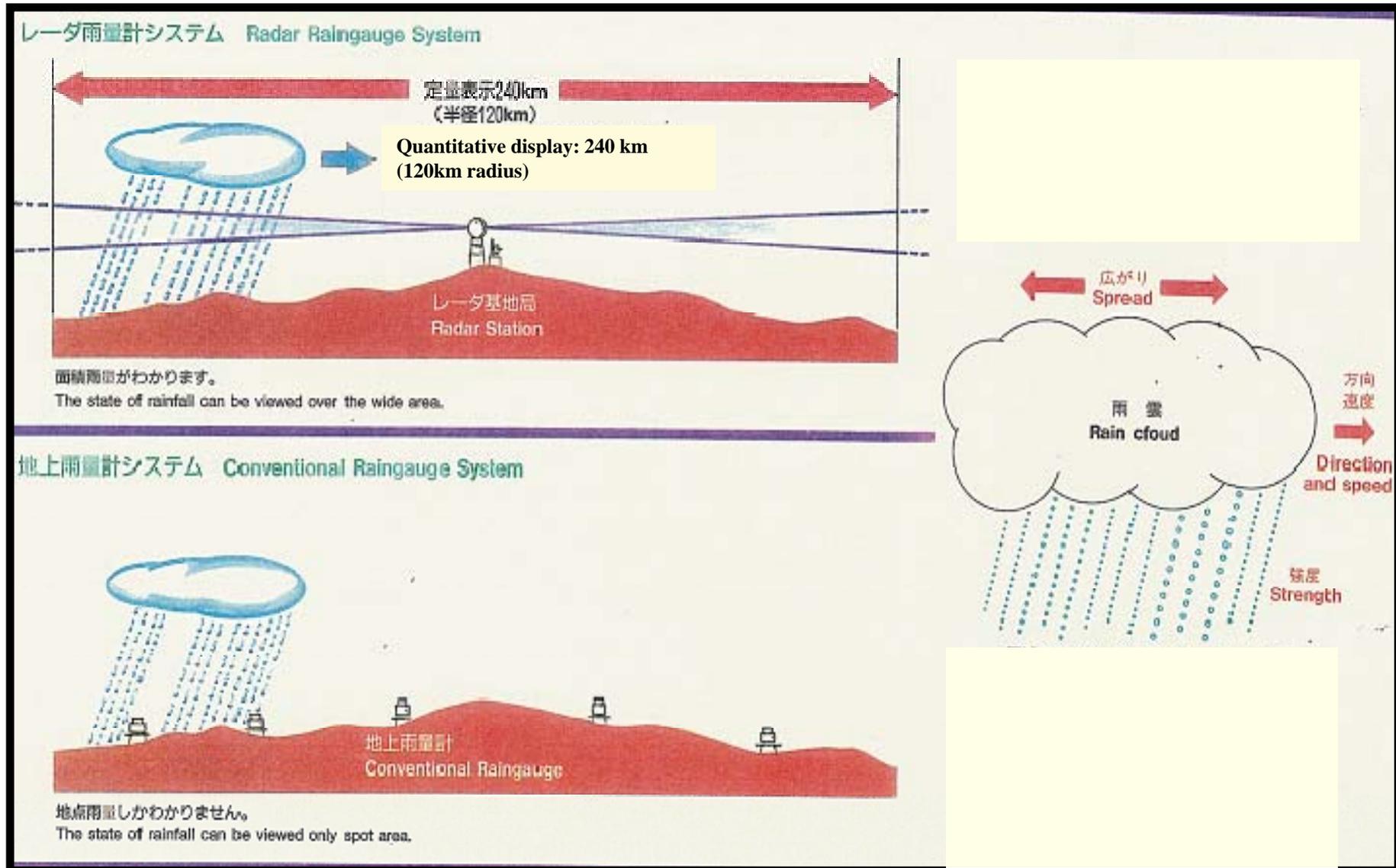
# Rainfall Observation

## Self-recording rain-gauge



# Rainfall Observation

## Radar rain-gauge



## Rainfall Observation

## Rada rain-gauge

### Mt.Akagi Radar Rain Gauge

*Measure the rainfall distribution  
by C-band radio wave.*

*Established in 1976.*

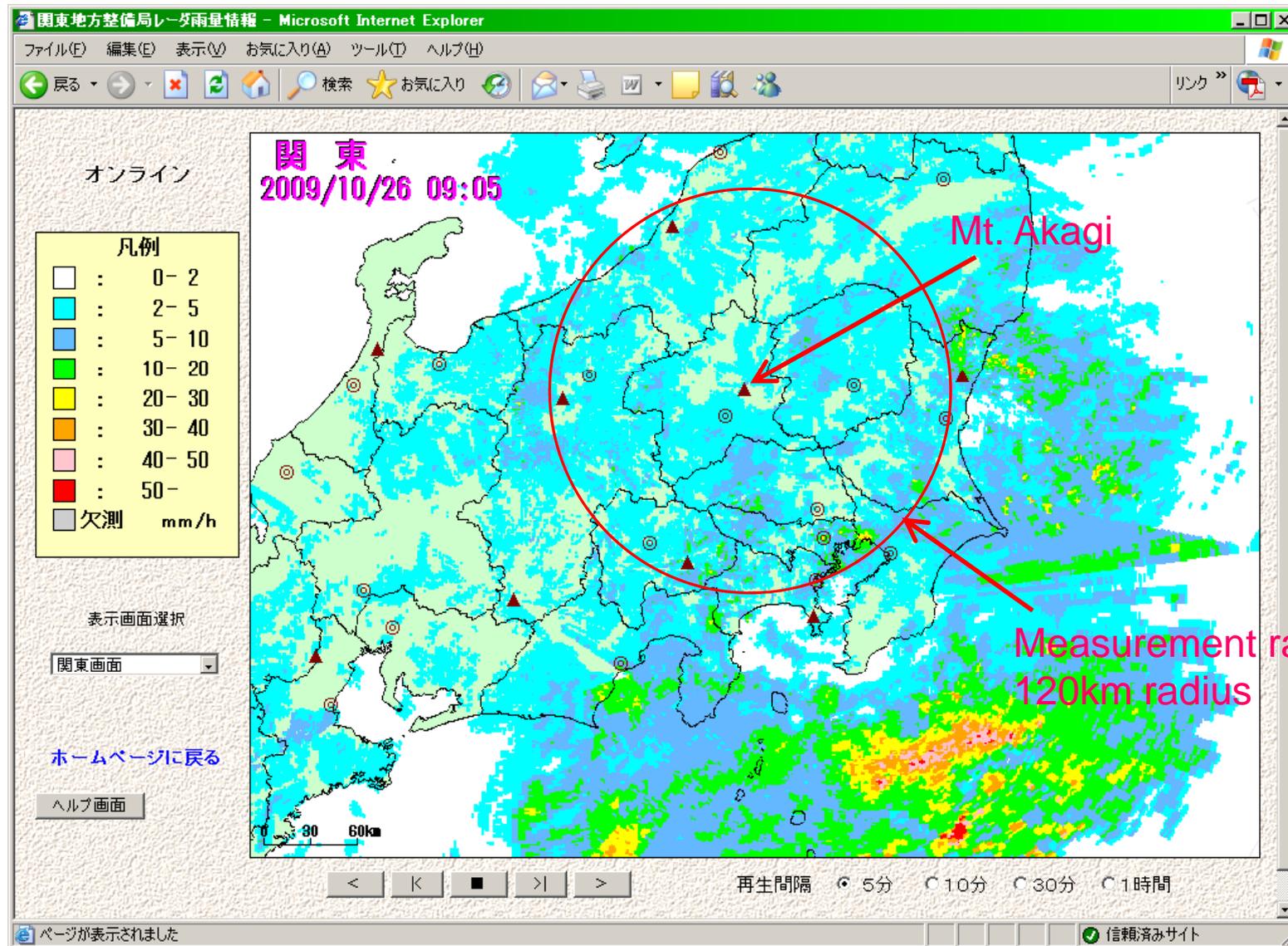
*The first radar rain gauge in Japan.*

*The measurement range is  
120km radius from the radar.*



# Rainfall Observation

Rada rain-gauge



*Rainfall distribution can be seen on the web in real-time.*



# Water Level Observation

*Water level must be observed in real-time to manage rivers.*

- *Flood period : for flood forecasting, for defense against flood*
- *Drought period : for management of the amount of water taken from river*
- *Approximate value of discharge in real-time has been converted from water level observed in real-time through the last year's H-Q Curve.*

*There are two types of water level observation.*

● **Normal observation**

*An observer reads water level on the standard staff gauge.*

● **Automatic observation**

*Automatic water level gauge with recording instruments is used to measure the water level every hour.*

*Normal observation data is used  
to calculate the H-Q Curve.*

*Automatic observation data is converted to  
the water discharge from the H-Q Curve.*



## Water Level Observation

Install gauging stations at important sites for river management, planning and works

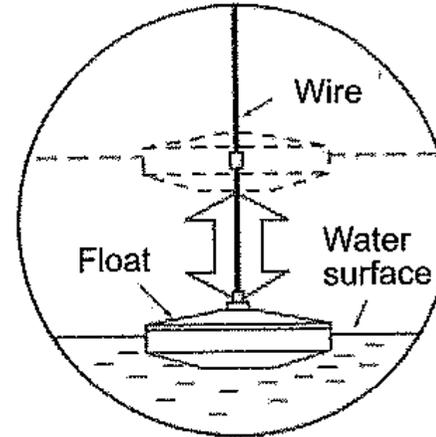
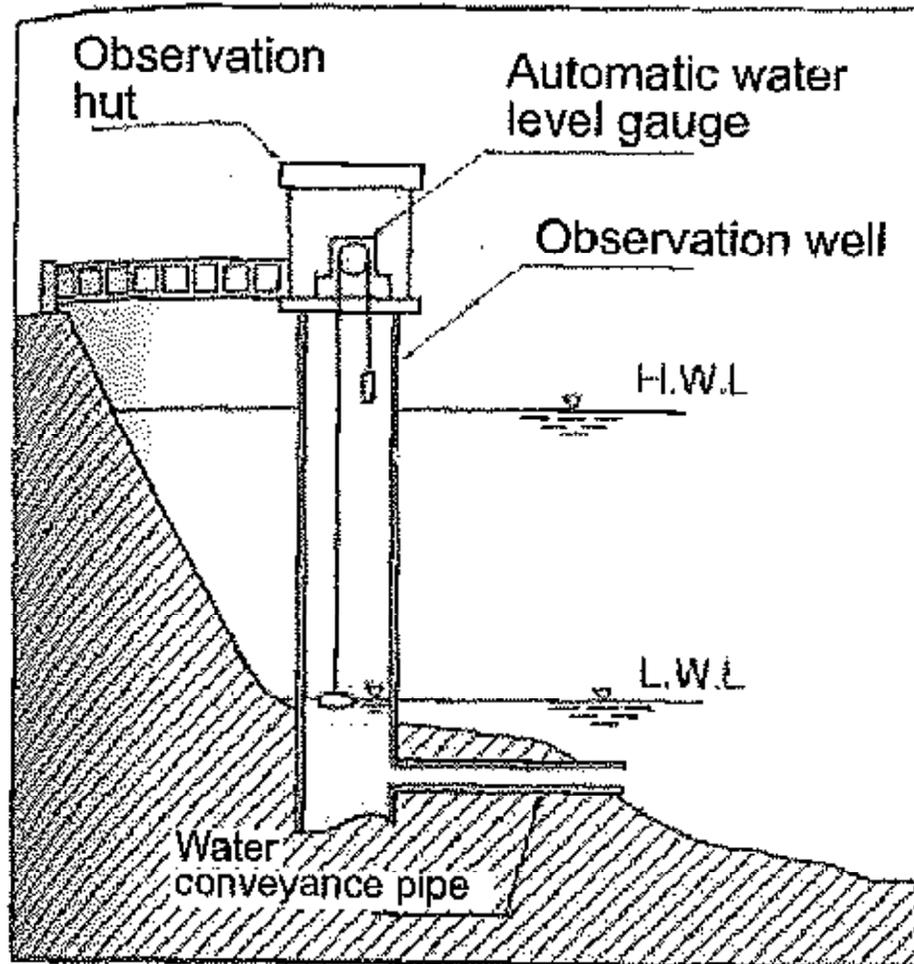
1. Before and after the confluence or the diversion of important tributaries or effluents; upstream and downstream of weir or floodgate.
2. Constricted reaches, retarding basin, lake, swamp, inundation prone area, river mouth and other locations important for grasping hydraulic conditions.

A gauging station at the location 1. should not be too close to a weir or a flood-gate. Locations 2 are area of discharge reduction, flood-wave propagation, influences of artificial operations or tidal waves.

# Water Level Observation

## Automatic water level gauges

### ● Float Type



Inside hut

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# Water Level Observation

*Automatic water level gauges*

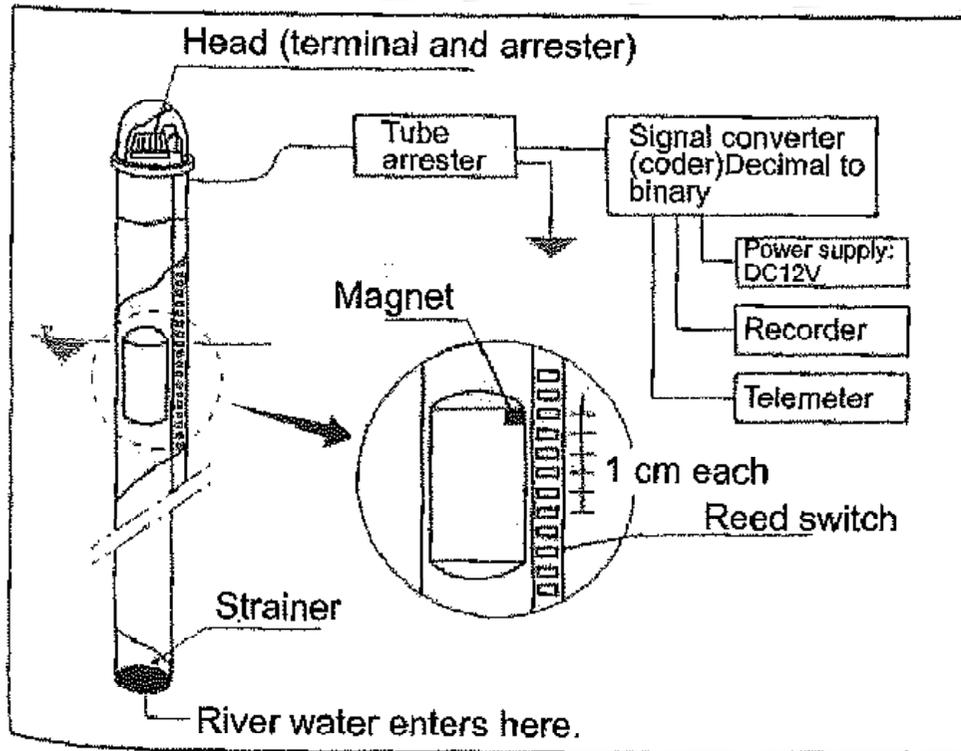
## ● *Float Type*



# Water Level Observation

## Automatic water level gauges

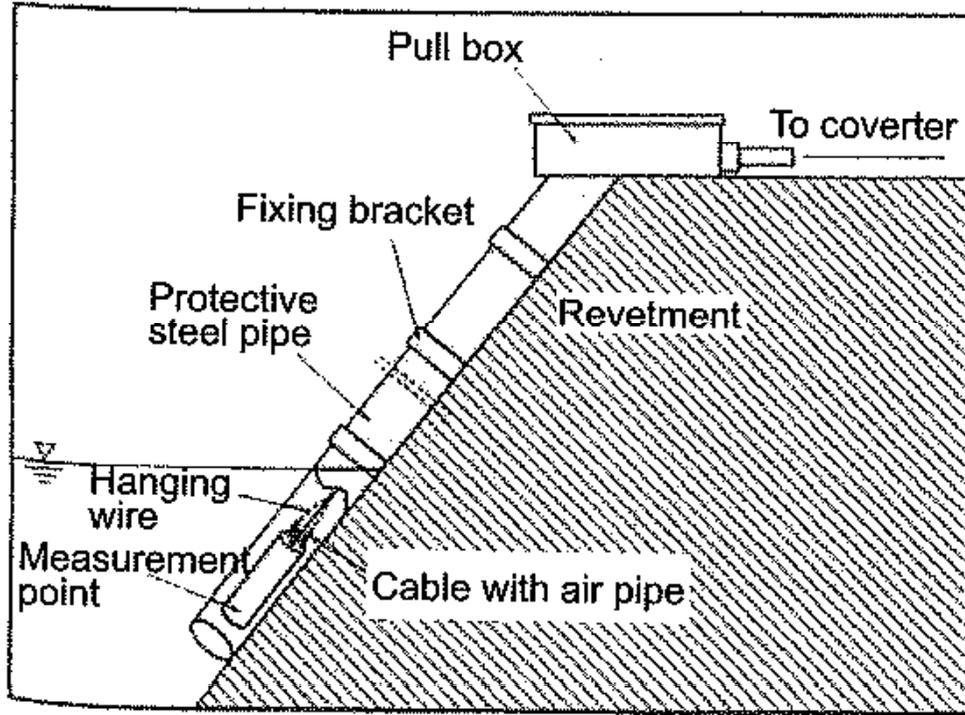
### ● Reed Switch Type



# Water Level Observation

Automatic water level gauges

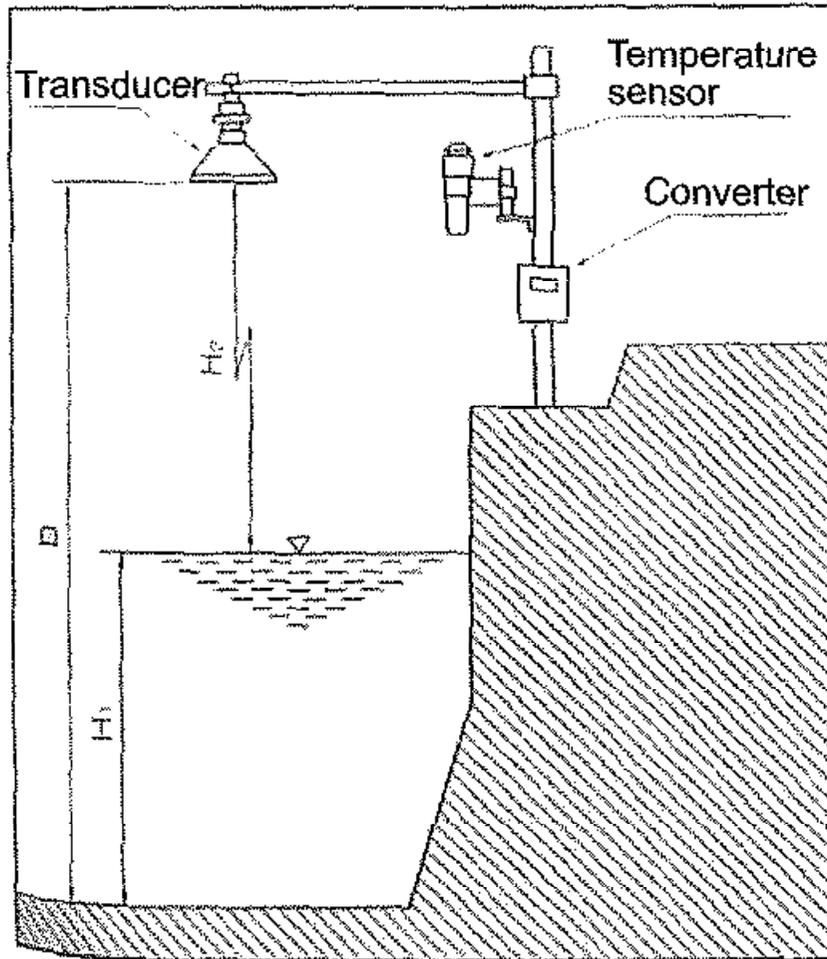
## ● Water Pressure Type



# Water Level Observation

Automatic water level gauges

## ● Non-contact ultrasonic Type



# Water Level Observation

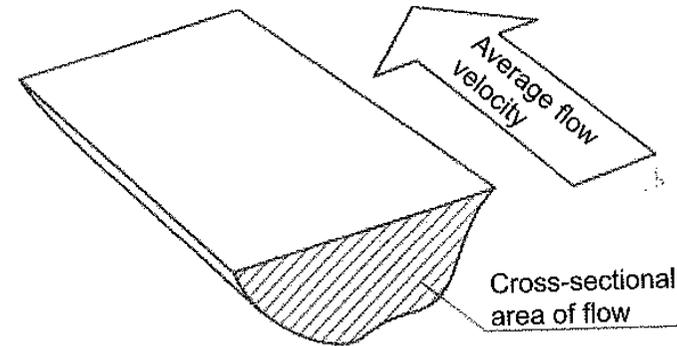


Important observation stations must be equipped with two types of water level measurement systems.

## Water Discharge Observation

*Discharge is fundamental to river management including river planning and flood forecasting. Discharge observation, therefore, needs to be conducted continually over many years.*

$$\text{Discharge} = \text{Cross-sectional area of flow} \times \text{Average flow velocity}$$



How to measure the flow velocity ?

- Method using portable current meter → Low water period
- Method using float → High water period

There are two type of discharge data

- observed data → They are used to calculate H-Q curve.
- rated data → They are converted from water level through H-Q Curve.

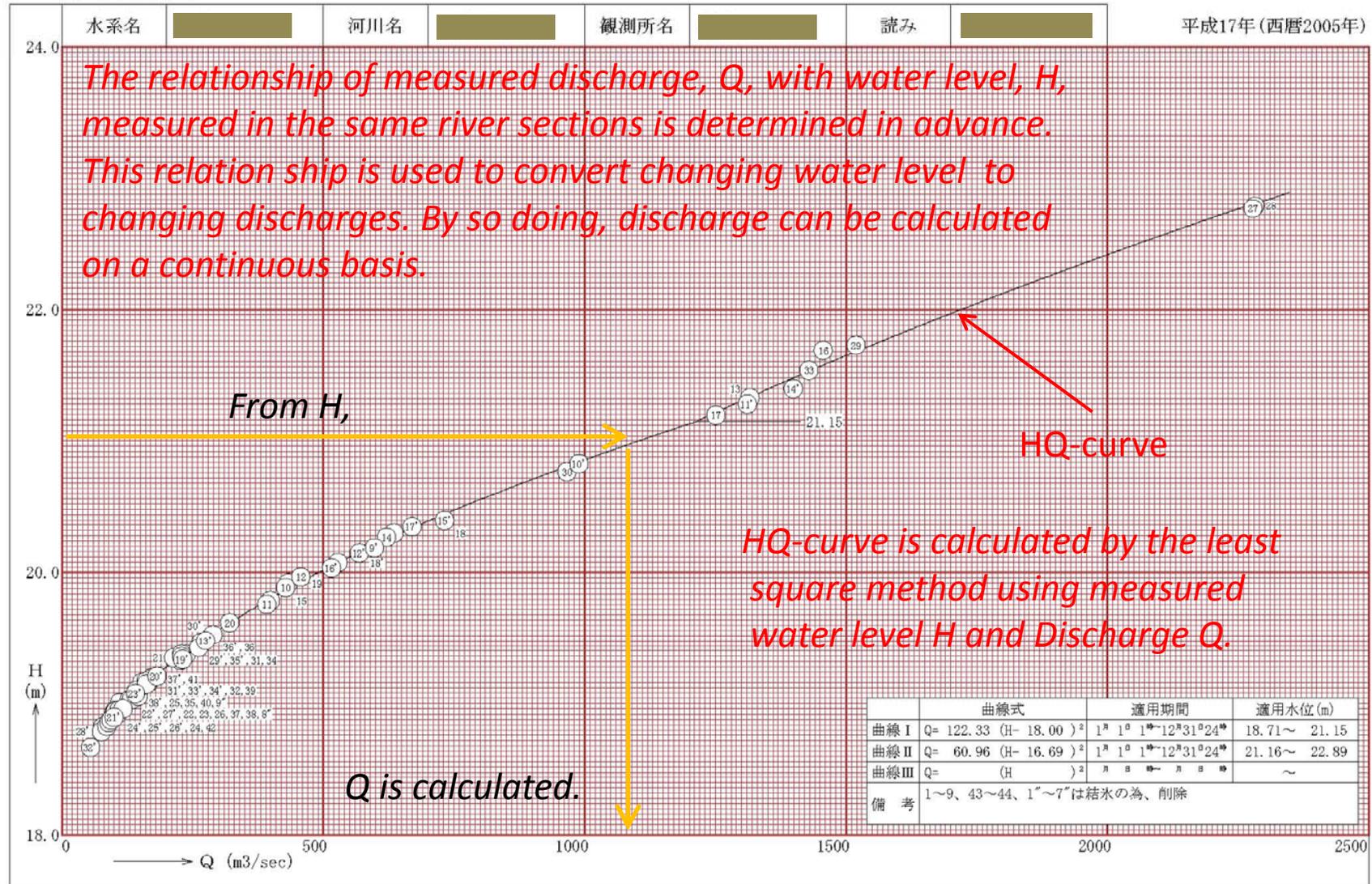
# Water Discharge Observation

Usually, HQ-curve is used to rate the discharge.

様式 3の10

[2000年度平均成果対応]

水位流量曲線図



Discharge Q (m<sup>3</sup>/s)

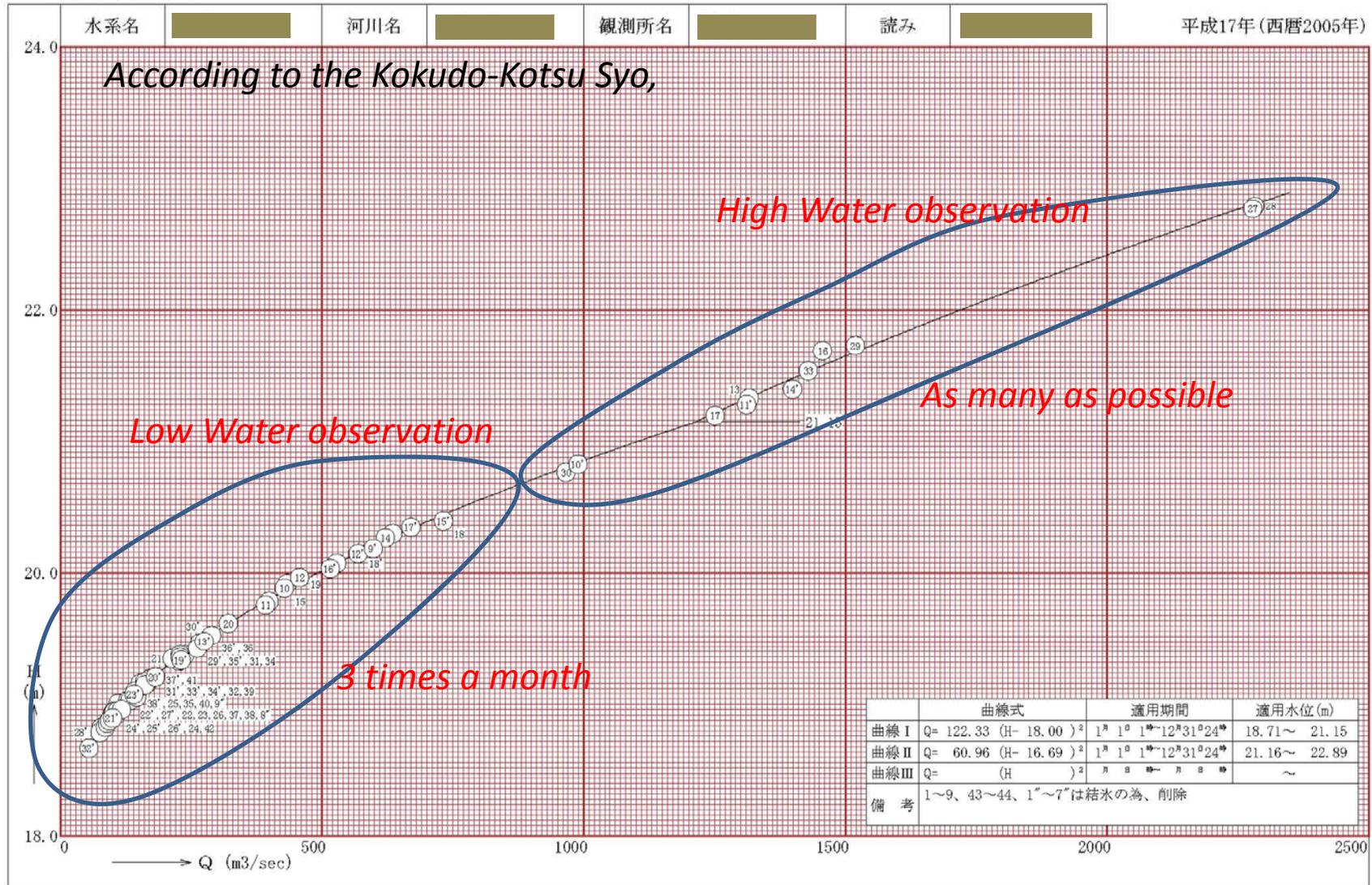
# Water Discharge Observation

Measured H and Q, which is necessary to calculate the H-Q Curve, is measured at low water period and high water period.

様式

[2000年度平均成果対応]

水位流量曲線図



Discharge Q (m3/s)

## Water Discharge Observation

*Low Water Discharge Observation*

# Water Discharge Observation

*Sanei type current meter*



*Price type current meter*



*A Scene of Low Water Discharge Observation*

*A portable type current meter*



## Water Discharge Observation



*Wire rope is stretched tight between both sides of river.*



*A Scene of Low Water Discharge Observation*

- They are using a rubber boat because there is no bridge.*

## Water Discharge Observation

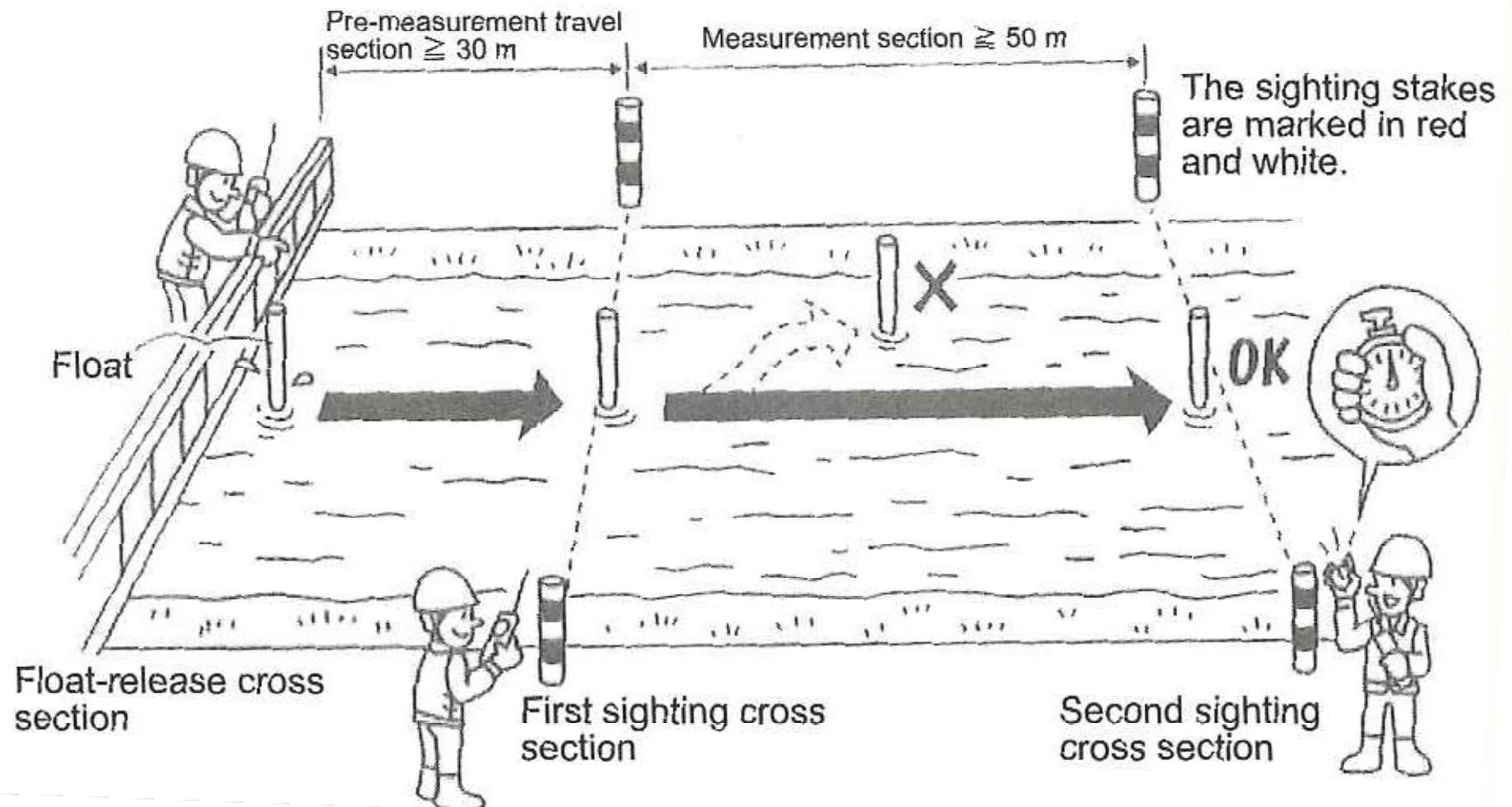


*A Scene of Low Water Discharge Observation  
Wading measurement – if river is small enough*

## Water Discharge Observation

*High Water Discharge Observation*

# Water Discharge Observation



## Water Discharge Observation

*Throwing 2meter-Float into the river from the bridge.*



*A Scene of High Water Discharge Observation*

## Water Discharge Observation



- *Workers throw a float into the river.*

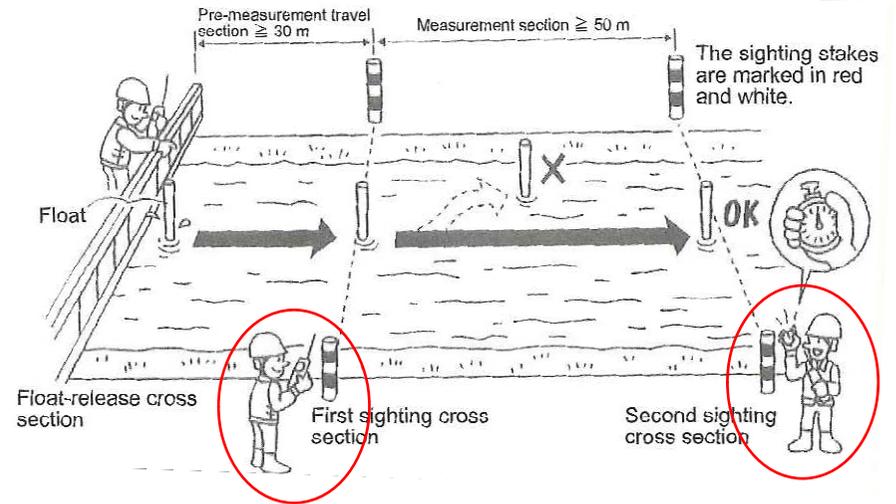


*A Scene of High Water Discharge Observation  
- The Float is flowing down the river.*

# Water Discharge Observation



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## A Scene of High Water Discharge Observation

- Measurers stand on the each sighting cross section.
- They check that a float passes the section.
- Time which the float took to be carried along between two sections is measured.



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# Water Discharge Observation



*Water level must be read on the staff gauge installed on the each section.*

***New Equipment  
for Water Discharge Observation  
has been Developed !!***

***ADCP***

***H-ADCP***

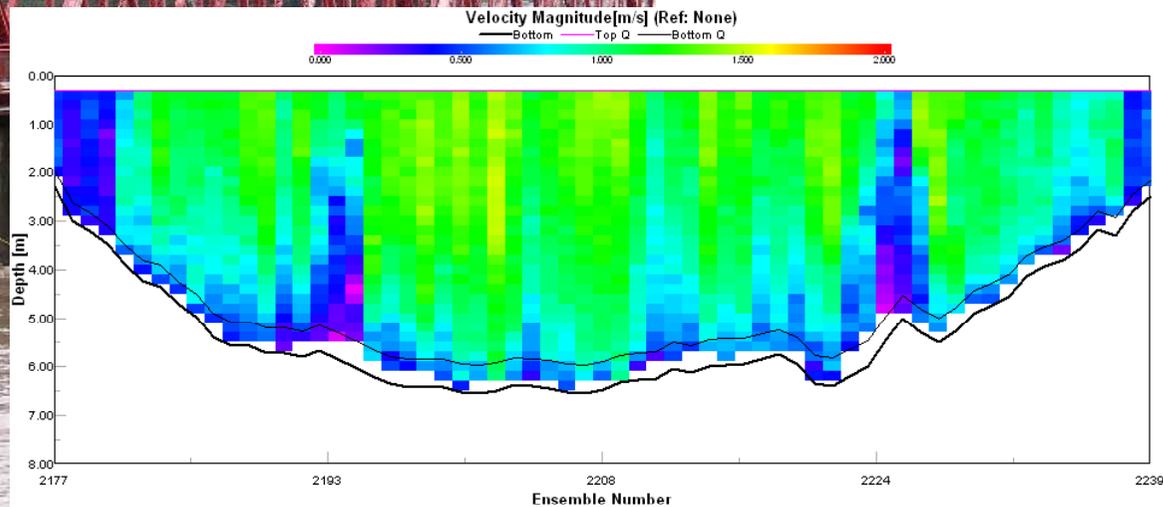
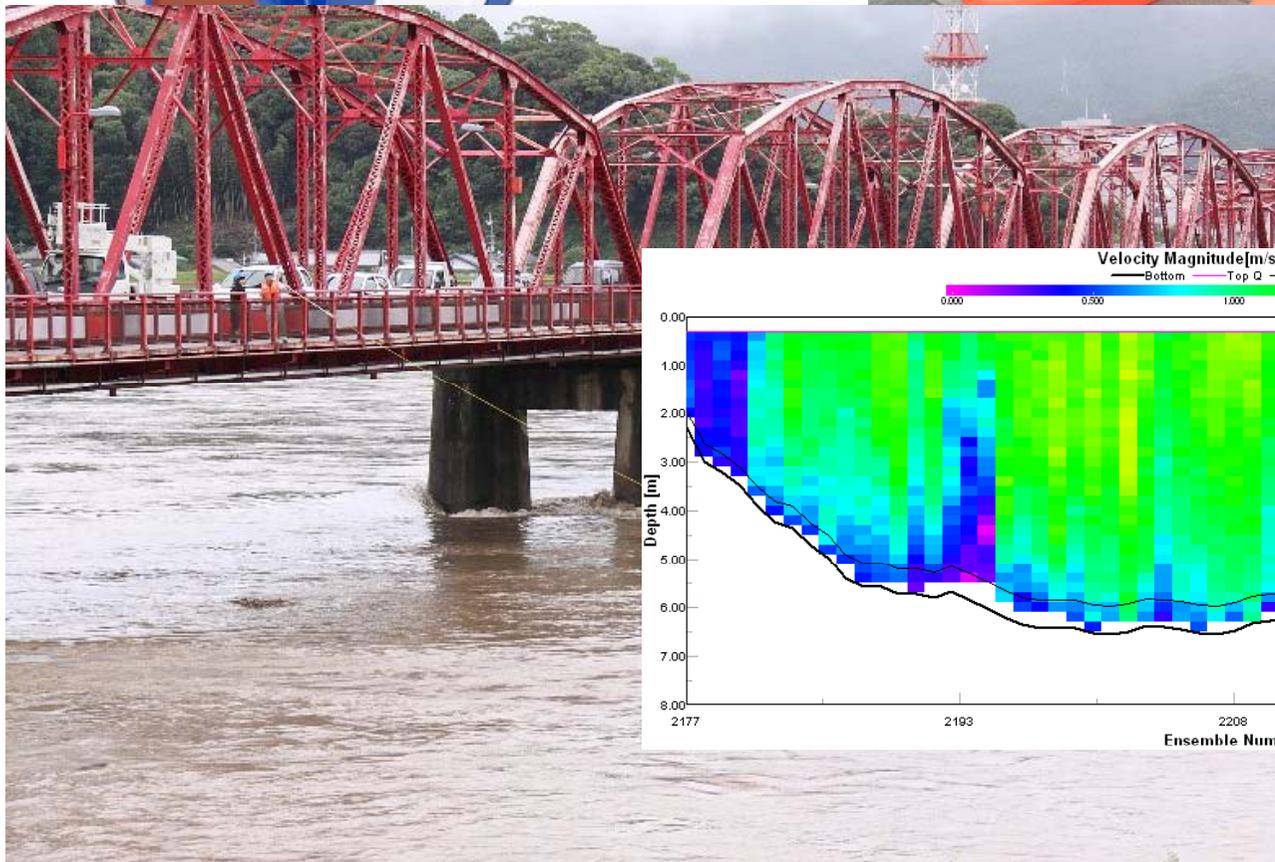
***Radio Current Meter***

# Water Discharge Observation

● ADCP transducer



# New Equipment



at

## Water Discharge Observation

● ADCP



Manned boat

## New Equipment

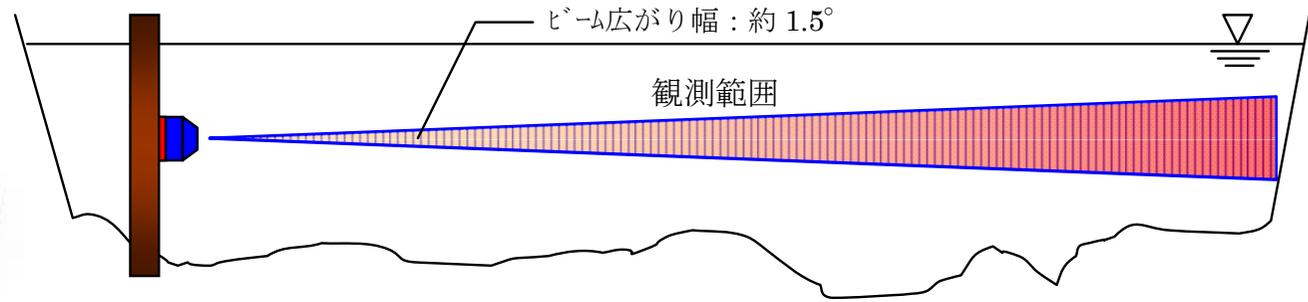
Radio controlled boat



# Water Discharge Observation

# New Equipment

● H-ADCP



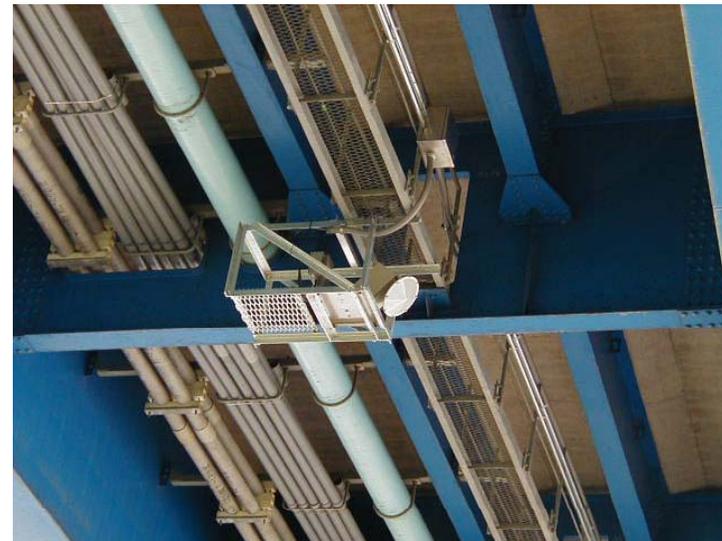
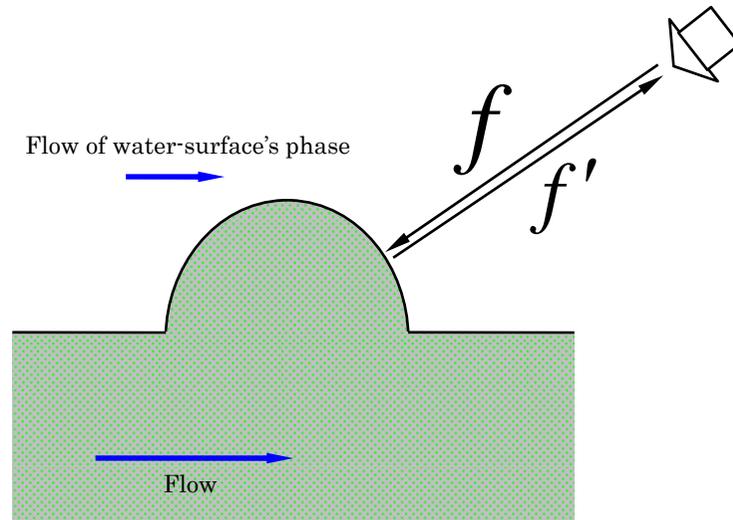
# Water Discharge Observation

## New Equipment

### ● Radio Current Meter – Fixed Type



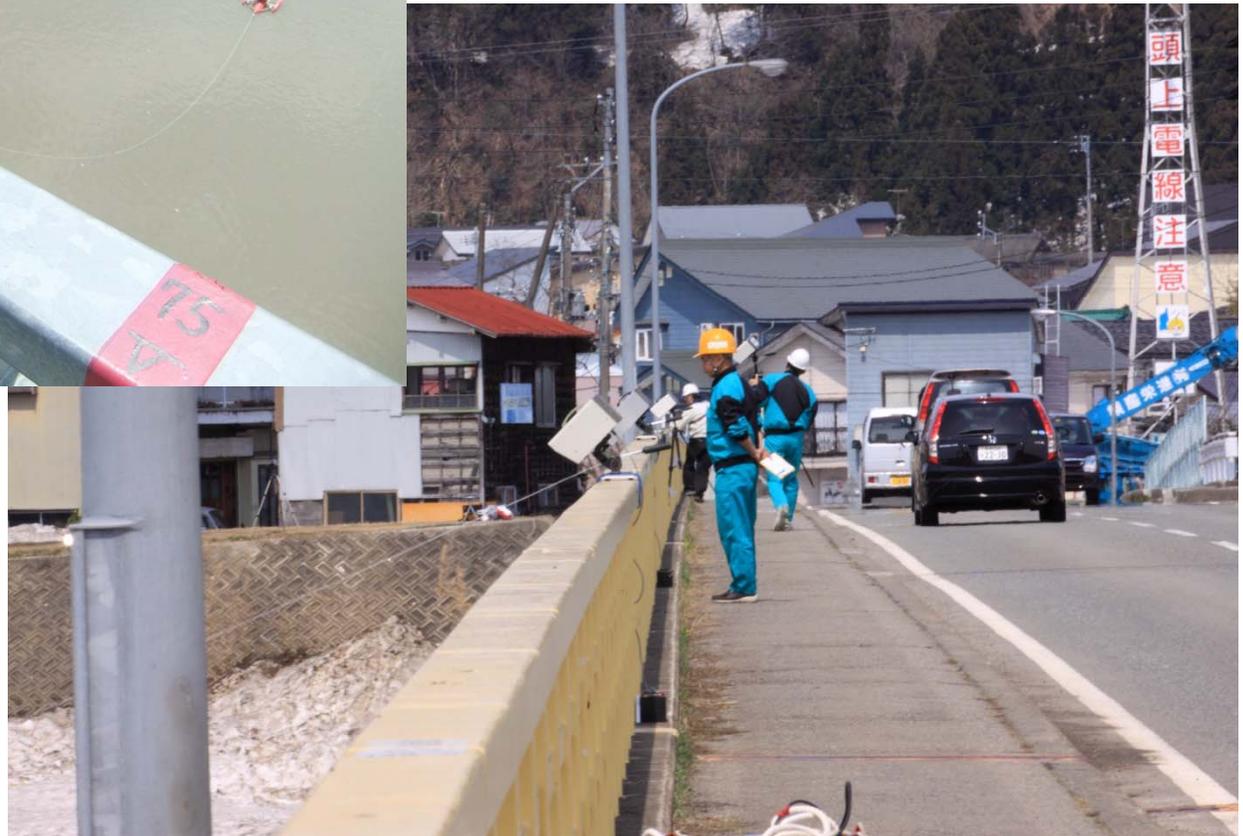
Radio Current Meter



## Water Discharge Observation

## New Equipment

### ● *Radio Current Meter – Portable Type*

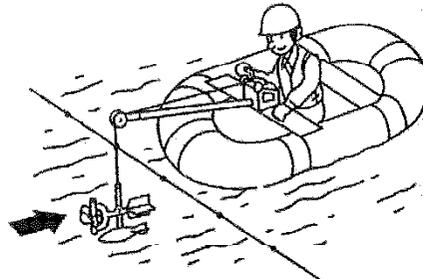


### 3.2 Discharge observation using rotary current meters

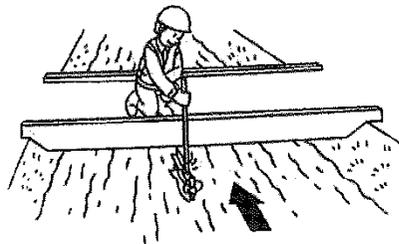
#### 3.2.1 Observation method



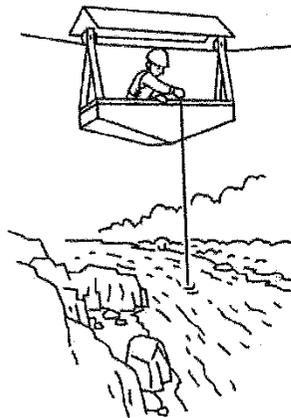
Wading measurement



Observation by boat

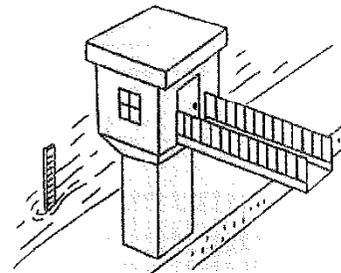


Observation from a bridge

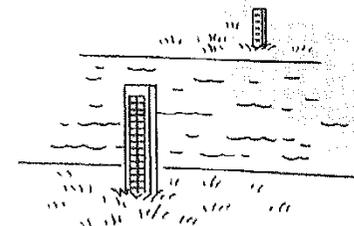


Observation from a suspended gondola

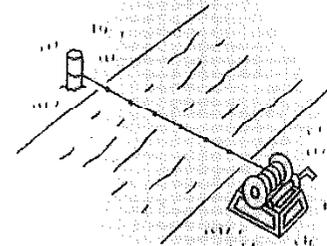
#### 3.2.2 Observation facilities



Water level observation station



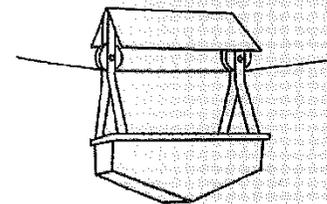
Cross-section stakes



Wire to which an observation boat is to be connected and a stake to which the wire is to be tied



Boat boom

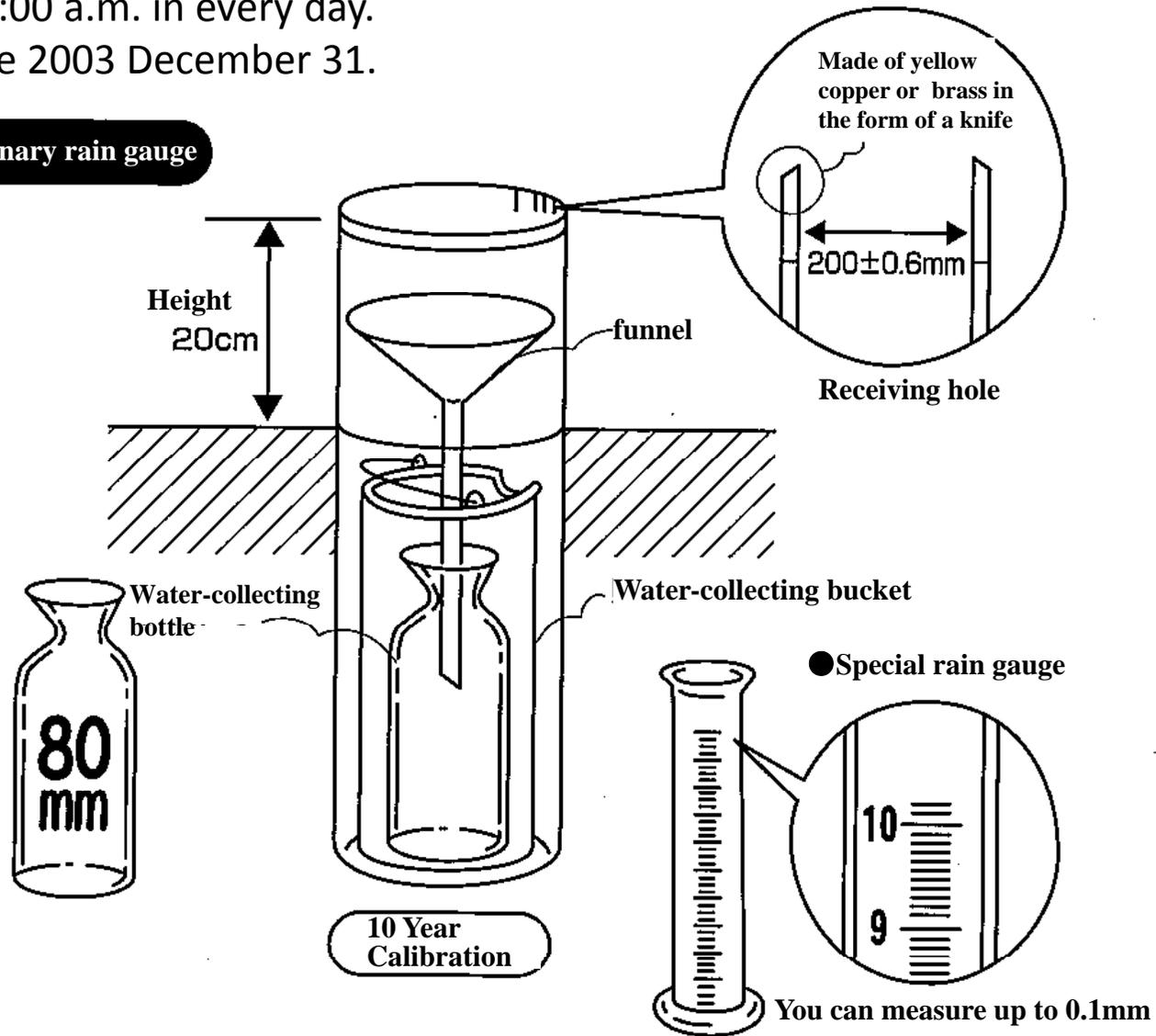


Cable and gondola

# Ordinary Rain Gauge

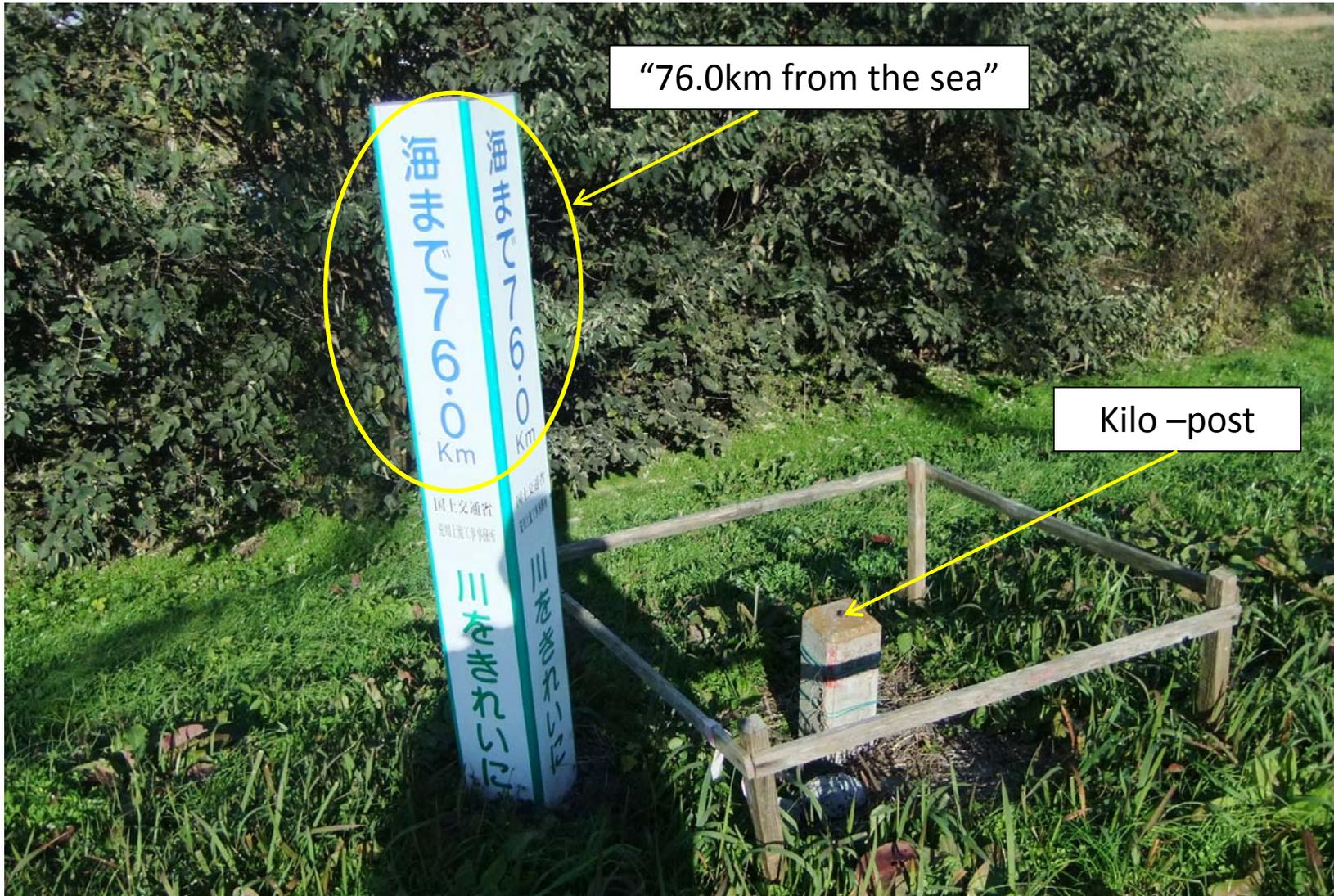
Measured at 9:00 a.m. in every day.  
Abolished since 2003 December 31.

**Ordinary rain gauge**



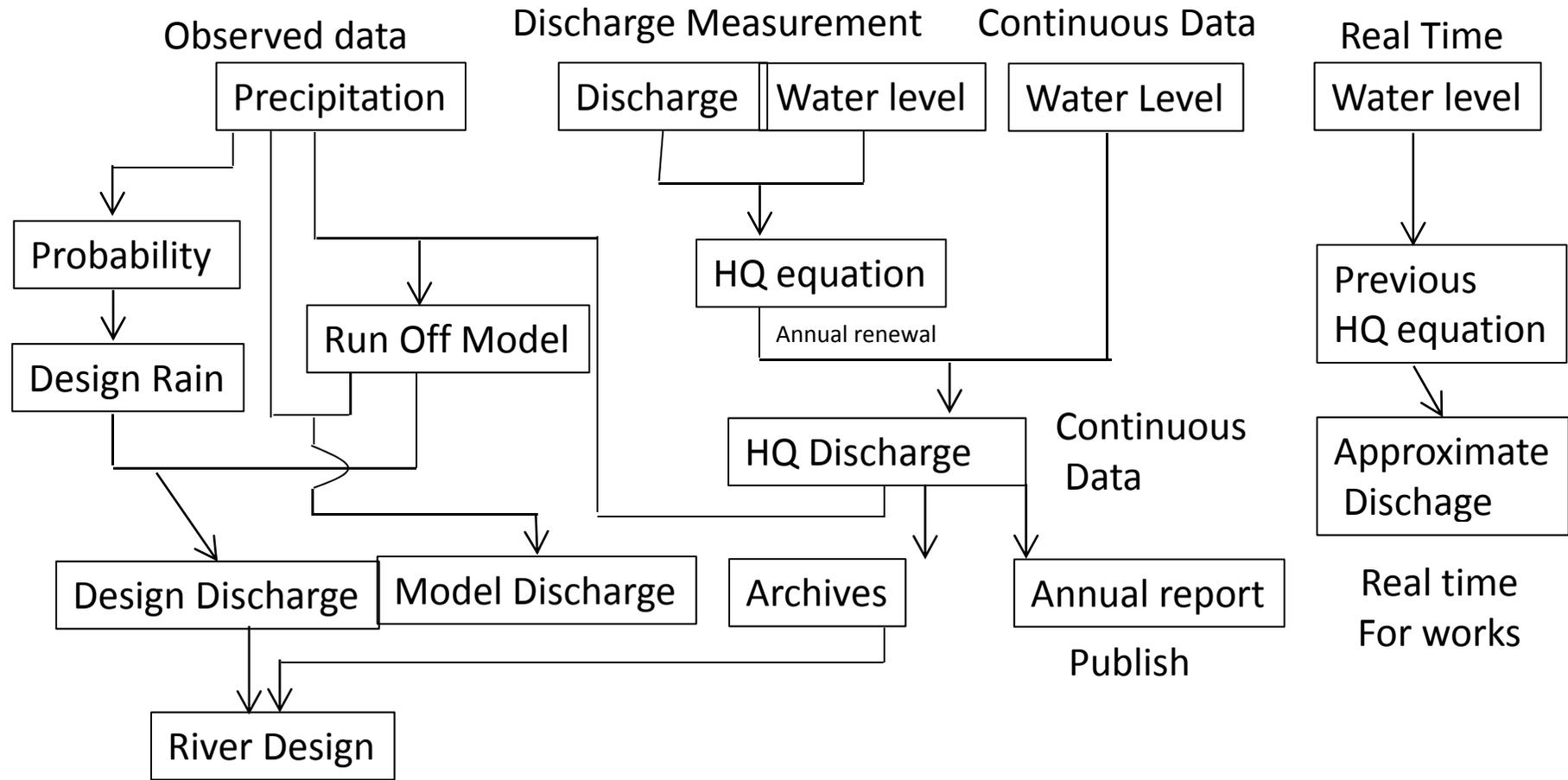






Kilo-post along the river (example)  
Arakawa river

- This Post is installed about 200m pitch in case of class A river
- This Post indicate the distance for the river mouth and the elevation



# History of Hydrological Observation in JAPAN

- 1937 Research for Comprehensive River and Water Works  
(Ministry of Interior, Ministry of Communication , Ministry of Agriculture and forest )
- 1950 Research for water usage (Ministry of Construction)
- 1951 Law of national land research
- 1952 Research Guideline for Hydrology (by MOC Vice Minister)
- 1964 New River Law
- 1966 Regulation for Hydrological Observation Works (by MOC Vice Minister)
- 1996 Amendment for Hydrological Observation Works  
(Category of the station, signs of station, observation time,  
scope of telemeter, measures for water quality/ground water level and quality)  
(by MOC Vice Minister)
- 2002 Amendment for Hydrological Observation works  
(Securing the quality of observation and action, abolish conventional observation,  
disclosure of the result of observation, development of technology)  
(by MLIT Vice Minister)

Thank you for your attention