Flood Forecasting in Japan and the Chao Phraya River Basin

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River Information System in Japan

- Dykes
- Upstream/downstream water stage observation and images
- Rainfall Observation (telemeter, radar)
- Rainfall forecast

**River Information System**

- Comprehend present river water stage, flow rate
- Inundation risk assessment (evacuation decision making information)
- Comprehend inundation status and forecast
- Forecast river water stage, flow rate
- Decide optimum operation of dams, water gates, and pumps
- Data archive and utilization in planning

- Data, operation status, images
- Instruct optimum operation (coordinated operation)
- Flood fighting instruction
- Damage situation

- Upstream Dam
- Water Gate
- Drainage Pump
- Retarding Basin

- River manager
- Met. Agency
- Power Supply, Agri.

- Internet
- Municipalities (proper measures and information transfer)
- Mass Media
- Wireless station for disaster prevention, alarm mail
- TV, radio

**General Public** (proper decision making and evacuation)
River Information System (PC)

**Available Information**

- **Radar rainfall**
  - Rainfall distribution, rainfall intensity can be viewed in time series in the transition of rain area

**Warning information**

- Indicate flood forecast and flood prevention warning, etc.

**Rainfall/Water Level/Flow Rate**

Indicates relation between water level of the river etc. or standard water level, and level of residential area

<table>
<thead>
<tr>
<th>Item</th>
<th>Standard</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Sustainable water level of flood fighting corps</td>
<td>Flood warning water level</td>
<td>Evacuation water level</td>
<td>Flood hazard water level</td>
<td>Planned high water level</td>
</tr>
<tr>
<td></td>
<td>2.00m</td>
<td>3.00m</td>
<td>3.50m</td>
<td>3.70m</td>
<td>4.57m</td>
</tr>
<tr>
<td>Site</td>
<td>Planned Maximum water volume</td>
<td>4400.00m³/s (15%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Standard</th>
<th>Current value</th>
<th>Planned Maximum water volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Sustainable water level of flood fighting corps</td>
<td>1.53m†</td>
<td>4400.00m³/s (15%)</td>
</tr>
</tbody>
</table>

**Flow Rate**

- Rainfall/Water Level/Flow Rate
  - List of water level above thresholds that indicate a level above the thresholds, such as flood hazard level, etc.

**List of water level above thresholds**

<table>
<thead>
<tr>
<th>Observation station</th>
<th>Water system</th>
<th>River name</th>
<th>Time of observation</th>
<th>Standard water level (m)</th>
<th>Location</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashino-kake Lake</td>
<td>Kanto, others</td>
<td>Ashino lake</td>
<td>2.47</td>
<td>12.40</td>
<td>Matrix</td>
<td>-</td>
</tr>
</tbody>
</table>
| Mt. Makie            | Yodo River   | Uji River  | 2.17                | 13.50                    | -        | left bank  | -1.50%     | National river
Provision of River Information via Mobile Phone

Rainfall observation

- **Realtime records**
  - Past records 60min.

- **Past records 12hr**

Water level observation

- **Realtime records**
  - Past records 60min.

- **Past records 12hr**

Radar

- **Past records 12hr**

※アニメーション表示画面へ戻る
Establishment of Thresholds for Evacuation Orders

In order to promote smooth evacuation actions, thresholds of water levels for evacuation orders have been established.

- Level 5: Flooding occurs
- Level 4: Flooding nearly occurs
- Level 3: Evacuation should be decided
- Level 2: Flood is cautionary, Flood fighters in action
- Level 1: Flood fighters stand by

Water Level and Risk Level

- Level 5: Flooding occurs
- Level 4: Flooding nearly occurs
- Level 3: Evacuation should be decided
- Level 2: Flood is cautionary, Flood fighters in action
- Level 1: Flood fighters stand by

Risk level

Level 5
Level 4
Level 3
Level 2
Level 1

Flooding occurs
Flooding nearly occurs
Evacuation should be decided
Flood is cautionary, Flood fighters in action
Flood fighters stand by

Top of Levee

River

Levee

Houses

Low Flow Channel

Flood Channel
Flood Forecasting of Small Rivers in Japan
Rainfall forecast:
- Nowcast (JMA) (1 hour)
- Rainy area migration analysis (FRICS) (3 hours)
- Short-term Precipitation Forecast (JMA) (6 hours)

Run-off calculation
- Lumped Model
- Distributed Model

Forecasting and Warning
- Flood fighting (stand-by, action)
- Evacuation (instruction, order)

Inundation analysis
- Expected inundation area (design flood scale)
Factors to be evaluated in selecting a model for operational flood forecasting

- **Accuracy** in reproducing past events;
- **Flexibility** in accommodating changes in local conditions;
- **Robustness** in dealing with abnormal data;
- **Availability** of input data required;
- **Speed** of generating output; and
- **Reasonable** (or free) license fee.

It should be noted that the model should run **real-time** using observed data and **actual** operation status of facilities.
(title) Flood Warning Information

(heading) X river reach flood warning level, water expected to rise further

(body) At Y water level station of the X river, water level reached the flood warning level. The water is expected to rise further. Please keep attention to coming flood warnings.

(present situation, forecast) Average rainfall of X river basin
  for 6 hours from ___:___ to ___:___ recorded ___mm
  for 3 hours from ___:___ to ___:___ forecast ___mm
Water level at Y water level station of the X river
  recorded at ___:___ ___m (increasing rapidly)
  forecast of ___:___ ___m

(references) Thresholds, contact information
Provision of River Information via Digital TV

Approximately 4 to 6 screens created for each prefecture. Screens can be switched arbitrarily using a remote control.

For rainfall, the four shades as represented by the circles express the intensity of rain, and the maximum number of observation locations is 9 locations.

The squares on the map are water level observation locations. For selected observation locations, the color flashes. Information for the selected observation location (changes in water level), and the current level, etc. are displayed.
A real-time inundation simulation system provides forecast inundation depth and area based on the information of dyke breach, observed/forecast rainfall and river water level.
Flood Risk Information System of the Chao Phraya River
Outline of the System

Prototype

Top page

Flow rate

[2 types of display]

- Plane view
- Bird's eye view

Inundation area

Flow rate graph

Water-level graph

Forecast from 1 to 7 days later

1. Forecast a river flow-rate and water-level with high accuracy (verified by the 2012 flood)
2. Practical application of inundation forecast for such a wide area had not ever seen anywhere in the world. (RRI model, LiDAR data etc.)
3. Simulation runtime is very short

Click! Click!

Inundation area

forecast from 1 to 7 days later

understandable when flood starts

possibility of flood 5 days after

Warning (maximum discharge)

Caution

Min possibility of flood 5 days after

Forecasting water level

display a color-coded inundation risk for each mesh
Structure of the System

- Observation Data: Rainfall, Water-level, Discharge
- Simulation Models: RRI model
- Rainfall Forecast: Quantitative Precipitation Estimate (QPE)
- Detailed topography: LiDAR data
- Satellite Images: GISTDA

Diagram:

- Data flow from RID TMD to RRI Simulation Model (LiDAR)
- Output of Water-level, Flow-rate, Inundation Area
- Calibration and Forecast 1-7 days later
- Today's GISTDA output
Flood Risk Information System Website

(1) Eye-catching, easy-to-use

(2) Top page has two big buttons; one for the Schematic Diagram display and the other for Flood Area display.

(3) Focuses on the forecast status of events (Present status information is limited to the one required for understanding the forecast)

(4) Numerals/data do not appear on the basic screens or on the graphs. (pop up from basic screens)

(5) Simple structure: Absolutely no manual is required to use the system

(6) English and Thai versions
Click and proceed to flow rate, water level forecast pages

Click and proceed to inundation forecast pages

Change between English and Thai versions.
Schematic Diagram (Plane View)

Flow rate/water level
- Normal
- Caution
- Warning (flooding)

Information update time

Displayed part of the plane view
Schematic Diagram (Plane View)

Click, and graphs of flow rate and water level at the point opens.

Move to Bird’s-eye View

Click, and flow rate at the point pops up.

Back to Top Page
Present

You can get the general idea of the time when flood begins.

MAX: with the maximum rainfall judged from historical data

MIN: with no rain

Risk level of the point

You can get the general idea of the time when flood begins.

warning level (when exceeded, flood begins.)

cautions level (set for each point)
You can get the general idea of the time when flood begins.

Time allowance

Water level
Inundation Area

Inundation Extent Overwrapped on Google Map
“High Risk” area (dark-blue), and “Risk” area (light-blue)

Risk: water depth between 20cm and 1.0m, High Risk: water depth more than 1.0m
Flood Area 7 days later
Word of Caution

• As the needs for prediction/forecast of floods are considered high, it is a natural course of actions to promote development of technologies of operational flood forecasting in Thailand.

• Close examination on the issues involved in forecast information should be made before introducing a flood forecasting system.

• In particular, uncertainties involved in the natural phenomena, observations, and simulation should be well-understood.

• The flood forecasting system should not simply display the calculation outputs, but be designed to furnish the users with necessary and not-misleading information effectively.