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DioVISTA/Flood Technologies & Use cases

Hitachi Power Solutions Co., Ltd.

Schedule

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Time	Course	Contents
10:00 -	1	Utilization of DioVISTA in the field of construction consulting
11:00 -	2	Utilization of Dam Dashboard in the Dam Sector
13:00 -	3	Utilization of DioVISTA in the field of non-life insurance
14:00 -	4	Utilization of DioVISTA in the field of disaster prevention administration
15:00 -	5	Proposal of BCP support for flood countermeasures for corporate disaster prevention
16:00 -	6	**DioVISTA Flood Simulator– Technologies & Use cases** DioVISTA technologies and use cases will be introduced. DioVISTA includes 3-D visualization, fast calculation, and intuitive operation.

Today's materials will be uploaded later.
Participants will receive an email with the link.

Outline

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1. Introduction – use cases
2. Features of DioVISTA
3. Editions of DioVISTA
4. Summary
5. Appendix

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Use case in Vietnam

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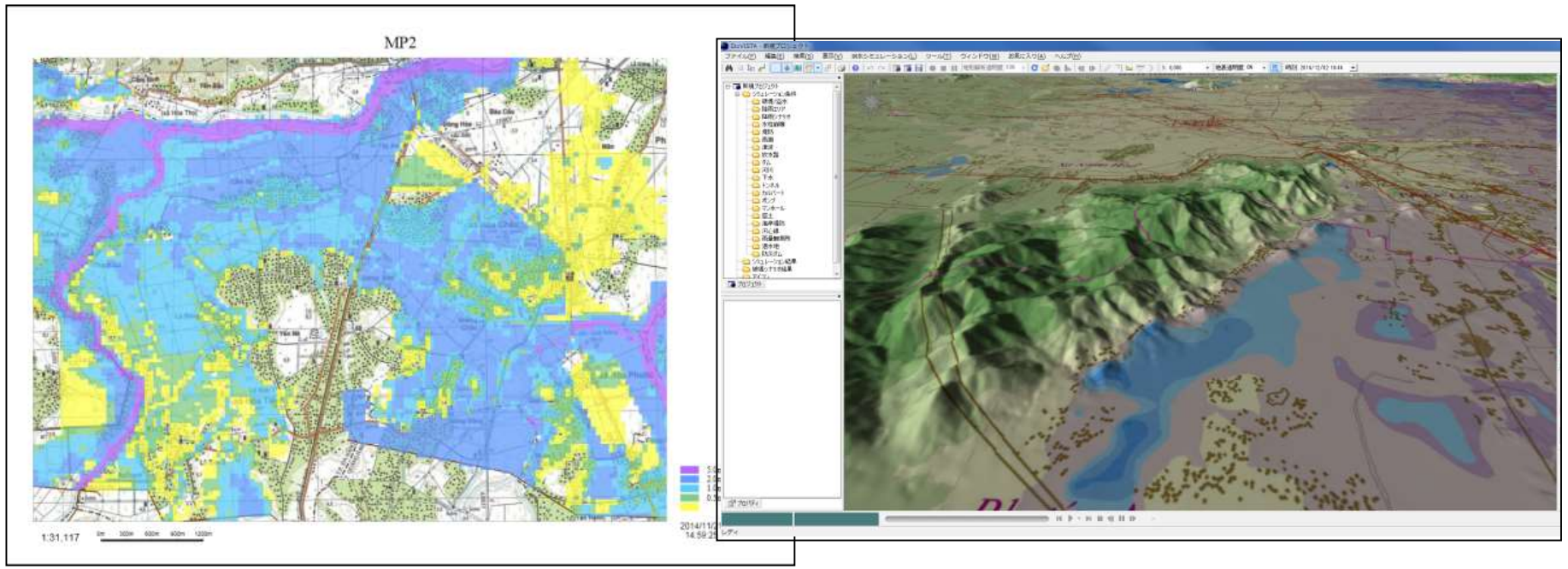
- We conducted feasibility study in Vietnam in 2014.
- Staff in Disaster Prevention Center in Da Nang City and Binh Dinh Province made flood hazard map using DioVISTA



Printed hazard map of Da Nang City 3D hazard map of Binh Dinh Province

Use case in Vietnam

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Scenes of Workshop Day 1 in Da Nang City

(a) Checking hydrological data	(b) Inputting data into DioVISTA

Use case in Vietnam

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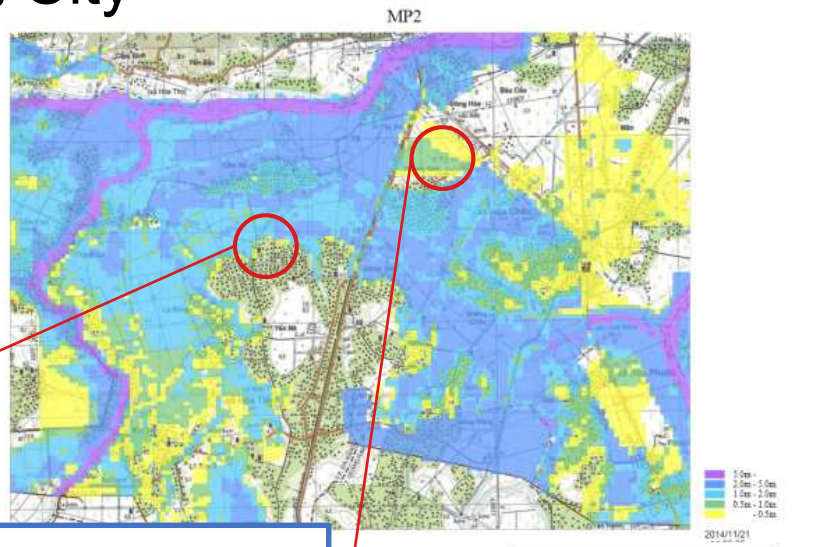
Scenes of Workshop Day 2 in Da Nang City

Validating hazard map by comparing historical flood level with



Simulation: 1-2 m Historical data: 1.4 m

Simulation: 0.5-1 m Historical data: 0.5 m

Use case in Vietnam

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Feedbacks from staff in Disaster Prevention Center in Da Nan City and Binh Dinh

No	Item	Score (1~5)
1	I can conduct flood simulation with DioVISTA	3.8
2	I can identify high risk area based on simulation result and site investigation	4.4
3	Enough data is used in DioVISTA	3.5
4	I want to continue using DioVISTA	4.9
5	This system should be improved toward flood forecasting	4.6

Vision of DioVISTA/Flood

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We aim to save people and properties from flood damage

Simulation result for May 2013 in Indonesia

Simple and Fast

Can be used in anywhere on the earth

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Functions of DioVISTA

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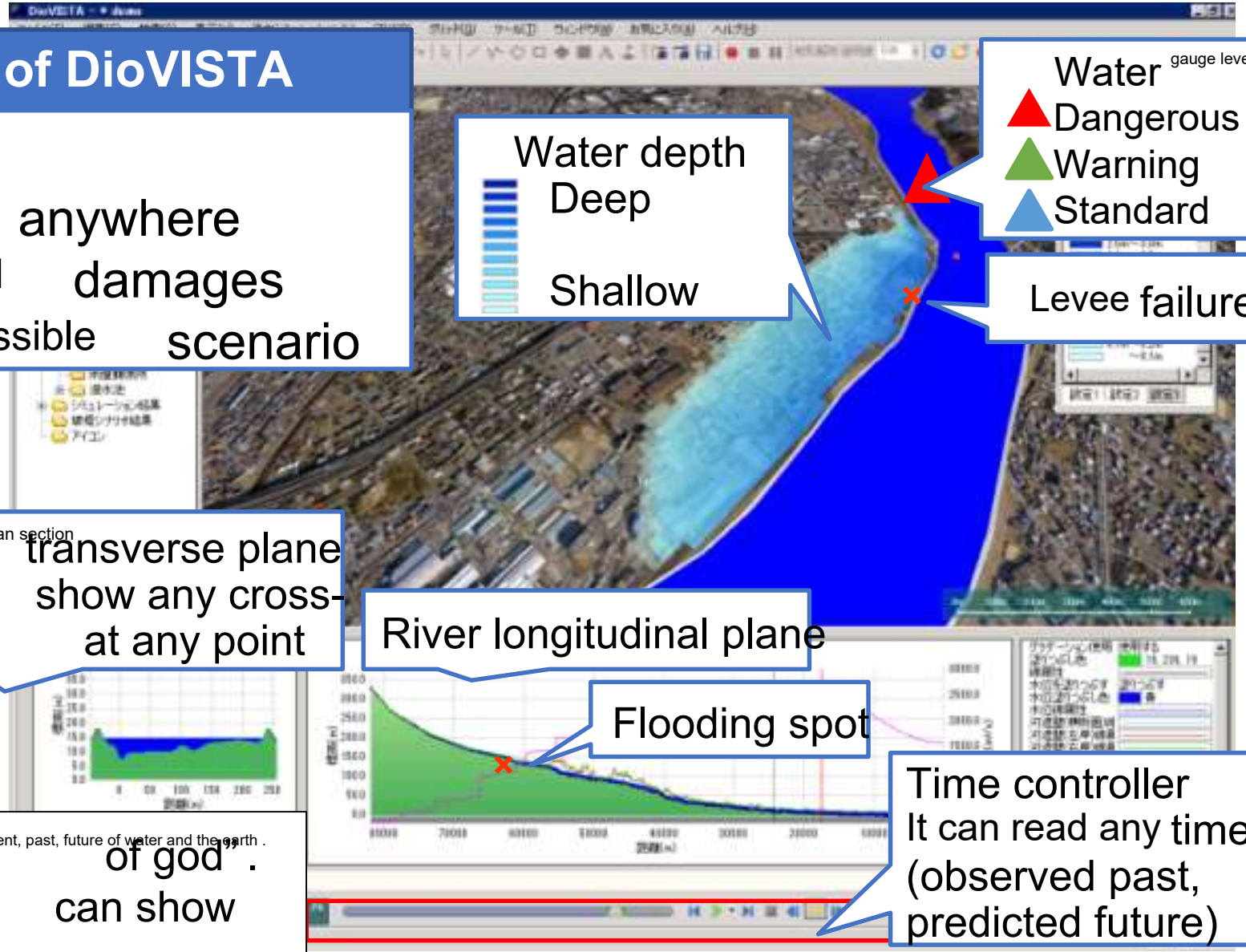
Main functions of DioVISTA

1. Predict flooded areas
2. Predict river level at anywhere
3. Analyze previous flood damages
4. Simulate based on possible scenario



DioVISTA: In Italian, it means “ sight We aim to make a system which present, past, future of water and the earth .
of god”.
can show

Features of DioVISTA

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1. **Fast and accurate simulations**
   Using original fast calculating method
2. **Advanced simulations with easy operations**
   Non-hydrologic-experts can also execute simulations easily
3. **Simulations based on rainfall as input**
   Display dangerous areas on the map and on the transit map to enable quick supports

Feature1:Fast and accurate simulations

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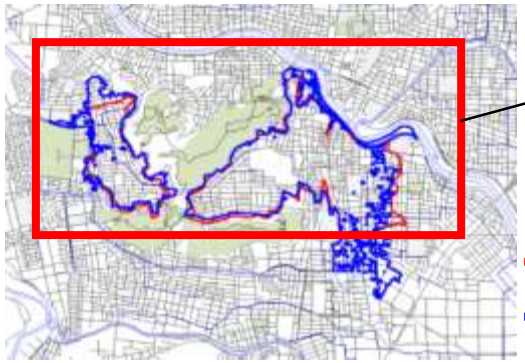
- Based on our original high-speed calculating method Dynamic DDM
  - Acquired patents in Japan, United States, and China

6 hours flood analysis can be done in 4 seconds. Visualization of mid-flow results is possible during executing simulation. Mesh size: 25 m

Accuracy validation

- Flood damage in Asuwa river, Fukuiken in 2004
- Flooded areas are predicted with high precision



Investigated area False negative ： 9% False positive ： 13% Observed flood areas by site investigation Predicted flood areas by simulation

Yamaguchi and Iwamura: Accuracy verification of flood simulation using Asuwa River flood case in 2004, Japan Society of Civil Engineers Next Annual Meeting, 2006 . Patent: JP:4761865, US:7603263, CN:PZL200610008661.4

Conventional method

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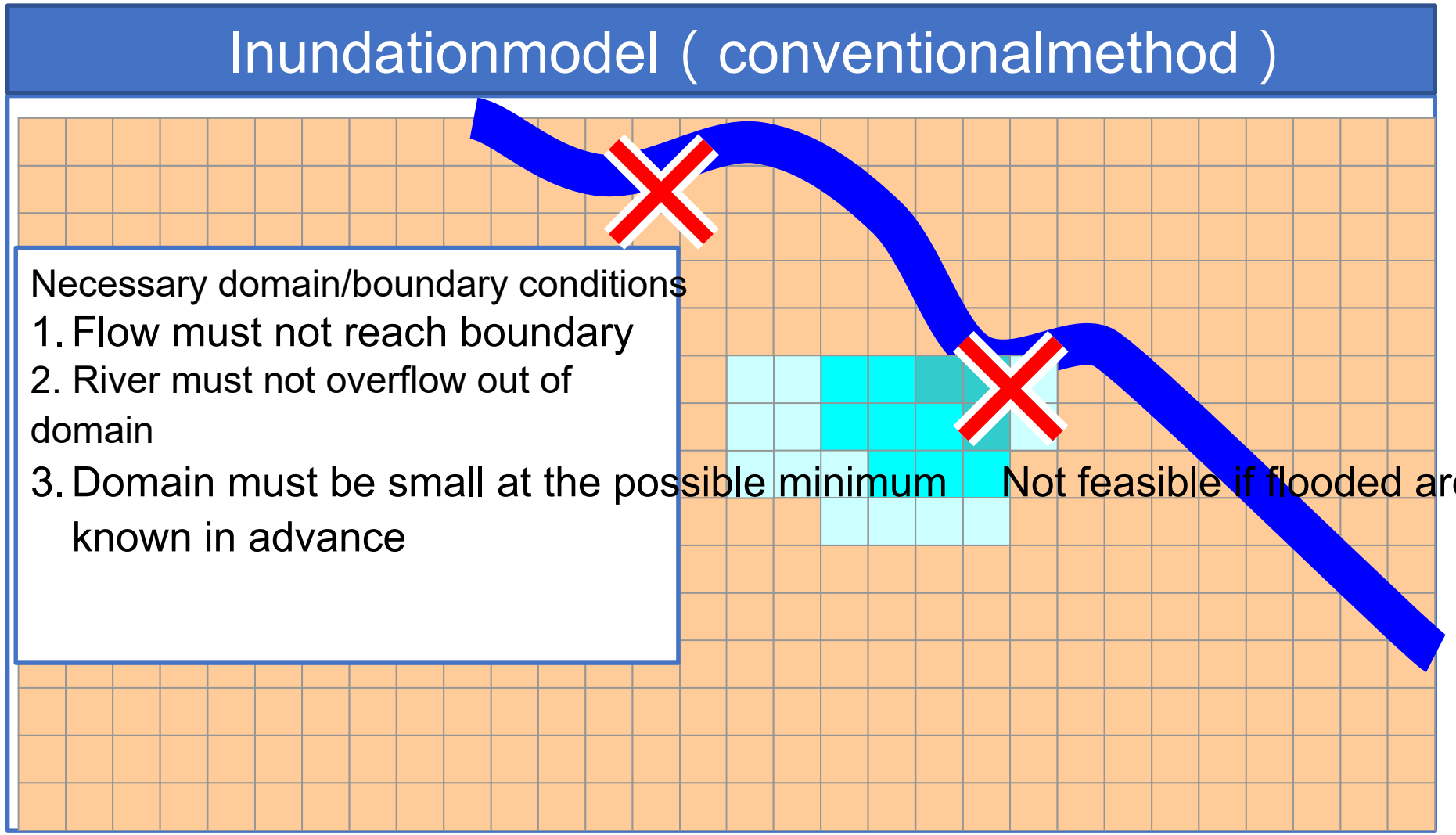

Our method

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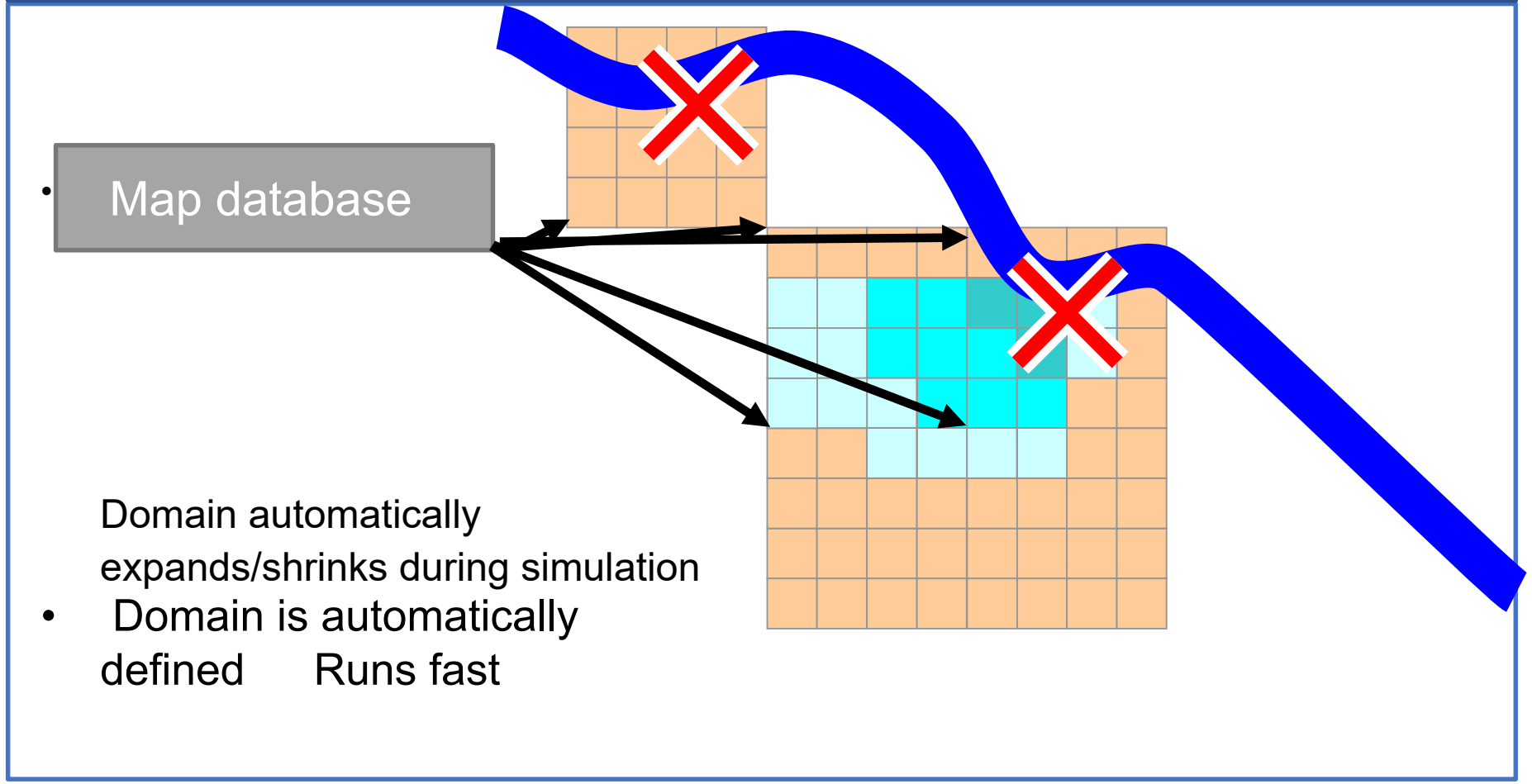
DynamicDDM (ourmethod,patented)



- Domain automatically expands/shrinks during simulation
- Domain is automatically defined Runs fast

Yamaguchi and Iwamura, Acceleration of Flood Simulation by Dynamic DDM, IPSJ Trans. Mathematical Modeling and Applications, 2007.

Characteristics of flood streams in city

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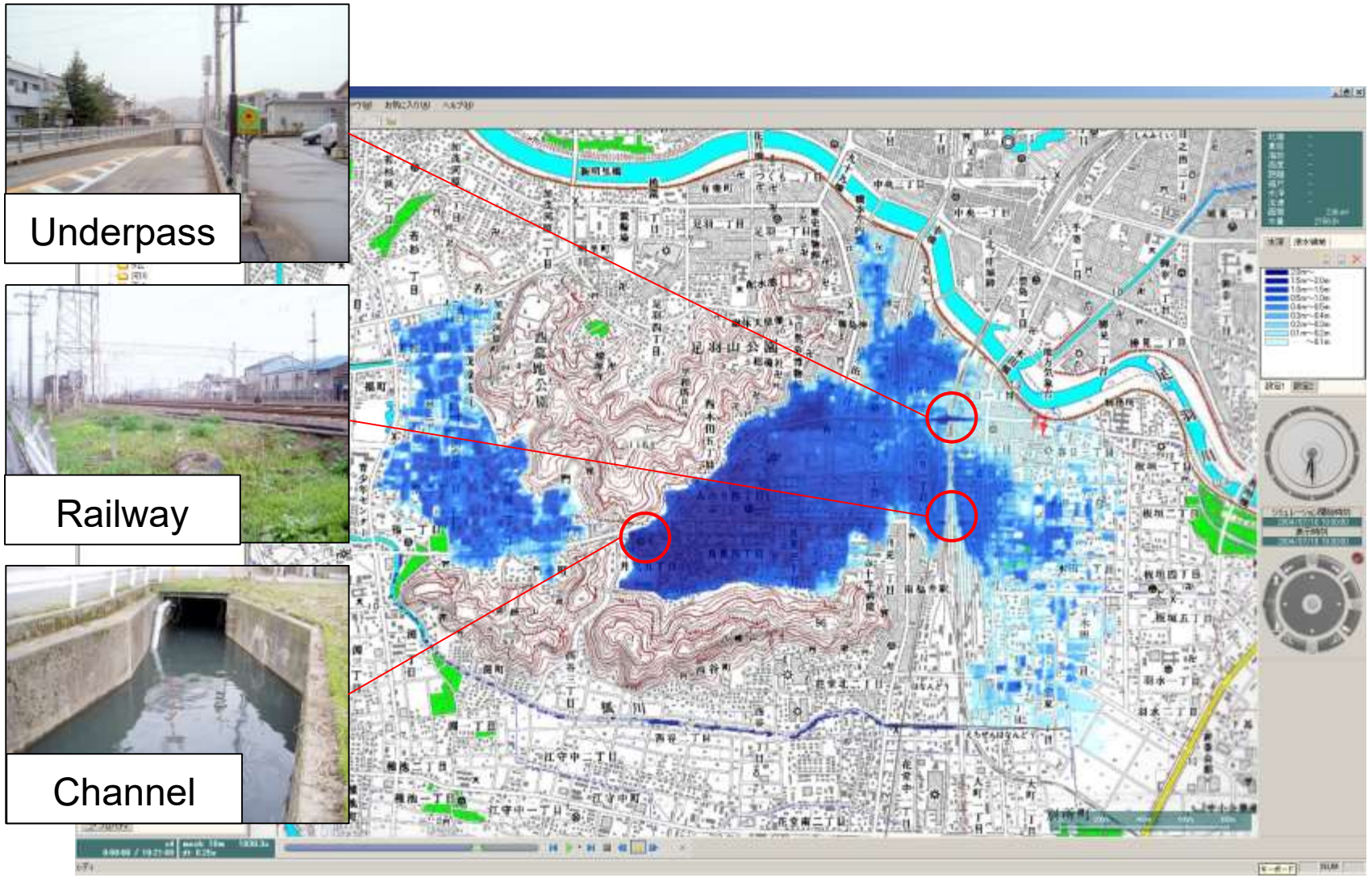

Current of water is affected by railway, road, underpass and etc..

Feature2:Advanced simulations with easy operations

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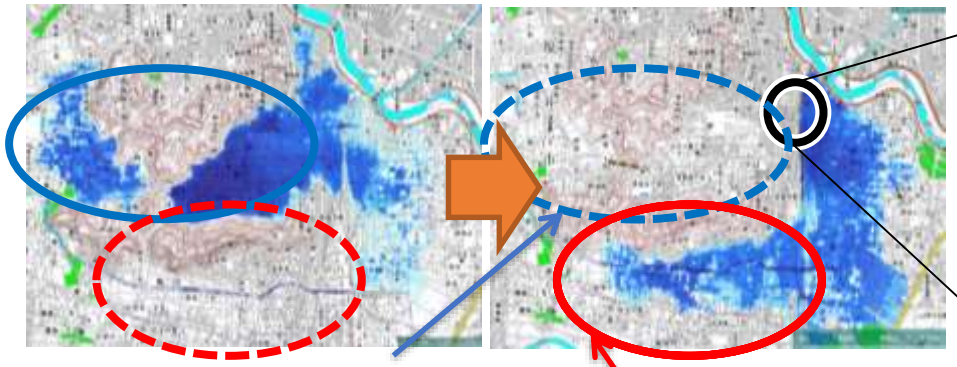
- Click where you want to set on the map to set sandbag wall

Setting sandbag wall

Intuitive operation using map data

Operation plan 1 Before After



Damage reduced area

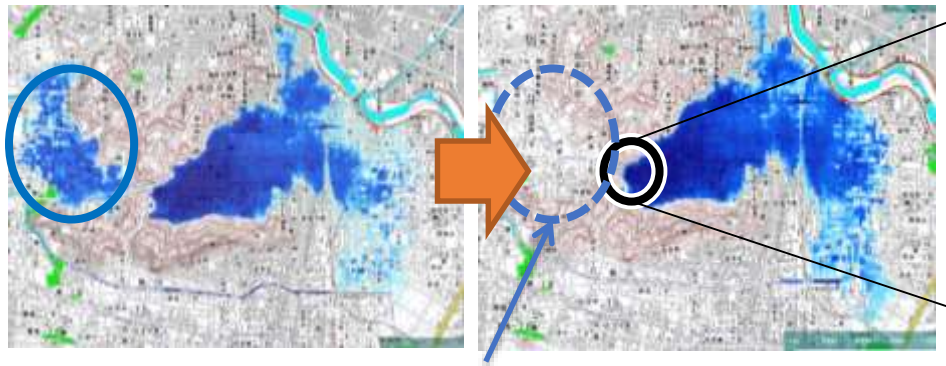
Damage increased area

Sandbag wall

Damage is reduced in central and western areas, but increased in southern area

Find better operation

Operation plan 2 Before After



Damage reduced area

Filled channel

Damage is reduced in western area

Feature3:Simulations with rainfall as input

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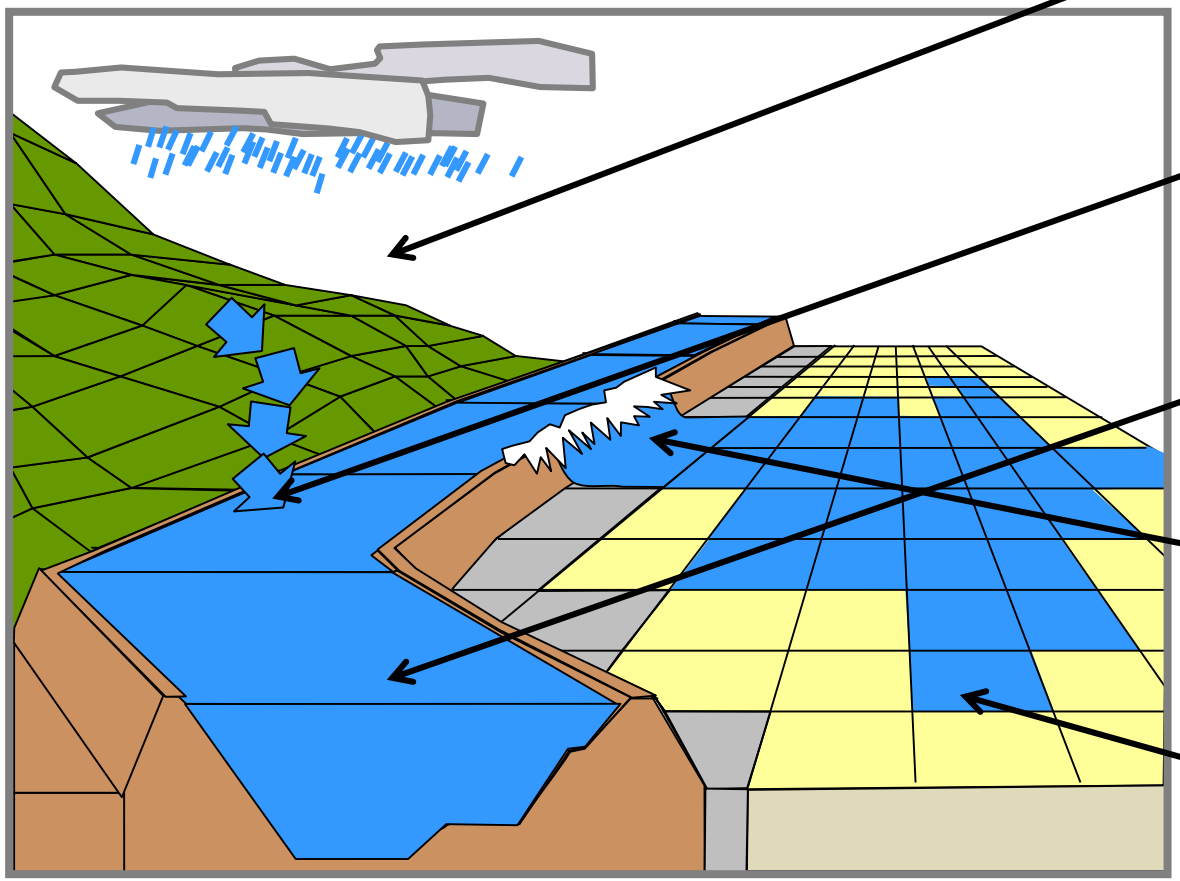
- Simulation from rainfall to flood can be done integrally
- Required models are made automatically from map data



Distributed runoff model

Runoff-River connection

1D river model

River-Plane connection

2D inundation model

Input of rainfall distribution time series

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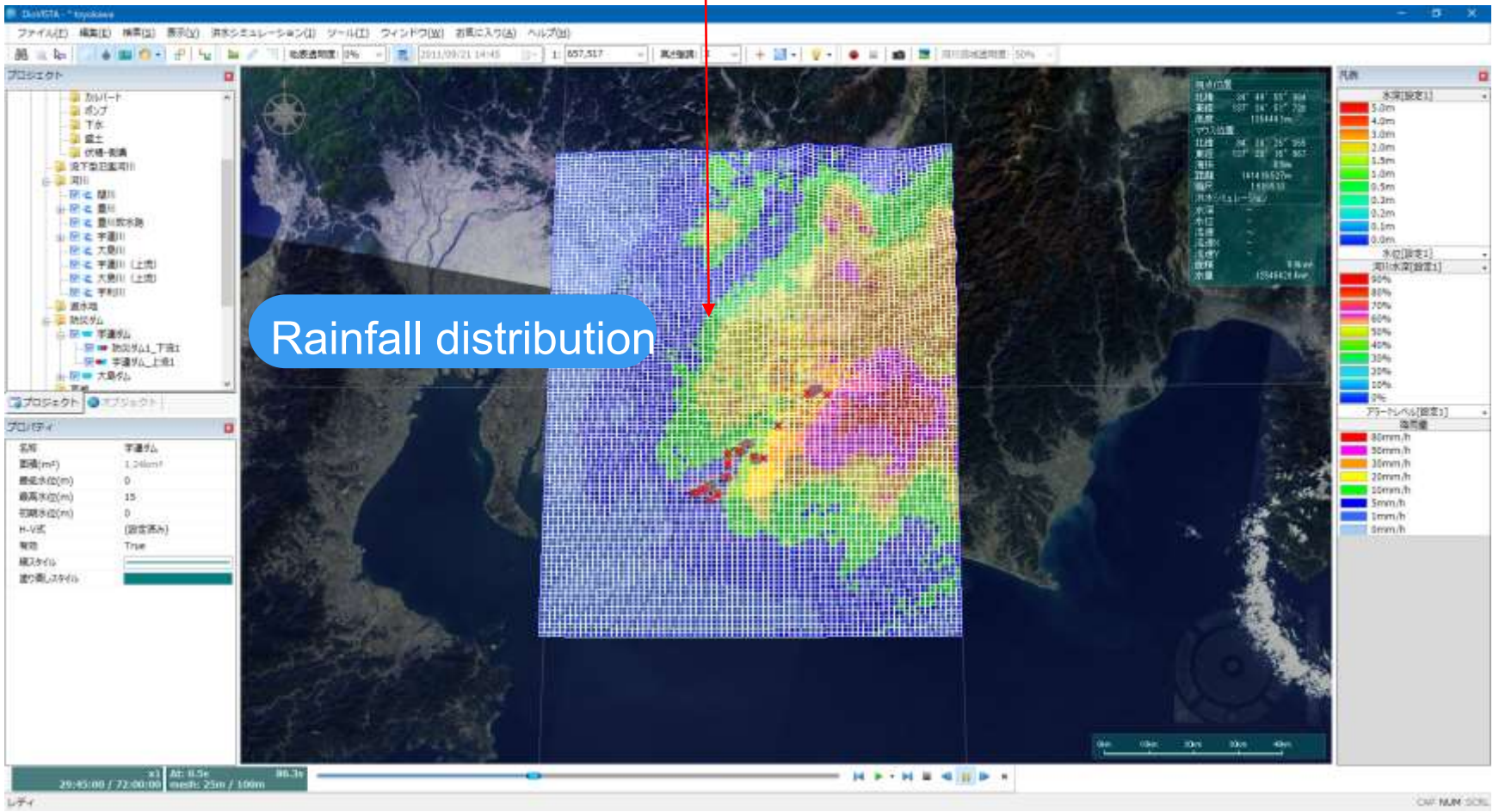
Inputobservedrainfalldistribution（Colorindicatesrainintensity）



Runoff model

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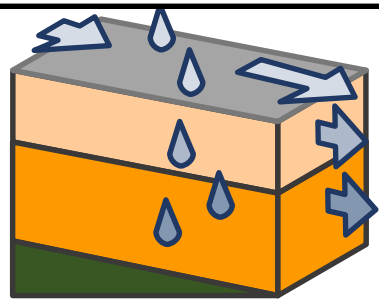
Analysis of rainwater permeation into soil



(a) Surface
(b) Saturated
(c) Unsaturated

Tachikawa et al., Development of Flow Flow Product Equation Introducing Mechanism of Saturated and Unsaturated Flow , Journal of Hydraulic Engineering, 2004.

Reservoir/River models

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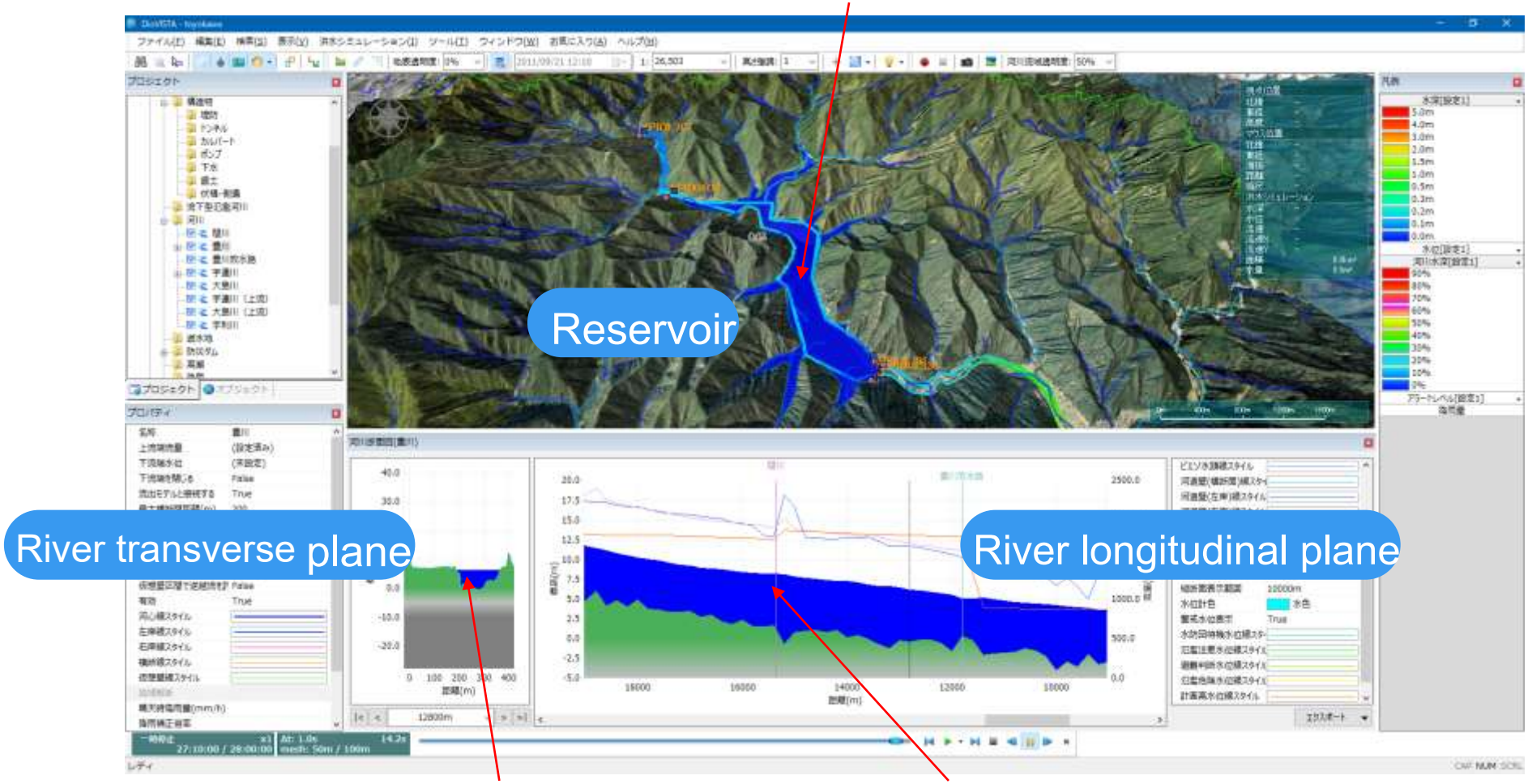
Reservoir（colorchangesfrombluetoreddependingonthewaterlevel）



River transverse plane River longitudinal plane

Inundation model

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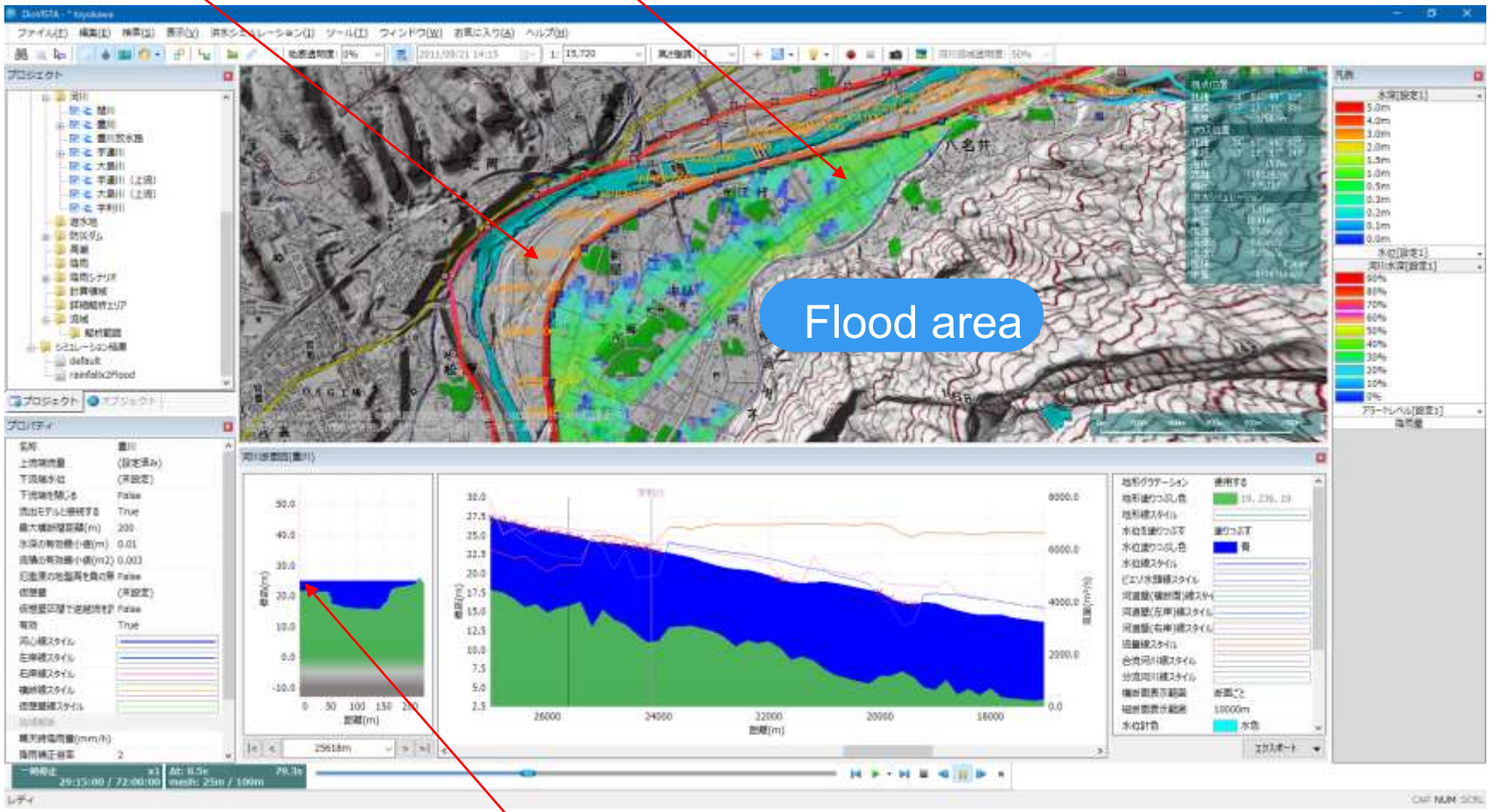
Downstream river

Flood area



Water level is over the height of the levee

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Editions

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System/Software

Edition	Features	Uses	Current clients
Enterprise	Inundation prediction for 24 hours a day, 365 days a year	• Staff arrangement • Decision of monitoring spots • Decision of evacuation advisory	• Municipalities
Professional	Flood damage simulation of possible heavy rain	• Quantitative evaluation of flood damage risks • Analysis of damage mechanism	• Insurance companies • Construction consultancy companies • Universities, Research institutes
Standard	Flood damage simulation of assumed levee failure	• Flooded area identification • Report preparation for disaster prevention planning	• Municipalities • Universities, Research institutes

Services

Service items	Contents	Current clients
Video making	• Flood damage simulation video for disaster prevention education	• Municipalities
Simulation and Report preparation	• Executing simulation based on possible scenario	• Insurance companies • Large plants, broadcasting stations • Construction consultancy companies

Features of enterprise edition

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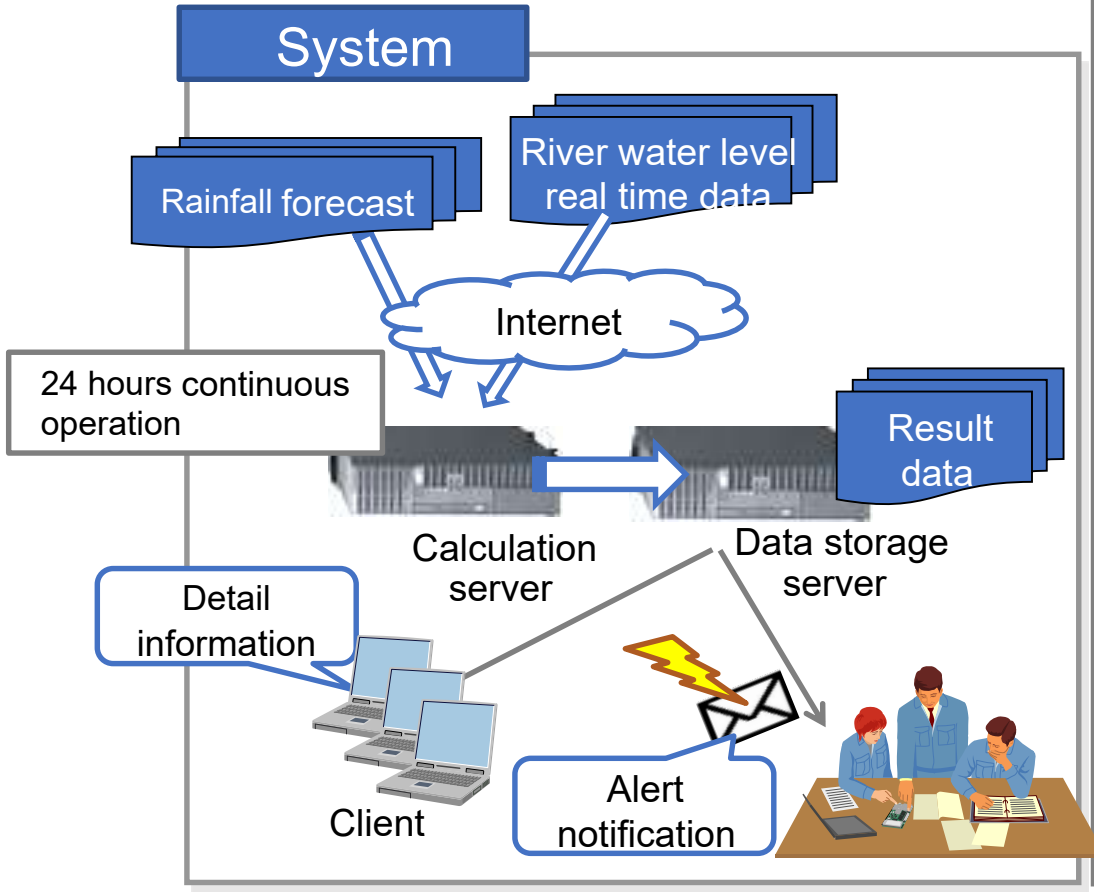
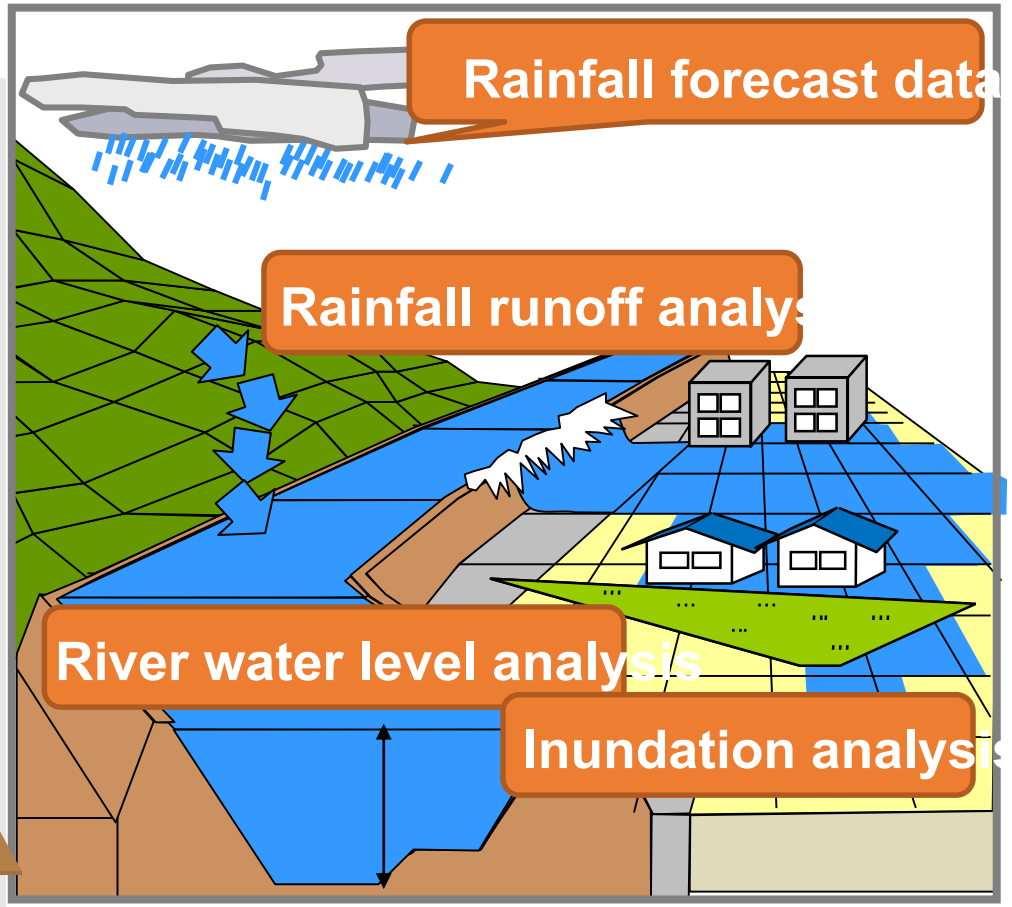
Enterprise

- Forecasts river water level and flooded area based on forecasted rainfall
- Updates the forecast regularly
- Early notification of inundation risk/possibility
  - Support decision of staff scheduling, evacuation advisory, etc.





Features of professional edition

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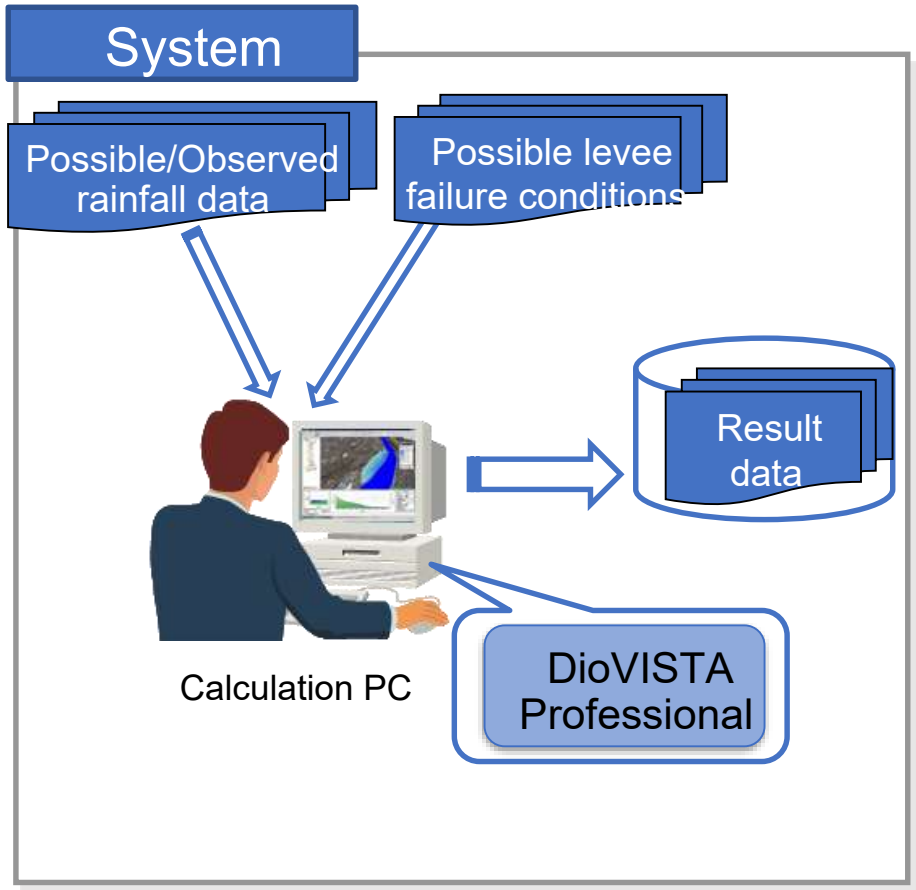
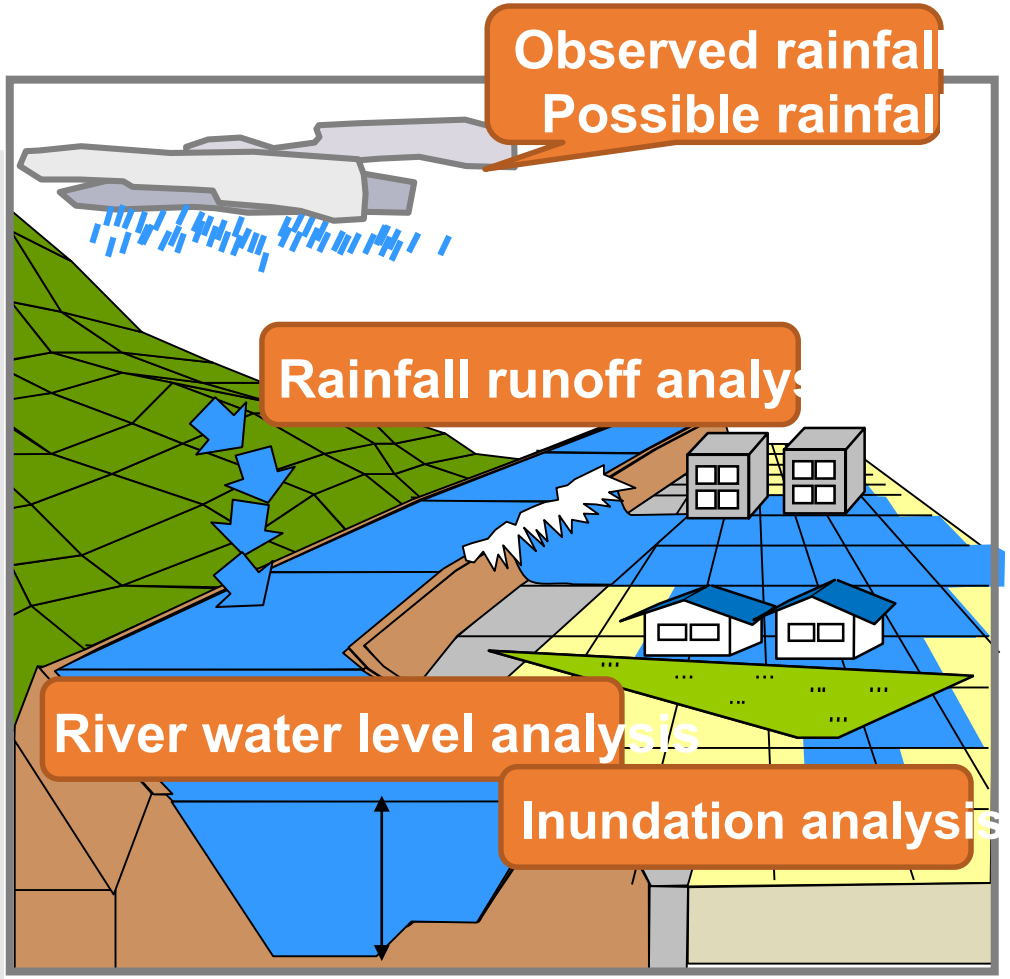
Professional• Predicts of river water level and flooded area based on possible rainfall

- Analysis of previous flood damage
- Preparation of flood damage risk curve





Features of standard edition

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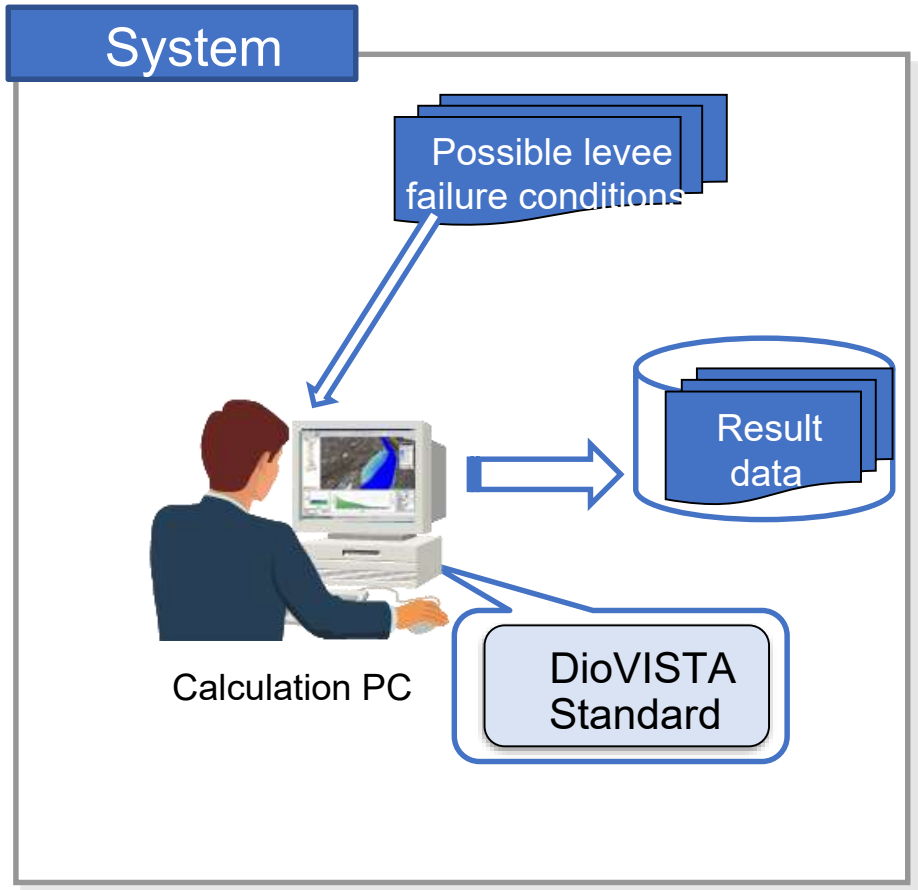
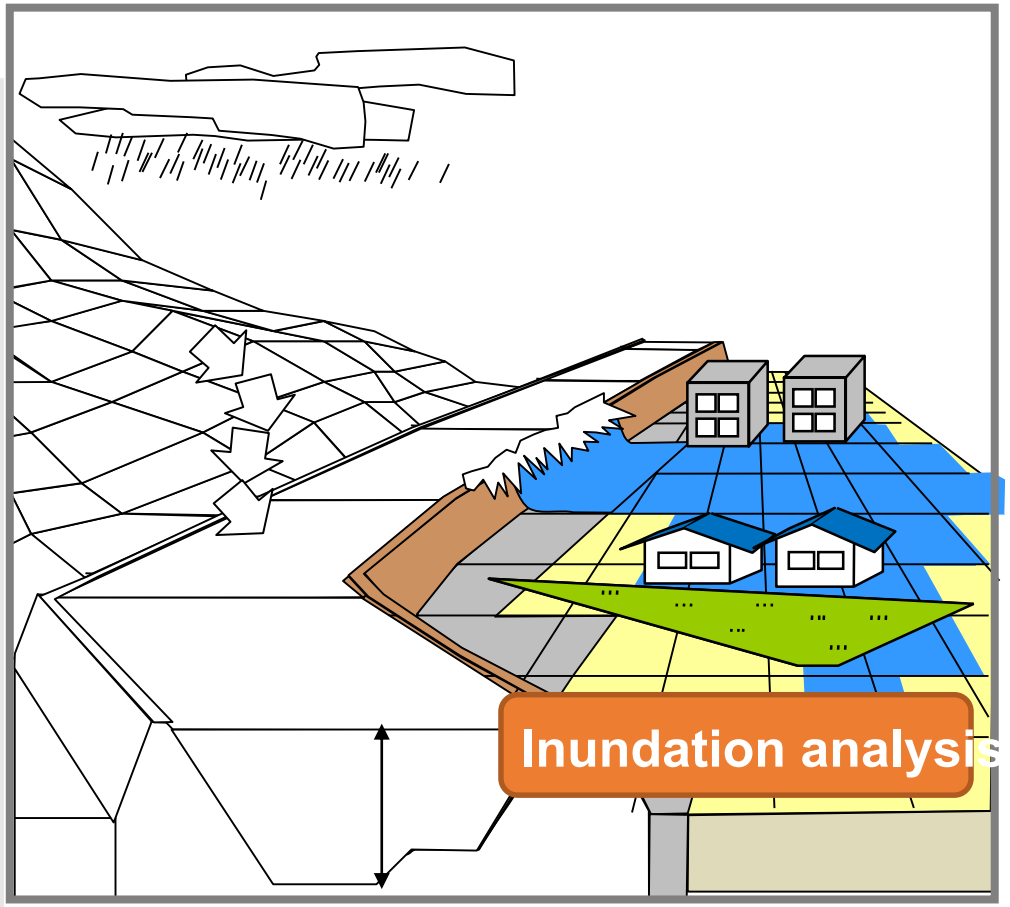
Standard

- Predicts flooded area based on possible levee failure
  - Easy operation for flood-specific analysis
  - Quick risk estimation of certain site
  - Report preparation for disaster prevention planning





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Summary

DioVISTA/Flood aims to protect people and properties from flood damage in anywhere on the earth.

DioVISTA/Flood provides fast, accurate and advanced simulations with easy operations.

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Appendix: Case 1: Simulation of Tone river

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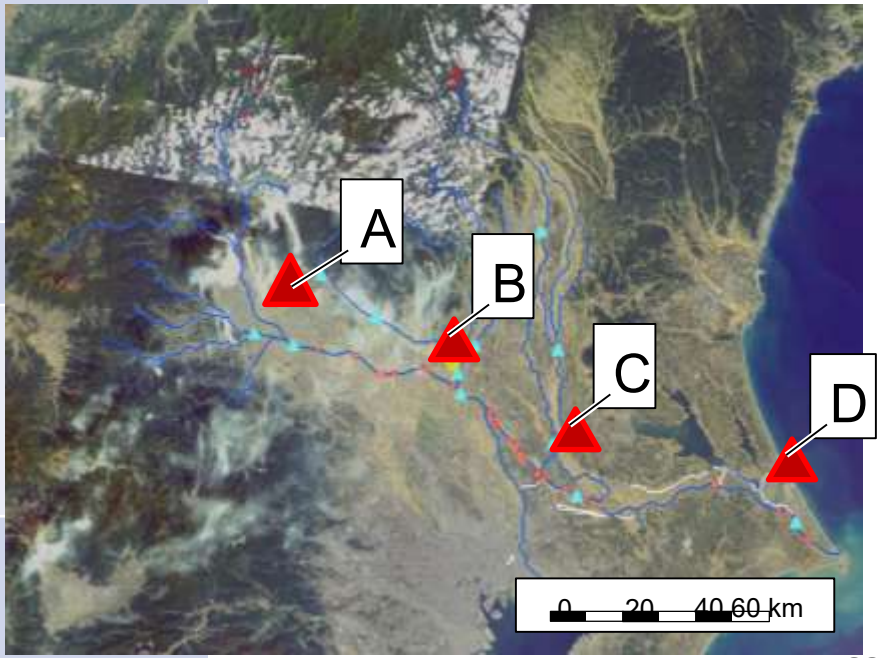
Tone river: The largest river basin in Japan, the second longest in Japan, contains large number of reservoirs, detention ponds, tributaries, drainage canals, etc. This complexity prevents Tone river from being simulated.

Target	Tone river
Runoff model	Catchment area: 16,840km2 Distributed model, cell size: 100m
River model	1 mainstream, 20 tributaries, 2 floodways Using measured cross sections 1D model, cell size: 50m
Inundation model	2D model, cell size: 50m
Detention pond model	2 ponds
Input conditions	Precipitation: radar, 1km, 30min Reservoir discharge: hourly Estuary tide level: hourly
Validation	Comparison with observed water level at 10 stations during Typhoon Fitow (2007)



Yamaguchi et al., Development of Large-Scale Water Disaster Simulation System for Non-life Insurance Field , Japan Society of Civil Engineers, 2012.

Simulation in Tone river – result 1

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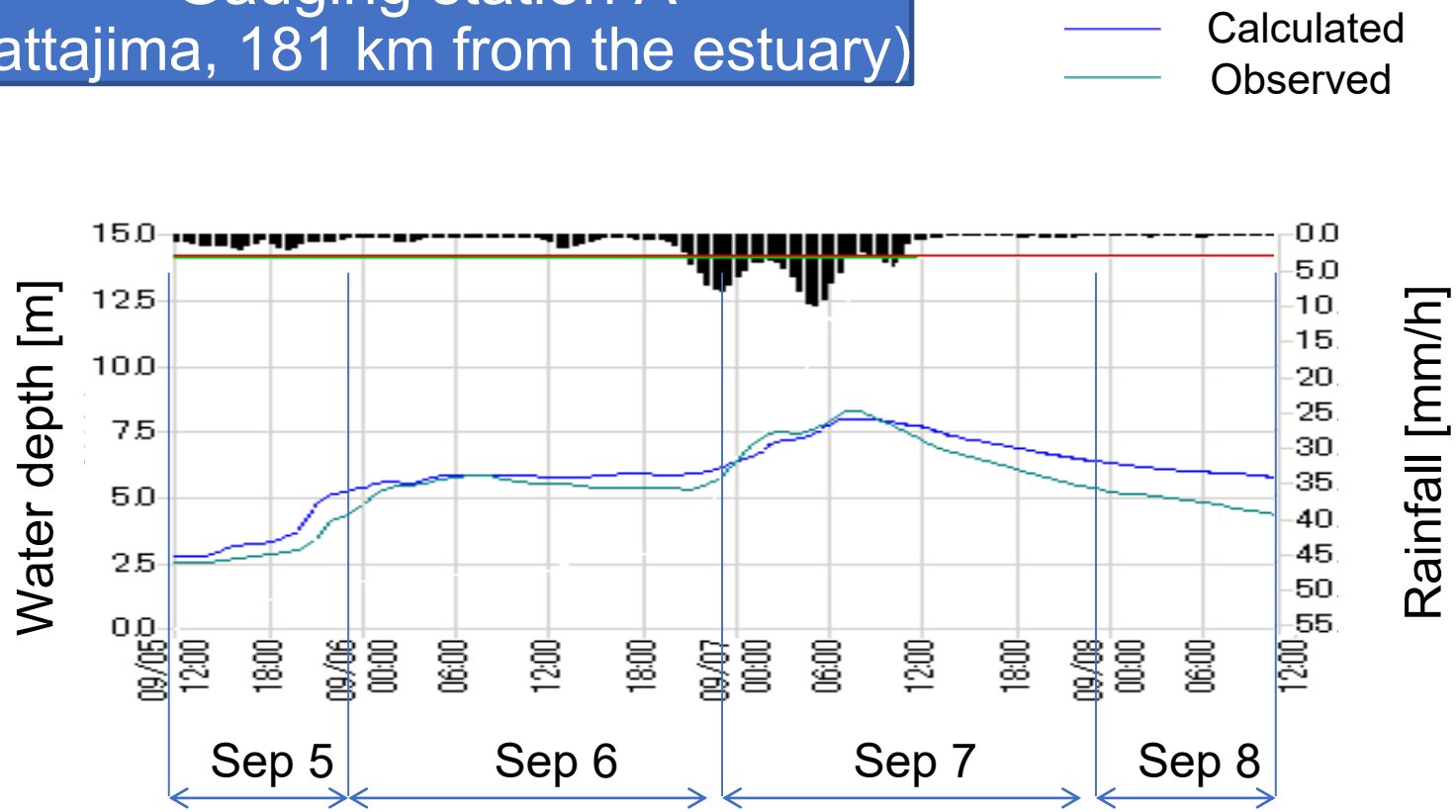
Simulation of high-water during Typhoon Fitow (2007)

Gauging station A
(Yattajima, 181 km from the estuary)



Source of observed data: Water water DB http://www1.river.go.jp/

Simulation in Tone river – result 2

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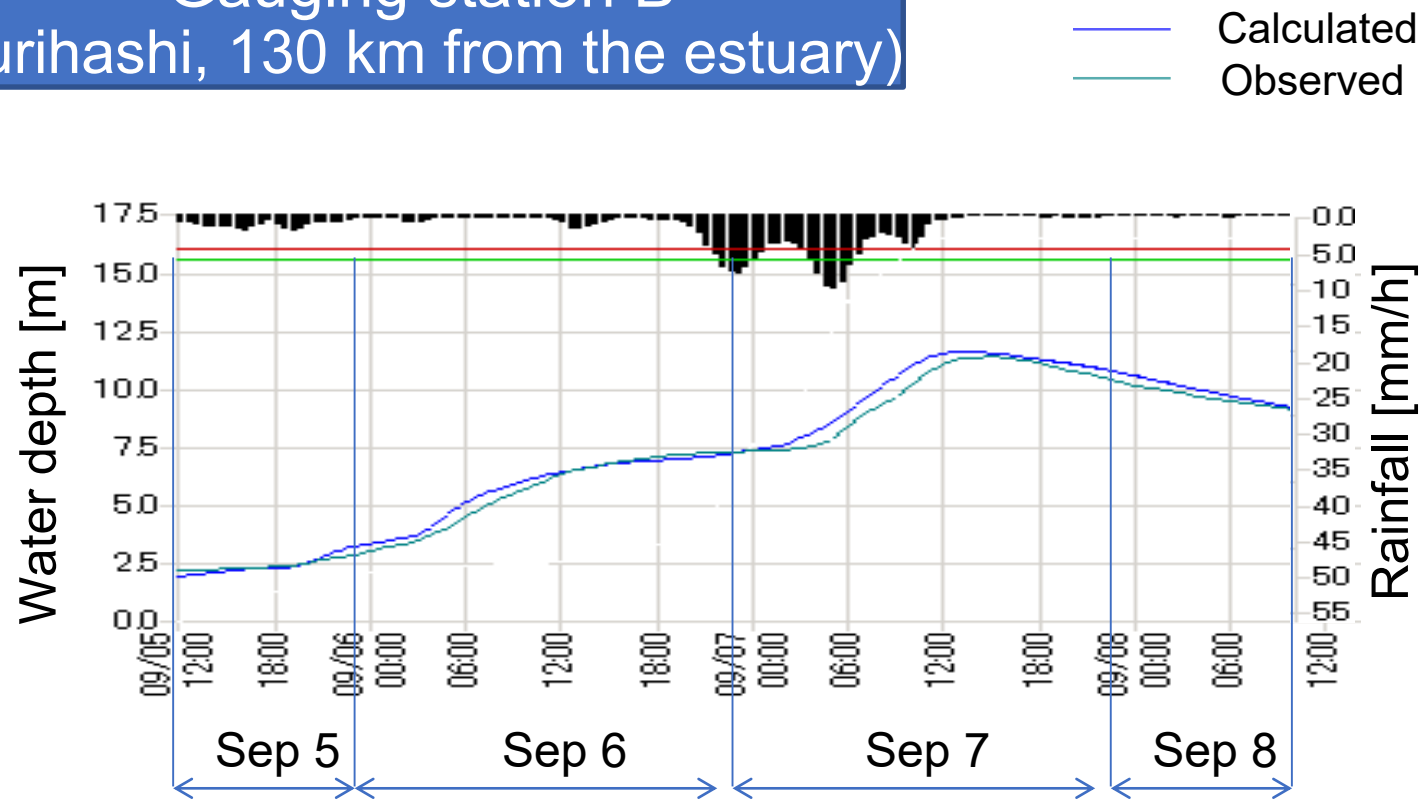
Simulation of high-water during Typhoon Fitow (2007)

Gauging station B
(Kurihashi, 130 km from the estuary)



Source of observed data: Water water DB http://www1.river.go.jp/

Simulation in Tone river – result 3

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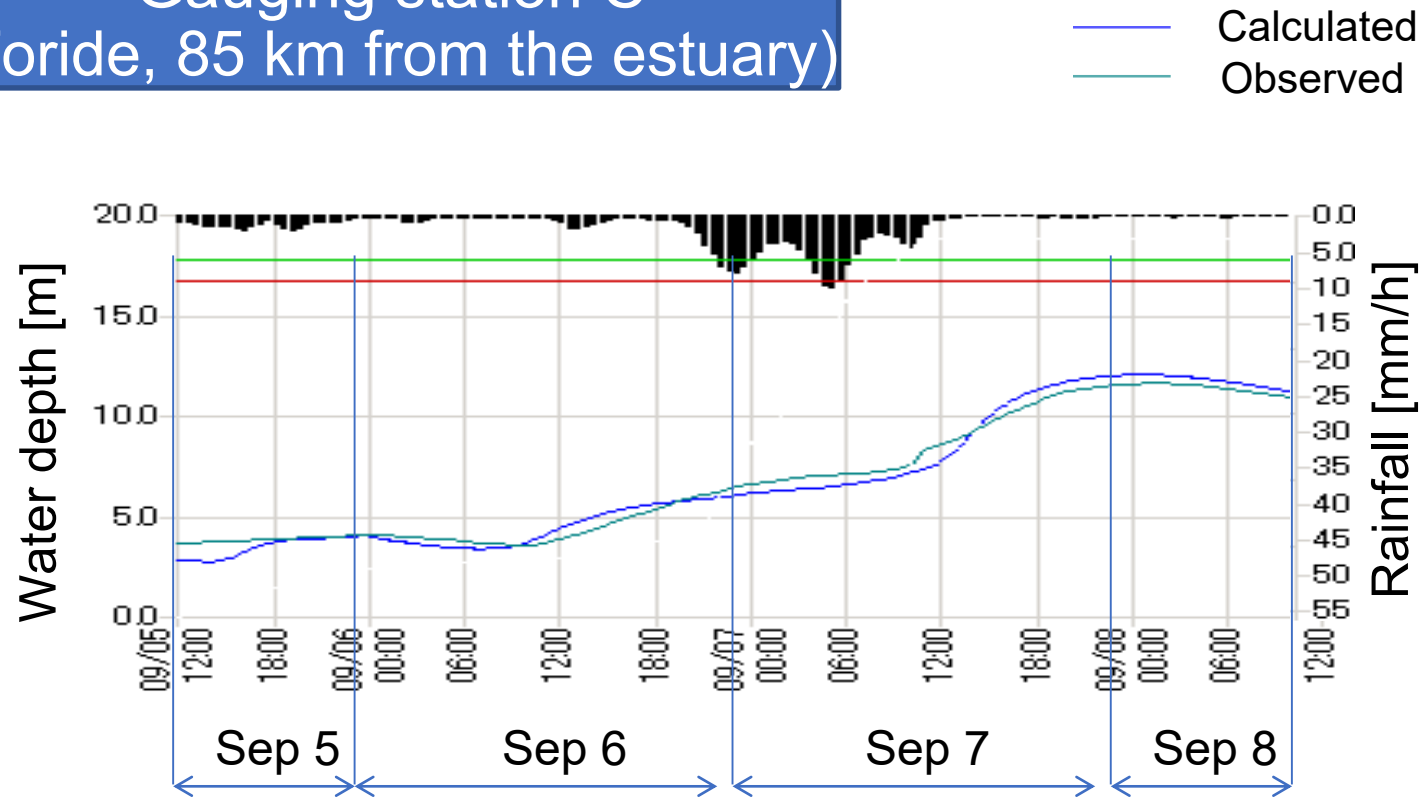
Simulation of high-water during Typhoon Fitow (2007)

Gauging station C
(Toride, 85 km from the estuary)



Source of observed data: Water water DB http://www1.river.go.jp/

Simulation in Tone river – result 4

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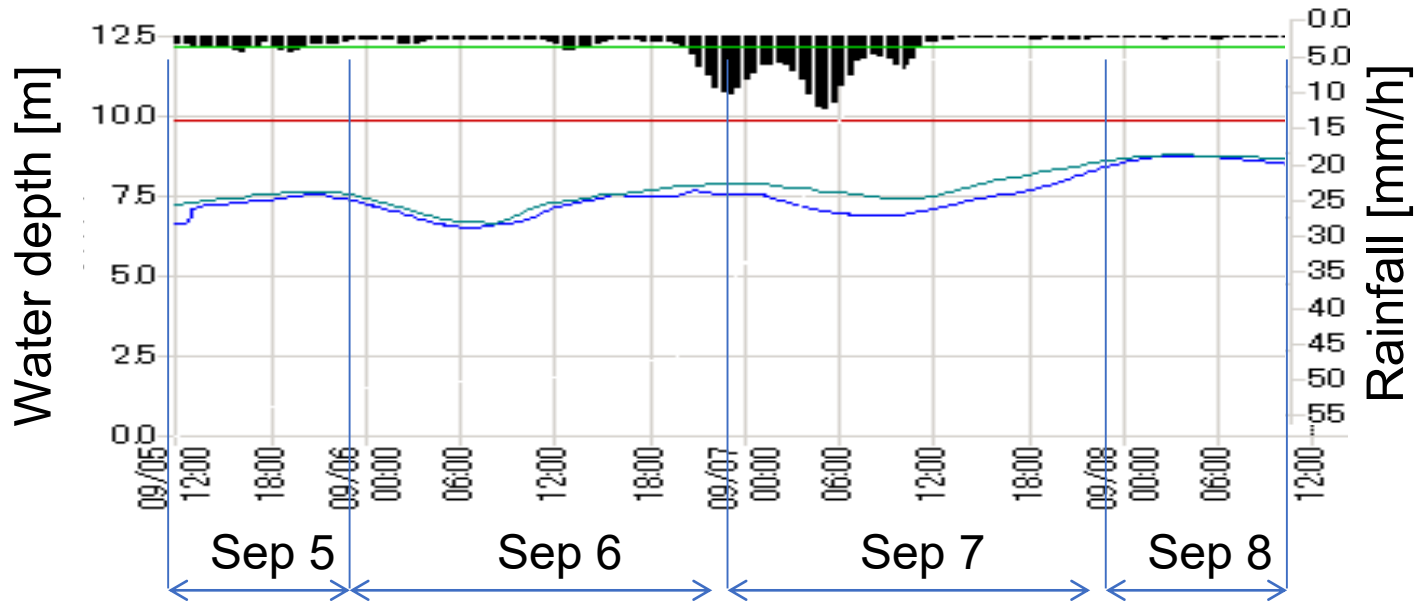
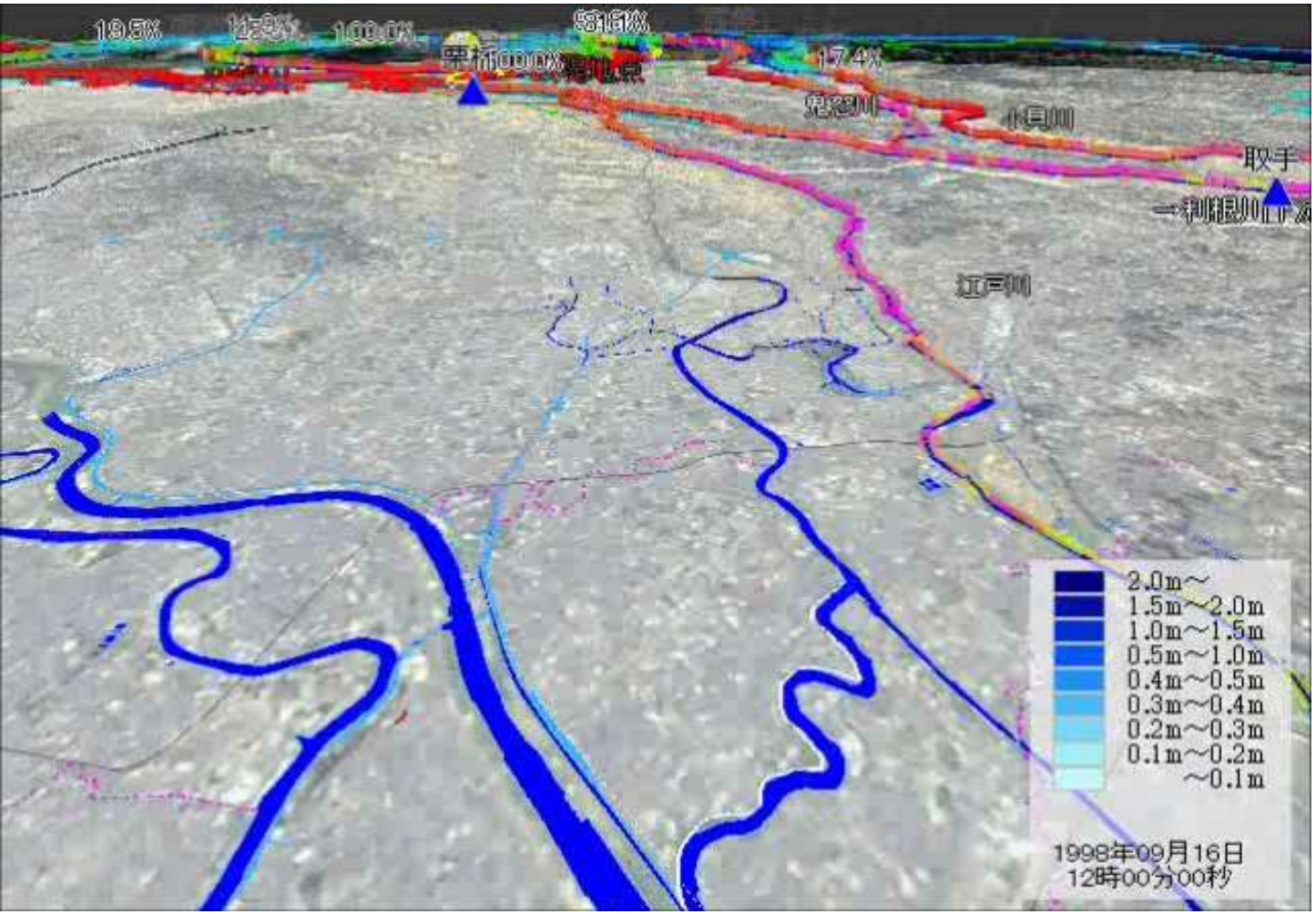
Simulation of high-water during Typhoon Fitow (2007)

Gauging station D
(Otanitta, 10 km from the estuary)



Source of observed data: Water water DB http://www1.river.go.jp/

Simulation in Tone river – result 5



Produced by video output function of DioVISTA

Large scale flood in Tokyo assuming heavy rainfall (return period: 200 years) and levee failure in Saitama Pref.. Simulated by the Tone river model.

Appendix: Case 1: Simulation of Yodo river

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Target river	Yodo river Catchment area: 4,392 km2 (excluding Lake Biwa basin) 1 mainstream, 28 tributaries, 7 dams

Runoff model
Distributed、100m

↓

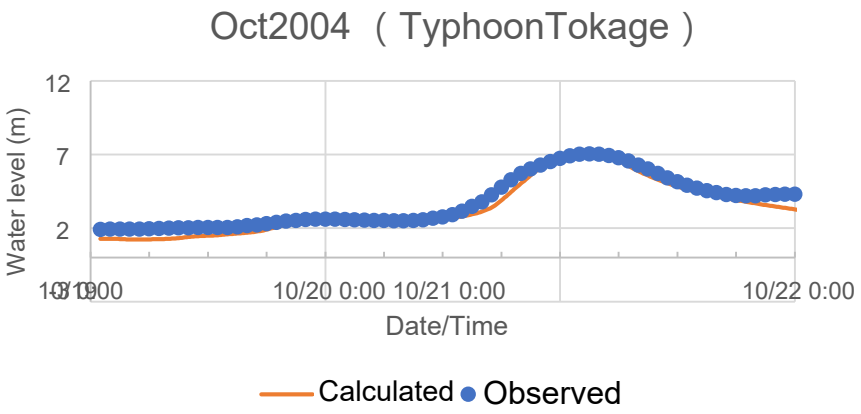
River model
1D unsteady, 50 m

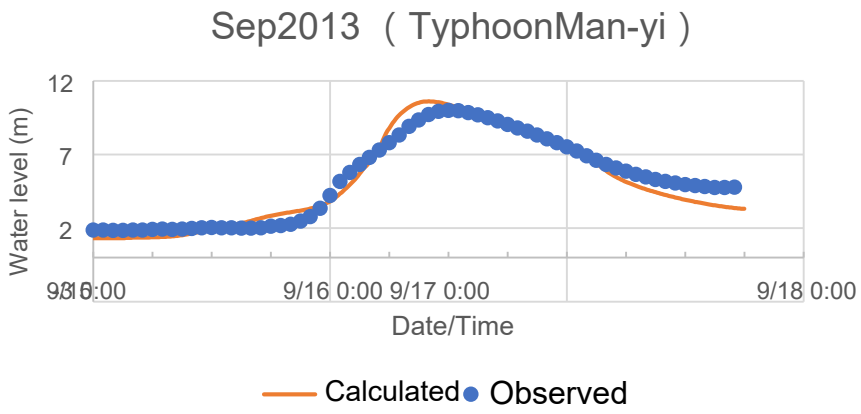
↕

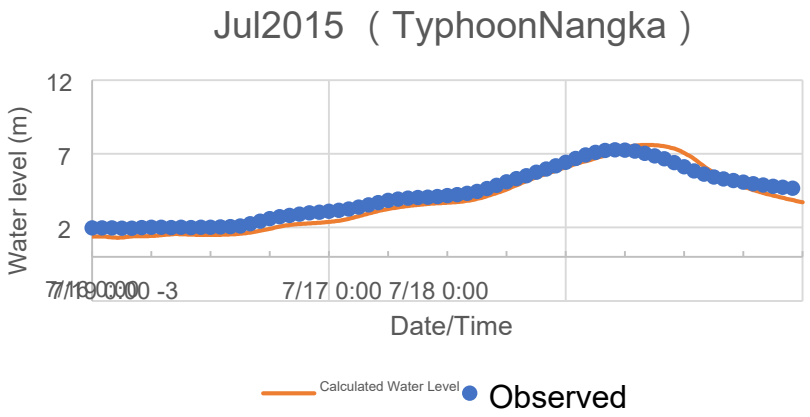
Inundation model
2D unsteady, 25m

Yamaguchi · Kusuda, Speeding up flood analysis by cloud computing , Japan Society of Civil Engineers, 2017.

Validation of Simulation







Compare observed and simulated water level at Hirakata Gauging station.

Source of observed data: Hydrological Water Quality Database http://www1.river.go.jp/