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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	建設コンサルタント分野におけるDioVISTAの活用
11:00 -	2	ダム分野におけるDam Dashboardの活用
13:00 -	3	損害保険分野におけるDioVISTAの活用
14:00 -	4	防災行政分野におけるDioVISTAの活用
15:00 -	5	企業防災分野にむけた水害対策BCP支援のご提案
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

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

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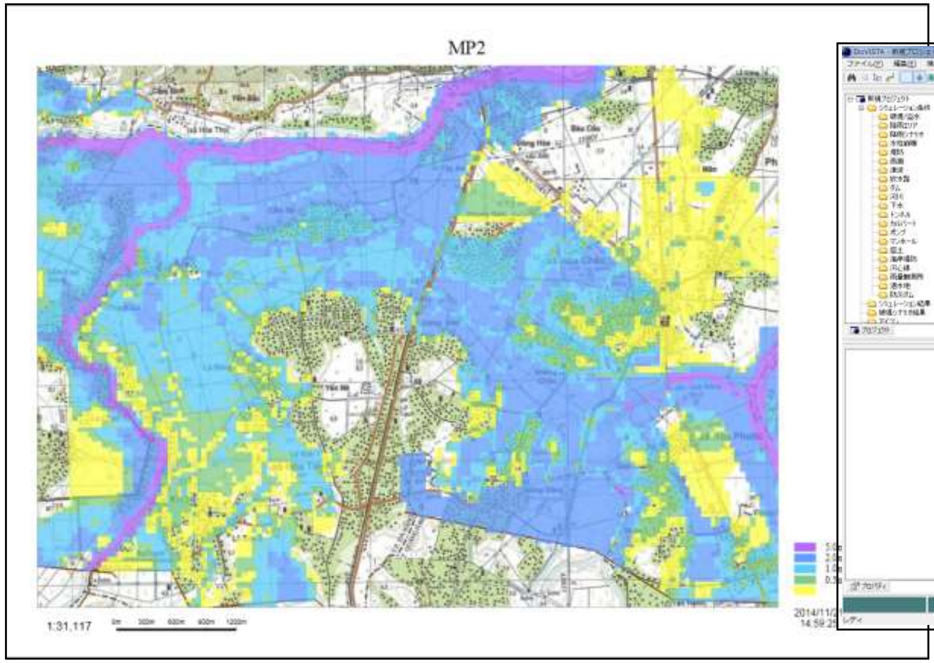
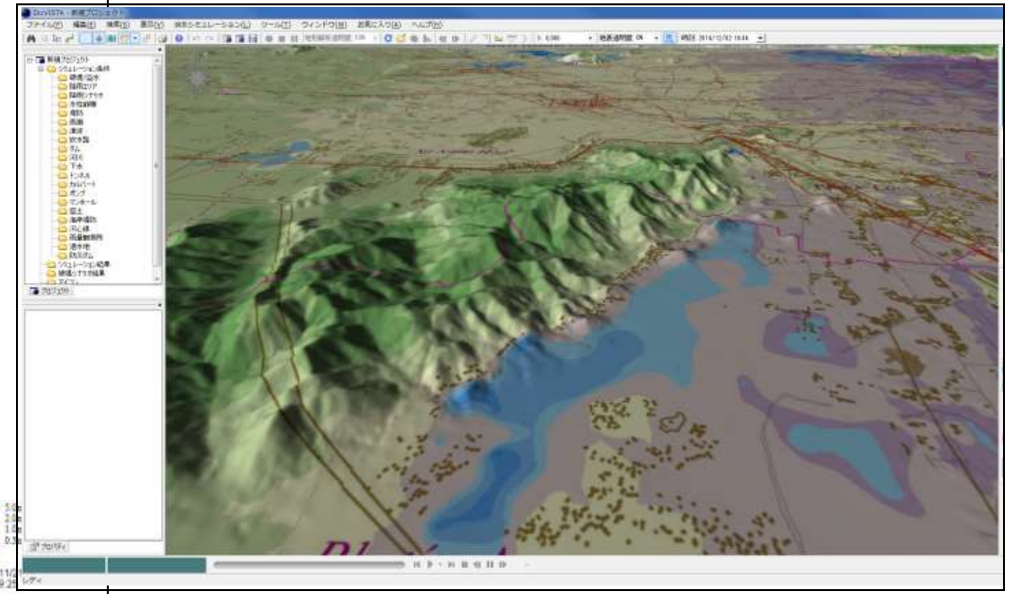
Use case in Vietnam

- 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

Scenes of Workshop Day 1 in Da Nang City

(a) Checking hydrological data	(b) Inputting data into DioVISTA
	
Disaster map Hydrological data book	DioVISTA in PC Hydrological data book

Use case in Vietnam

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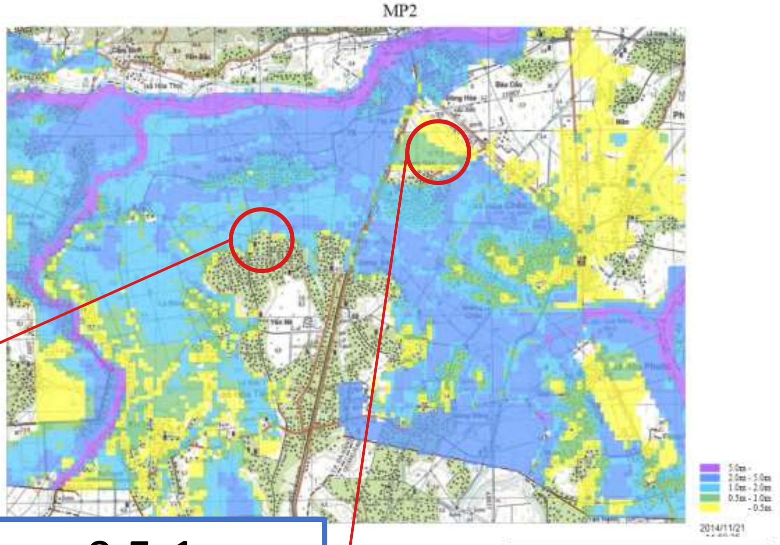
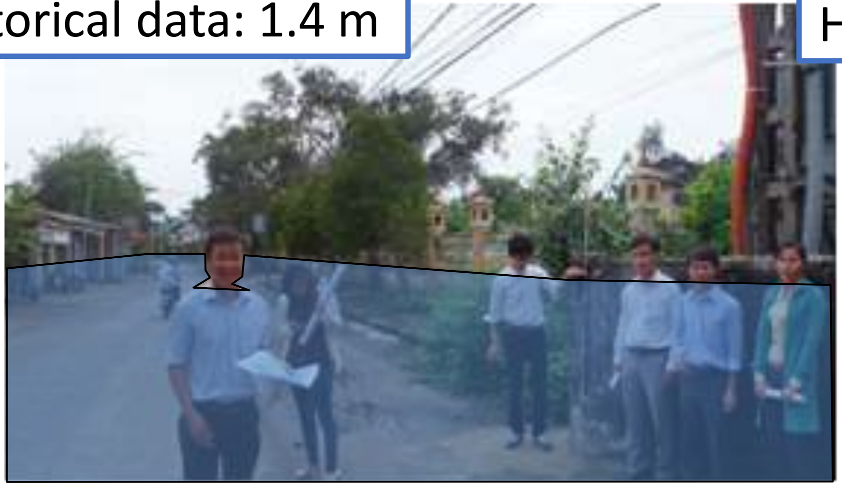
Scenes of Workshop Day 2 in Da Nang City

Validating hazard map by comparing historical flood level with simulated result



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

Outline

Functions of DioVISTA

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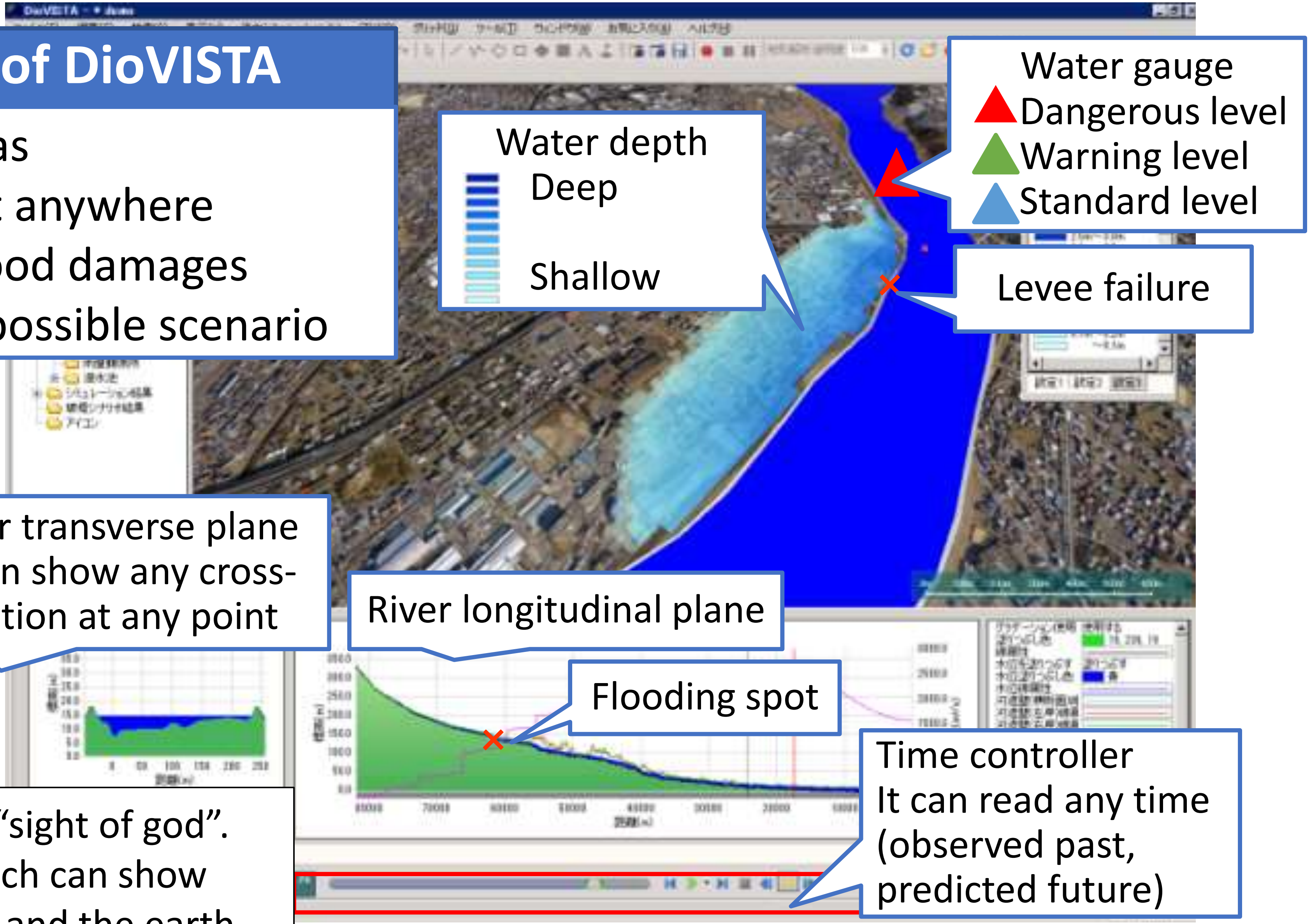
Main functions of DioVISTA

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 of god".
We aim to make a system which can show present, past, future of water and the earth .

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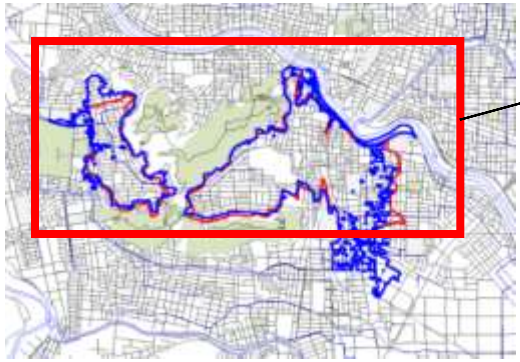
- Based on our original high-speed calculating method Dynamic DDM
  - Acquired patents in Japan, United States, and China

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

山口・岩村: 2004年足羽川洪水事例による氾濫シミュレーションの精度検証, 土木学会 次学術講演会, 2006.
Patent: JP:4761865, US:7603263, CN:PZL200610008661.4

Conventional method

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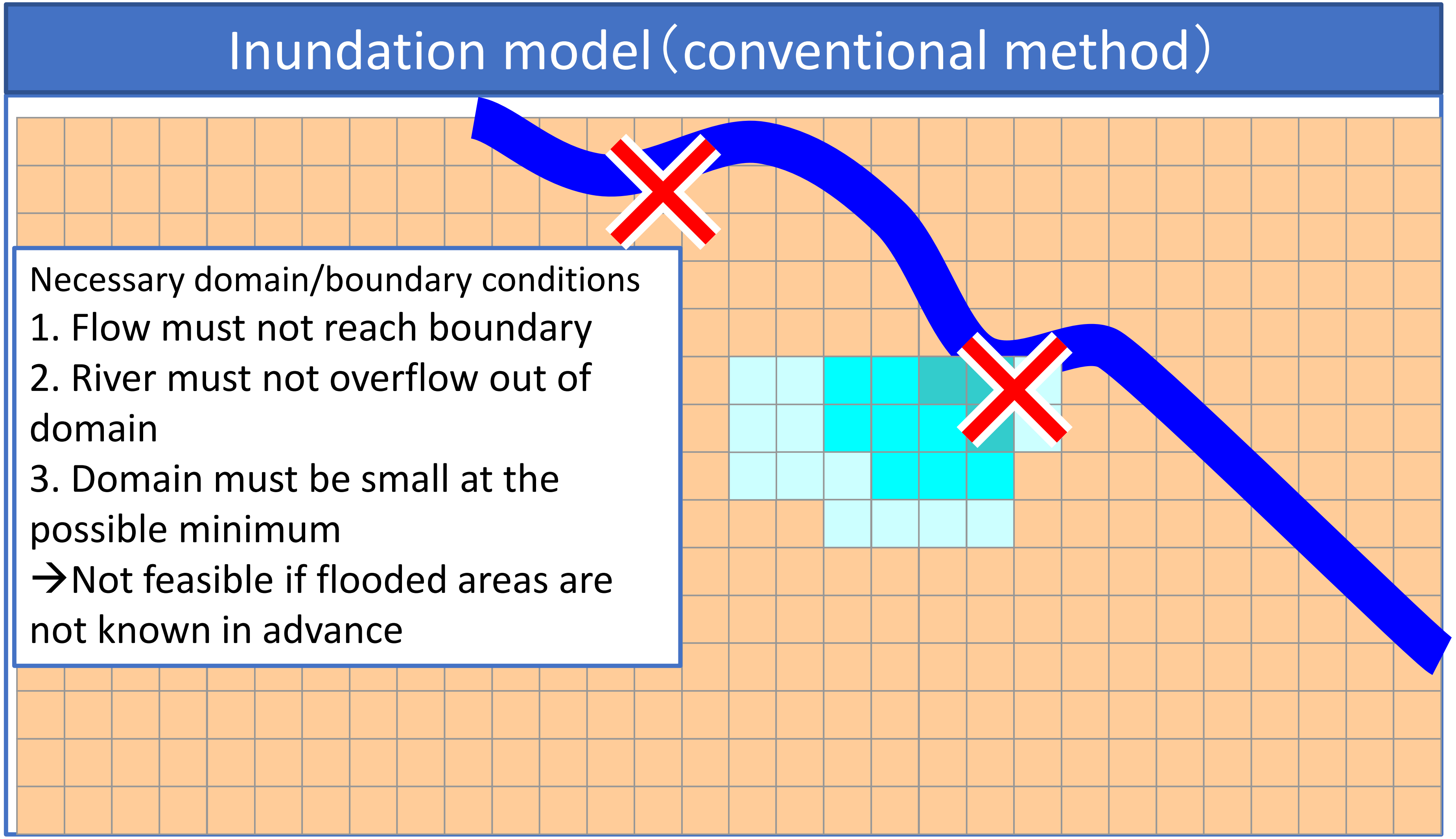
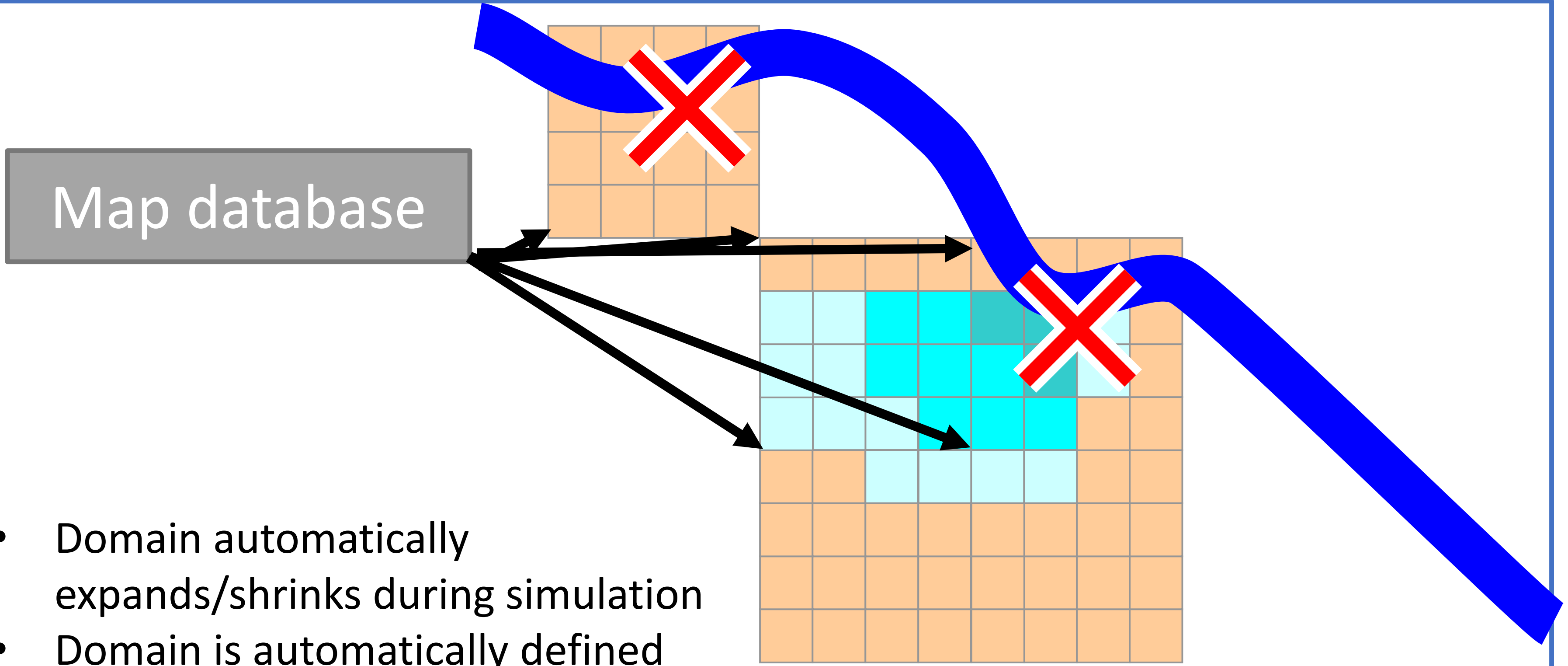


Our method

Dynamic DDM（our method, patented）



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

⇒ Runs fast

山口･岩村, Dynamic DDMによる氾濫シミュレーションの高速化, 情報処理学会論文誌数理モデル化と応用, 2007.

Characteristics of flood streams in city

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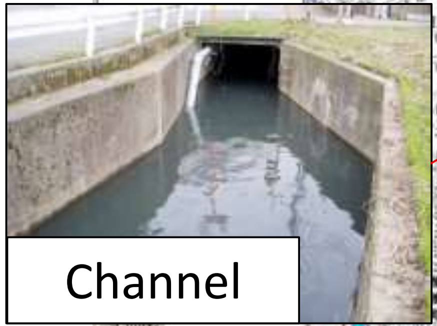

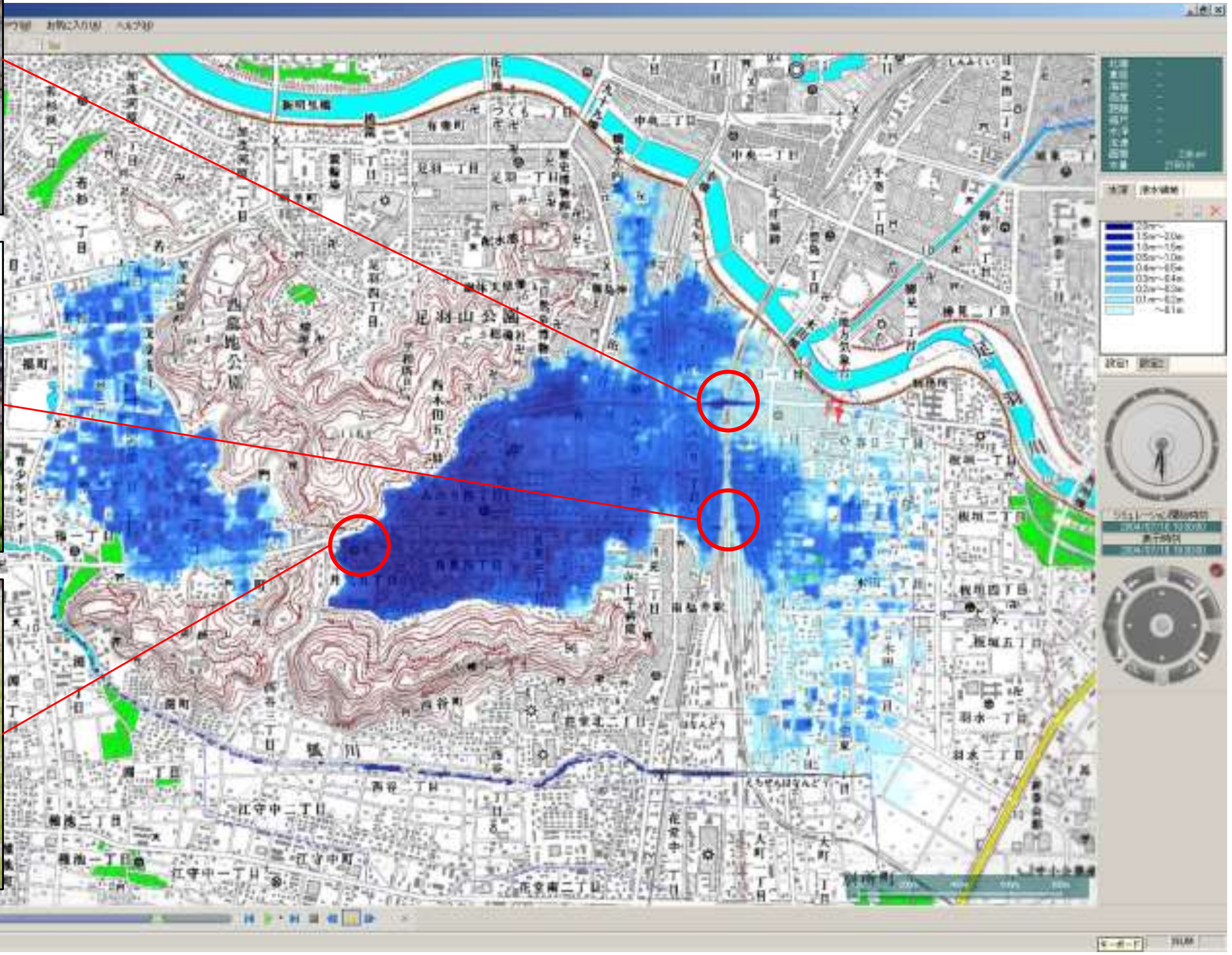

Current of water is affected by railway, road, underpass and etc..

Feature2:Advanced simulations with easy operations

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Setting sandbag wall

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

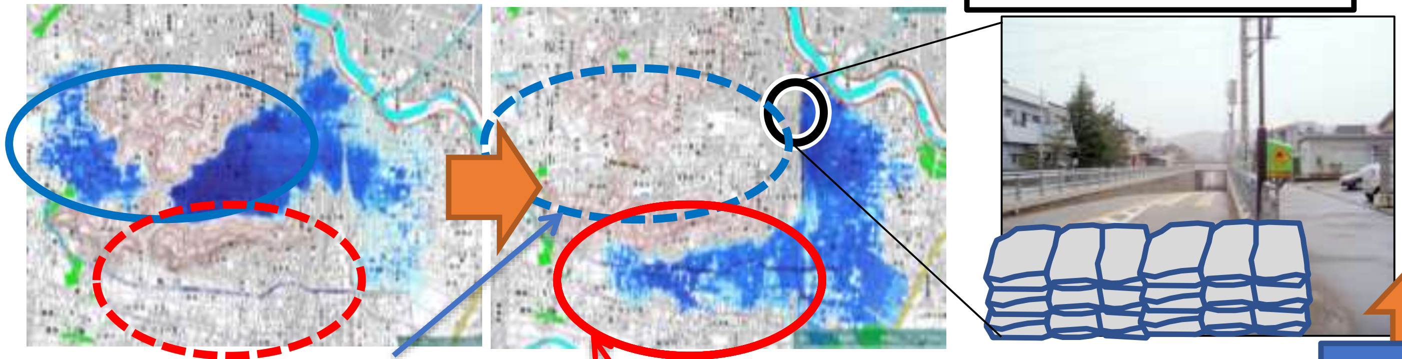
➔ Intuitive operation using map data

Operation plan 1

Before

After

Sandbag wall



Damage reduced area

Damage increased area

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

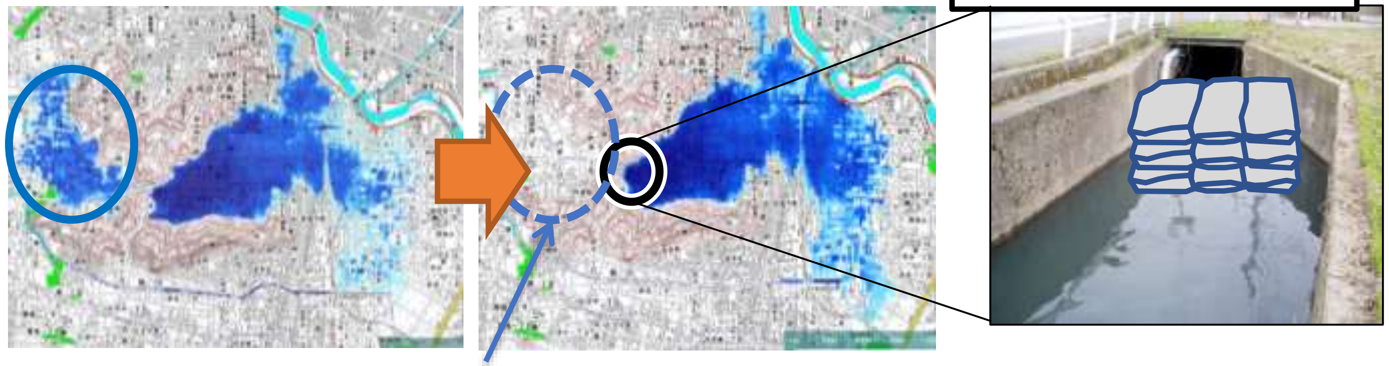
Find better operation

Operation plan 2

Before

After

Filled channel

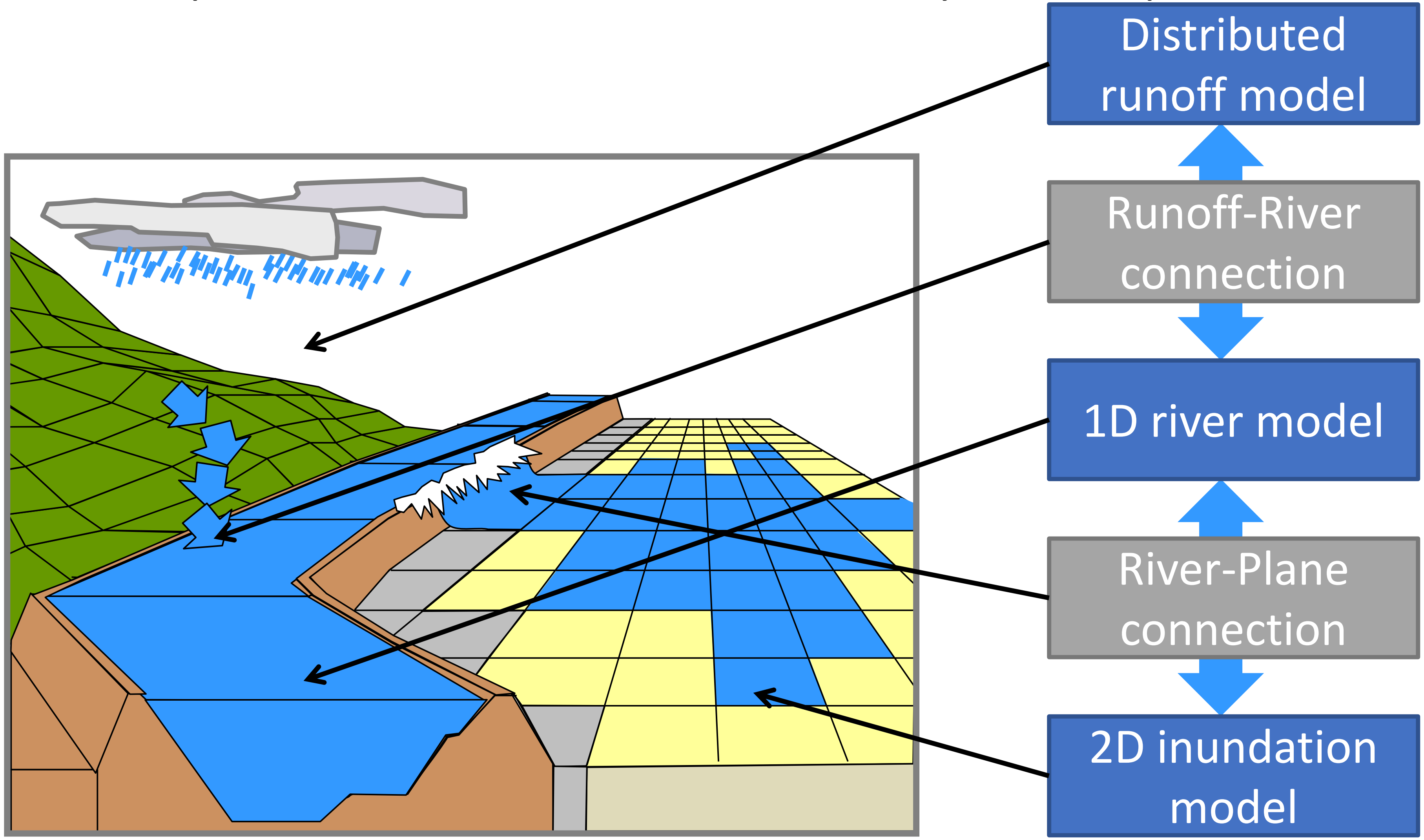


Damage reduced area

Damage is reduced in western area

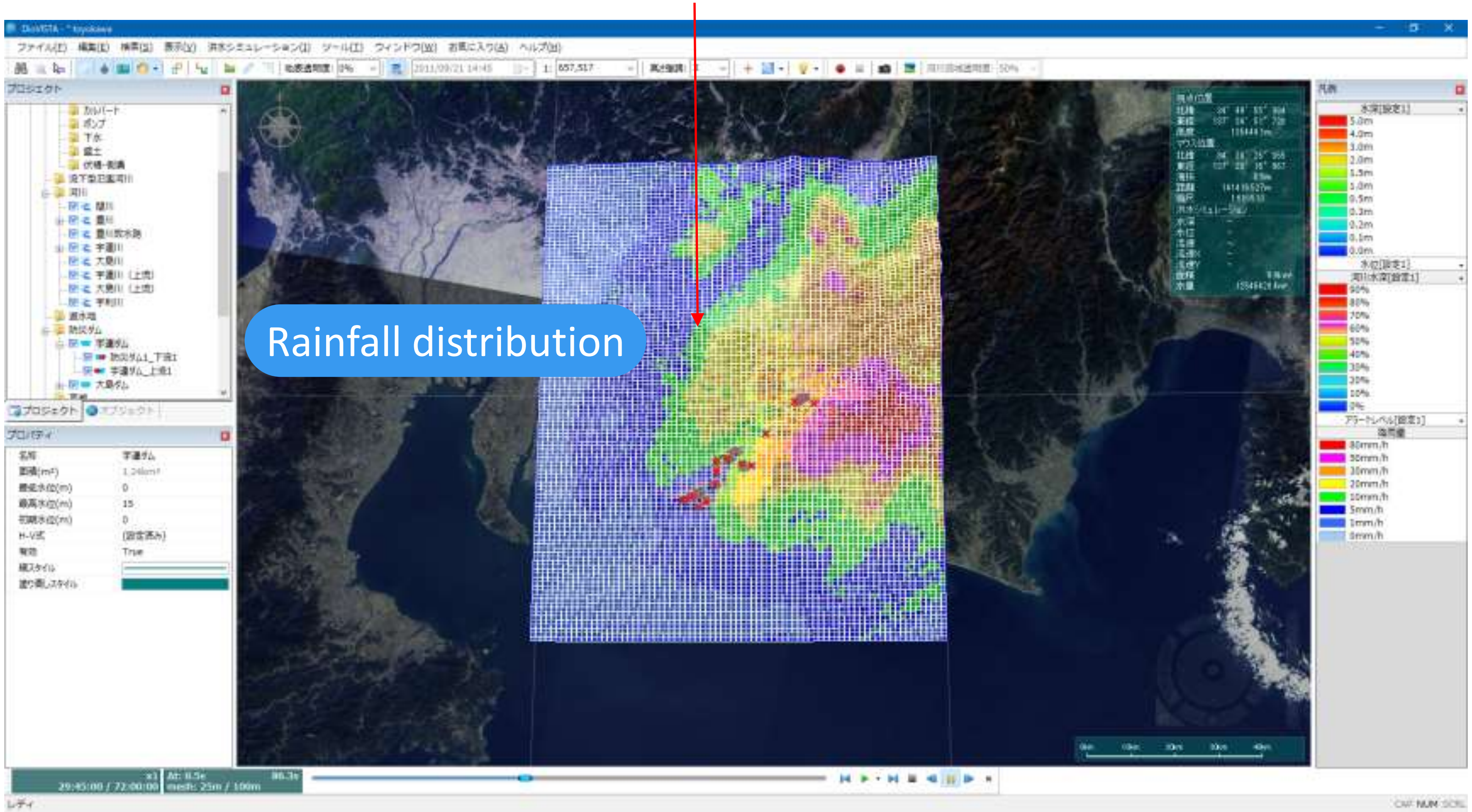
Feature3:Simulations with rainfall as input

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



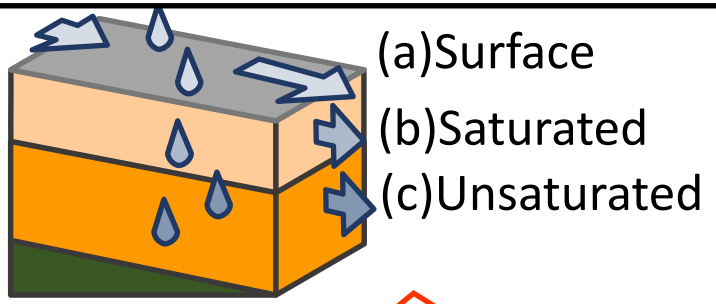
Input of rainfall distribution time series

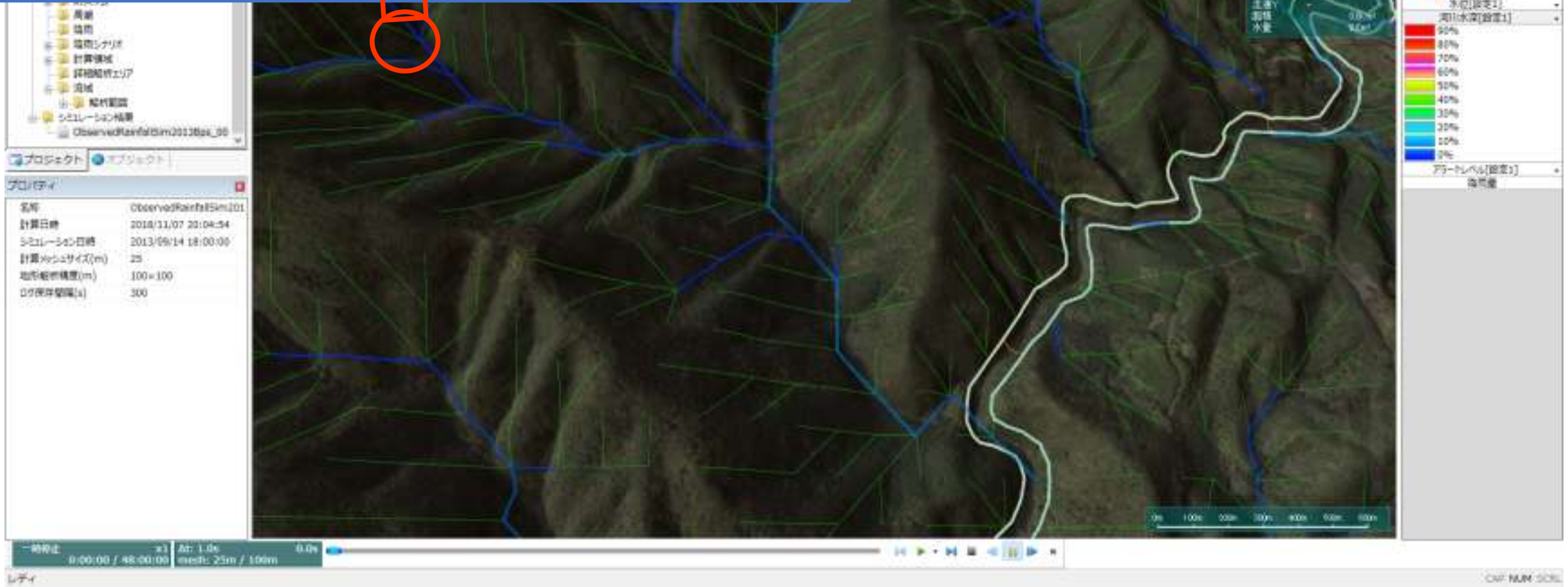
Input observed rainfall distribution（Color indicates rain intensity）



Runoff model

Analysis of rainwater permeation into soil

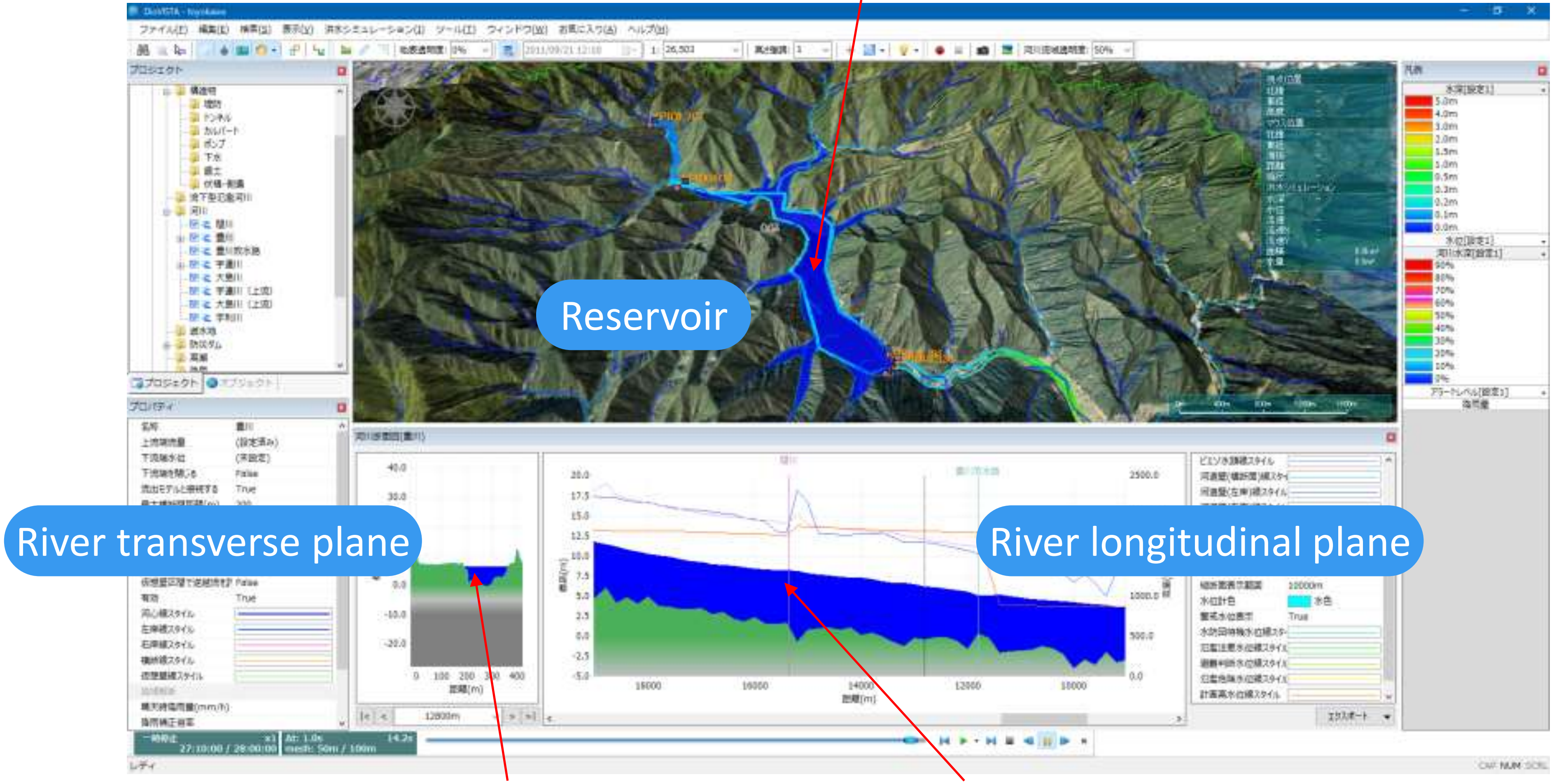




立川ら, 飽和・不飽和流れの機構を導入した流量流積関係式の開発, 水工学論文集, 2004.

Reservoir/River models

Reservoir（color changes from blue to red depending on the water level）



River transverse plane River longitudinal plane

Inundation model

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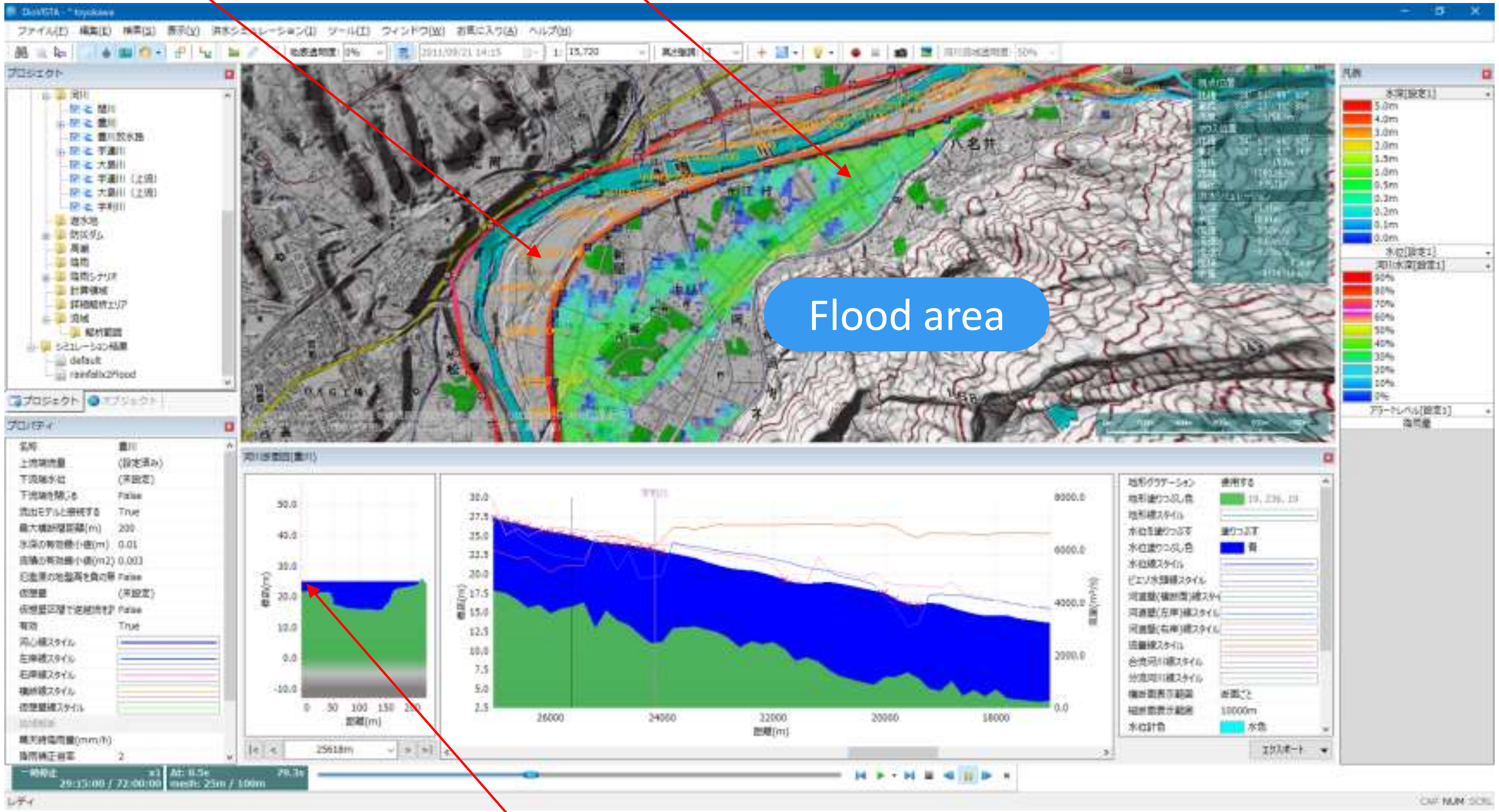
Downstream river

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

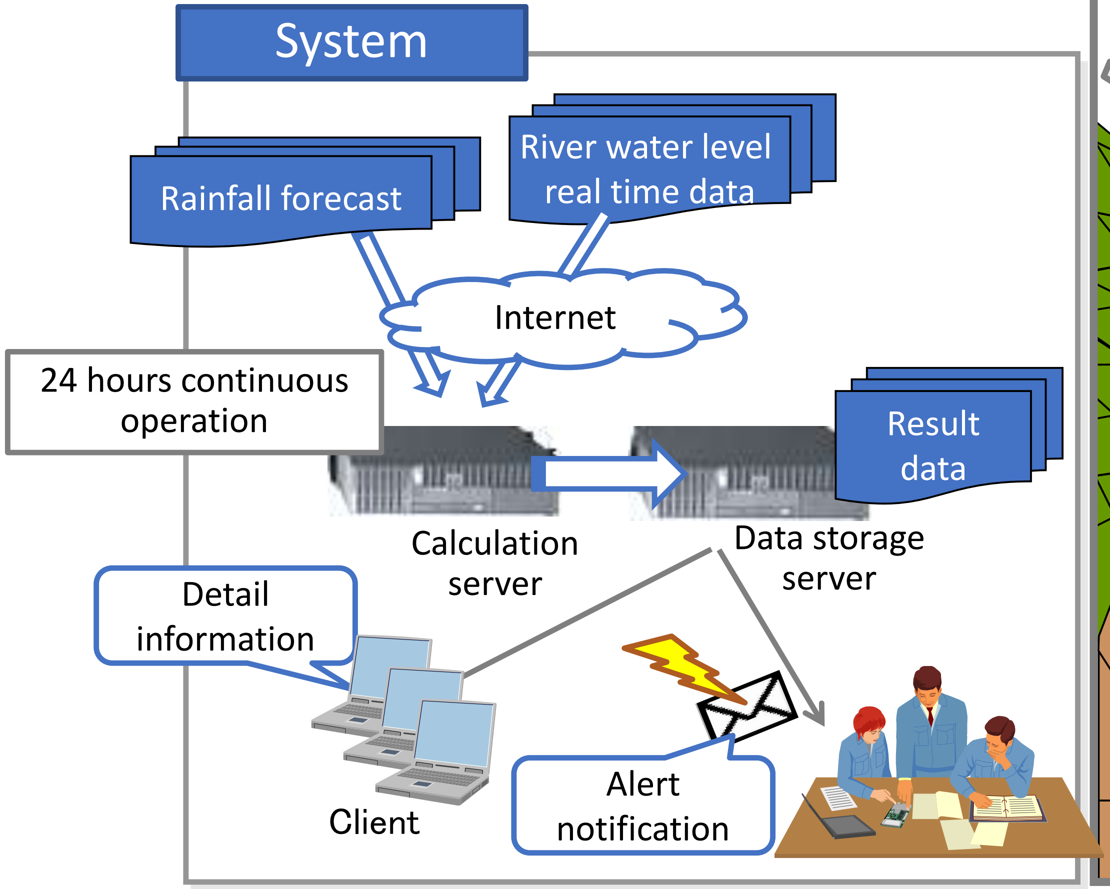
Services

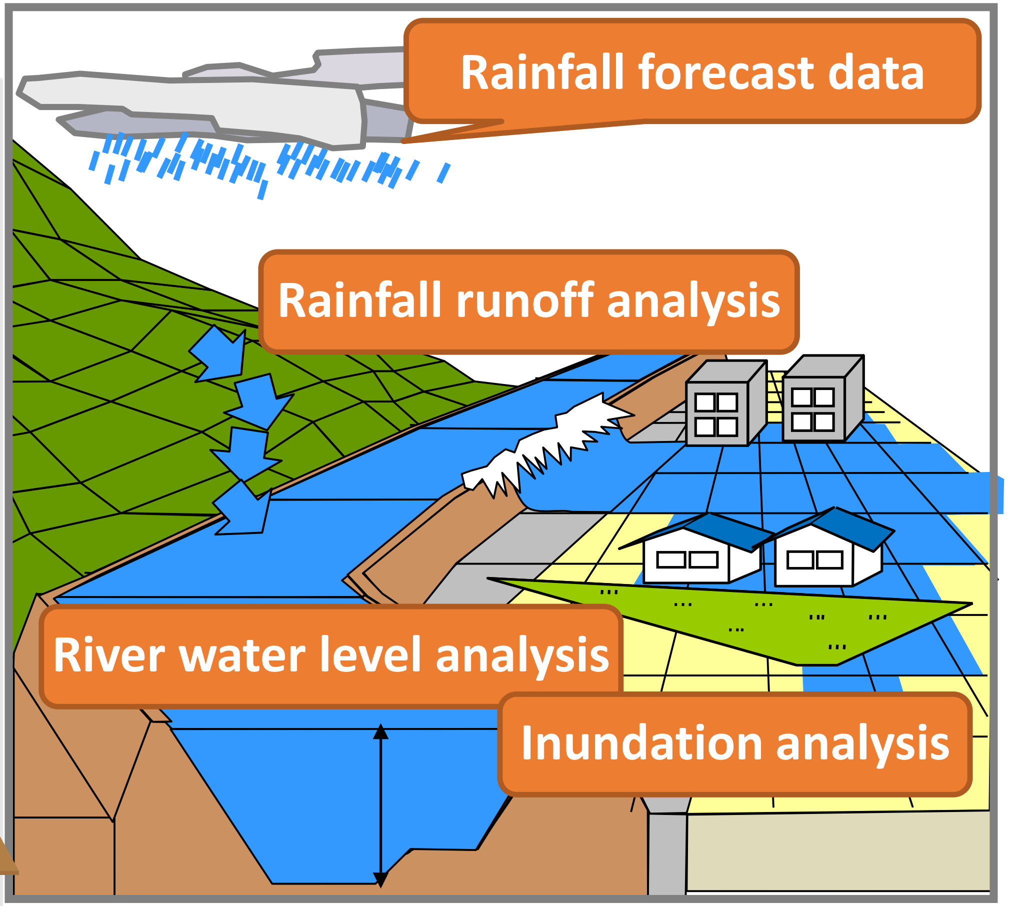
Service items	Contents	Current clients
Video making	• Flood damage simulation video for disaster prevention education	• Municipalities
Simulation and Report preparation	• Executing simulation based on possible scenario	• Insurance companies • Large plants, broadcasting stations • Construction consultancy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

Features of enterprise edition

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.

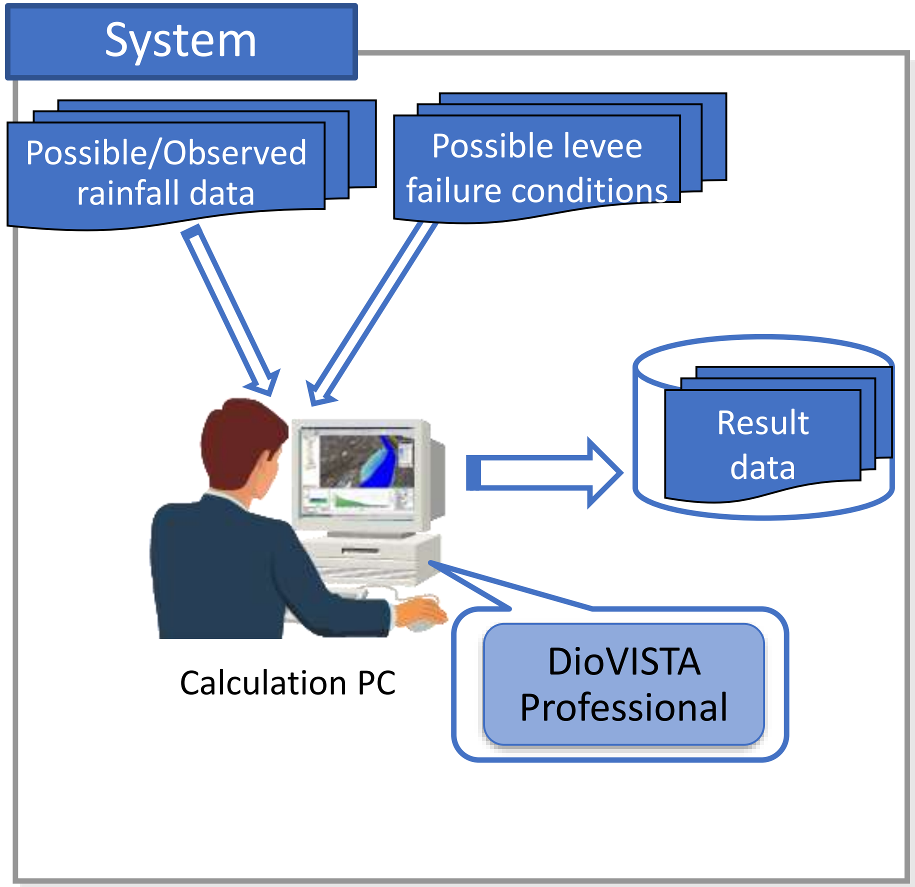


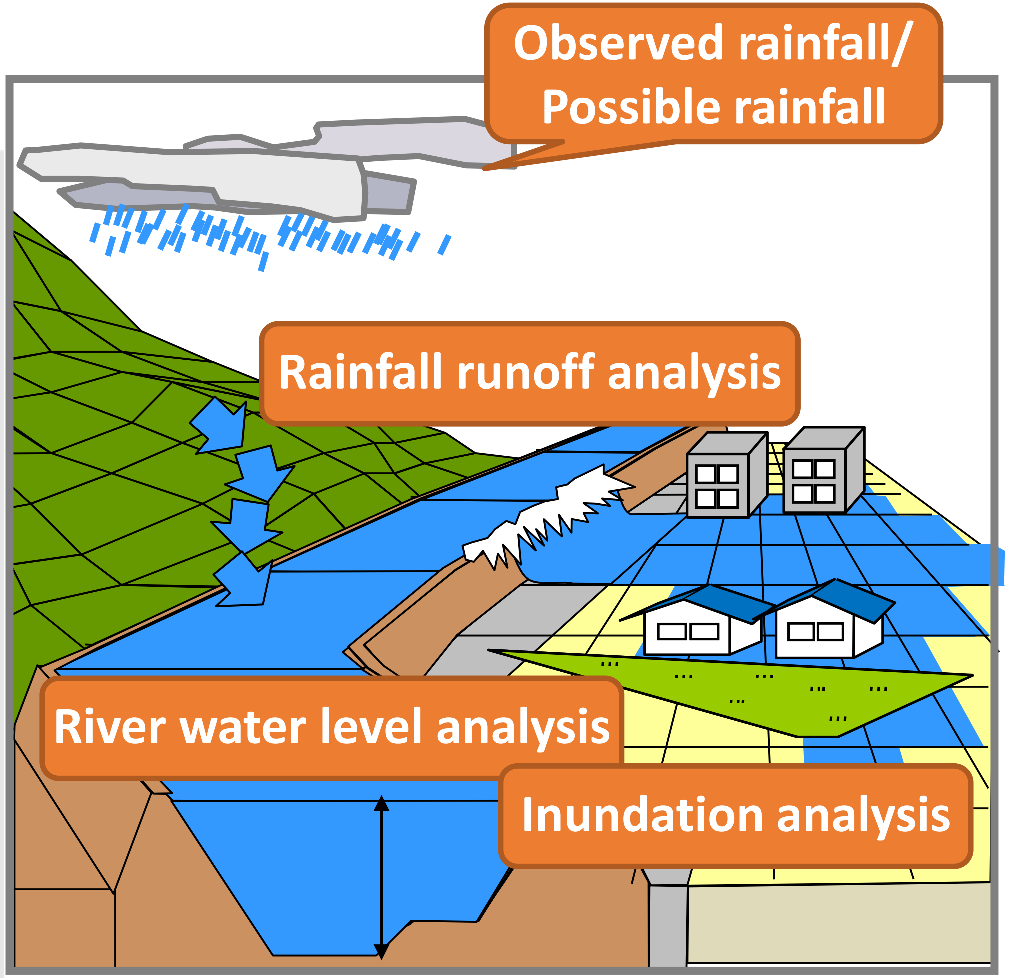


Features of professional edition

Professional

- Predicts of river water level and flooded area based on possible rainfall
  - Analysis of previous flood damage
  - Preparation of flood damage risk curve

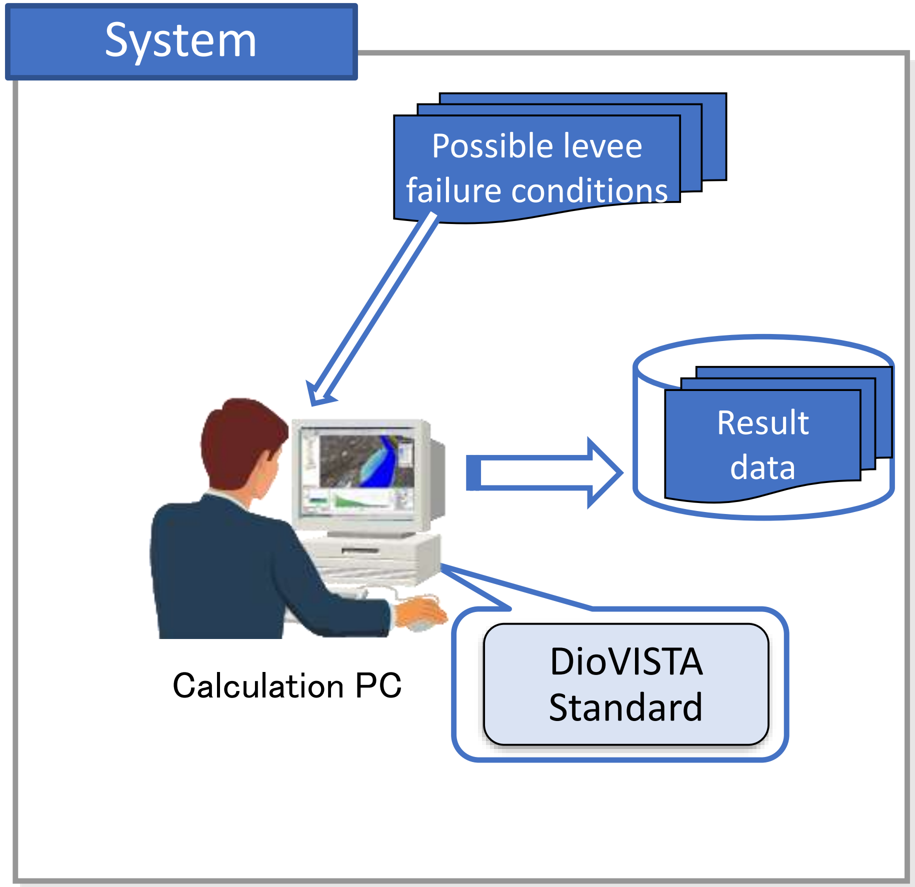


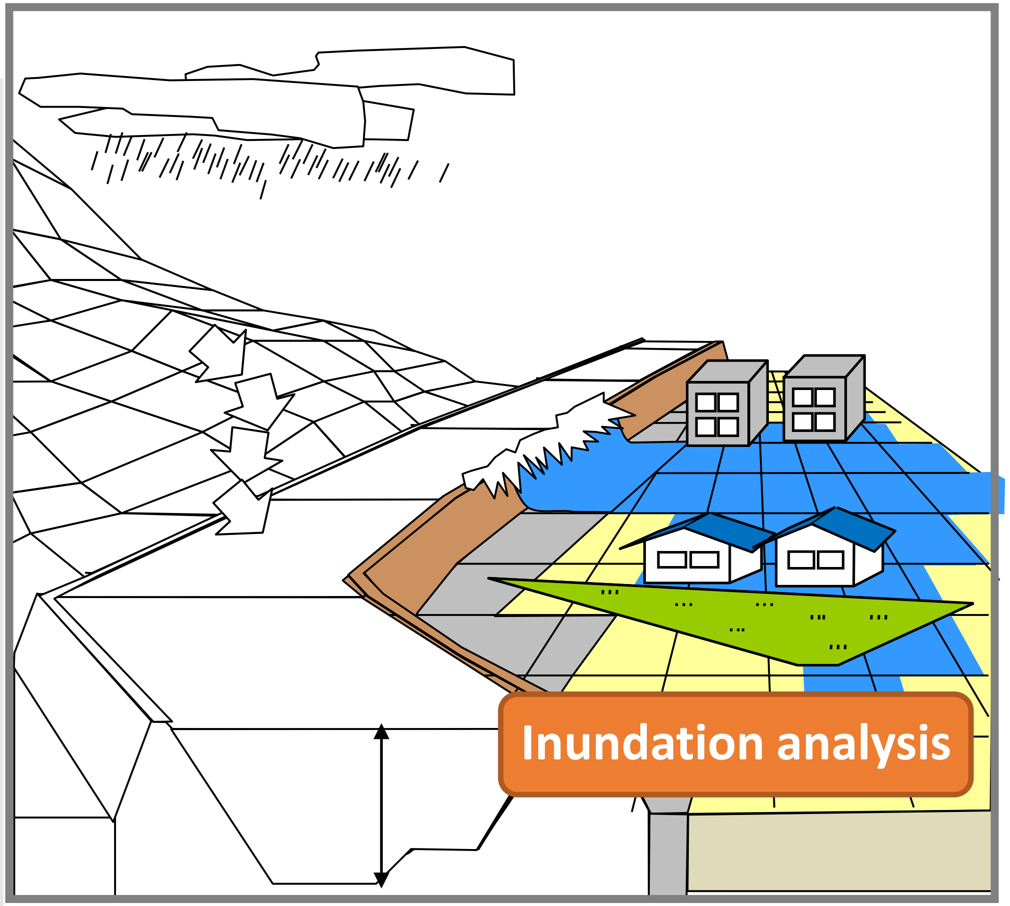


Features of standard edition

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





Outline

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

Summary

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

DioVISTA/Flood enables

fast, accurate and advanced simulations with easy operations.

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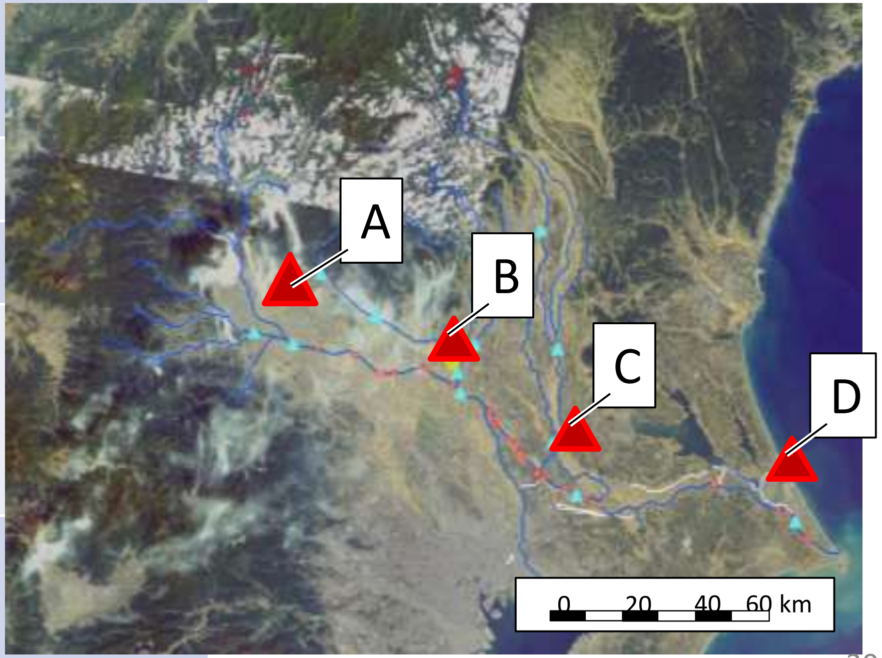
Appendix: Case 1: Simulation of Tone river

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: 16,840km^2 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)



山口ら, 損害保険分野のための大規模水災シミュレーションシステムの開発, 土木学会 次学術講演会, 2012.

Simulation in Tone river – result 1

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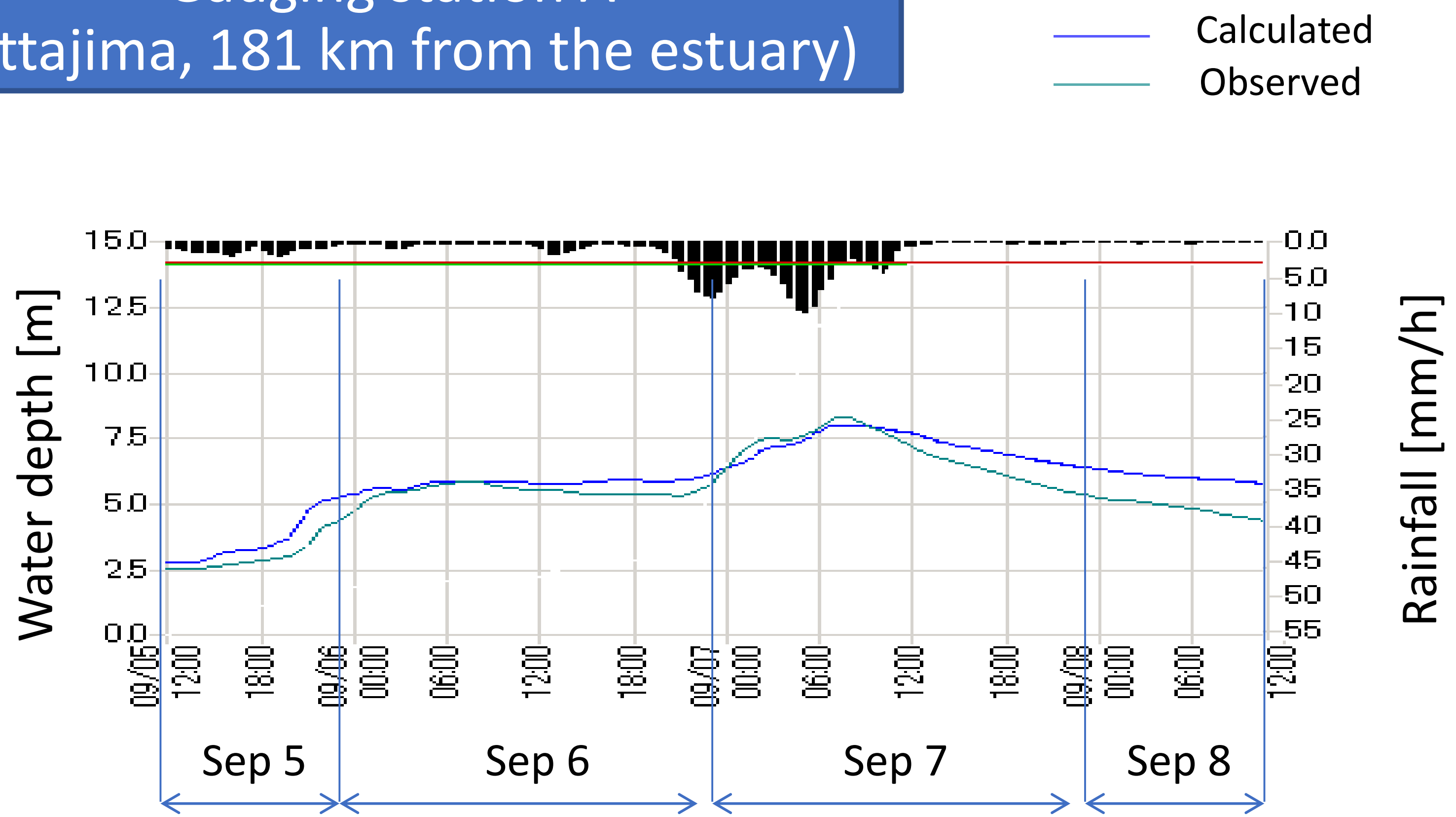
Simulation of high-water during Typhoon Fitow (2007)

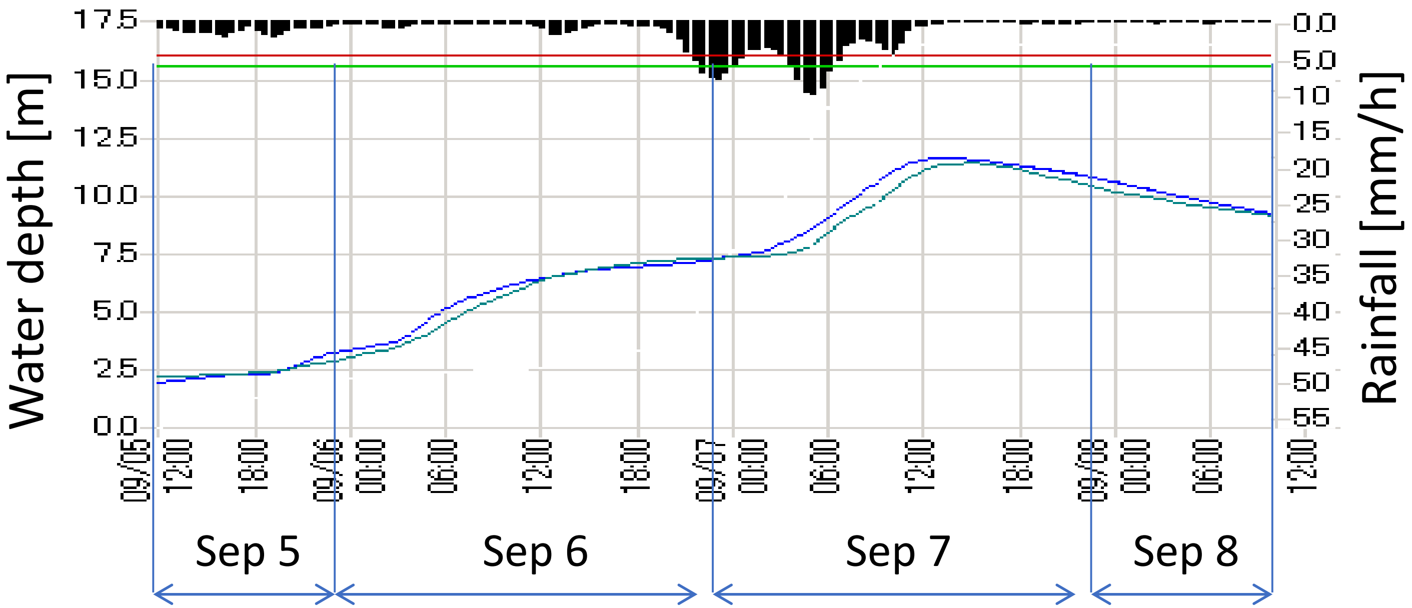
Gauging station A
(Yattajima, 181 km from the estuary)



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

Simulation of high-water during Typhoon Fitow (2007)

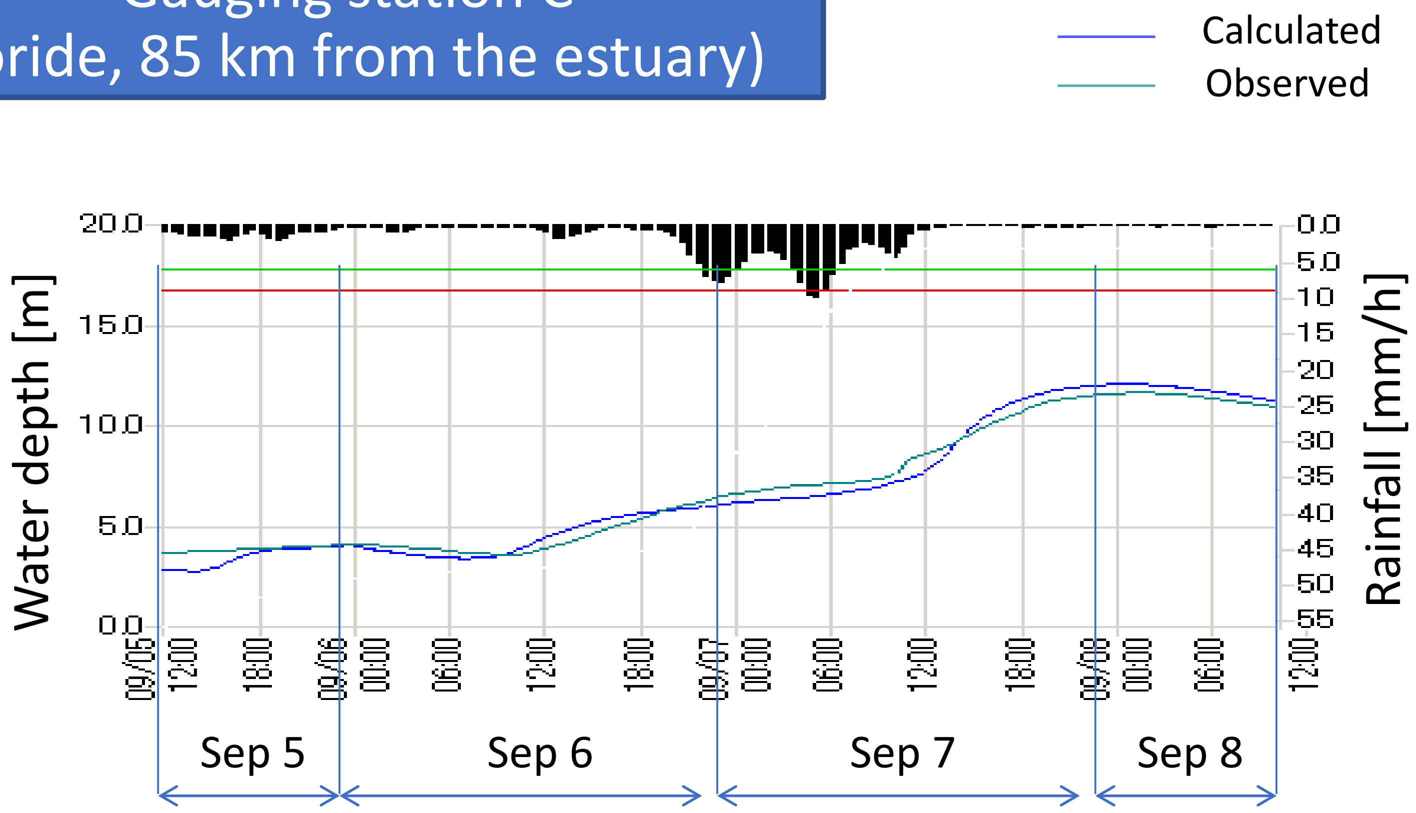
Gauging station B
(Kurihashi, 130 km from the estuary)



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

Simulation of high-water during Typhoon Fitow (2007)

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

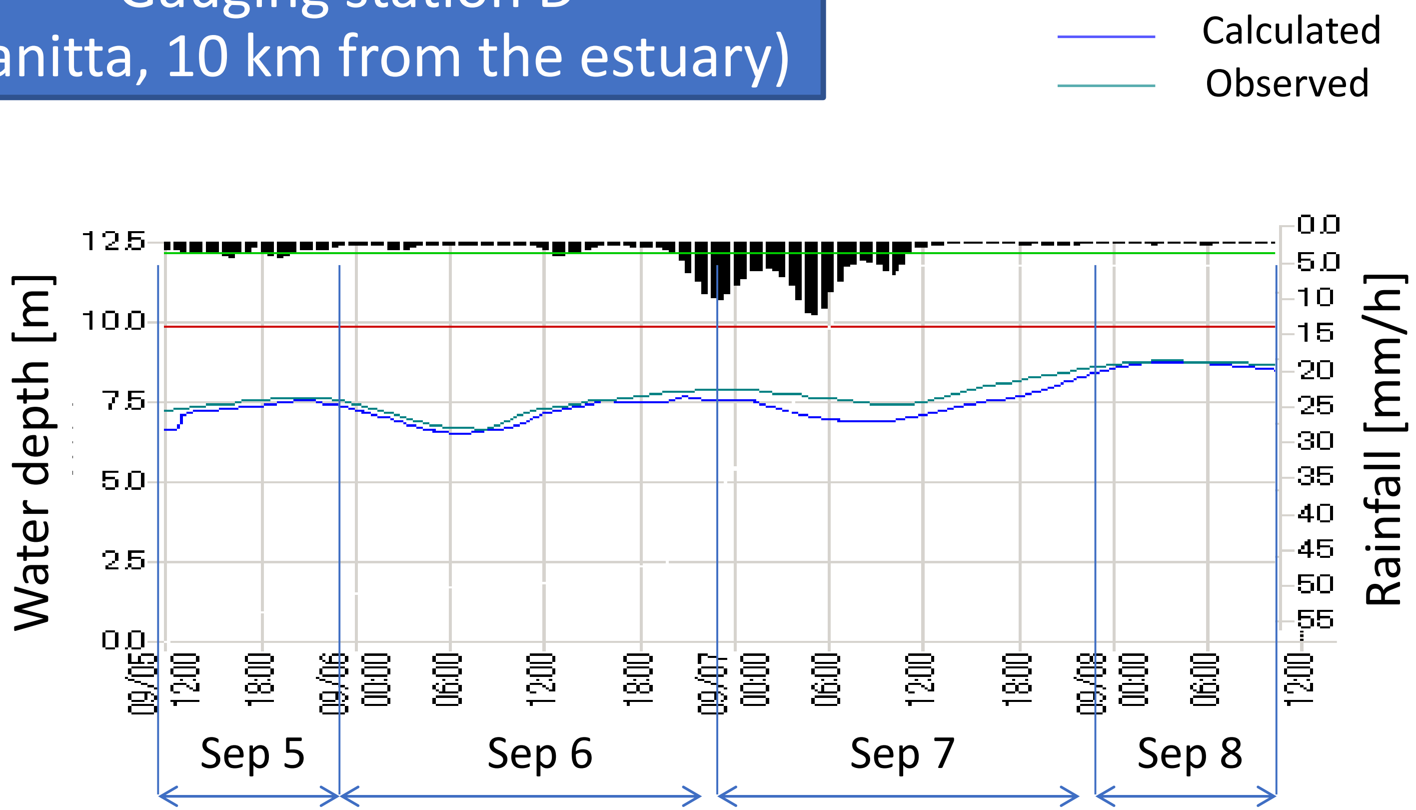


Source of observed data: 水水DB http://www1.river.go.jp/

Simulation in Tone river – result 4

Simulation of high-water during Typhoon Fitow (2007)

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



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

Simulation in Tone river – result 5

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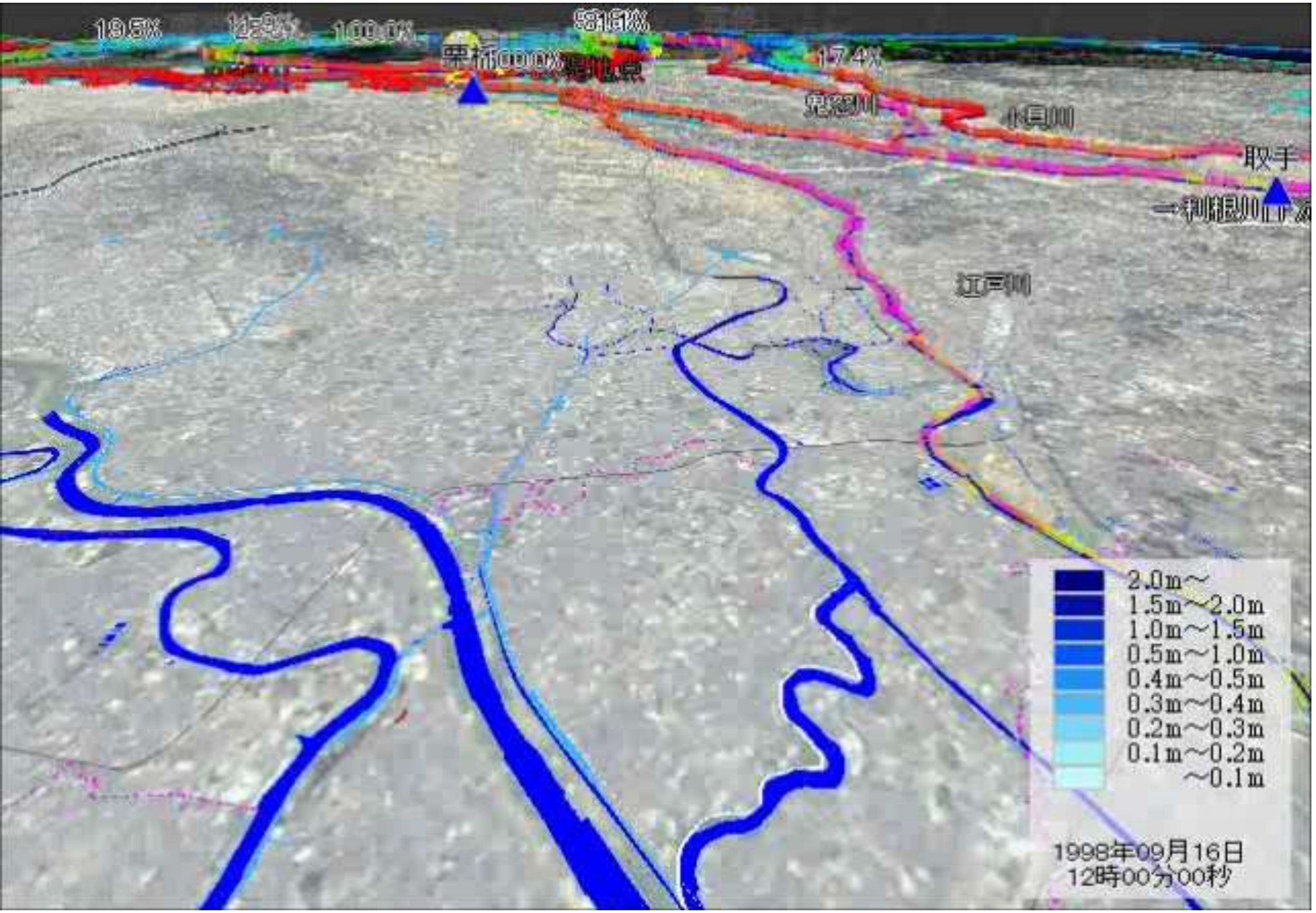

Produced by video output function of DioVISTA

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 km^2 (excluding Lake Biwa basin) 1 mainstream, 28 tributaries, 7 dams

Runoff model

Distributed、100m

↓

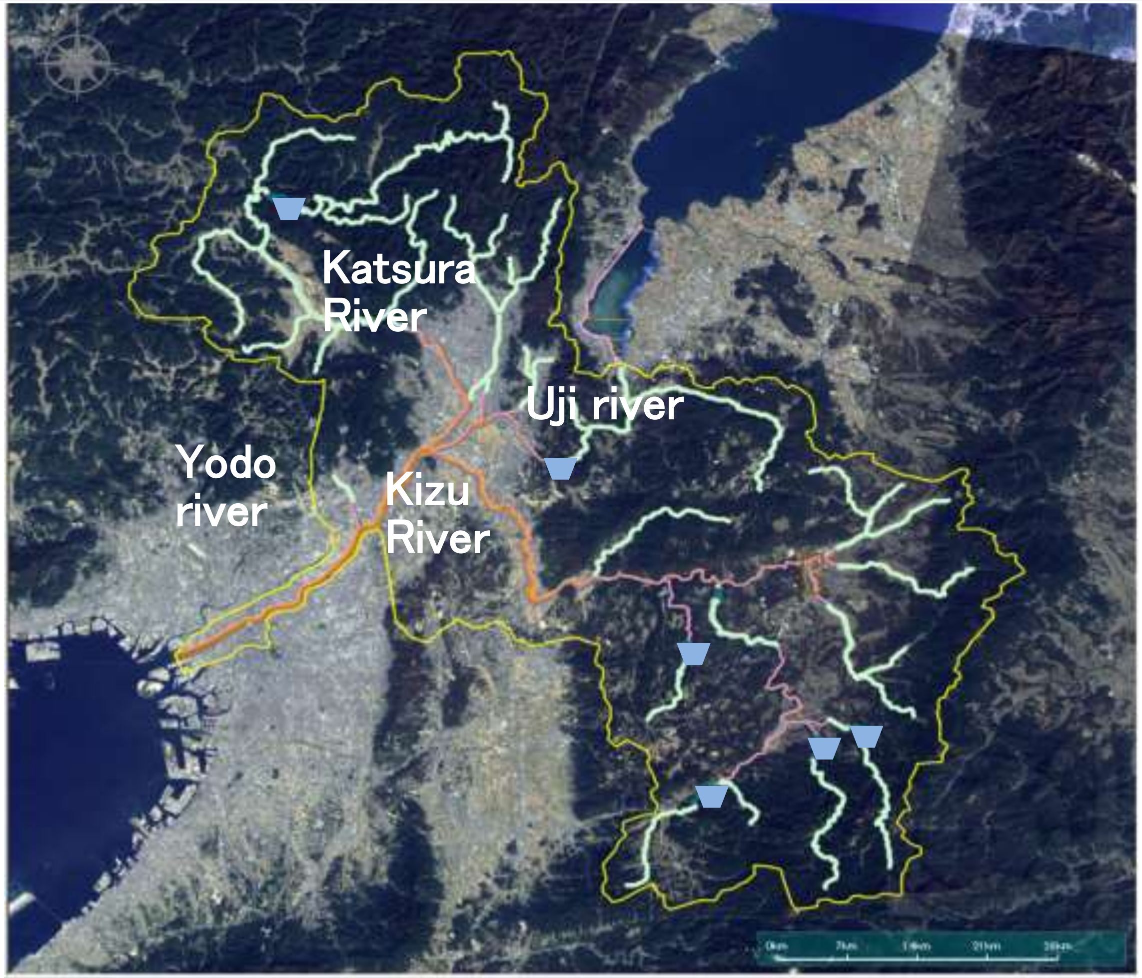
River model

1D unsteady, 50 m

↕

Inundation model

2D unsteady, 25m



山口・楠田, クラウドコンピューティングによる浸水解析の高速化, 土木学会 次学術講演会, 2017.

Validation of Simulation

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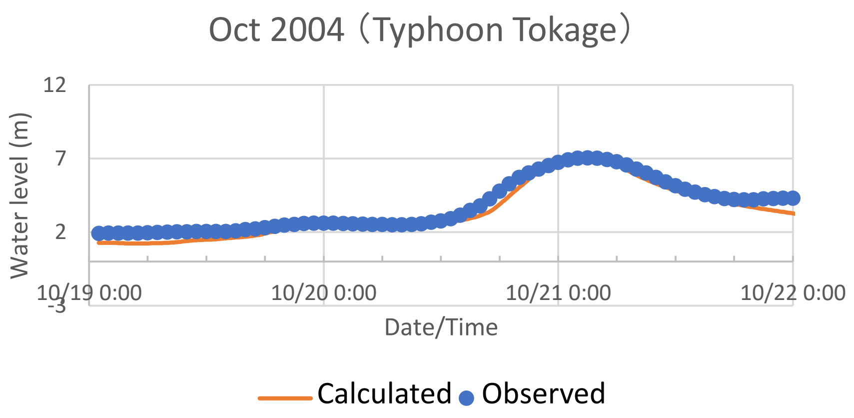

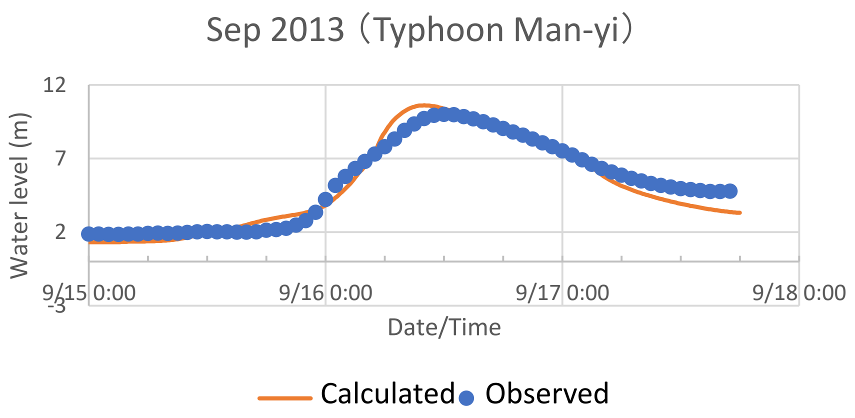

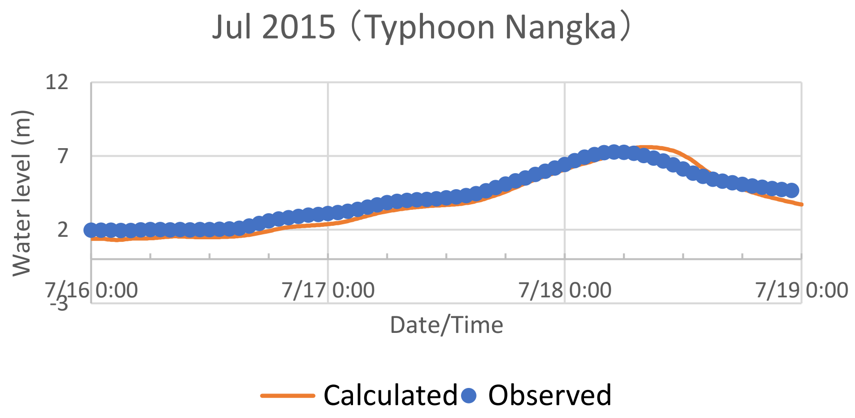

Compare observed and simulated water level at Hirakata Gauging station.

Source of observed data: 水文水質データベース http://www1.river.go.jp/