A Preliminary Integrated Tsunami Scenario Simulation

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Research Field:
 Disaster mitigation by non-structural countermeasure
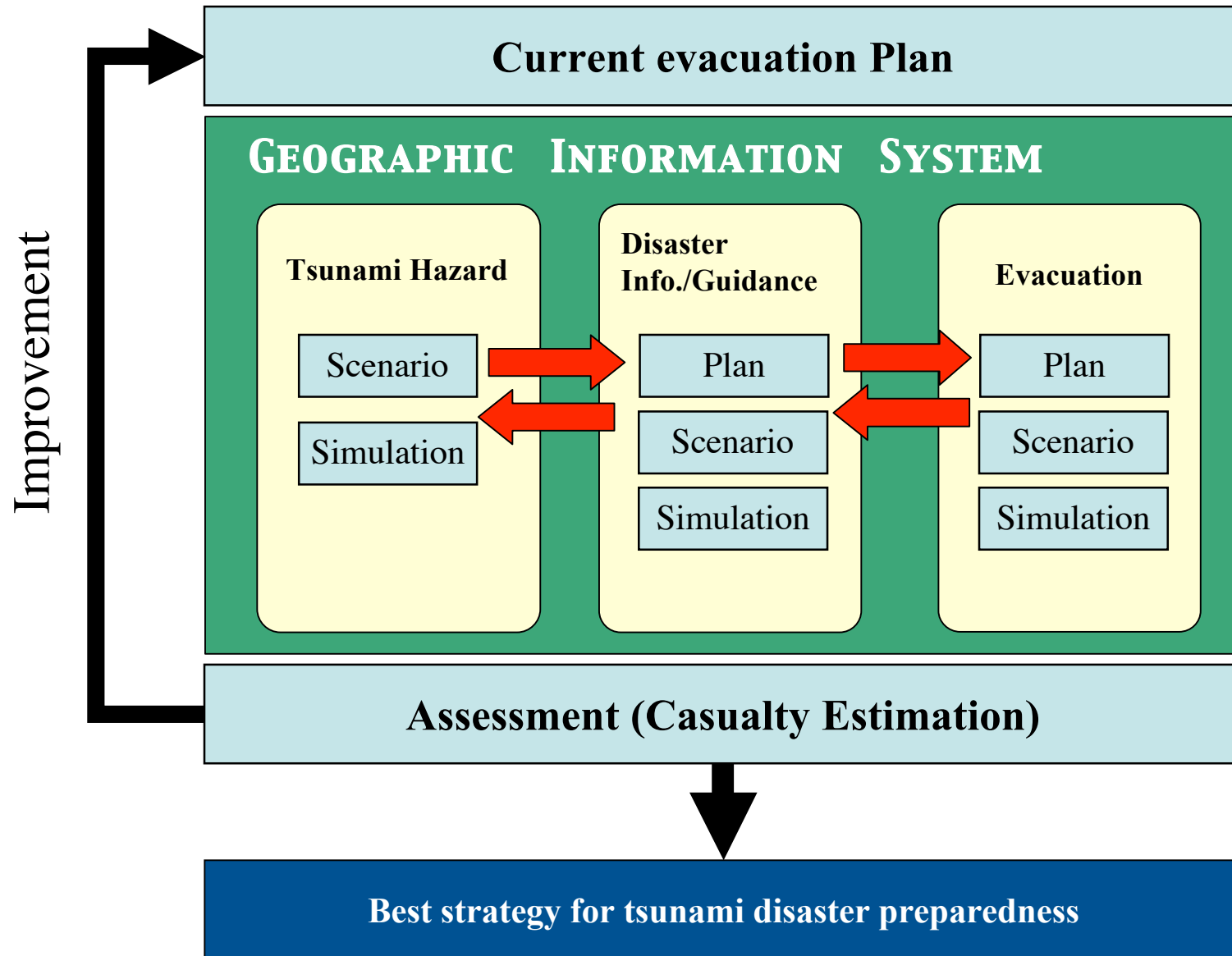 **/ Evacuation Behavior / Disaster Information /**
 / Disaster Education   / Crisis Management   /
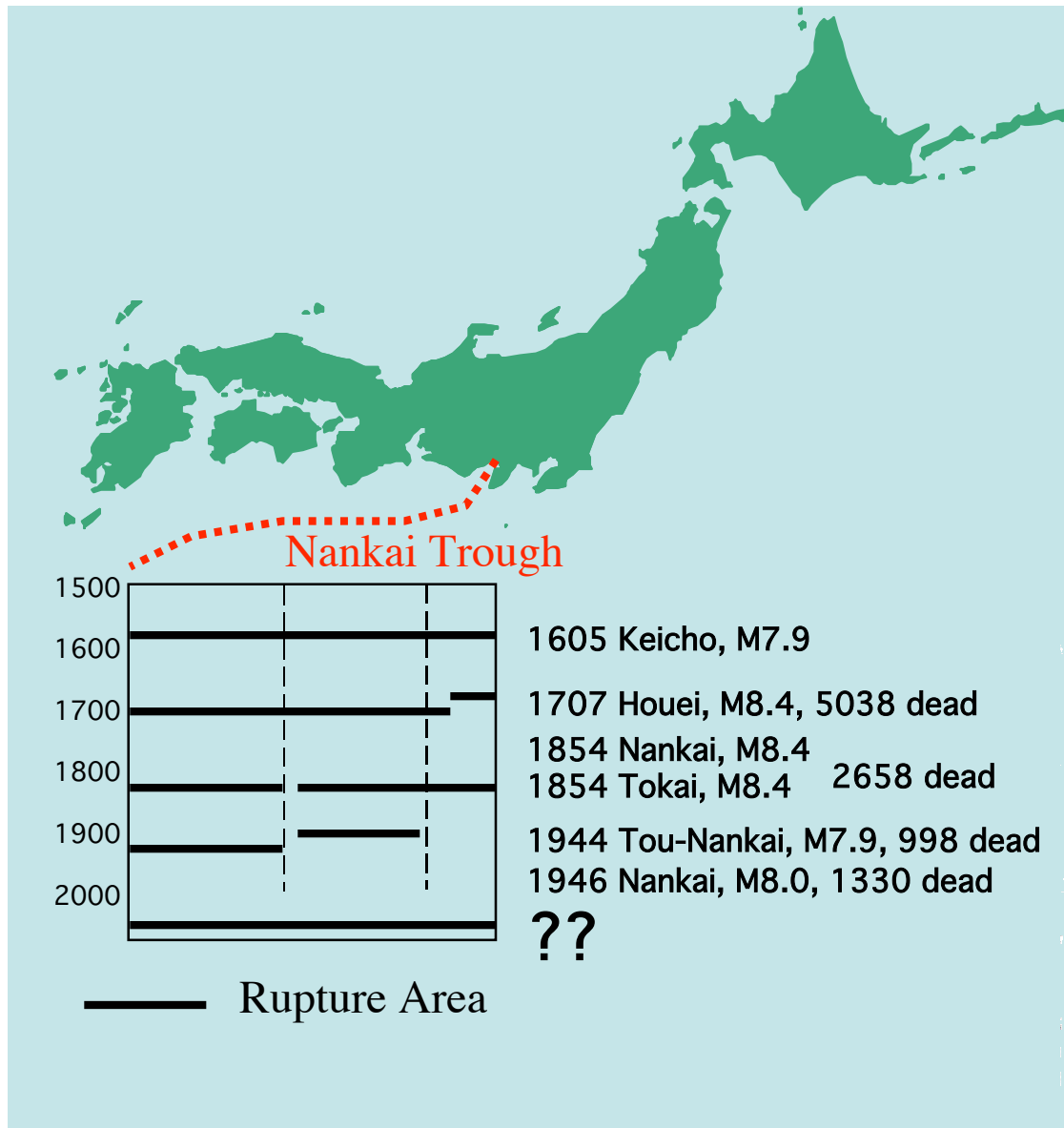
Research Purpose

- Human damage mitigation from tsunami

- Developing a tool to diagnose tsunami
  evacuation plan in a coastal community

  → Integrated Tsunami Scenario Simulator

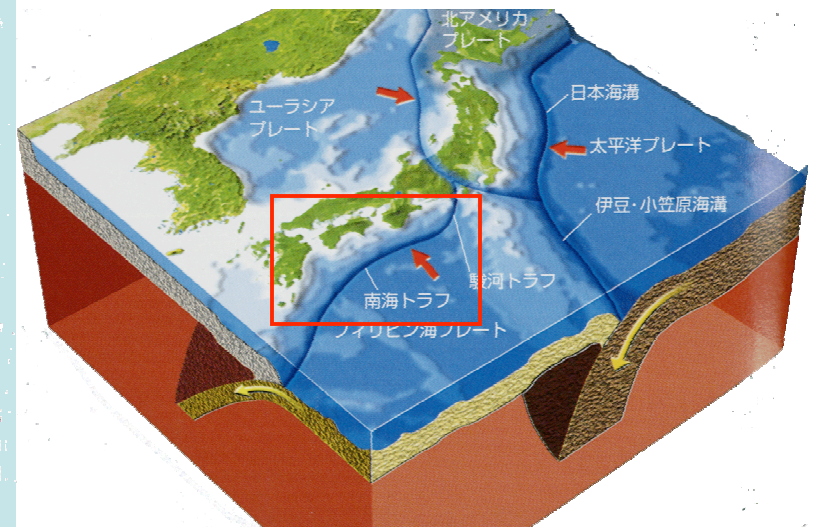# Tsunami Scenario Simulator consists of three model elements

Current evacuation Plan

GEOGRAPHIC INFORMATION SYSTEM

Tsunami Hazard

Scenario

Simulation

Disaster Info./Guidance

Plan

Scenario

Simulation

Evacuation

Plan

Scenario

Simulation

Improvement

Assessment (Casualty Estimation)

Best strategy for tsunami disaster preparedness

Our Concern

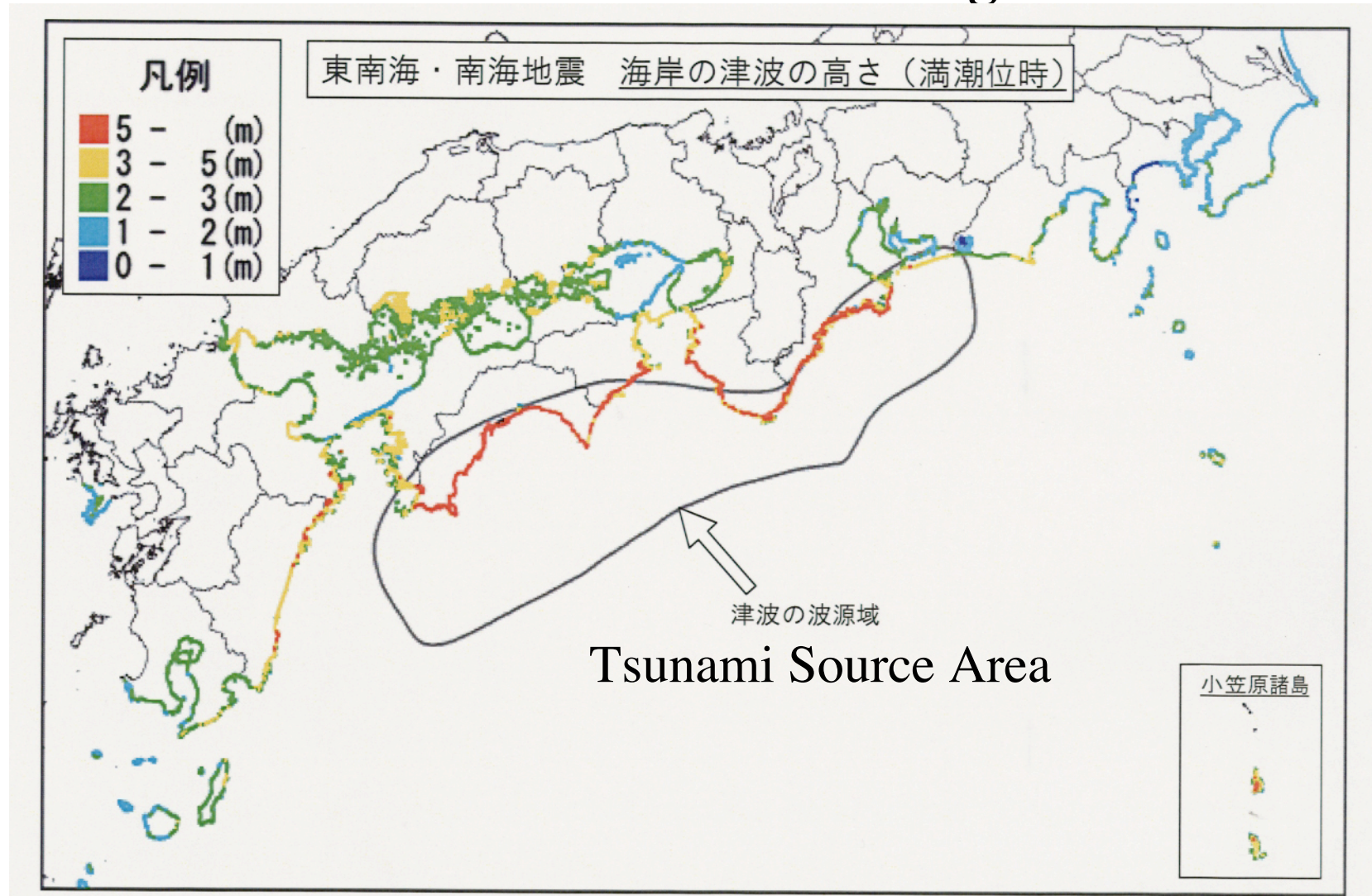# Megathrust earthquake along Nankai Trough

✓Subducting 4-5 cm /yr
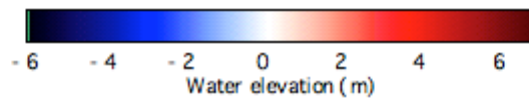✓Magnitude Mw8.6
✓Probability : 40～50 %
within next 30 years

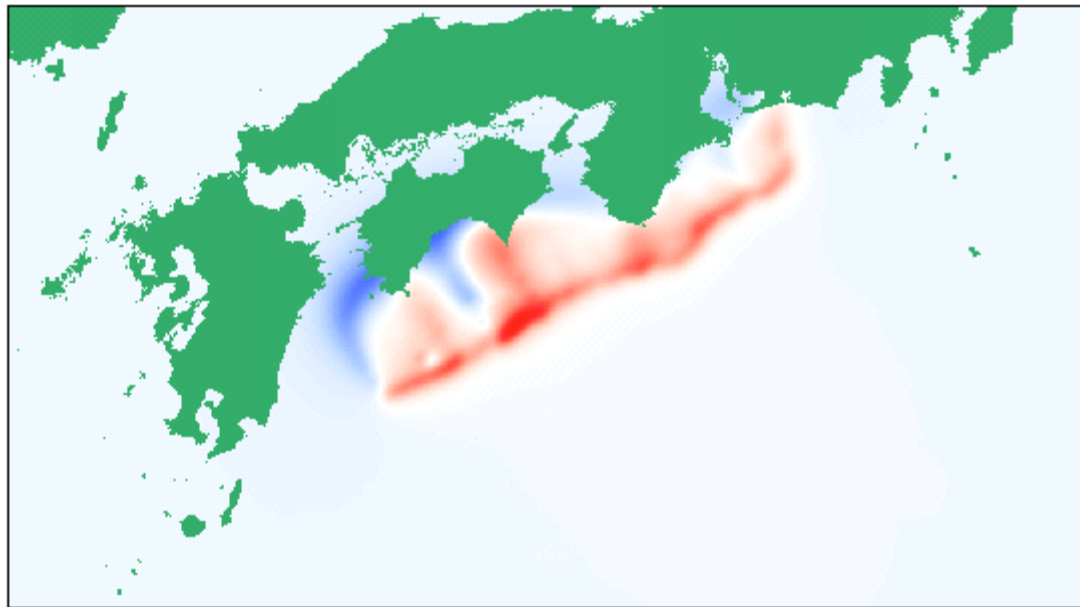Nankai Trough

1605 Keicho, M7.9

1707 Houei, M8.4, 5038 dead

1854 Nankai, M8.4
1854 Tokai, M8.4   2658 dead

1944 Tou-Nankai, M7.9, 998 dead
1946 Nankai, M8.0, 1330 dead
??

Rupture Area

Estimated Tsunami Height

凡例
- 5 – (m)
- 3 – 5 (m)
- 2 – 3 (m)
- 1 – 2 (m)
- 0 – 1 (m)

東南海・南海地震　海岸の津波の高さ（満潮位時）

津波の波源域
Tsunami Source Area

小笠原諸島

What is expected to happen ?
Tsunami Hazard

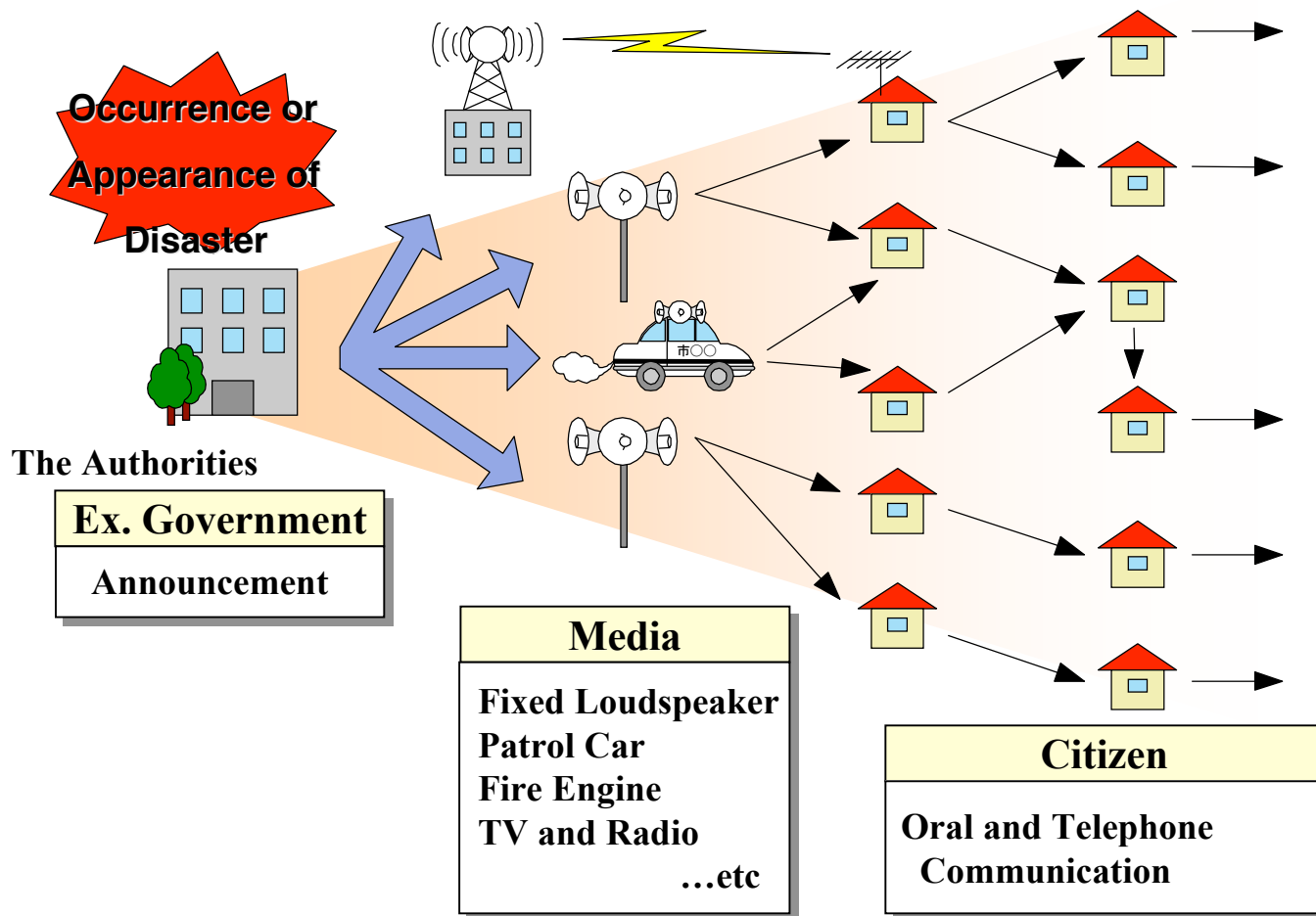Water elevation (m)

Tsunami Scenario Simulator consists of three model elements

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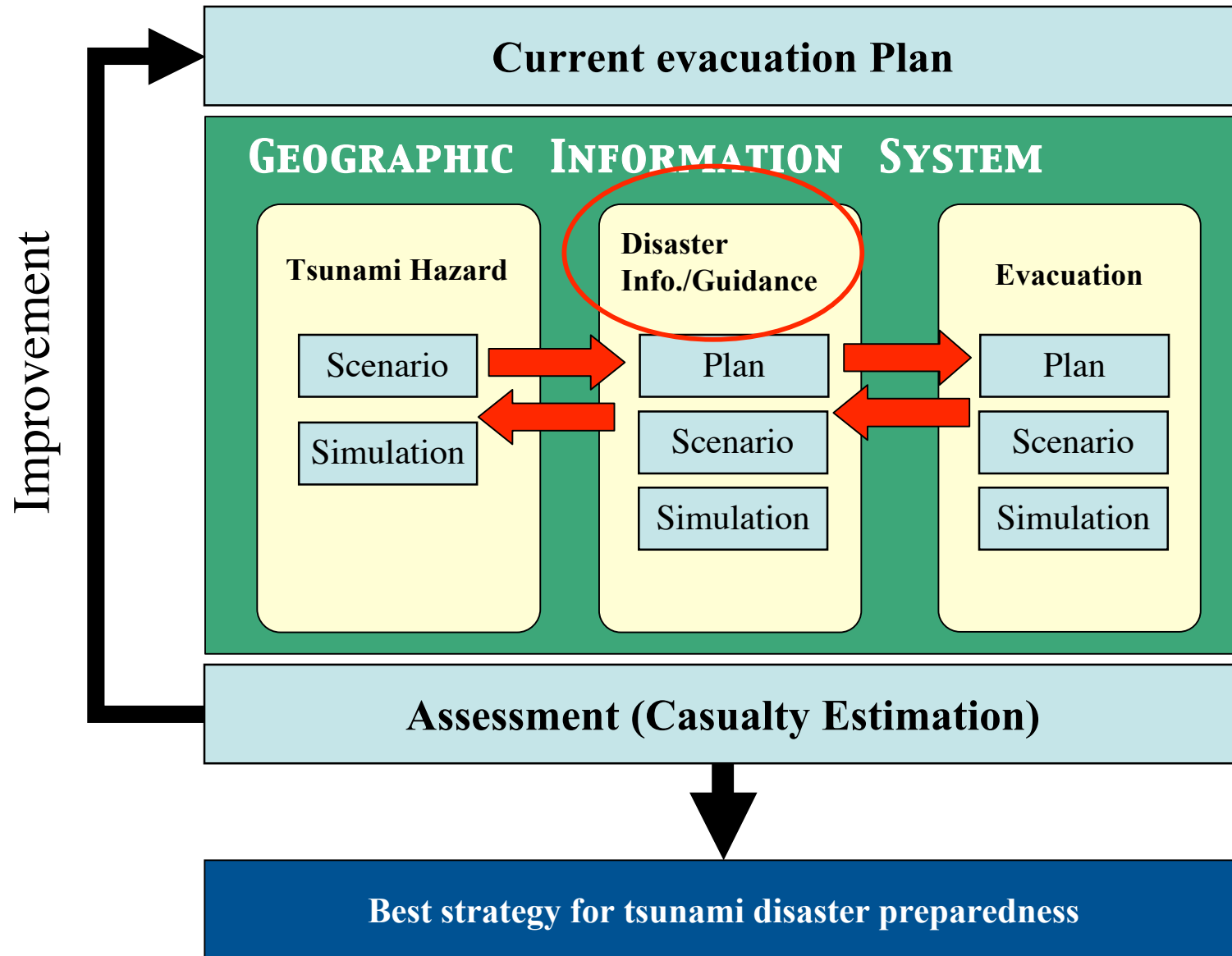
The Basic Structure of Simulation

■ **The Disaster information transmission**
       is described as a network generation

Occurrence or Appearance of Disaster

The Authorities

Ex. Government
Announcement

Media
Fixed Loudspeaker Patrol Car Fire Engine TV and Radio   …etc

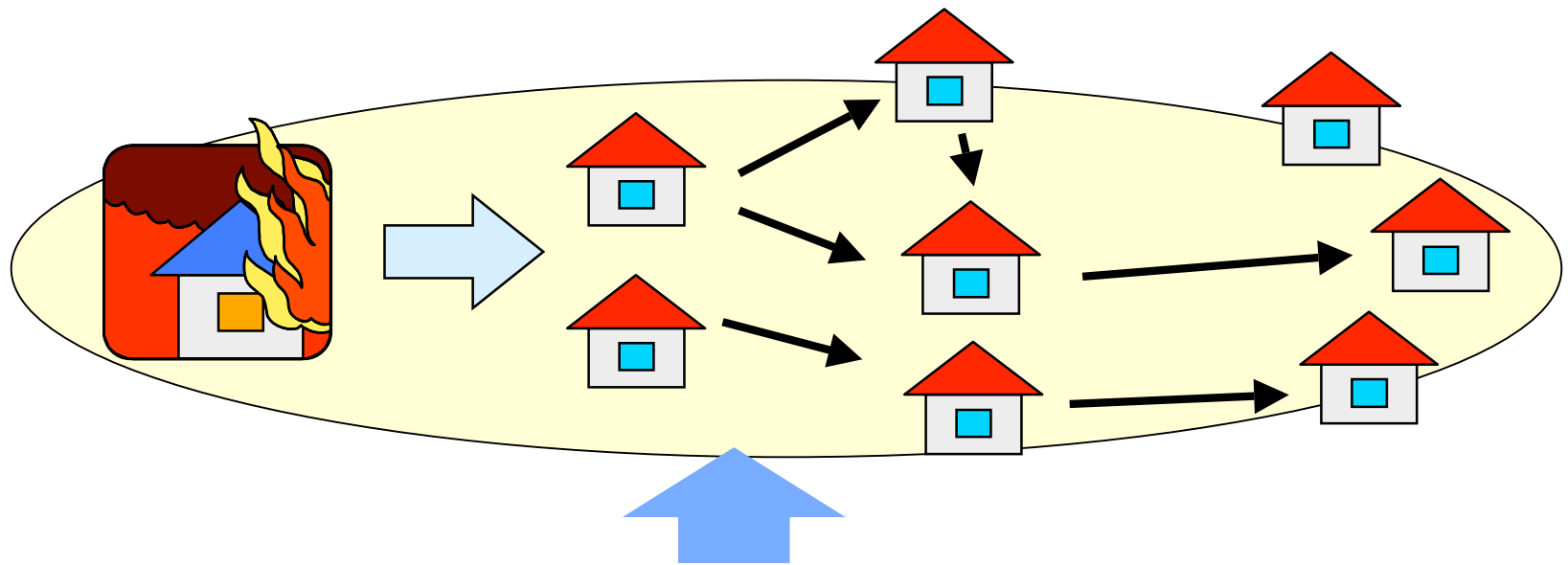| Citizen |
| --- |
| Oral and Telephone Communication |

Expression of Oral Communication Network

The base network is composed of oral communication network.
The media will be added to this base network.
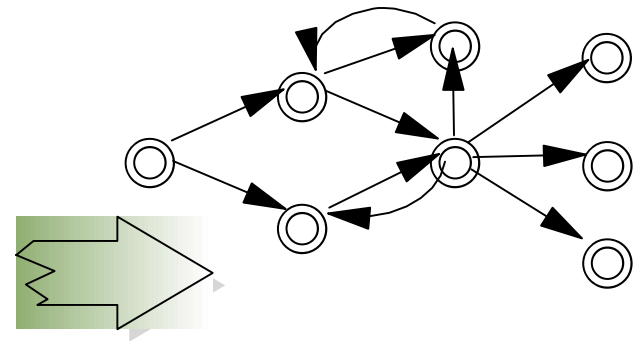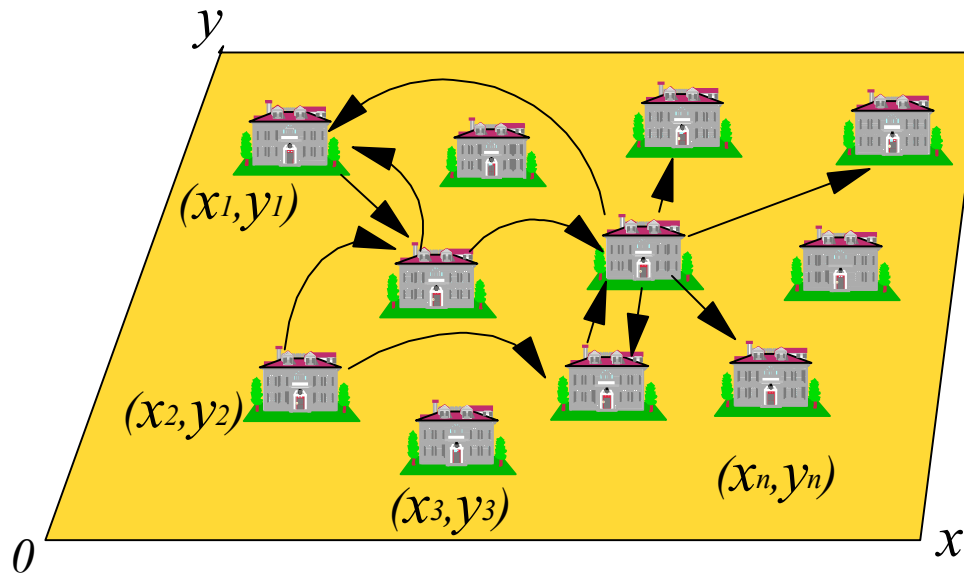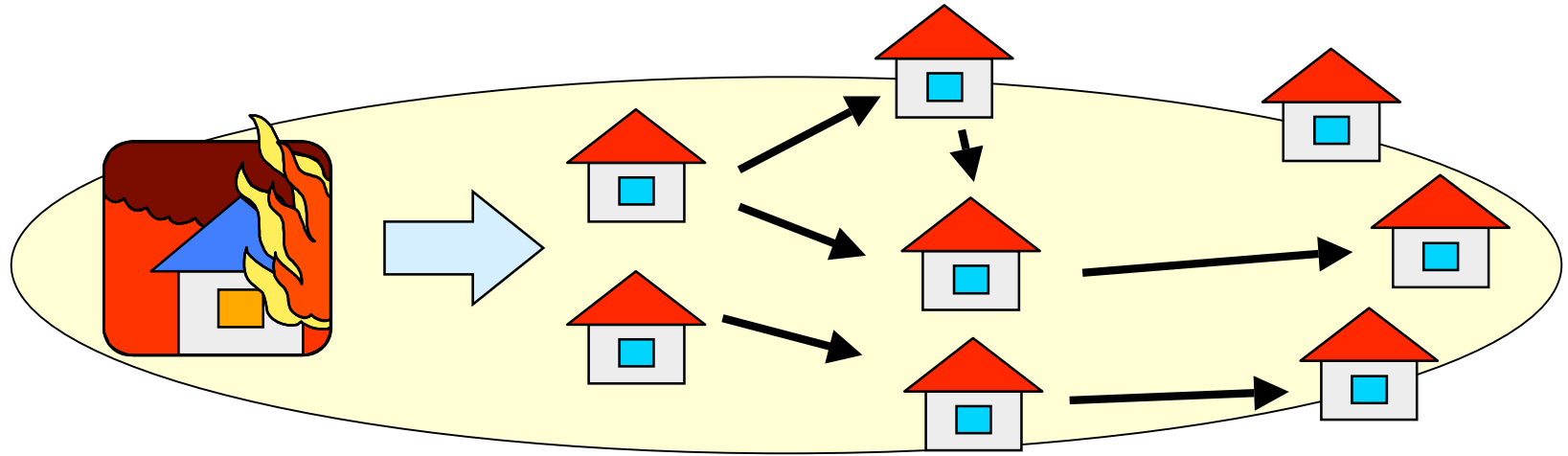
Expression and Control of Oral Communication

The generation of oral communication network is controlled with 4 parameters.

The Control Parameters of Oral Communication Network
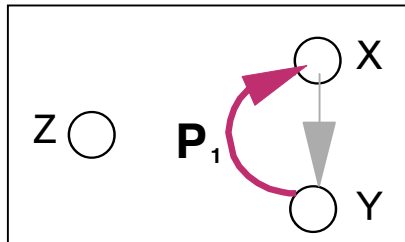
The Number of Contacts(Receivers)   **The Distance of Each Contact**

The Timing of Each Contact   **Communication Parameters**
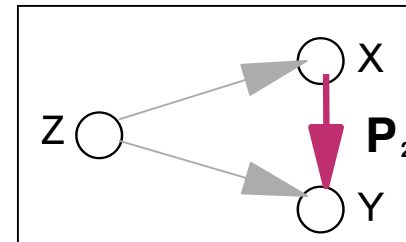
Communication Parameters

/Communication Parameters reflects
companionable level of neighbor community
ex. Urban Community < Rural Community

Reflection Linkage

$$P_1 = \pi + (1 - \pi)d$$

π :Reflection Bias Parameter
d :Random Choice Probability
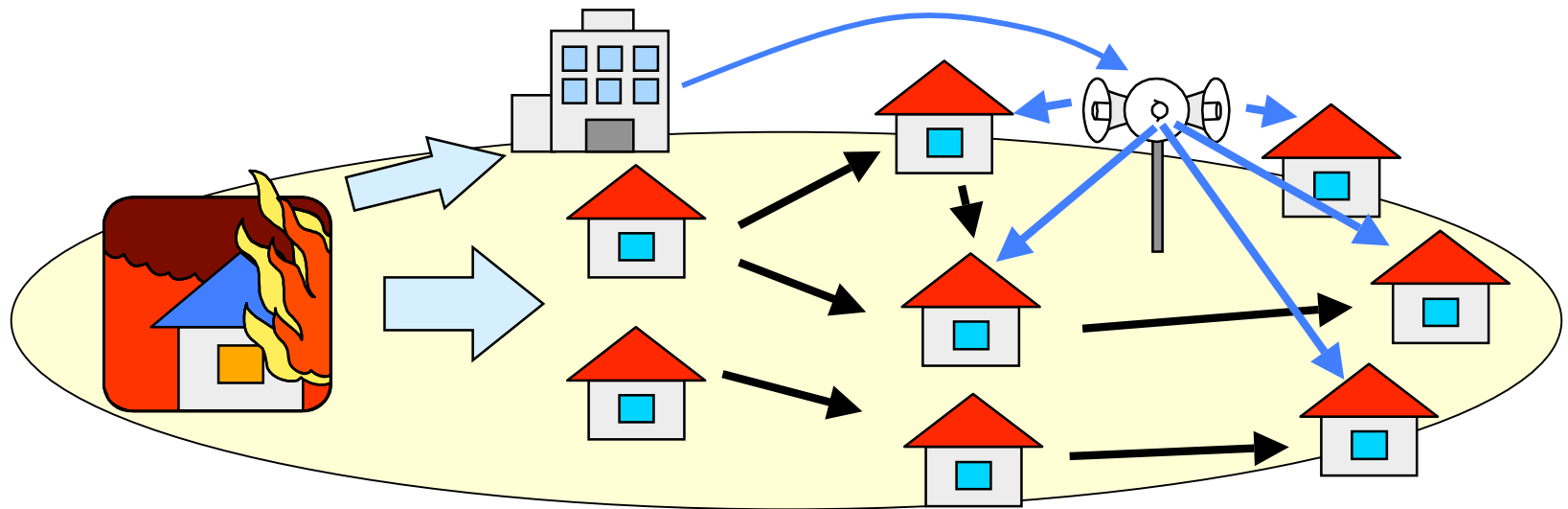P_1 :Linkage Prob. Y to X

Mutual Linkage

$$P_2 = \sigma + (1 - \sigma)d$$

σ :Mutual Bias Parameter
d :Random Choice Probability
P_2 :Linkage Prob. X to Y

π, σ :These Bias Parameters work against Random Linkage

Expression of Media (in case of Fixed Loudspeakers)

■ The Loudspeaker is combined into oral communication network
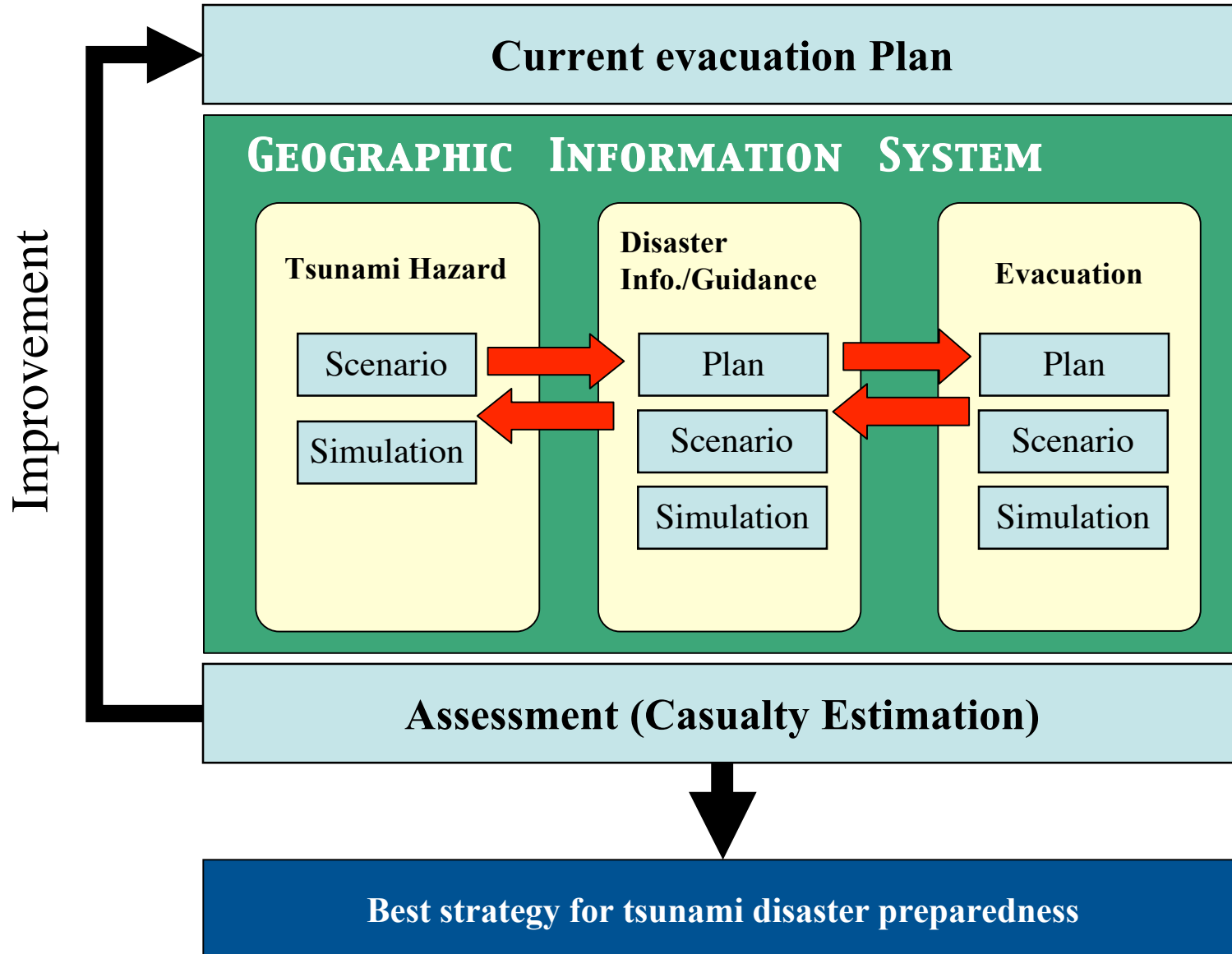

The Parameters for Loudspeaker

#1 Location ,   #2 Audible Distance,   #3 Audience Rating,

#4 Announce Frequency and Each Timings

Description of Transmission Media and Its Functions
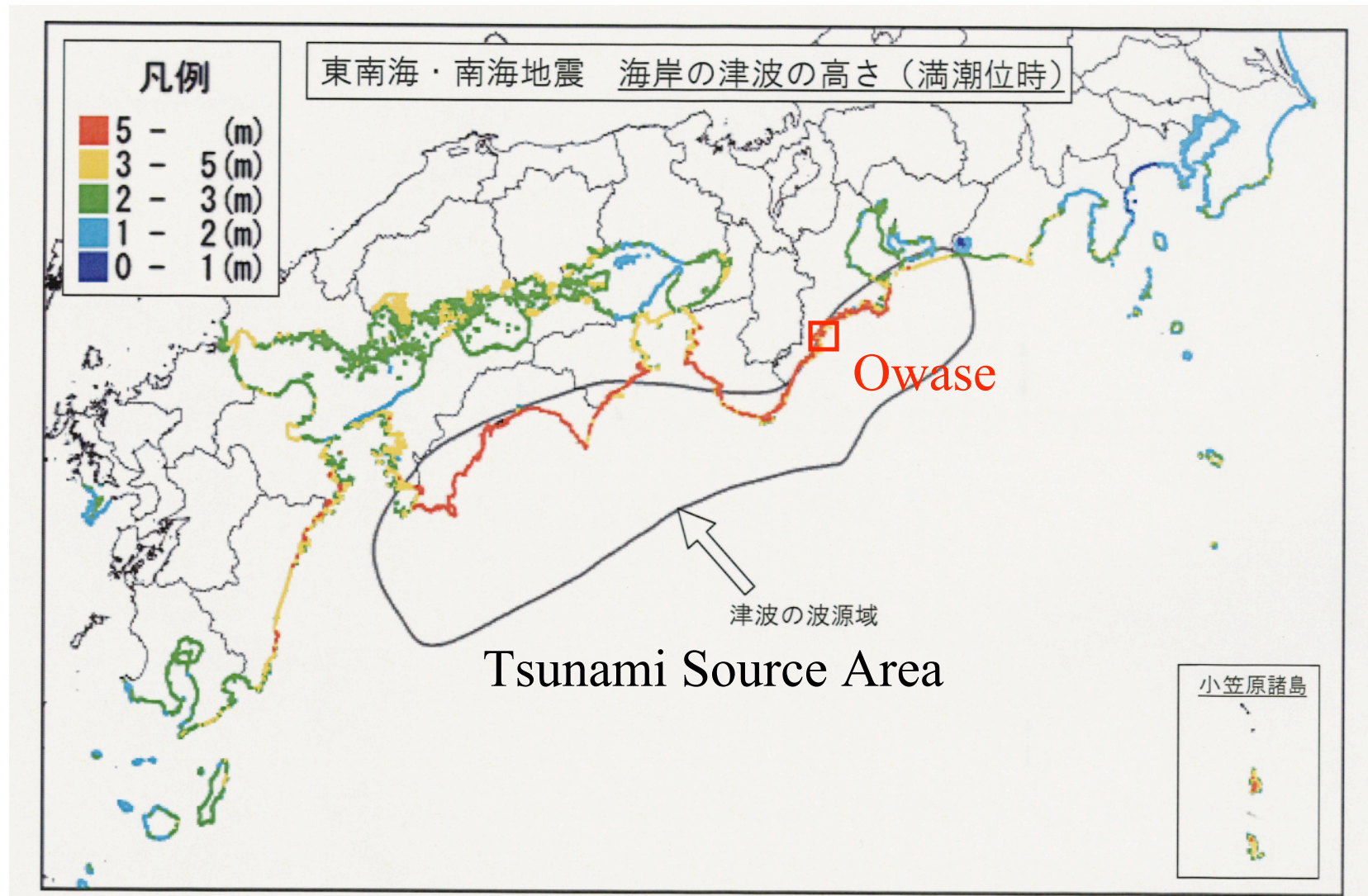
■ The functions of each media is described by using following parameters in the simulation.

Media	Parameter
Oral Communication	The Distribution of Number of Contacts, Walking-speed, The Distribution of Distance to Receiver, Commu. Para.
Telephone	The Distribution of Number of Contacts, Connecting Ratio
Patrol car, Fire Engine (With Loudspeaker)	The Route and Speed, Departure Time, Audible Distance, Audience Rating
Fixed Loudspeaker	Audible Distance, Audience Rating, Announce Frequency and Timings
TV, Radio	Audience Rating, Announce Frequency and Each Timings

Diagnosis with three model elements

Improvement

Current evacuation Plan

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Assessment (Casualty Estimation)

Best strategy for tsunami disaster preparedness

Implementation at OWASE

凡例
- 5 −　(m)
- 3 − 5 (m)
- 2 − 3 (m)
- 1 − 2 (m)
- 0 − 1 (m)

東南海・南海地震　海岸の津波の高さ（満潮位時）

Owase

津波の波源域

Tsunami Source Area

小笠原諸島

City of **Owase**

Population : 24,000,
Household : 10,000

Computed tsunami waveform at Owase Bay

Water level (m)

Time after the quake (minutes)
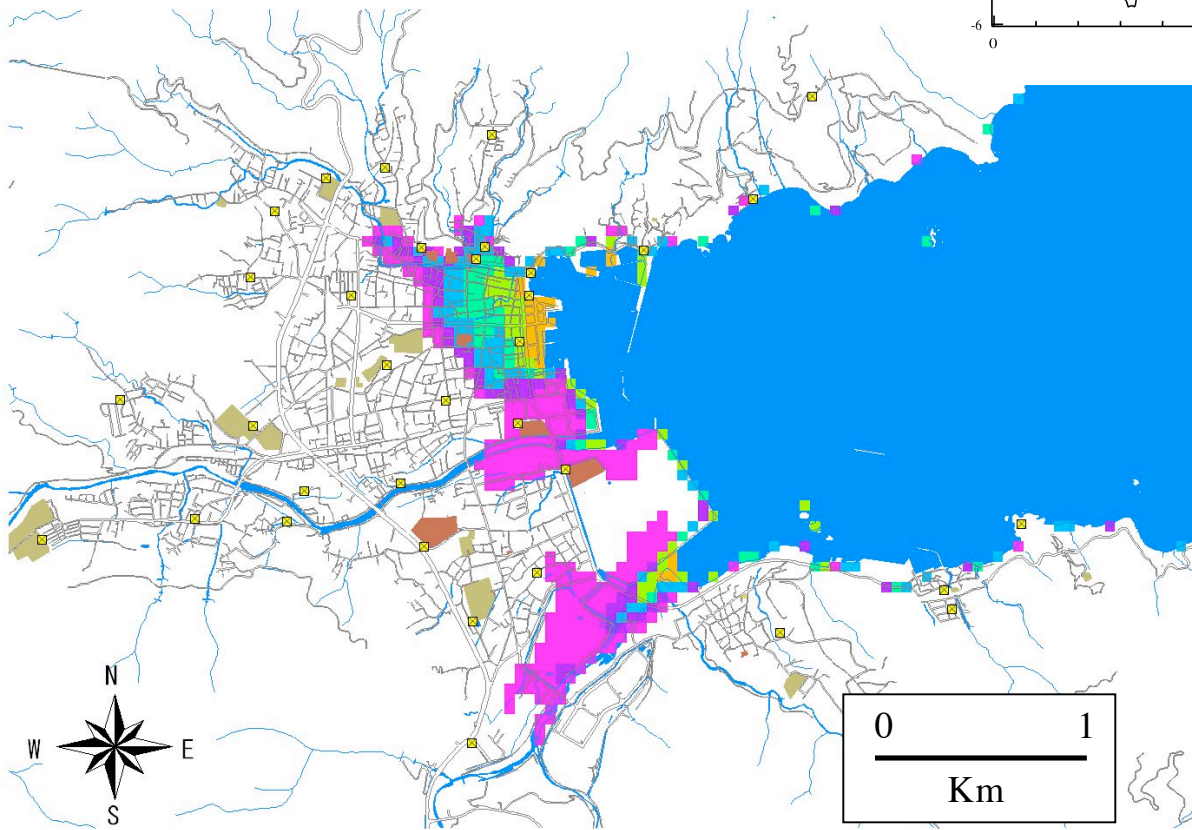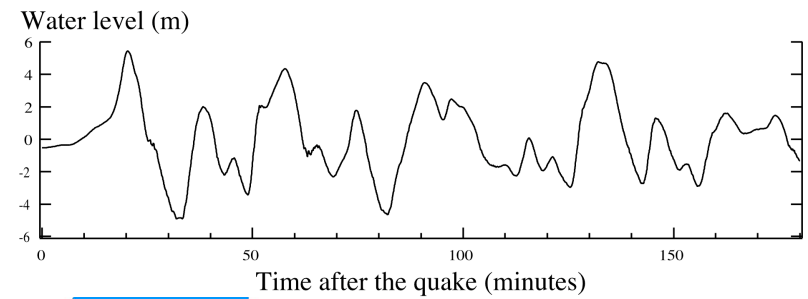
Estimated
inundation depth

	0 − 1 m
	1 − 2 m
	2 − 3 m
	3 − 4 m
	4 − 5 m
	5 − 6 m
	6 − 7 m
	7 − 8 m

N
W E
S

0   1
Km
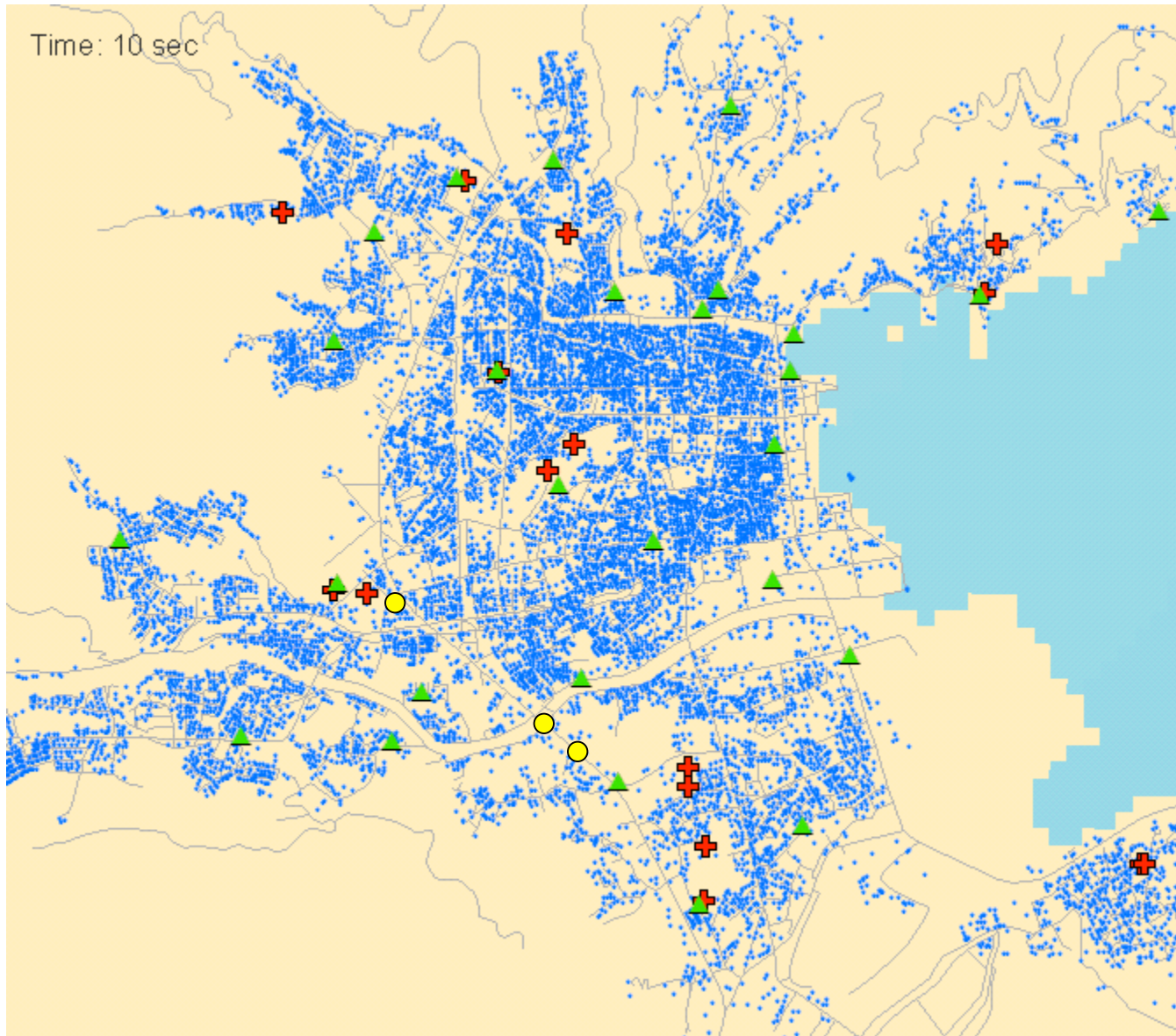
Tsunami Disaster within the city of Owase
Preliminary model result

Scenario

✓ Loud speaker : Issue the warning 5 minutes after the ground shaking stops
✓ Patrol cars : Issue the guidance 5 minutes after the ground shaking stops
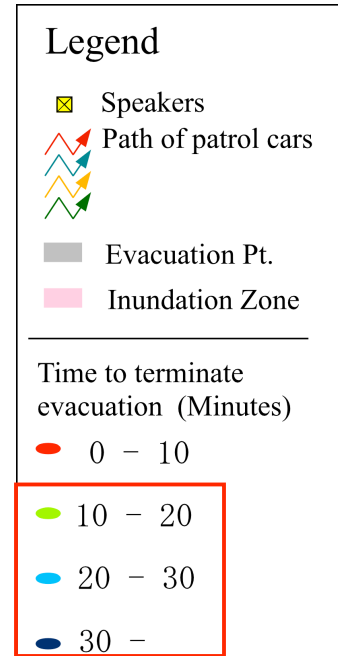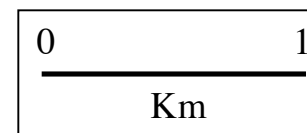✓ Mass media : Issue the warning 8 minutes after the ground shaking stops

Legend

✚	Evacuation Pt.
▲	Loudspeaker
●	Patrol car
•	Evacuee

Time: 10 sec

Assessment
Estimation of tsunami evacuation time
Preliminary model result

Legend

⊠ Speakers

Path of patrol cars

▢ Evacuation Pt.

▢ Inundation Zone

Time to terminate
evacuation (Minutes)

● 0 – 10

● 10 – 20

● 20 – 30

● 30 –

0   1

Km

Assessment
Estimation of tsunami evacuation time
Preliminary model result

Legend

⊠ Speakers

Path of patrol cars

Evacuation Pt.

Inundation Zone

Time to terminate
evacuation (Minutes)

● 0 – 10

● 10 – 20

● 20 – 30

● 30 –

0   1

Km
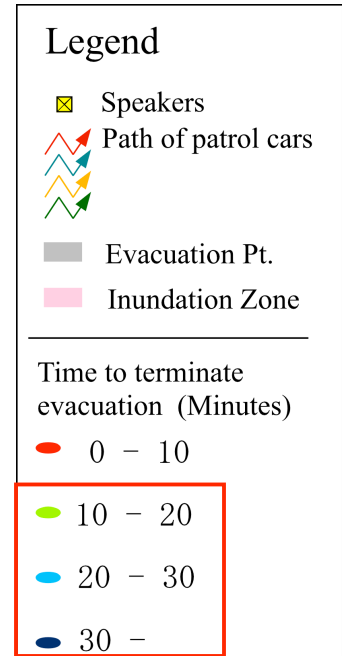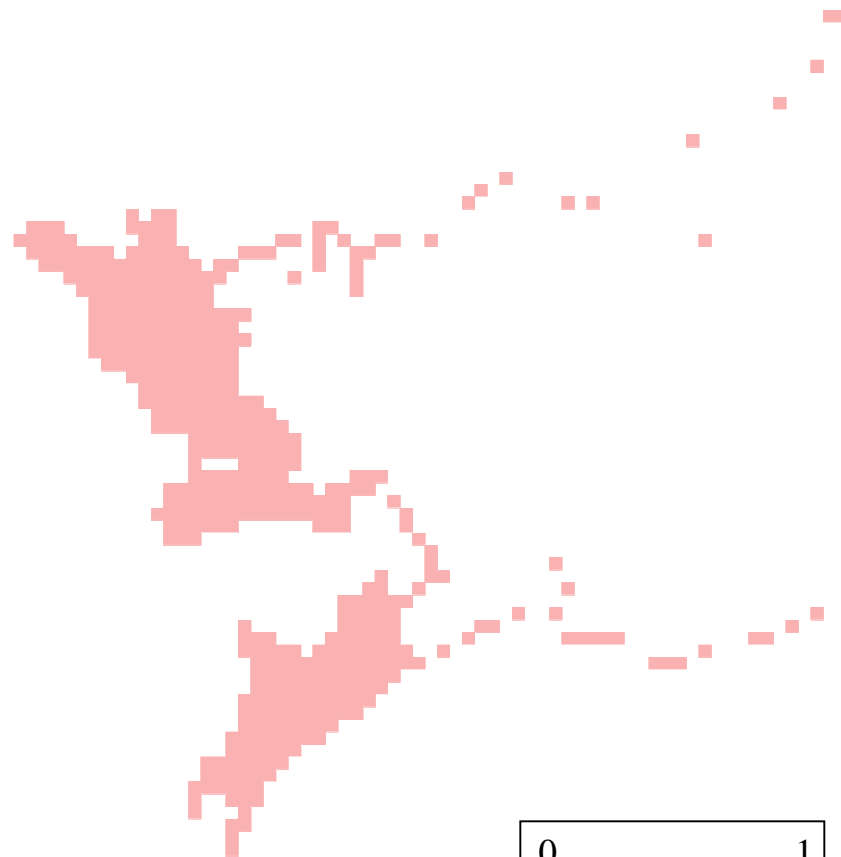
Future Research

✓ Estimation of casualties

 Interaction between model elements

 What is the best plan ?

✓ Model improvement

 Where is model limit ?

 What are we trying to simulate ? Individuals or Regional characteristics ?

✓ Implementation

 Where is the limit of evacuation plan?

 For local government, for public

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Thank you