



Immediate Countermeasure Simulation Supporting by Ships at Disasters

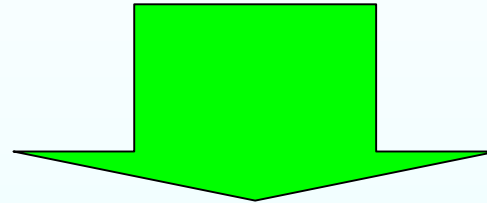
SAKABE Kumi

International Maritime Education and Research Center

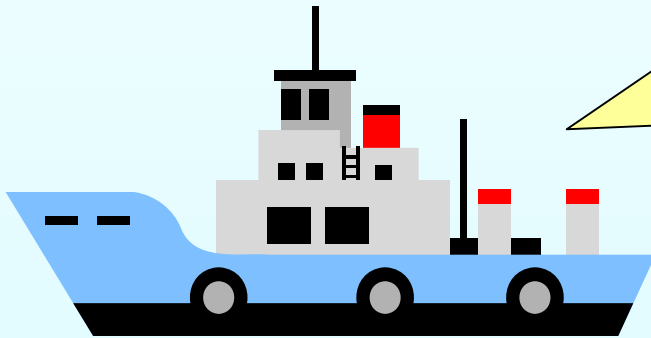
Kobe University

The Great Hanshin-Awaji earthquake (1995)

Land transportation was heavily damaged.



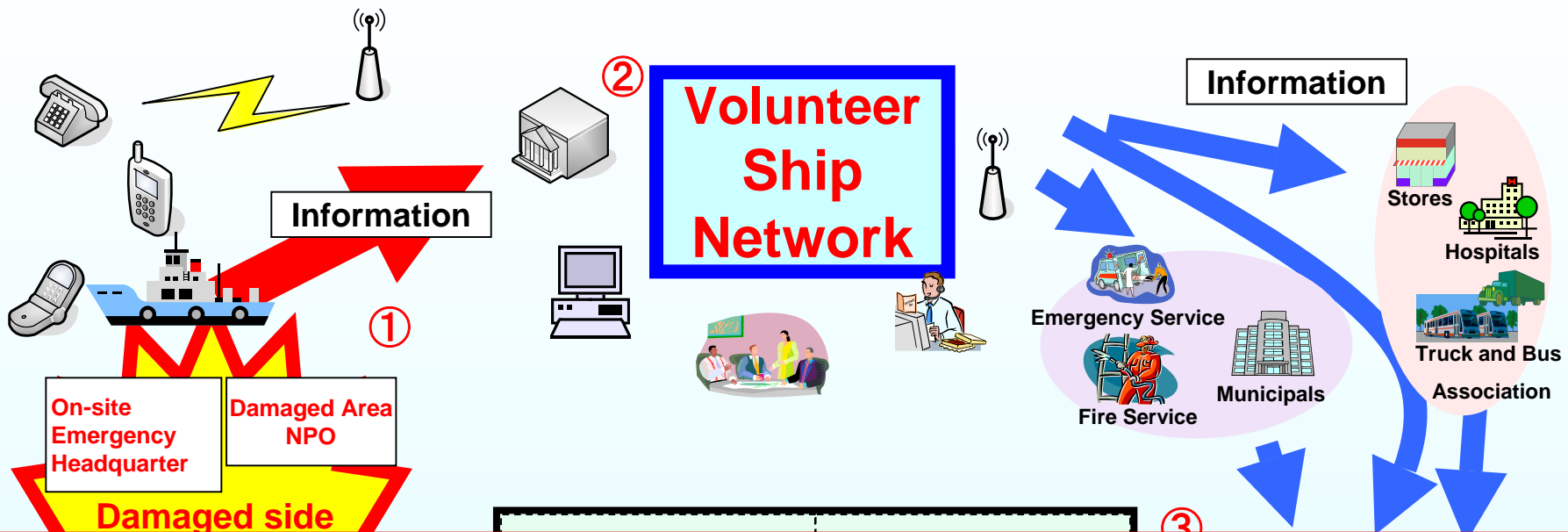
Marine transportation



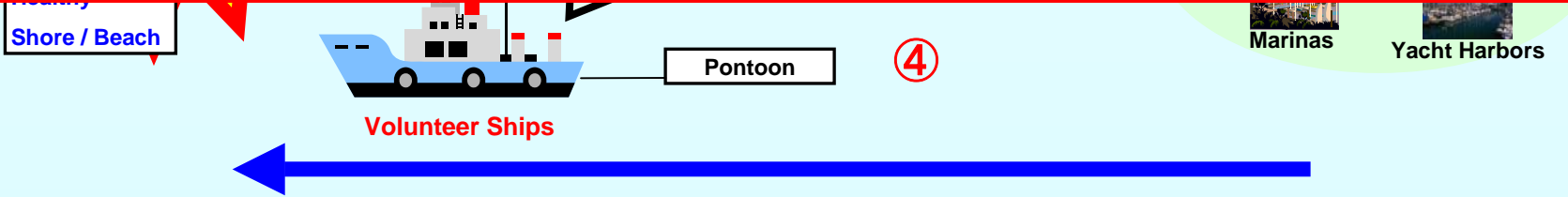
- Ships carried supply and casualties.
- Ferries moored at quays in harbor and became accommodations for victims.

Many kinds of ships played a big role from immediate countermeasure scenes to the recovery.

Organized Supporting Network in Countermeasure Scenes by Ships



By using system dynamics computer program, number of ship and time required to carry commodities by ships are simulated.



Outline of Simulation Model

■ **Estimated Damage area** : Kochi city

■ **Discuss about** :

- Number of ships

- Quantity of

 - supporting supply carried

 - required time

■ **Type of Supply** : Water

A map of Japan with the island of Shikoku highlighted in light brown. Kochi city is marked with a red dot and a blue line pointing to a text box.

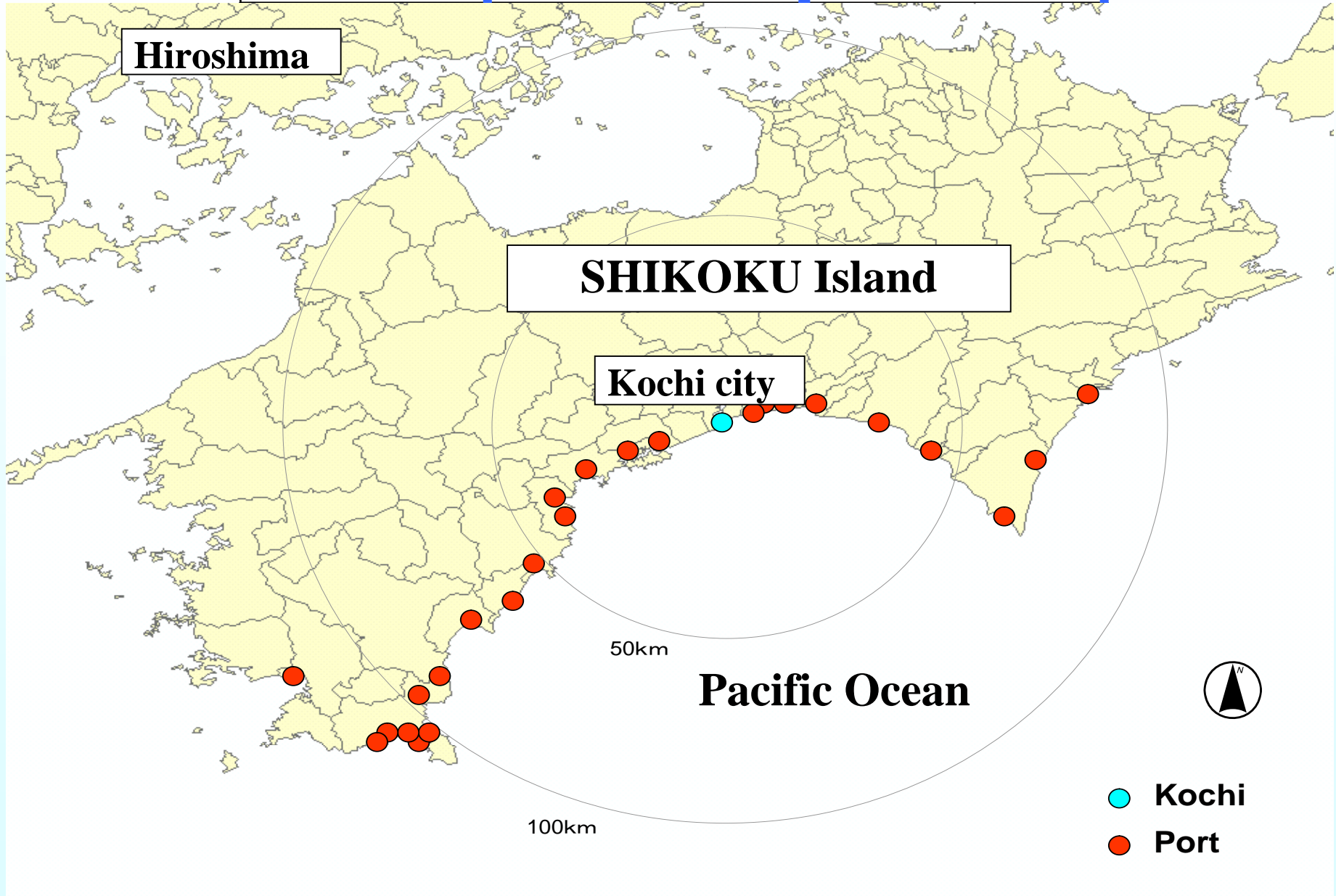
Kochi city

■ **Elements** : Port scale, distance, water volume, ship size, loading capacity, ship speed

List of 26 Ports



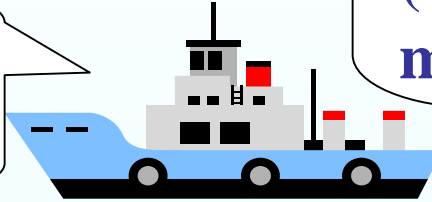
Port	Distance to Kochi city	Number of ships less than 5GT class
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Ship size : **3GT**

Average ship speed :
8 knot



Capacity: **700kg**
(Water:500L, Man:2 & margin)

In Kobe,
14% of population \Rightarrow Victim

50,000 people suffered.

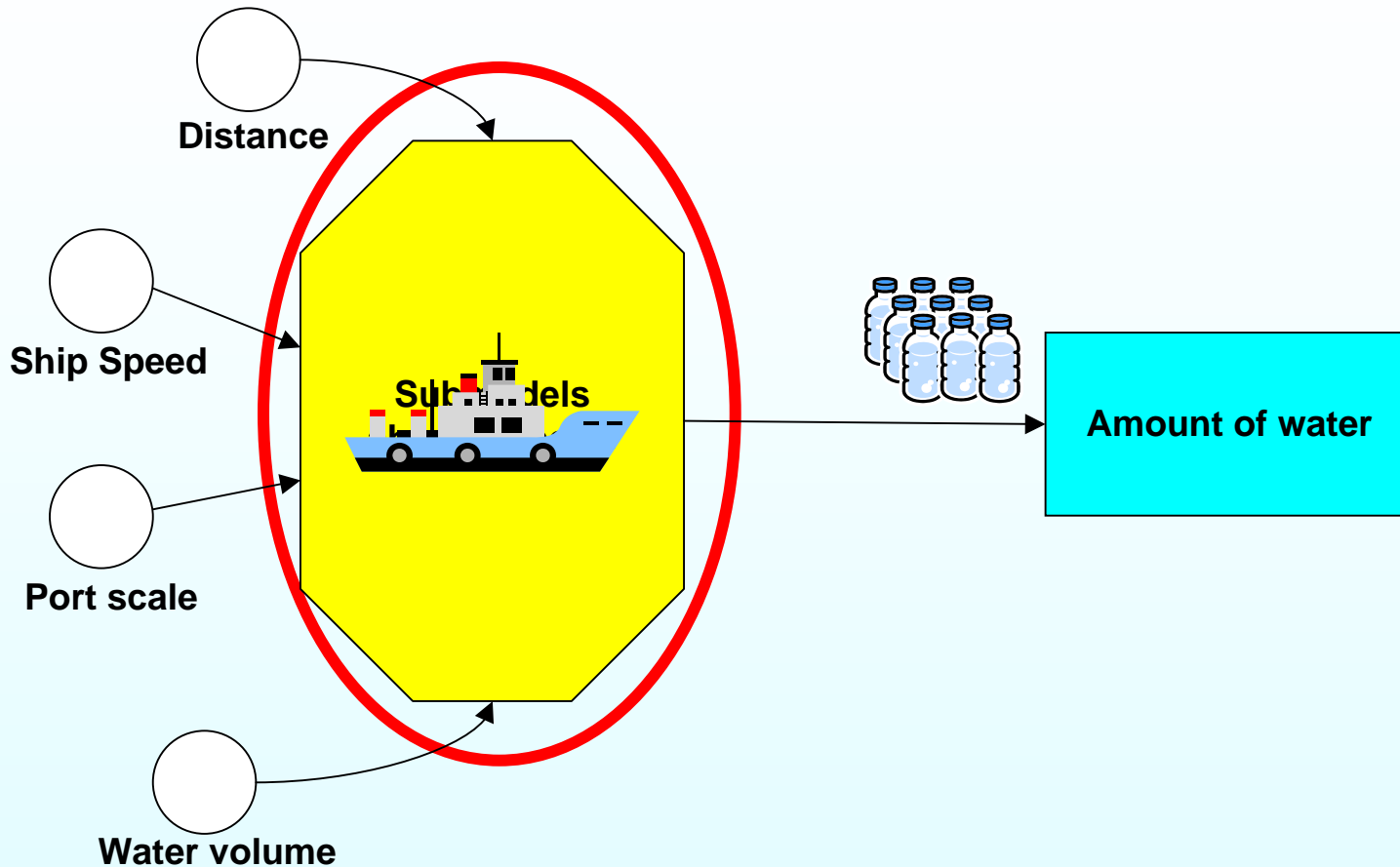
Apply this 14% possibility
to Kochi city as well.

Kochi city

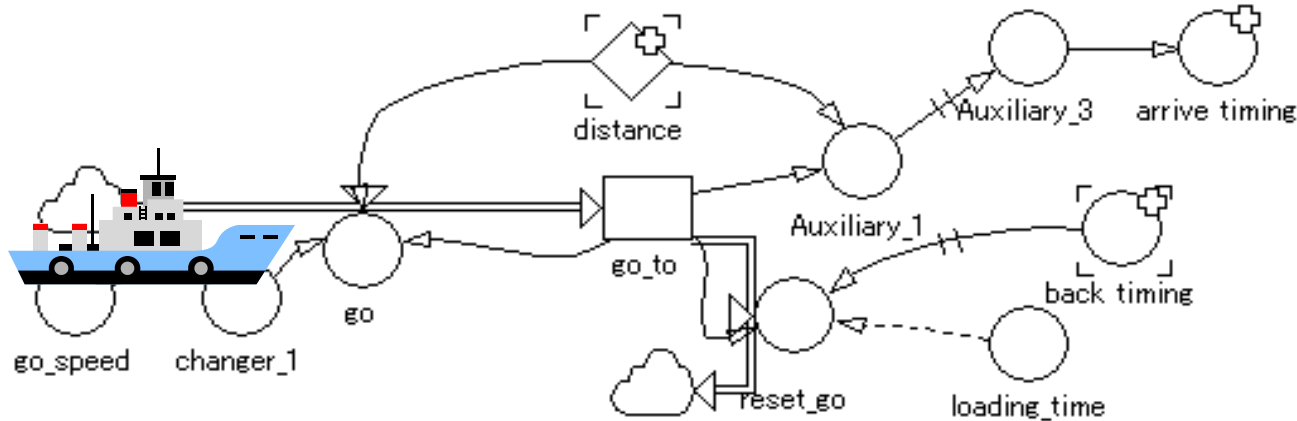
330,000 people

Kochi city needs about
450,000 liters of water
for 3 days totally.

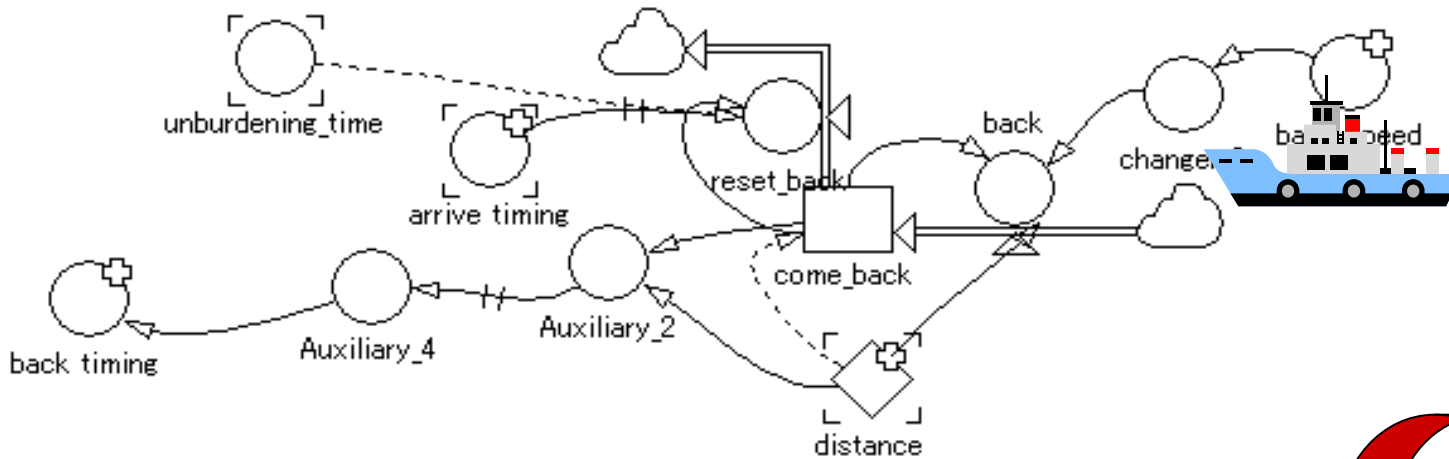
1 person needs 3 liters of water
per day for first 3 days.



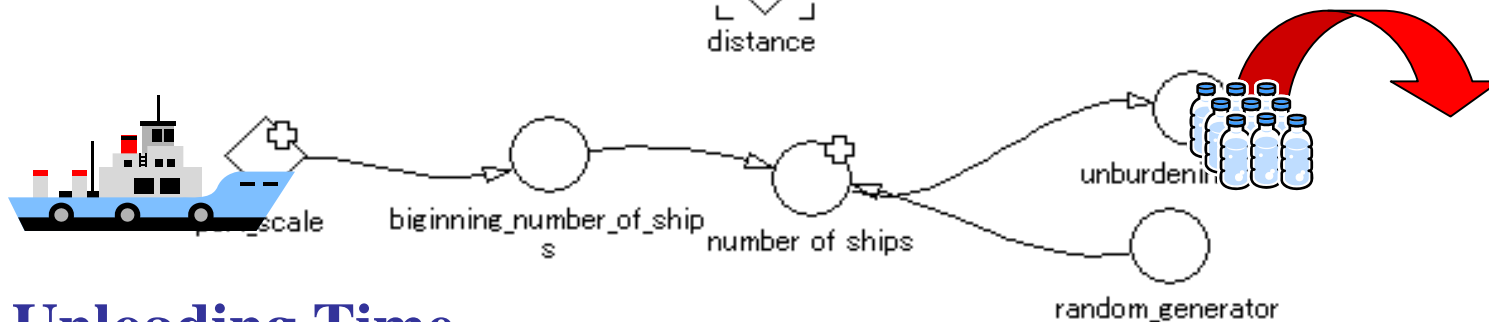
Sub-models about 26 ports are in this red circle.



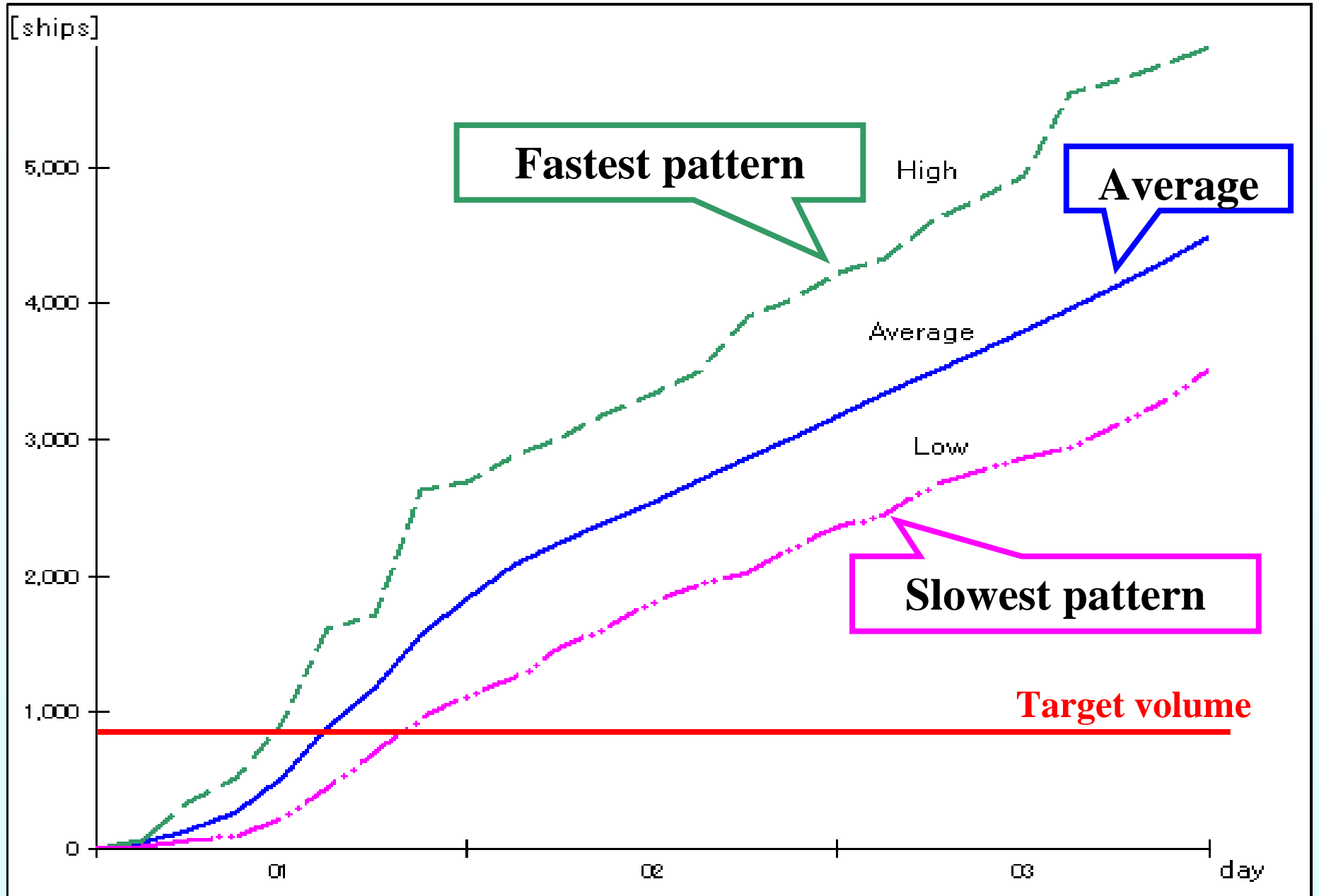
To damaged area.



From damaged area.



Unloading Time





1200000

1000000

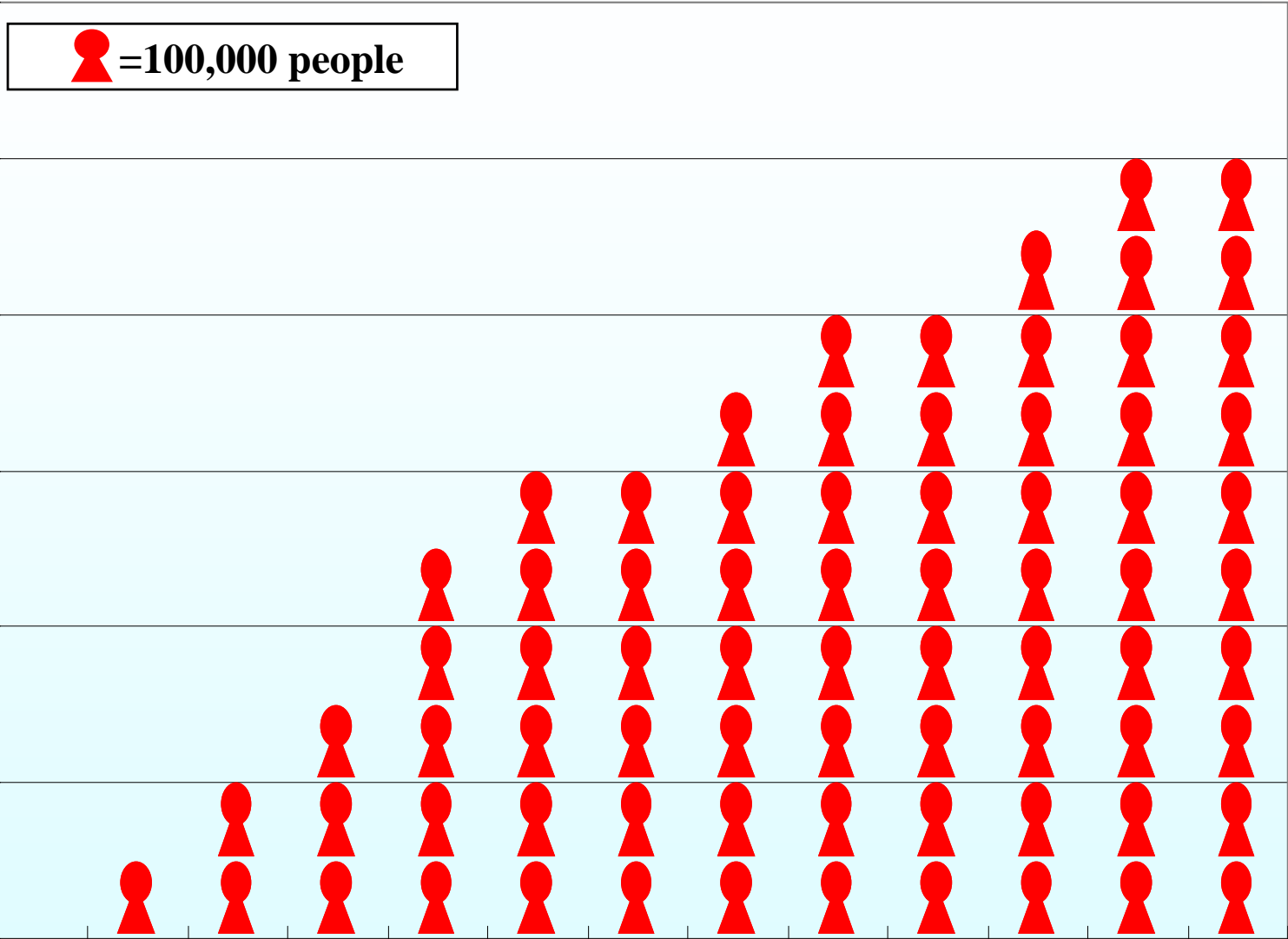
800000

600000

400000

200000

0



0:00

6:00

12:00

18:00

0:00

6:00

12:00

18:00

0:00

6:00

12:00

18:00

0:00

[time]

1st day

2nd day

3rd day

4th day



■ From the simulation, time required for ships to carry 450,000 liters of water was

- 18 hours (average)

- 12 hours (fastest pattern)

- 21 hours (slowest pattern)

Ports or ships supposed to support may be damaged and cannot go to support due to a damage scale of the disaster.

■ In this simulation model, supply was only water.

Foods, fuels, commodities, medicines, medical staffs have to be carried.

Time required to supply enough water will increase.



- **To simulate more precisely,**
 - **types of supplies have to be increased.**
 - **consider that supplies will be used and its amount will decrease.**

- **Support from sea after disaster can supply enough water to Kochi city.**

This shows the efficiency of support from sea by ships.



- **Constructing the supporting network**
- **Surveying the number of supportable ships**
- **Improving simulation model**

Improved simulation model will be able to propose more effective support by simulating usage of ships by basic mind of 5W1H at disasters.



Thank you for your attention.

謝謝！

Data of The Elements



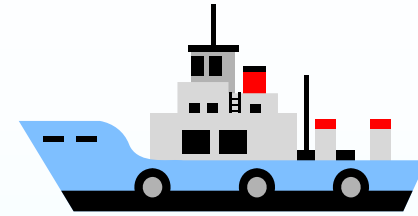
-Assumptions-

- The size of all ships is **3GT**.

- 1 ship can carry **700kg**.

 - Capacity of the ship is about 10 people.

 - Assuming that weight of 1 person is 70kg.



- 1 ship carry **500kg** load excluding 2 operators' weight and the margin.

 - ⇒ 1 ship carry **500 liters of water**.

- **50,000** people suffered.

- 1 person needs **3 liters of water** per day for first 3 days.

 - ⇒ Kochi city needs about **450,000 liters of water** for 3 days totally.