

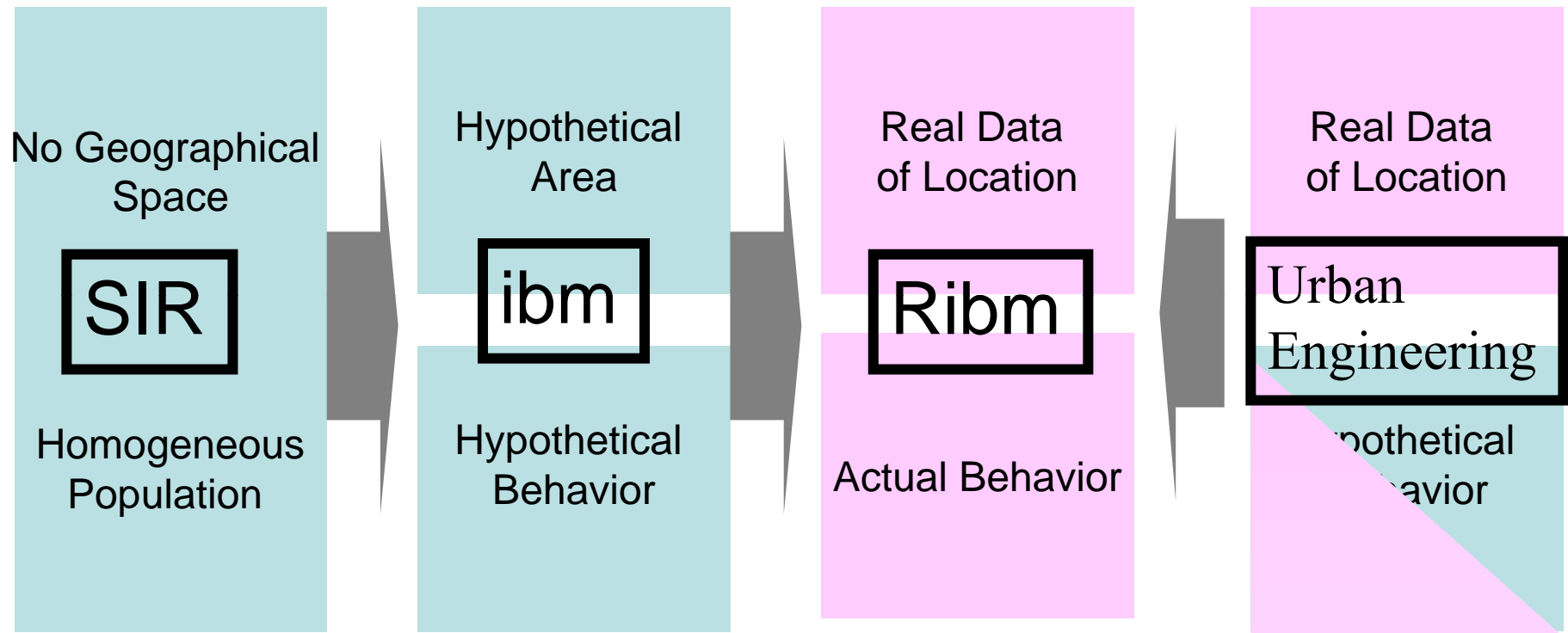
# GIS for Pandemic Simulation in Japan

Infectious Disease Surveillance Center,  
National Institute of Infectious Diseases,  
Japan

# Pandemic Simulation

- Evidence for preparation planning for pandemic flu
- Required the most realistic and detail simulation to determine policies

# Brief History of Mathematical modeling for Pandemic Flu from SIR to Ribm



Ferguson2005	Germann2006
Longini2005	Ferguson2006
Ohkusa2006	Glass2006

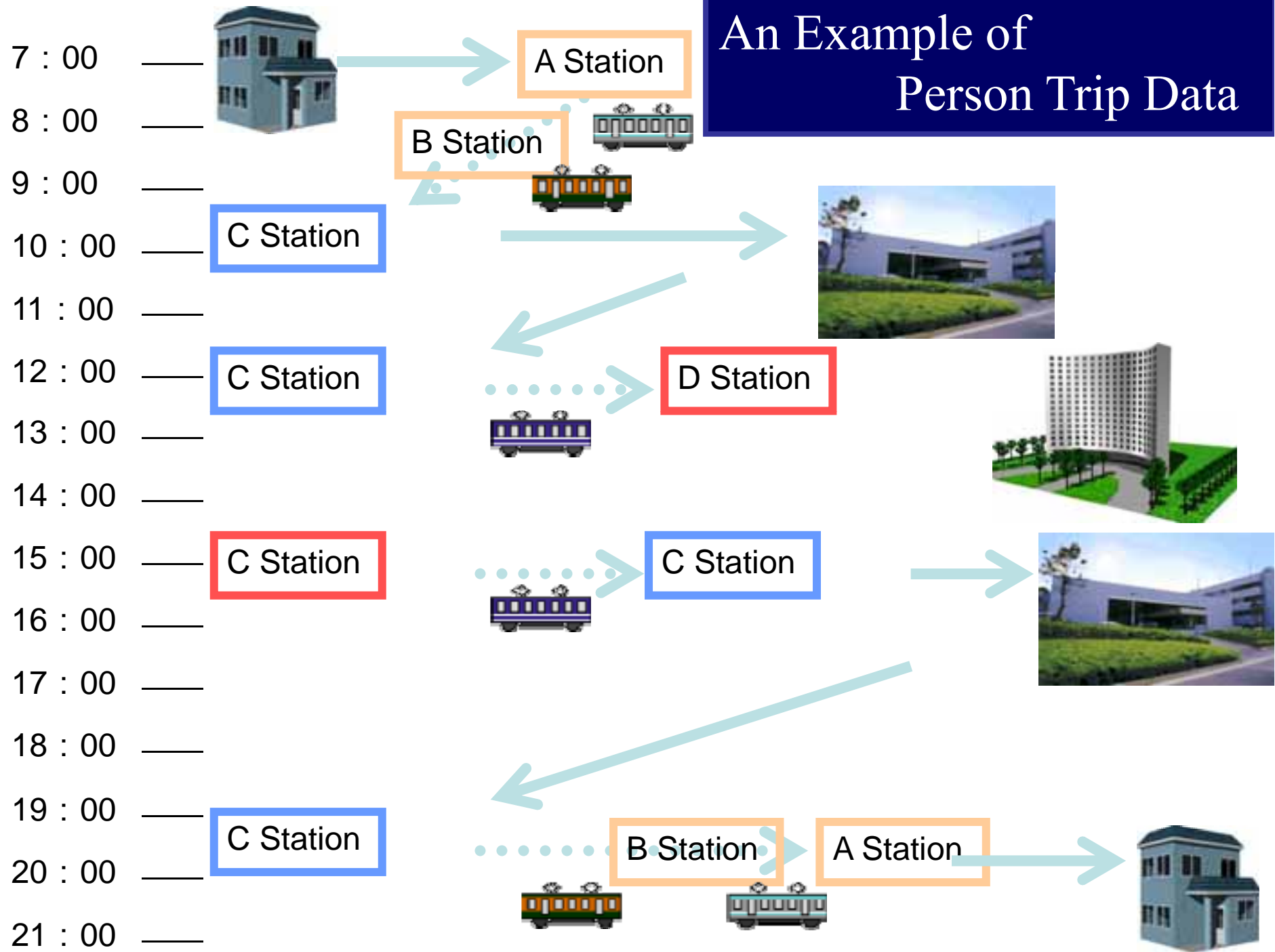
This study

Eubank2004
Eubank2005
Shichijo 2006

# Person-Trip Data of Tokyo Metropolitan Area

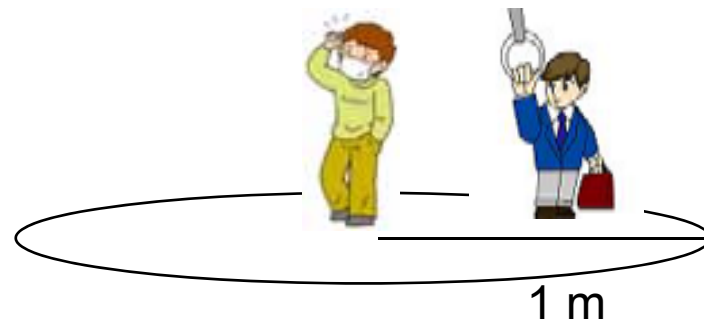
- Data of the location and transportation of 0.9 million persons a day in the Tokyo metropolitan area ,which has a population of 33 million, is available
- about 2% of the population is randomly chosen and is surveyed.
- This data includes family members, transportation mode, and location.
- Location was recorded at home, or school, workplace, shopping center...,
- and the area where these people can be identified in terms of more than 1,600 zones
- Moreover, it contains the name of the station where they get and get off the train, and the timing.

# An Example of Person Trip Data

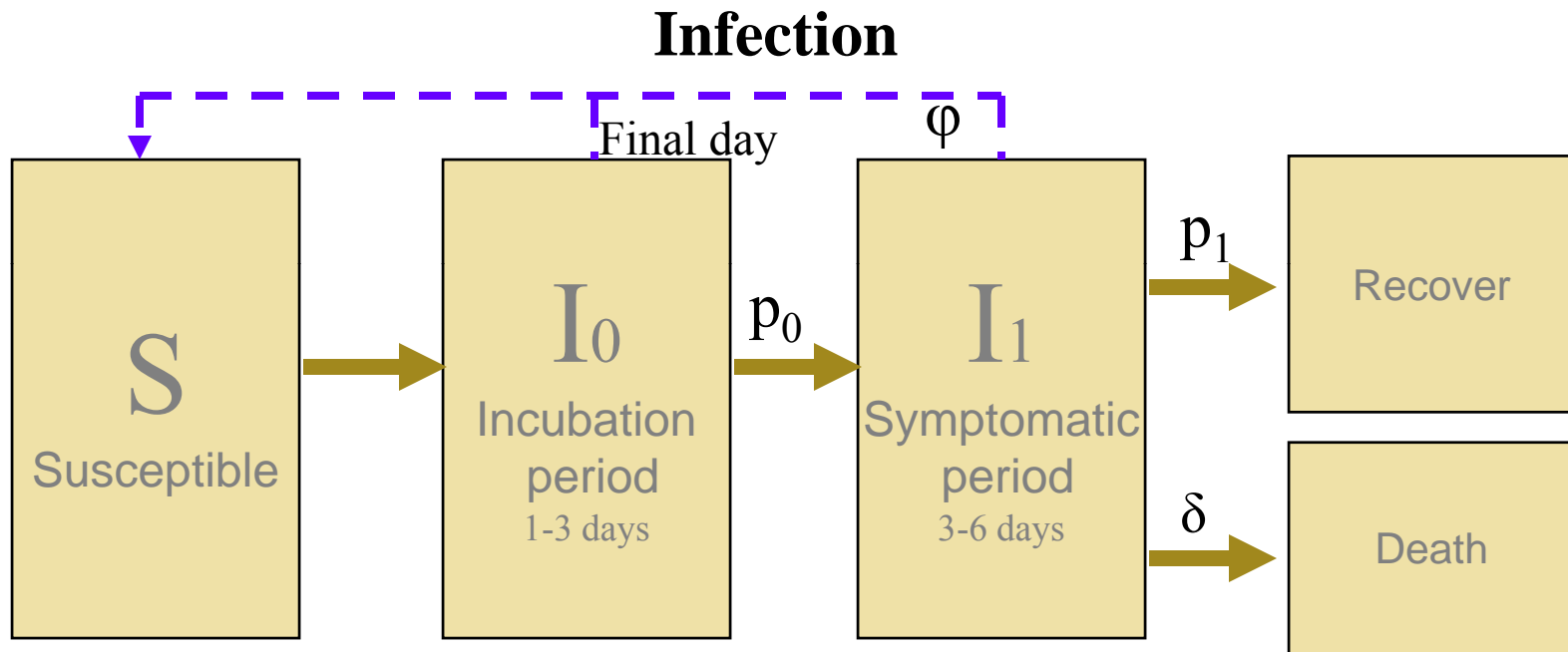


# Estimated Number of Contact

- Identifies location of all person in the data in every 6 minutes.
- Number of contact was estimated as number of persons who were less than 1m distances from patients
- If data indicates n person in the same area or train or bus, and at the same time, the number of contacts was estimated as  $n \times 3.14 / (\text{sampling rate} \times \text{area width in m}^2)$



# Natural History

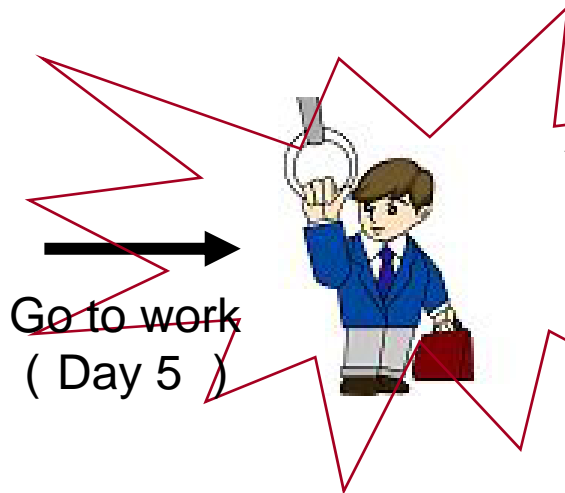
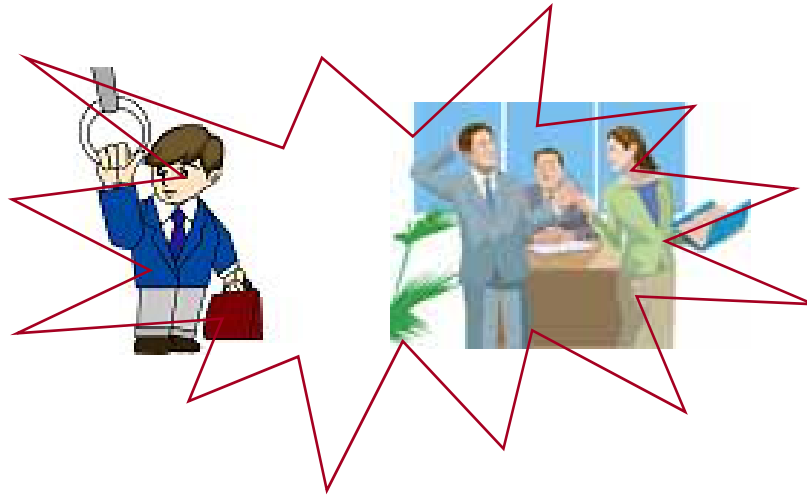


# Scenario

Coming back from the affected area  
(Day 3 )



Go to work  
( Day4 )



Go to work  
( Day 5 )

Afternoon in Day 5

Visiting a doctor



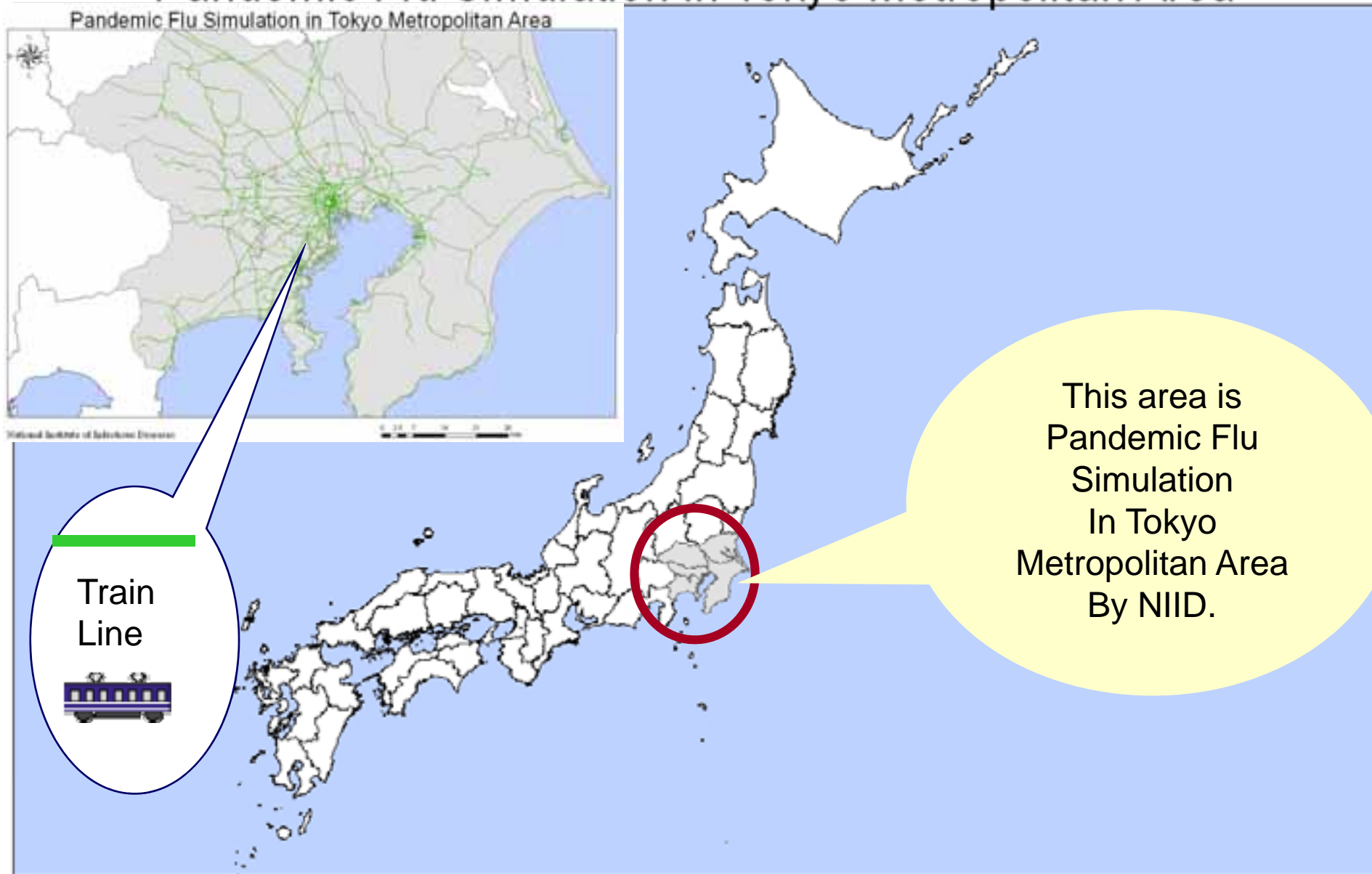


# GIS for Pandemic Simulation

- Understanding the speed of spread intuitively
- Evaluation and planning of policies
  - Area closure
  - School closure and voluntary staying at home
  - Location of medical facility
- Simulation for Tokyo metropolitan
- Effectiveness of area closure
  - Effectiveness of school closure and voluntary staying at home
- Nation wide simulation
- Simulation for local city

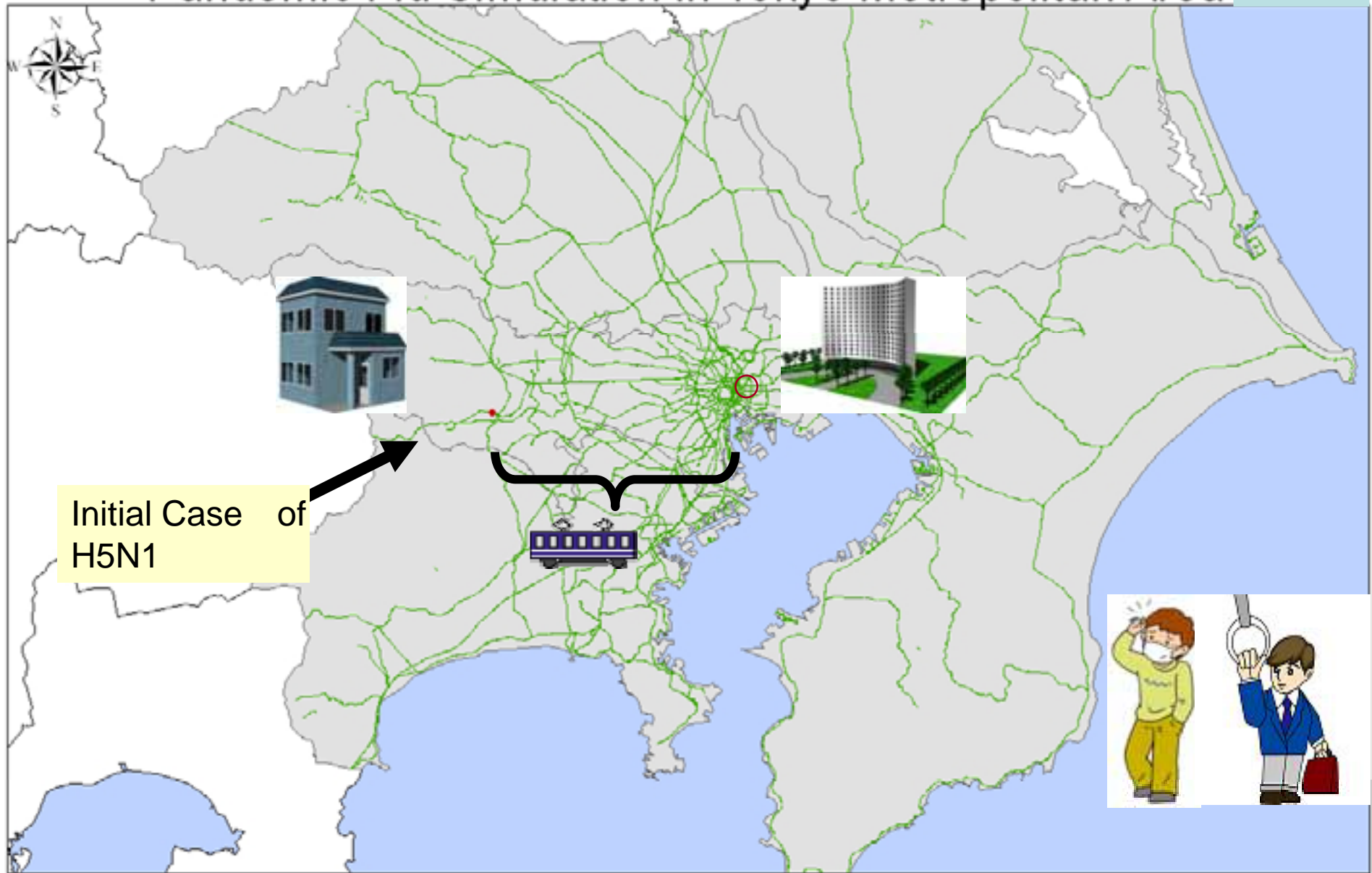
# Simulation for Tokyo Metropolitan

# Pandemic Flu Simulation in Tokyo Metropolitan Area



# Pandemic Flu Simulation in Tokyo Metropolitan Area

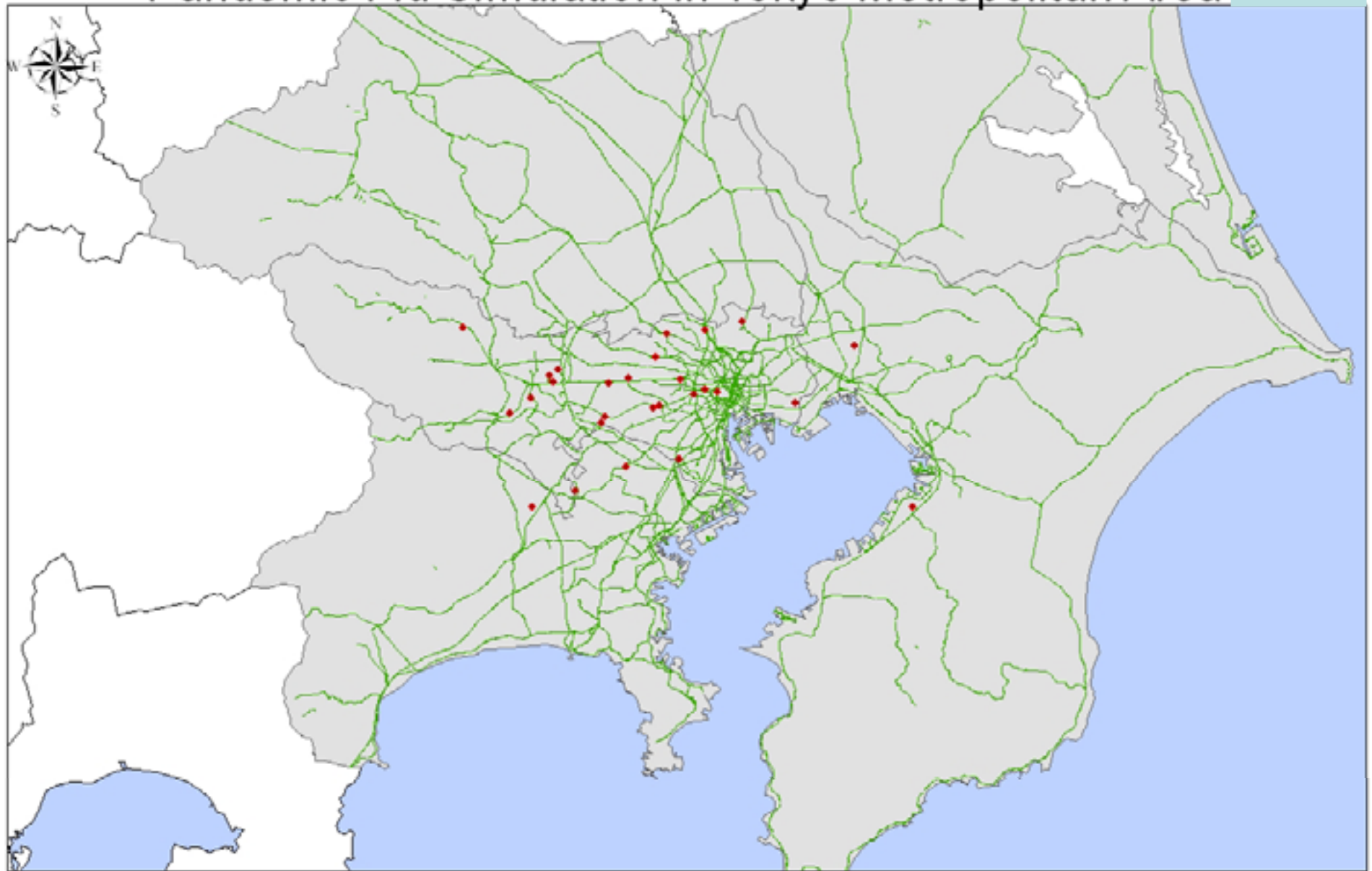
Day 3



Initial Case of H5N1

# Pandemic Flu Simulation in Tokyo Metropolitan Area

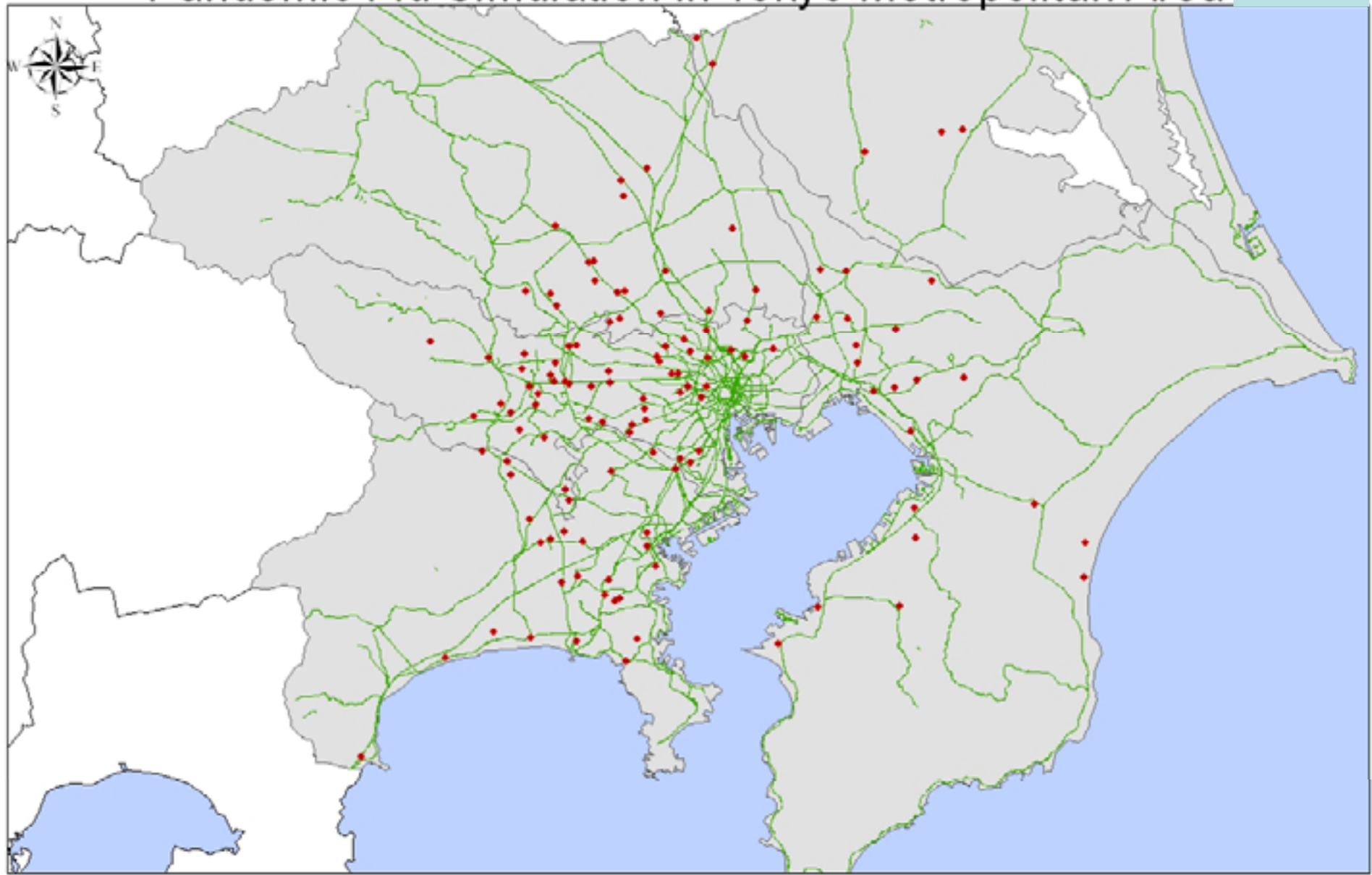
Day 4





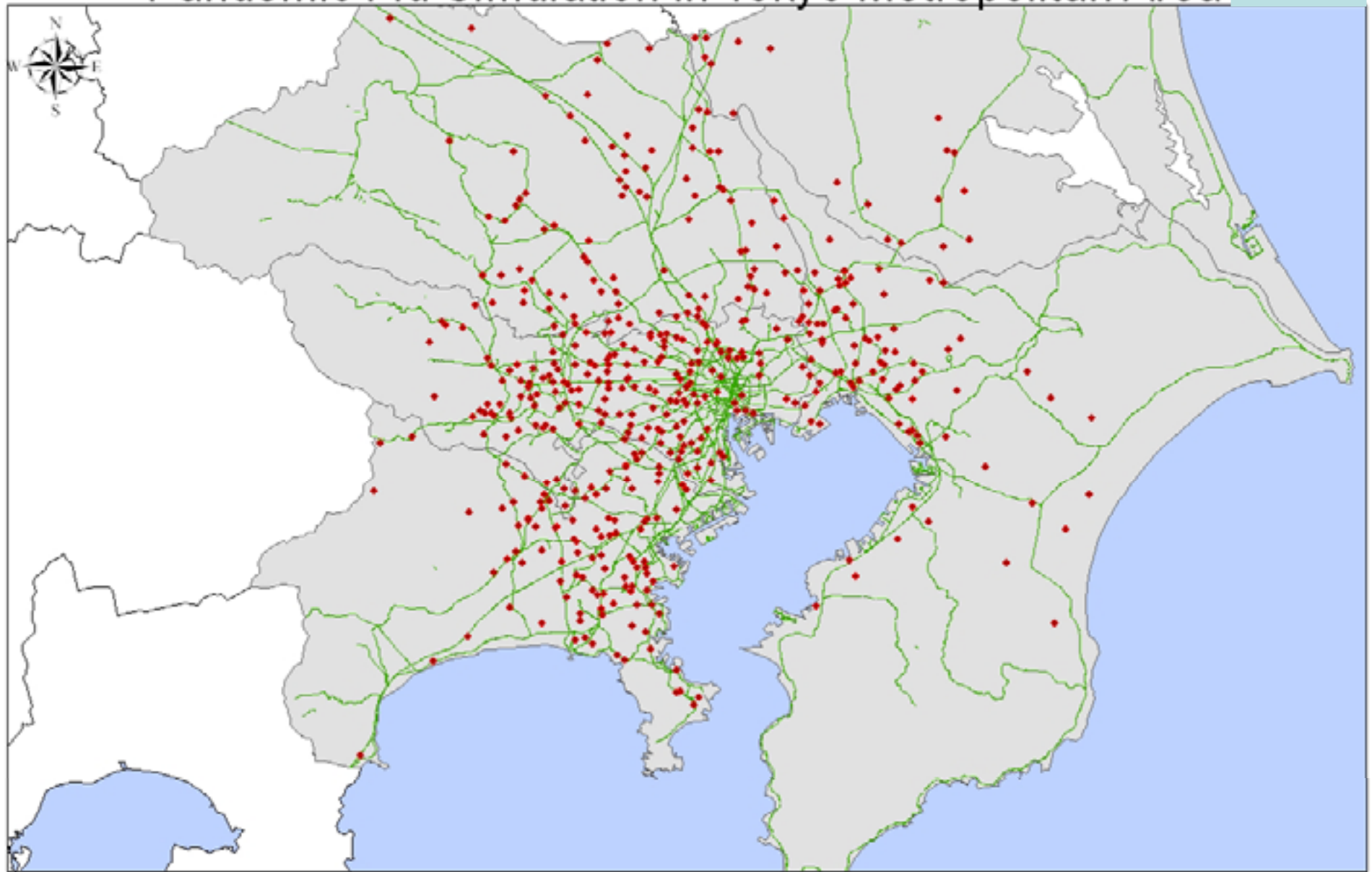
# Pandemic Flu Simulation in Tokyo Metropolitan Area

Day 5



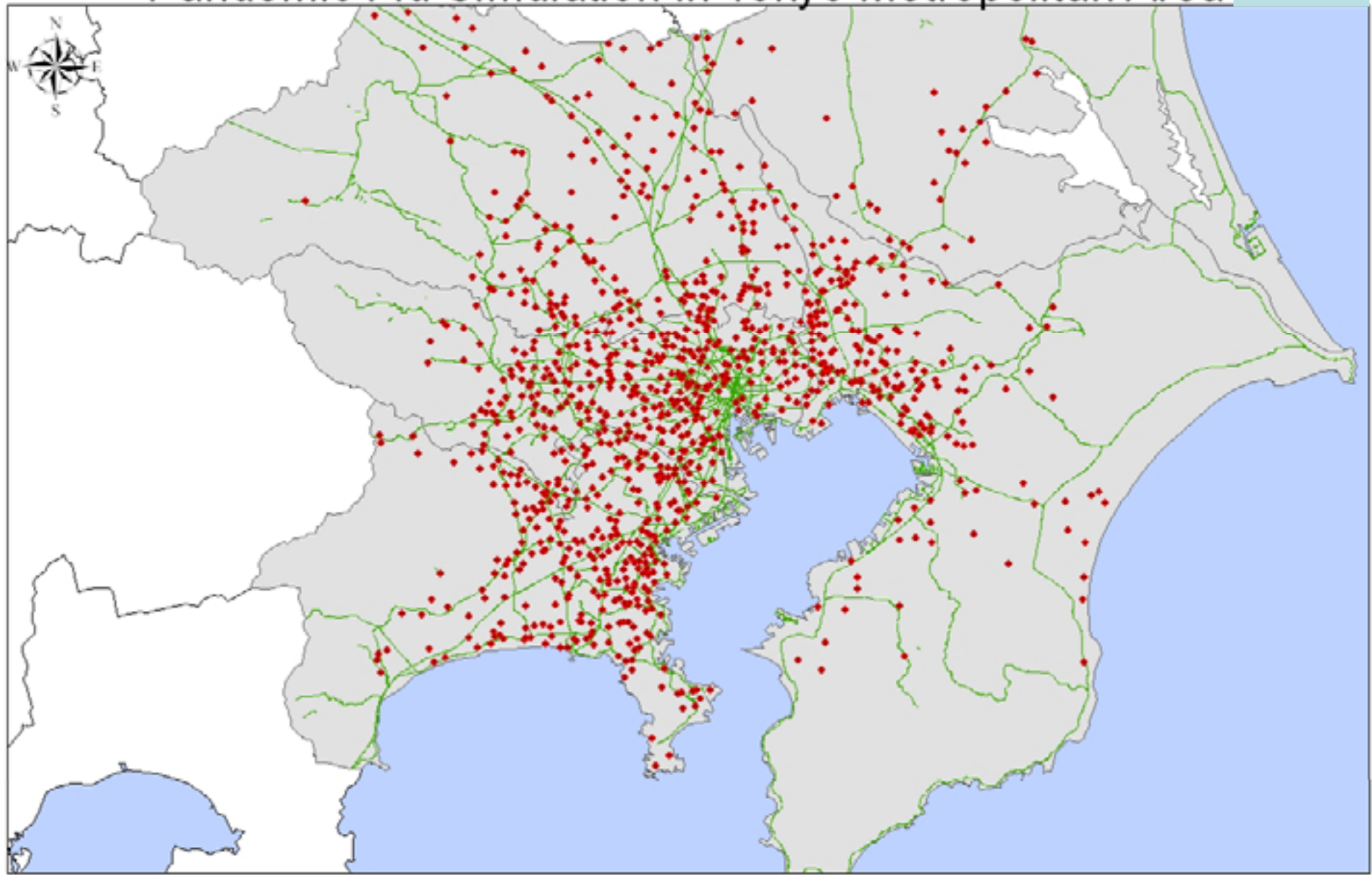
# Pandemic Flu Simulation in Tokyo Metropolitan Area

Day 6



# Pandemic Flu Simulation in Tokyo Metropolitan Area

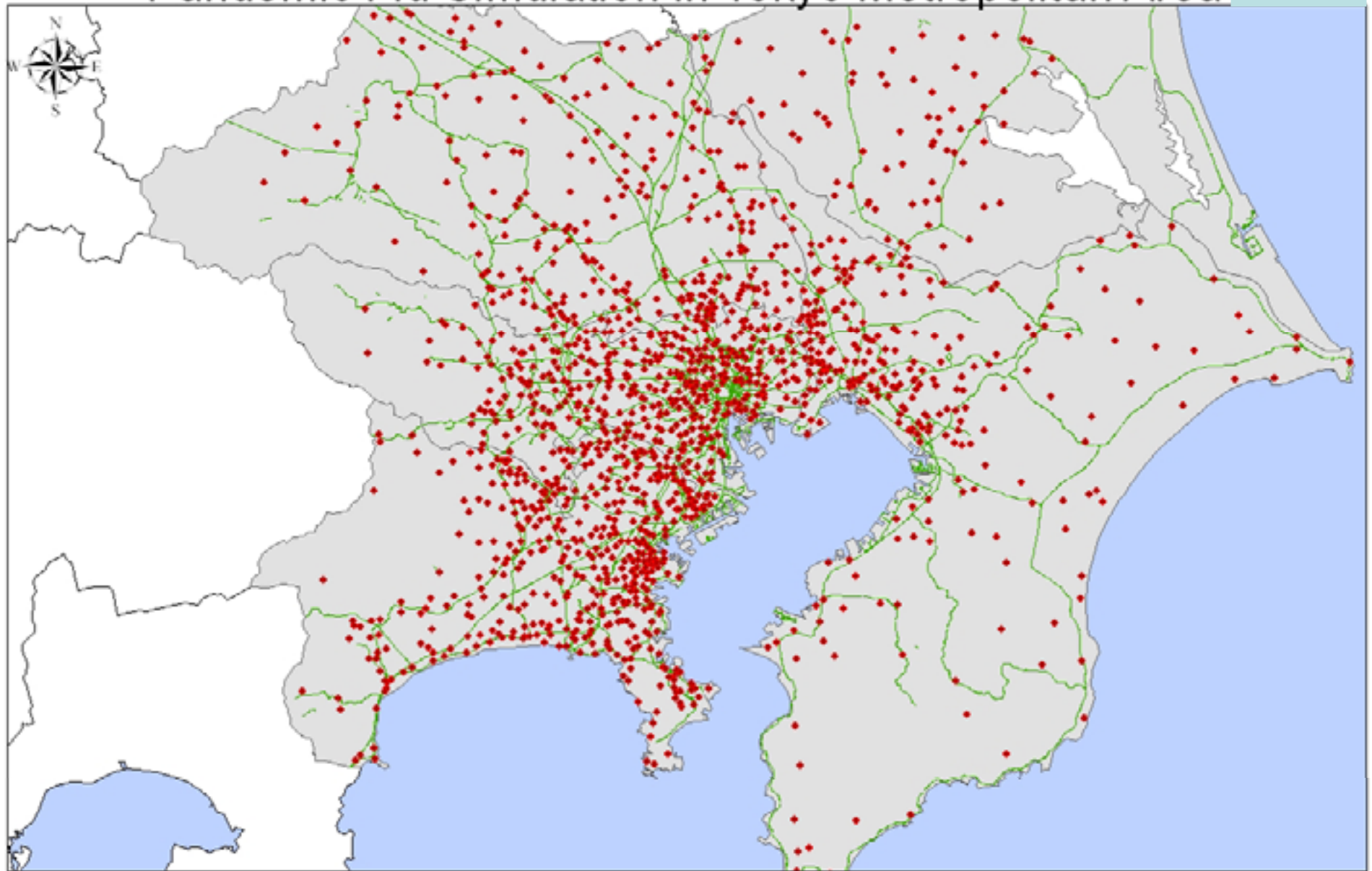
Day 7





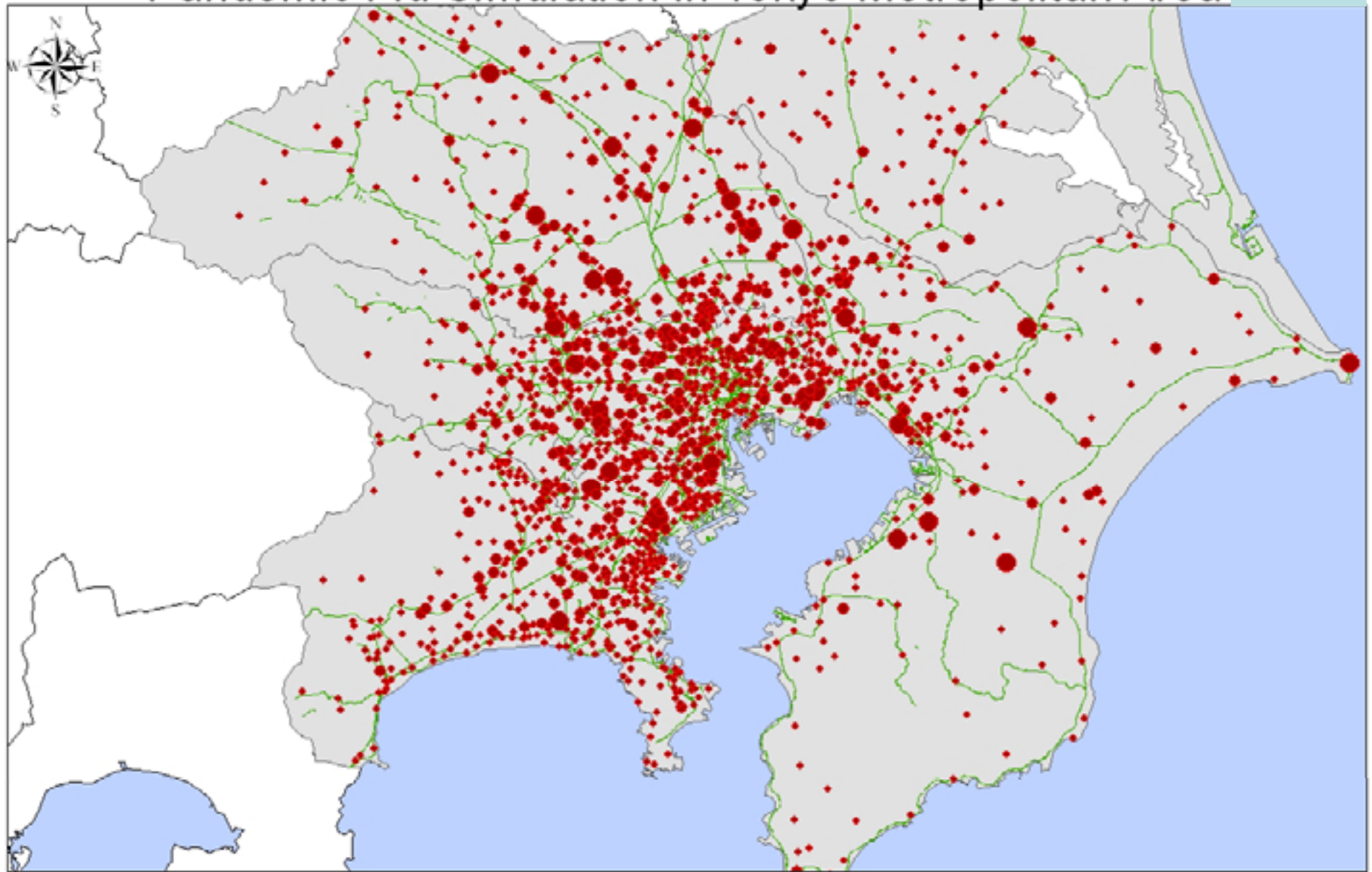
# Pandemic Flu Simulation in Tokyo Metropolitan Area

Day 8



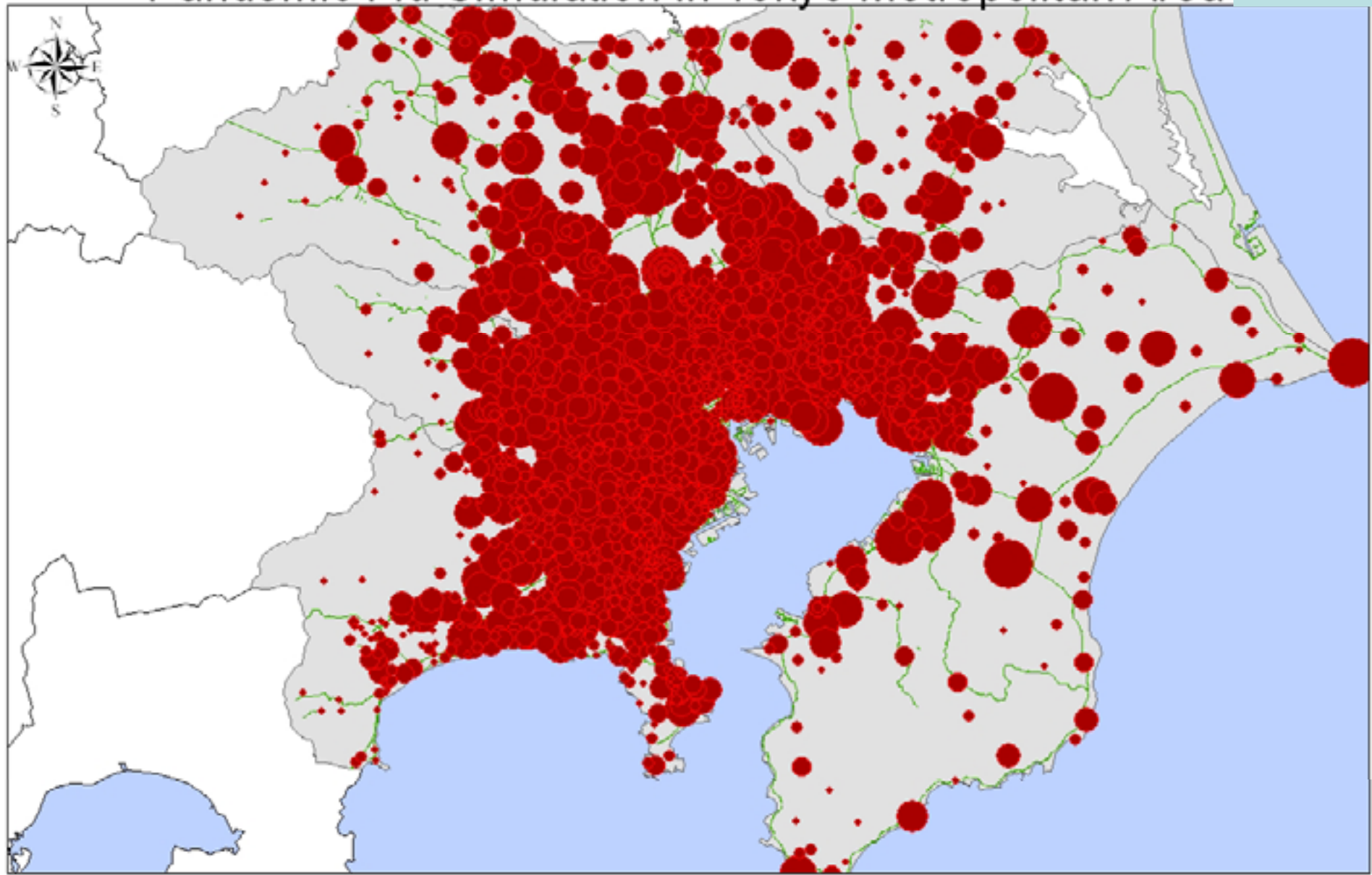
# Pandemic Flu Simulation in Tokyo Metropolitan Area

Day 9



# Pandemic Flu Simulation in Tokyo Metropolitan Area

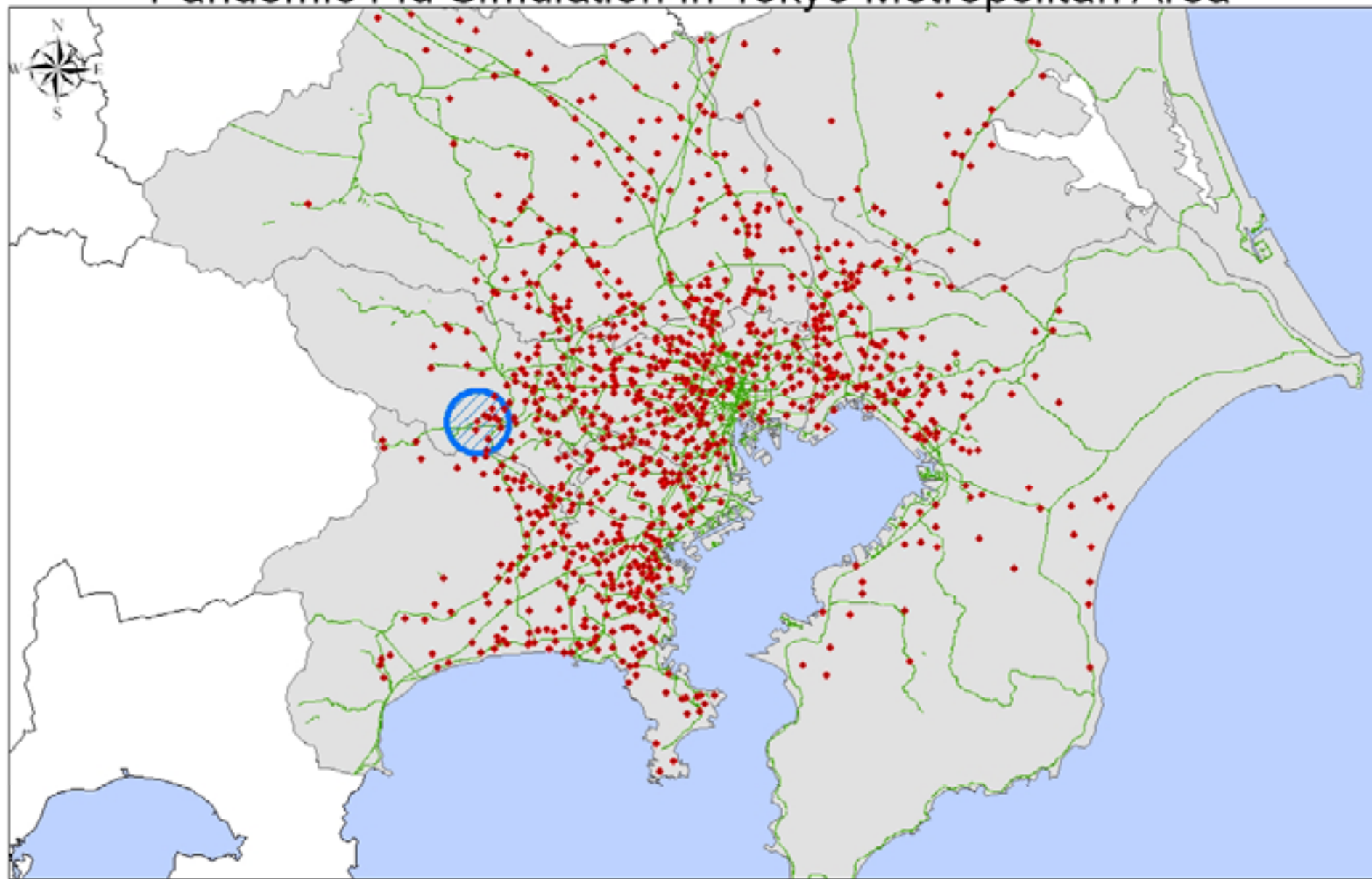
Day 10



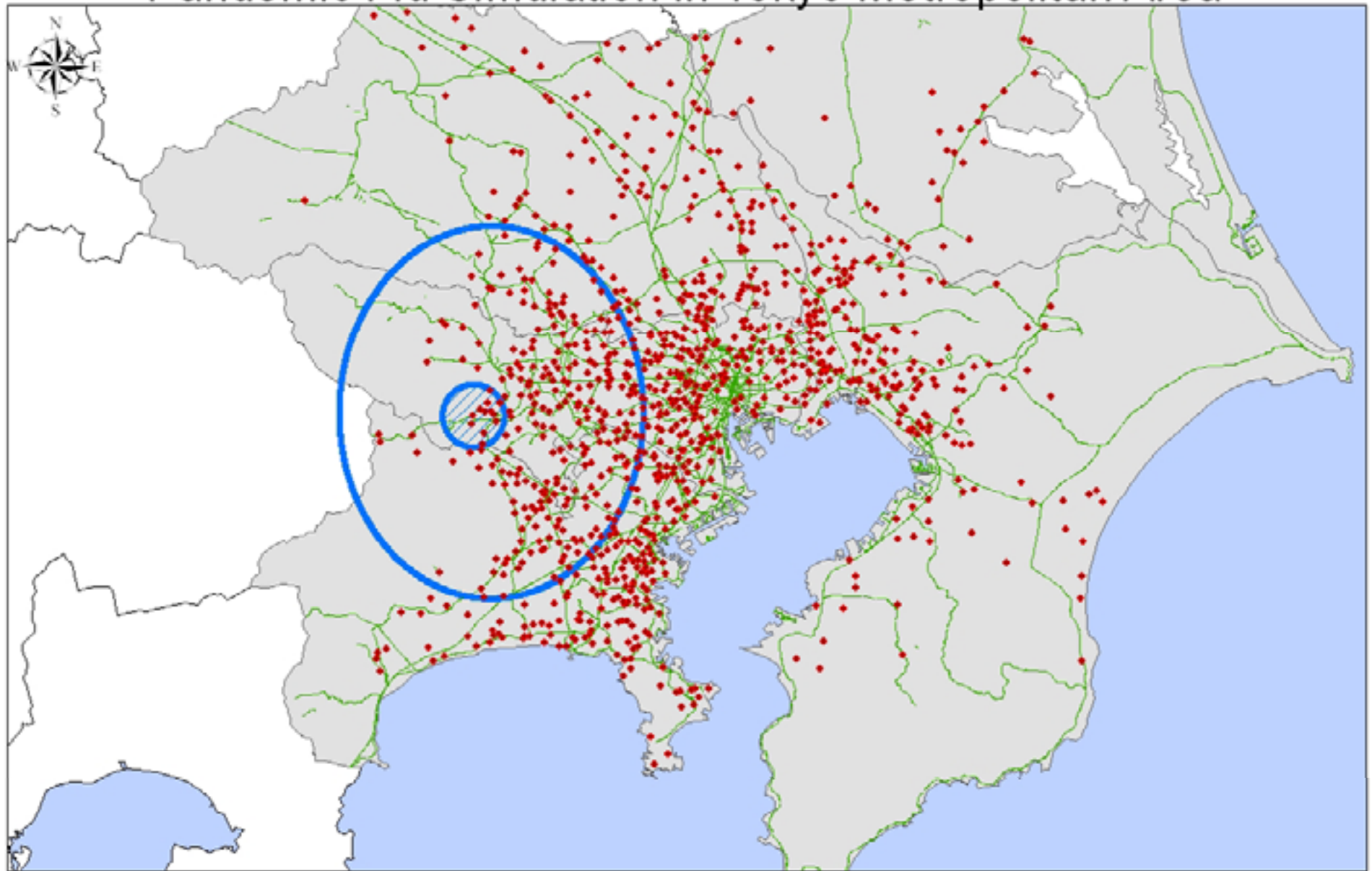
# Area Closure



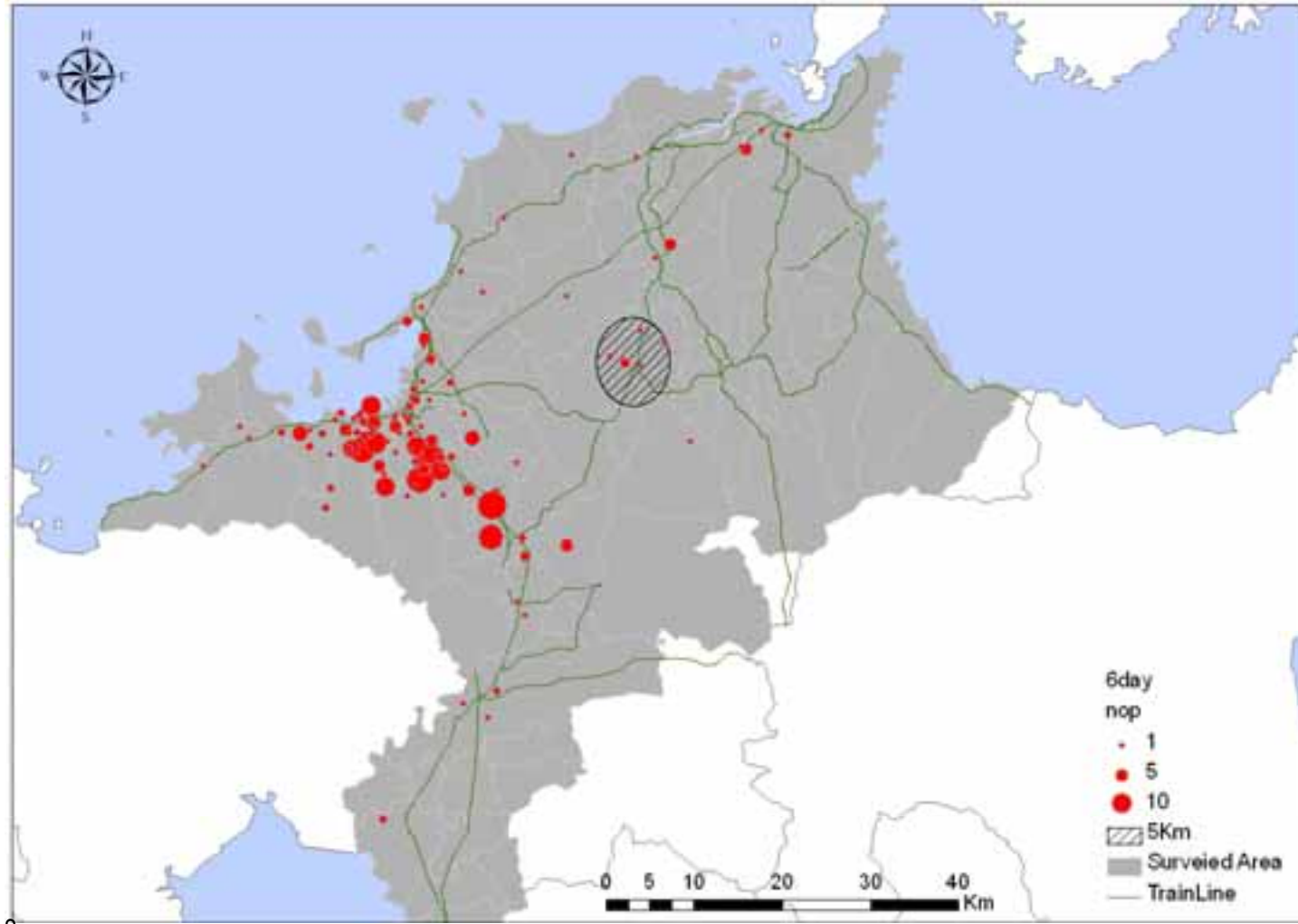
# Pandemic Flu Simulation in Tokyo Metropolitan Area



# Pandemic Flu Simulation in Tokyo Metropolitan Area



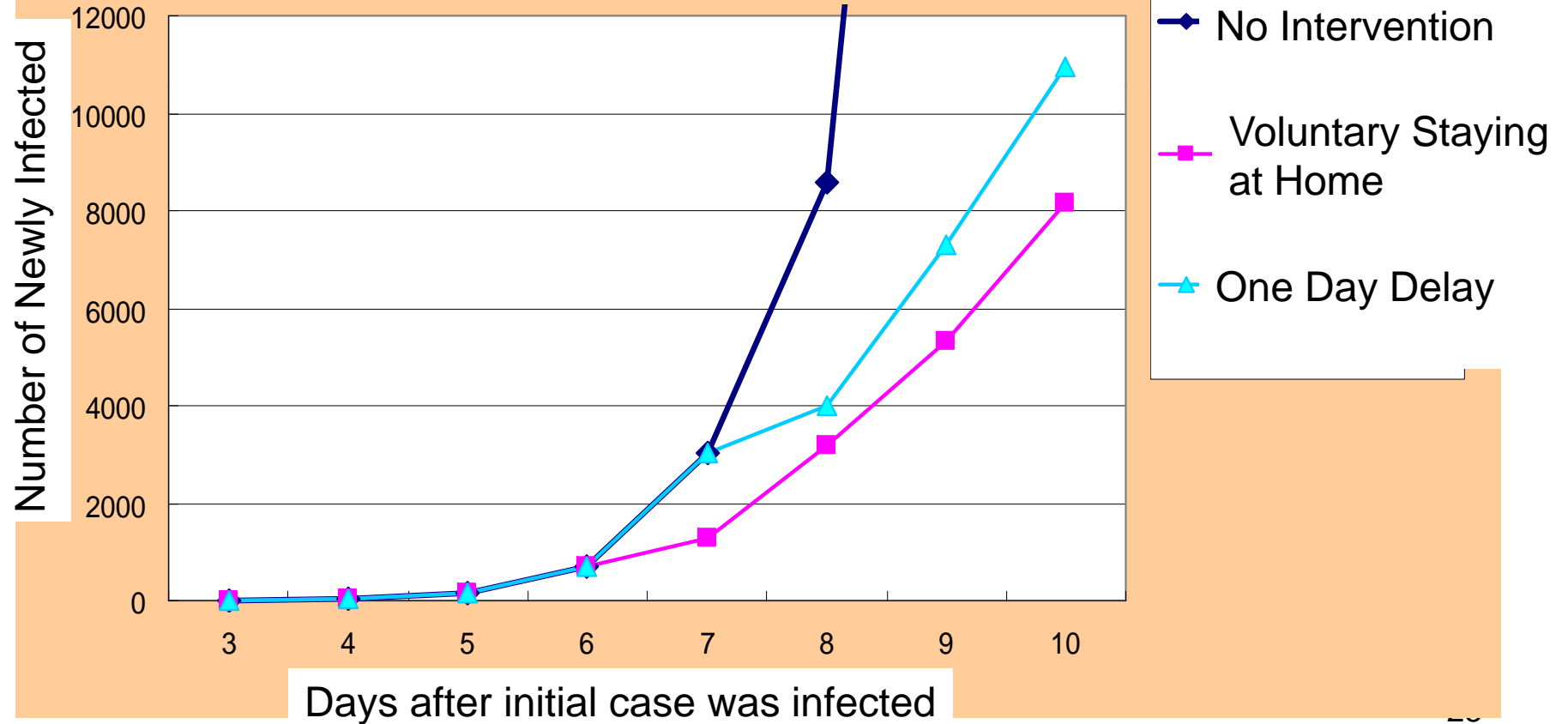
# Simulation at Fukuoka



# School Closure and Voluntary Staying at Home



# Epidemic Curve in Tokyo



# Day 4

No Intervention

Voluntary Restriction



# Day 5

No Intervention

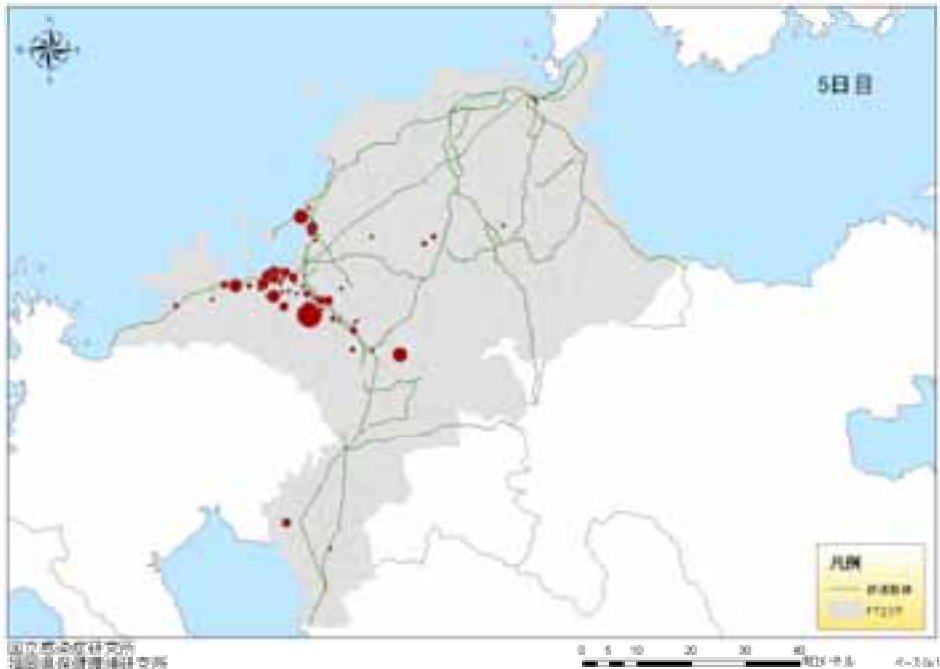
Voluntary Restriction



# Day 6

No Intervention

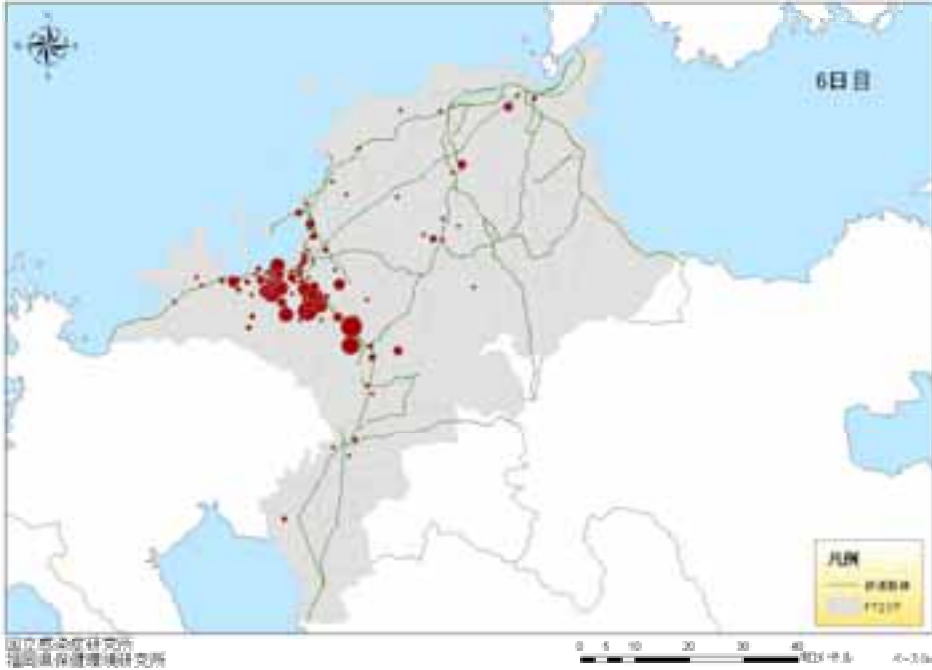
Voluntary Restriction



# Day 7

No Intervention

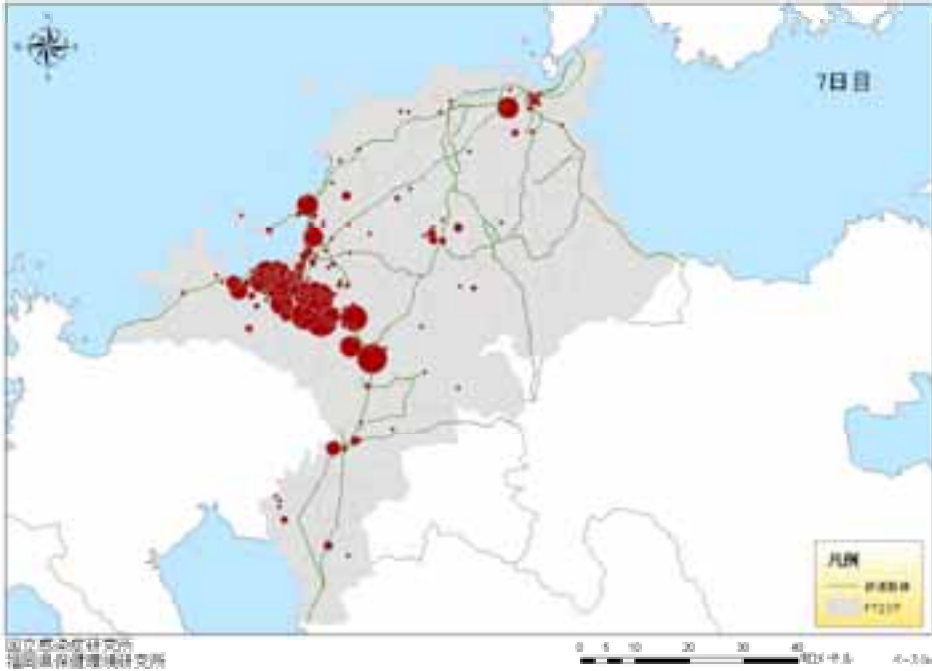
Voluntary Restriction



# Day 8

No Intervention

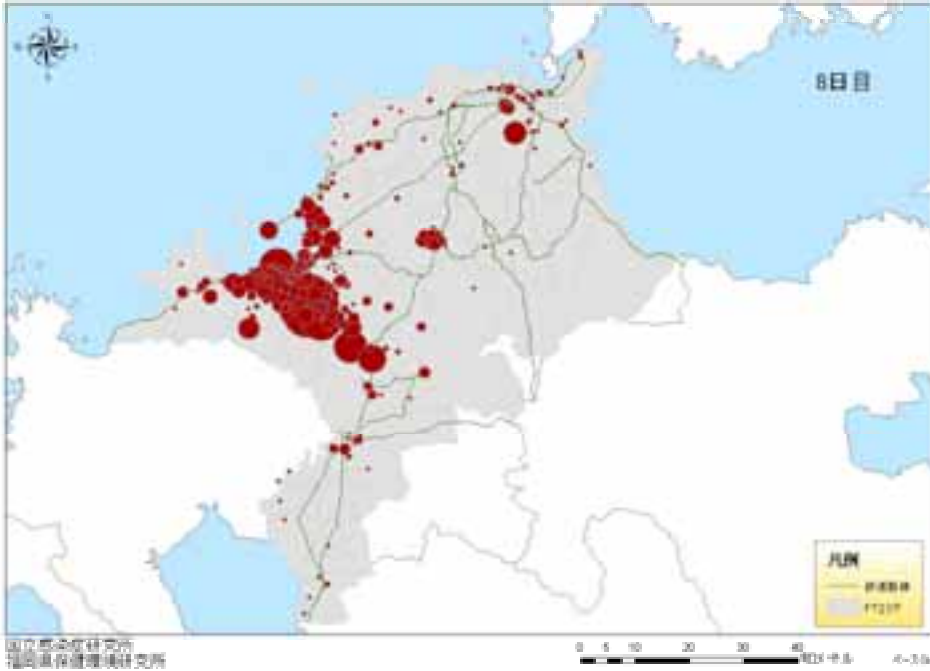
Voluntary Restriction



# Day 9

No Intervention

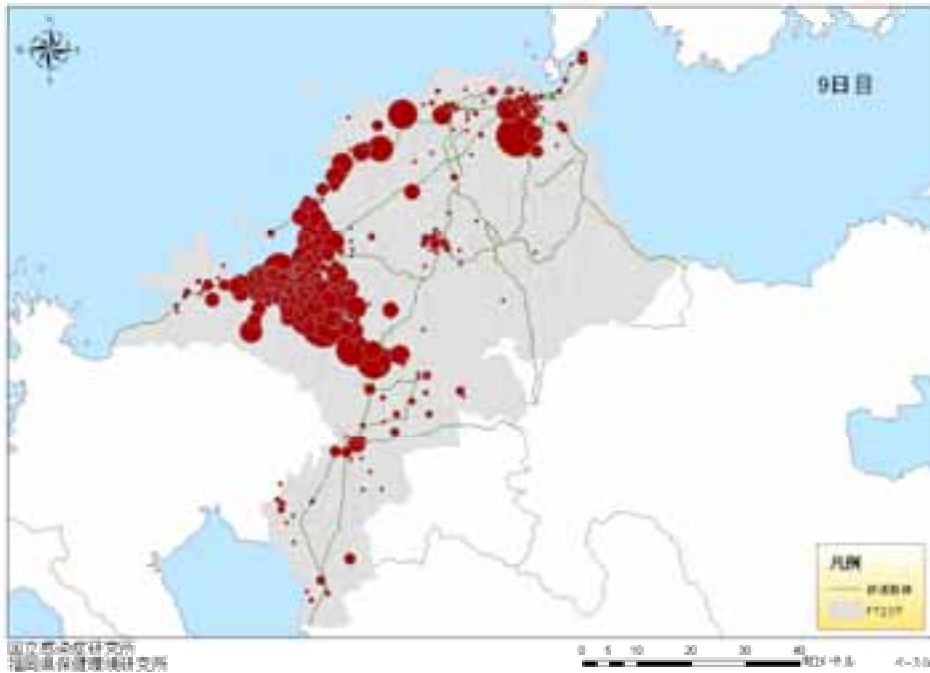
Voluntary Restriction



No Intervention

# Day 10

Voluntary Restriction

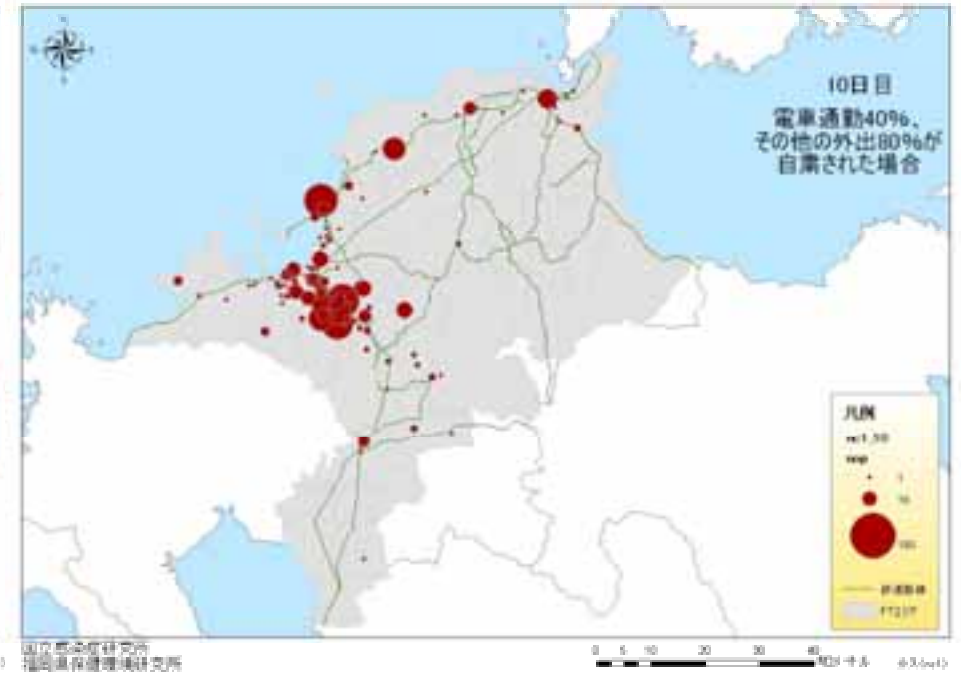
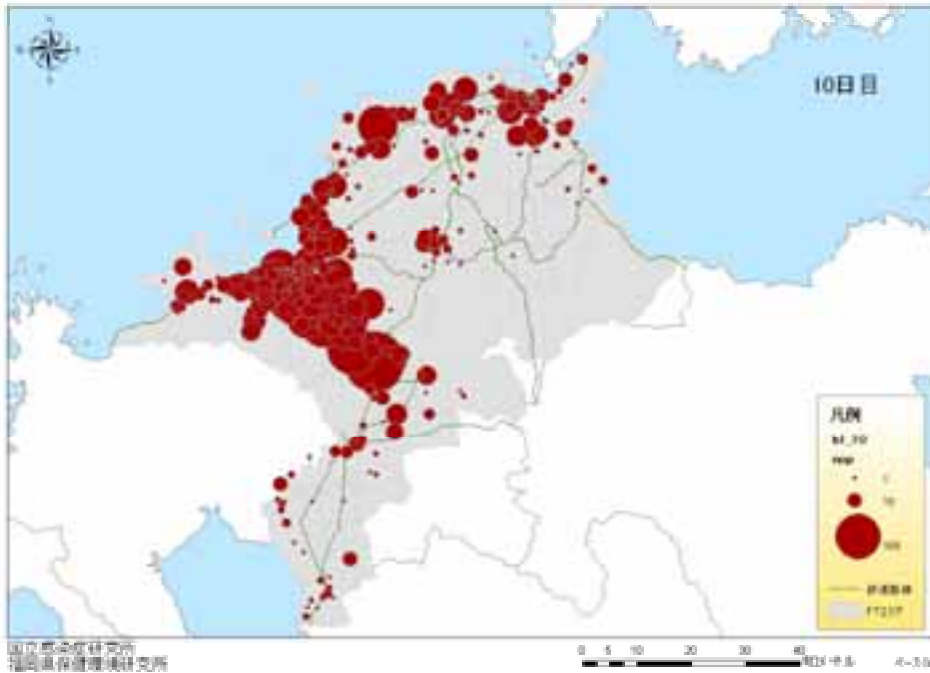




No Intervention

# Day 11

Voluntary Restriction



# Nation Wide Simulation



Day 3





Day 4





Day 5



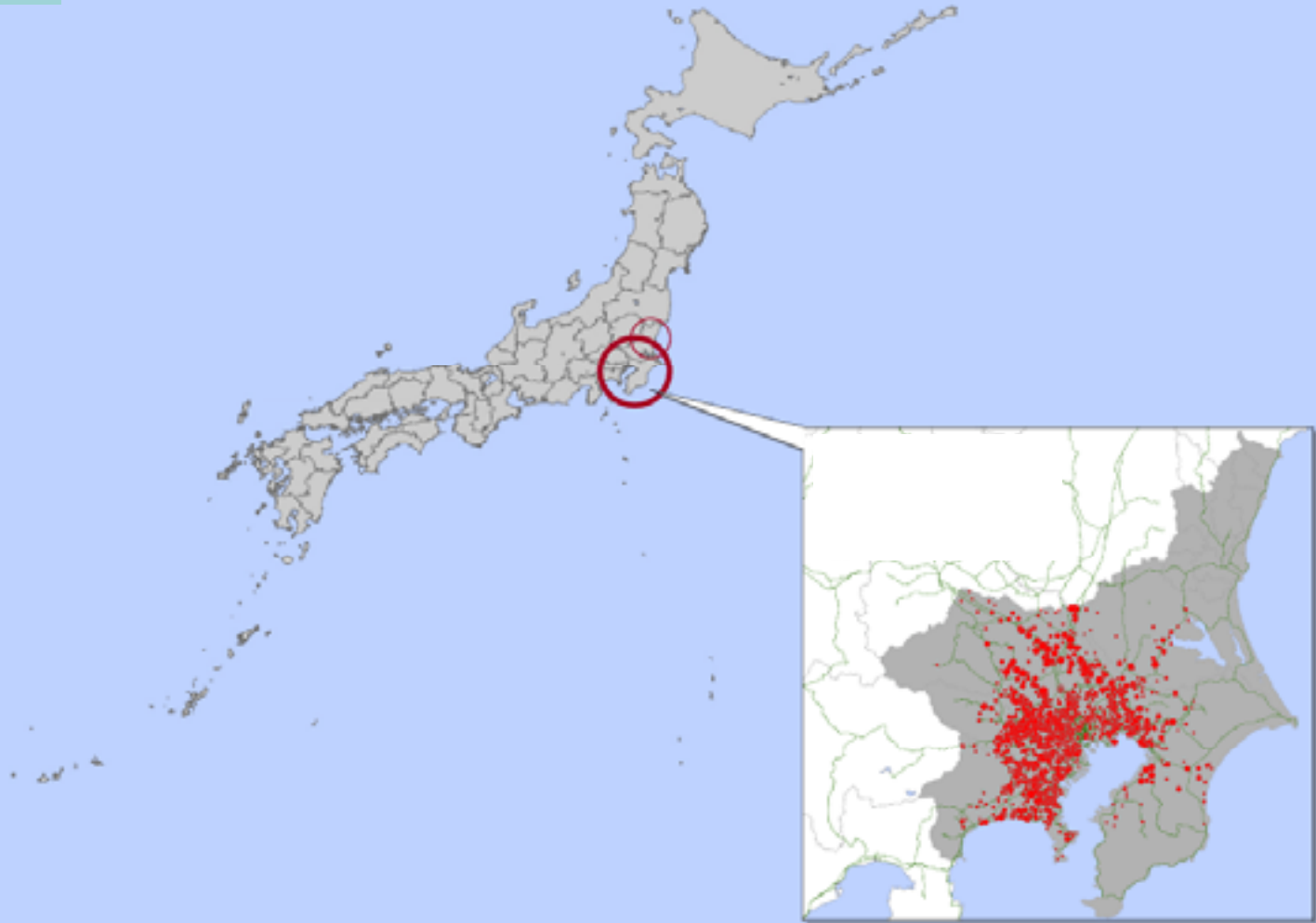


Day 6





Day 7





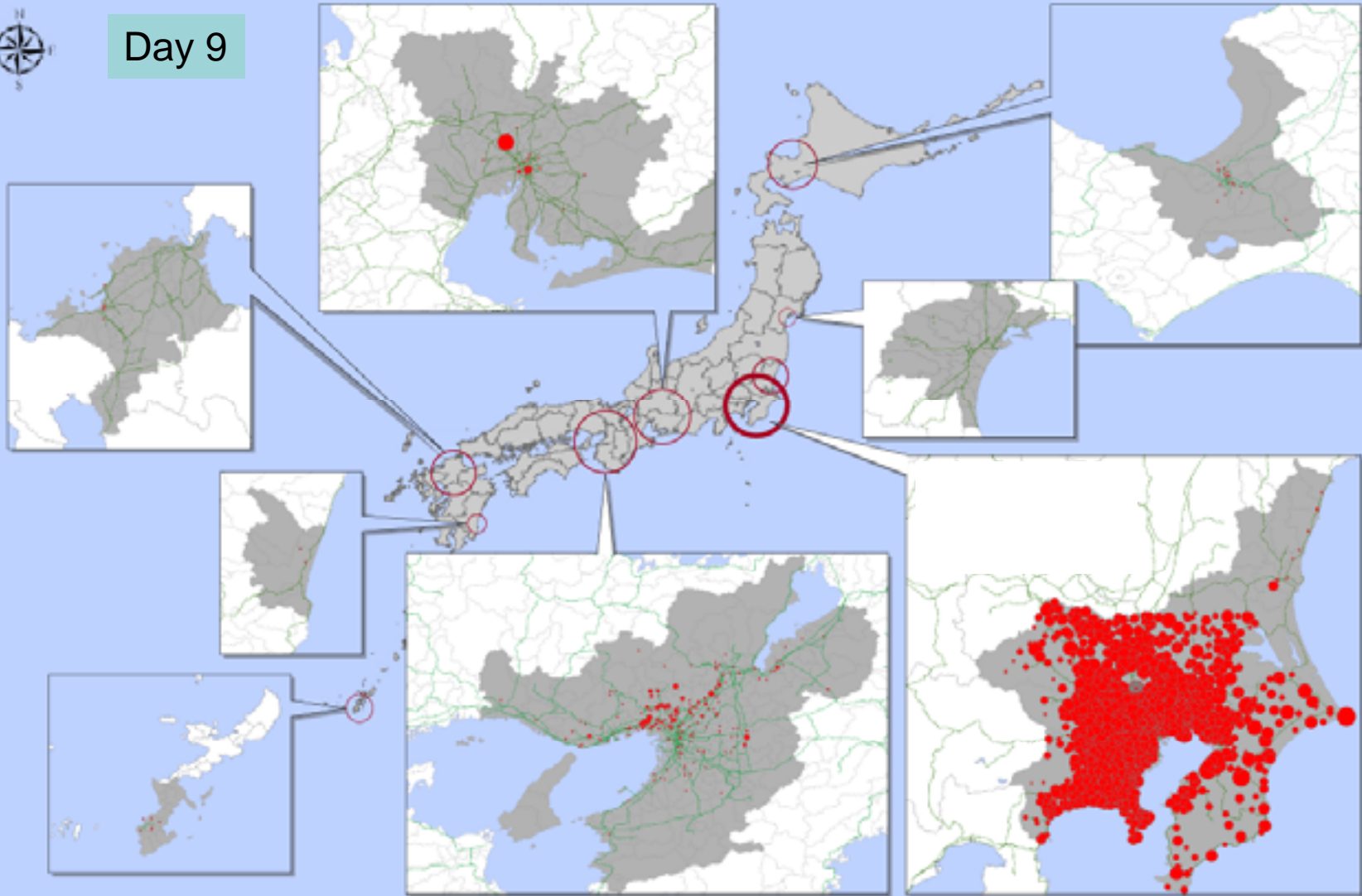
Day 8





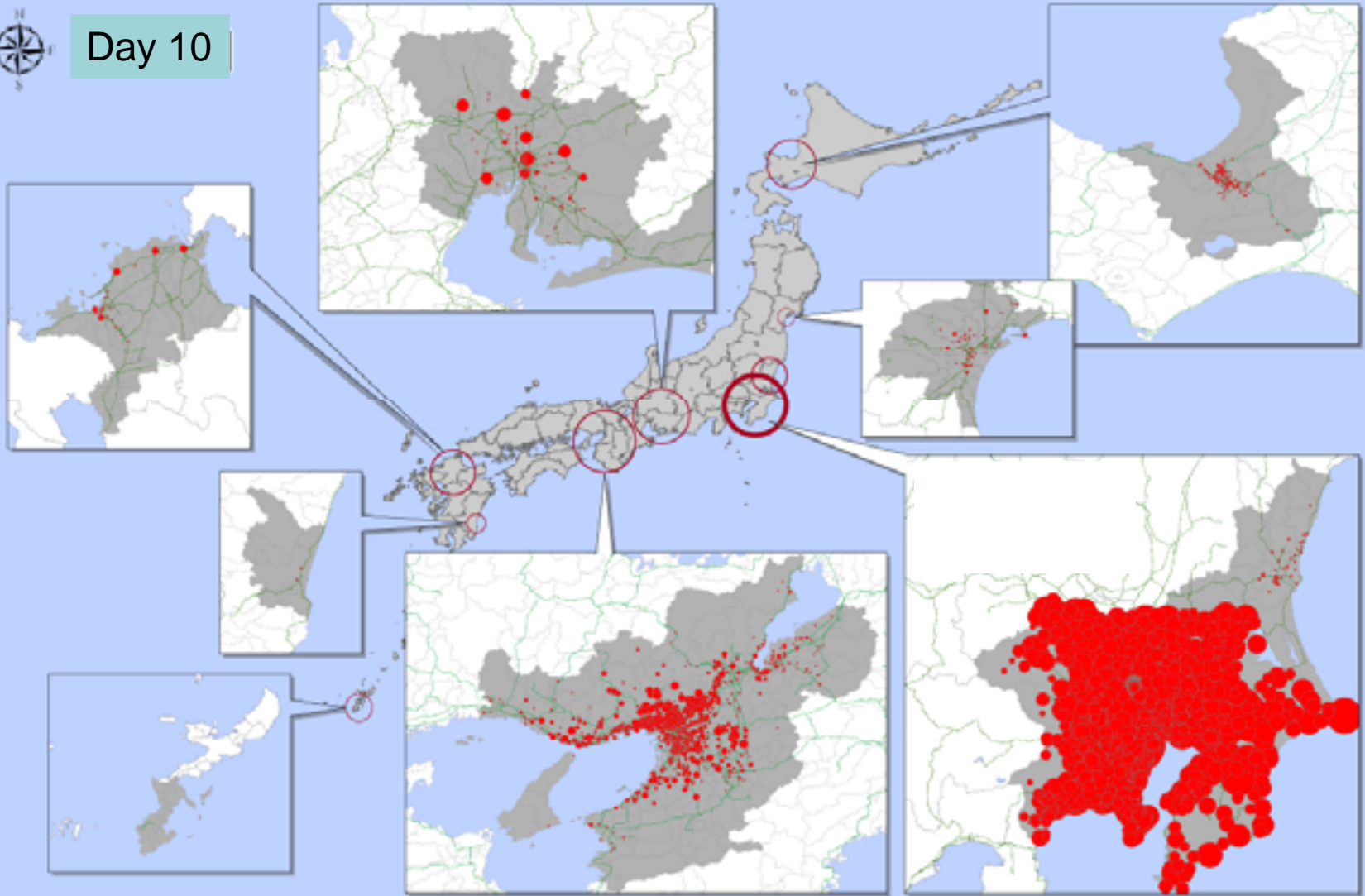


Day 9



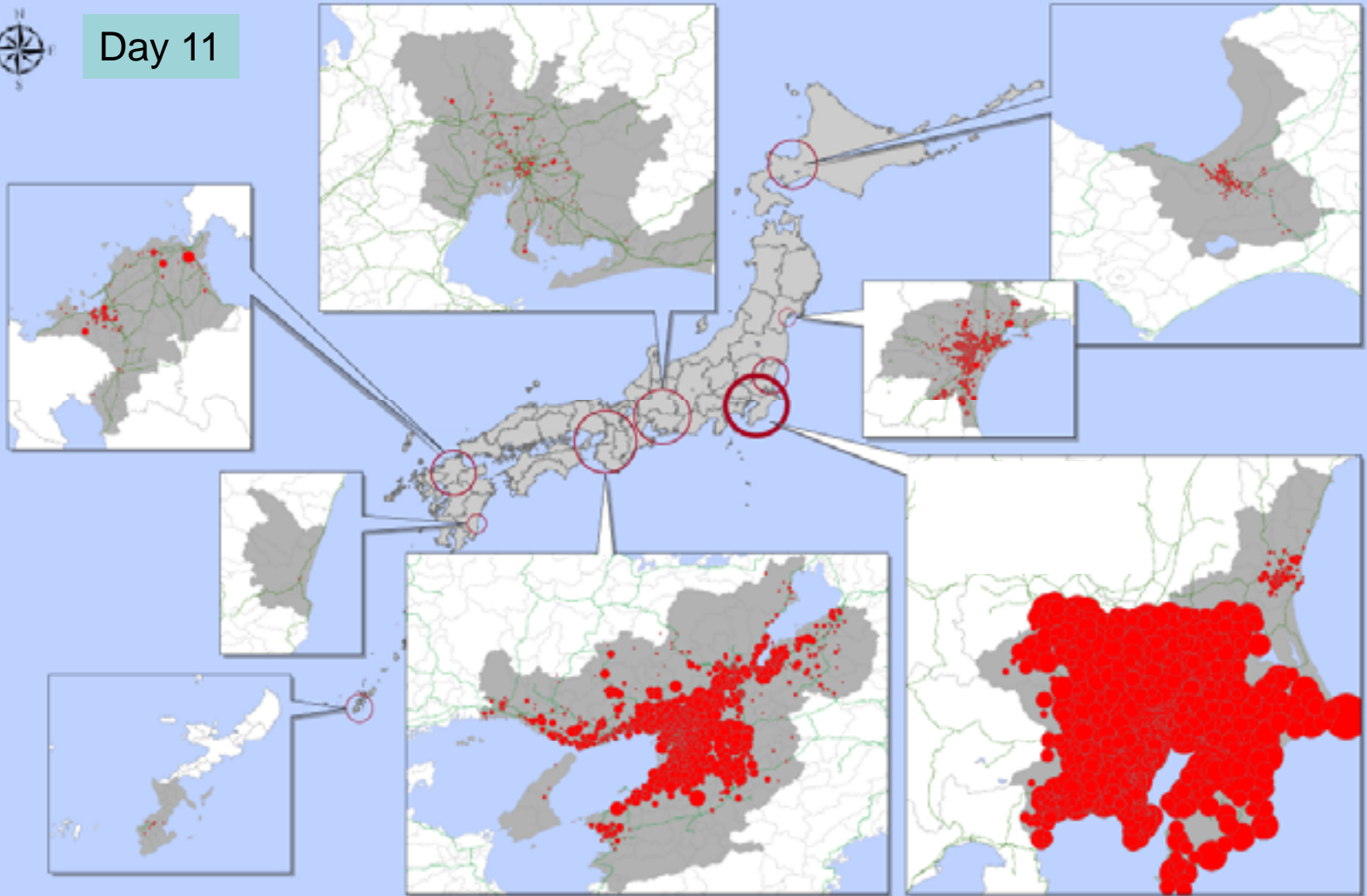


Day 10



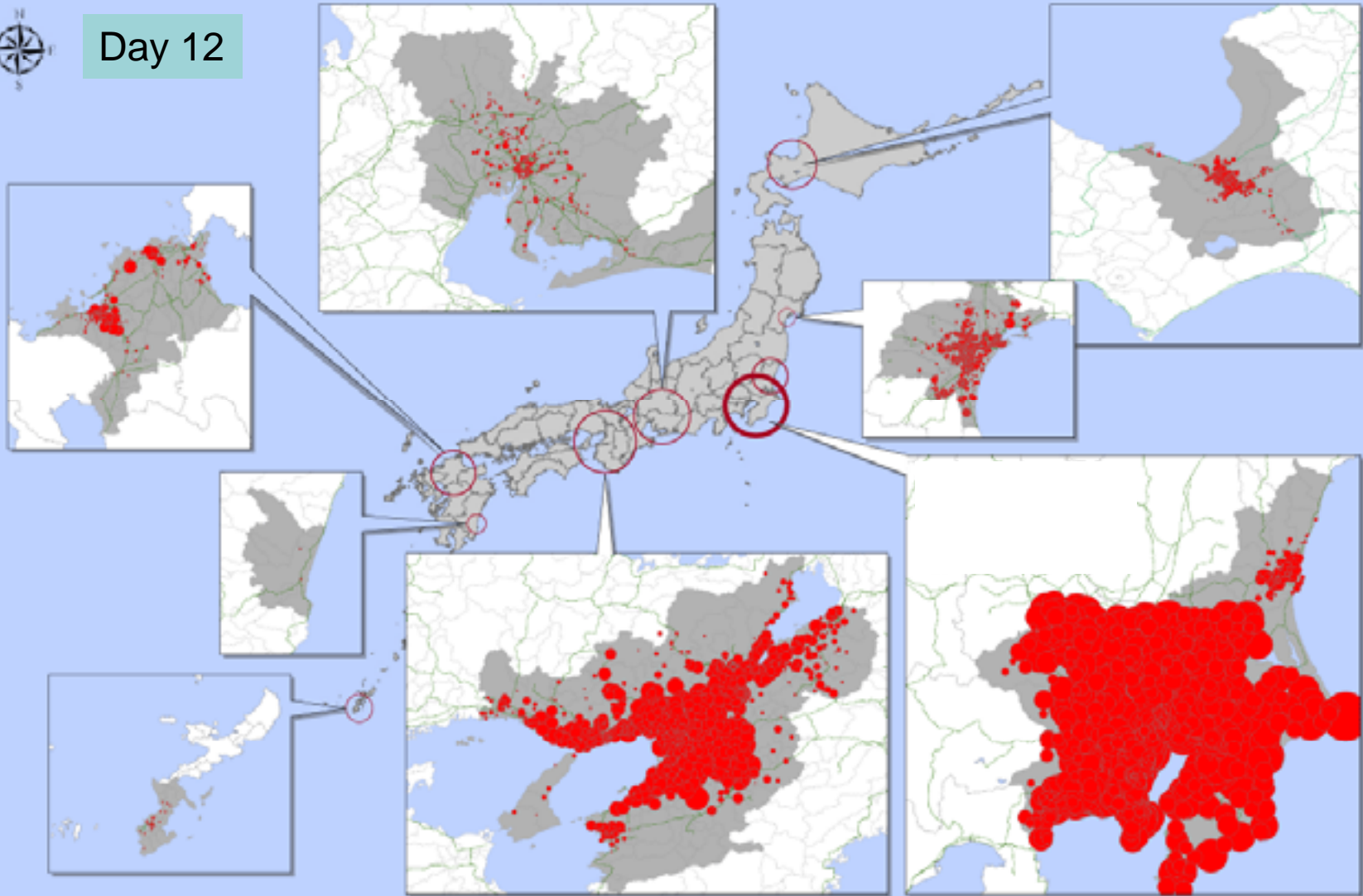


Day 11





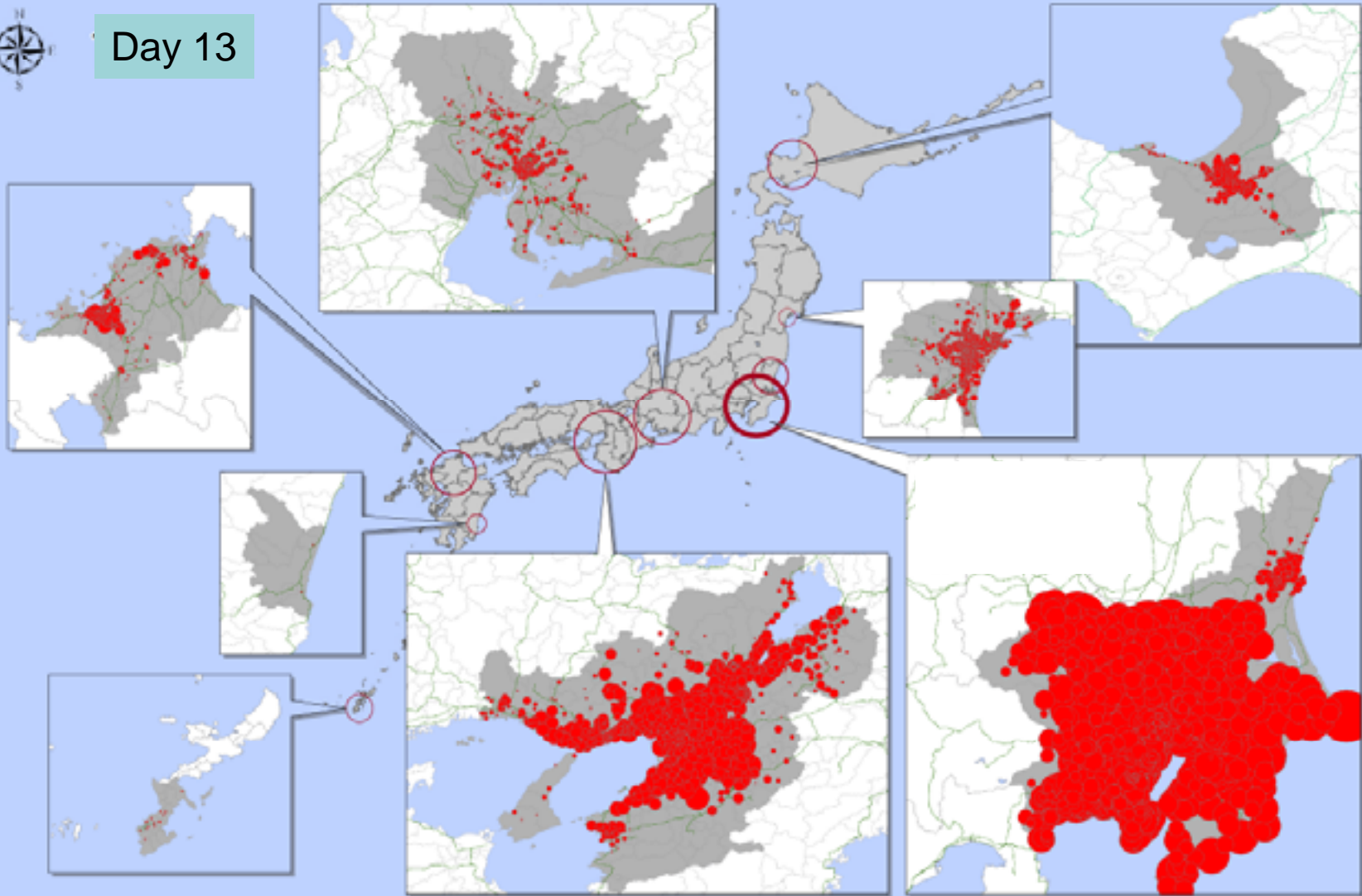
Day 12





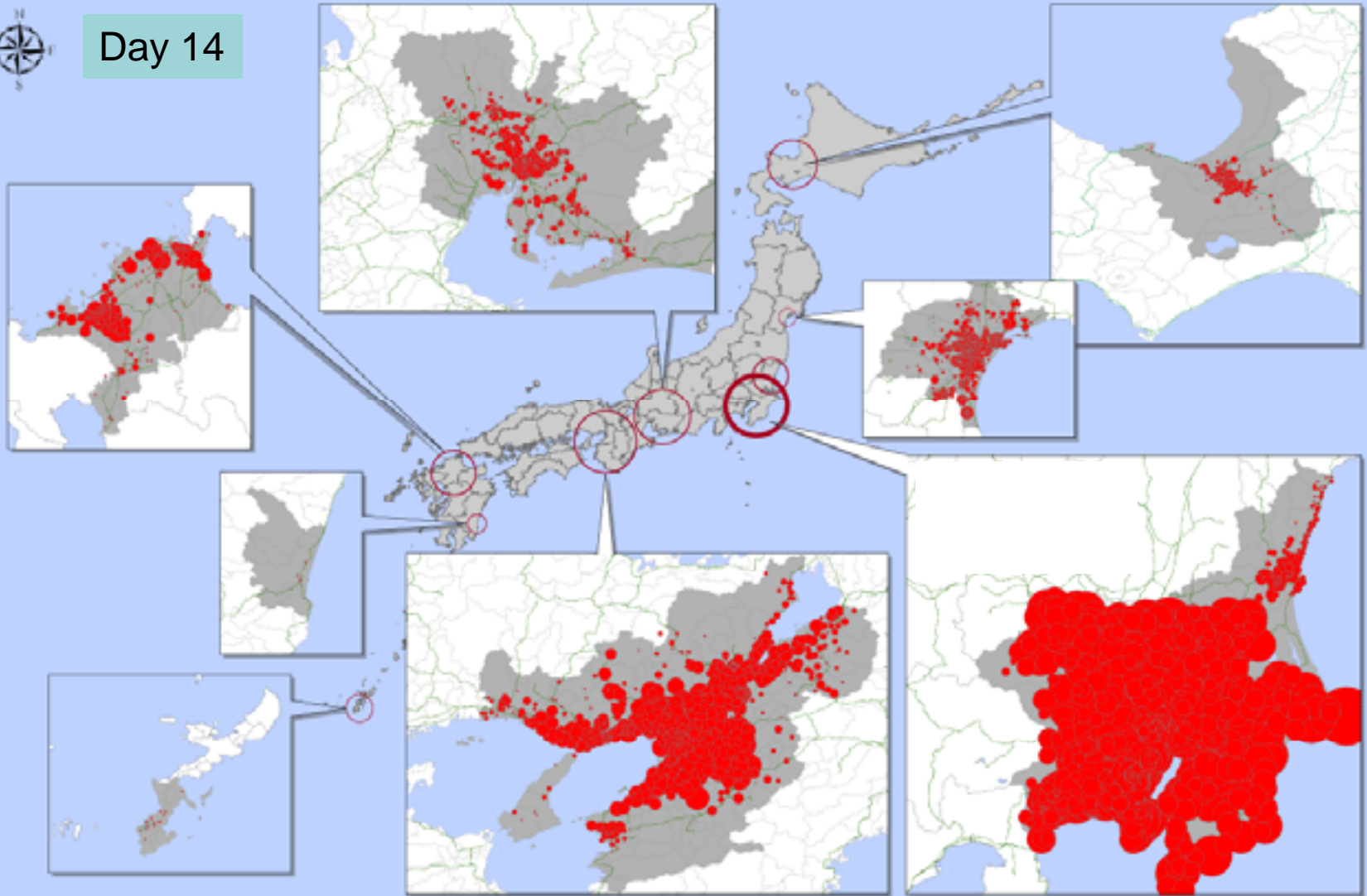


Day 13





Day 14



# Simulation for Local City



# Containment at the Local City

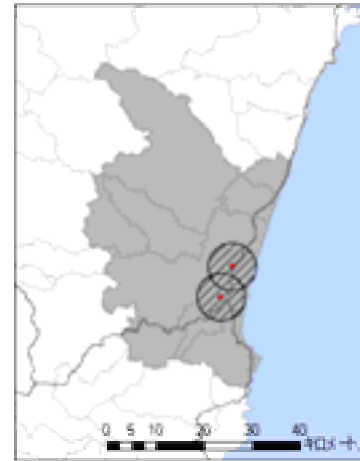
8day



9day



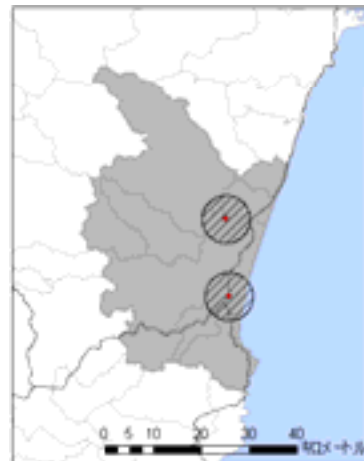
10day



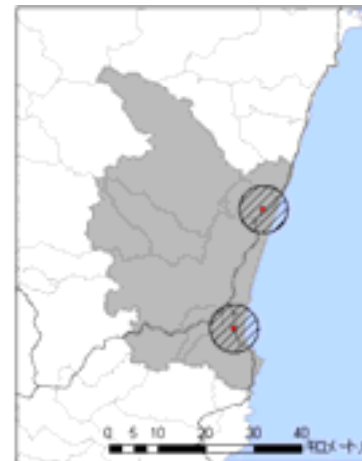
11day



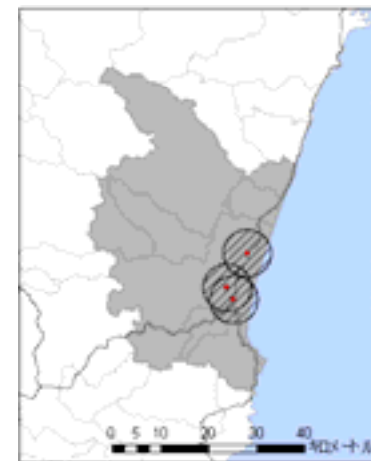
12day



13day



14day



# Conclusion

- Speed in the geographical dispersion is very fast in a big city
- Nation wide spread just delays for 2 or 3 days after the initial case was confirmed
- Therefore area closure seems to be meaningless in the big city
- However, in the local city, it may possible and may containment
- On the other hand, school closure and voluntary staying at home is a very powerful countermeasure
- It can reduce new infections by more than 90%, hopefully we can control the outbreak
- Conversely, geographic dispersion may not be affected very much



# Challenges

- We extend the simulation area to all area where the survey was conducted
- We also extend the model to the area where the survey was not conducted

Thank you  
for your attention

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