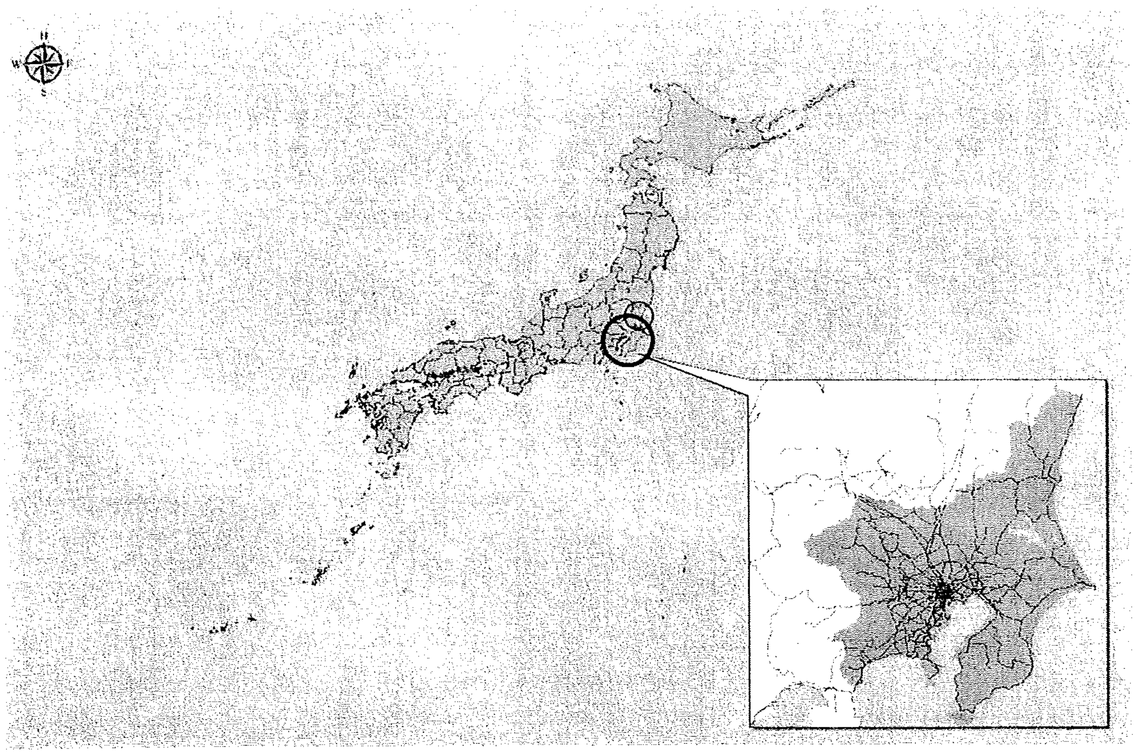

Fig. 3. Day 4 after initial case is infected. This figure shows the locations of new infections 4 days after the initial case was infected.

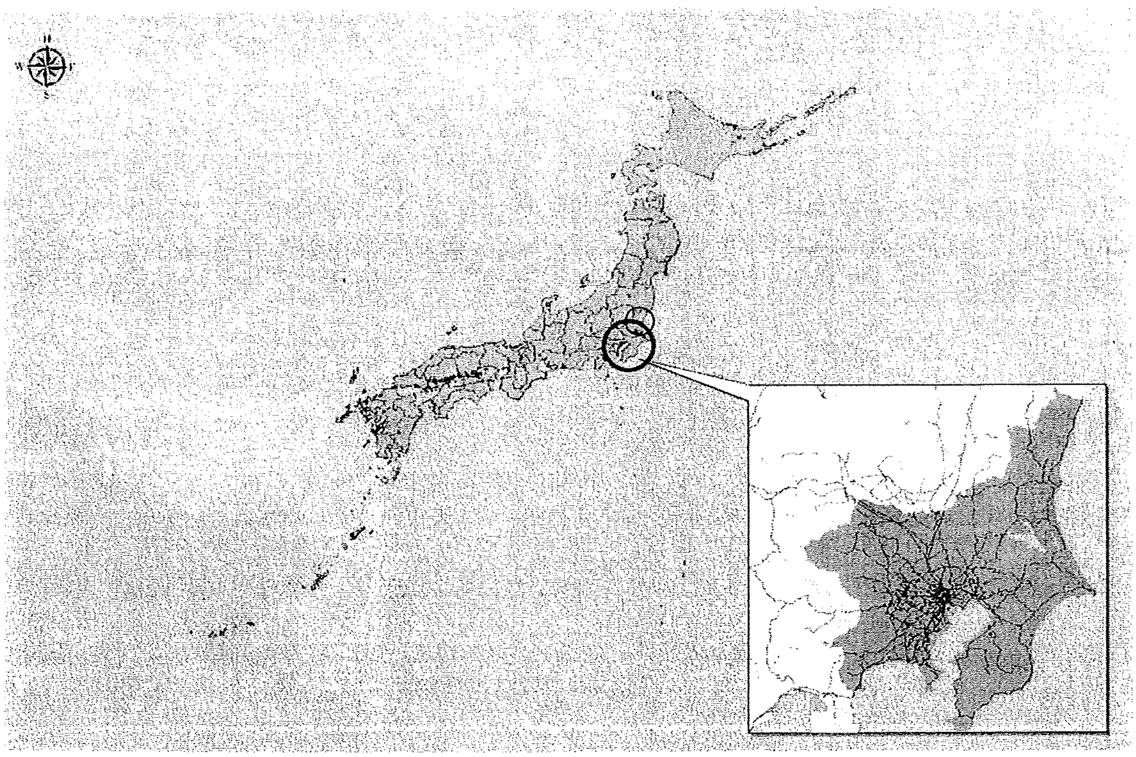

Fig. 4. Day 5 after initial case is infected. This figure shows the locations of new infections 5 days after the initial case was infected.

and Okinawa. Because the initial case is not detected until day 6, there is only 1 day between its detection and the appearance of the first cases in other cities, and this is not enough time to put a quarantine into effect. Thus it is probably not feasible to place a quarantine in Tokyo. Other regions, however, might benefit from a quarantine: in smaller cities like Miyazaki and Okinawa, the disease seems to spread more slowly than it does in big cities such as Tokyo or Kansai. Quarantines in these regions may help to contain the local outbreaks.

This simulation has many limitations. First, due to the limits of our computational resources, we cannot simulate the whole course of an influenza pandemic. Though the early phase is regarded as the most important period to plan for, the entire

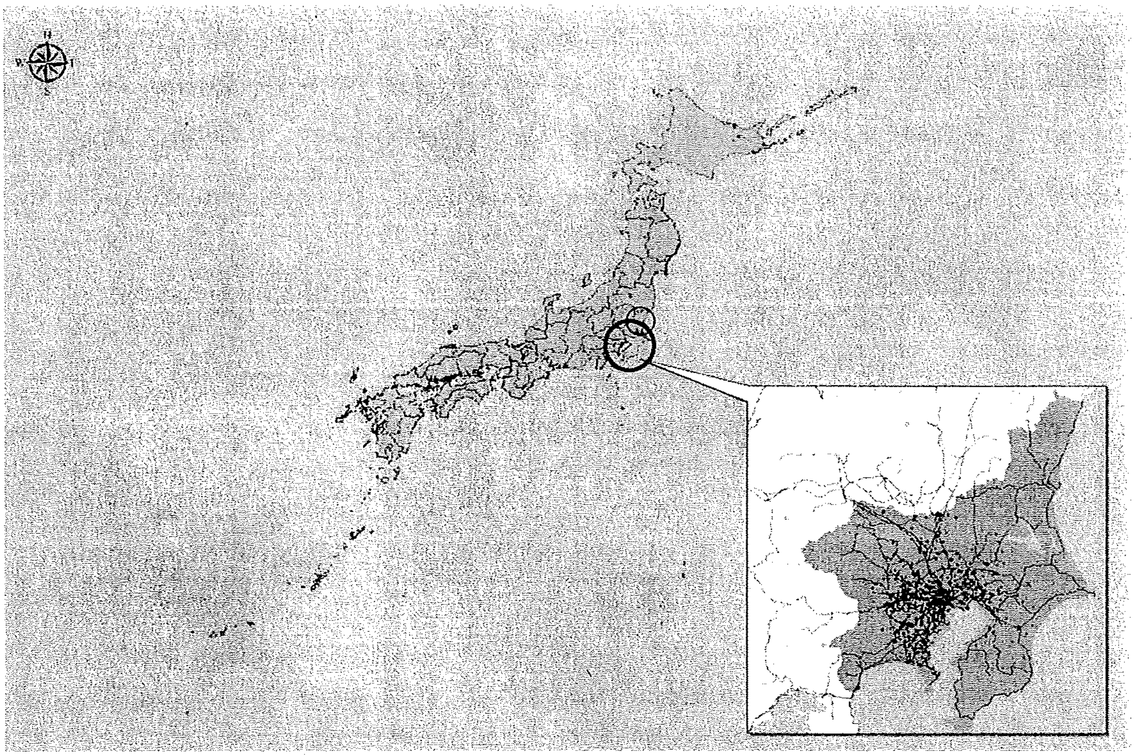

Fig. 5. Day 6 after initial case is infected. The locations of persons newly infected 6 days after the initial case was infected. Note that, in our model, this is the earliest day on which the initial case could be diagnosed.

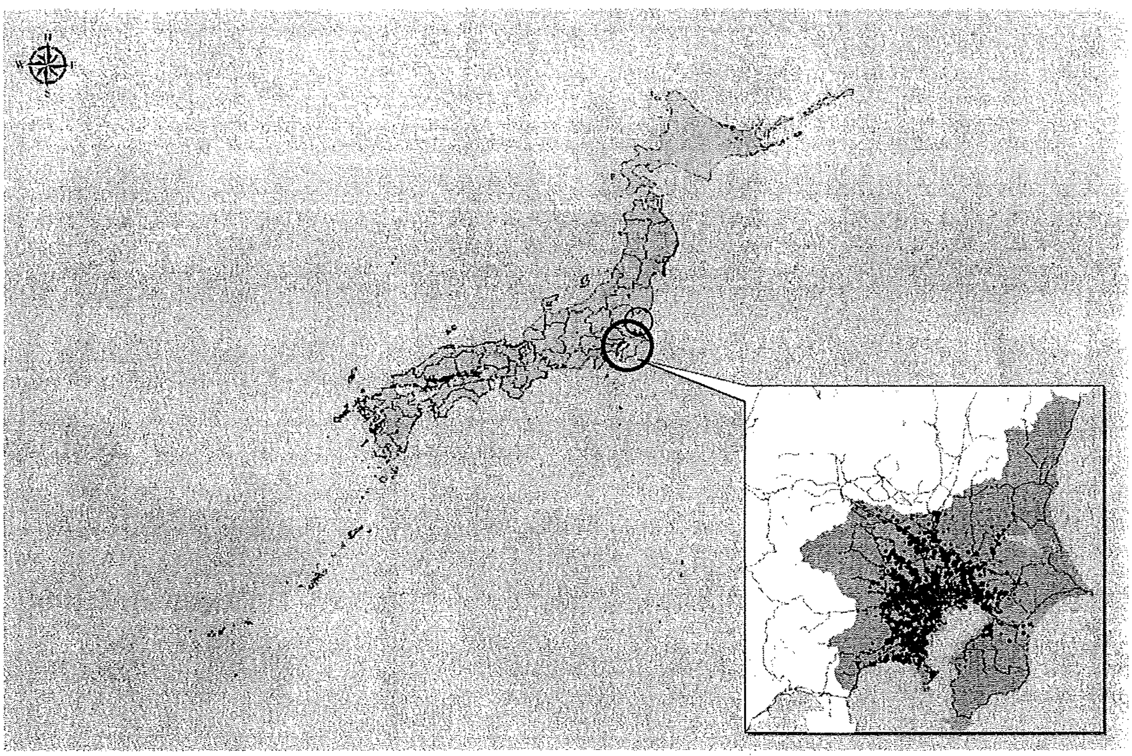

Fig. 6. Day 7 after initial case is infected. This figure shows the locations of new infections 7 days after the initial case was infected.

duration and specifically the time when the number of cases peaks are also important. To properly evaluate the entire course of the pandemic will require more computer resources and the efficient use of parallel computing.

A second limitation is that the effects of countermeasures such as antiviral prophylaxis, school closures, and/or vaccinations have never been examined. The estimated effects of these actions on a pandemic are usually taken into account in the formation of preparedness plans by individual countries and by WHO. In principle, we can factor these elements into our model as well, but we must caution that including countermeasures in a model makes it even more necessary for that model to simulate the entire course of an influenza pandemic, for, although effective countermeasures may reduce the in-

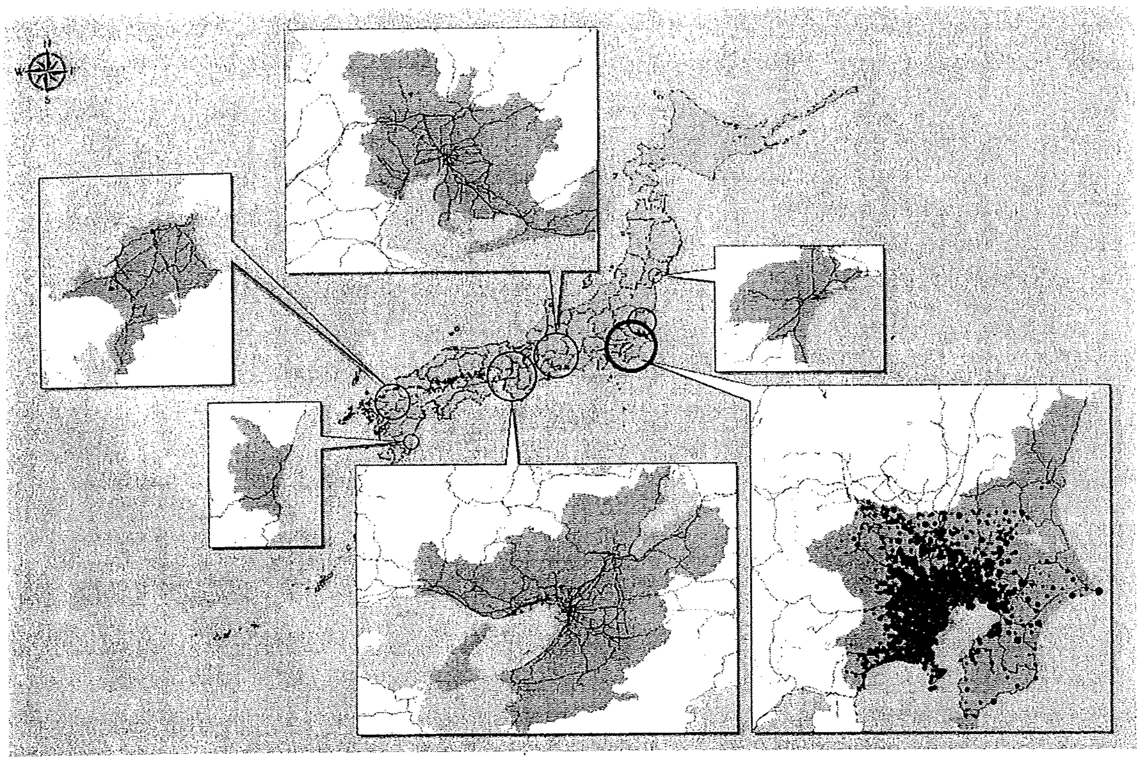

Fig. 7. Day 8 after initial case is infected. This figure shows the locations of new infections 8 days after the initial case was infected. Note that the disease has now spread to other cities.

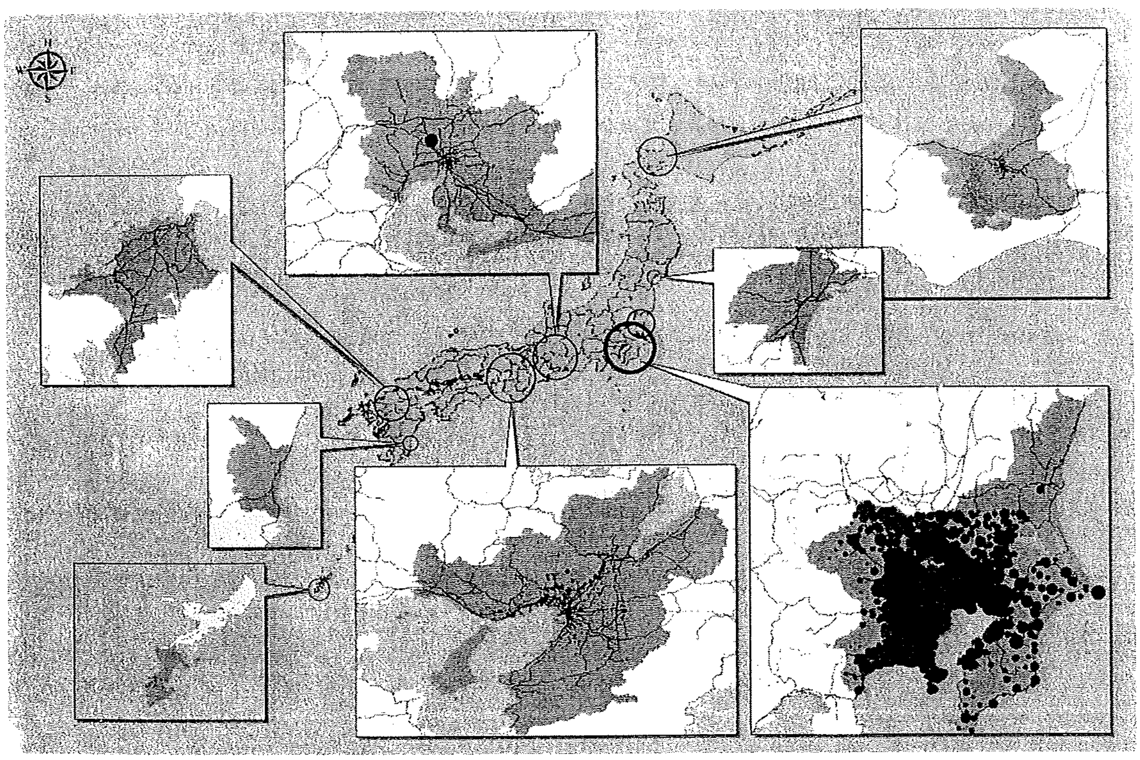

Fig. 8. Day 9 after initial case is infected. This figure shows the locations of new infections 9 days after the initial case was infected.

tensity of a pandemic's peak, they can also sometimes extend its duration, and we will not be able to observe their overall effect if we cannot simulate the whole course of the pandemic.

Moreover, the results of other simulation studies are usually shown as averages, with distributions, of the results obtained in several iterations. As mentioned above, our computer resources are limited; we were not able to perform several iterations of our simulation. This is a particularly significant limitation in ribm, because variation in the assumed scenario of the initial case is a potential source of variation in the outcome. To overcome this limitation, we must gain access to increased computer resources and make use of parallel computing. Even with our present resources, however, we can guess that, although the timing of the peak may

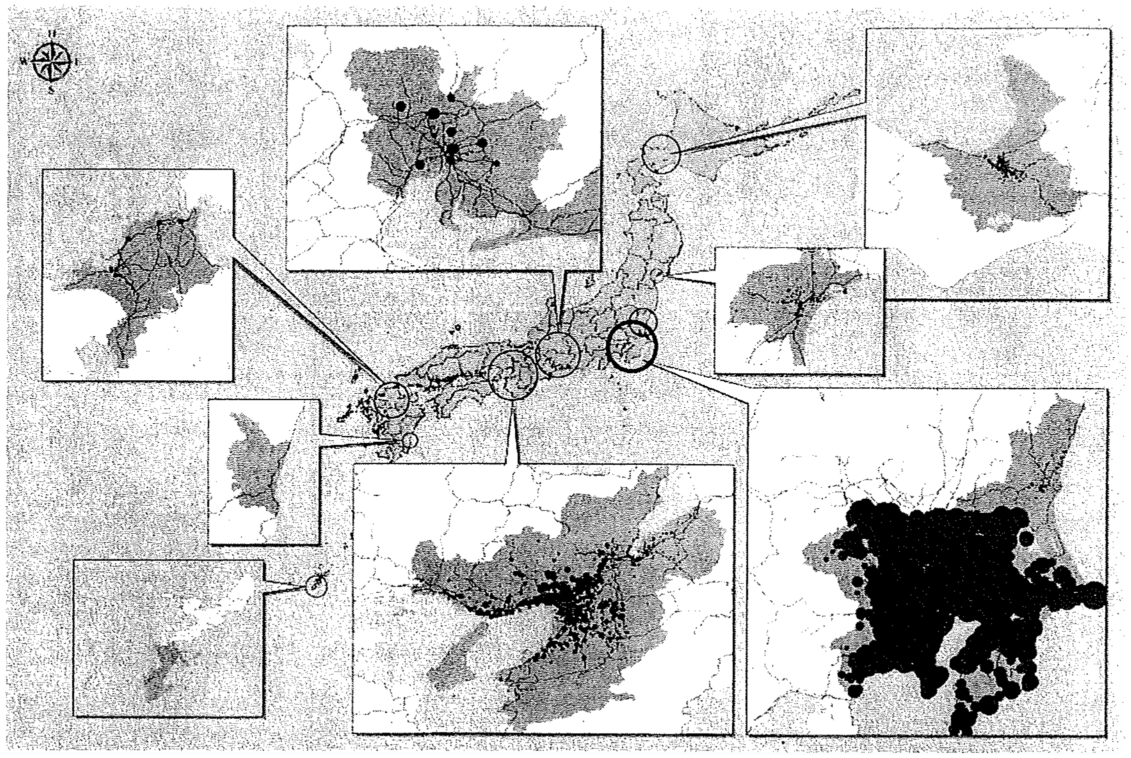

Fig. 9. Day 10 after initial case is infected. This figure shows the locations of new infections 10 days after the initial case was infected.

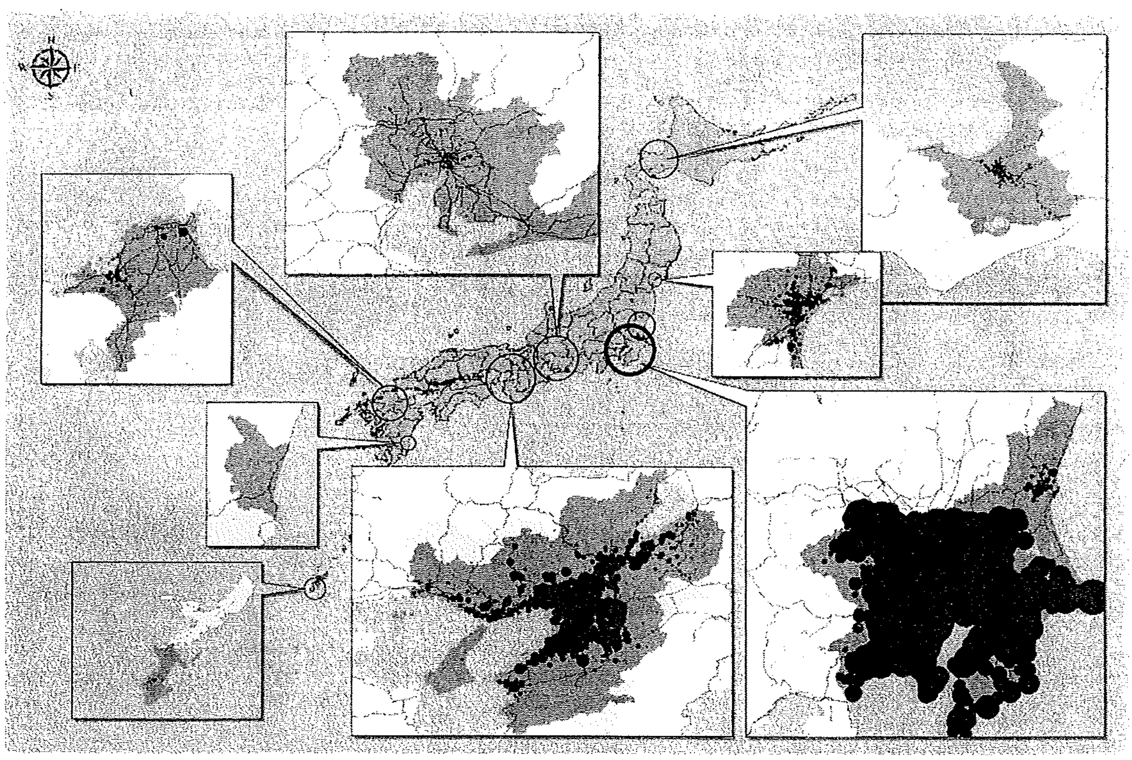

Fig. 10. Day 11 after initial case is infected. This figure shows the locations of new infections 11 days after the initial case was infected.

vary among the iterations, the number of cases at the peak of the pandemic and the cumulative total number of infected persons will vary less, because these outcomes are more strongly influenced by such factors as city layouts and transportation patterns.

In addition to correcting these limitations, a natural next step in our research is to extend our application of ribm to other regions of the country. Yet because PT surveys have not yet been conducted in other regions, we must find another way to acquire data on commuting and transportation. One option is to obtain such data from certain censuses that record means of commuting from home to school or workplace and that classify this information by city or town. We must find a way to extend ribm to regions without PT data if

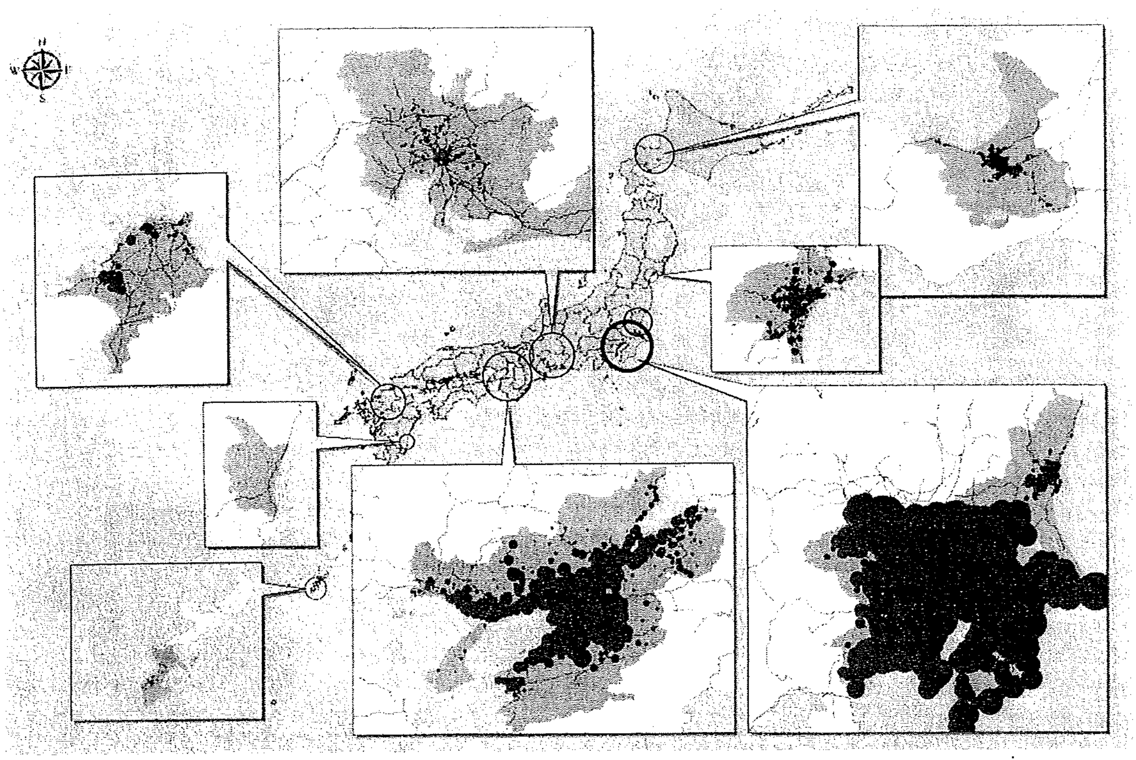

Fig. 11. Day 12 after initial case is infected. This figure shows the locations of new infections 12 days after the initial case was infected.

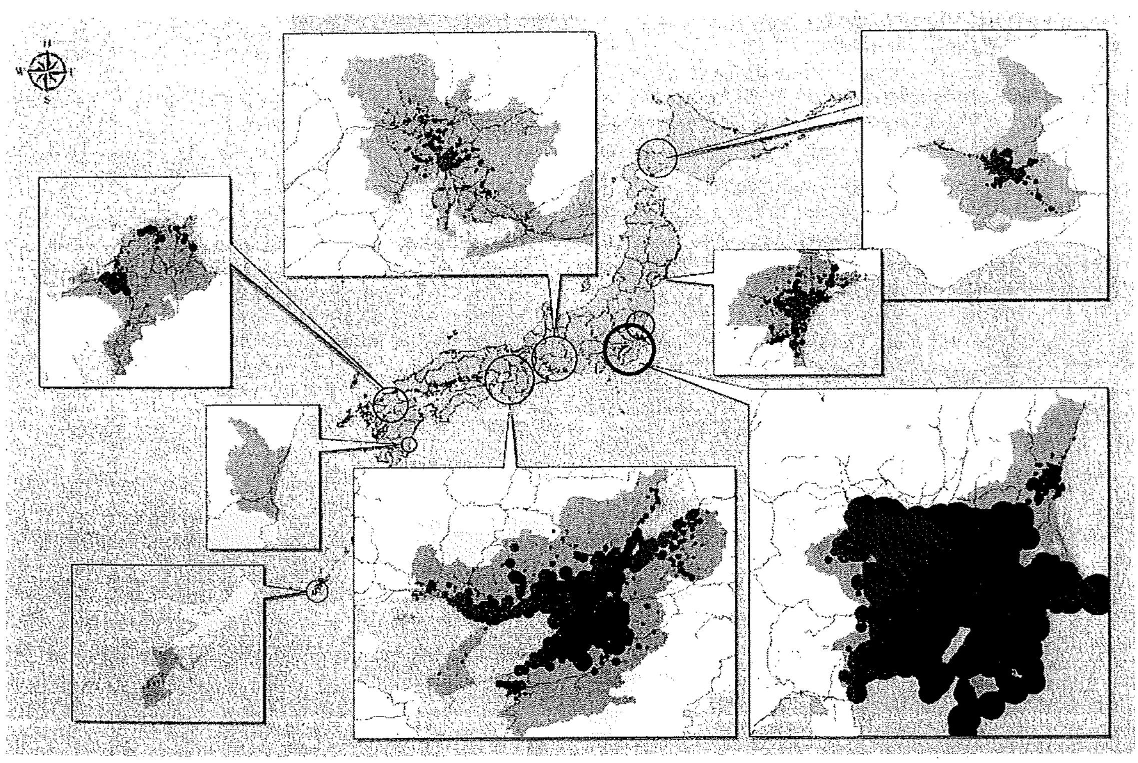

Fig. 12. Day 13 after initial case is infected. This figure shows the locations of new infections 13 days after the initial case was infected.

our research is to be useful on a nationwide scale.

This study applied ribm to a potential influenza pandemic in Japan. ribm offers the most realistic simulation of the speed and direction of the spread of infection, and it is hoped that this study will encourage its use in the creation of preparedness plans for pandemic influenza (11).

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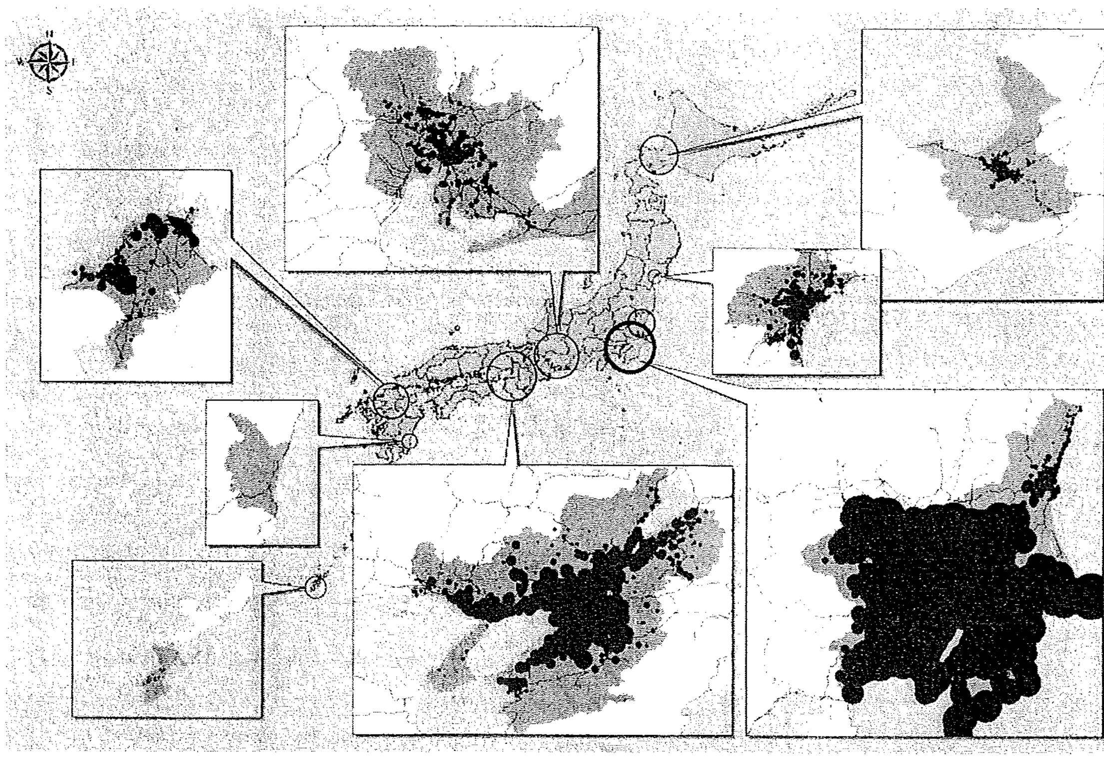

Fig. 13. Day 14 after initial case is infected. This figure shows the locations of new infections 14 days after the initial case was infected.

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