# Technology for the Estimation of Pedestrians' Trajectories
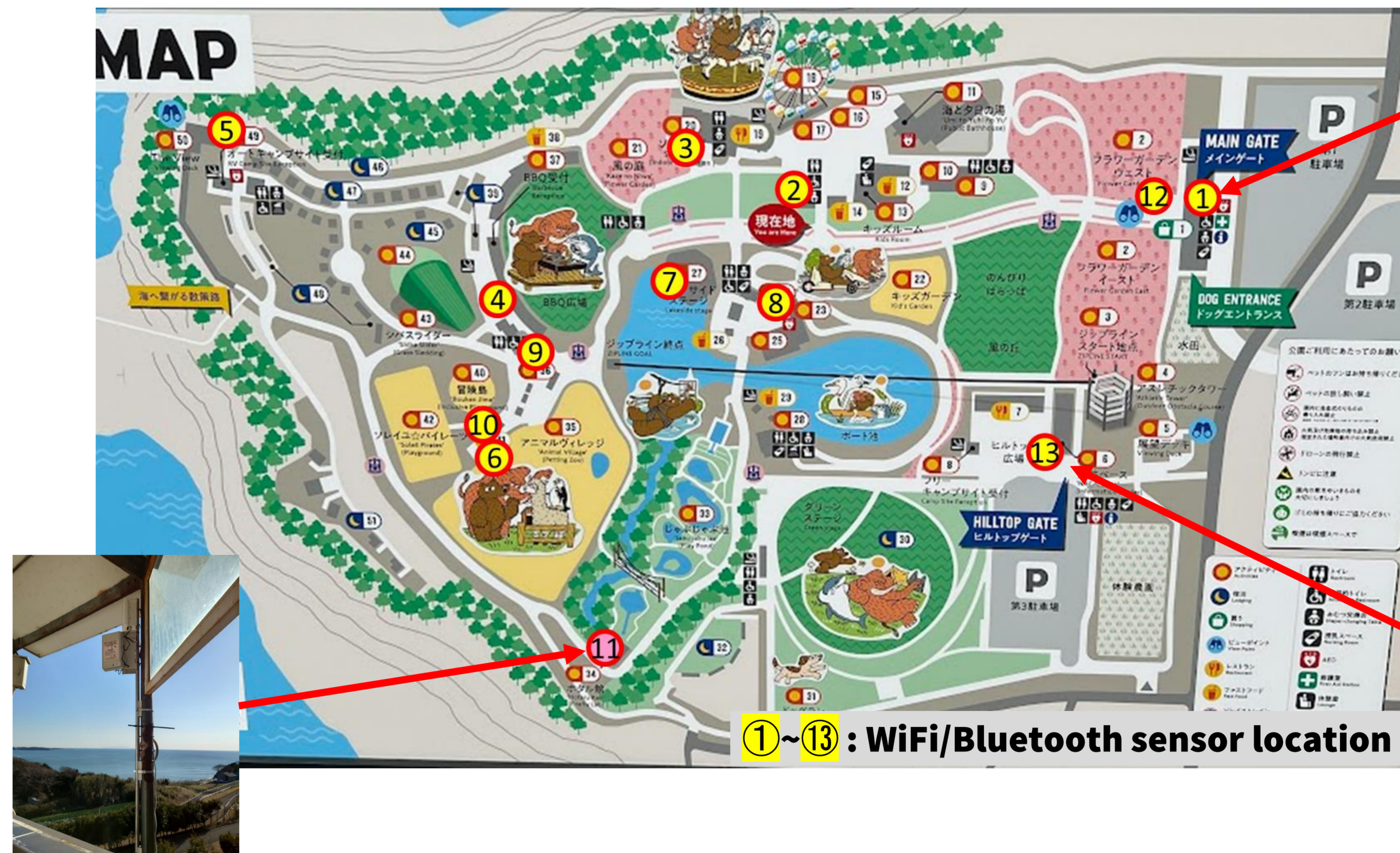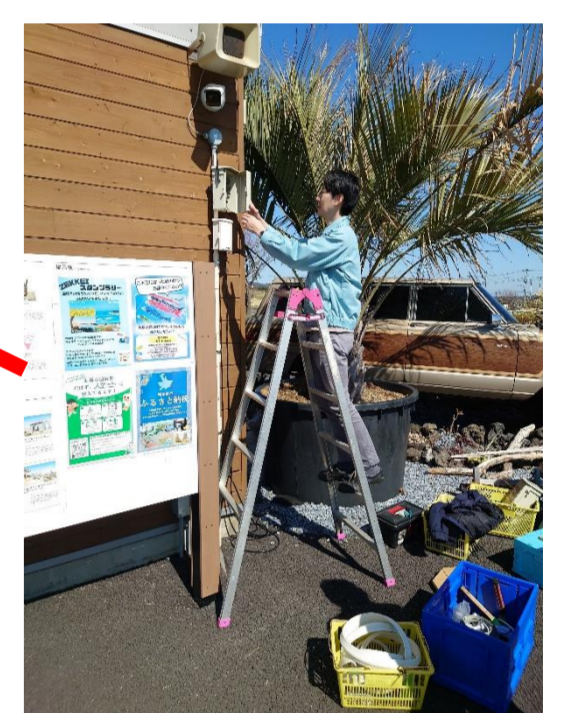
● Online Collection of WiFi/Bluetooth Packet Signal

Newly developed WiFi/Bluetooth packet signal sensor collects the randomized ID numbers of mobile devices with timestamps and RSSIs (Receiving Signal Strength Index) and transmit them via the internet. The operators who may interest in the people flow in a town, a park, an event venue, etc. can easily set up the monitoring system with those sensors.

WiFi/Bluetooth Packet Signal Sensor
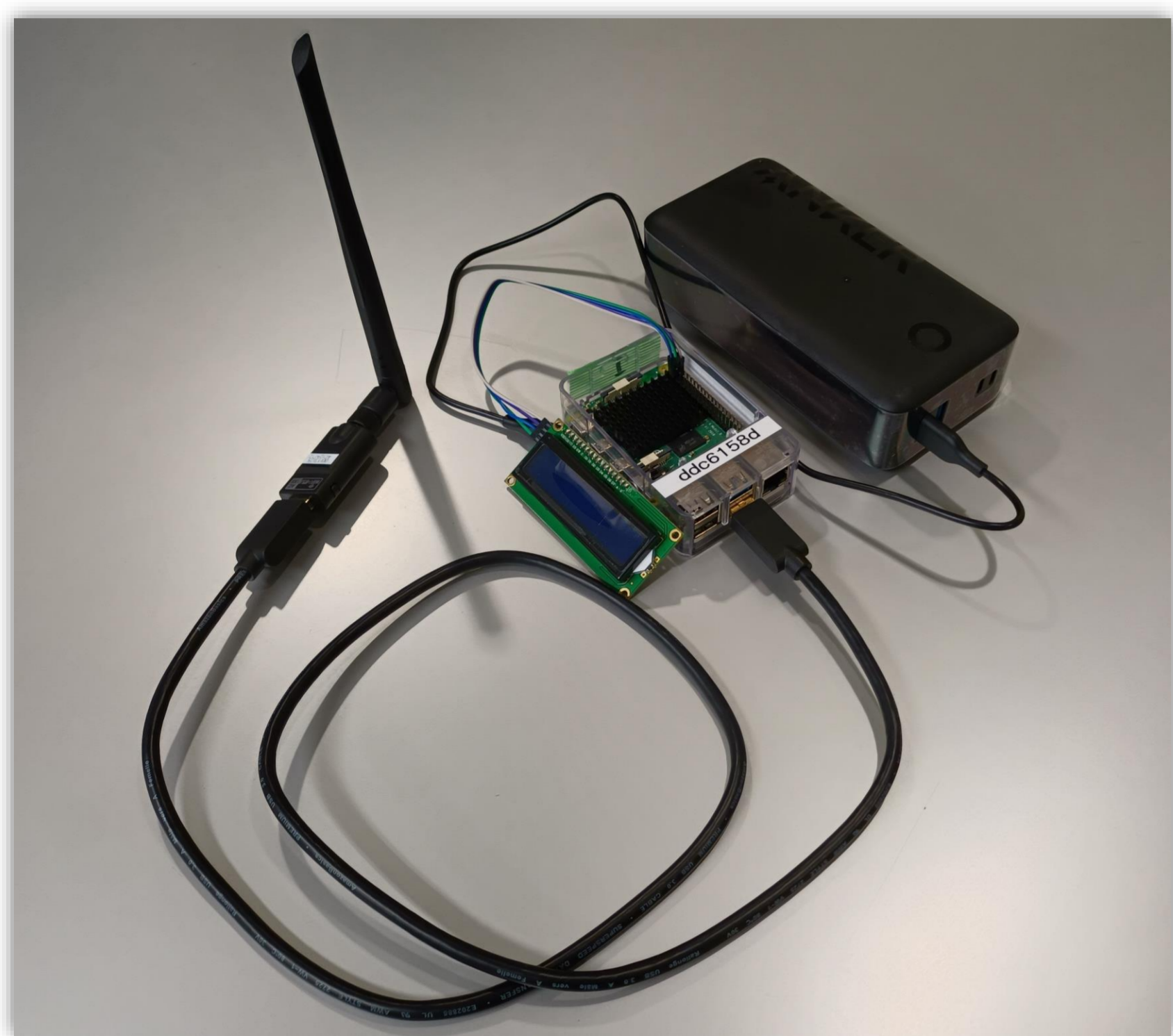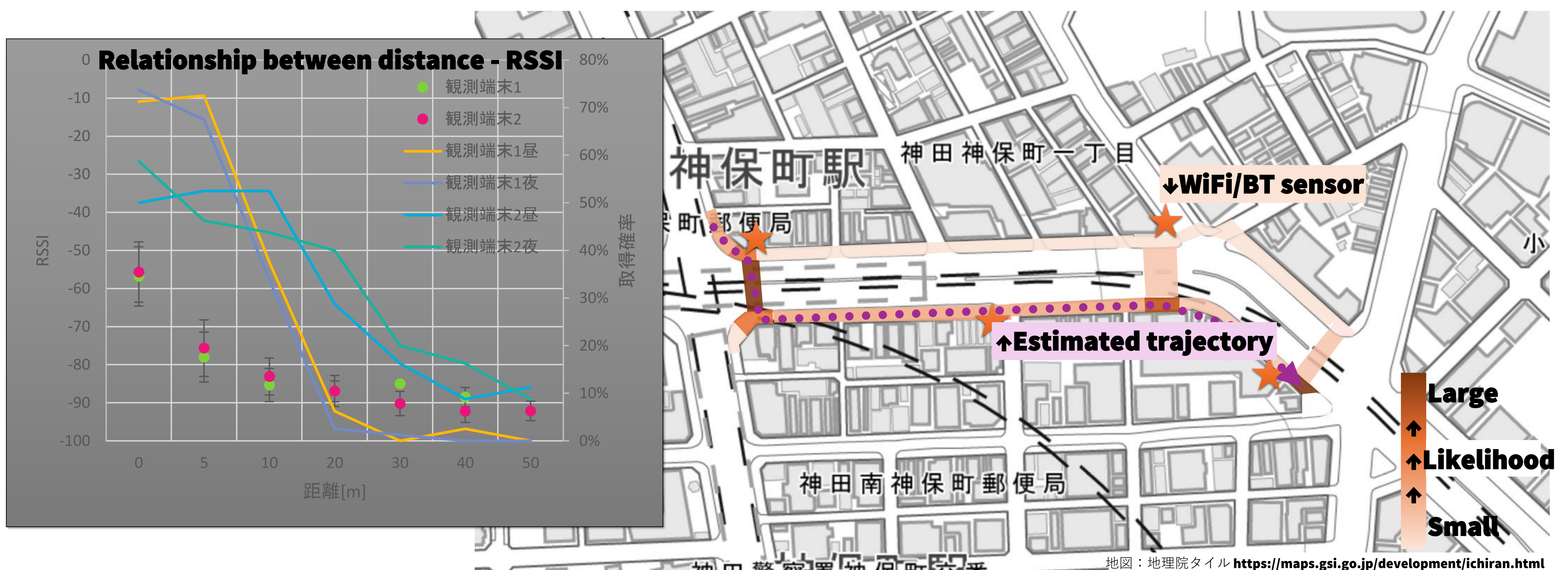
①~⑬ : WiFi/Bluetooth sensor location

WiFi/Bluetooth Sensor locations in Soleil Hills Park, Yokosuka-city

● Estimation of Pedestrian's Trajectory

The RSSI of WiFi/Bluetooth Packet Signal is attenuated by the distance to a device. We have developed the ID tracking methodology to estimate pedestrian's trajectory in 10m order resolution with a smaller number of sensors. In the estimation, the meth utilizes the relationship of distance-RSSI and the place transition probabilities embedded in a discretized walkable space. The estimation result is provided with the form of most likely time-space trajectory. Those estimated trajectories will be used to the microscopic agent simulation.

Relationship between distance - RSSI

観測端末1
観測端末2
観測端末1昼
観測端末1夜
観測端末2昼
観測端末2夜

RSSI / 取得確率 / 距離[m]

↓WiFi/BT sensor

↑Estimated trajectory

Large / ↑ Likelihood ↑ / Small

地図：地理院タイル https://maps.gsi.go.jp/development/ichiran.html

i-Transport Lab. Co.,Ltd.

# Nowcast / Forecast Technologies for Crowd Flow Prediction
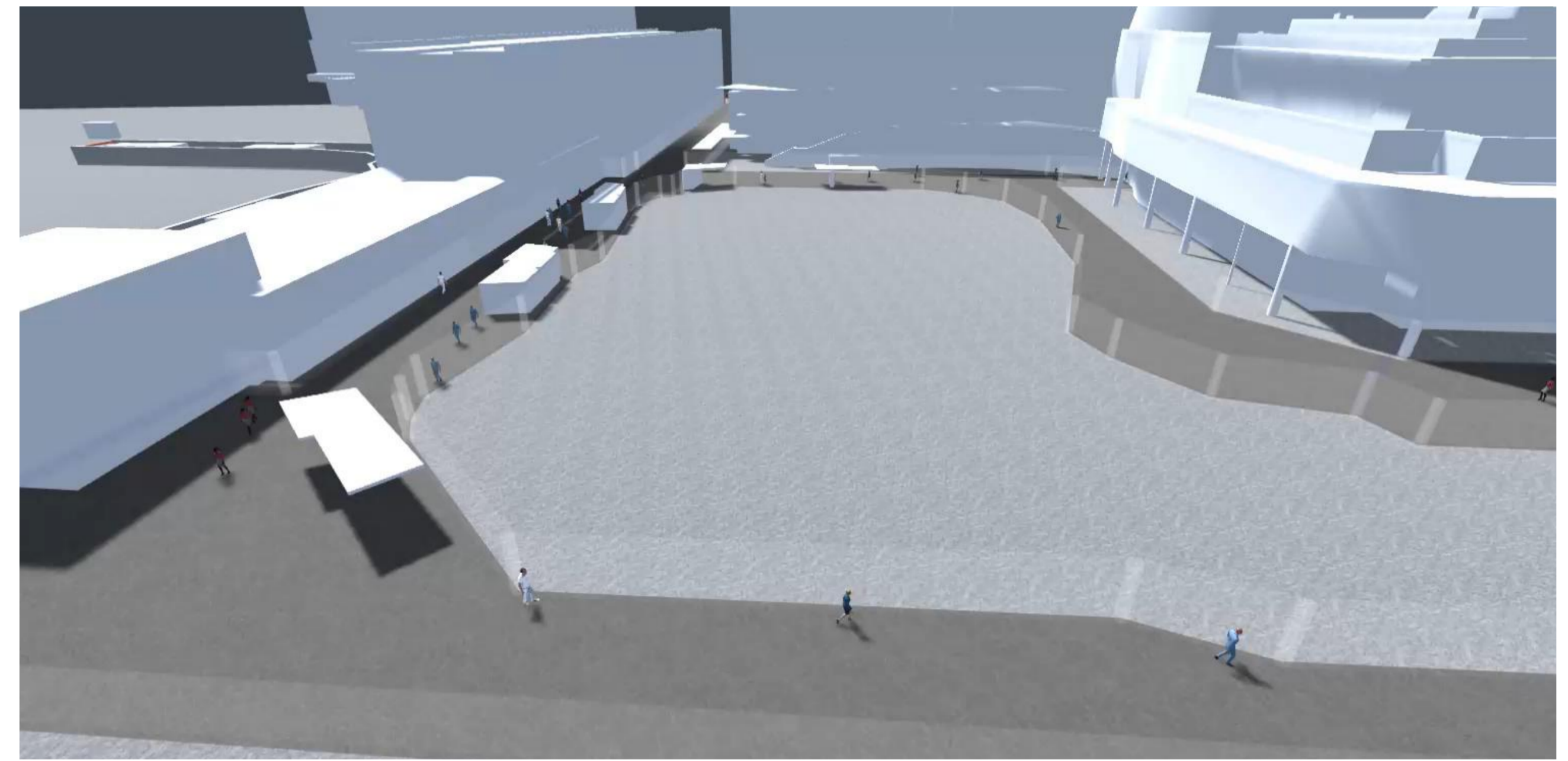
● Crowd Flow Nowcast

The 'Nowcast' of crowd flow is so-called online simulation which continuously adjusts its inputs and key parameters with real time observed data. The 'Kashiwa-no-ha Crowd Flow Nowcast' takes in the real time pedestrian count data from the local management organization and reproduces 'today's' crowd flow in the area every minutes. The 'Nowcast' enables social feedback loop in cyber-physical system and will contribute to maintain the quality of walkable space.

Pedestrian count sensors implemented by the Urban Development Centre of Kashiwa (UDCK)

Time series of pedestrian counts (9th December 2023)

Dots: measured volume
Lines: estimated volume
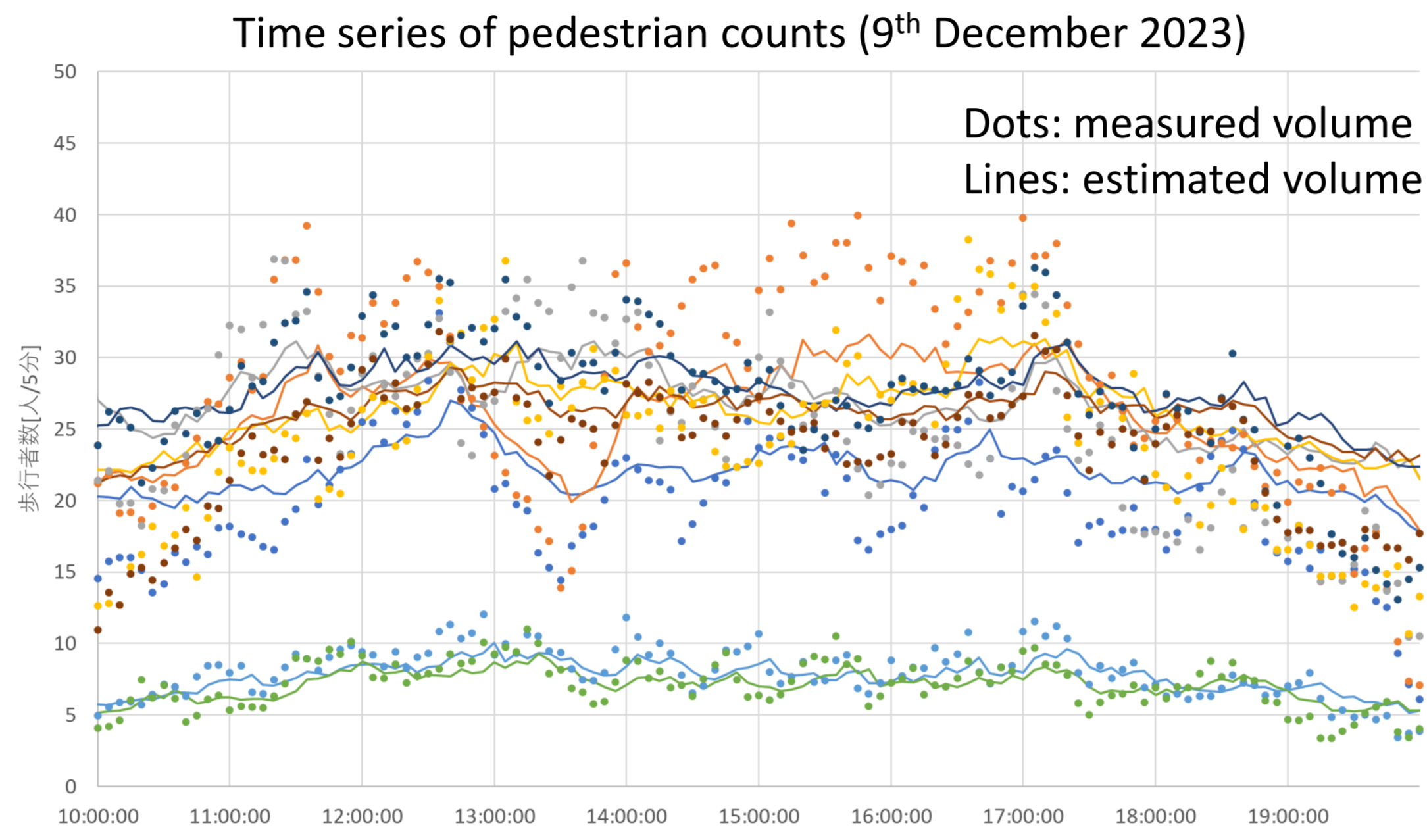
Estimated pedestrian O-D flow with an online particle filter being fed to the 'Nowcast' simulation

The 'Kashiwa-no-ha Crowd Flow Nowcast' agent simulation reproducing, quantifying and visualizing 'Today's' condition

● Crowd Flow Forecast

The framework of the 'Nowcast' can be applied to the 'Forecast' by replacing the real-time input data with the predicted data. We are now developing the 'Enoshima Crowd Flow Forecast' under the collaboration with the Toyoda Lab (IIS, the University of Tokyo), which provides the hourly time series of 7-days-future population in target area based on AI-learning model with SNS articles. The 'Forecast' provides the future crowd conditions of next weekend to help the local authorities suffering with over-tourism to plan and to prepare the measures of congestion mitigation in advance.

ENOSHIMA CROWD FORECAST

Leaflet | Map tiles by Carto, under CC BY 3.0. Data by OpenStreetMap, under ODbL

混雑　　　　　　　閑散

Predicted population in Enoshima Island on Monday 1st Jan. 2024

https://twitter.com/_home2x__/status/1654078271452...

Extreme congestion can be seen in high season

すばな通り　✕

Predicted future crowd condition at the main corridor of Enoshima Island

Portal site of the 'Enoshima Crowd Forecast'

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