

災害デジタルツインのいま・みらい

越村 俊一

東北大学災害科学国際研究所・教授

株式会社RTi-cast・CTO

koshimura@tohoku.ac.jp





 **AUTODESK**



Digital Twin





Chapter 24 - Digital twin paradigm for coastal disaster risk reduction and resilience

Shunichi Koshimura^{1 2 3}, Nobuhito Mori⁴, Naotaka Chikasada⁵, Keiko Udo³, Junichi Ninomiya⁶, Yoshihiro Okumura⁷, Erick Mas^{1 2 3}

Show more ▾

+ Add to Mendeley  Share  Cite

<https://doi.org/10.1016/B978-0-443-18987-6.00024-5>

[Get rights and content ↗](#)

Abstract

Coastal digital twin (CDT) is a new research and practice paradigm in coastal science and engineering to enhance disaster resilience. The components of CDT have three functionalities. One is the transformation from “Data” to “Information” by integrating “Sensing” and “Monitoring.” The second is “Modeling” and “Inference” by using available data and information. The third is “Policy Design” to gain implications and decide “Policies” for optimal “Practices” to enhance social resilience. The fusion of these components and the feedback loop in a cyber-physical system is the key to gaining knowledge and insights for optimal solutions in the physical world.

Koshimura et al (2025) "Digital twin paradigm for coastal disaster risk reduction and resilience", 543-559, 2024.

<https://doi.org/10.1016/B978-0-443-18987-6.00024-5>

in K. Goda, R. D. Risi, A. R. Gusman, I. Nistor, eds, Probabilistic Tsunami Hazard and Risk Analysis Towards Disaster Risk Reduction and Resilience, 460p.

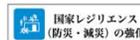
SIPスマート防災ネットワークの構築 2023年度～



文字の大きさ 標準 大きく



スマート防災ネットワークの構築



[ホーム](#) | [お知らせ](#) | [課題について](#) | [サブ課題](#) | [研究機関向け情報](#) | [お問い合わせ](#)



サブ課題

> サブ課題一覧

> A 災害情報の広域かつ
瞬時把握・共有

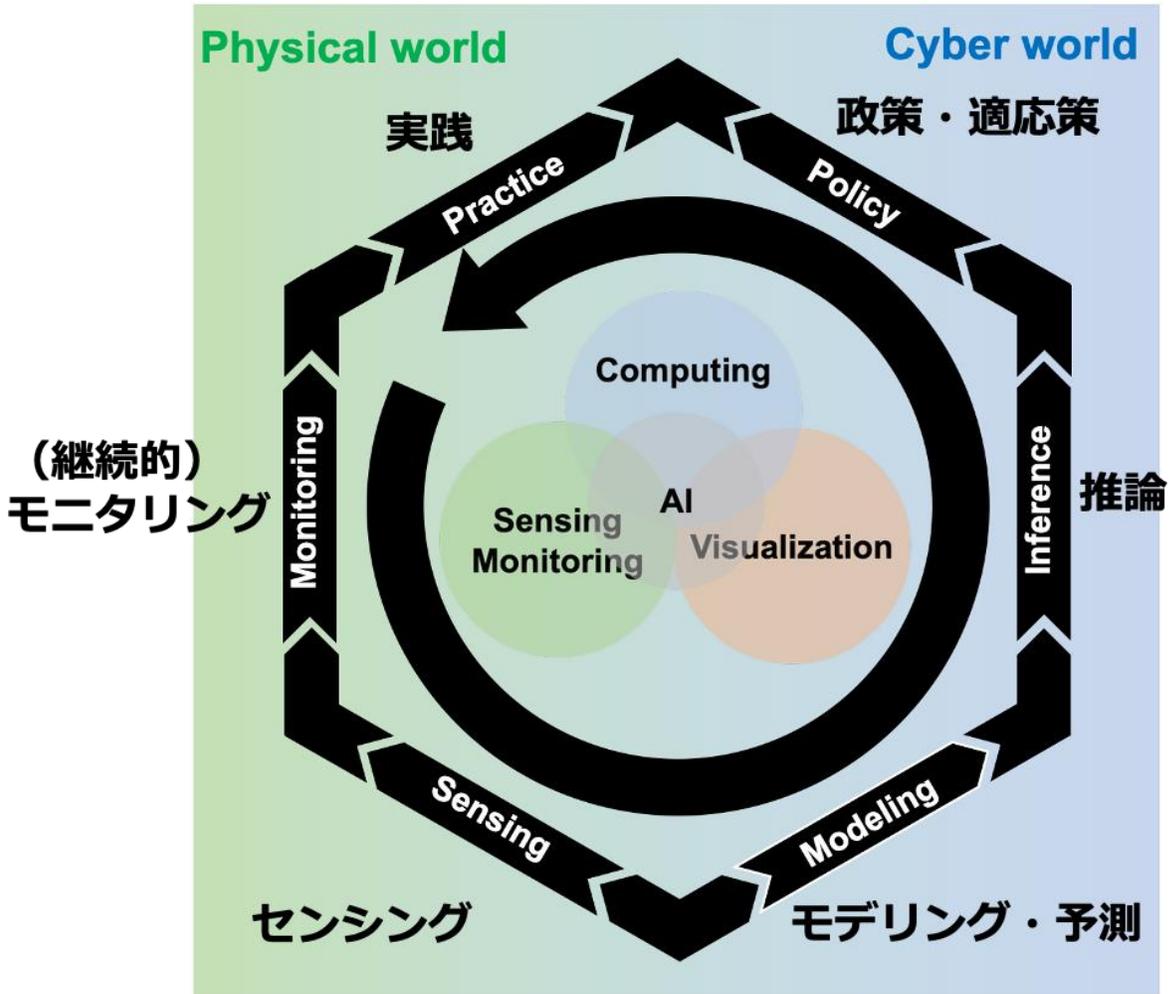
> B リスク情報による
防災行動の促進

> C 災害実動機関における組織
横断の情報共有・活用

> D 流域内の貯留機能を最大限
活用した被害軽減の実現

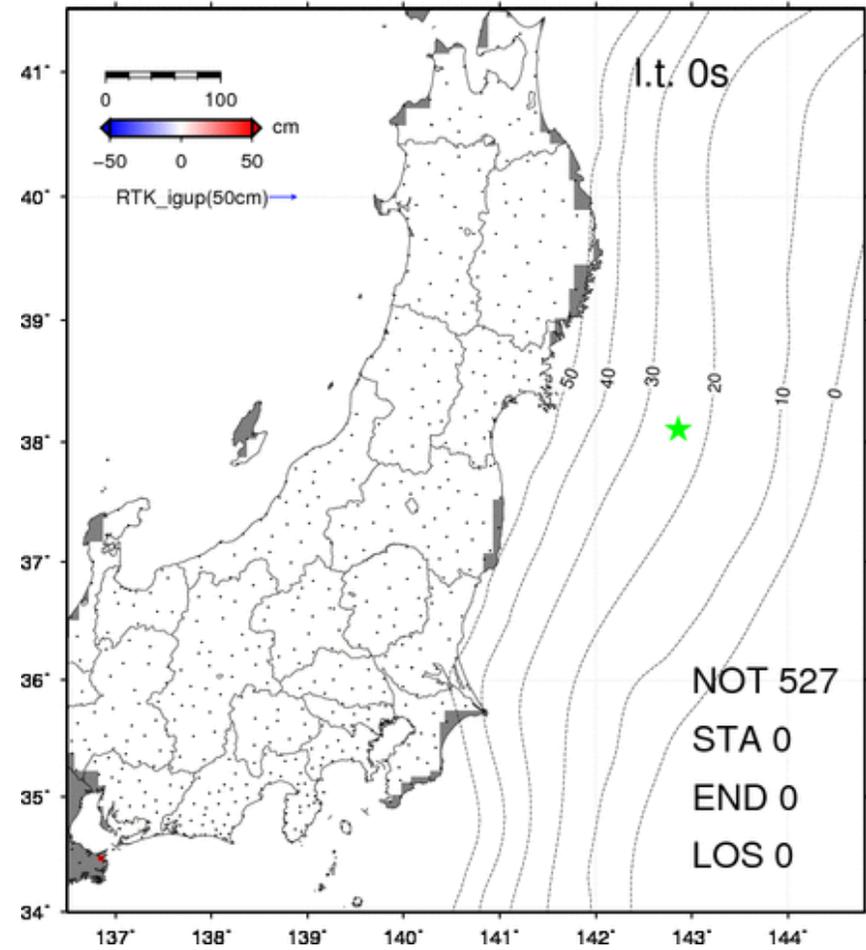
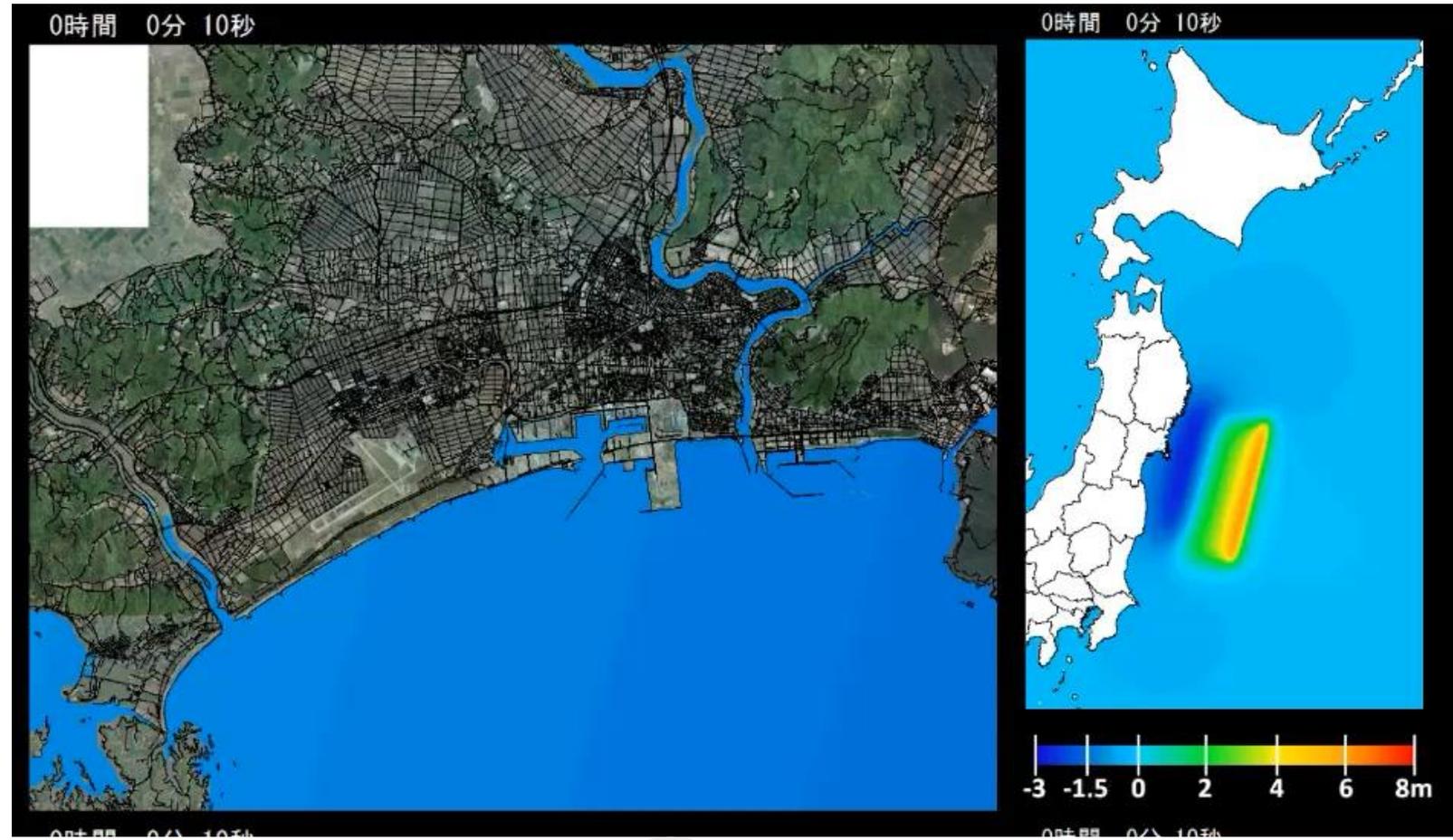
> E 防災デジタルツインの構築

Digital Twin (Koshimura et al., 2025)



- 物理世界の「センシング」と仮想世界の「モデリング・シミュレーション」融合による「推論・政策」が物理世界の「**実践**」に**フィードバック**される。
- 「実践」の結果が「モニタリング」され、次のステップへの「入力」となり、**フィード・フォワードループ**ができる。
- フィード・フォワードループが自動で瞬時に更新される。

Operational GNSS-based Tsunami Inundation Forecast TsunamiCast by RTi-cast, Inc.



Ohta et al. (2012)



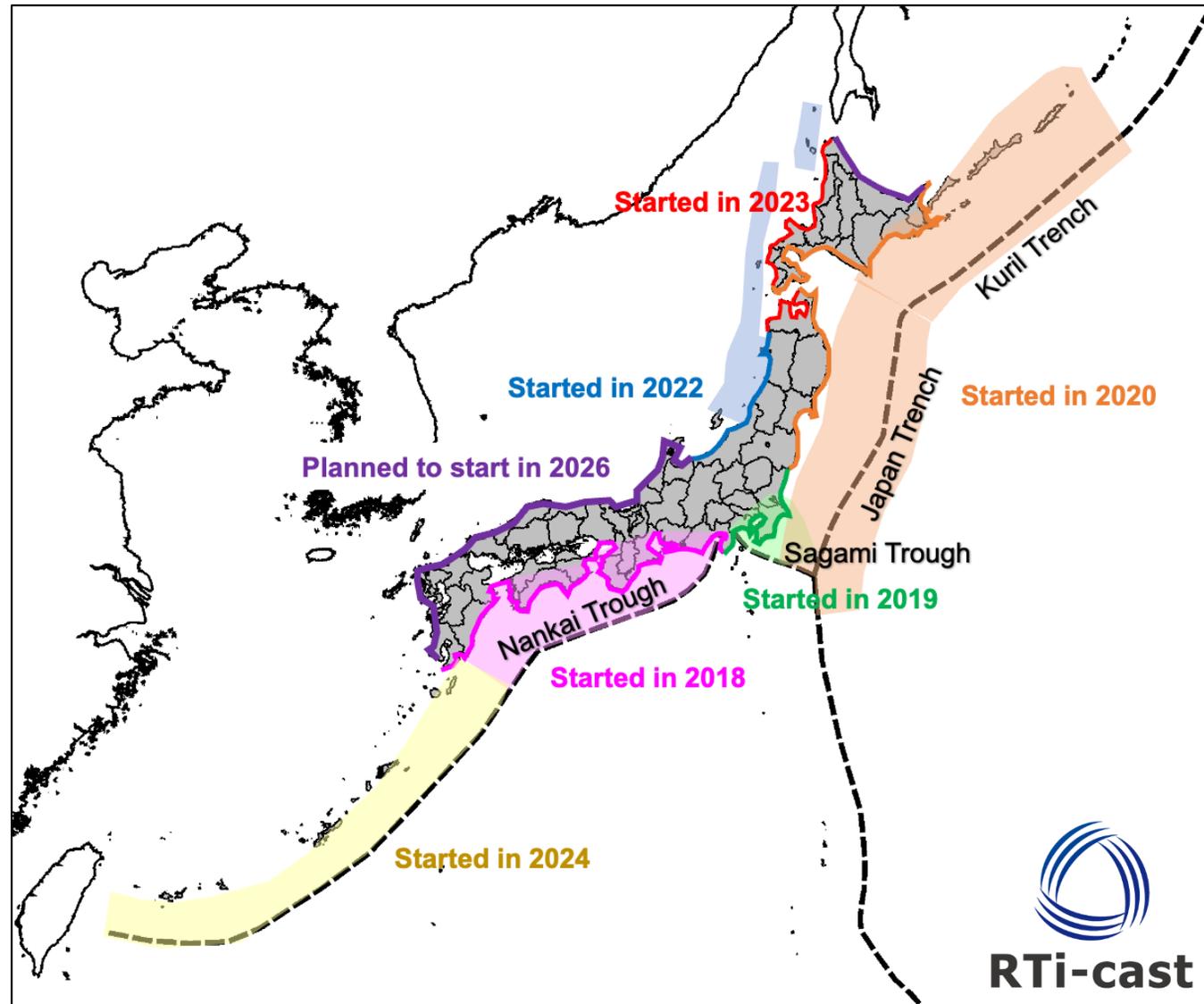
小林広明教授



太田雄策教授

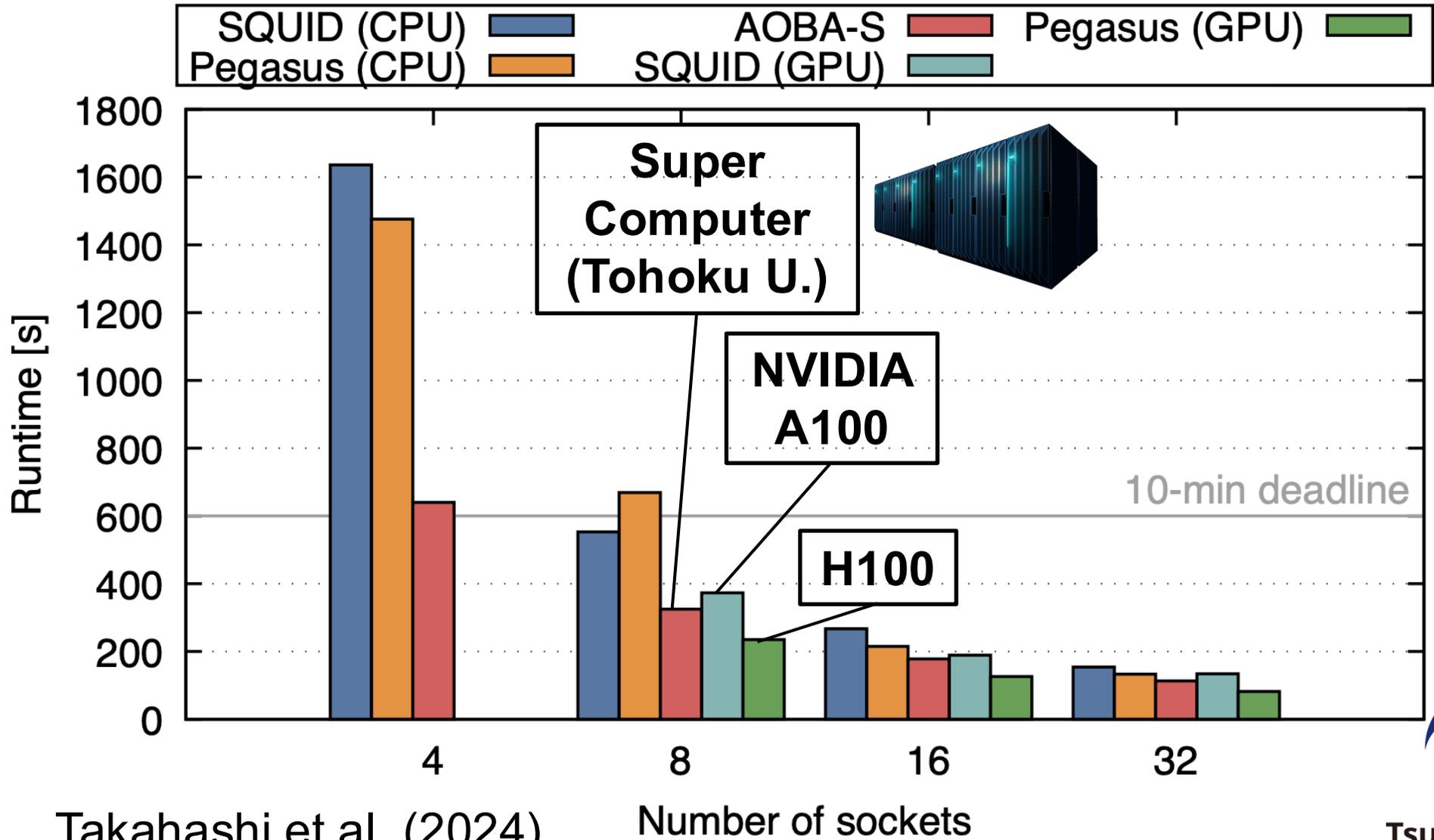


Nation-wide Impact-based Tsunami Forecast System for Cabinet Office of Japan and Prefectural Government



Performance of TsunamiCast for Diverse Users

Time to Complete Prefecture scale's **6-hour Forecast with 10m Resolution**

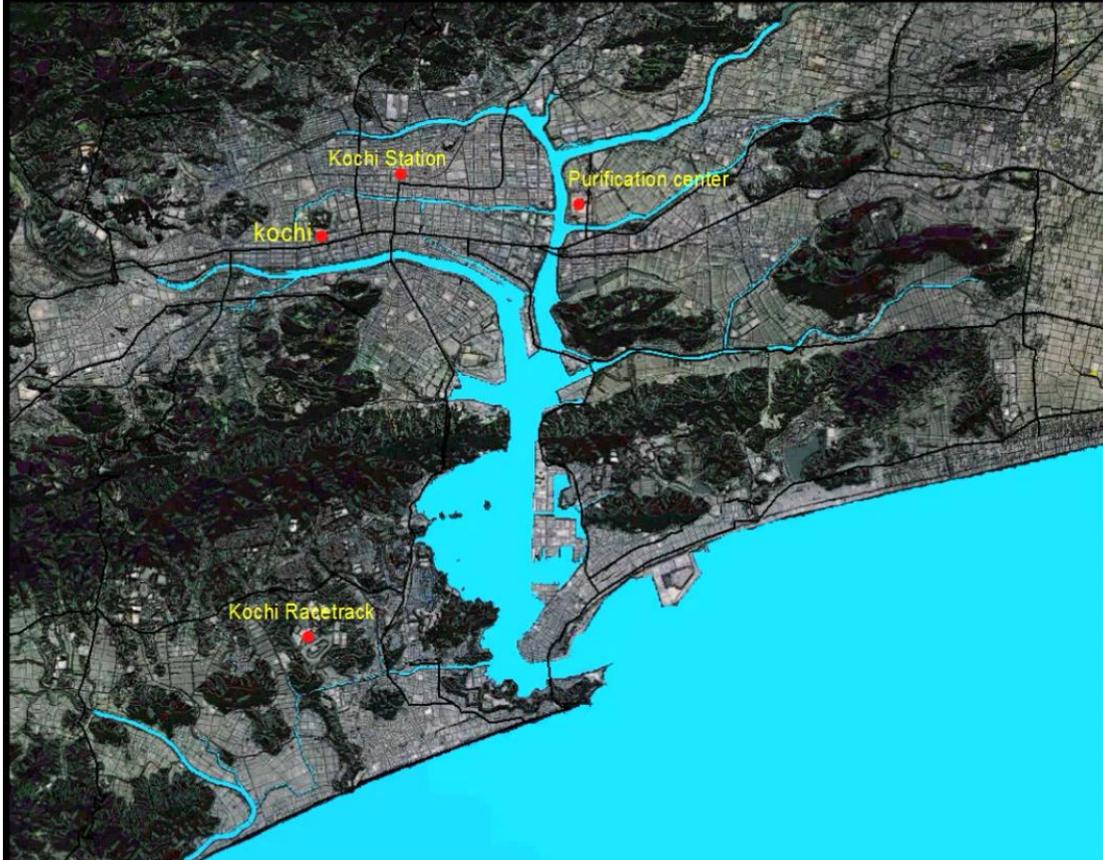


滝沢寛之教授

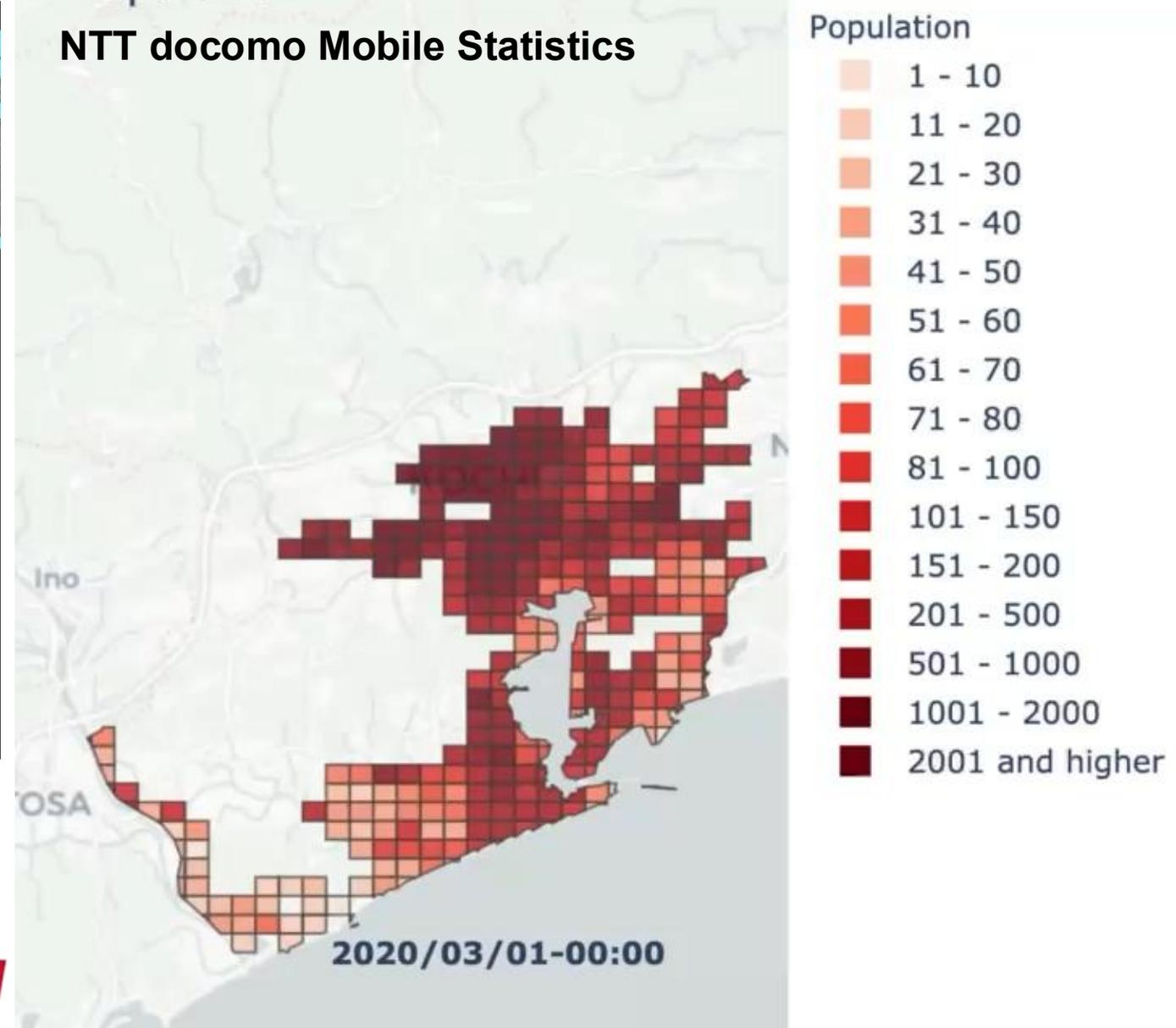


Real-time Exposure Estimates Every Hour, Every 500 m

0時間 0分 10秒



NTT docomo Mobile Statistics

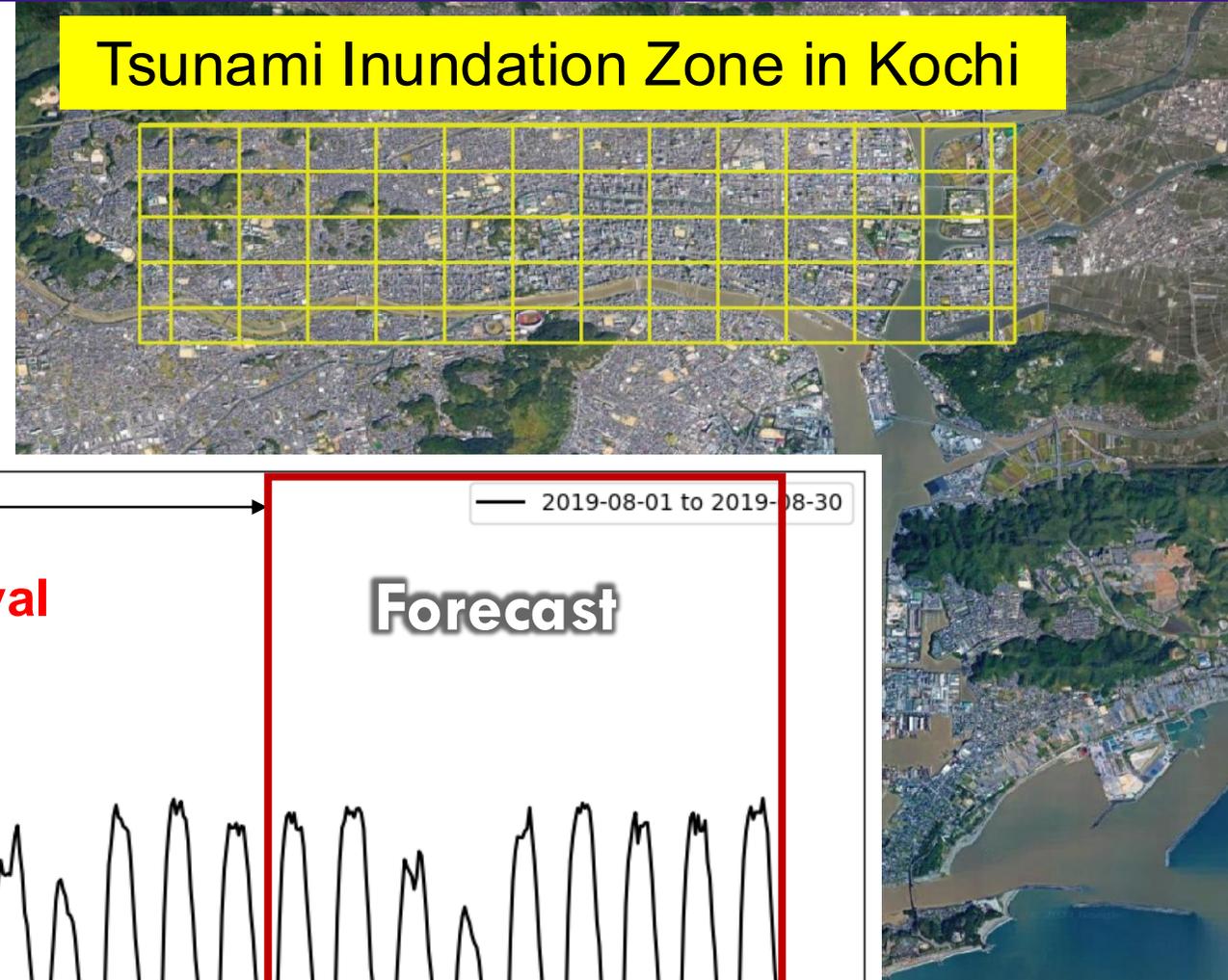


Short-term Population Forecast

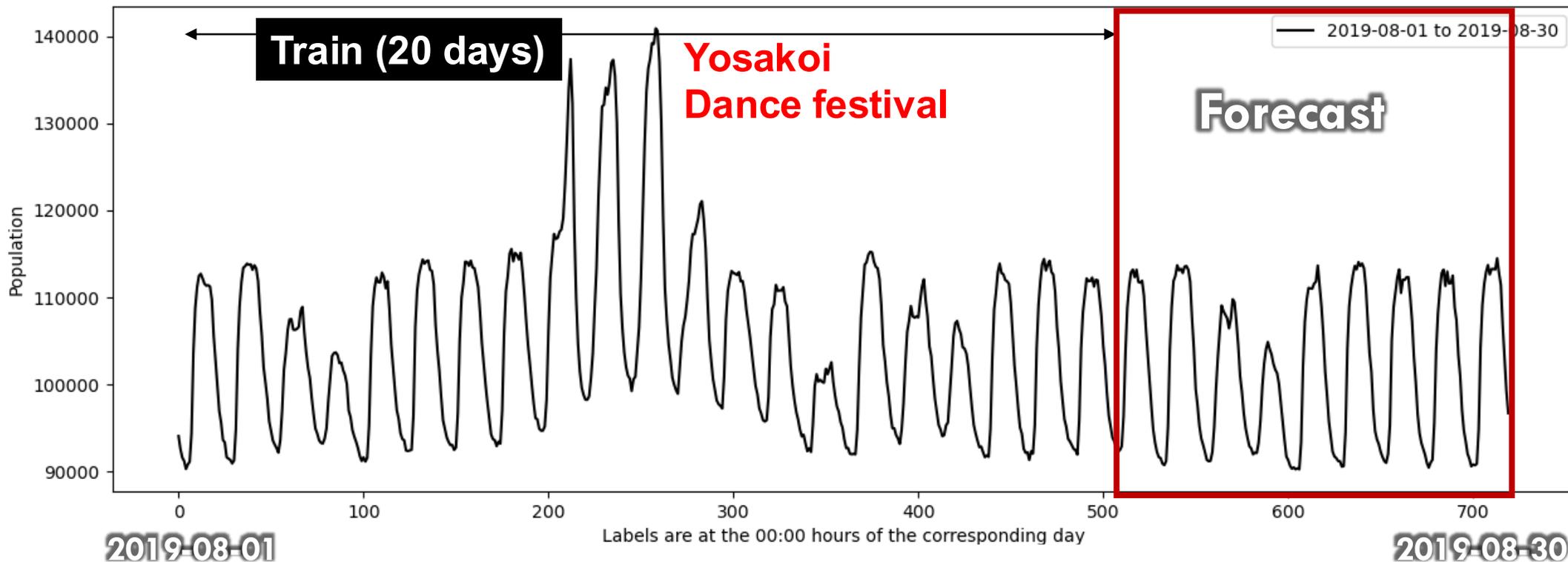


Erick Mas 准教授

Tsunami Inundation Zone in Kochi



Time series of Population [2019-08-01-30]

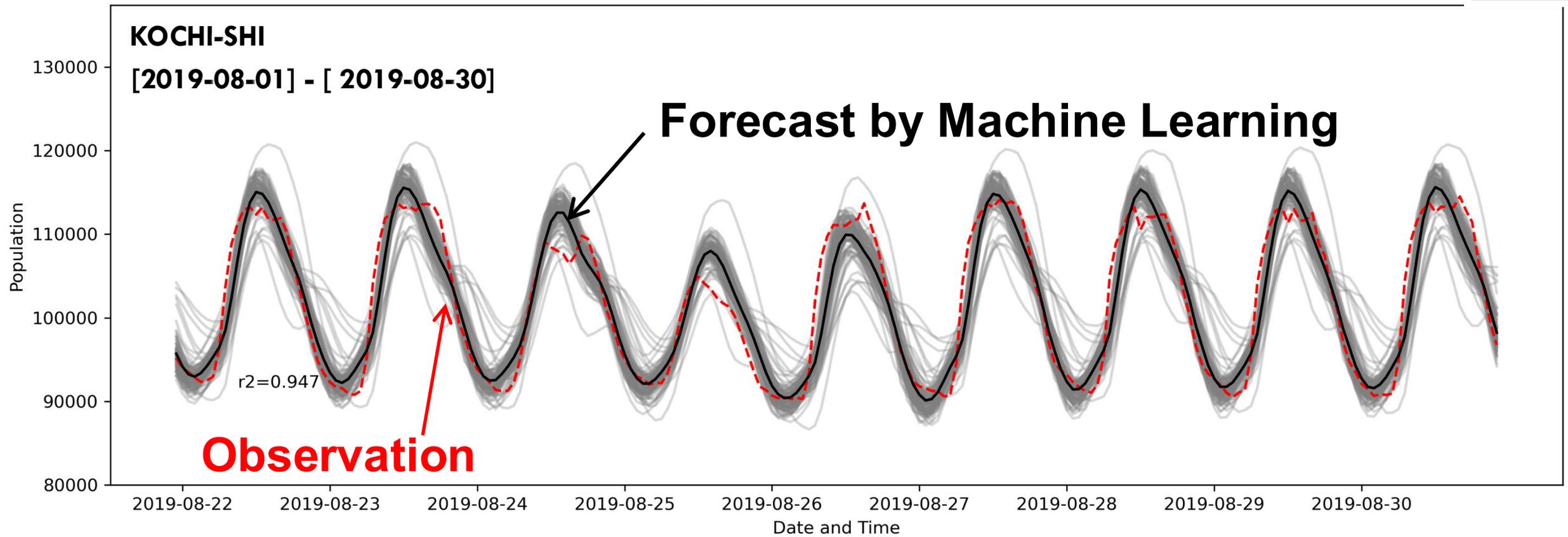
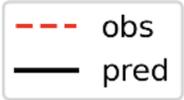


Short-term Population Forecast



Time series of Population

Forecast of Kochi using Walk-forward validation with CNN-LSTM model

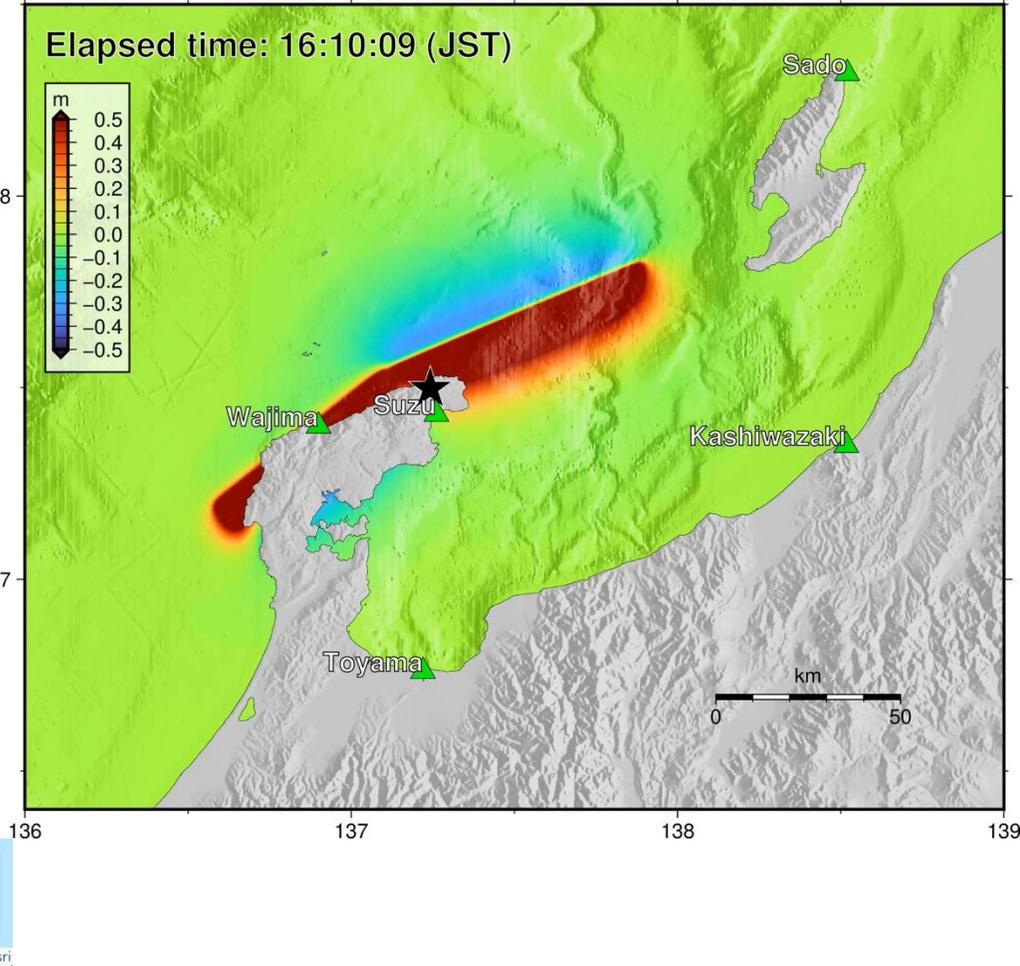
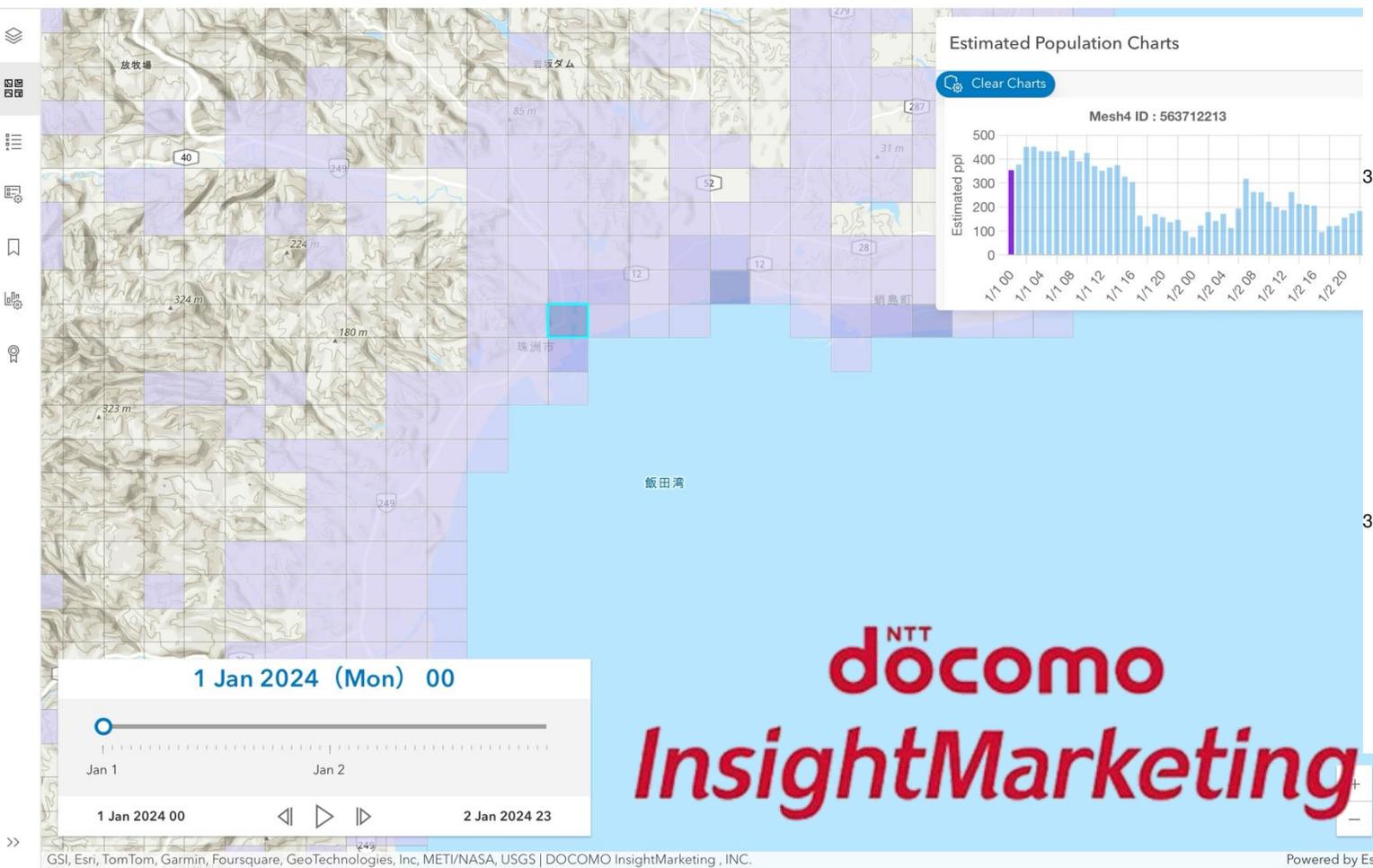


layer Lu et al. (2020)

Real-time Exposure Mapping

The 2024 Noto Peninsula Earthquake Tsunami

Mobile Spatial Statistics Viewer - IRIDeS, Tohoku University

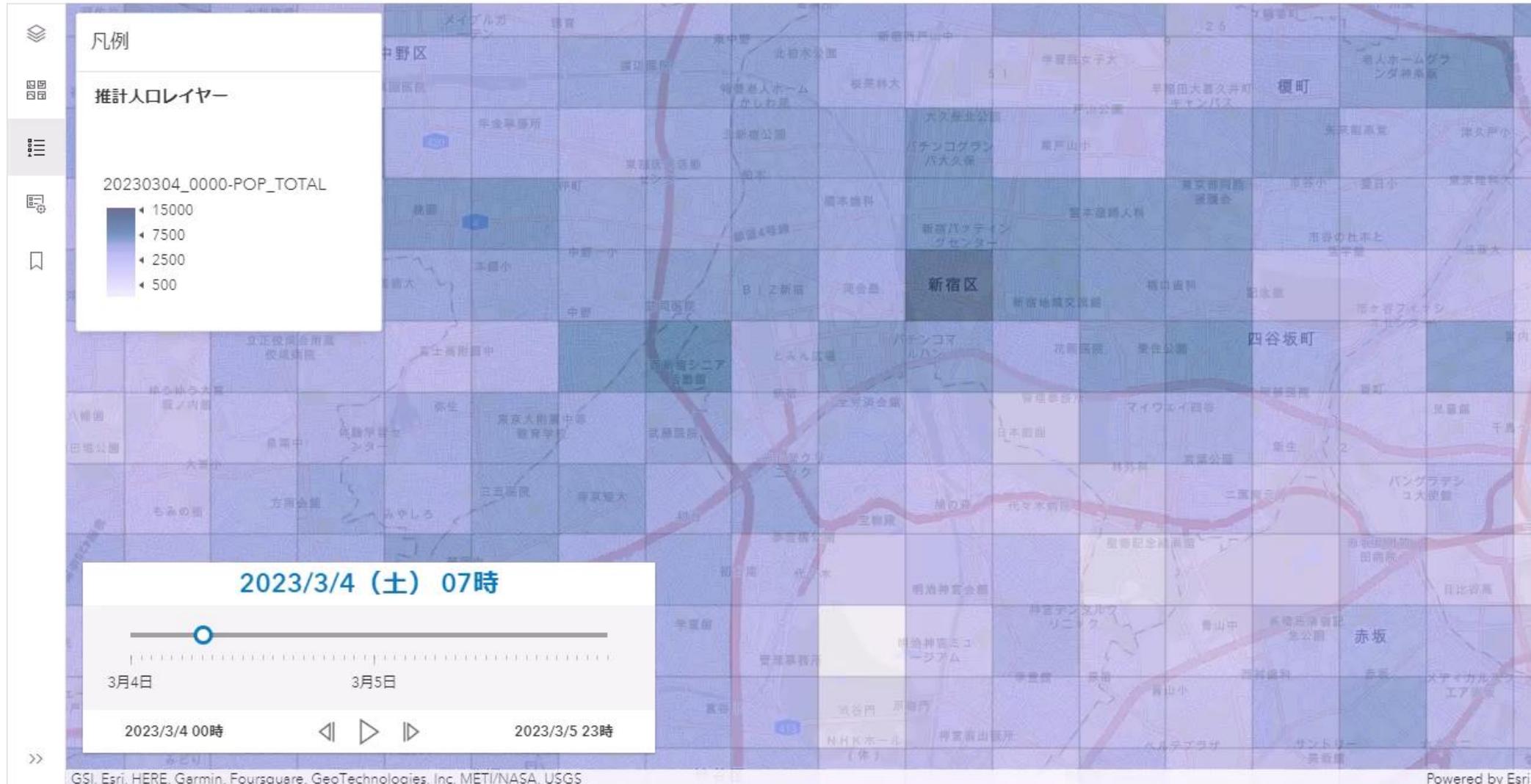


GSI, Esri, TomTom, Garmin, Foursquare, GeoTechnologies, Inc, METI/NASA, USGS | DOCOMO InsightMarketing, INC.

Powered by Esri

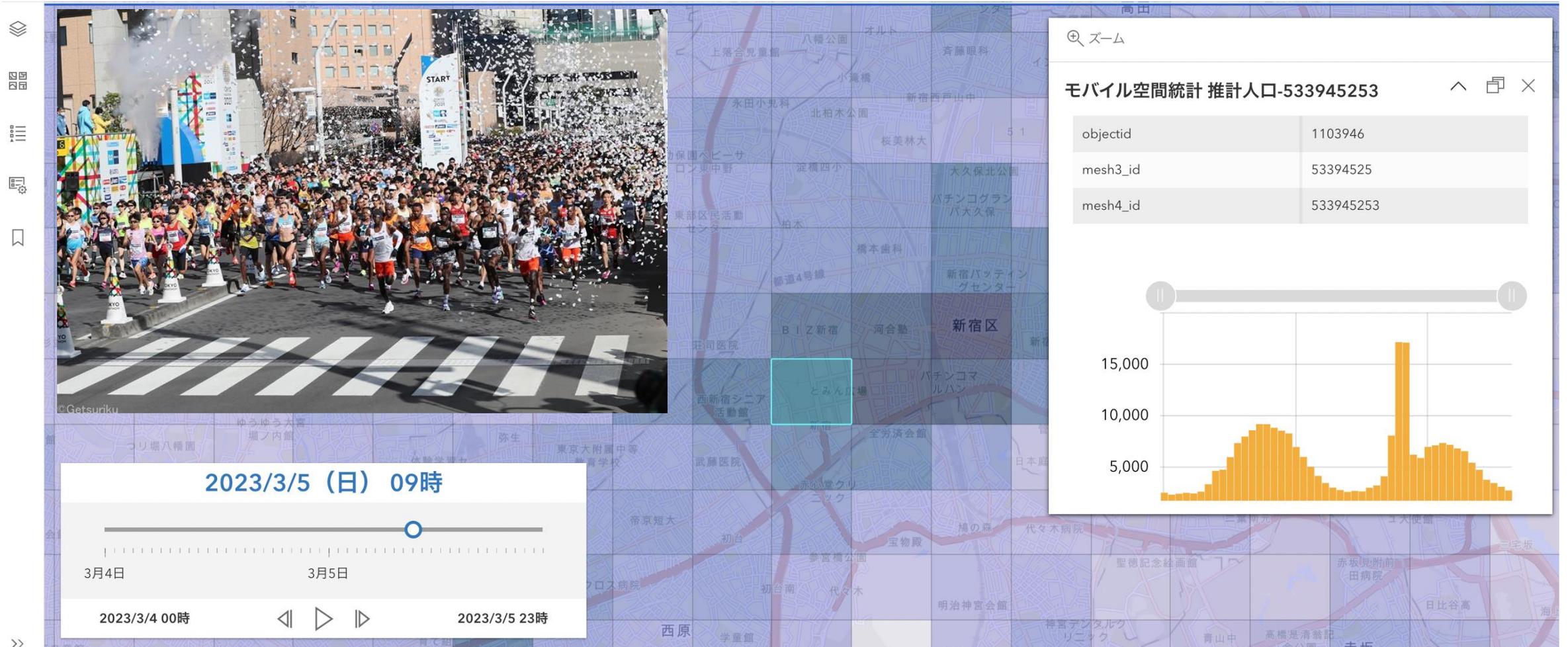
Population at Shinjuku, Tokyo (5 March)

モバイル空間統計 Viewer - 東北大学 災害科学国際研究所 (IRIDes)



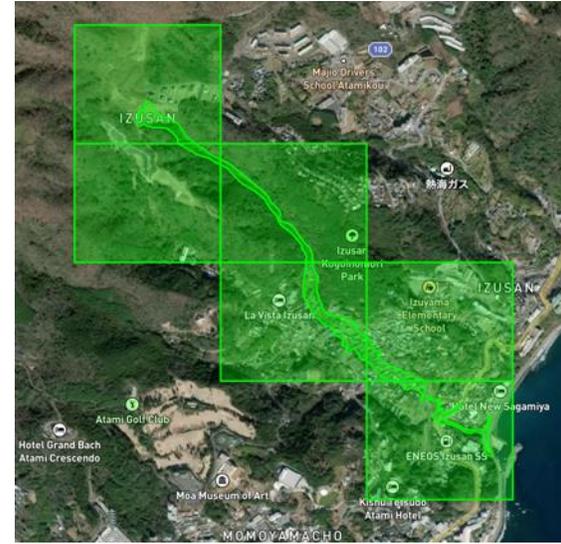
Population at Shinjuku, Tokyo (5 March)

モバイル空間統計 Viewer - 東北大学 災害科学国際研究所 (IRIDes)

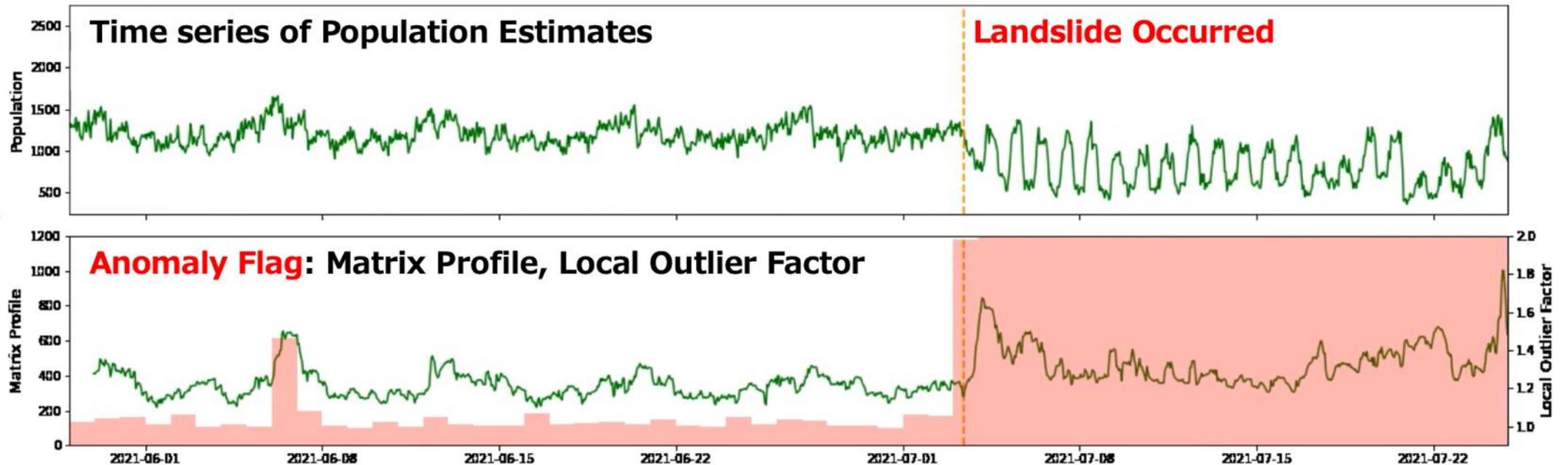


2021 Atami Landslide, Shizuoka Prefecture

killed 27 people



Monitoring Point

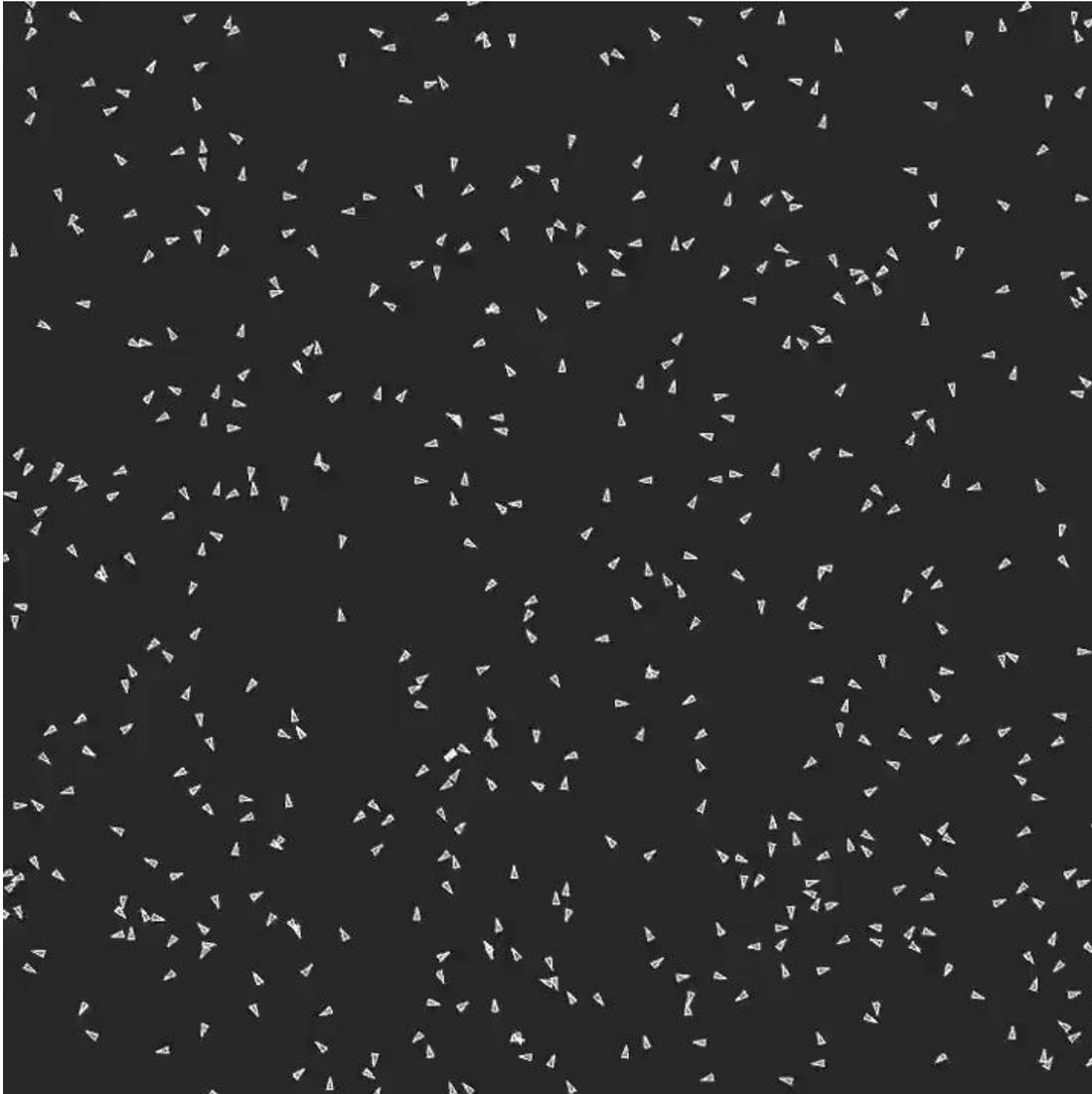


Driving is not a Good Idea

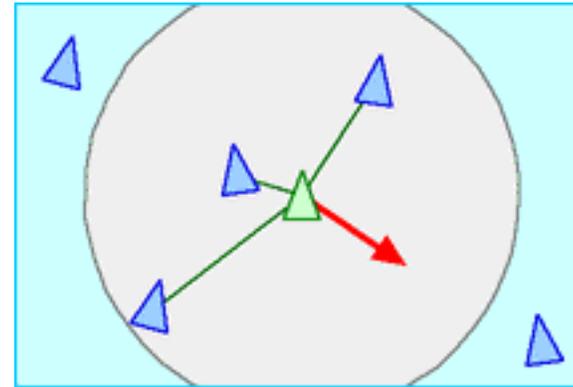


3月11日 午後4時前
仙台市宮城野区

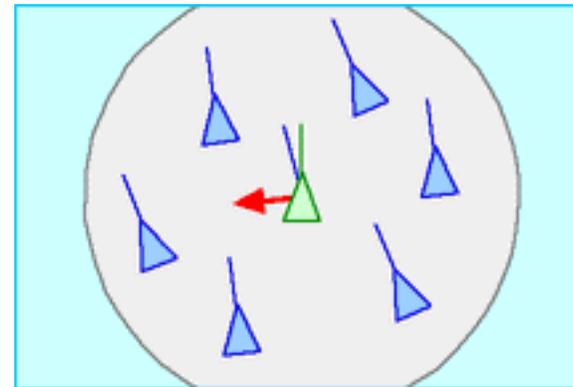
Boids by Craig Reynolds (1987)



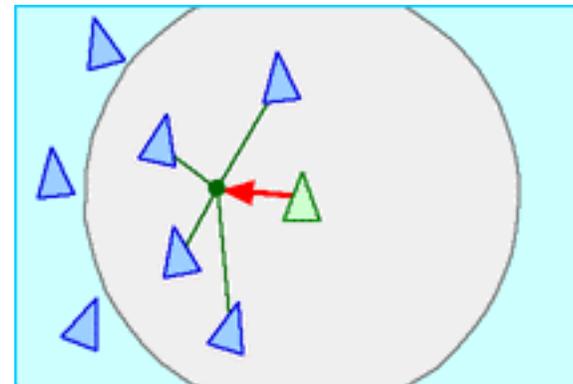
<https://www.youtube.com/shorts/9gTjJxgBH5U>



Separation
分離



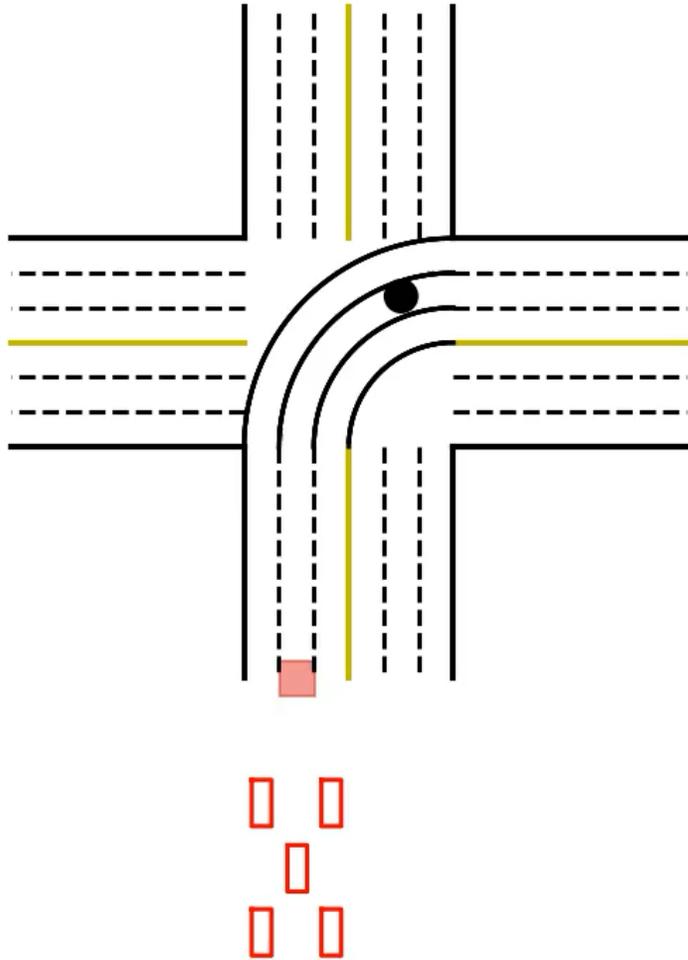
Alignment
整列



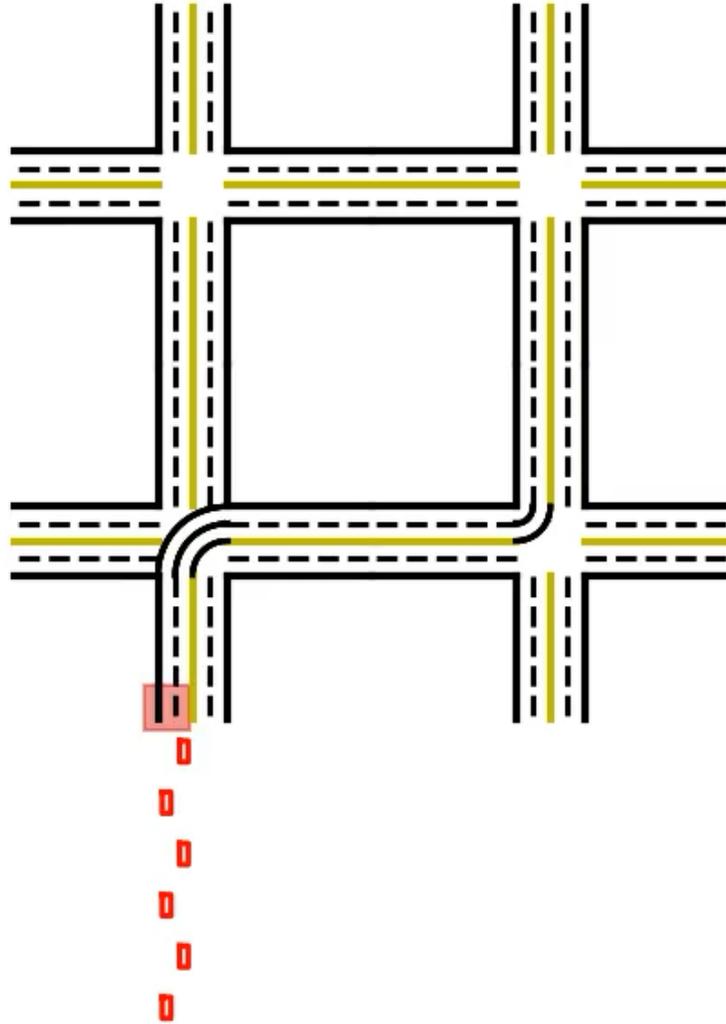
Cohesion
結合

Swarm Intelligence for Automated Drive

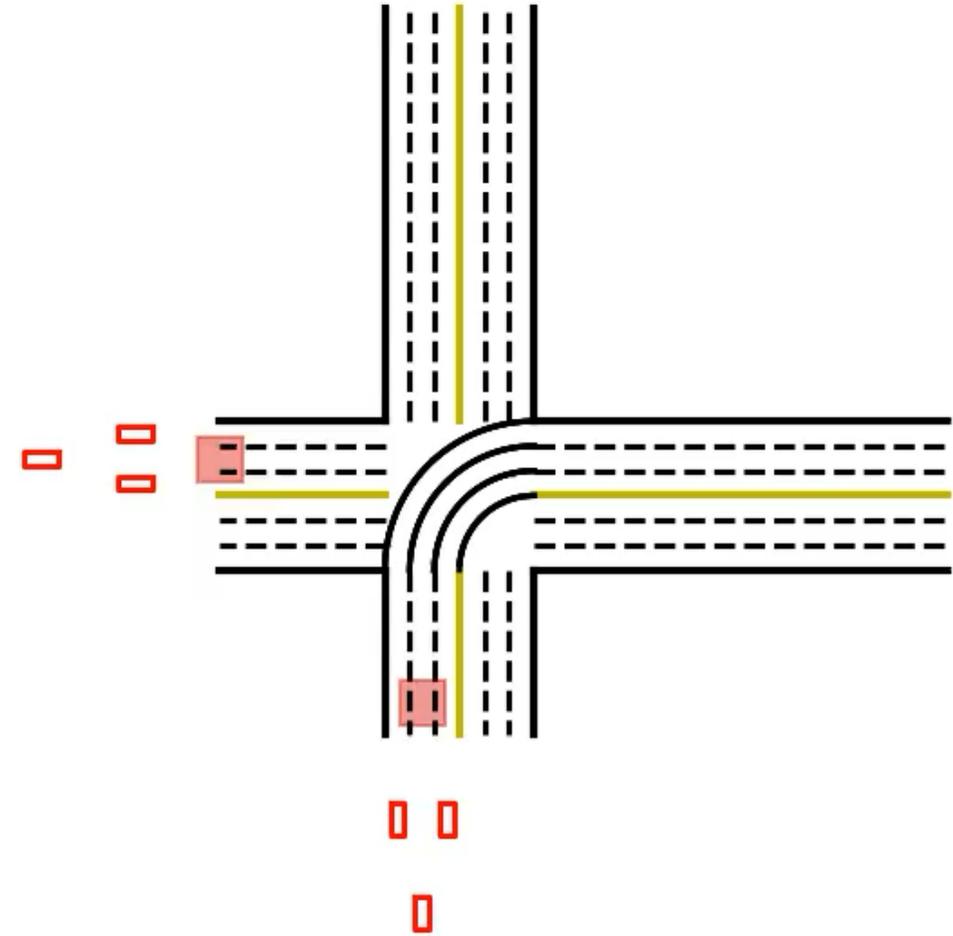
Obstacle Avoidance



Platooning

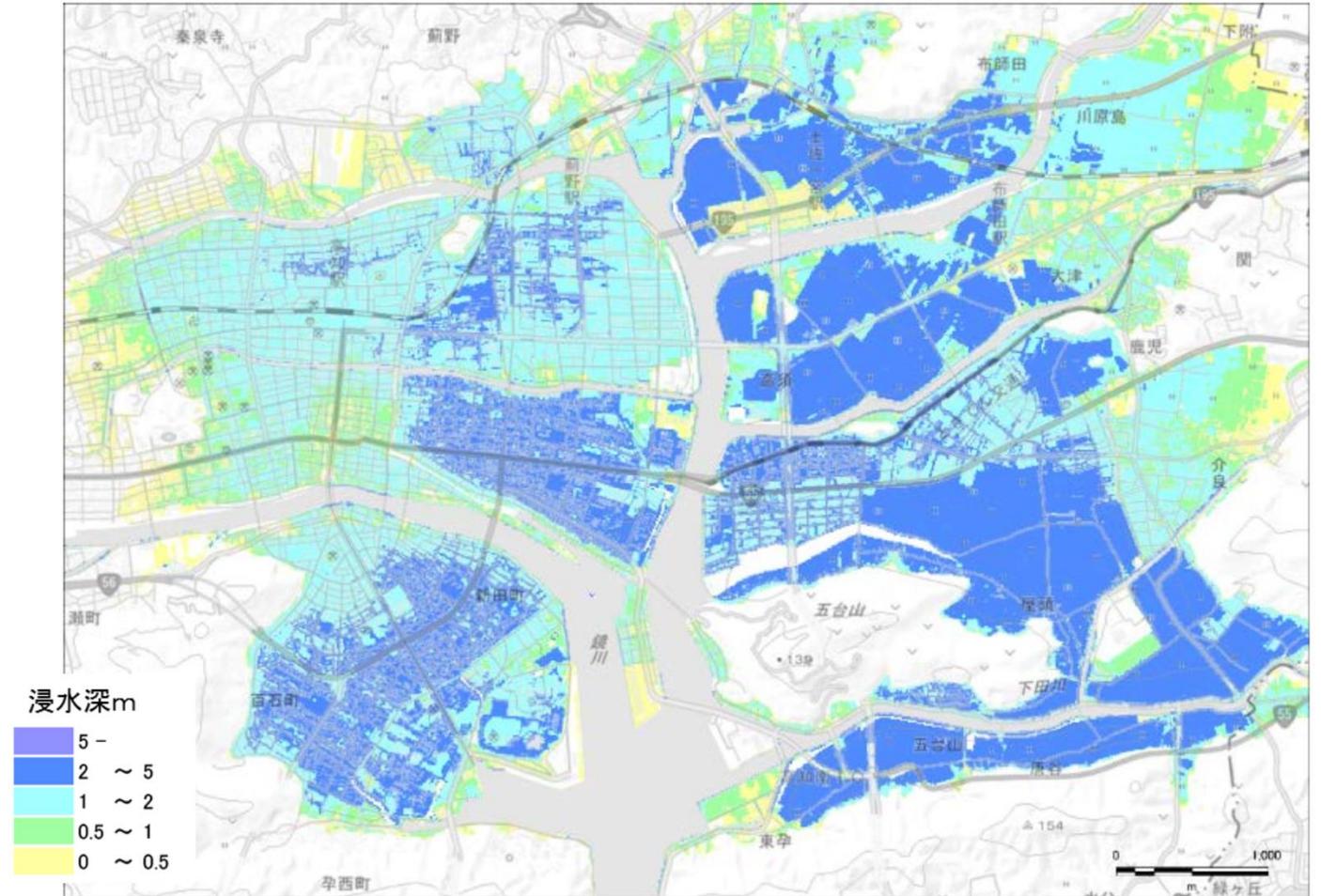


Merging



Kochi city, Nankai Trough Earthquake Tsunami

- 南海トラフ地震津波災害，地盤沈降による長期湛水 2,800ha，最大13万人の救出計画（目標10日間）
- 同時に，浸水域内，中山間地域への孤立被災者への支援物資の輸送
- 排水計画のWhat-if分析

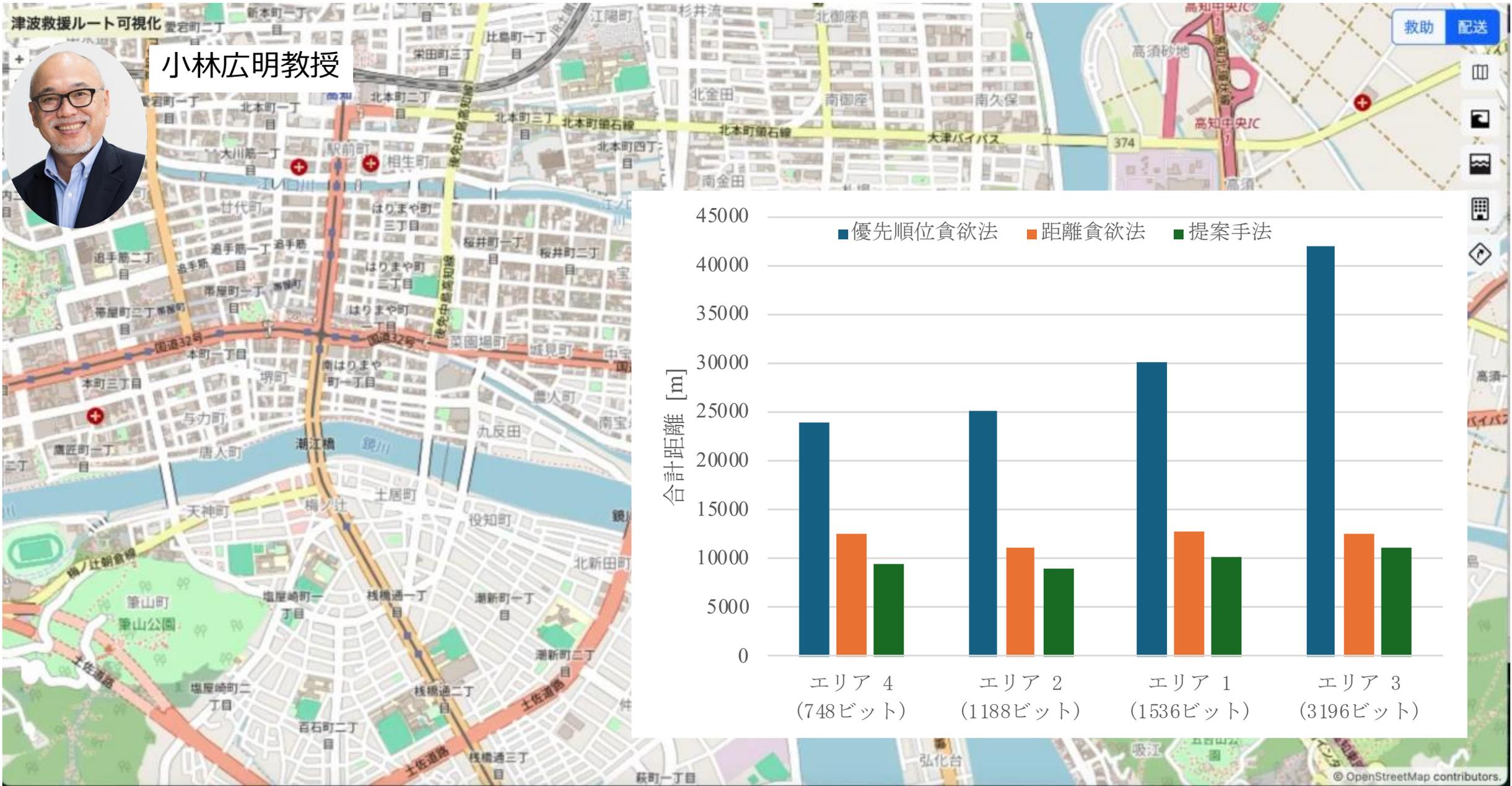


出典：高知県

Quantum Annealing for Resilience



小林広明教授



Multi-Agent System for Medical Response in a Virtual Disaster City



Ruben Vescovo

setup go go once

Parameters taken out from Code to use in Behavior Space.

#dmat #victims
0 0

On erase-previous-files?
Off

On from-files?
Off

On export-locations?
Off

On replicate?
Off

On movie?
Off

GRID (ON/OFF)

Change Date & Time

Show Space 1 Division

Show Space 2 Division

show-victims

#add-dmat 11 units #add-victims 100

Add DMAT teams

UPDATE

● ● ● ● 被災者 (トリアージレベル) DMAT本部 DMAT隊参集地点
● 病院 (医療ニーズ: 赤、黄、緑、灰) ● 航空機 ● 災害拠点病院
● DMAT隊員 ● 救急車 ● 消防署 ● 広域搬送拠点

浸水 非浸水 環境

宮城県との共同研究開始 (2025~)
宮城野原広域防災拠点整備事業

1. モデル設定

- DMATチームのアサイン
- 病院 (医療ニーズ設定)
- 被災者推定・トリアージ
- 広域搬送拠点設営
- DMAT活動拠点設定

2. シミュレーション開始

- DMATチーム参集
- DMAT活動拠点設置
- 緊急車両配備
- 被災者の探索・治療
- 患者の搬送・移動
- 域内搬送・広域搬送

3. 出力

- 受け入れ病床数の経時変化
- 搬送者数の経時変化
- 被災者救護数

4. 評価 (政策的示唆)

- DMATの活動計画
- 搬送計画
- 医療資源配置

Future of Tsunami Digital Twin : Personalized Alert



07:00:00

Thank you for your attention



TsunamiCast

TsunamiCast Channel on YouTube

<https://www.youtube.com/@TsunamiCast>