

# 新型コロナウイルス対応における移動制限とその効果・影響の分析

## Examining impacts of moving restrictions against the novel coronavirus epidemics

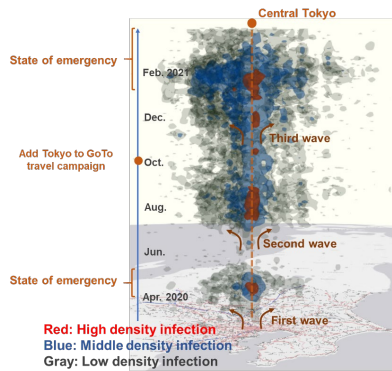
### 活動報告・研究成果の概要

#### ● 目的 外出自粛要請（日本モデル）の評価と検証

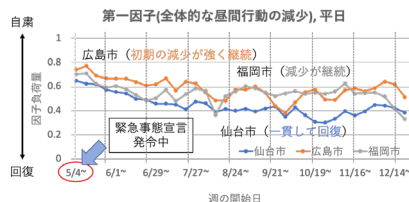
- 2020年4月に実施された緊急事態宣言では外出自粛要請によって、人の動き（モビリティ）を減らし、流行を制御しようと試みた
- その感染拡大防止の効果と社会的影響とは何であったか。

#### ① 人の動きと感染拡大の統計科学的分析

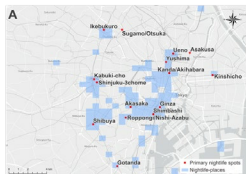
- 流行推移と人の動きの関連： 流行の時空間推移の可視化からも確認（1A）
- モバイル空間統計を活用し、各都市で共通する人々の滞留人口変化のパターンを特定・都市の類型化(1B)
- 「夜の街」型のメッシュ（1C）の滞留人口の変化が感染拡大率と強く関連することを統計学的に確認(1D)



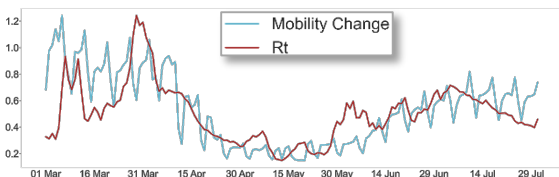
1A: COVID-19時空間密度



1B: 都市別のモビリティパターン推移



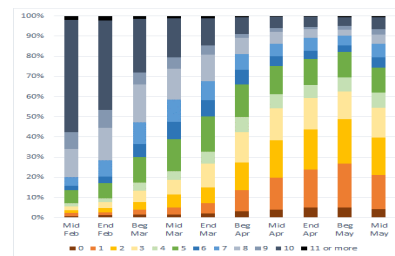
1C: 「夜の街」型地区の推定



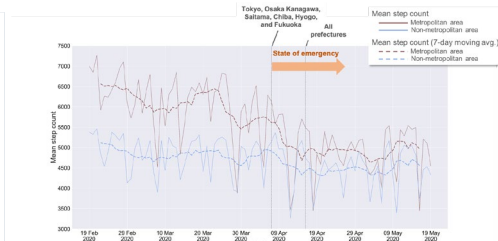
1D 「夜の街」型地区の滞留人口推移とCOVID-19再生産数

#### ② 個人の生活行動変化の社会科学的分析

- 緊急事態宣言と関連した外出行動の大幅な減少をオンライン調査で確認（2A）
- 女性、低所得、非就労、公共交通利用、慢性疾患あり等の属性で外出抑制が大
- 外出に対する世間の目を気にすることも、外出抑制と関連
- iPhoneヘルスケアアプリの記録から、大都市圏・若年層で歩行量や外出の大きな減少（2B）
- 身体活動の低下、座位時間の増加、メンタルヘルスの低下なども地域特性と関連



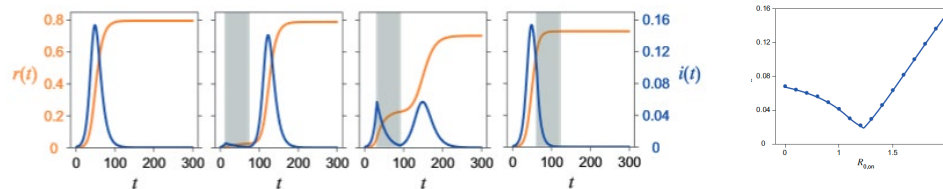
2A: 緊急事態宣言と外出行動の推移



2B: 緊急事態宣言と歩数の推移

#### ③ 感染拡大防止効果の情報科学的検討

- 強制力の無い感染抑制が有効な流行制御戦略となりうることの理論疫学的検討（単純ケースとして、1回の介入の場合の数理解析・シミュレーション）（3A）
- 感染者数を最も少なく抑えられる適度な介入タイミングと強度があり、強すぎる介入は人々の社会生活に大きな影響を及ぼすのみならず、感染拡大防止の観点からも最善でないと示唆（3B）



3A: タイミングの異なる介入効果のシミュレーション

3B: 介入強度と流行抑制効果

#### ● 結論

- 非強制的でない外出抑制である「日本モデル」が、2020年4月の緊急事態宣言では、モビリティ抑制を通して感染制御に有効であった。
- 一方で、外出抑制が困難であった人々、外出抑制によって影響を大きく受けた人々が地域特性に応じて存在したことを確認した。

# 新型コロナウイルス対応における移動制限とその効果・影響の分析

## Examining impacts of moving restrictions against the novel coronavirus epidemics

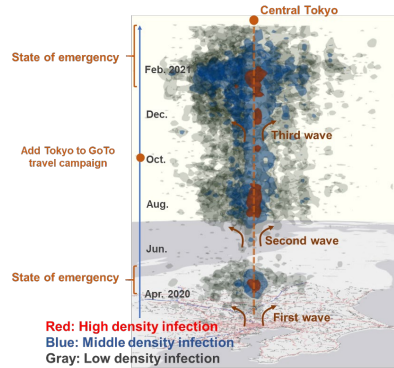
### Activity report • Results

#### ● Aim: Assessing the Japanese model of self-restraint

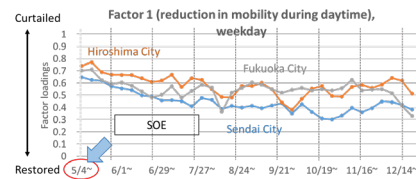
- The state of emergency (SOE) declared in April 2020 attempted to control the epidemic by asking people to refrain from going out, thus reducing mobility.
- What was the effect of this on preventing the spread of the disease and what was the social impact?

#### ① Statistical analysis of human movement and infection spread

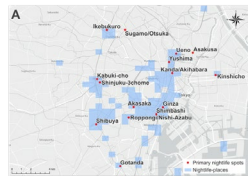
- Association between epidemic trends and human mobility: the visualisation of spatio-temporal trends of epidemics clearly indicated this (1A).
- Using Mobile Spatial Statistics, common patterns of changes in the ambient population in each city were extracted resulting in classification of cities (1B).
- Changes in the ambient population of "nightlife" type grids (1C) were most strongly associated with the changes in reproduction rates of COVID-19 (1D).



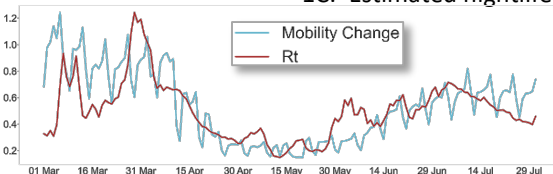
1A: Space-time density of COVID-19



1B: Temporal changes of mobility patterns in three cities.



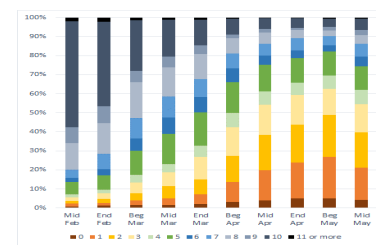
1C: Estimated nightlife type grids



1D Temporal changes in the ambient population in nightlife type grids and reproduction numbers of COVID-19

#### ② Social scientific analysis of individual life behavior change

- Online survey confirmed significant reduction in outing behaviour associated with SOE (2A)
- Women, low income, not working, using public transport, and having a chronic illness were more likely to be discouraged from going out
- Concerns about public perceptions of going out were also associated with reduced going out
- Large decrease in walking and going out in metropolitan areas and younger age groups were observed according to iPhone healthcare app records (2B)
- Decline in physical activity, increase in sedentary time and decline in mental health were also associated with regional characteristics



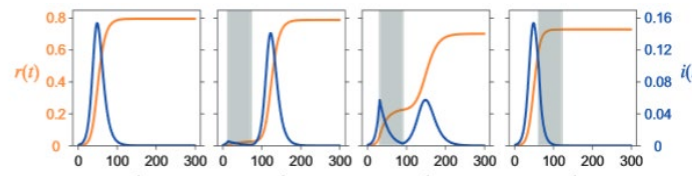
2A: SOE and changes in outing behaviors



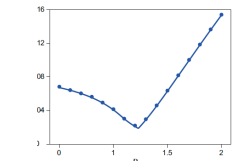
2B: SOE and step count changes

#### ③ Informatics study of the effect on preventing the spread of infection

- Theoretical epidemiological investigation of whether uncoerced infection control can be an effective epidemic control strategy (mathematical analysis and simulation of a single intervention as a simple case) (3A)
- It is suggested that there is an appropriate timing and intensity of intervention that can reduce the number of infected people to the lowest level, and that interventions that are too strong not only have a significant impact on people's social lives, but are also not the best in terms of preventing the spread of infection (3B)



3A: Simulation of the effects of interventions with different timing



3B: Intervention intensity and epidemic reductions

#### ● Conclusion

- The "Japan model" of non-coercive curtailment of going out was effective in controlling infection through mobility suppression during the emergency declaration in April 2020.
- On the other hand, there were people who had difficulty in curtailing their mobility and people who were greatly affected by curtailing their mobility, depending on area characteristics.