OECD.EO

東京大学
THE UNIVERSITY OF TOKYO

Harnessing EO and census data for subnational risk analyses of environmental hazards

The case of Japan

StatEO26 conference – Earth observation for Official Statistics and policy indicators

5-7 May 2026

Presented by Mikaël Maes (OECD Environment Directorate)

Joint work with Ivan Haščič, Villas Vidvei, Hiroshi Okamoto, Hisashi Yoshikawa, Yusuke Horinouchi, Muyun Wang, Shuntaro Nozawa and Sho Yamasaki

The IPCC's Framework for Disaster Risk

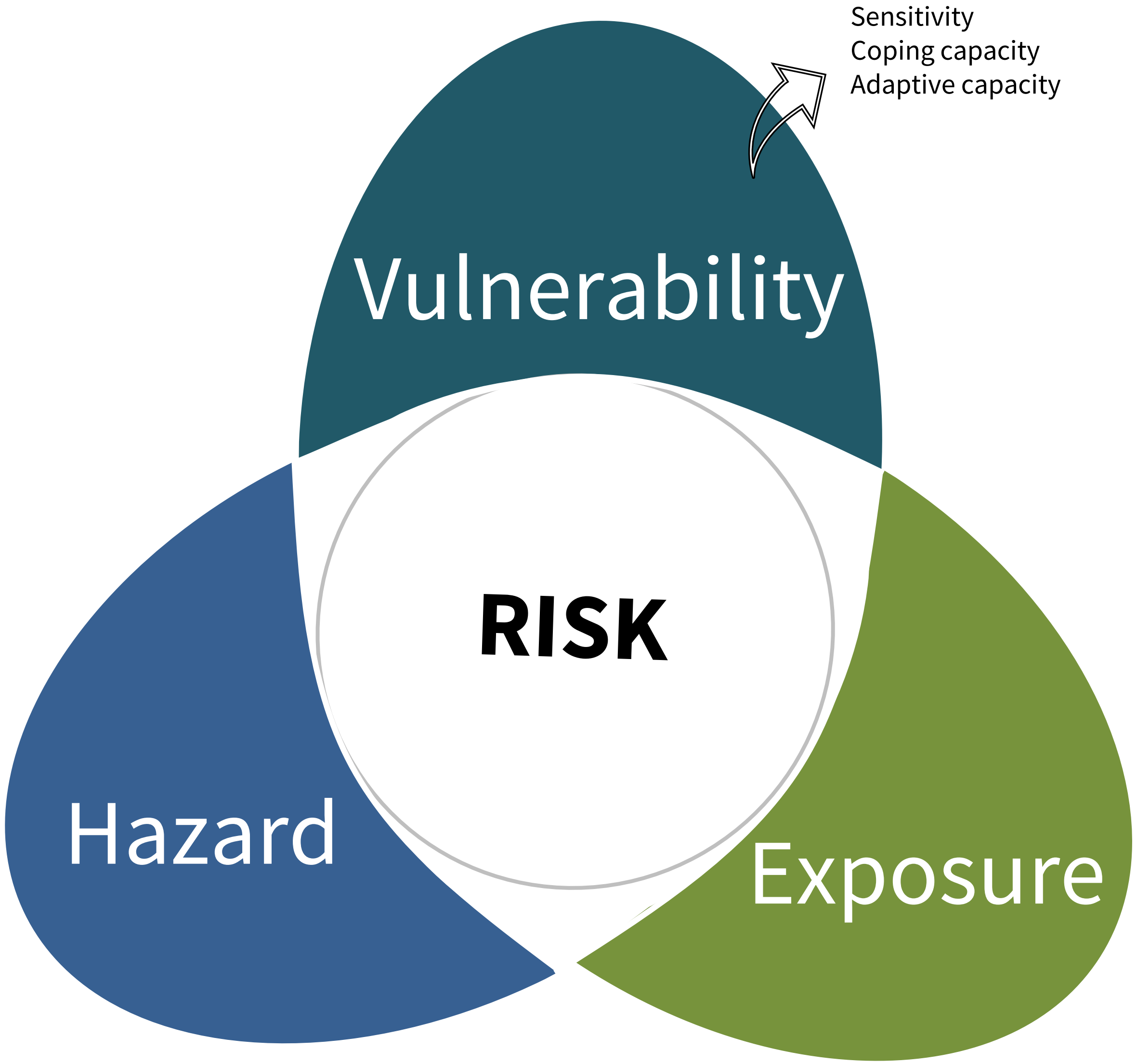
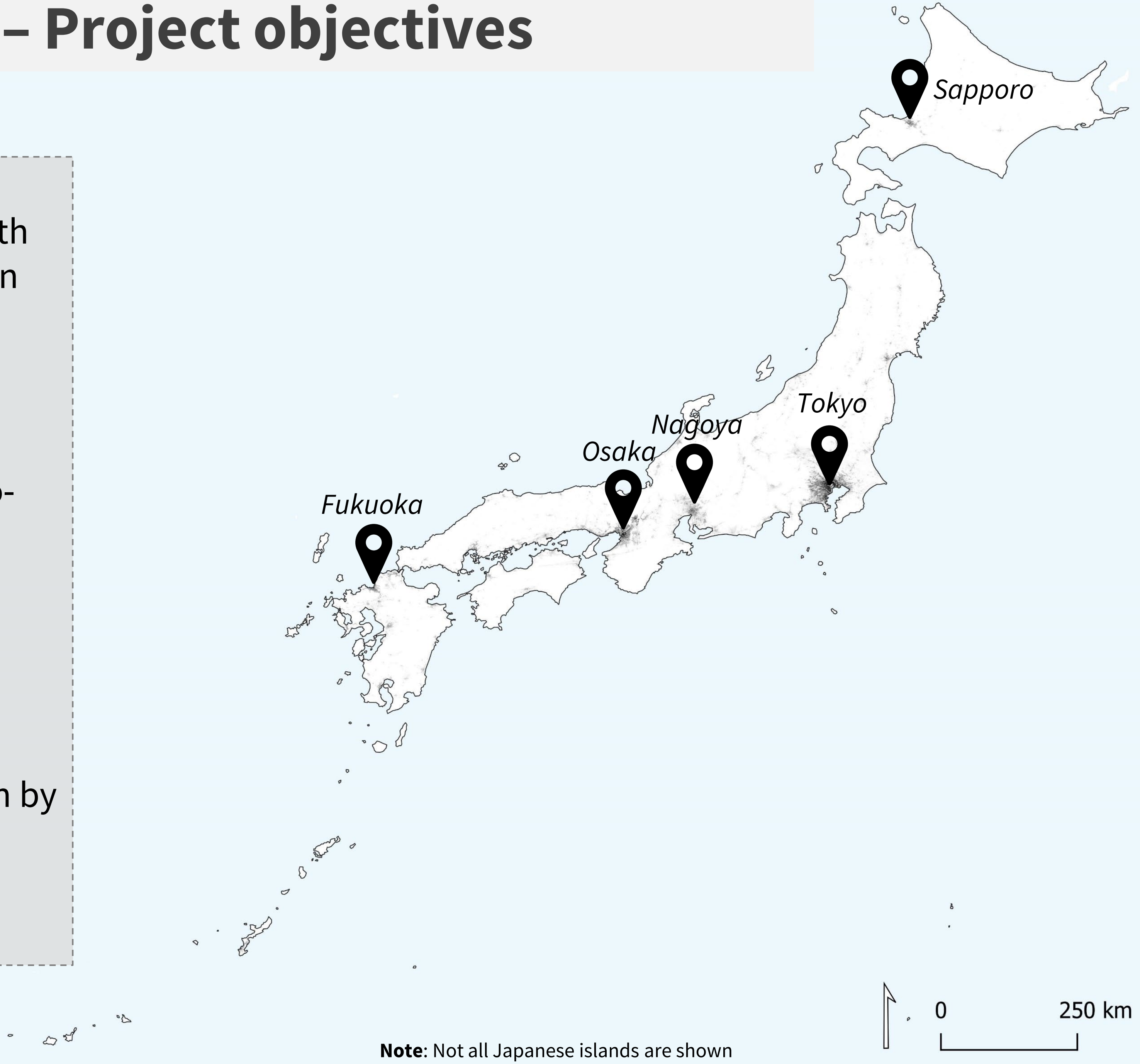


Figure adapted from IPCC (2014) & IPCC (2022)

The case country of Japan – Project objectives

- **What.** Identify key environmental hazards with important impacts on the population in Japan and how the risk varies according to socio-demographic characteristics
- **How.** Identify relevant Earth observation and geo-referenced socio-demographic and socio-economic data from both census and non-census sources
- **Outcome.** Develop a methodology for quantifying the exposure and risk of the Japanese population to two environmental hazards: (a) extreme heat and (b) air pollution by creating a set of national and subnational hazard, hazard-exposure and risk indicators



Note: Not all Japanese islands are shown

Japan has an aging population, outstripping all OECD countries

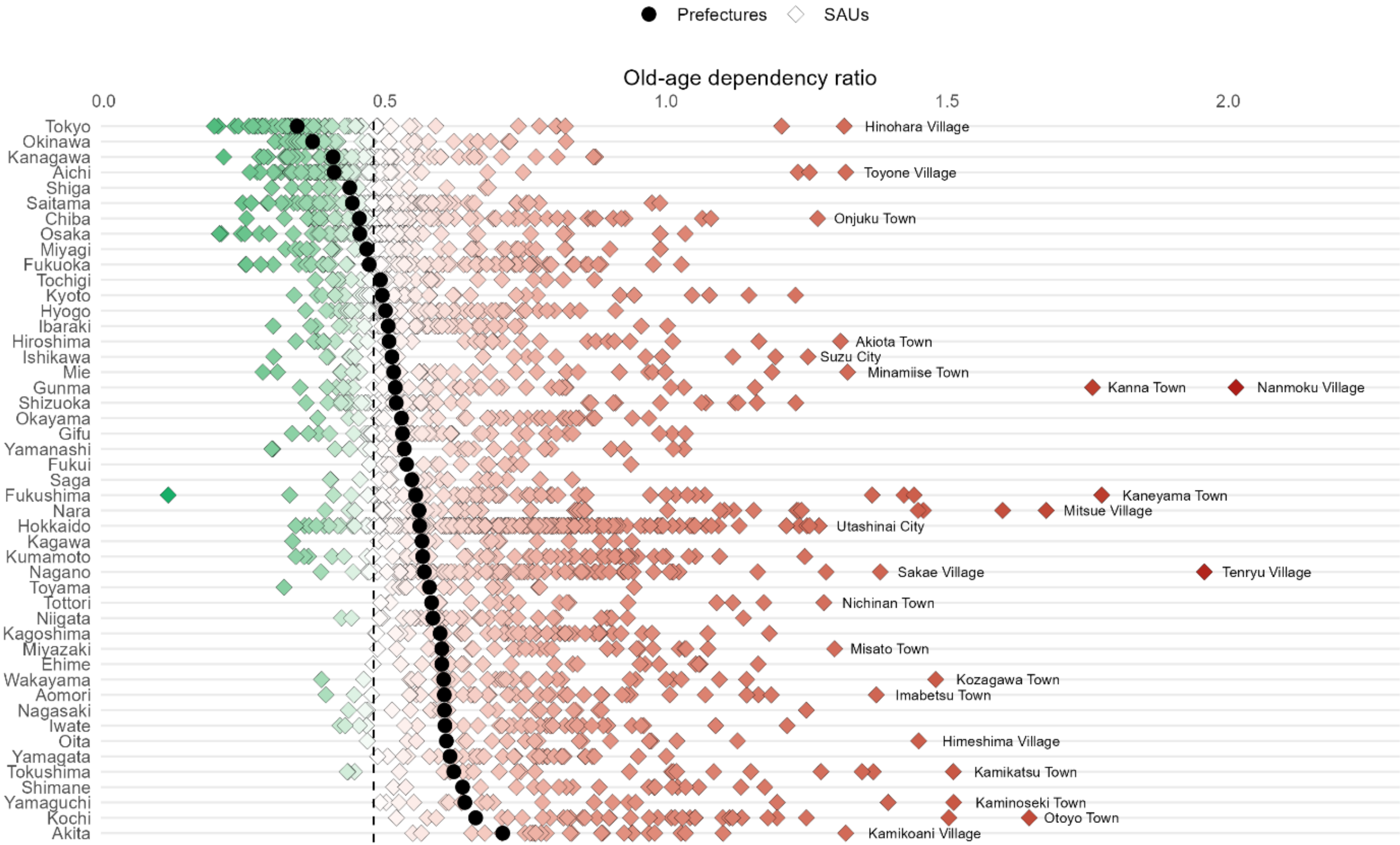
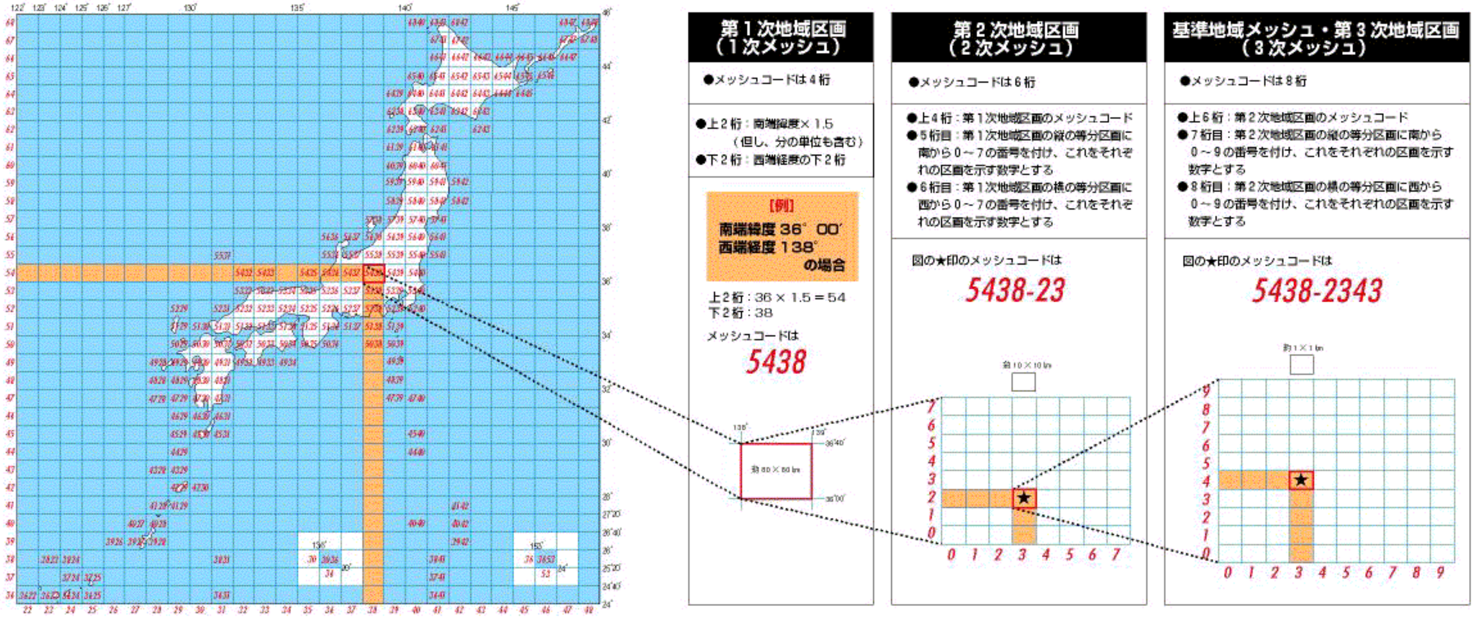


Figure. Old-age dependency ratio across Japanese prefectures and Small Area Units, 2020. Dotted line is national average

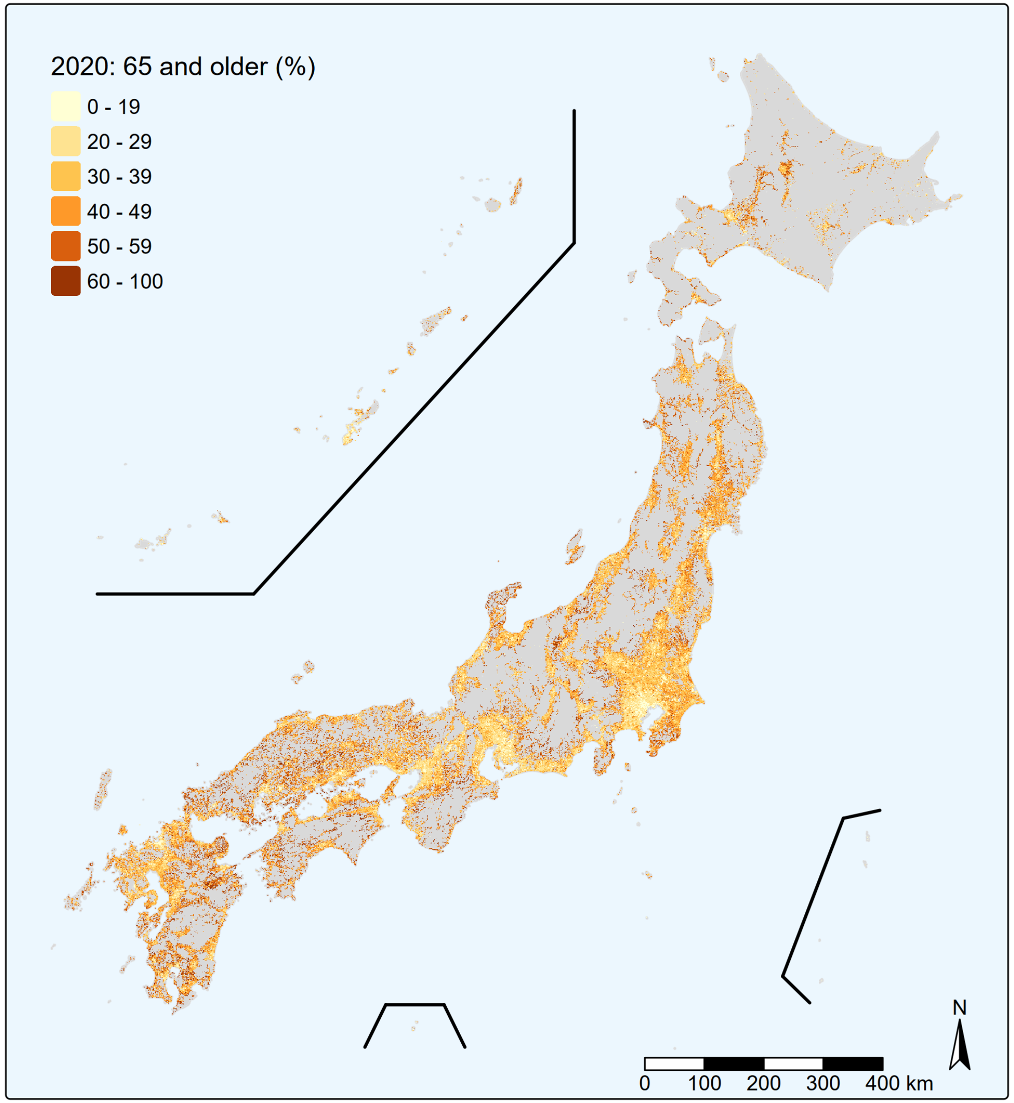
Note: Out of 1896 SAUs, 158 have an old-age dependency rate exceeding 1.0, indicating that there are more elderly (+65-years old) than working-age residents (15–64 years old). **Source**: Population Census (2020)

Spatially explicit Census data as a foundation for risk assessments

Grid Square System and grid code for Statistical use



Share of aged population (+65 years old)



A stepwise approach to developing vulnerability & risk indicators

Step 1 Epidemiological review

Synthesise evidence on the key drivers that shape vulnerability to extreme heat and air-pollution

Step 2 Data source identification

Identify relevant Census and non-Census data, including EO data for identifying the (i) hazard, (ii) population and (iii) vulnerability

Step 3 Hazard identification

Develop key indicators for monitoring extreme heat and air pollution

Step 4 Hazard-exposure analysis

Overlaying with population Census data to develop population-weighted exposure indicators

Step 5 Vulnerability identification

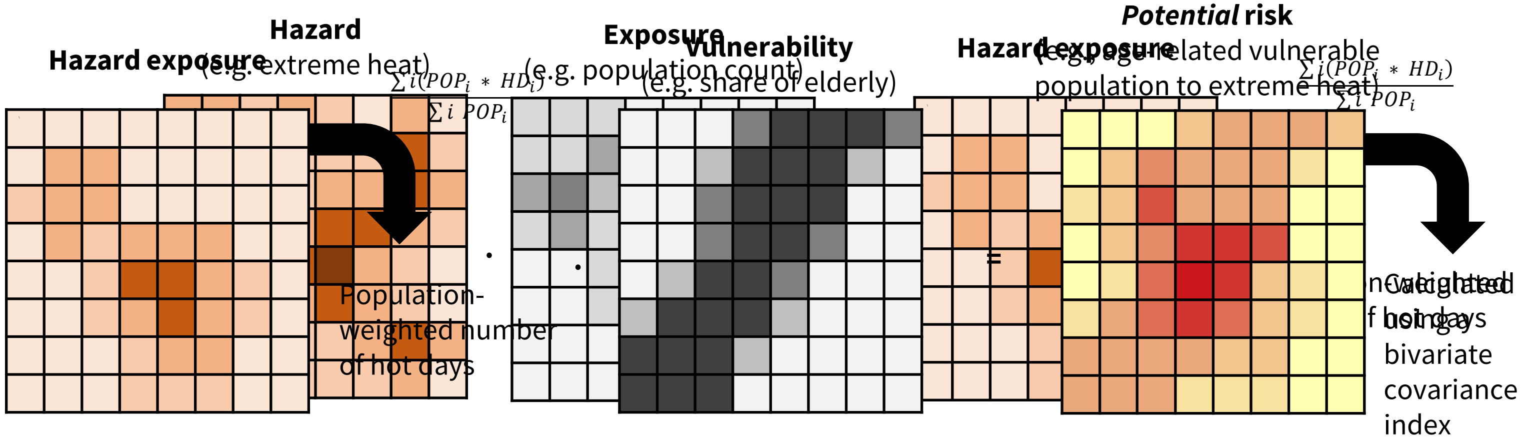
Develop key indicators for identifying vulnerable populations (e.g. the elderly, deprived areas)

Step 6 Risk indicator development

Produce an estimate of *potential* risk by using a bivariate covariance measurement method

Step 7 Validation

Compare the *potential* risk indicator with impact data (i.e., mortality due to extreme heat)



Impact data is key for assessing extreme heat and validation

- **Impact data** are important to study the risk and vulnerability to extreme heat by:
  - Providing evidence on which hazard and vulnerability variables best explain the extreme heat burden
  - Providing possibilities for investigating and validating indicators' explanatory power

- Two data sources are used in this work:
  - **Heat stroke deaths** as reported by medical examiners (prefecture-month level)
  - **Excess all-cause mortality due to ambient temperature** (municipality-year and prefecture-year levels)

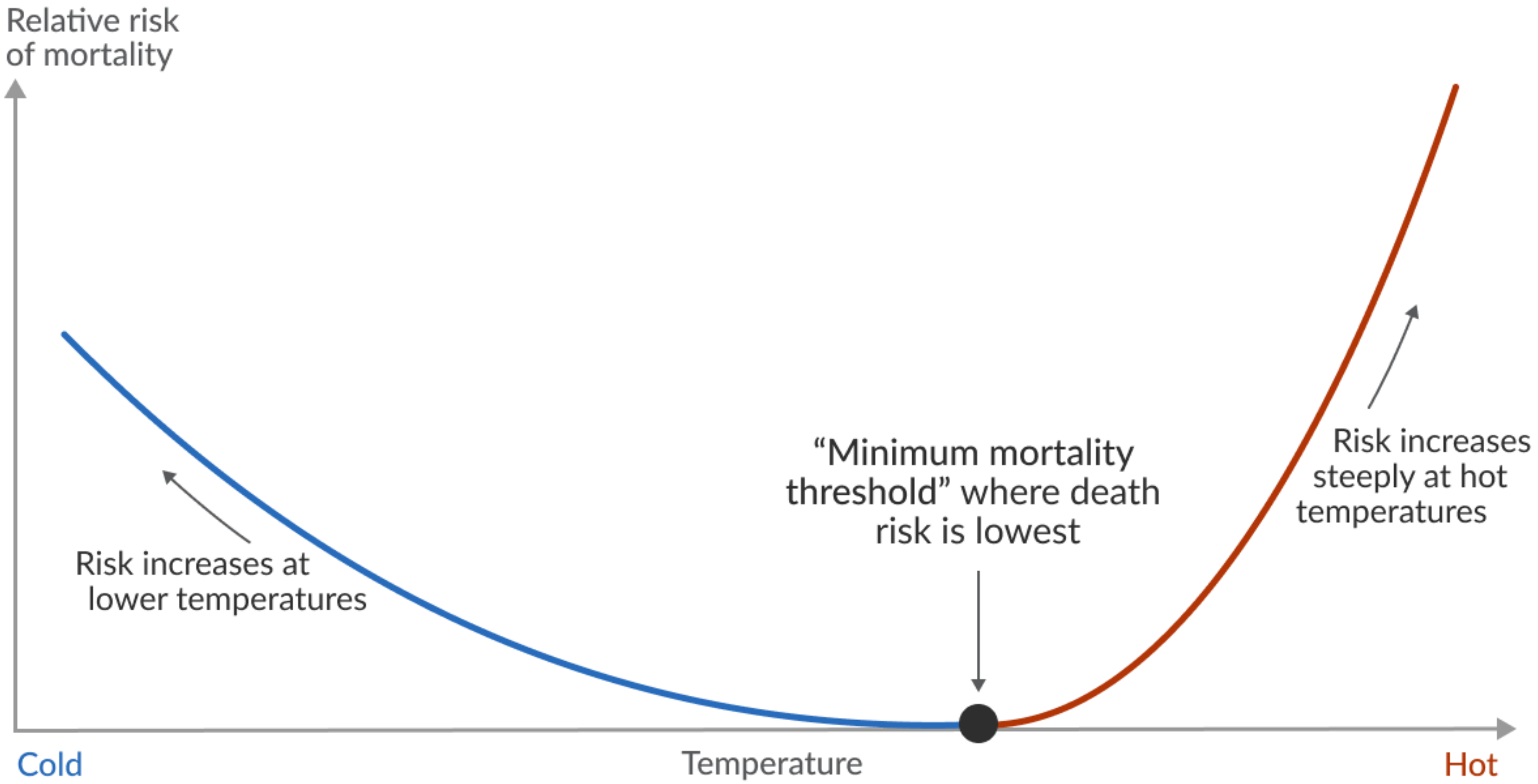


Figure: U-shaped association between temperature and relative risk of mortality. This U-shaped association is discussed in many scientific articles (e.g., Lüthi, et al., 2023).

Monitoring population exposure

- We moved to a dual approach, combining both an absolute and relative threshold, where hot days are defined as:
  - Exceeding the local 95th percentile of the climate reference period, and
  - Exceeding 30°C
- This approach helps capture both locally hot conditions more consistently across different climatic zones, while still accounting for basic minimum absolute threshold.

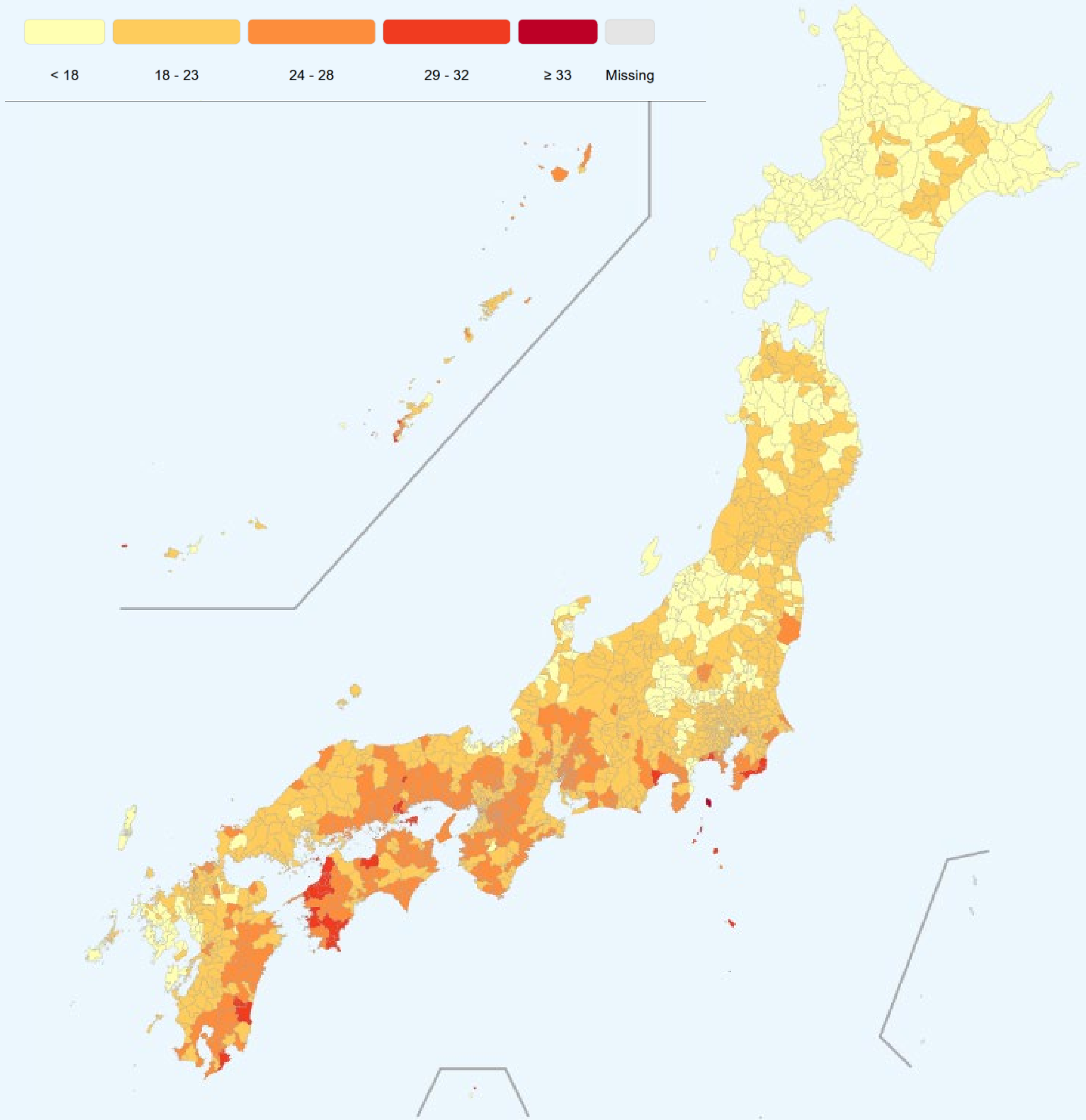


Figure: Annual number of hot days where population-weighted daily maximum temperature exceeds the local 95th percentile of the 2010-2020 reference period and is above 30°C, across Japanese municipalities, 2020

Source: Author's calculations using data from NARO (2026) and the Statistics Bureau of Japan (2020)

Municipalities at potential risk to heat burdens (2020)

- Urban-rural divide is particularly relevant due to its high population density
- Hokkaido has a lower potential risk since it is greener but also has a different climate, so the absolute threshold may play a part in this.
- Validation using impact data has proven challenging at the municipal level.
  - Municipalities across Japan have small population sizes, leading to low excess heat mortality estimates [or high uncertainty]
  - Aggregate measure of excess heat mortality from 2010-2019, so not year specific

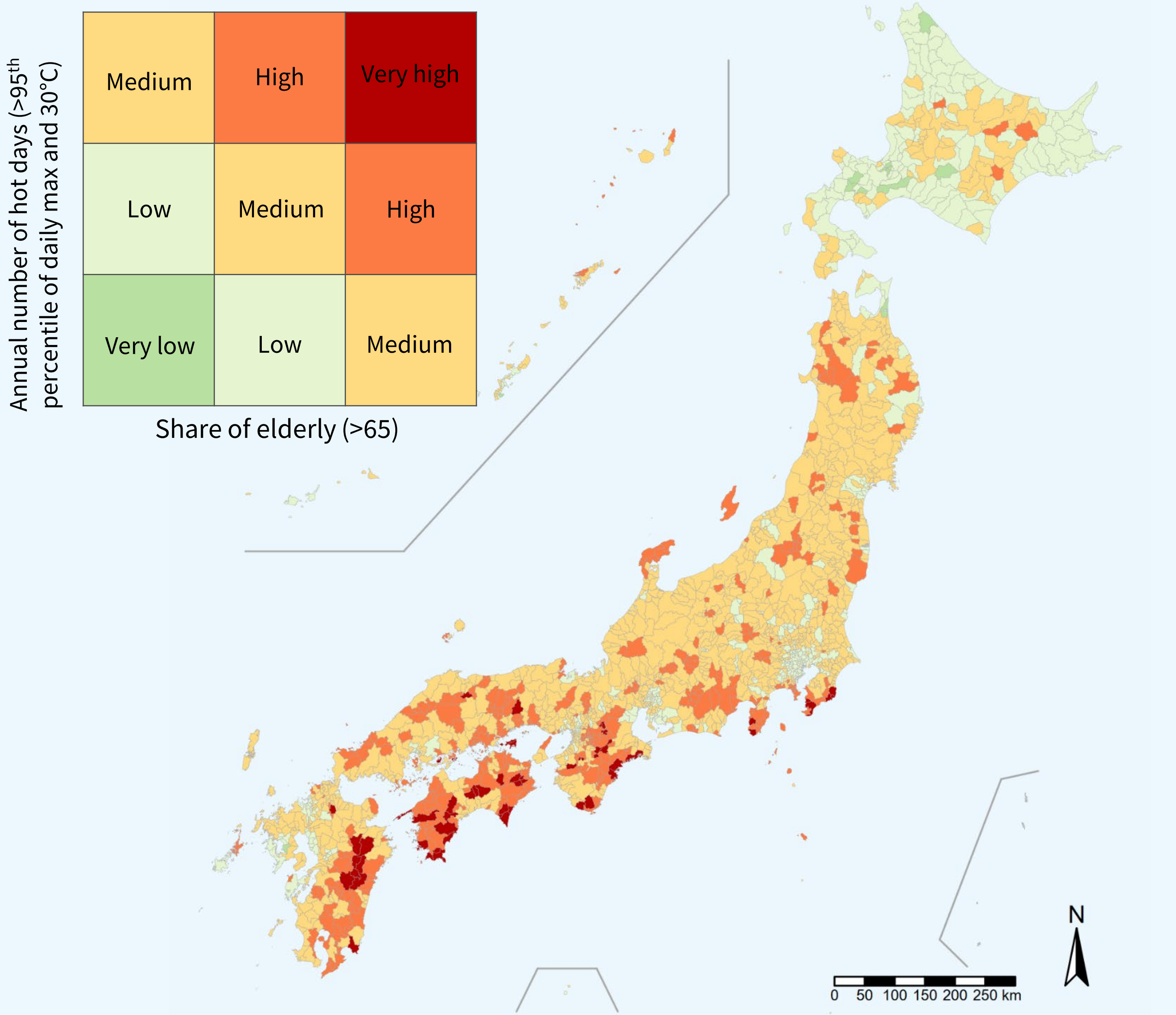


Figure: Potential risk, which combines the annual number of hot days (days/year, 2020) and share of the elderly population (%, 2020)

Source: Author's calculations using data from NARO (2026) and the Statistics Bureau of Japan (2020)

Next steps

Step 1 Epidemiological review

Synthesise evidence on the key drivers that shape vulnerability to extreme heat and air-pollution

Step 2 Data source identification
Identify relevant Census and non-Census data, including EO data for identifying the (i) hazard, (ii) population and (iii) vulnerability

Step 3 Hazard identification

Develop key indicators for monitoring extreme heat and air pollution

Step 4 Hazard-exposure analysis

Overlaying with population Census data to develop population-weighted exposure indicators

Step 5 Vulnerability identification

Develop key indicators for identifying vulnerable populations (e.g. the elderly, deprived areas)

Step 6 Risk indicator development

Produce an estimate of *potential* risk by using a bivariate covariance measurement method

Step 7 Validation

Compare the *potential* risk indicator with impact data (i.e., mortality due to extreme heat)

Step 8 Global data source identification
Identify relevant global EO data sources to identify the hazard that could replace national level data

Step 8 Cross-country indicator development
Repeat steps 2-5 and include other countries with granular Census data to identify population vulnerability

Step 9 Discussion and review

Post-indicator analysis on how including other countries affects *potential* risk indicator results

OECD.EO

Thank you for listening!

Contact:

Ivan Haščič, ivan.hascic@oecd.org

Villas Vidvei, villas.vidvei@oecd.org

Mikaël J.A. Maes, mikael.maes@oecd.org