

Visualization and Evaluation of 3D Urban Design for Heatwave Risk Management

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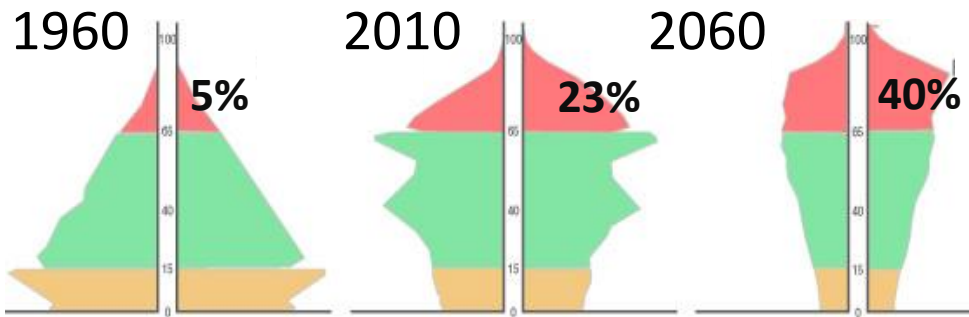


Caixa Geral
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LISBON, Portugal
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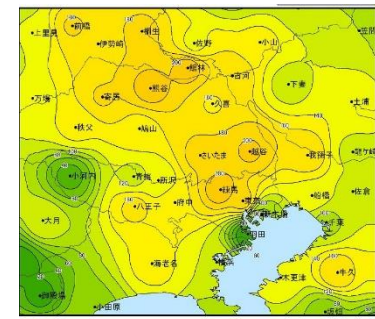
Introduction

- Heatwave risk in Tokyo is rapidly increasing because:
 - aging demographic trend
 - progress of the global warming

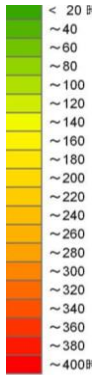


Japan's Population Pyramid

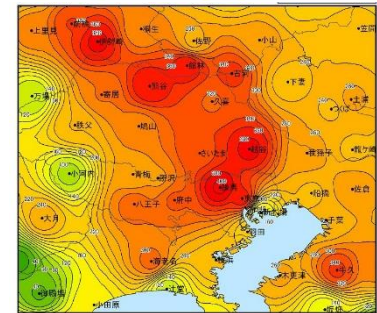
1980
-1985



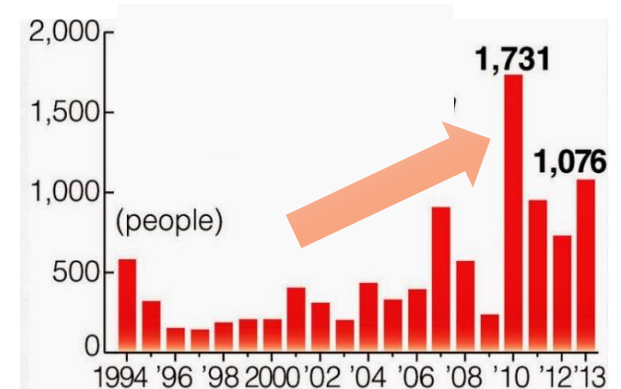
Value
(°C)



2000
-2004



Number of hot days (temp.>30)
in Tokyo



Deaths from heatstroke in Japan

Introduction (contd.)

- **For 2020 Tokyo Olympic Game, we need to enhance resilience against heatwave risks.**

Too dangerous!



Japanese Animation Festival in Tokyo

Micro urban structure and heatwave risk

- Heatwave risk change depending on land cover, location and height of buildings, trees, ...

→ **3D urban structure** is a key factor determining urban heatwave risk

However, it is largely unexplored how to design 3D urban structure in terms of the heatwave risk mitigation/adaptation

↑

While many urban studies have **simulated** micro temperatures (e.g. by 2 m grids) to tackle this issue, it would be more desirable to use **actual** micro temperature data.

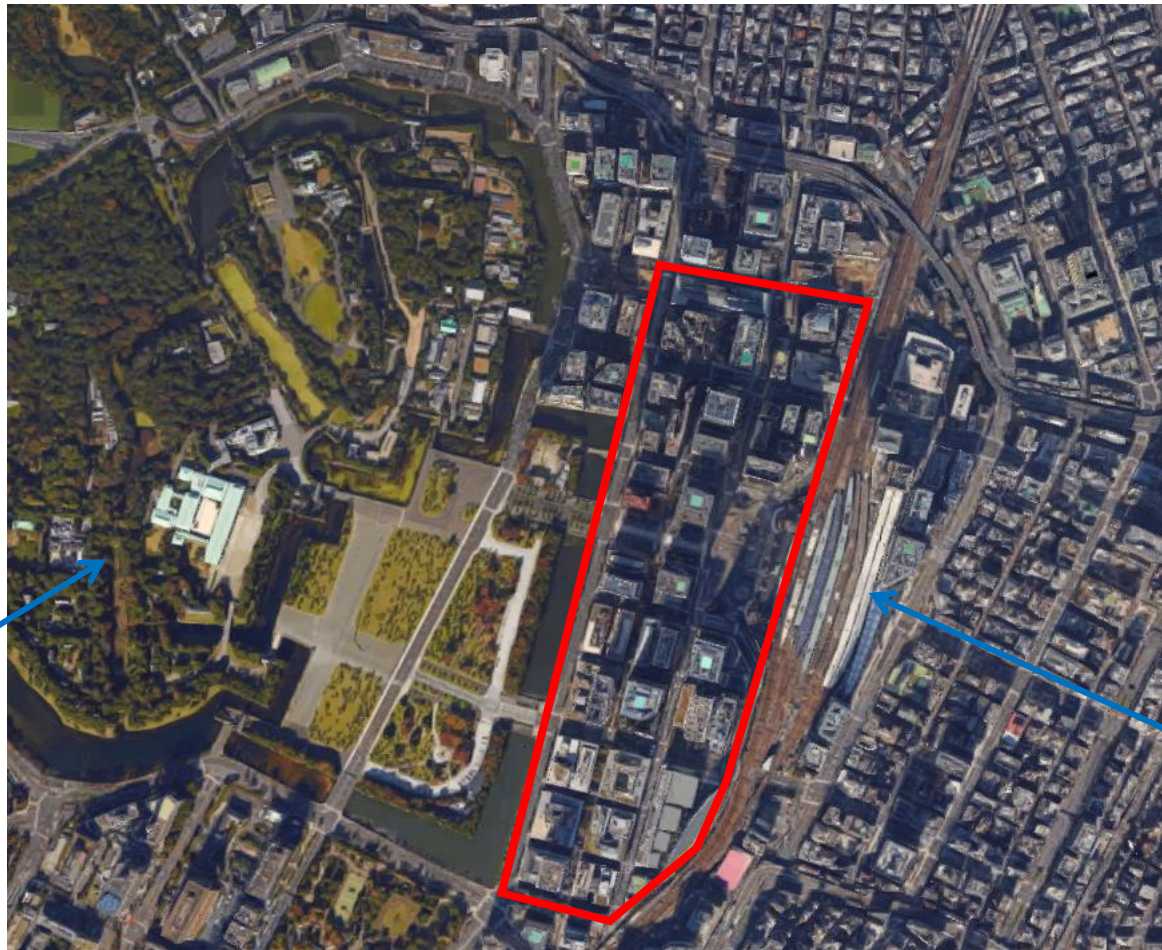
Objective

- This study reveals how the urban design of central Tokyo area should be in terms of heat-island risk reduction.
- Following tasks are needed to achieve it:
 - **1st : Mapping actual detail surface temperatures**
 - **2nd: 3D visualization of buildings**
 - 3rd: Analysis of the relationship between landscape and surface temperatures
 - 4th: Using detailed People Flow data, evaluation the risk and introduction to cold spots/routes.

Target Area

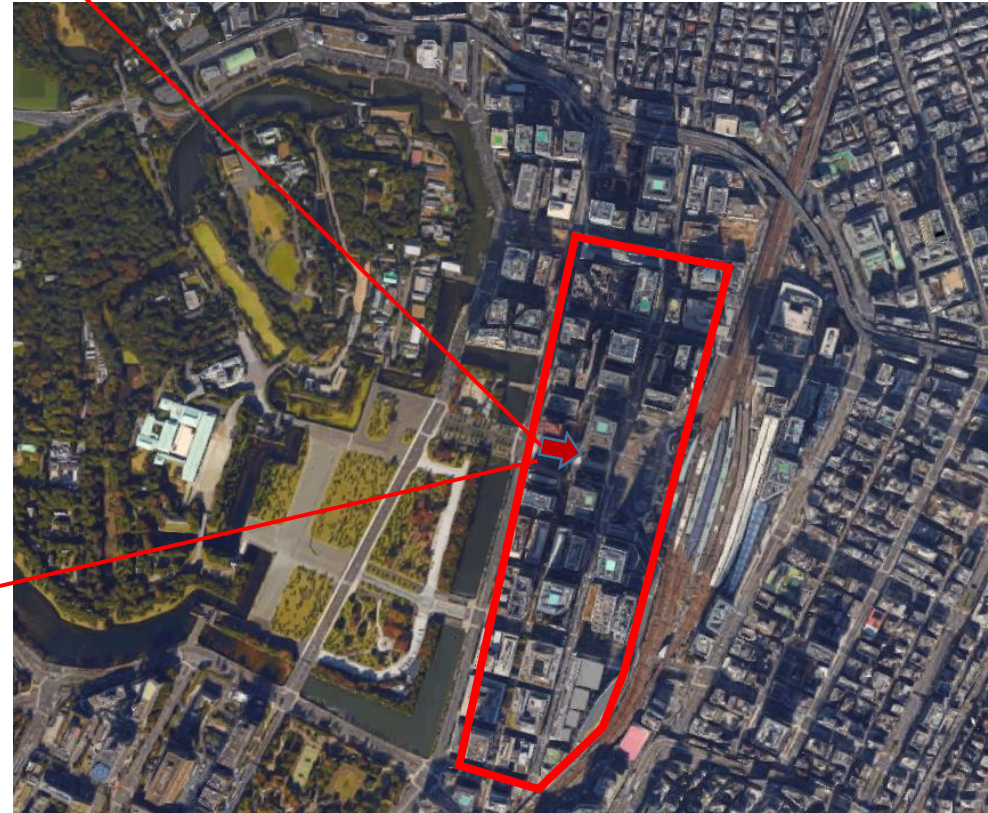
- **Marunouchi District** (in front of Tokyo Sta.)

imperial
palace



Tokyo
Sta.

Target Area



Surface temperature monitoring

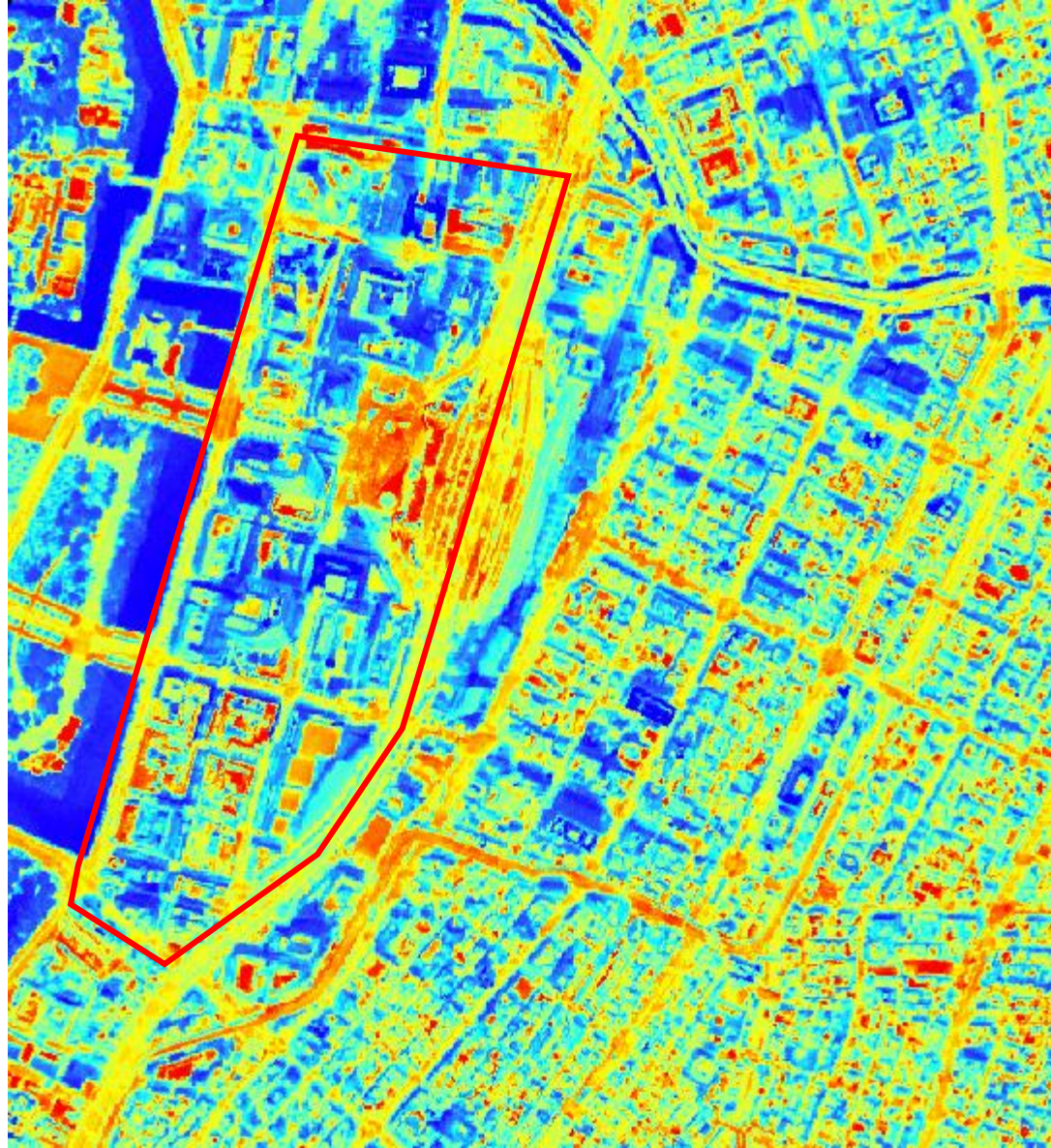
- An airborne observation was conducted in collaboration with Tokyo Metropolitan Research Institute for Environmental Protection

At 12-13 in Aug.19, 2015
Flight level : 610 m

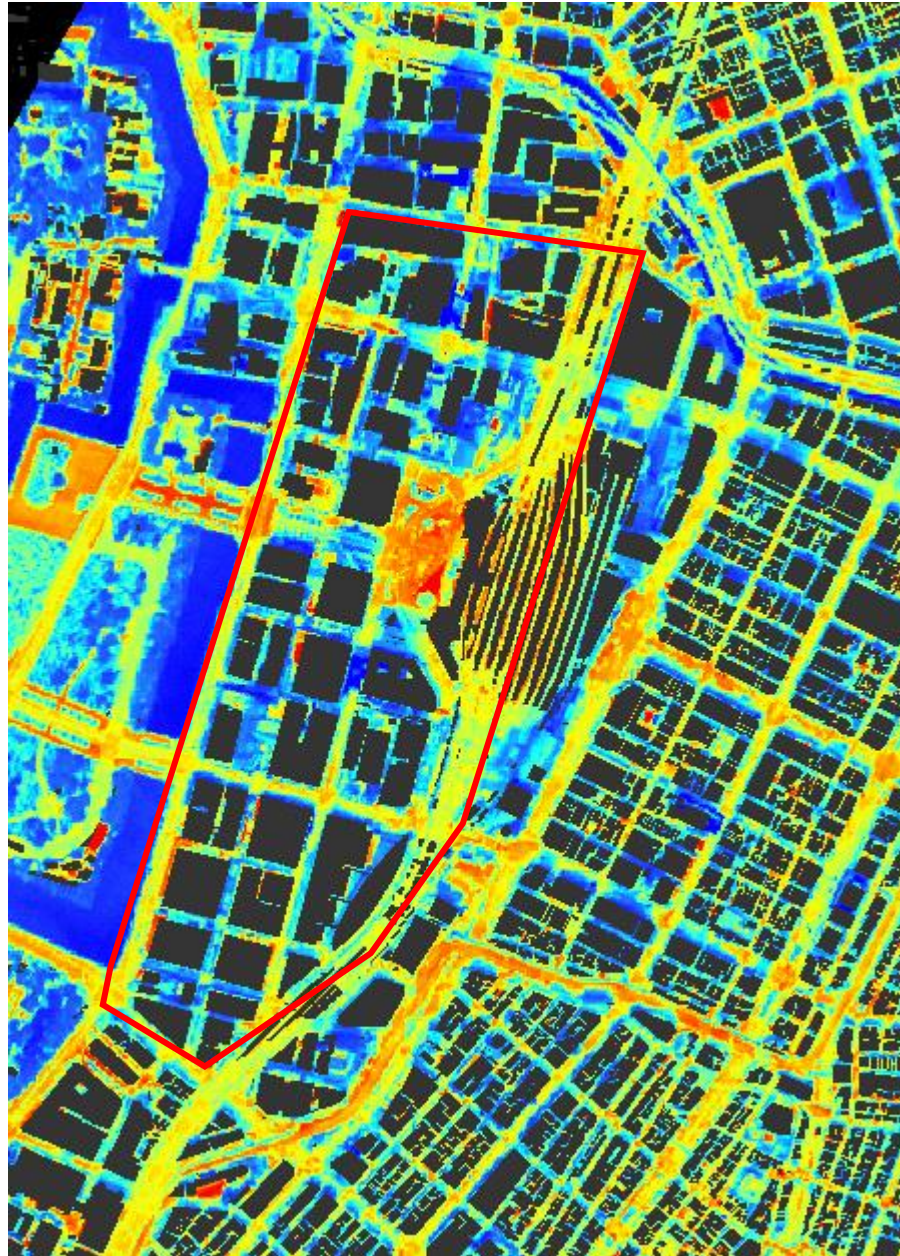


Monitored surface temperatures

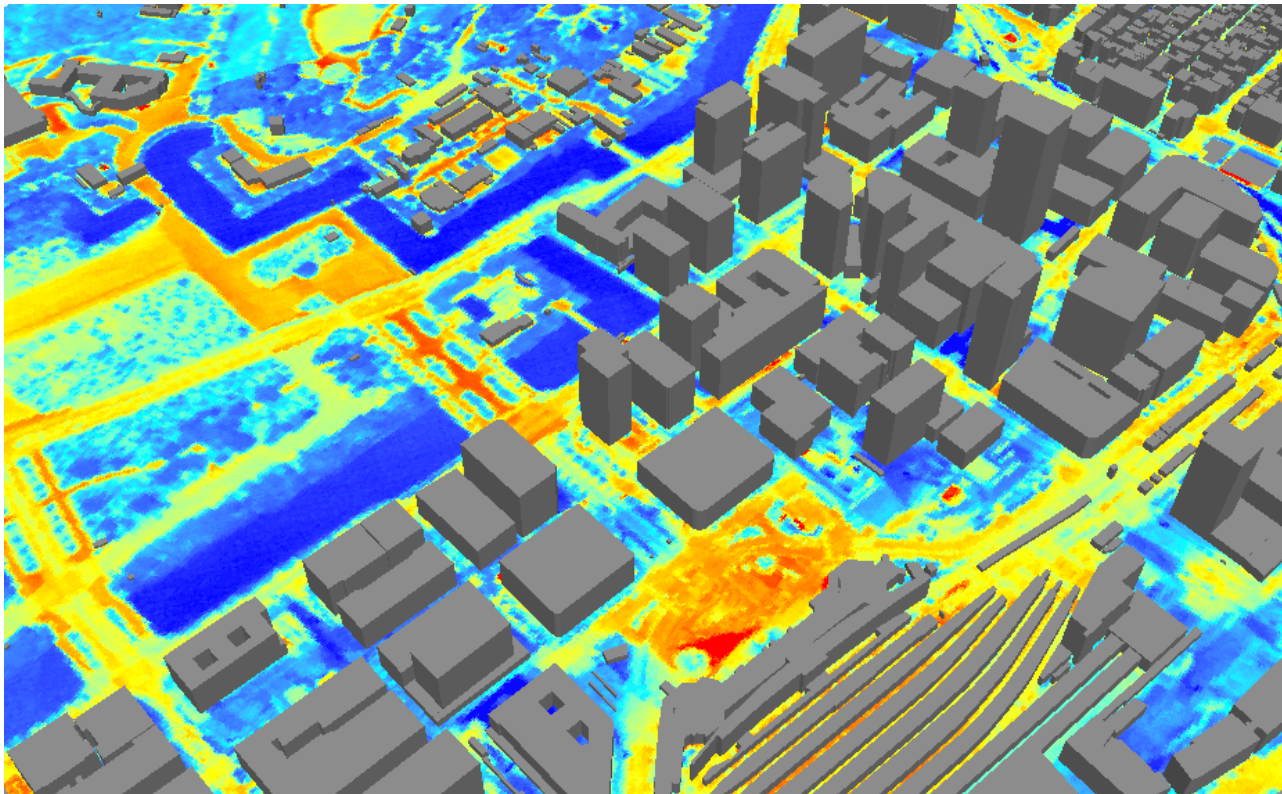
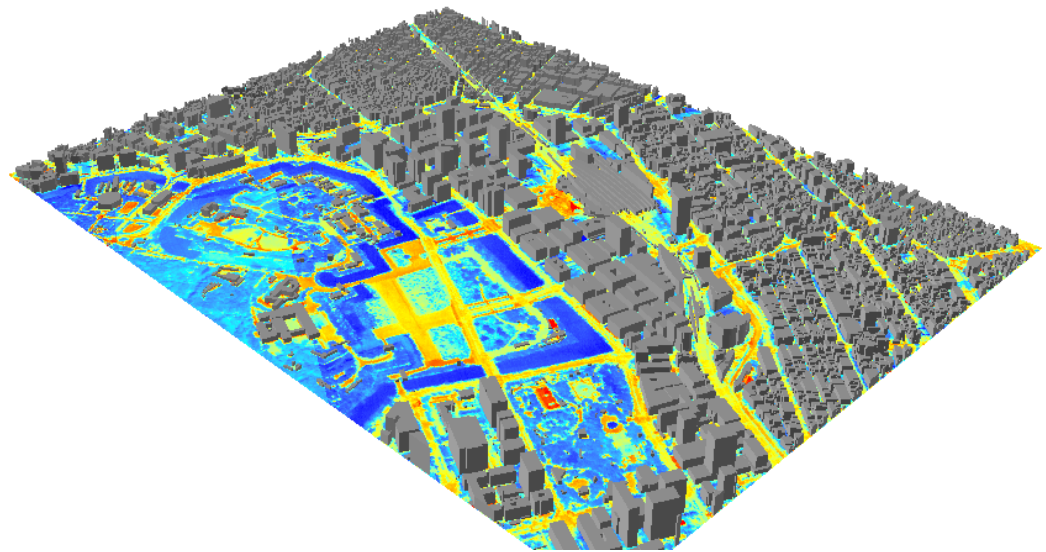
Spatial resolution:
2m grid



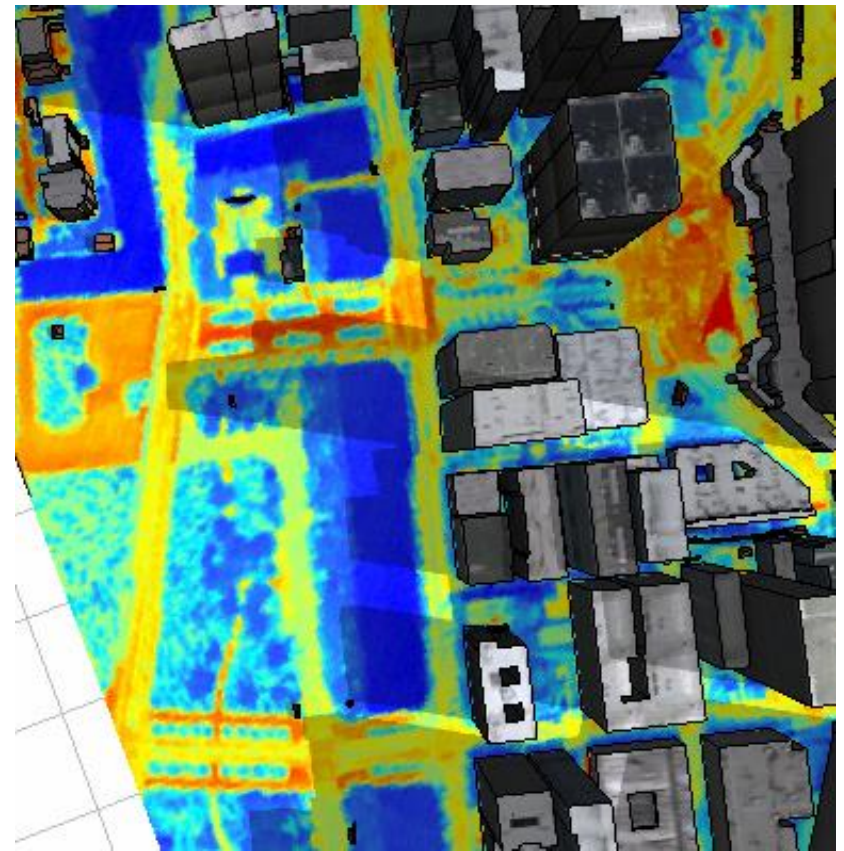
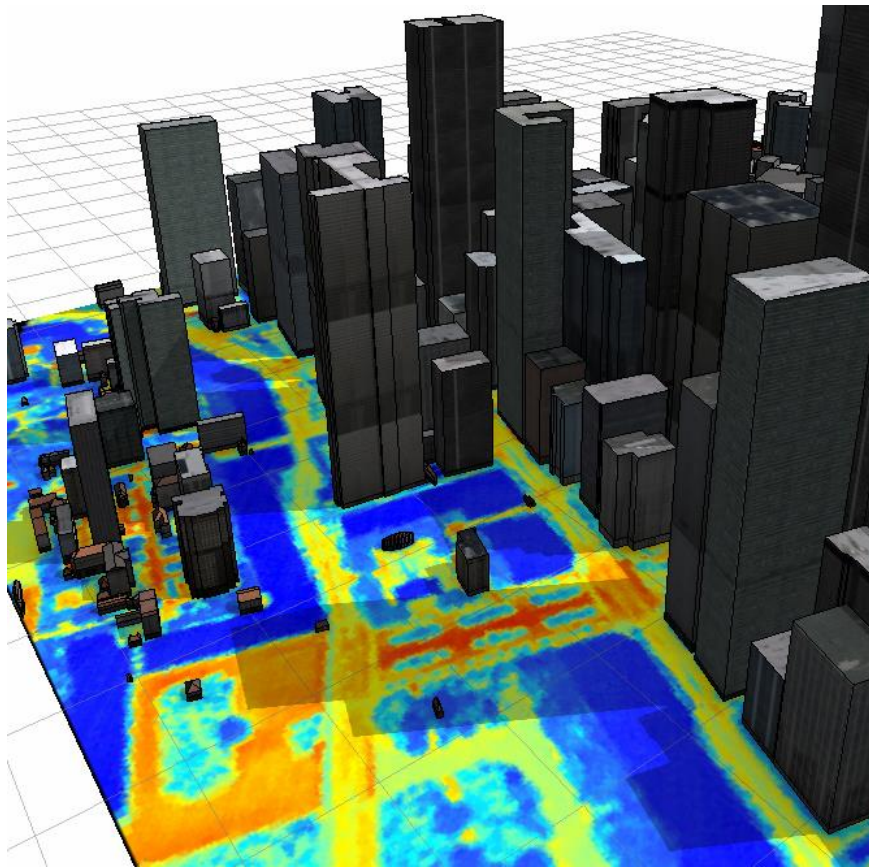
2D Buildings



3D Buildings



3D Buildings with texture



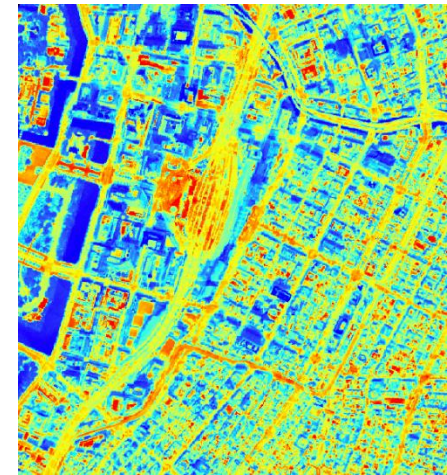
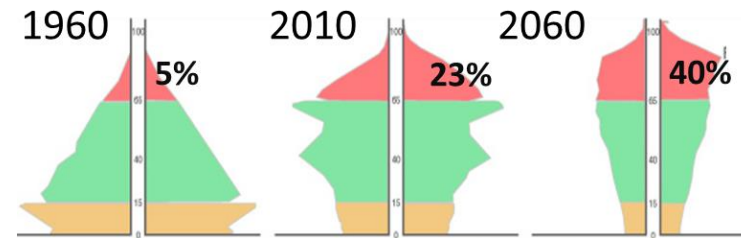
Heatwave risk

• Cause

- Carbon consciousness
- Aging society

• Understanding

- Surface temperature map
- 3D building with textures and land cover map



Solutions

• Mitigation

- Tree planting , Change texture of buildings, etc.

• Adaptation

- Induction to cold spots/routes.

importance: active reaction (e.g., using air conditioner) is to proceed the risk, in the long run.

Future works

- Comparison of urban scenarios in terms of
 - Good landscape
 - Sound eco-system
 - Low risk to urban risks (e.g., flood; **heatwave**)
- More detail analysis is needed
 - 1st : Mapping surface temperatures
 - 2nd: 3D visualization of buildings
 - **3rd : Analysis of the relationship between landscape and surface temperatures**
 - **4th: Using detailed People Flow data, evaluation the risk and introduction to cold spots/routes.**

