Heat Stress Impact On Urban population in Asian Countries – Case Of Japan and Vietnam

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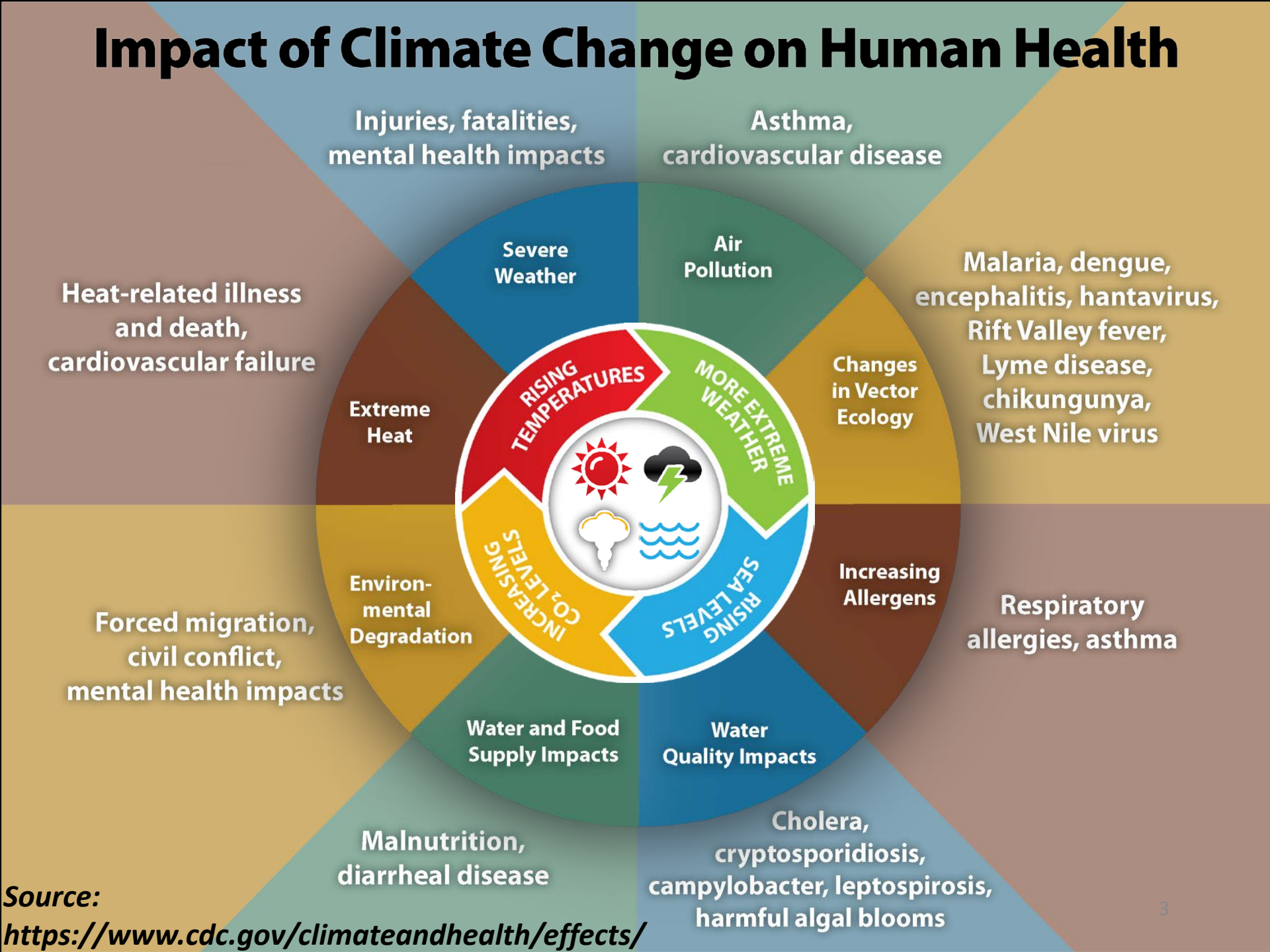
Introduction of speaker

Marcin Jarzebski

- Personal
  - Born in 1985 in Poland
  - Living in Tokyo since 2011
  - Religion: Catholic
- Education:
  - 2009 M.S., Nicolaus Copernicus University, Poland (Environmental Studies) and Saxion Universities of Applied Sciences in Deventer (The Netherlands)
  - 2015 Ph.D., University of Tokyo, Japan (Sustainability Science)
- Professional:
  - 2016.01 ~ Project Researcher, at Integrated Research System for Sustainability Science (IR3S) the University of Tokyo
  - 2010 - 2011 Graduate Research Assistant at Environmental Monitoring Laboratory, University of the Philippines
- Professional services:
  - 2012 ~ Member of editorial board of Ecological Questions Journal
- Research interests:
  - Climate change impact health
  - Food security in Africa
  - Community Forestry
  - Resilience
- Contact: jarzebski@ir3s.u-tokyo.ac.jp

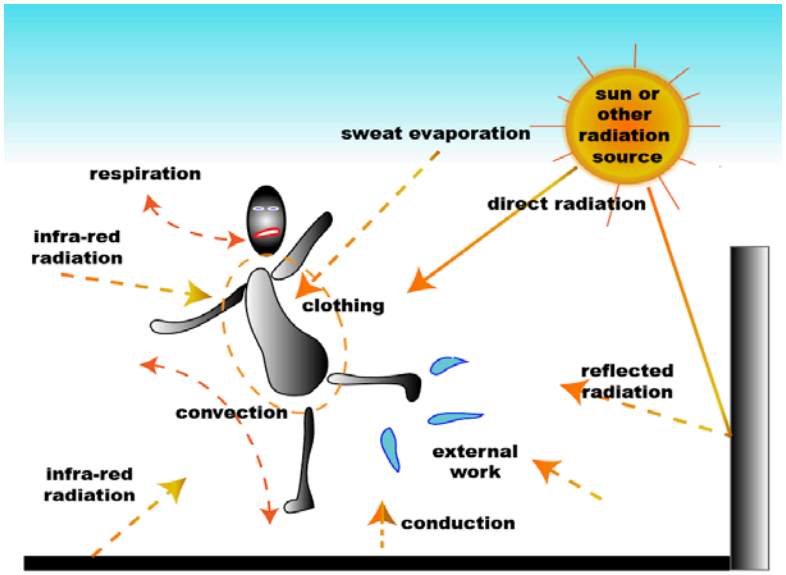
Impact of Climate Change on Human Health



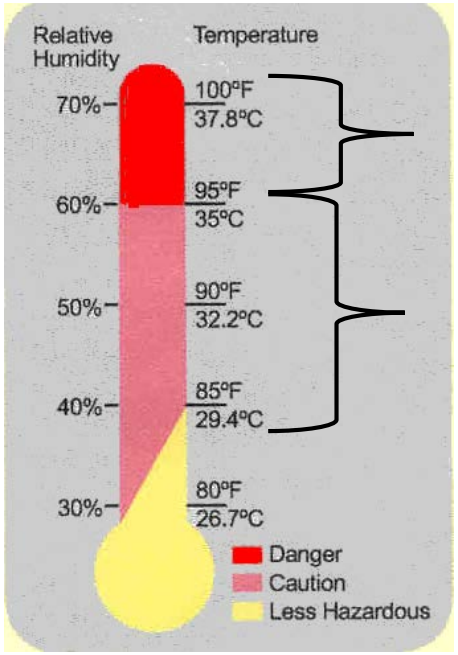
Source:
https://www.cdc.gov/climateandhealth/effects/

Heat Stress

Condition under which body is unable to cool itself suffiently to maintain healthy temperature



(adapted from *Havenith, 2001*)



Danger

Caution

Source: US Department of Labor, 2002

Causes of heat stress:

- Heat exposure
- Hot and crowded conditions
- Lack of air flow
- Dehydration

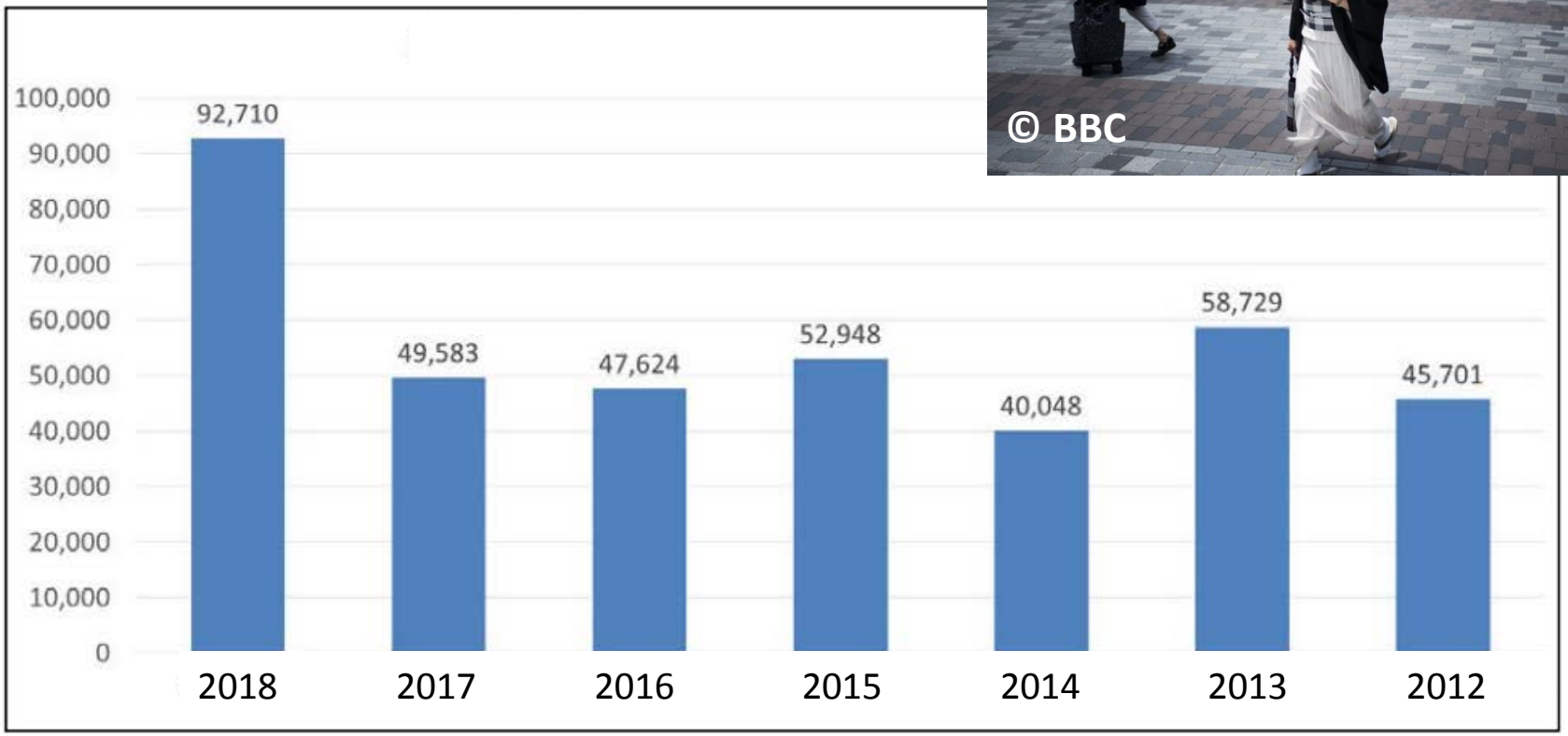
People most at risk of heat-related illne

- Elderly people
- Babies and young children
- People on medications
- Outdoor worker
- Living without air conditioning

(*Source: Department of Health & Human Services of Victoria, 2016*)

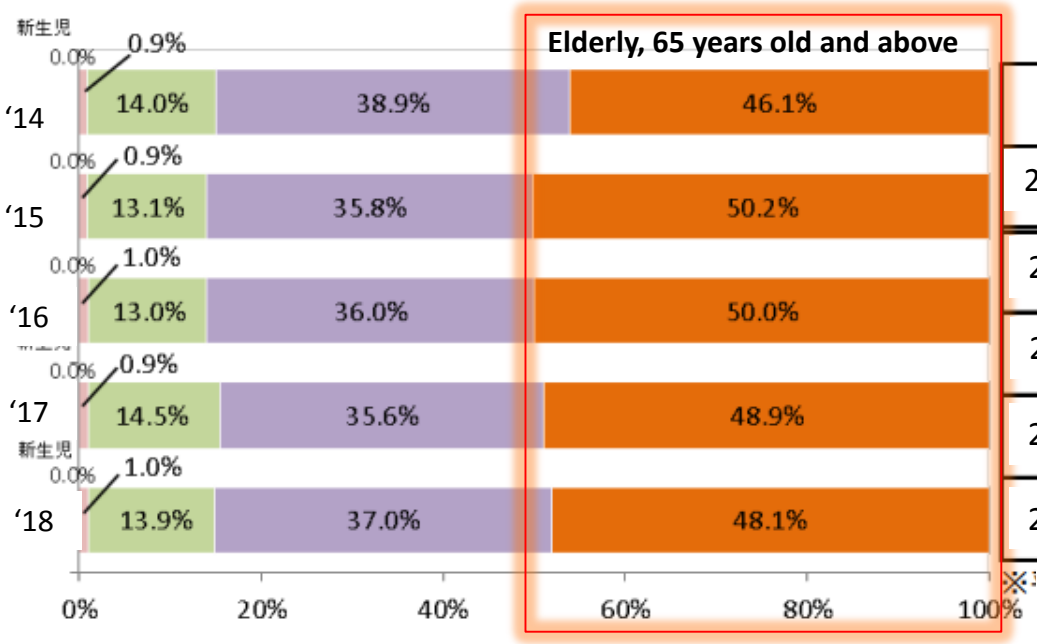
Number of emergency case due to heat stroke in Japan Comparison with the same period, in previous years

- 2018 brought unprecedented levels of heat wave
- Japan's weather agency has declared a heatwave as natural disaster



Source: Ministry of Health, Labour and Welfare, Japan (2018)

Elderly are the most vulnerable group (based on Japanese statistics)



	Age groups					
	< 28d	28d≥7yo	7-17yo	18-64yo	65≤	TOTAL
2014	4	359	5,622	15,595	18,468	40,048
	0.0%	0.9%	14.0%	38.9%	46.1%	100%
2015	2	503	7,333	19,998	28,016	55,852
	0.0%	0.9%	13.1%	35.8%	50.2%	100%
2016	4	482	6,548	18,150	25,228	50,412
	0.0%	1.0%	13.0%	36.0%	50.0%	100%
2017	8	482	7,685	18,879	25,930	52,984
	0.0%	0.9%	14.5%	35.6%	48.9%	100%
2018	8	967	13,192	35,189	45,781	95,137
	0.0%	1.0%	13.9%	37.0%	48.1%	100%

※ *Data from May to September, except 2014, when it was given for June to September*

Infants, below 28 days
Children and infants, 28 days to 6 years old
Children, 7 to 17 years old
Adults, 18-64 years old
Elderly, 65 years old and above

Source: Ministry of Health, Labour and Welfare, Japan (2018)

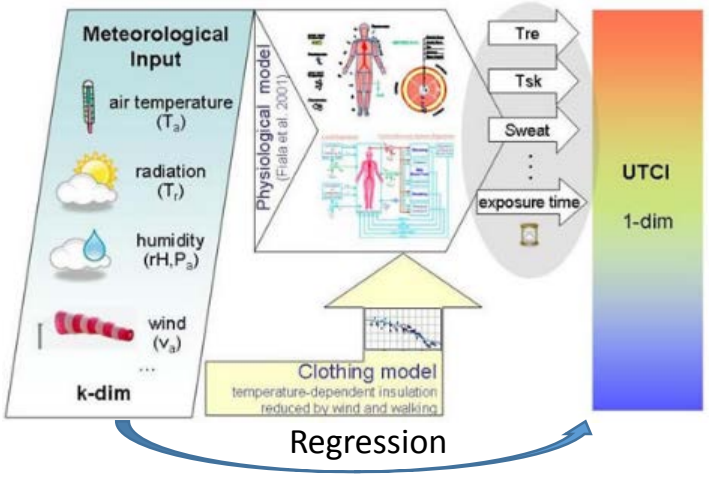
UTCI (Universal Thermal Climate Index)

Ambient temperature which provide the same human physiological response by combining the influence of temperature, humidity, wind speed and radiation on outdoor working condition.

$$UTCI = f(Ta, Va, Tmrt, Vp)$$

Where:

Ta: temperature
Va: wind speed
Tmrt: mean radiant temperature (calculated from Solar Radiation)
Vp : water vapor (calculated from relative humidity (RH) and Ta)



Assumption:
walk: 4km/h
weight : 74kg
fat:14%
metabolic rate : 135W/m^2

Stress category	UTCI (°C) range
Extreme heat stress	+46 and above
Very strong stress	+38 to +46
Strong stress	+32 to +38
Moderate stress	+26 to +32
No thermal stress	+9 to +26

Concept of UTCI derived as equivalent temperature from the dynamic multivariate response of the thermophysiological UTCI-Fiala model (*Fiala et al. 2012*), which was coupled with a clothing model (*Havenith et al. 2011*)

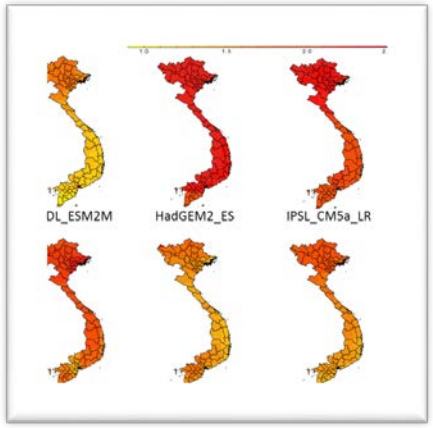
Vulnerability Index

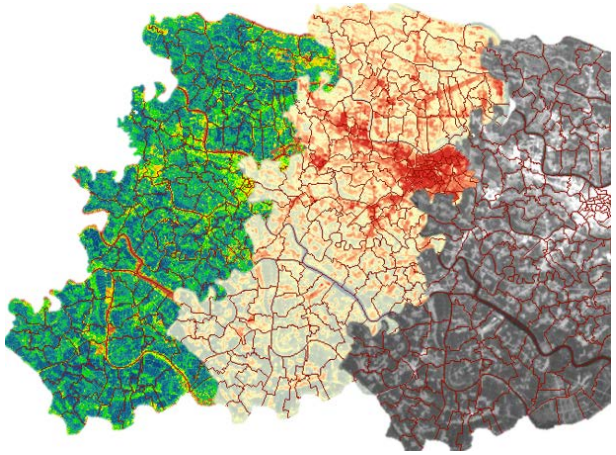
(Normalized value of UTCI

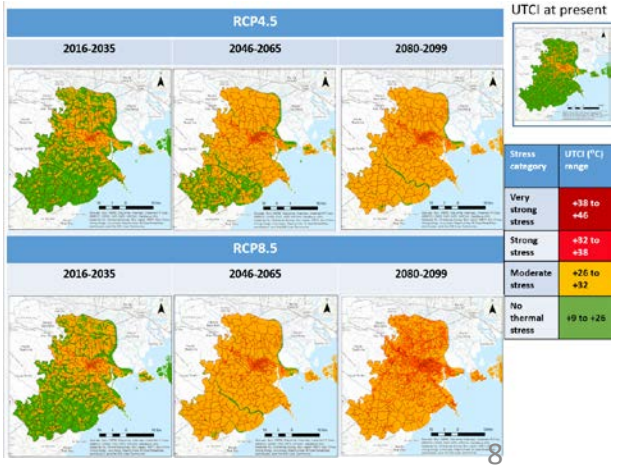
+

Elderly population with population density) / 2

Processing data



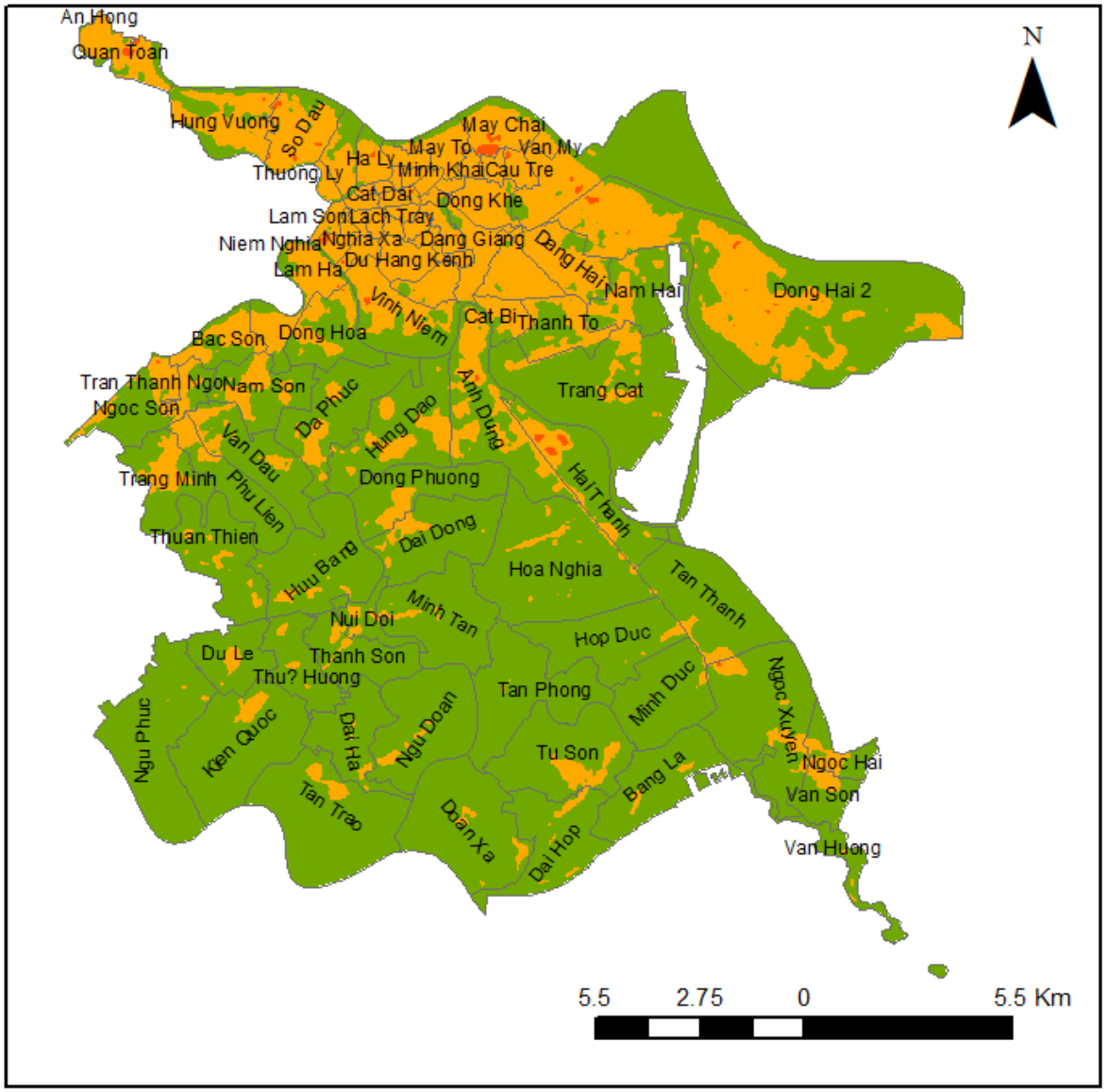





QL279
QL18
Linh
QL37
QL18
Uông Bí
Cẩm Phả
CẨM PHẢ
Hạ Long
Đảo Trà Bản
Dương
AH14
QL10
đảo Hà Nam
Hai Phòng
Đảo Cát Bà
QL5B
QL37
Quần đảo
Long Châu
9A
ái Bình
QL39B
HẠT
QL37B
T. QUẤT LÂM

Haiphong

Heat stress 1986-2005
(average UTCI max for June-August)



Average 37.30

Stress category	UTCI (°C) range
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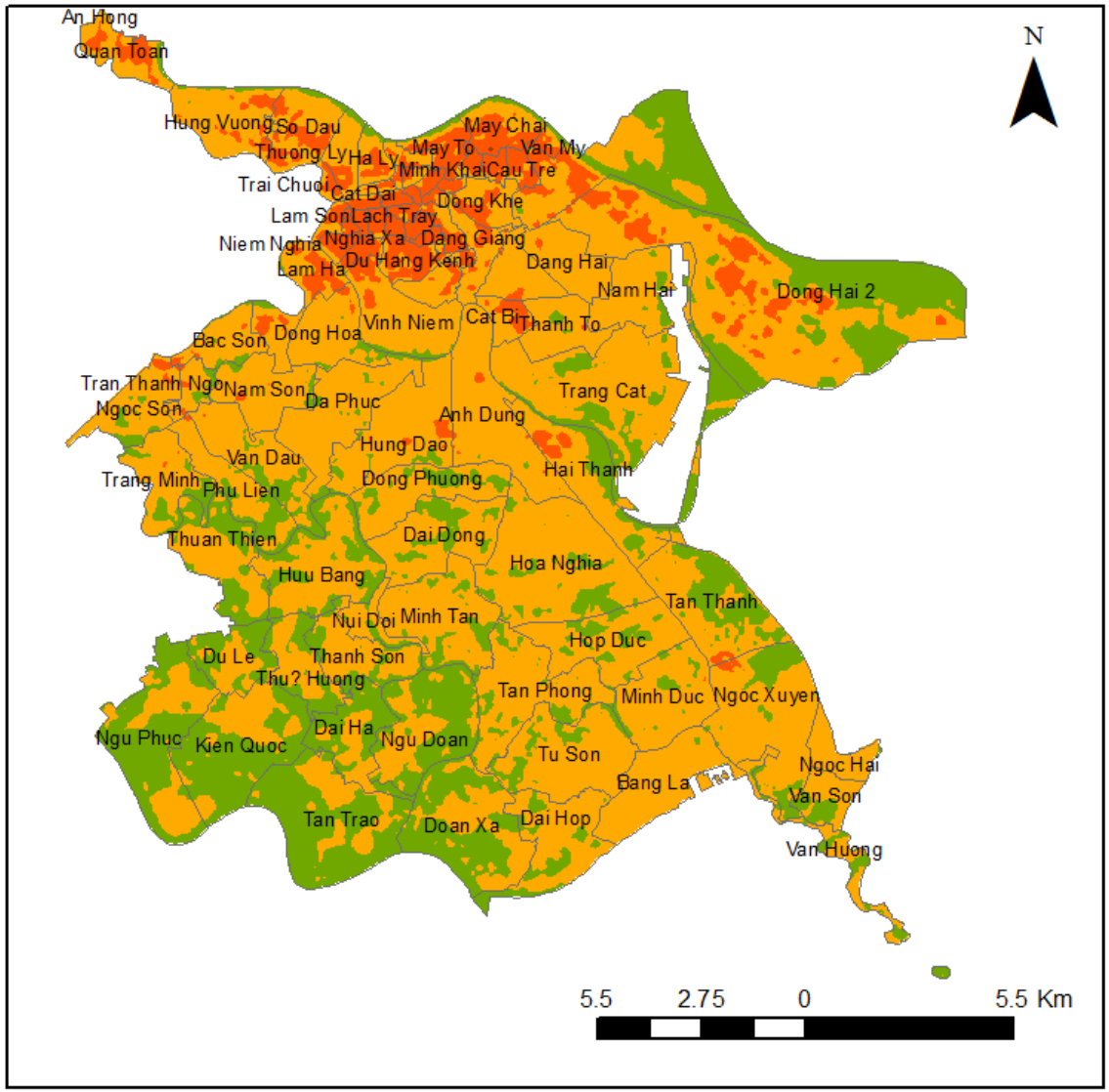
Heat stress in 2045-2065, RCP4.5 (average for 7 scenarios)



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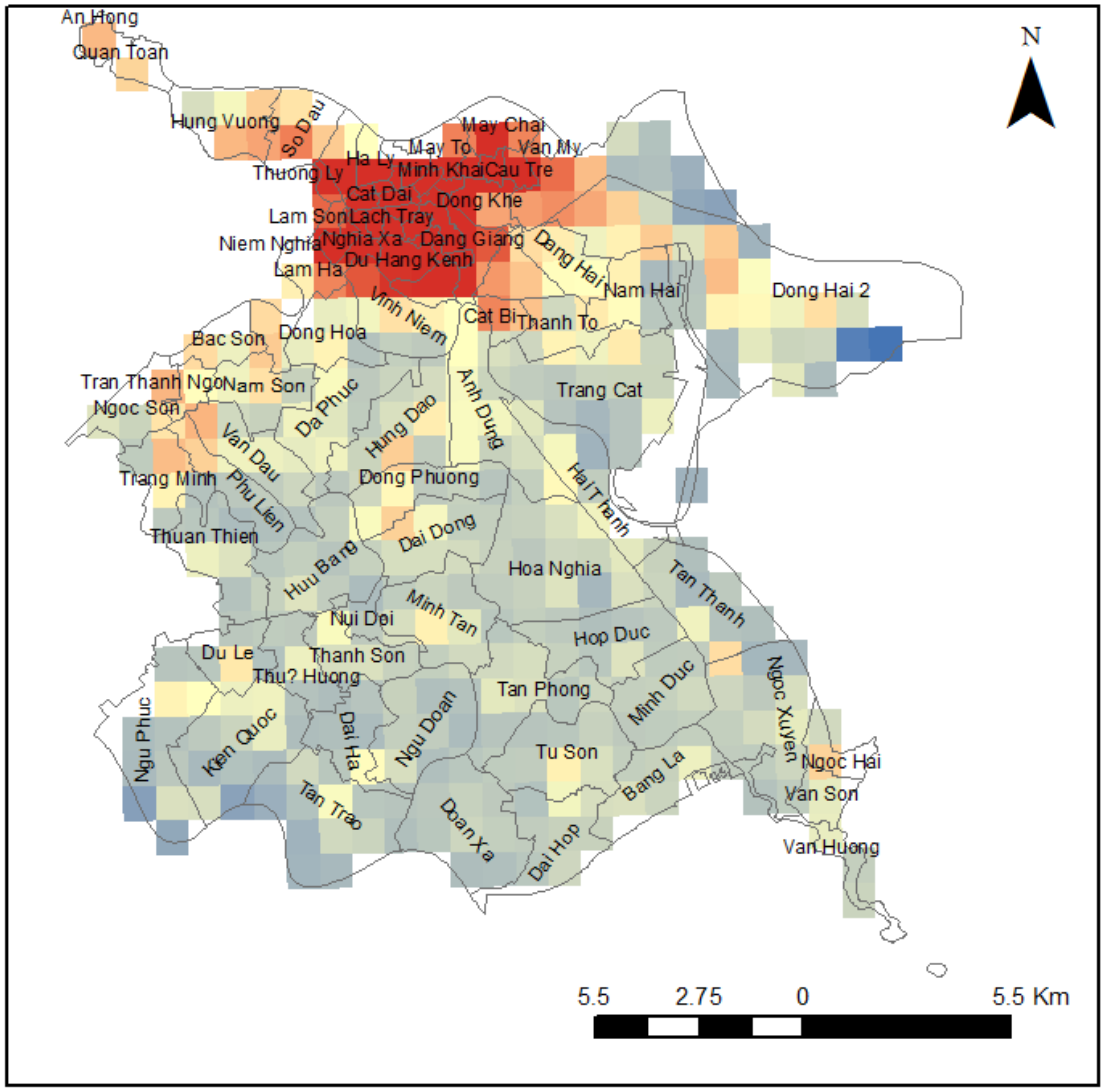
Vulnerability in 2045-2065, RCP4.5
(average for 7 scenarios)



Vulnerability

High

Moderate

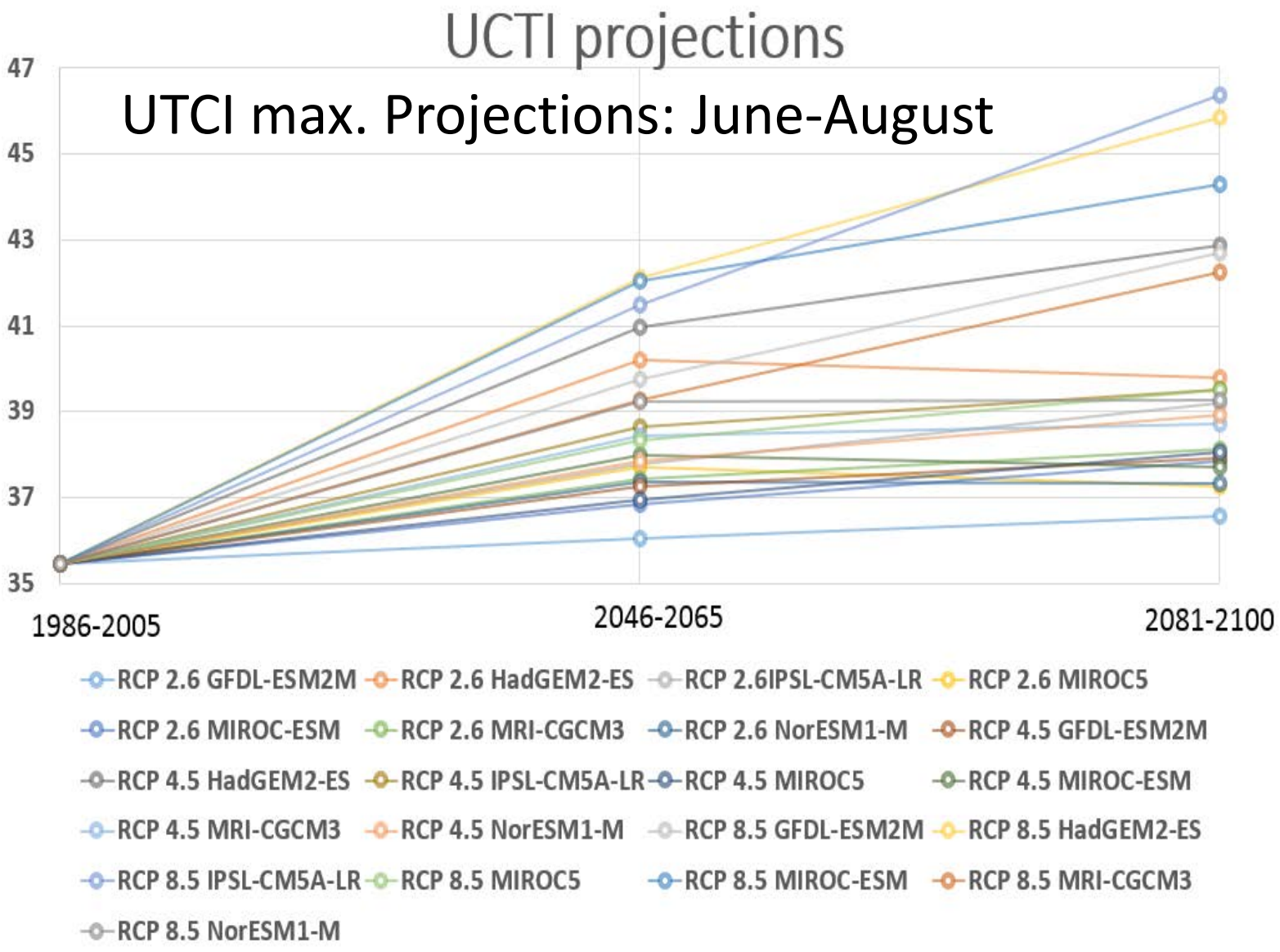
Low

UTCI

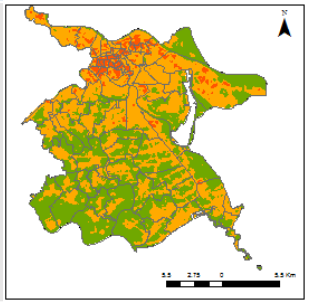
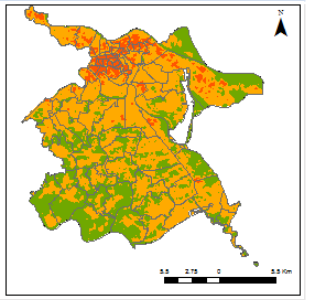
Extreme heat stress

Very strong stress

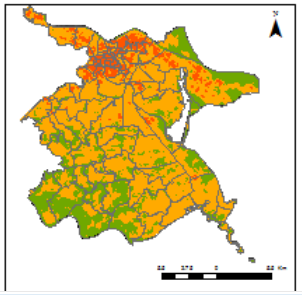
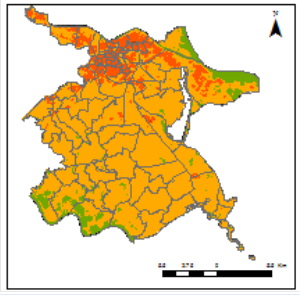
Strong stress



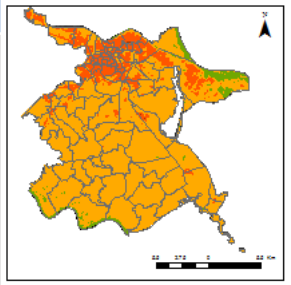
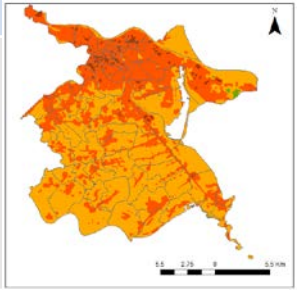
UTCI under RCP 2.6 (average of scenarios)

2046-2065	2081-2100
+2.17 (compared to 1986-205) 	**+2.56** (compared to 1986-205) 

UTCI under RCP 4.5 (average of scenarios)

2046-2065	2081-2100
+2.84 (compared to 1986-205) 	**+3.64** (compared to 1986-205) 

UTCI under RCP 8.5 (average of scenarios)

2046-2065	2081-2100
+4.09 (compared to 1986-205) 	**+7.27** (compared to 1986-205) 

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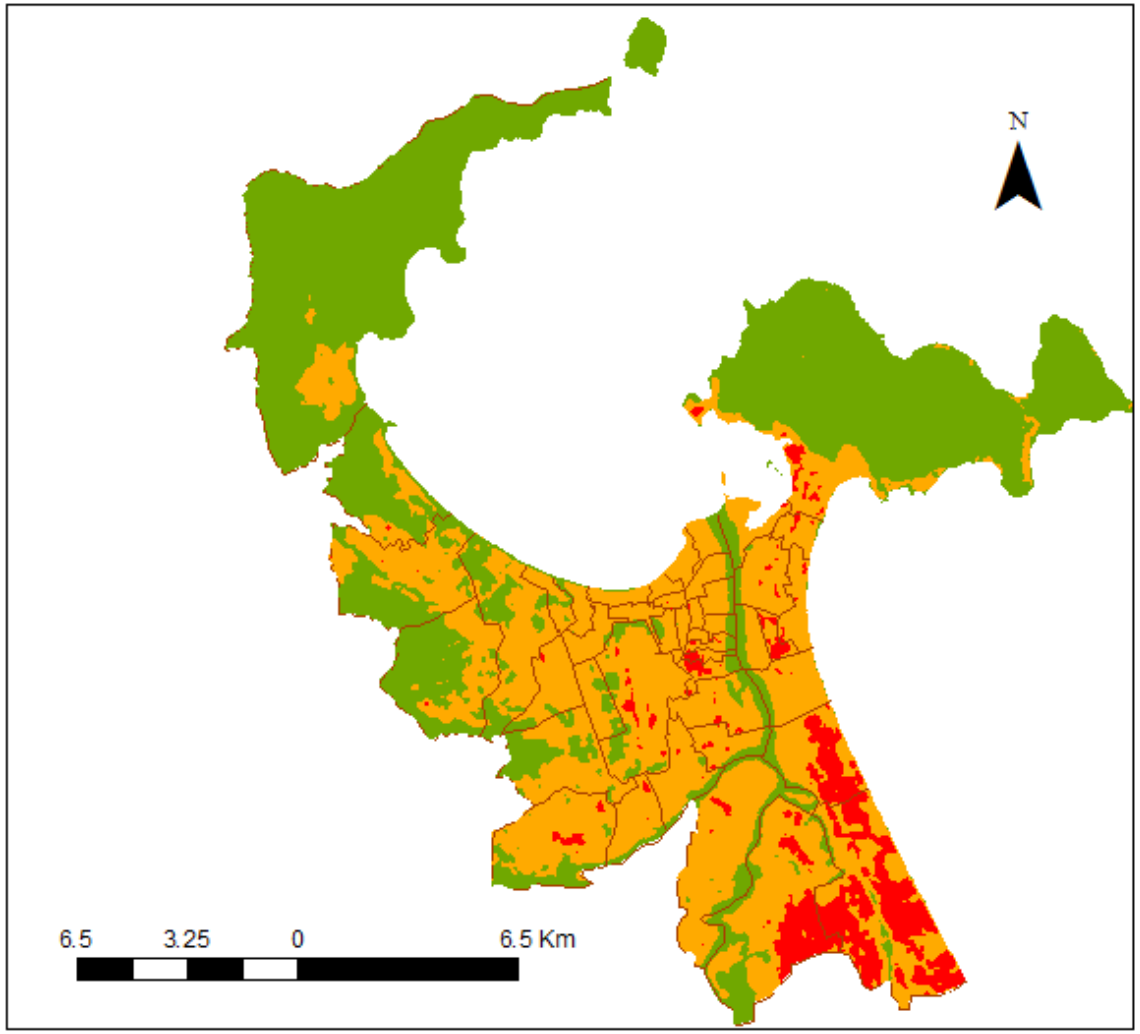
Da Nang


TT. LĂNG CÔ
AH1
Da Nang
East Vietnam Sea
CÙ LAO CHÀM
QL14G
Hội An
QL1A

Heat stress 1986-2005
(average UTCI max for June-August)



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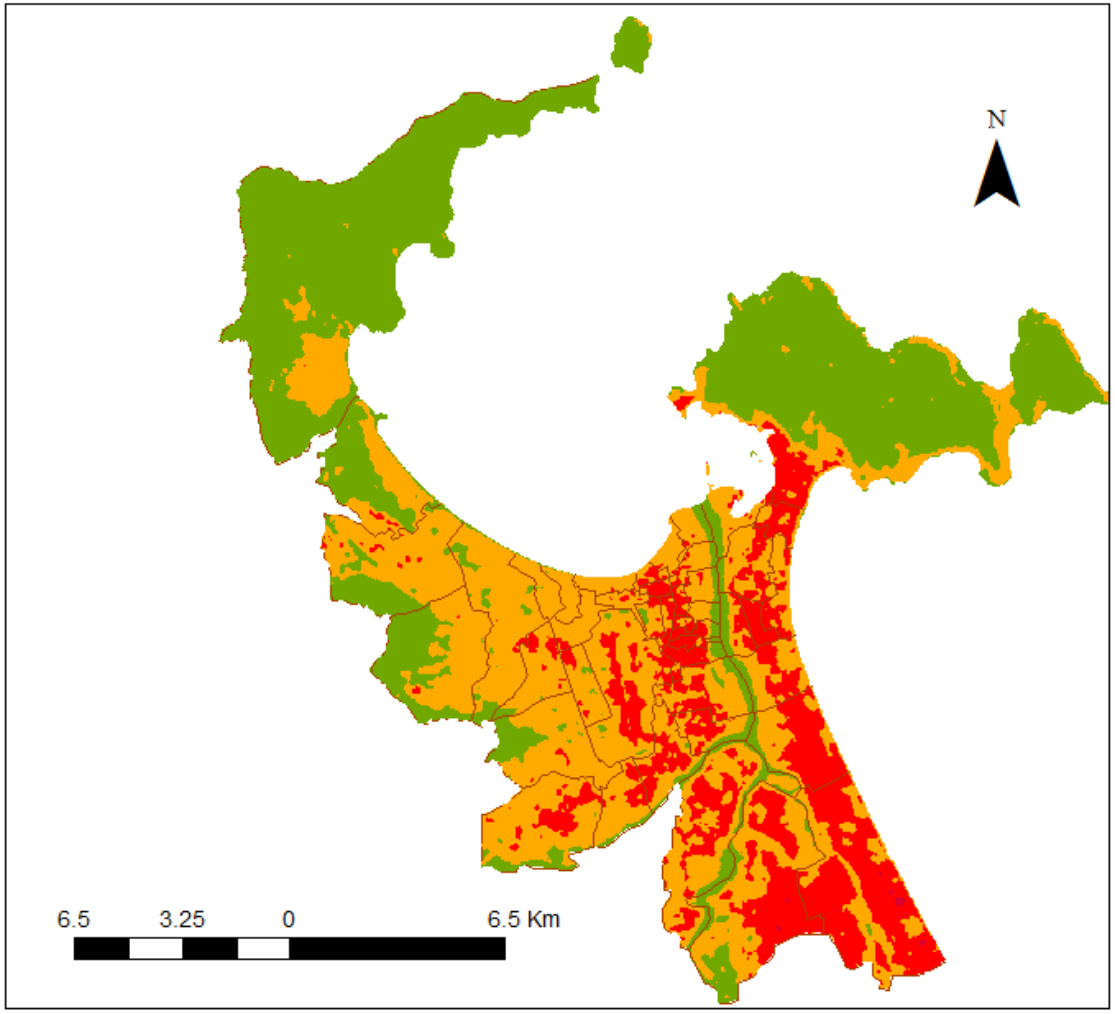
Heat stress in 2045-2065, RCP4.5
(average for 7 scenarios)



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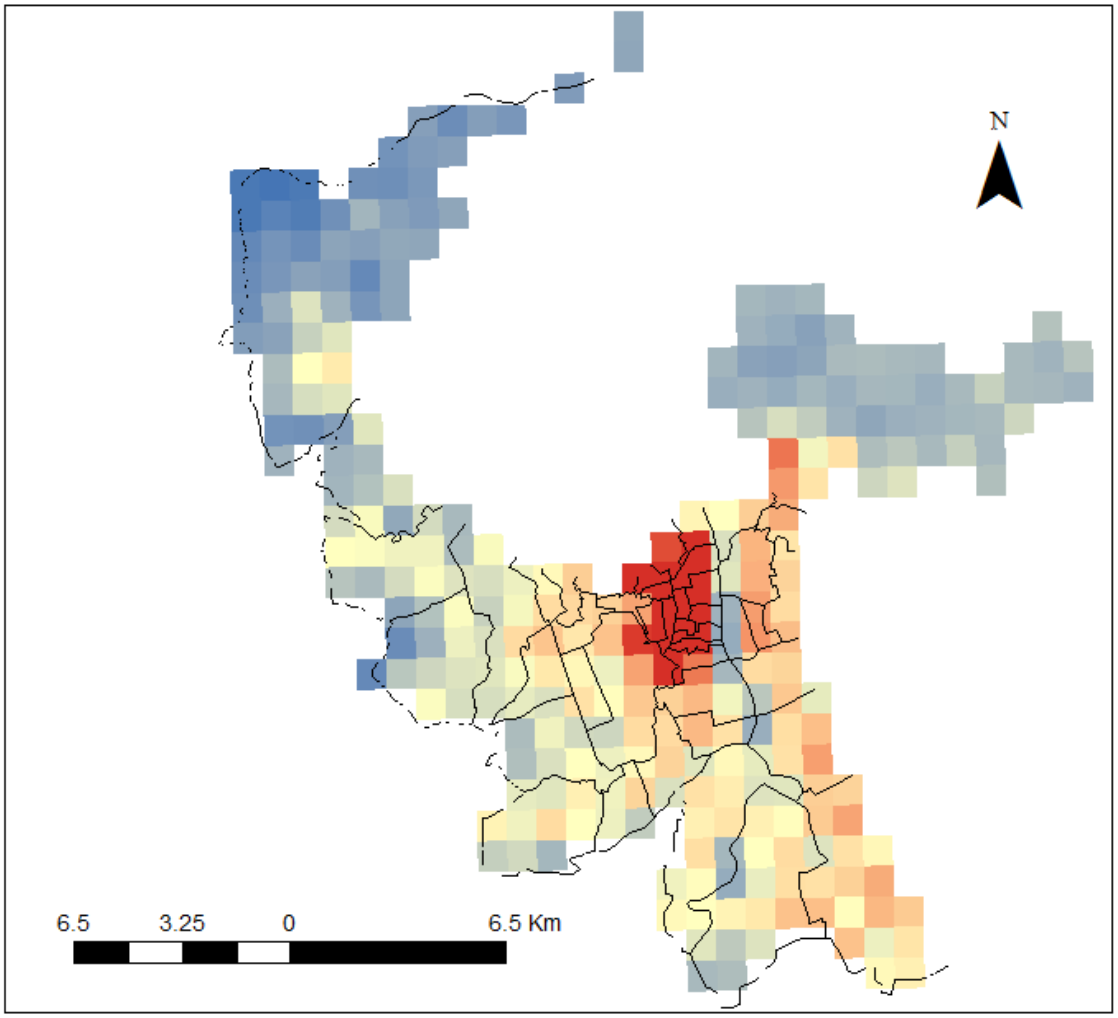
Vulnerability in 2045-2065, RCP4.5
(average for 7 scenarios)



Vulnerability
(Elderly & population density : UCTI)

High

Moderate

Low

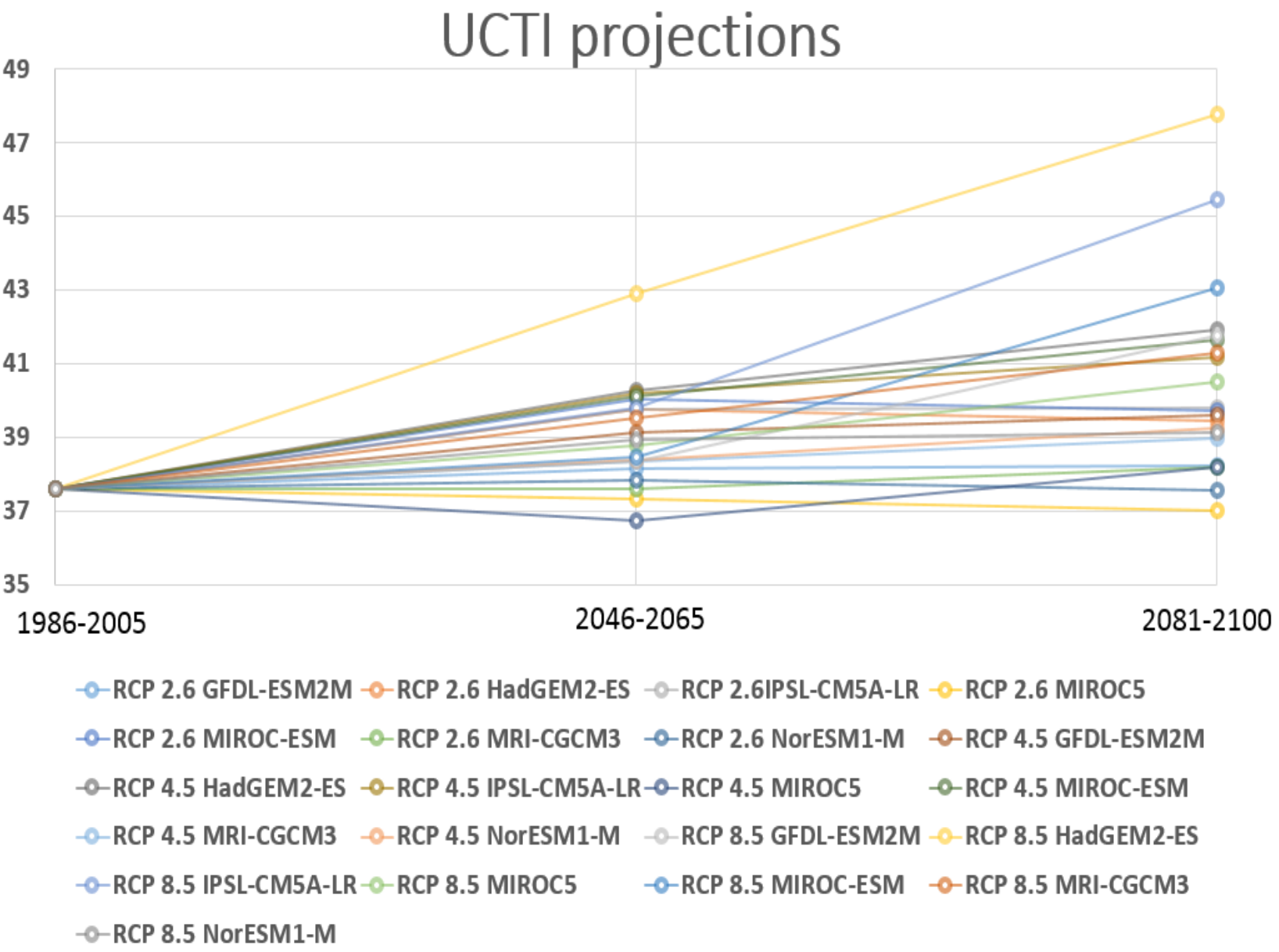
UTCI max. Projections: June-August

UTCI

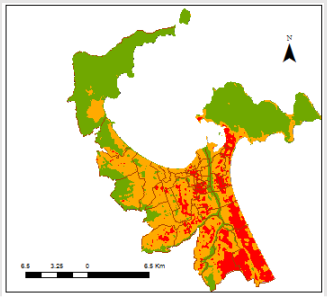
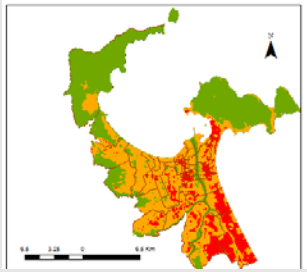
Extreme heat stress

Very strong stress

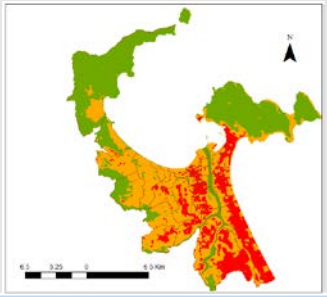
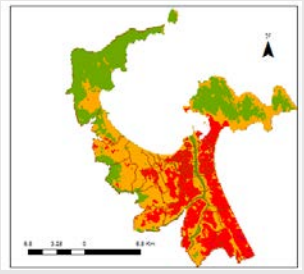
Strong stress



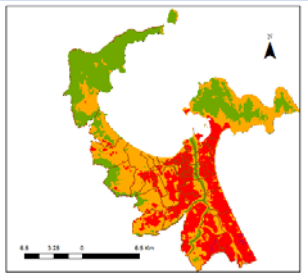
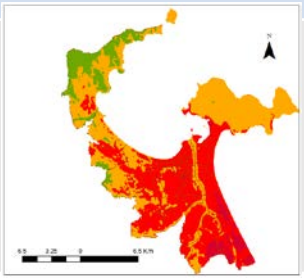
UTCI under RCP 2.6 (average of scenarios)

2046-2065	2081-2100
+1.05 (compared to 1986-205) 	**+0.98** (compared to 1986-205) 

UTCI under RCP 4.5 (average of scenarios)

2046-2065	2081-2100
+1.45 (compared to 1986-205) 	**+2.53** (compared to 1986-205) 

UTCI under RCP 8.5 (average of scenarios)

2046-2065	2081-2100
+2.72 (compared to 1986-205) 	**+5.30** (compared to 1986-205) 

Stress category	UTCI (°C) range
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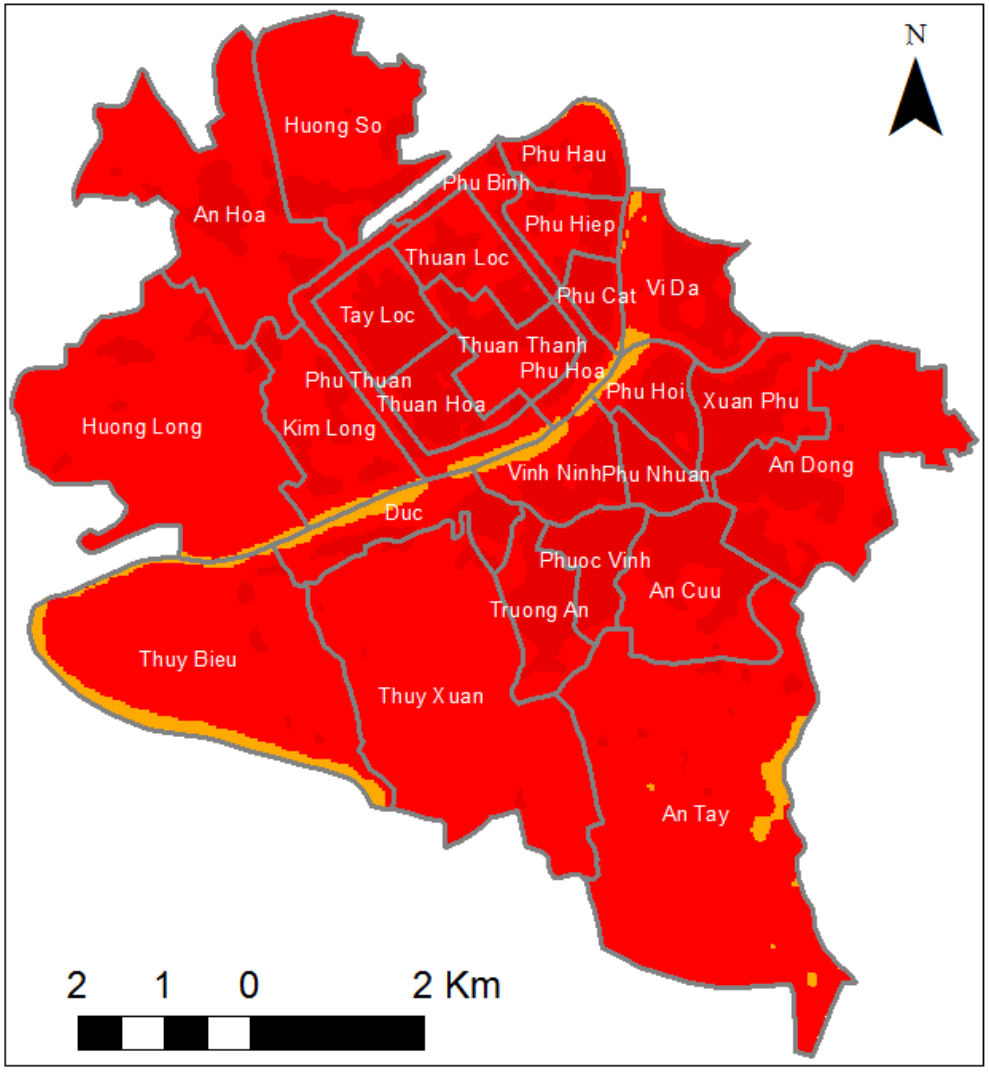
Very strong stress	**+38 to +46**
Strong stress	**+32 to +38**
Moderate stress	**+26 to +32**
No thermal stress	**+9 to +26**

Hue


QL49B
QL1A
Hương Trà
Huế
QL1A
Hương Thủy
QL49B
QL49
QL49
QL1A

Heat stress 1986-2005
(average UTCI max for June-August)



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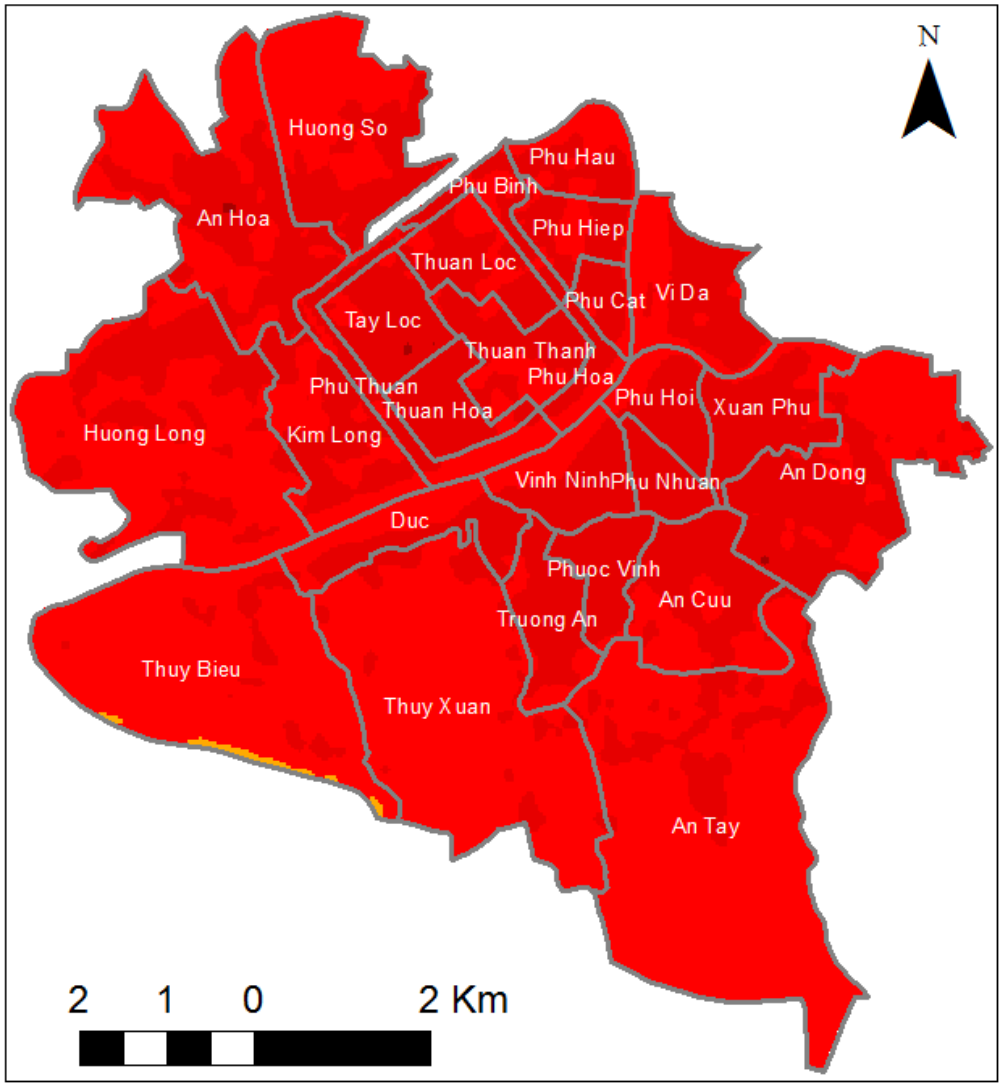
Heat stress in 2045-2065, RCP4.5 (average for 7 scenarios)



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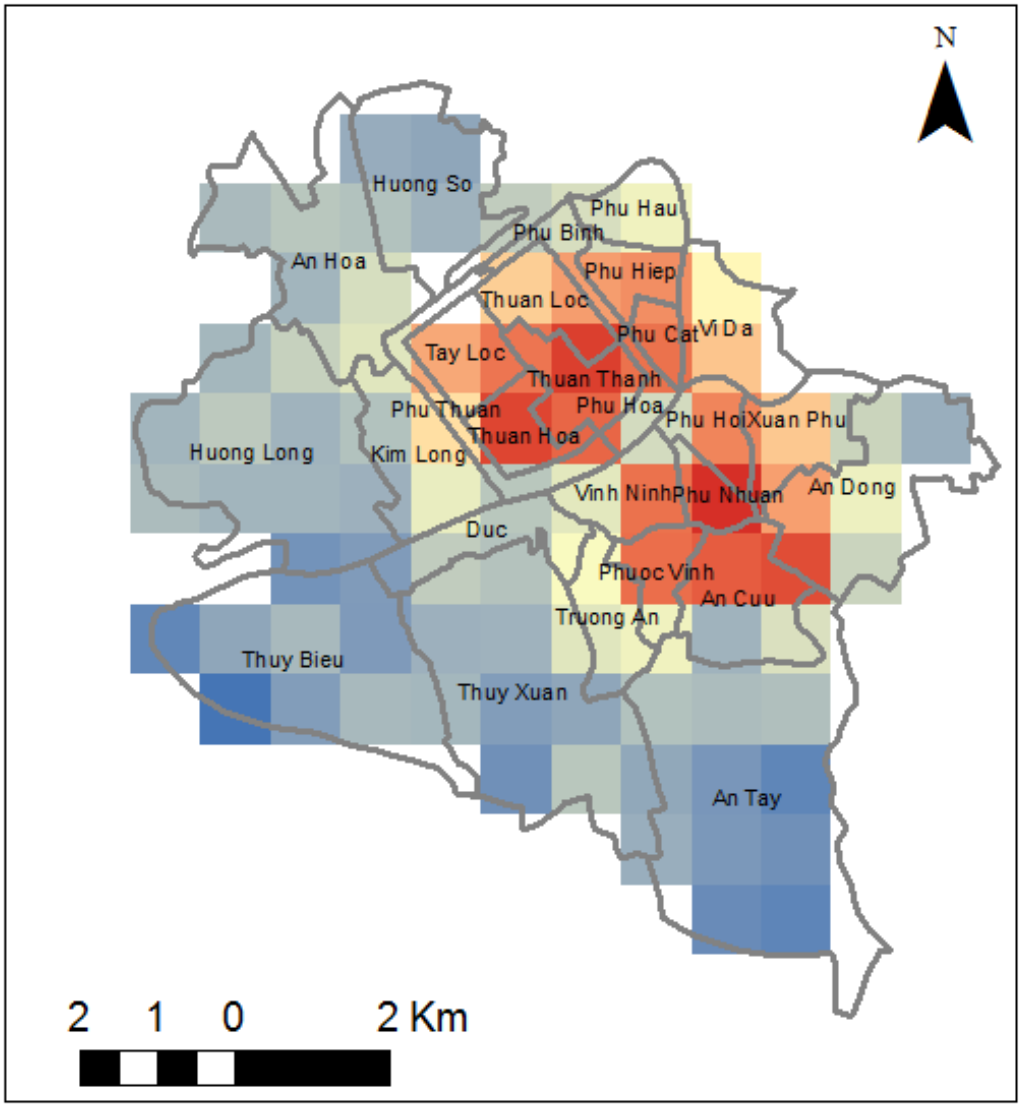
Vulnerability in 2045-2065, RCP4.5
(average for 7 scenarios)



Vulnerability
(Elderly & population density : UCTI)

High

Moderate

Low

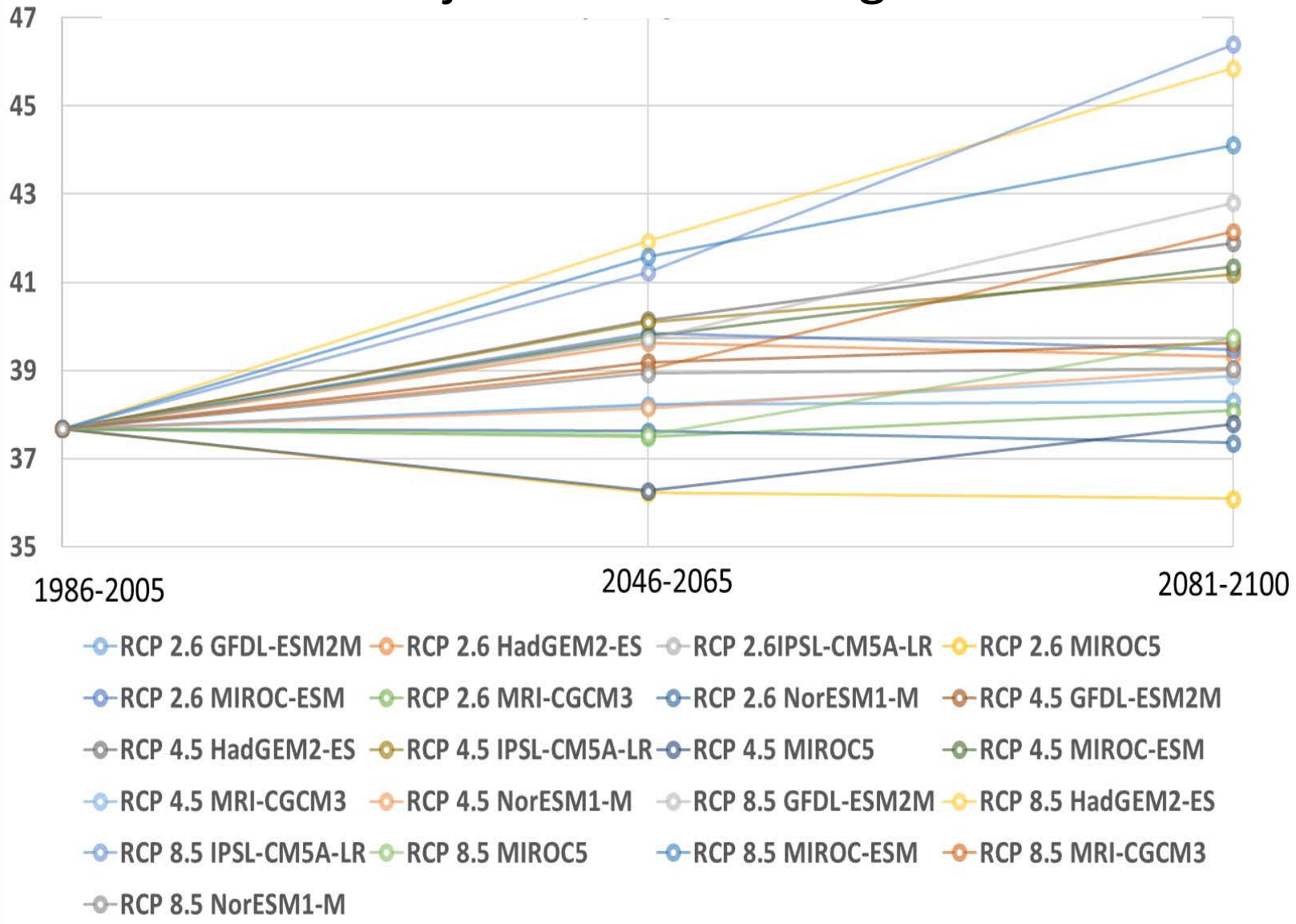
UTCI

Extreme heat stress

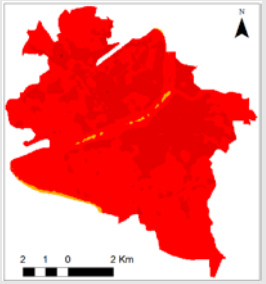
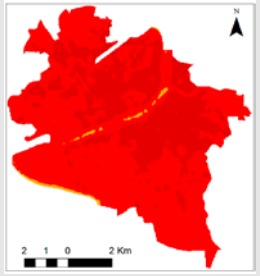
Very strong stress

Strong stress

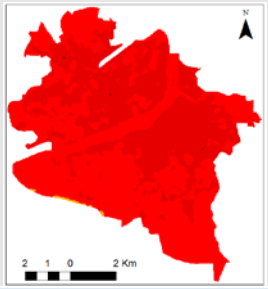
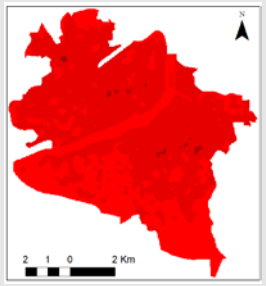
UTCImax. Projections: June-August



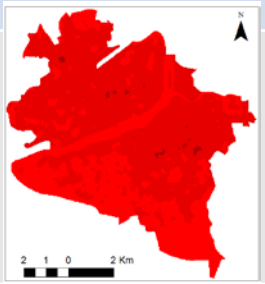
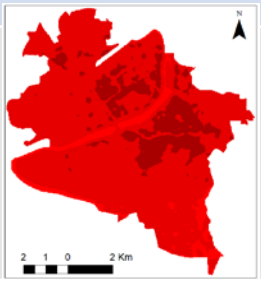
UTCI under RCP 2.6 (average of scenarios)

2046-2065	2081-2100
+0.71 (compared to 1986-205) 	**+0.66** (compared to 1986-205) 

UTCI under RCP 4.5 (average of scenarios)

2046-2065	2081-2100
+1.15 (compared to 1986-205) 	**+2.28** (compared to 1986-205) 

UTCI under RCP 8.5 (average of scenarios)

2046-2065	2081-2100
+2.31 (compared to 1986-205) 	**+5.19** (compared to 1986-205) 

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Adaptation options	Short term	Long term
• Information in public:		
• Rising awareness of citizens to heat risk, especially vulnerable groups (children, elderly, sick person, outdoors workers)	✓	
• Raising awareness of public health agency and local government, and rising their preparedness	✓	
• Public health agency and local government preparedness	✓	
• Heat warning systems	✓	
• Urban Structure:		
• Urban greening and water landscape		✓
• Increasing albedo of building		✓
• Technology:		
• Electrical vehicles		✓
• Cooling systems	✓	
• Public transport		✓

Recommendation for urban planning

- **Areas of high vulnerability need to have taken actions to improve surface albedo of roofs and streets, and to increase urban greening to reduce surface and air temperature.**
- **These areas, despite being central, should avoid further increase of houses in urban planning, and instead allocate space for blue-green infrastructure.**
- **Traffic of petrol driver wheedles needs to be restricted.**

Summary

- The heat stress is already reaching high level during summer time
- Under the climate change, there will be significant increase of the heat stress magnitude
- Climate scenarios and models vary in forecasting but it is certain that most of the city is to be under high heat stress
- Adaptation to prevent impacts of heatwaves is necessary for future urban planning