Assessing future heatwave risk change considering climate change scenarios

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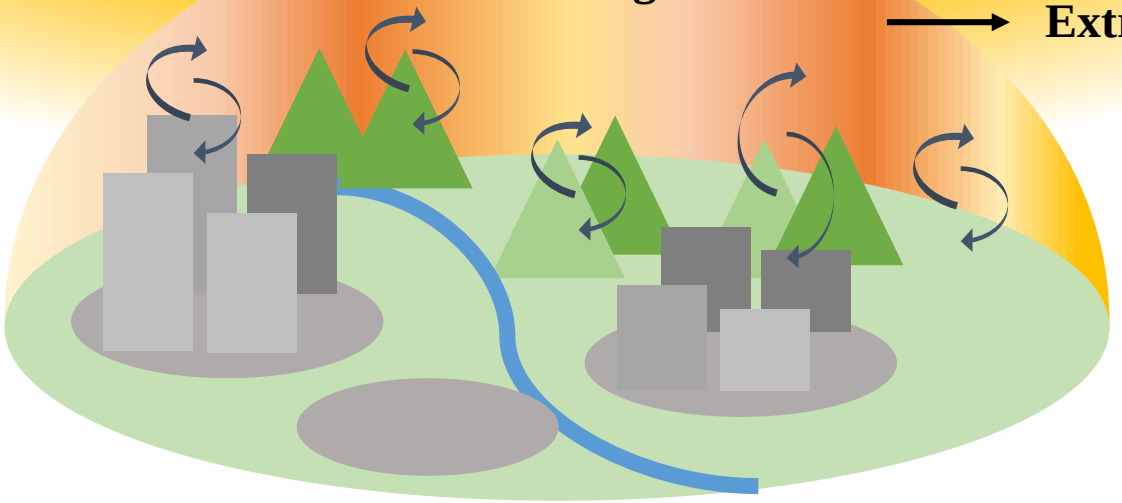
Global convection current

interaction between
local land surface & global current

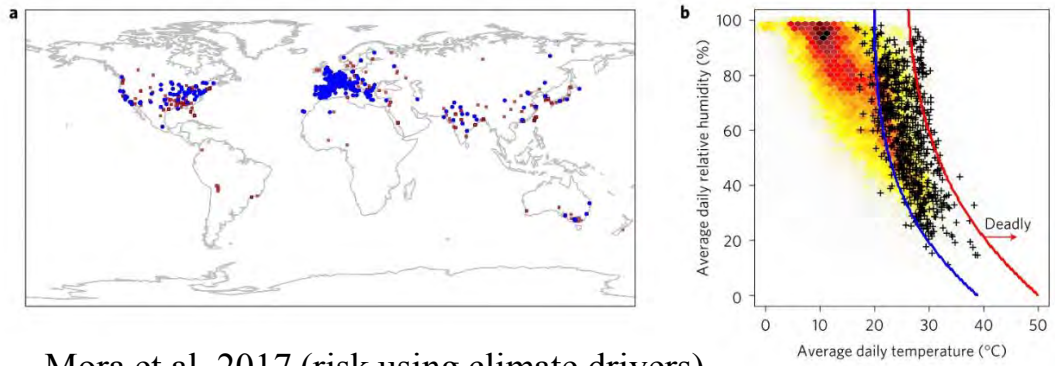


Extreme climate risk

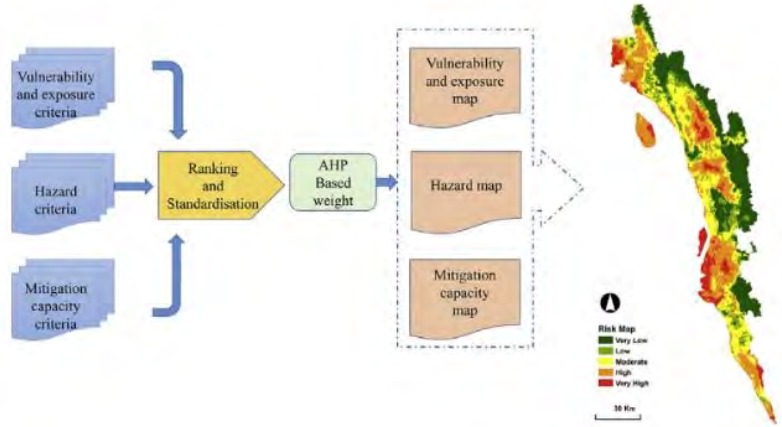
Surface physical & socio-economic aspects

Adaptive capacity

Sensitivity



Mora et al. 2017 (risk using climate drivers)



Hoque et al. 2019 (Index based analysis)

Limitation of previous studies

① limited considering of surface characteristics

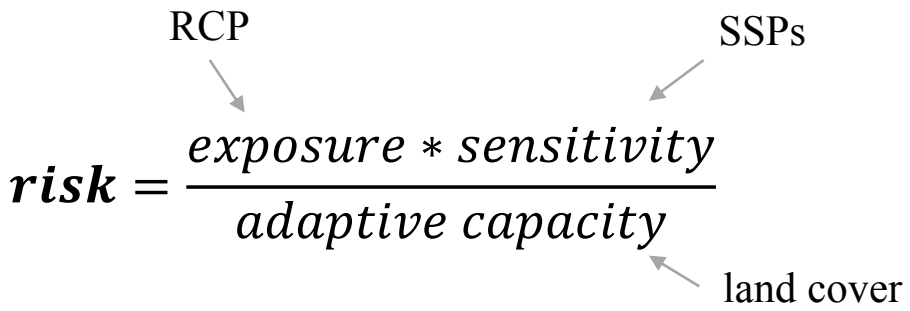
② Index based

③ hard to quantify & compare risk

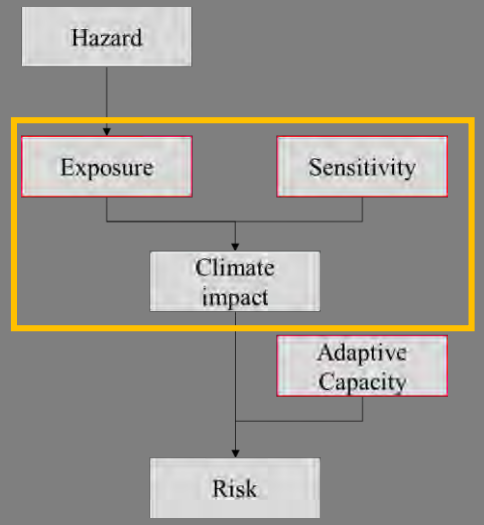
spatially and temporally !

→ Combine exposure and vulnerability using not an index based method

How to assess the risks for extreme climate events **Spatially & Temporally ?**

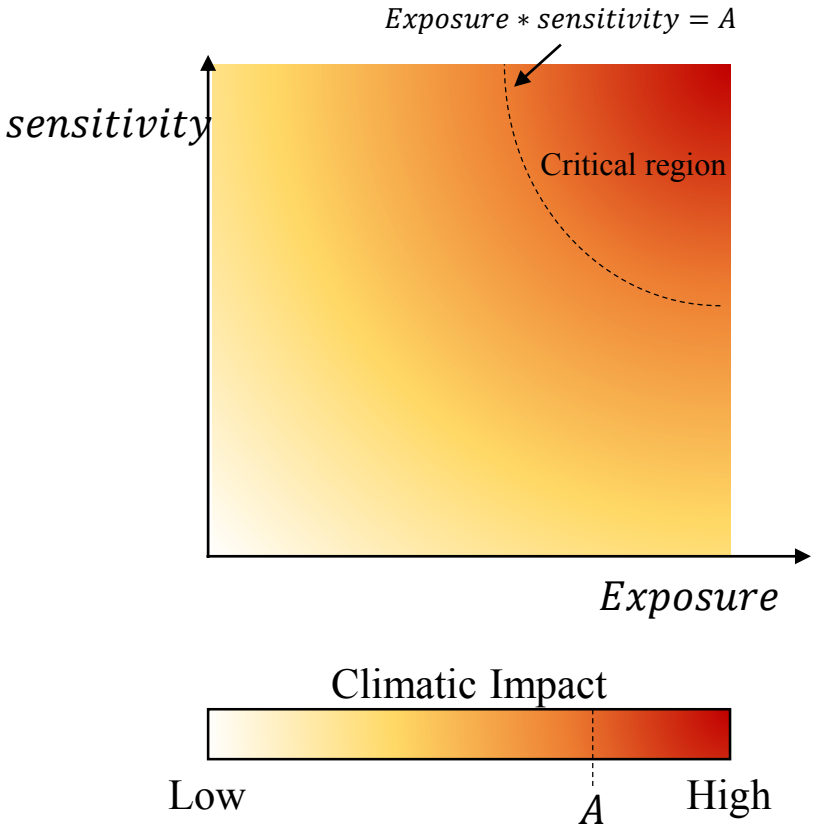


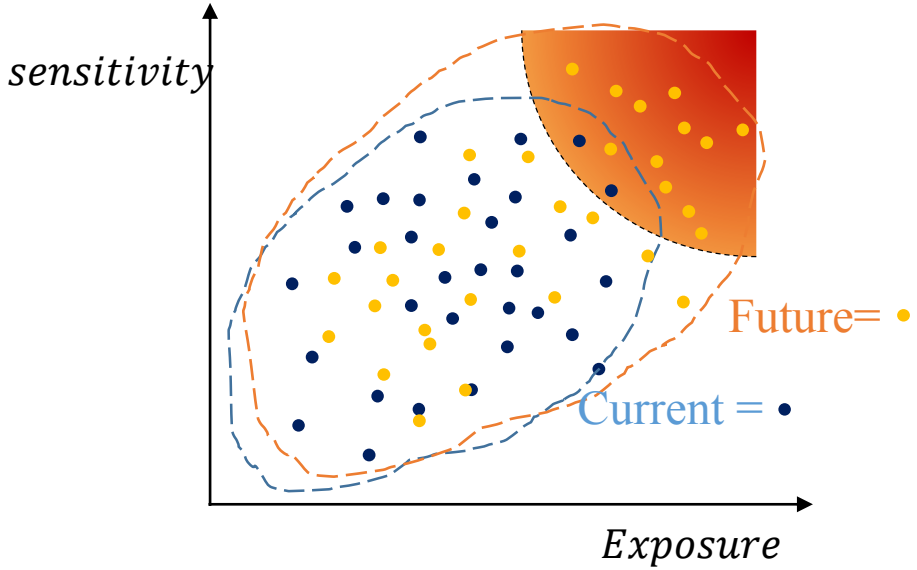
- Connected with climate change scenario (RCP, SSPs, land cover change)
- Case study for Seoul, Korea



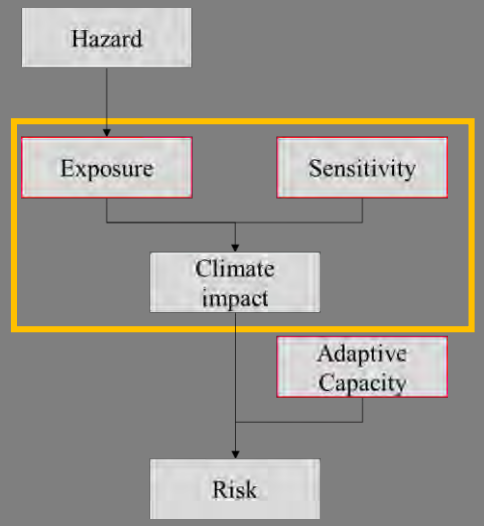
$Exposure * sensitivity$

= the number of extreme event for sensitivity populations per year





Area in the critical region
Current=2 → Future=12



$Exposure * sensitivity$

= the number of extreme event for sensitivity populations per year

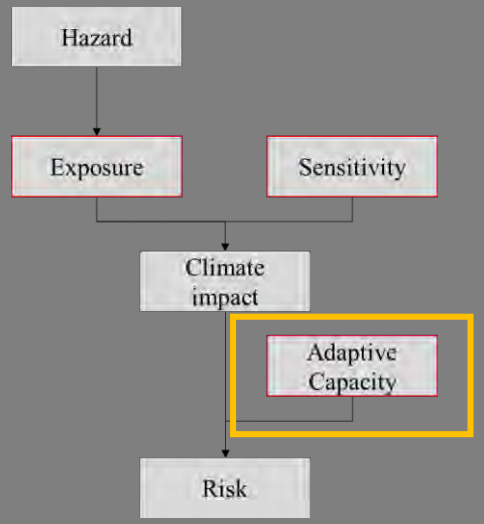
Exposure = the day of extreme heat event per year

Extreme heat event = daily mean temperature > 98 % for 2011-2018 temp (=29.5 ℃ for Seoul)

sensitivity = the sensitivity population (old and isolation)

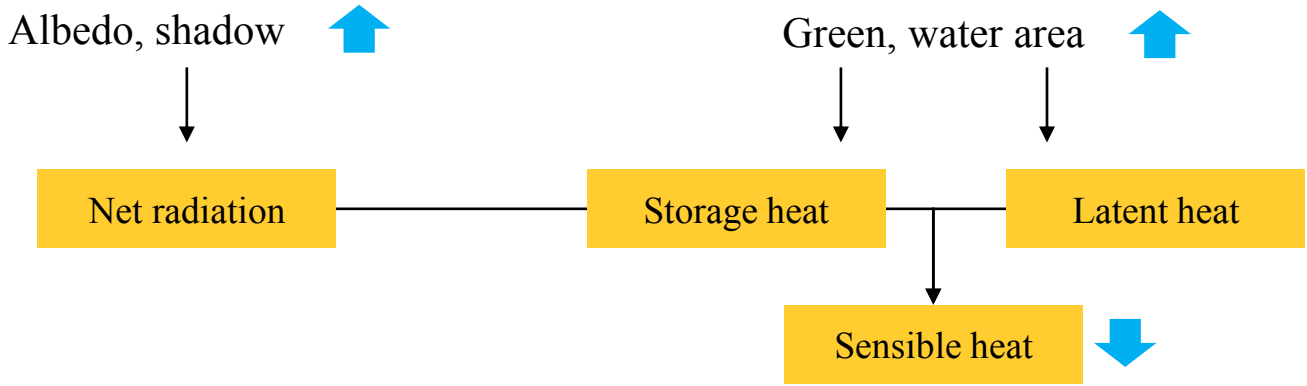
Old: over 65 years old

Isolation: single person housing



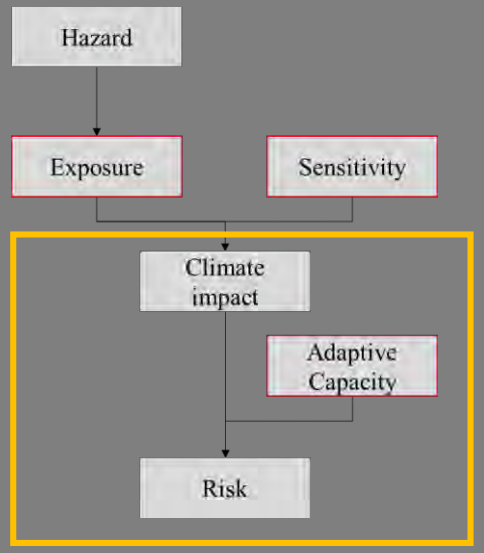
Adaptive Capacity : spatial capacity to reduce heat flux

Variables
1. Albedo
2. Building shadow area
3. Green area
4. Water area



$$adaptive\ capacity = \sum Effect\ of\ reducing\ heat\ flux$$

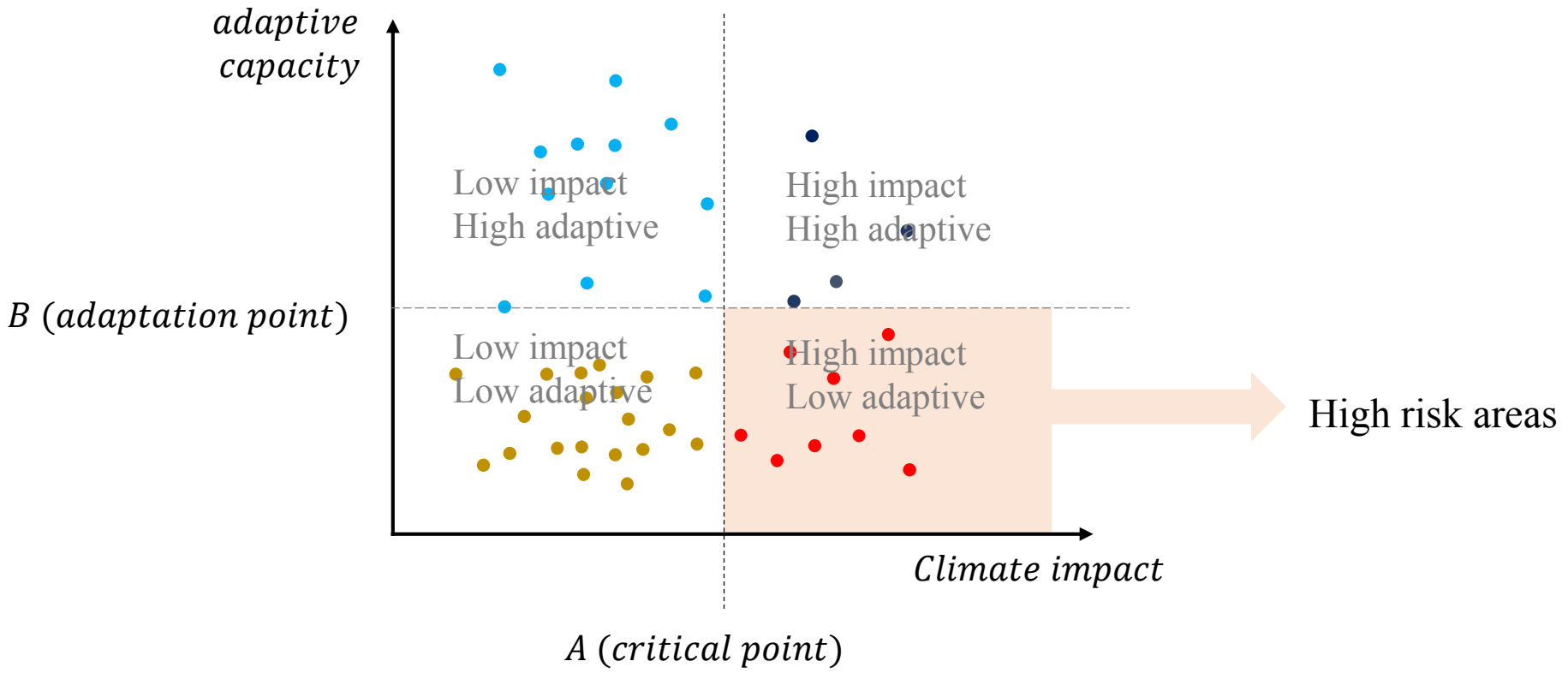
Equation reference: Kwon et al., 2019

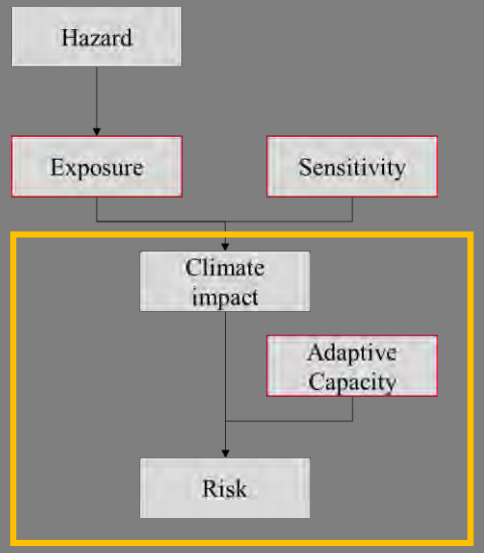


$$\frac{Climate\ impact}{adaptive\ capacity}$$

= Risk considering adaptive capacity

(=how much the spatial characteristics can reduce urban heat)

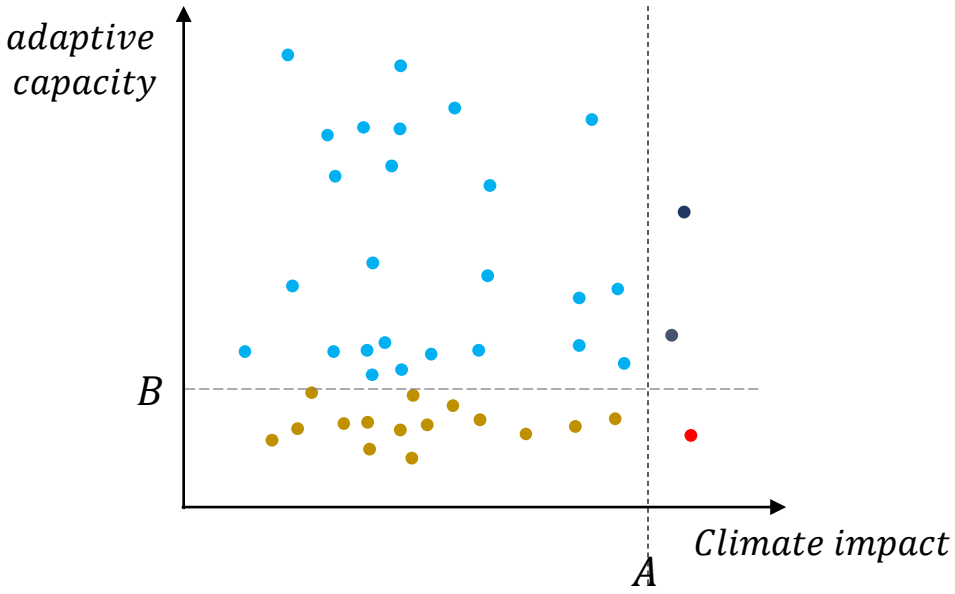




$$\frac{Climate\ impact}{adaptive\ capacity}$$

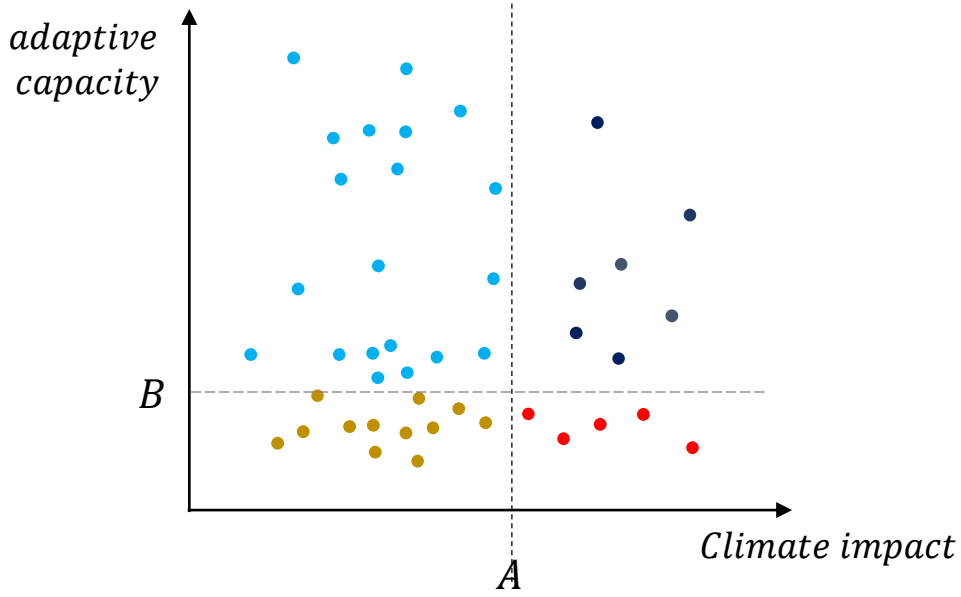
= Risk considering adaptive capacity

Current



High Risk areas = 1

Future



High Risk areas = 5

Case study → A : 2,000 people * days/year

B : 50 % of adaptive capacity values

Case study

- Seoul
- 1km resolution
- RCP 4.5 & 8.5
- SSP 3 & 5

Base: RCP 4.5 & SSP 3

Assess spatial exposure, sensitivity, and adaptive capacity of Seoul

Spatial exposure & risk variation by RCPs

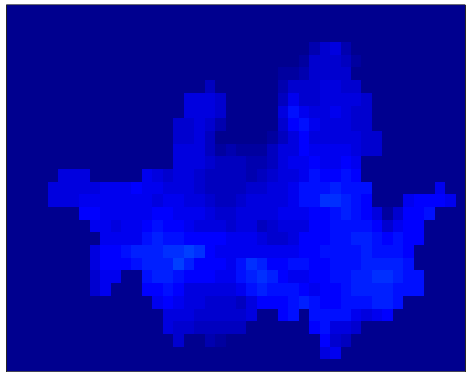
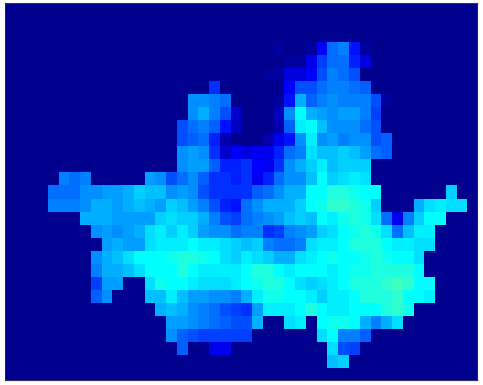
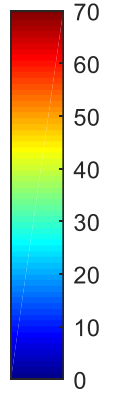
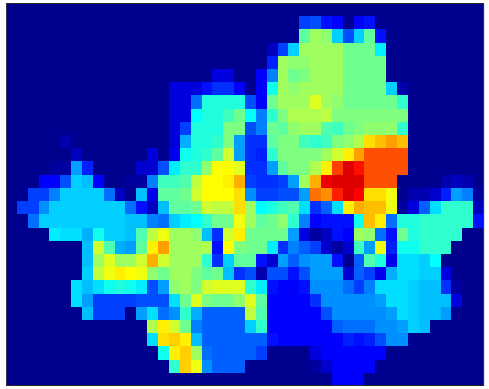
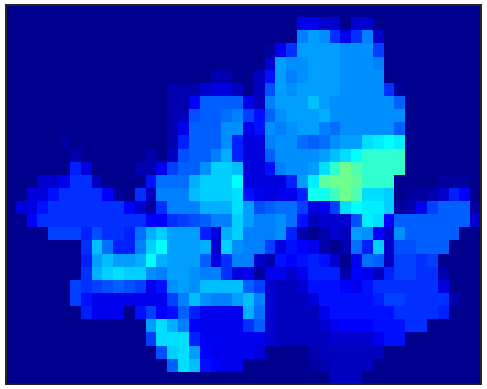
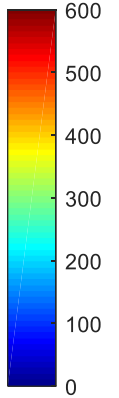
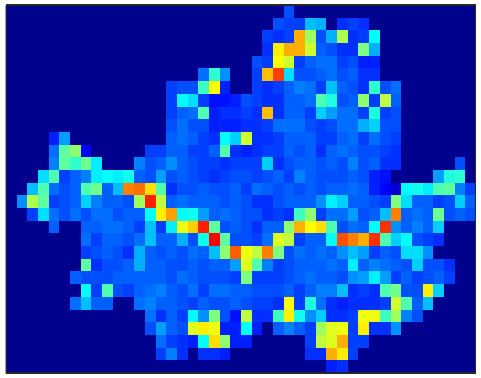
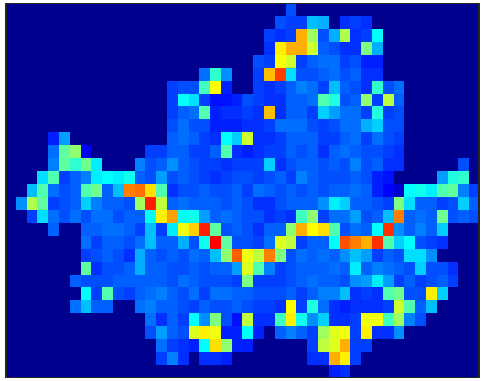
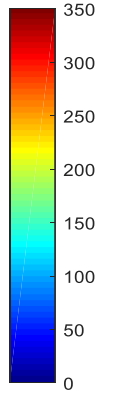
Spatial sensitivity & risk variation by SSPs

Spatial adaptive capacity & risk variation by Sample land cover change

2040s
2090s

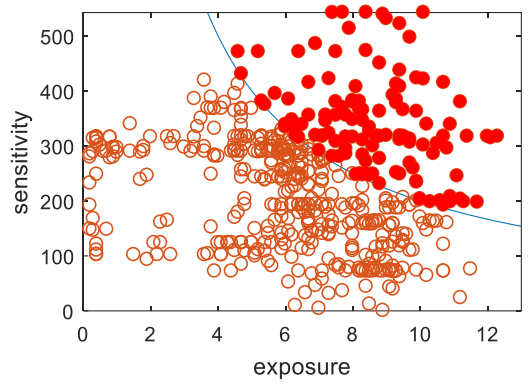
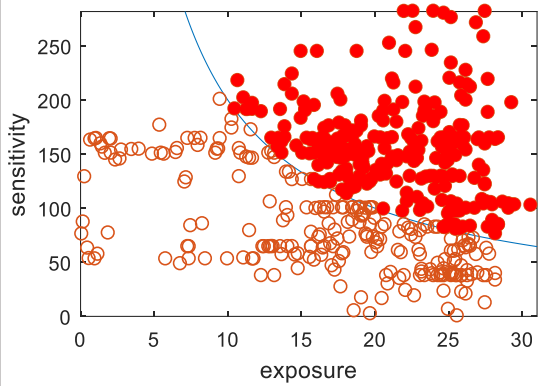
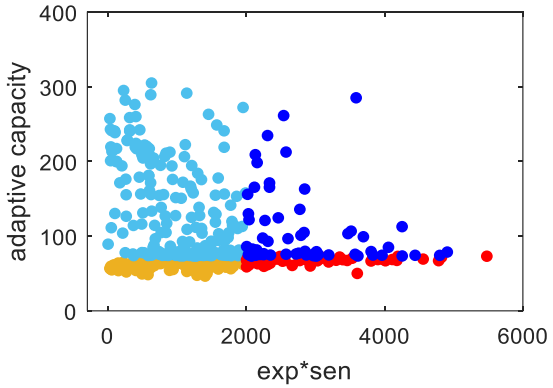
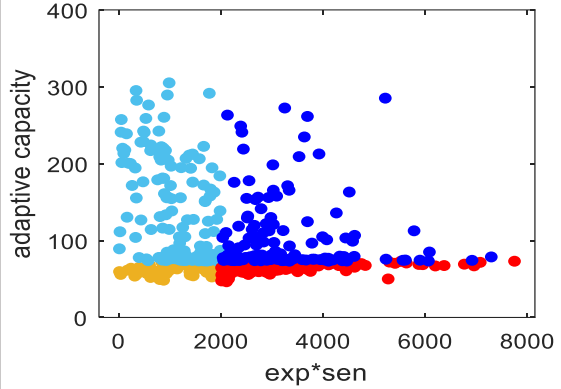
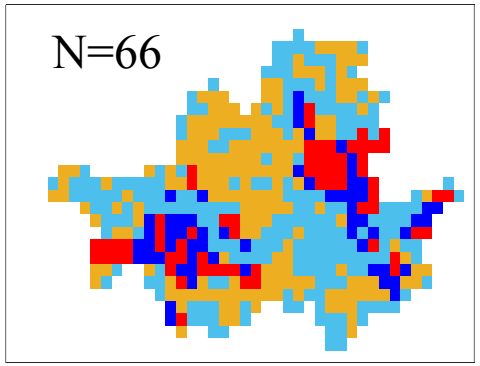
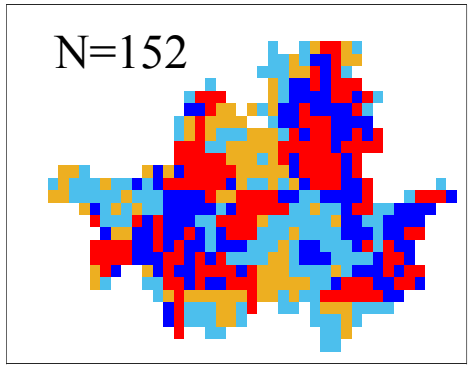
Case study Results

- Base scenario
- RCP 4.5 & SSP 3

	2041-2050	2091-2100	legend
Exposure (day/year/㎢)			
Sensitivity (people/㎢)			
Adaptive capacity (W/㎡)			

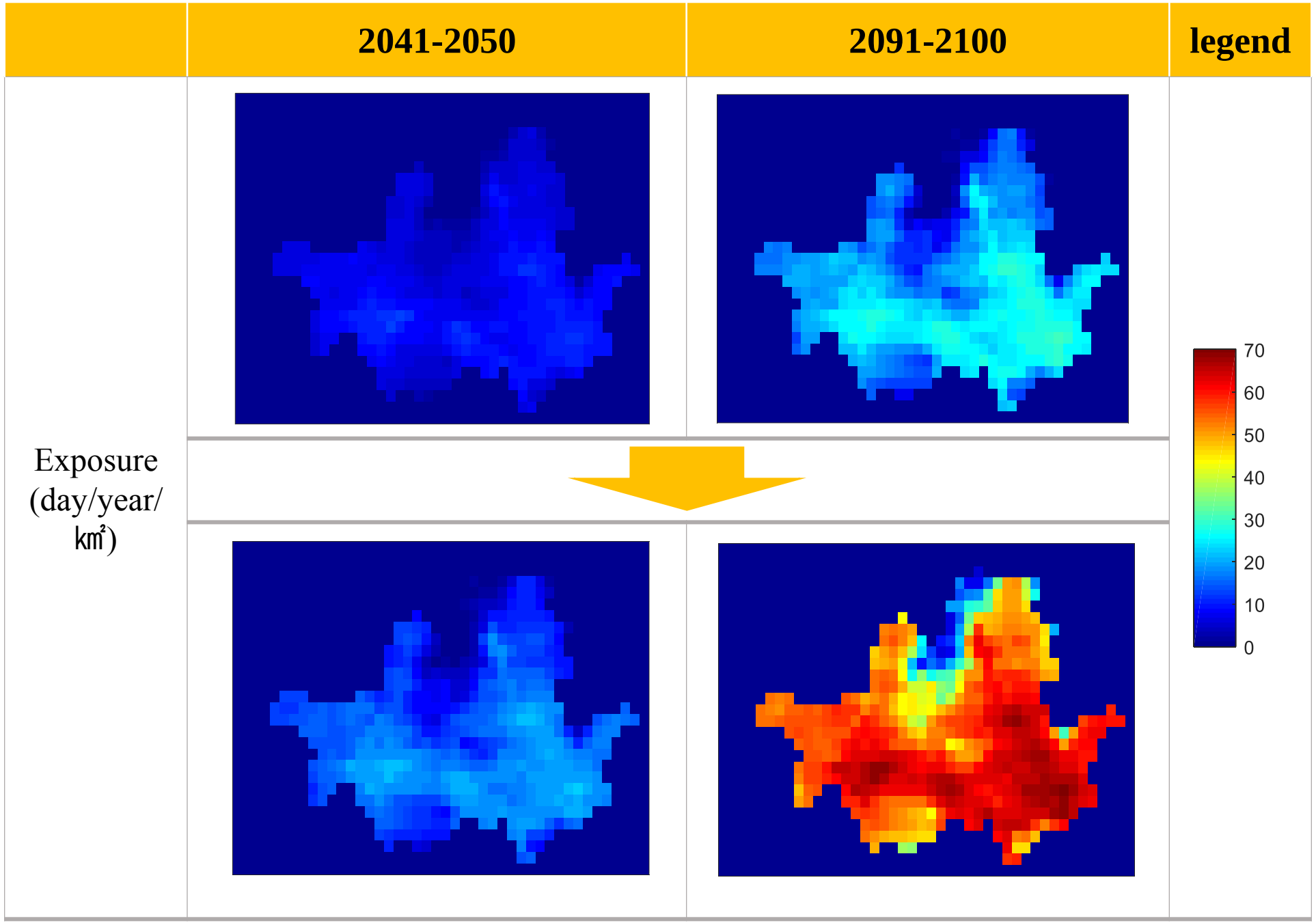
Case study Results

- Base scenario
- RCP 4.5 & SSP 3

	2041-2050	2091-2100
Exposure*sensitivity		
Exposure*sensitivity / adaptive capacity		
High risk area (red)		

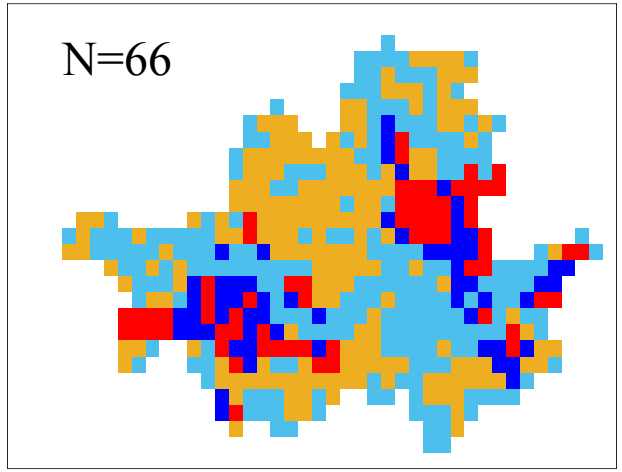
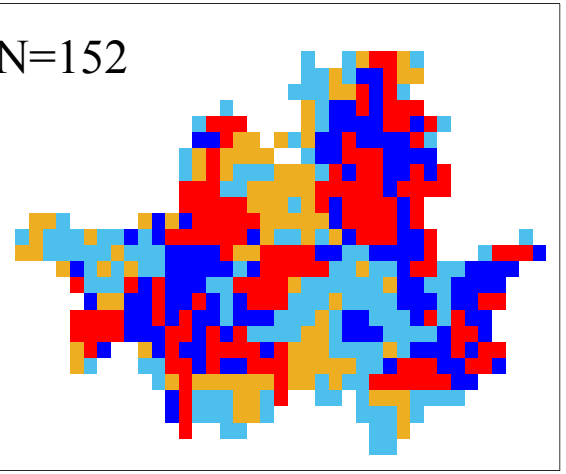
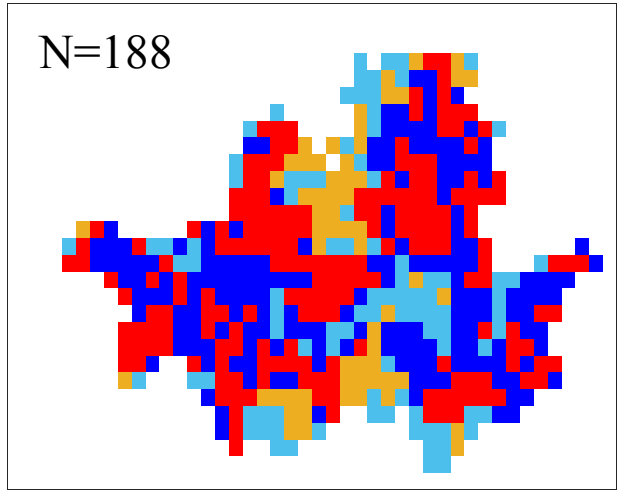
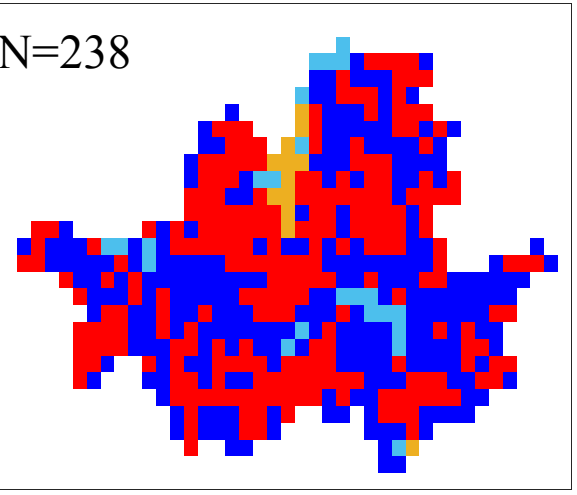
Case study Results

- **High exposure scenario (change exposure)**
- **RCP 8.5 & SSP 3**



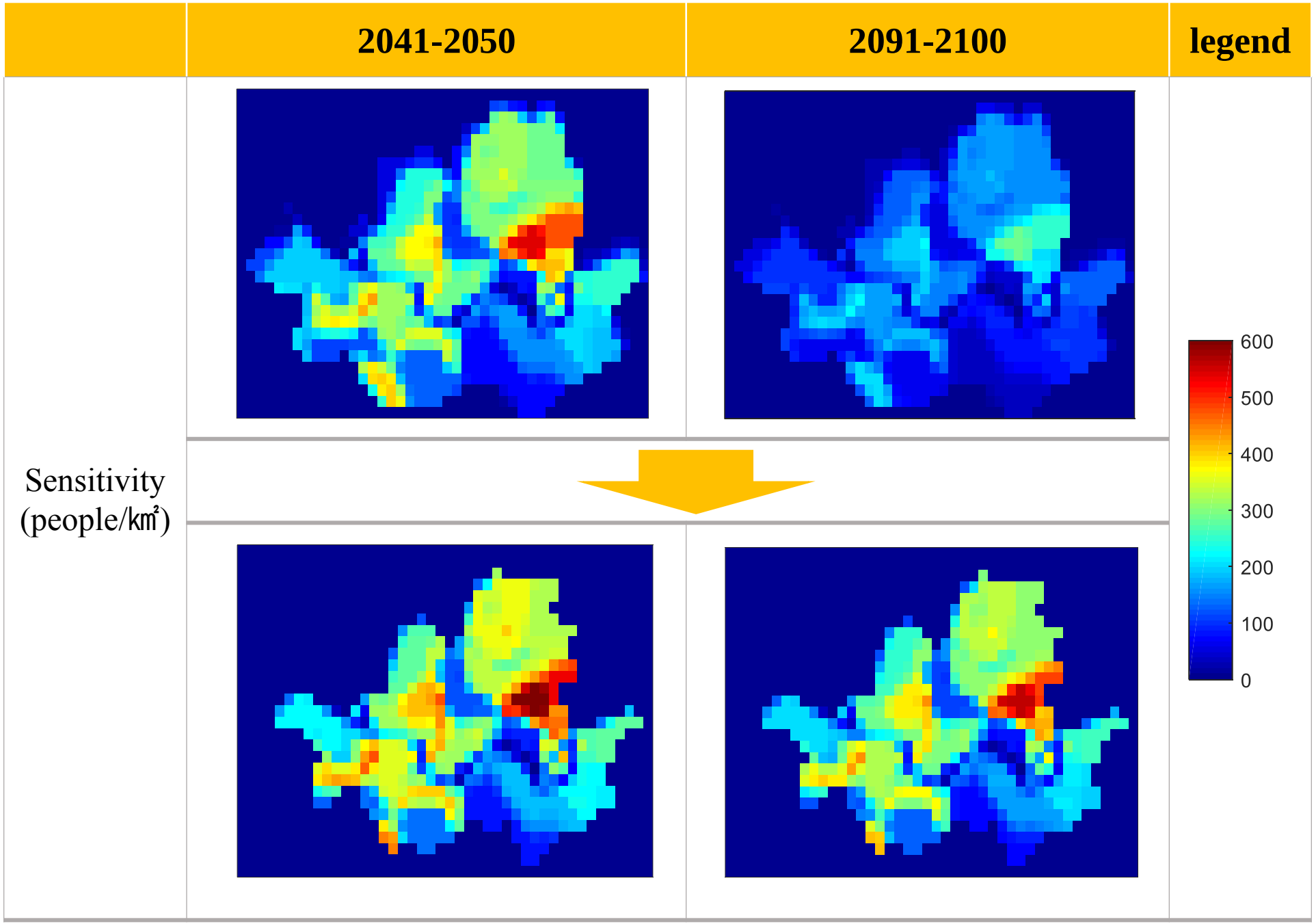
Case study Results

- **High exposure scenario (change exposure)**
- **RCP 8.5 & SSP 3**

	2041-2050	2091-2100	legend
High risk area (red)	N=66 	N=152 	H-H L-H L-L H-L impact-adaptation
	N=188 	N=238 	

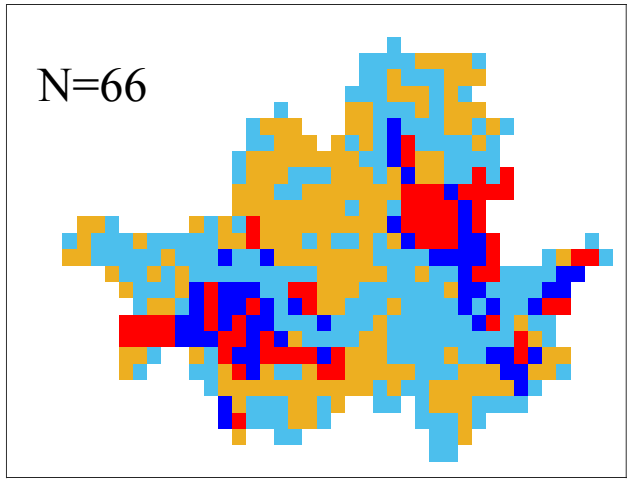
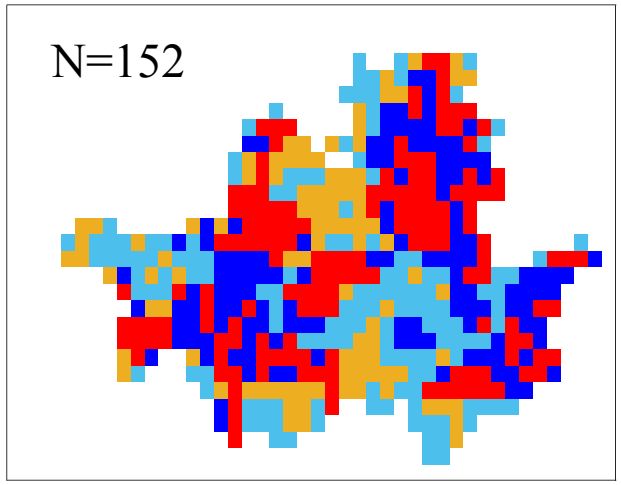
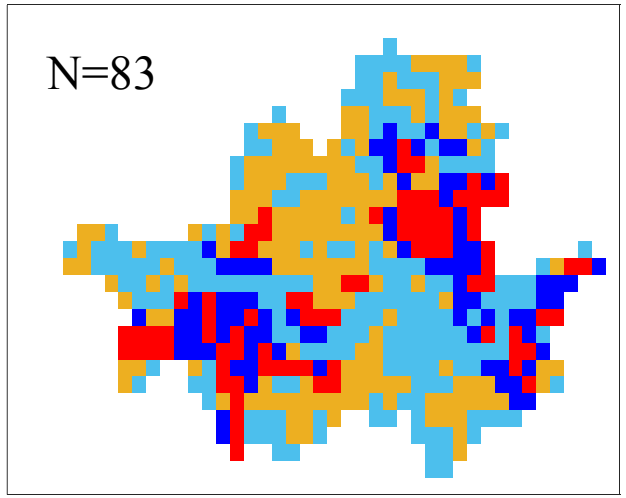
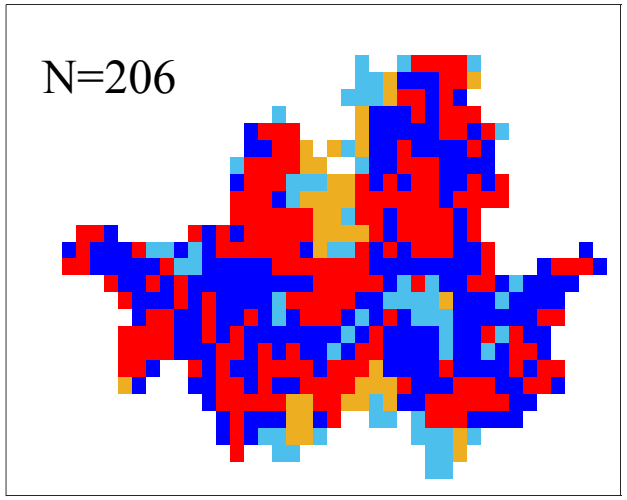
Case study Results

- High population scenario (change sensitivity)
- RCP 4.5 & SSP 5



Case study Results

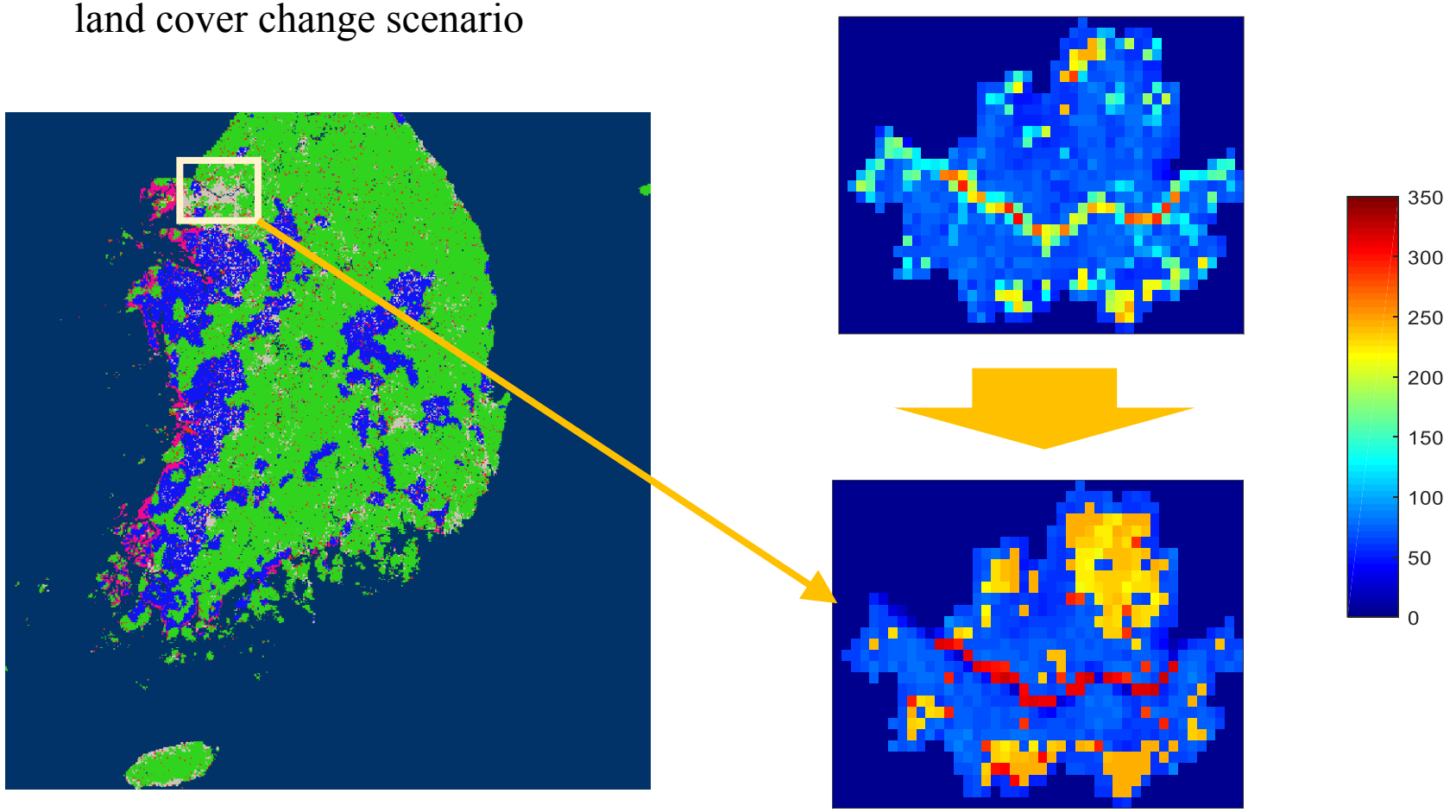
- High population scenario (change sensitivity)
- RCP 4.5 & SSP 5

	2041-2050	2091-2100	legend
High risk area (red)			H-H L-H L-L H-L impact-adaptation
			

Case study Results

- **Land cover change scenario (change adaptive capacity)**
- **RCP 4.5 & SSP 3**

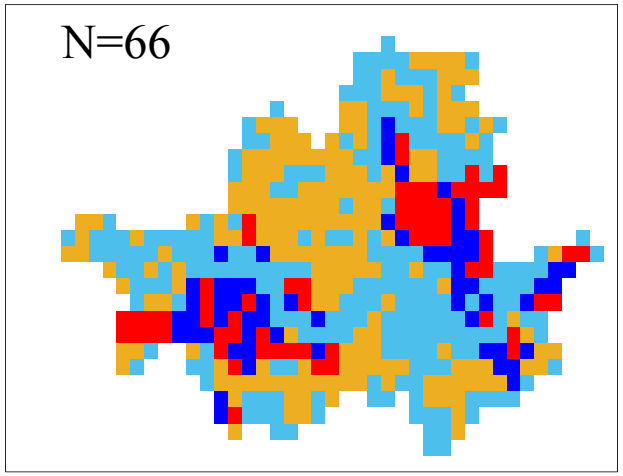
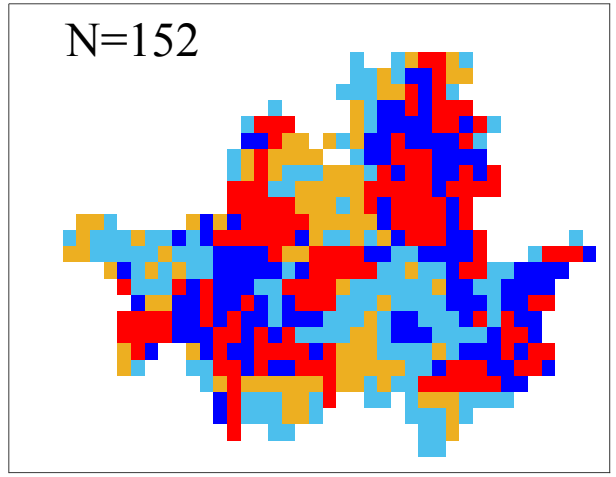
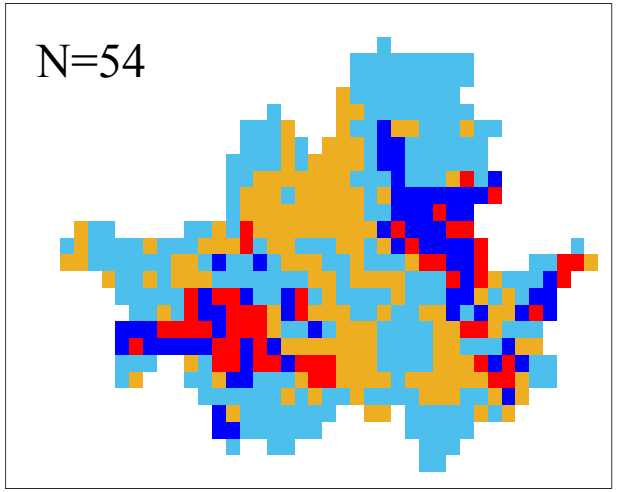
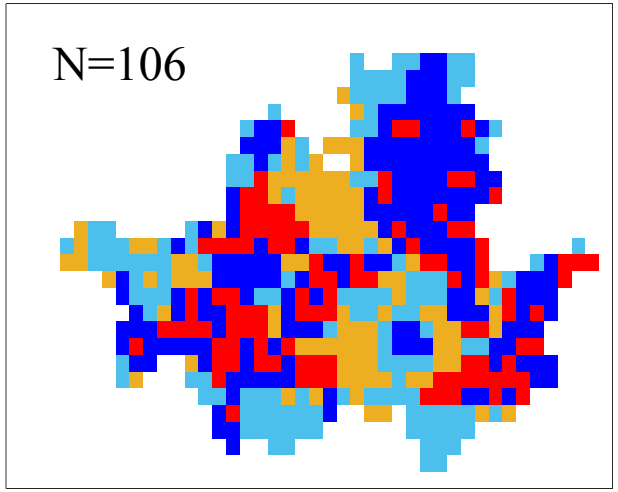
"MOTIVE (impact model)"
land cover change scenario



(prediction for 2050s, regarding minimizing future disasters & maximizing economical efficiency)

Case study Results

- **Land cover change scenario (change adaptive capacity)**
- **RCP 4.5 & SSP 3**

	2041-2050	2091-2100	legend
High risk area (red)			H-H L-H L-L H-L impact-adaptation
			

Conclusions

① RCP 8.5 and SSP 5 increase exposure and sensitive population

→ increase high risk area

② Predicted land cover (in the impact model) increase adaptive capacity of outskirt area

→ decrease high risk area

③ The model finds out spatial and temporal variations of risk

→ help consider equity, develop adaptation plan

→ when the large increase of exposure is expected, we need to increase adaptive capacity

④ Integrate other sectors (land cover change) with heat wave risk

Limitations and future works

① Selecting threshold needs more scientific evidence (heat death data …)

② Climate drivers: air temperature + humidity

③ Applying this model to other climate risks (drought risk, flood risk …)

: explore adaptive capacity variables for each risk in the regional ~ national scale

Thank you

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