서울대학교 SEOUL NATIONAL UNIVERSITY 부산대학교 PUSAN NATIONAL UNIVERSITY 고려대학교 KOREA UNIVERSITY

Securing climate resilience in urban space using technology assessments and decision-making support system

—

28th AIM International Workshop

Hui Cheul Jung (KEI, Korea), Dong Kun Lee (SNU, Korea),
Jung Hee Hyun (IIASA, Austria)

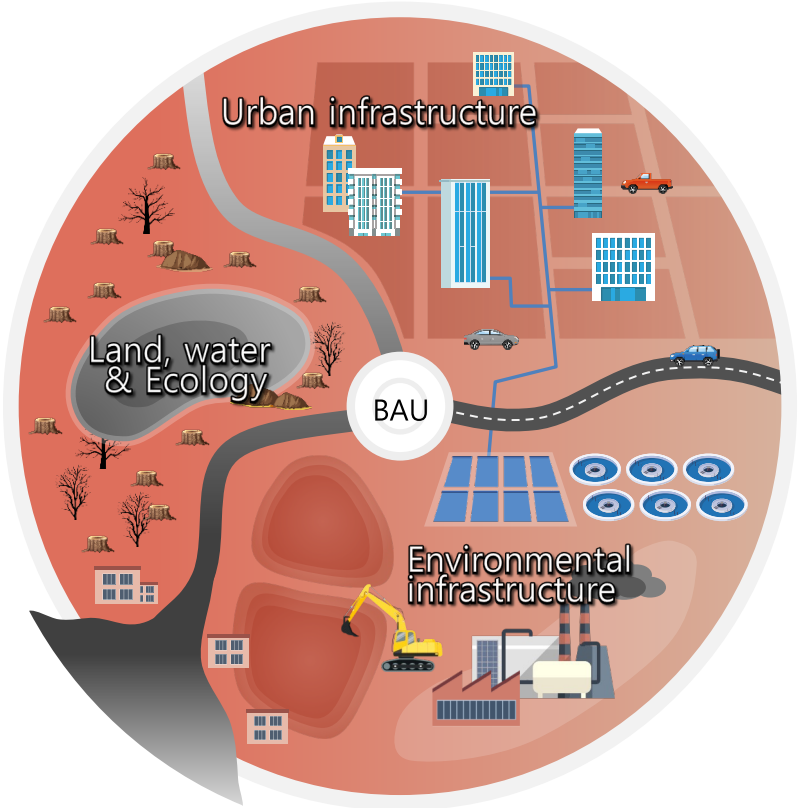
Contents

서울대학교 SEOUL NATIONAL UNIVERSITY 부산대학교 PUSAN NATIONAL UNIVERSITY 고려대학교 KOREA UNIVERSITY

Research Background

Gaps in bottom-up considerations of climate resilient development paths

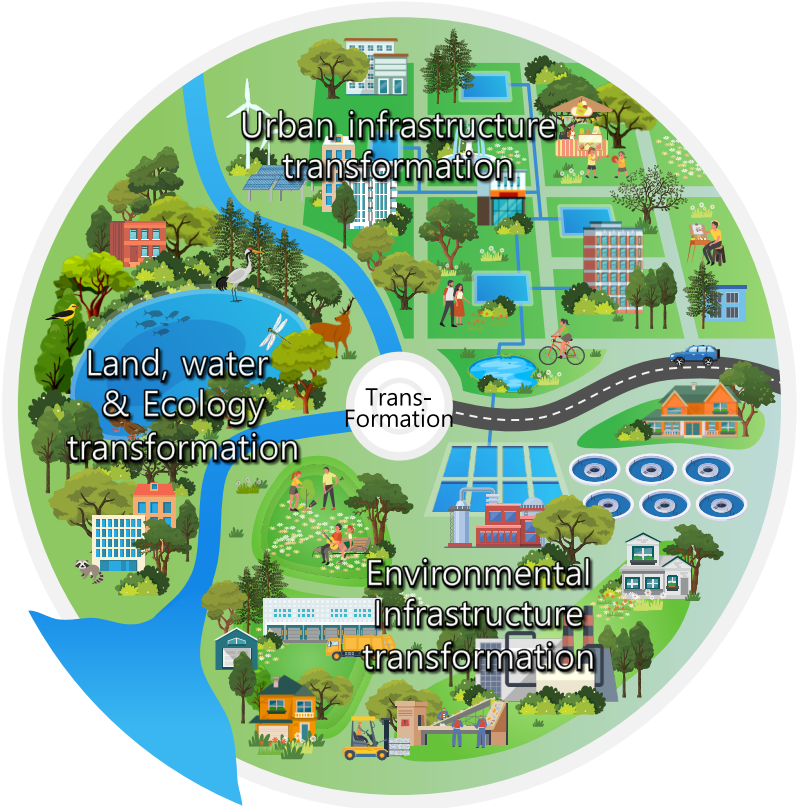
Lack of integration of siloed local responses to climate impacts



Contextualized

Engagement

Governance



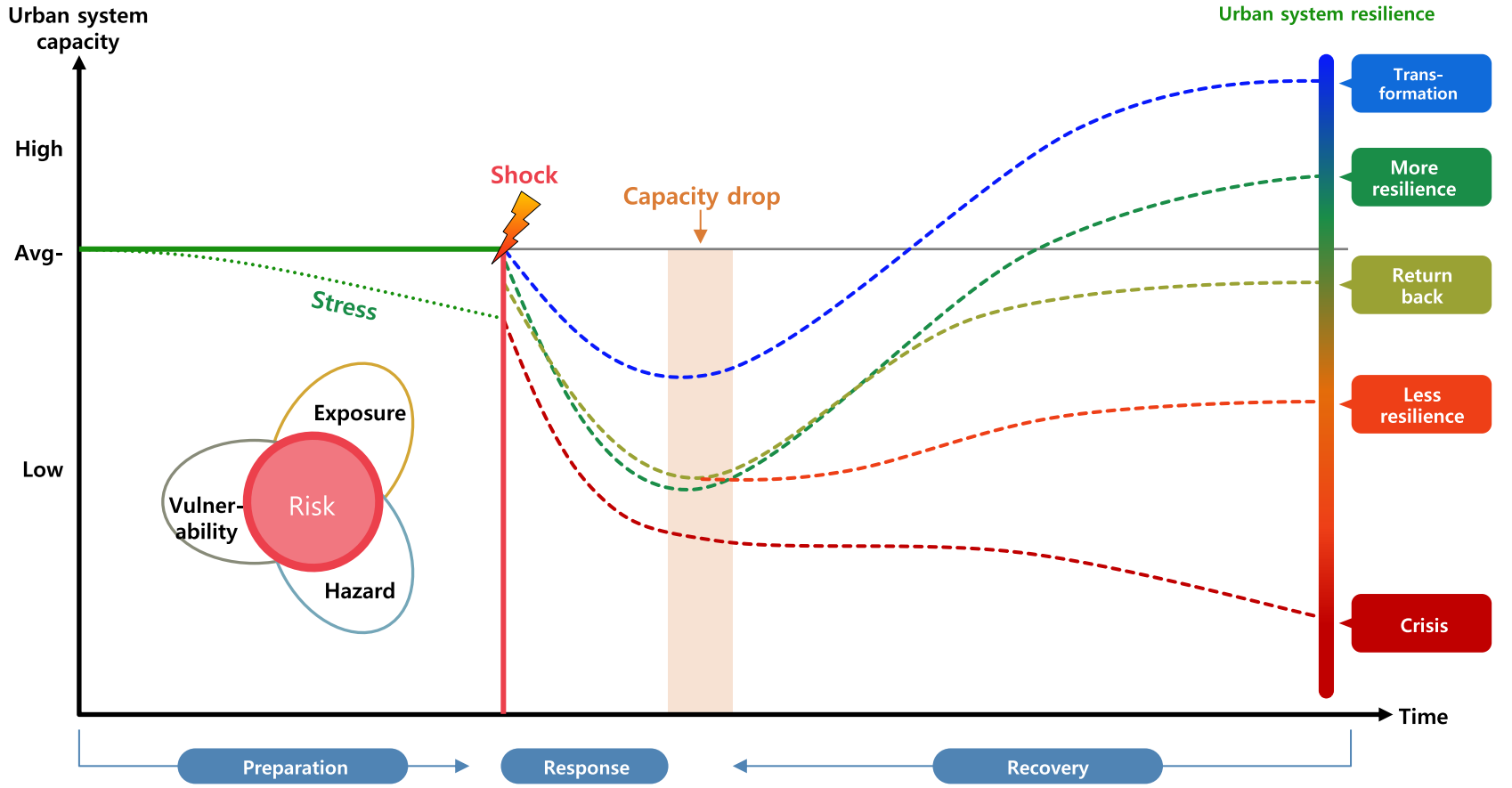
Inconsistent
Climate Responses

Sustainable
Climate Responses

Research Background

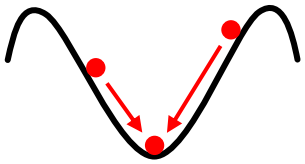
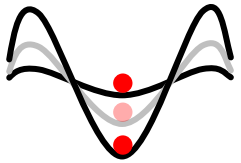
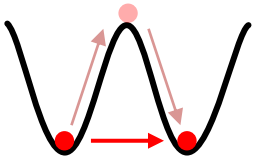
What is climate resilience ?

System capacity to overcome risk or shocks. Climate resilience can be increased through decision-making processes for adaptation, learning and system transformation, while maintaining the intrinsic structure and function of the system.



Research Background

Transformational adaptation for climate resilience

	Change within a system (Incremental adjustment)	Change of the system (Transformation)
	 [Maintaining / Restoring Equilibrium State]	 [Change in current equilibrium state]  [Change to a new equilibrium state]
Systems — Top-down	**Phase 2** • E.g. : Disaster engineering, economic resilience. • Typical methods: models, stress tests. • gray infra solutions and more for short-term recovery needs • Not a comprehensive management strategy that addresses social, economic and physical factors, multiple risks	**Phase 3** • E.g. : adaptation & transformation, flexible planning & design; adaptive management. • Typical methods: planning tools, assessment tools, design research, scenarios. • Addressing the social, cultural and economic root causes of risk from a pre-scale long-term, predictable disaster
People & communities — Bottom-up	**Phase 1** • E.g. : Self-sufficiency; social aspects of disaster planning & preparedness. • Typical methods: indicators, surveys, inter-views, case studies	**Phase 2** • E.g. : Social innovation, social justice, grass-roots actions, bottom-up transformative governance. • Typical methods: possibly case studies, creative tools, narrative collection, citizen science.

Research Project Overview

Evaluation of technology on securing climate resilience in urban space and the development of the decision-making support system

Project goal: Assess the non-structural and social factors of enhancing urban climate resilience, including evaluation of technologies

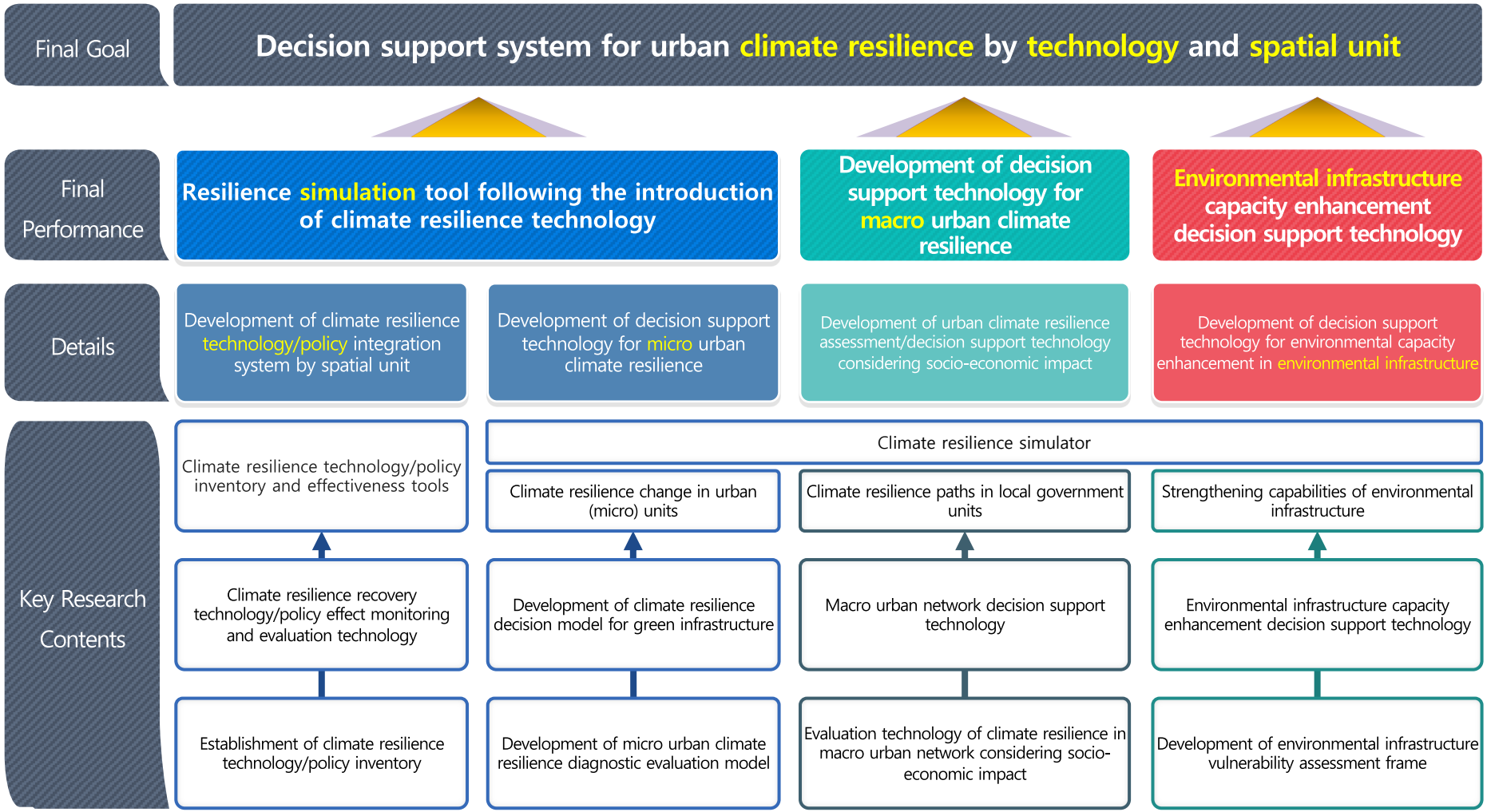
Project Outcome: Development of a decision support system that customizes integrated climate resilience improvement plans with diagnostic evaluations of the effectiveness and application of various technologies

- Monitoring and evaluation of climate resilience technology/policy effectiveness by spatial unit
- Assess macro scale urban network climate resilience that links to micro scale assessments
- Development of Urban Climate Resilience simulator

Project time: 2022.04 – 2028.12

Budget: ₩17,936,000,000 ($13.8M)

Project Objectives



Project Team and Work Packages

[Host Organzation **(SNU)**]

Establishment of technology/policy and effect DB for securing climate resilience

Urban and environmental infrastructure

- Construction and classification of technology/policy DB
- Integrated review of existing concepts (adaptation, green new deal, etc.) And systematization from the perspective of sdgs and climate resilience
- Discovery and suggestion of technologies/policies that have been identified for qualitative and quantitative efficiency and effectiveness
- Reports, literature / Corporate catalog
- Measurement and monitoring of short-term effects of technology
- Establishment of standardized technology/policy and effect inventory

[Host 1 **(PNU)**] [Host O. **(SNU)**] [Host 2 **(KU)**]

Climate resilience diagnostic evaluation and decision support

Proposal of 3 major cities by region considering damage from extreme climate and ability to adapt and evaluation and selection by the ministry of environment

Urban area

Macro	Micro
Evaluation/prediction methodology	Development methods
Typification of urban area	Threshold setting
Socioeconomic impact	Economic analysis
Technology/policy combination optimization	Technology placement optimization

Environmental infrastructure

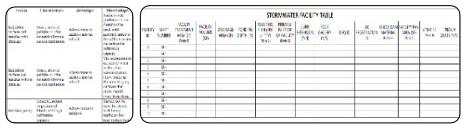
Water/waste resources/ecosystem

- Evaluation frame development
- Development of evaluation indicators
- Analyze the effect of policy/technology application
- Decision support

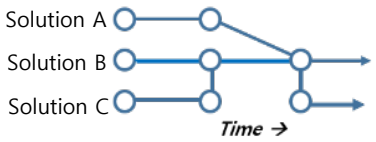
Applying climate and socioeconomic scenarios (RCP/SSP)

UI System

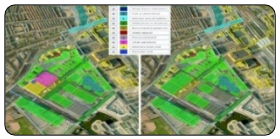
Securing climate resilience by spatial unit Technology/policy and effect inquiry



Climate resilience recovery path simulation tool considering climate change



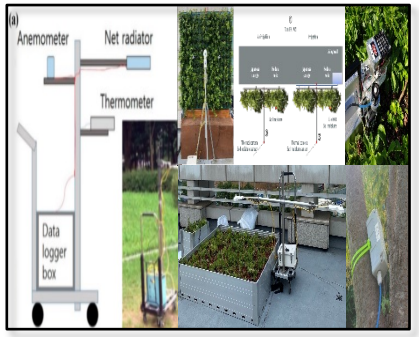
Resilience change simulation tool following the introduction of climate resilience technology



Integrated technology M&E system for climate change resilience

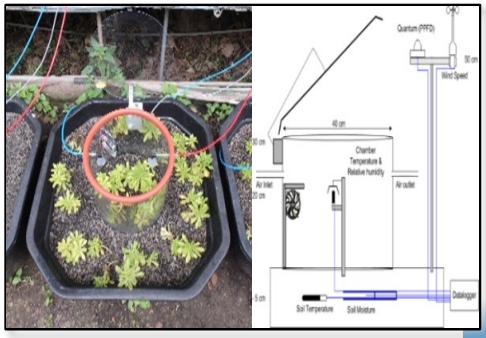
(1) Development of mid- to long-term technology evaluation/monitoring technology for policies and technologies to restore resilience to climate change, and enhancement of reliability of technology effectiveness

Monitoring of cooling effect of urban heat



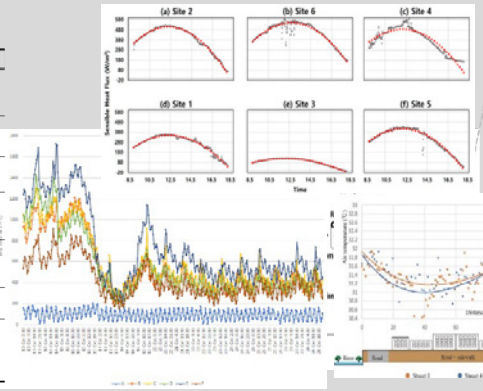
Monitoring the flood reduction effect of urban green areas

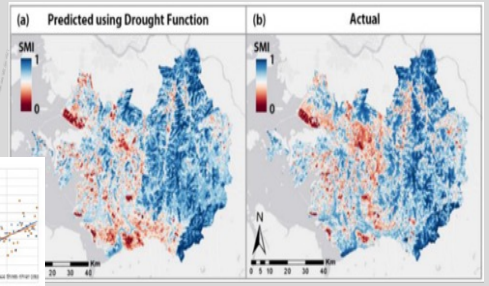
Reducing module Carbon flux monitoring



Development of monitoring technology for each classification technology and establishment of guidelines for securing climate resilience

제목	적용기술	규모 및 장소	측정방법	평가기준	정량적 효과	기술적용 공간	저자
폭염	자동개폐차양, 양산, 증발식냉각	미시규모 일본	측정	MRT, SET*	MRT 13°C, SET* 2.8°C 감소, 미스트스프레이: SET* 4.2 °C	수직적, 수평적	Takebayashi, H., et al. (2018)
	벽면녹화	미시규모 이란	풍력계,습도계 및 온도계 15분마다 기록	대기온도	최고 온도 저감: 7.6°C 평균 온도 저감: 1.76°C	수직적 벽면	Shafiee, E.,(2020)
	투수포장	체인스웨어 미국	Envi-met 모델링	온도, PMV	온도 저감 0.1 ~ 0.6	도시 수평적	Moretti, L.,(2021)
	옥상녹화	대학교 옥상, 이탈리아	0.254mm 티핑 버킷 우량계, 유량계, 압력 변환기, 시뮬레이션 모델	유출량 감소, 첨두 유량 감소, 첨두 유량 지연 시간, 유출 시작 시간	지하 유출수의 평균값 32.0% 22%~24% 유출량 감소	수평적	Palermo, S. A., et al., (2019)
폭우	가로녹화	중간 밀도 주거 집수지, 미국	0.25mm 티핑 버킷 우량계, 수중 압력 변환기, 도플러형 속도 센서	유출량, 감수길이, 첨두 유량	가로수케는피 제거시 우수 유출량 4% 증가 유출량 감소 나무당 6376L	수평적	Selbig, W. R., et al., (2022)
	옥상녹화	옥상, 영국	우량계, 압력 센서	Runoff Retention	연간 50.2%의 누적 유지율에 해당	도시 옥상	Stovin, V.,(2012)
	옥상녹화	디킨 대학교 Waurn Ponds(WP) 캠퍼스, 호주	Gis 모델링	Runoff Retention, 홍수 범위	옥상녹화는 총 집수 면적을 4044m²로 줄이고 최대 수심을 49.5cm에서 45.8cm로 줄임	도시 옥상	ChunLuLiu(2017)

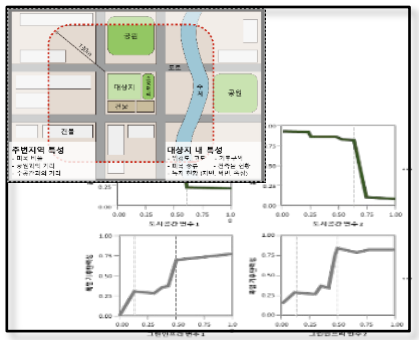




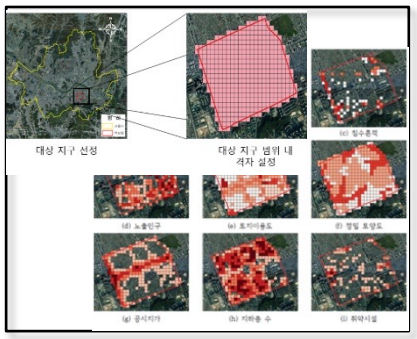
Urban Climate Resilience Simulator Development

(2) Spatial analysis of Urban Heat / Heavy Rain Thresholds and establishment of Micro-Macro Linkage Plan

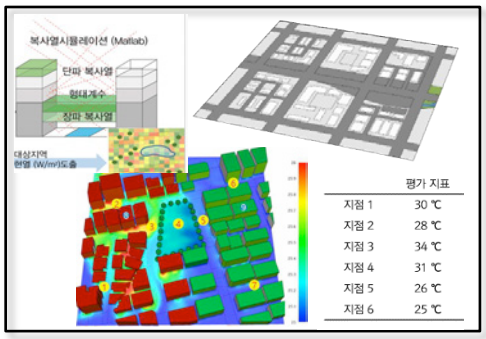
Deriving the Study Area Threshold



Establishment of Micro-Macro Linkage Plan

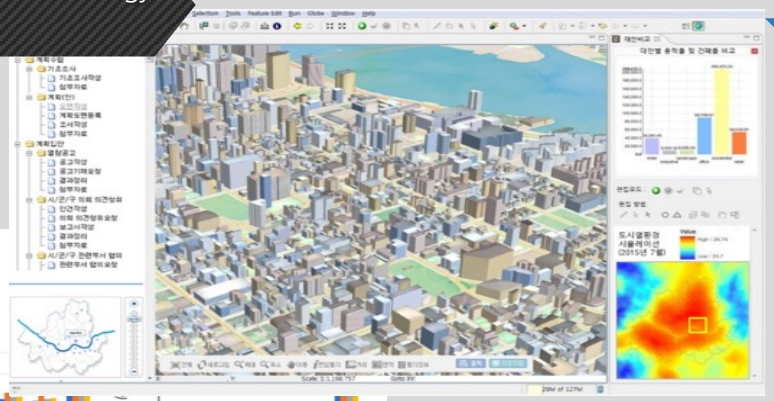


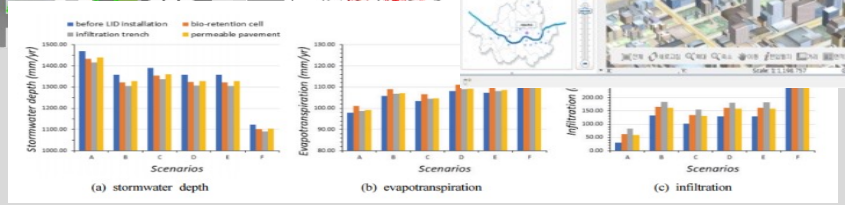
Urban Heat / Heavy Rain Simulator Development



Analysis of Changes in Threshold according to the Establishment of Technology and Policy for Securing Climate Resilience

	변경
지점 1	-3
지점 2	-6
지점 3	-2
지점 4	-4
지점 5	-1
지점 6	-3

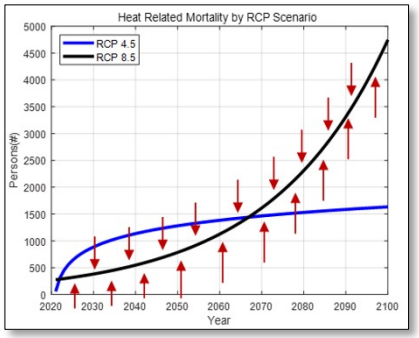




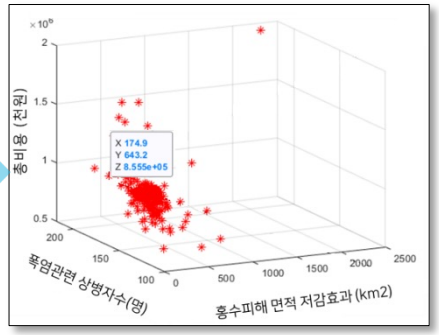
Urban Climate Resilience Simulator Functions

(3) Suggestion of climate resilience pathways for technology and adoption scale for each option within the budget set during each stage and planning period

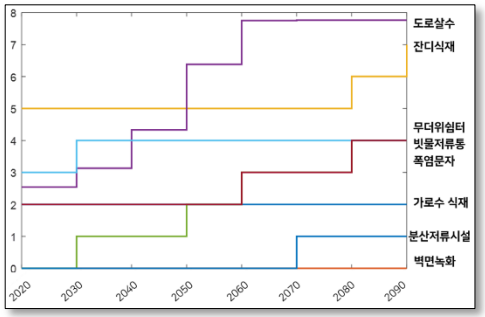
Evaluating the impact of technology adoption



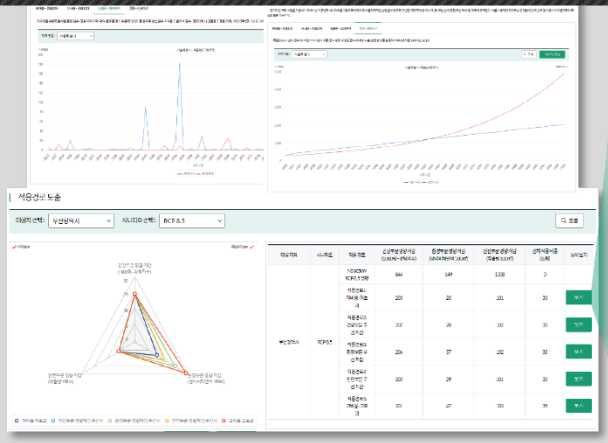
Climate Resilience Path Converging to Optimal

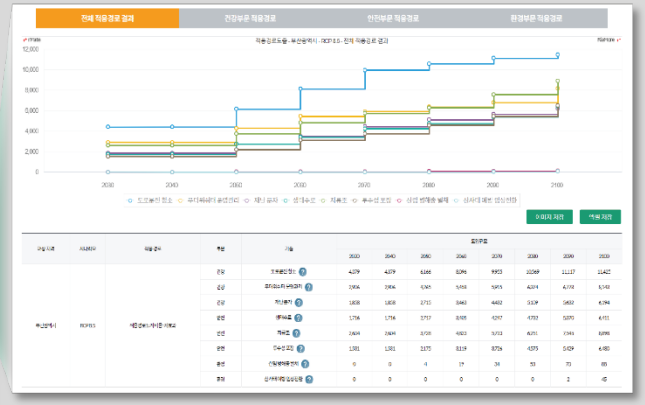


Scale of technology of the pathway over time



A system capable of presenting various cost/sector-specific efficiencies and different optimal adaptation paths

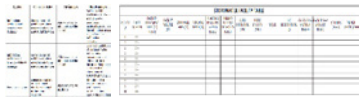




Urban Climate Resilience Simulator UI

[Function of UI system]

Technology/policy and effect inquiry to secure climate resilience by spatial unit



A technology for securing climate resilience and an effect inquiry system that can be introduced into the space desired by the user according to the space scale

Climate Resilience Recovery Path Simulation Tool Considering Climate Change

A technology for securing climate resilience and an effect inquiry system that can be introduced into the space desired by the user according to the space scale

Resilience simulation tool following the introduction of climate resilience technology

Providing a simulation tool to evaluate the change in resilience caused by the introduction of climate resilience technology

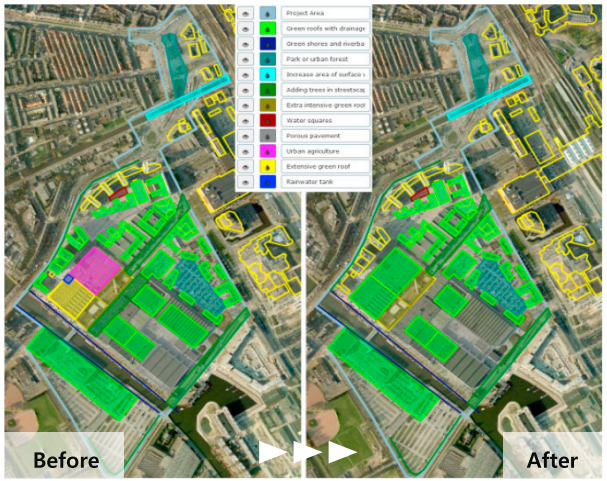
[Example of UI system]

Inquiry about technology/policy and effect for securing climate resilience by spatial unit

land use | space scale | Tech-nology | Policy

- Cool roof — resilience ability
- Green roof — resilience ability
- Green wall — resilience ability
- Street tree — resilience ability
- Thermal insula-tion packaging — resilience ability
- Smart irrigation system — resilience ability

Resilience change simulation tool
following the introduction of climate resilience technology



Climate resilience recovery path simulation tool
considering climate change

Selected Climate Resilience Technology

- (+) Cool roof
- (+) Green roof
- (+) Green wall
- ( ) Street tree
- ( ) Smart irrigation system

Effect of technology to secure climate resilience

- Total resilience capacity
- Thermal mitigation effect
- Water disaster mitigation effect
- Carbon storage capacity

Thank you