

Cases From East Asia: South Korea



Structure

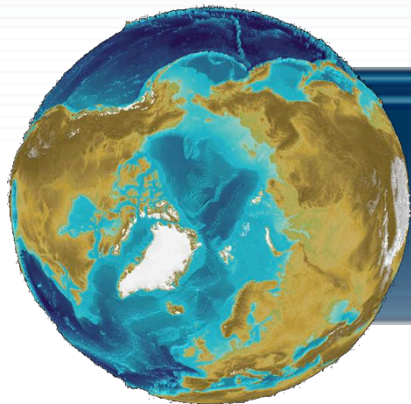
1 Introduction

2 Climate Change Adaptation

3 Water and Ecosystem Restoration

4 Conclusion 

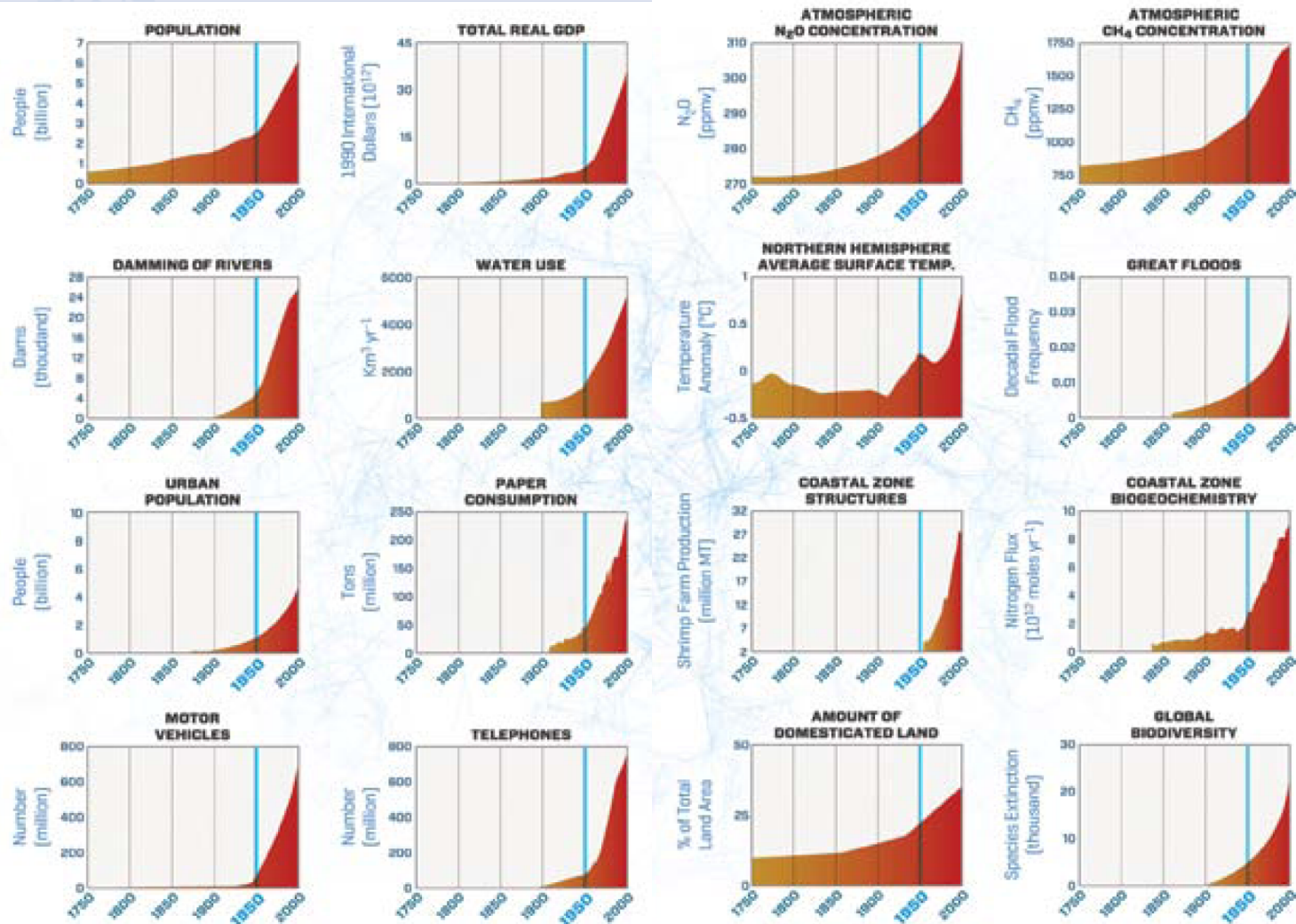




1. Introduction

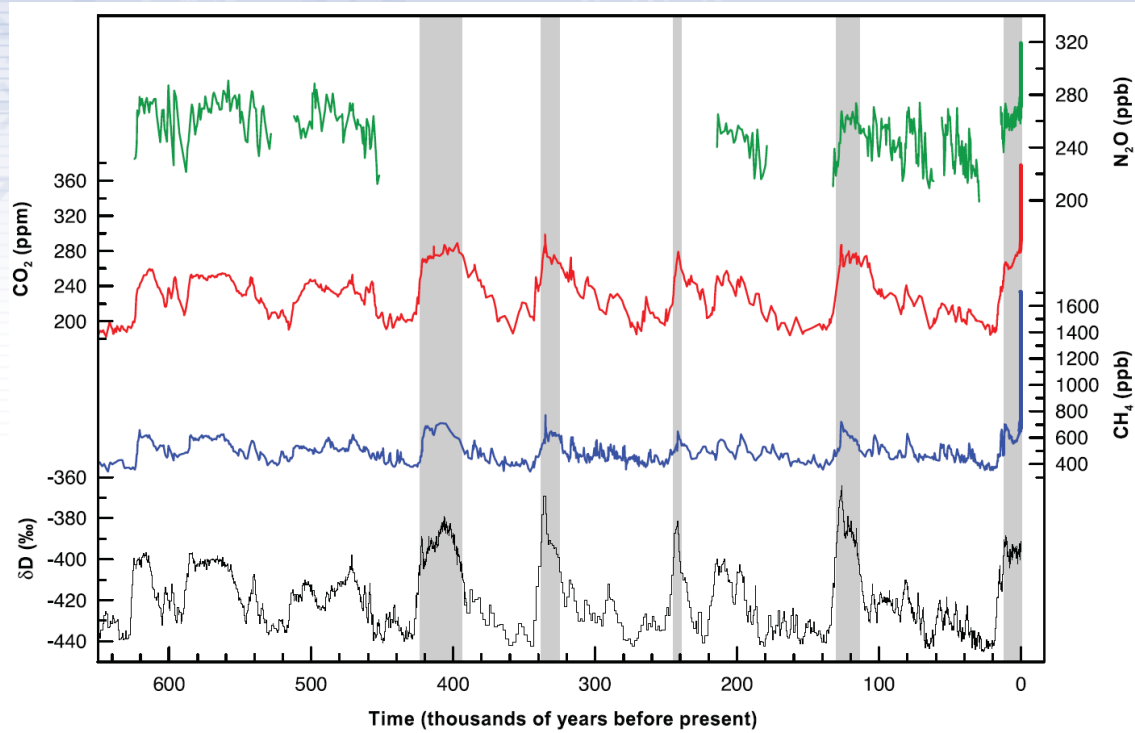


Great Acceleration

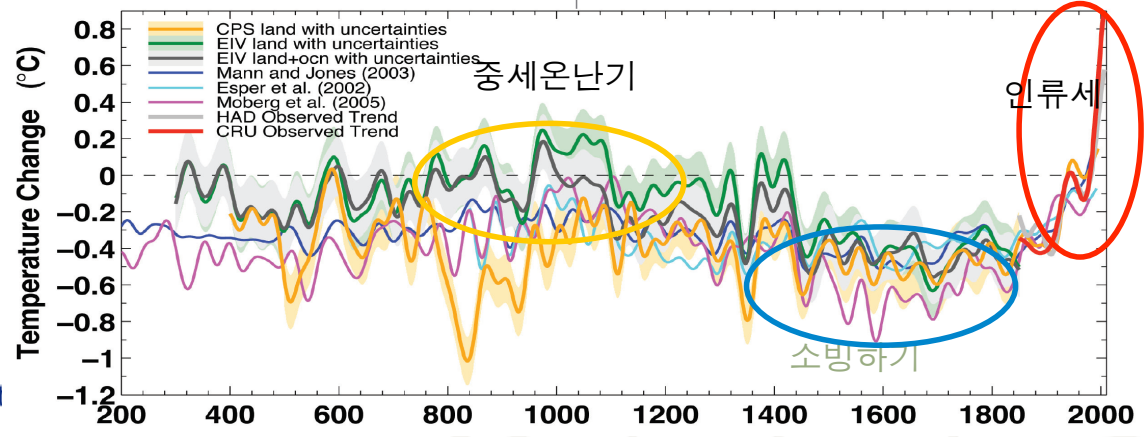




Into the Anthropocene



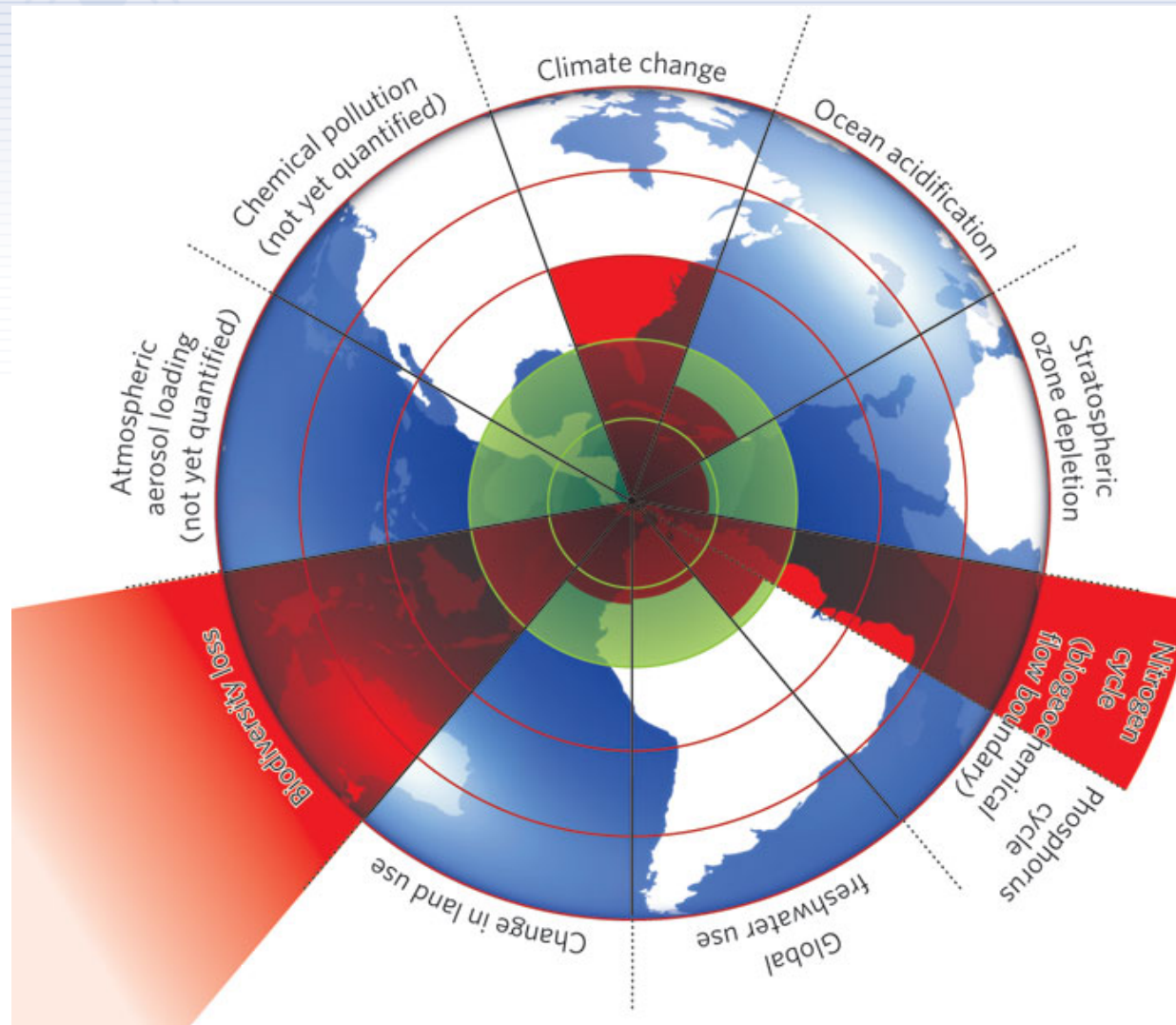
Glacial-Interglacial Ice Core Data
(IPCC, 2007)



Mann et al. (2008)



Endangered Planetary Boundaries

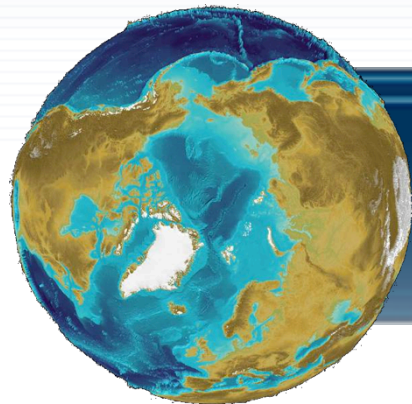


Rockstrom et al. (2009)



Korea Polar Research Institute

- Safe operating space for humanity.
- 3 boundaries have already been crossed.

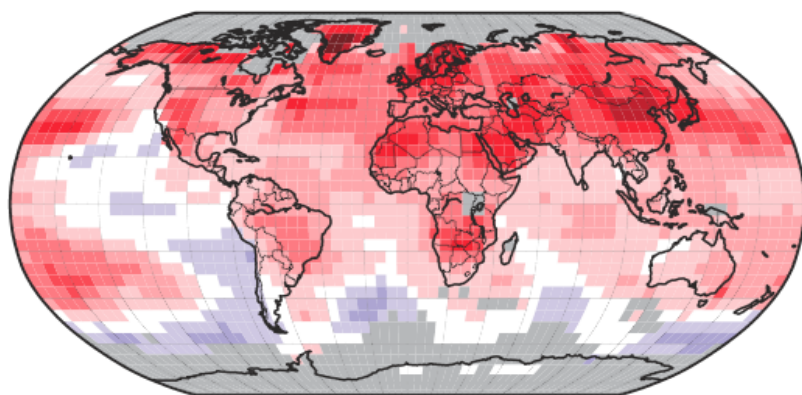


2. Climate Change Adaptation

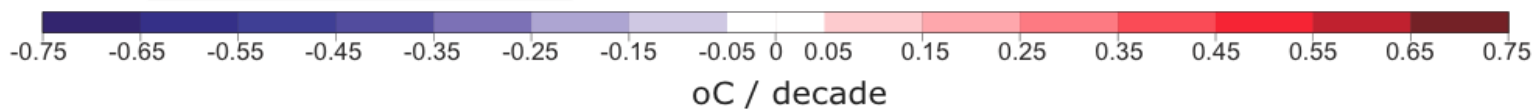
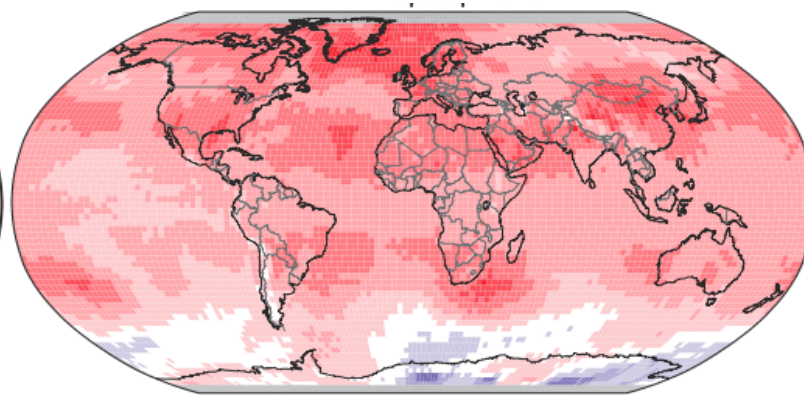


Global Warming

Surface



Above

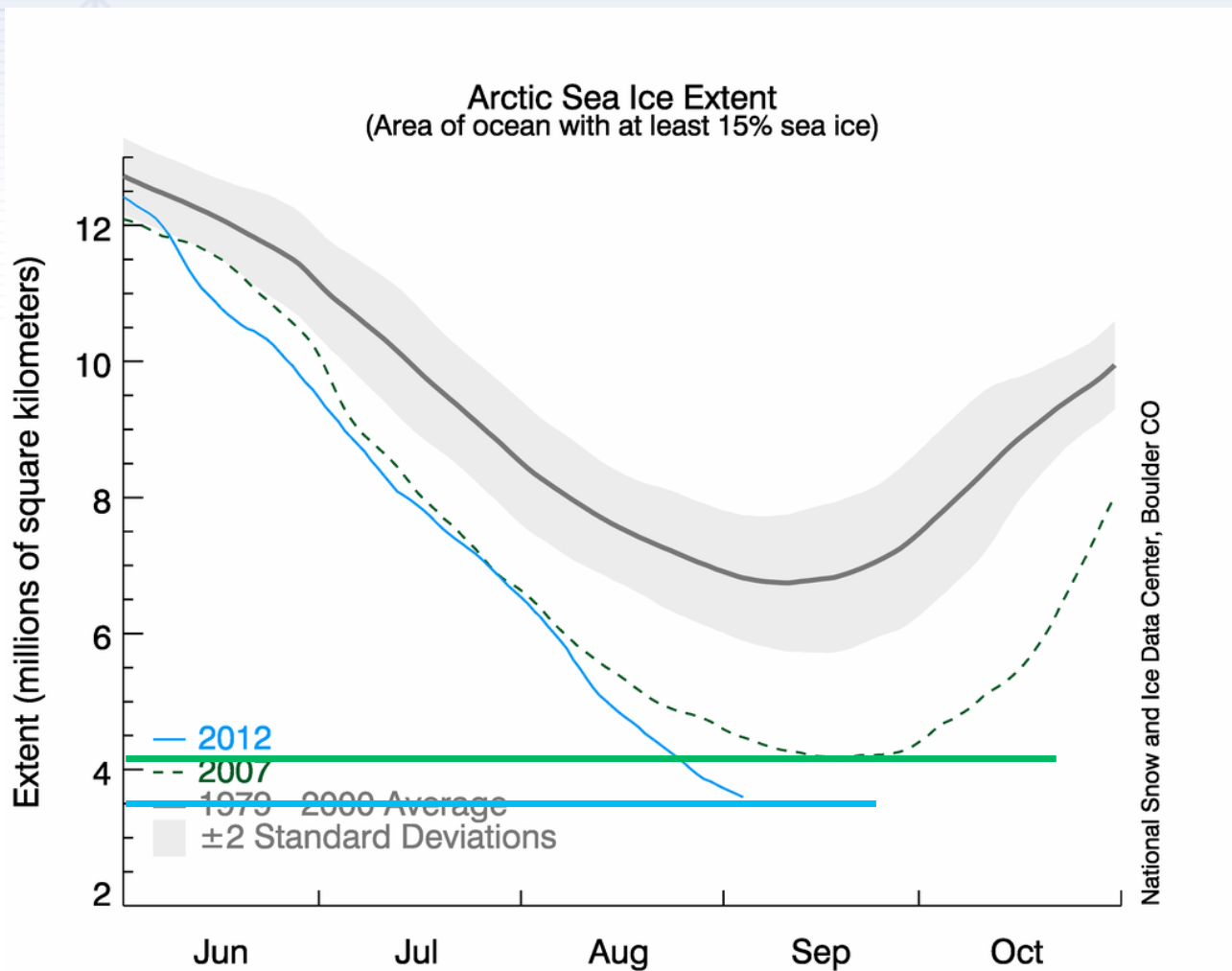


Global temperature trends from 1979 to 2005

IPCC (2007)



Rapid Arctic Sea Ice Melting

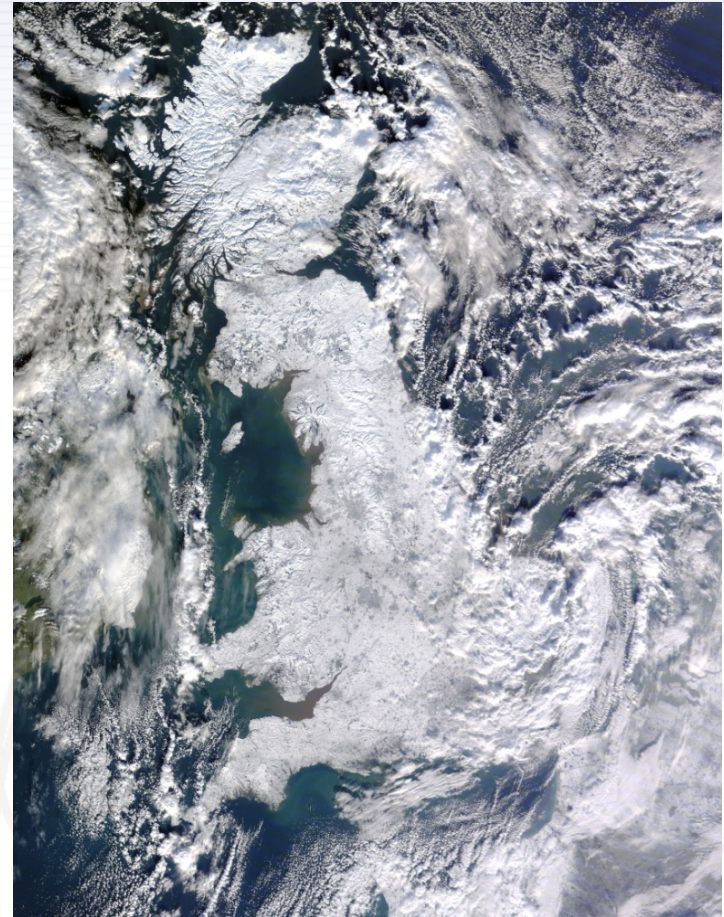




Northern Hemisphere Cold Surge



Virginia, USA



United Kingdom



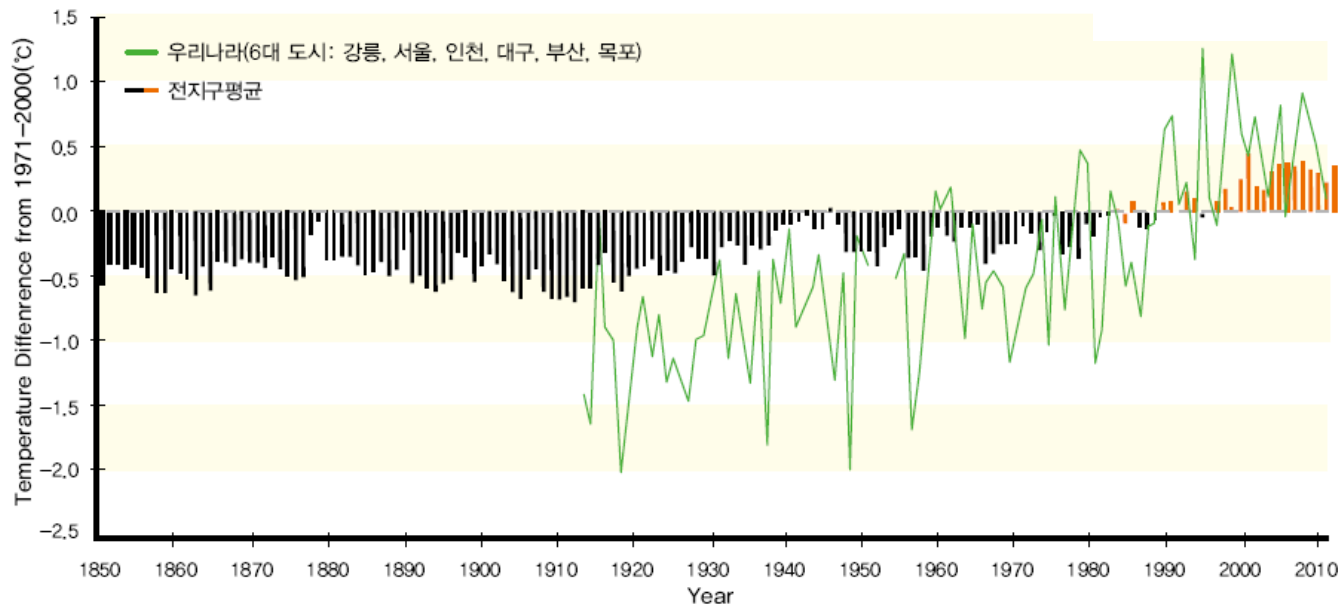
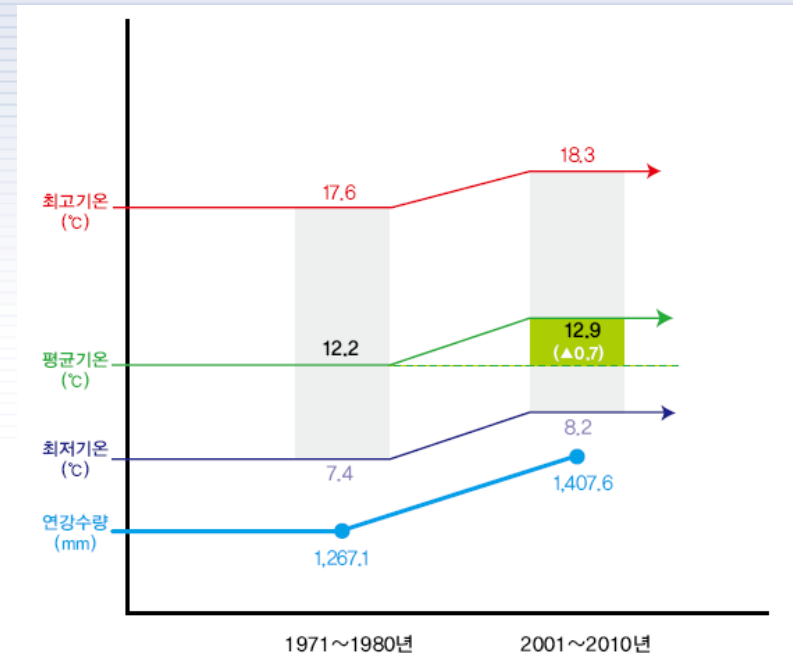
Seoul, Korea





Warming over Korea

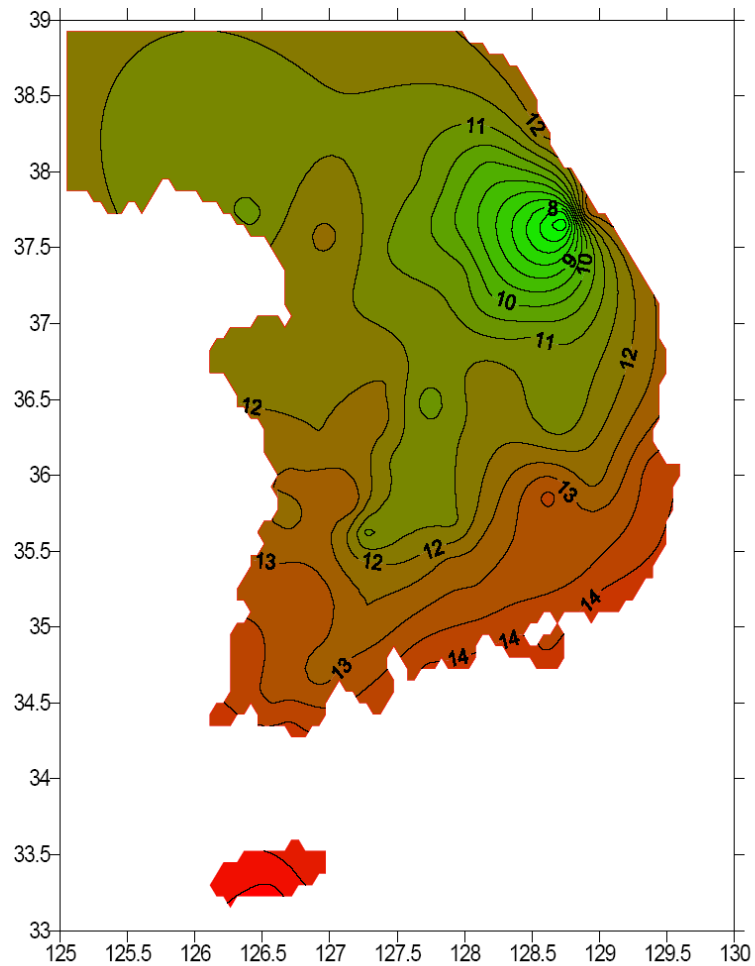
- 1.8 degC increase in SAT for the past 100 years over Korea
- This rate of SAT increase is twice the global mean warming, probably due to urban heat island effect



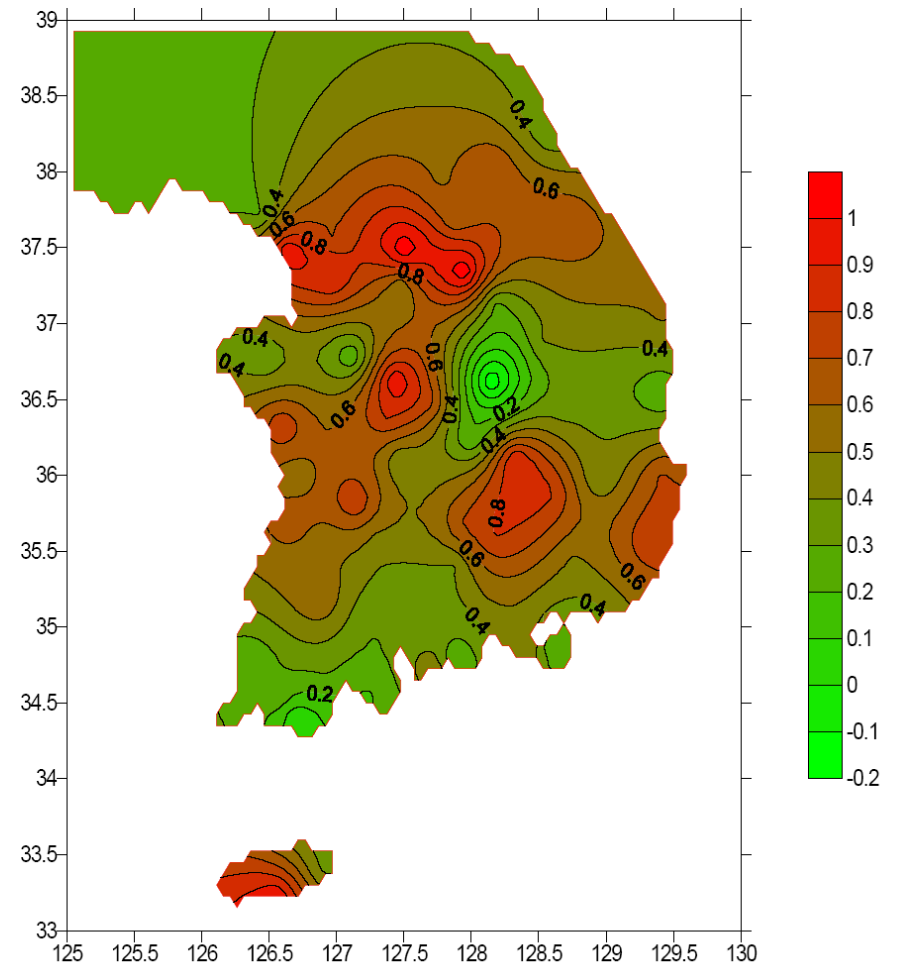


Annual-mean SAT change pattern

(a) 1971-2000



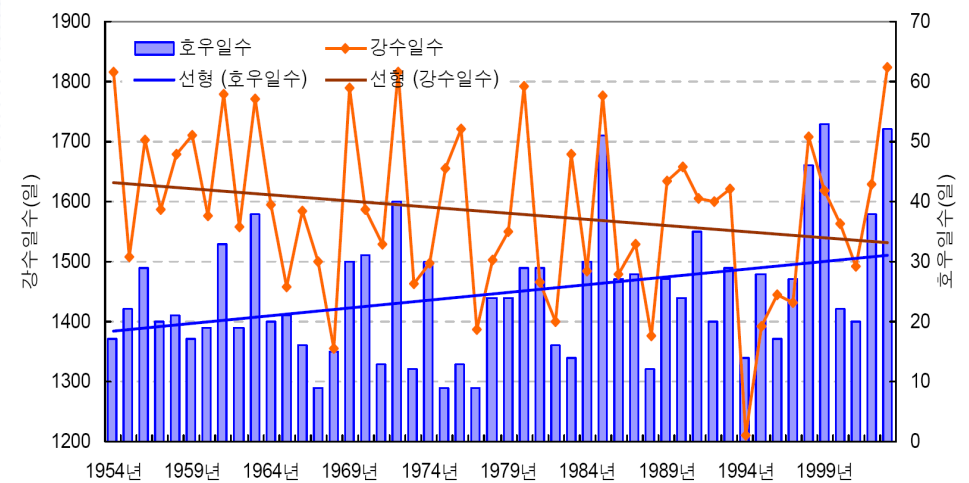
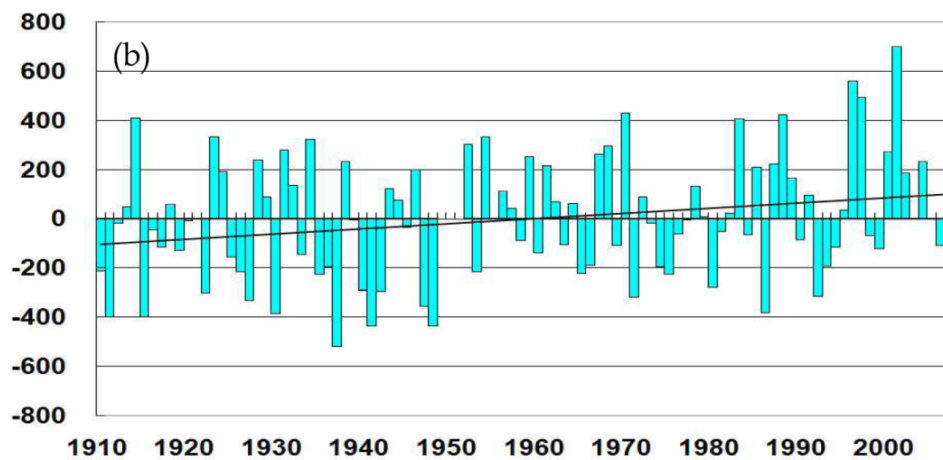
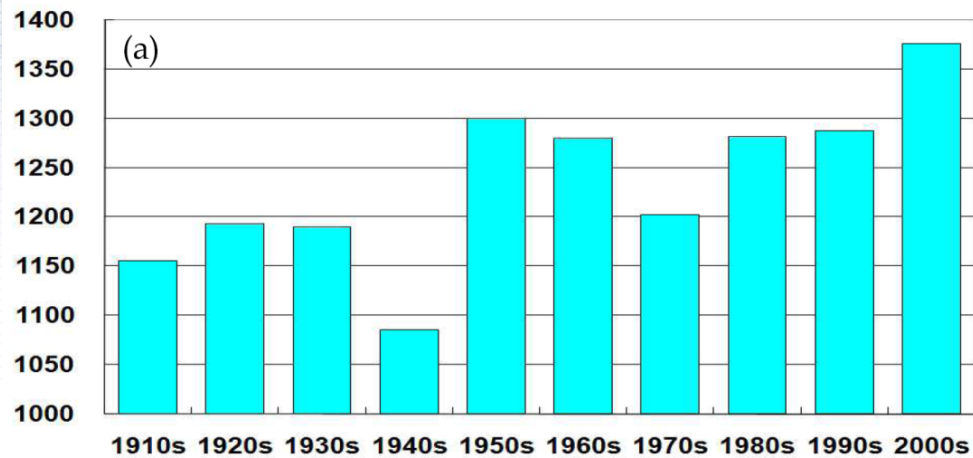
(b) (1999-2008)-(1971-2000)



KMA (2009)



Rainfall over Korea

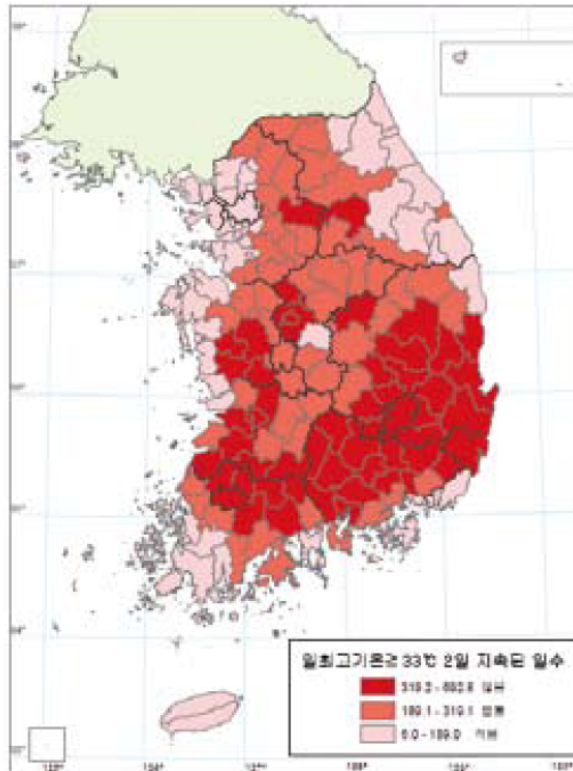


KMA (2004a)

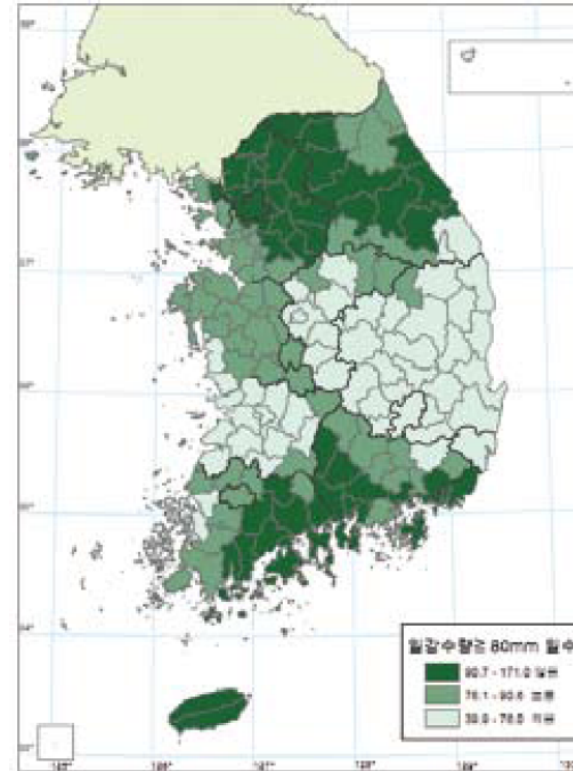


More Frequent Extreme Weather

연누적 폭염일수



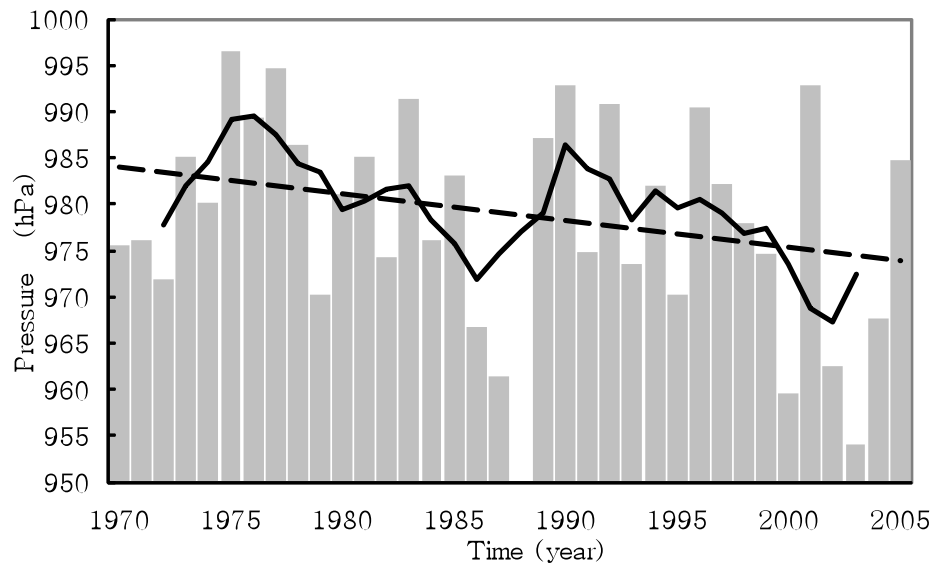
연누적 호우일수



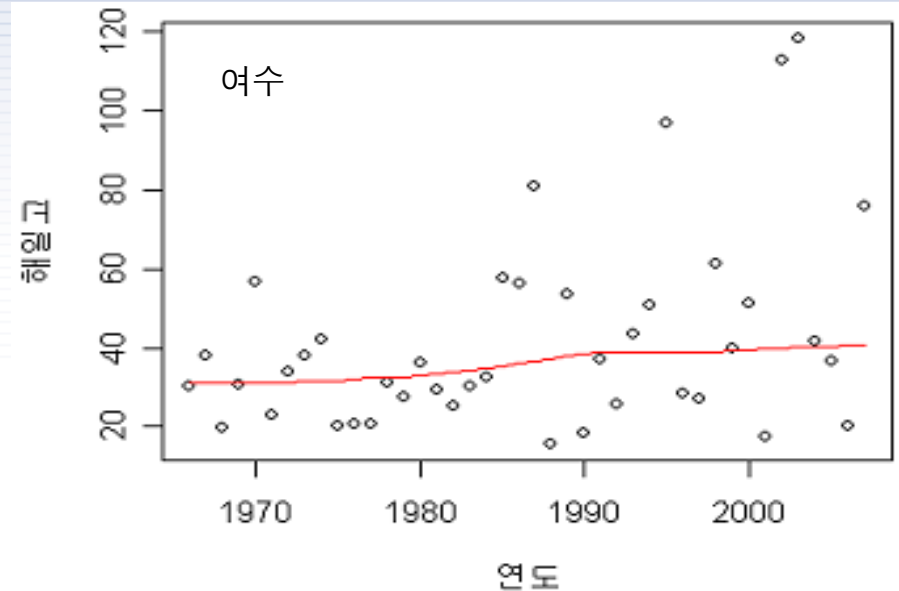
- Increase in days exceeding 33 degC
- Increase in number of days exceeding precipitation over 80mm



Typhoon and Storm Surge



Atmosphere pressure of typhoon

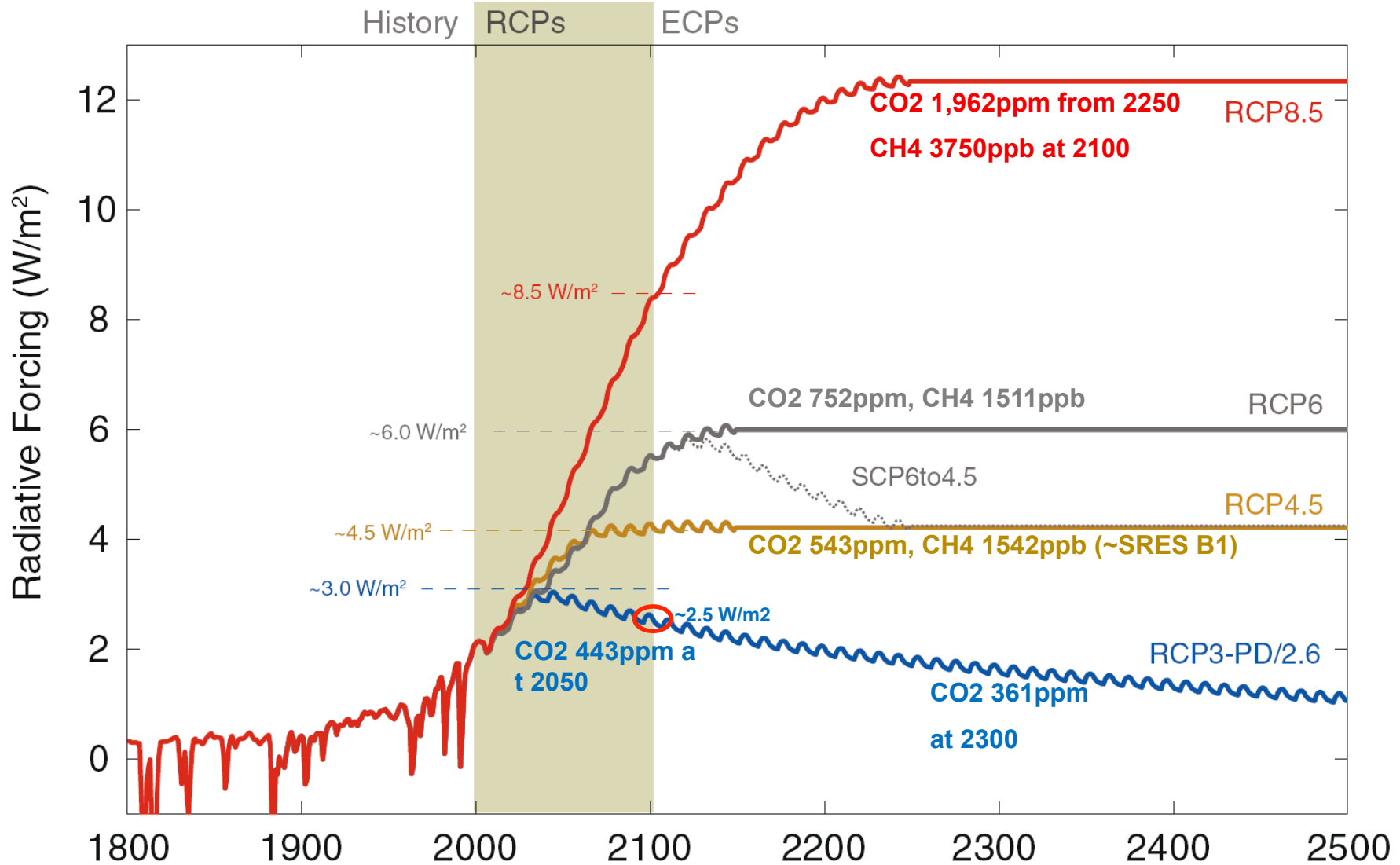


Wave height change

- Reduction of typhoon occurrences, but their intensities are stronger
- More frequent approaches along west coast of Korea

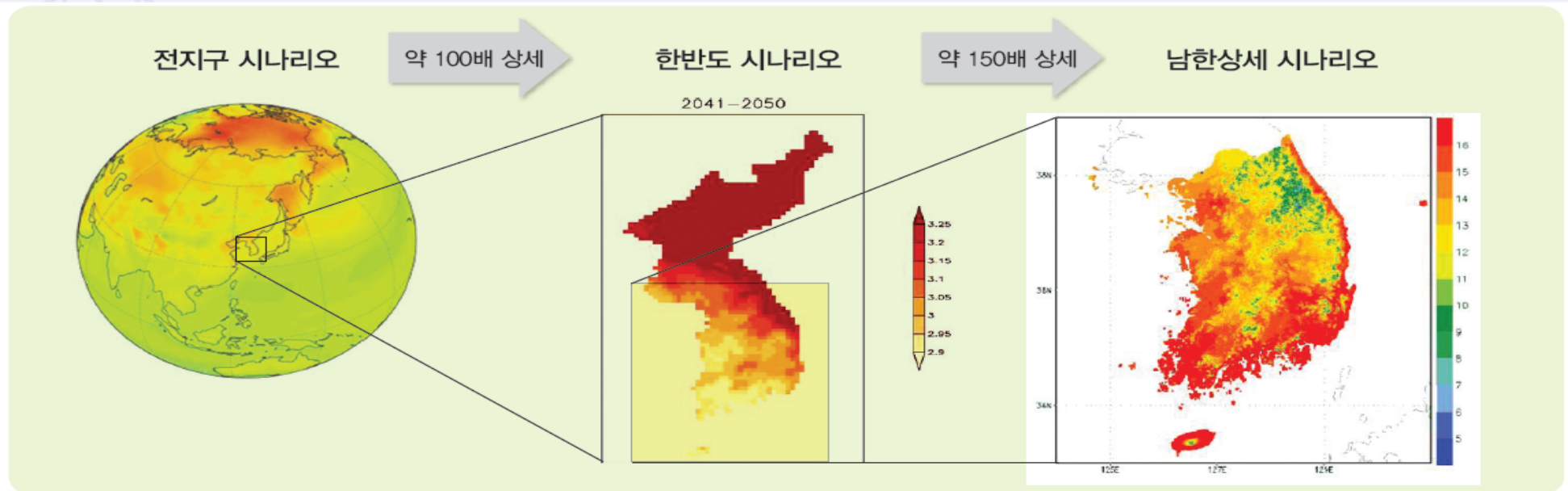


Radiative forcing for RCP





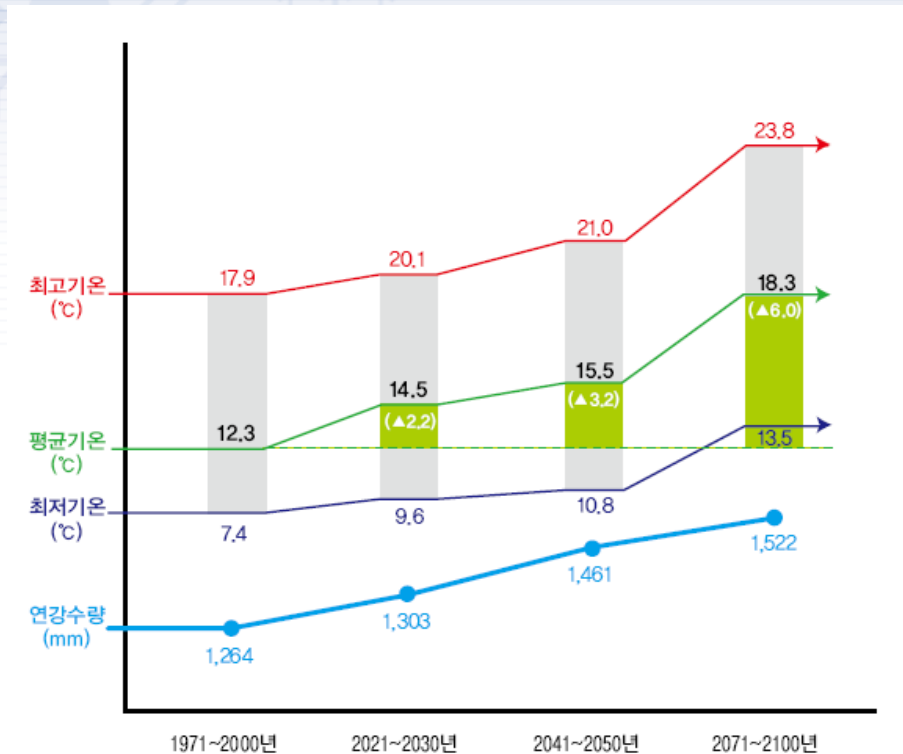
Climate Change Prediction



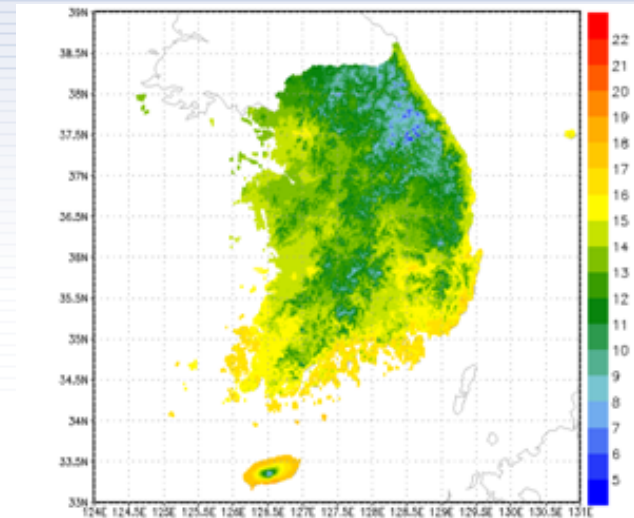
• Hadley Center UM model



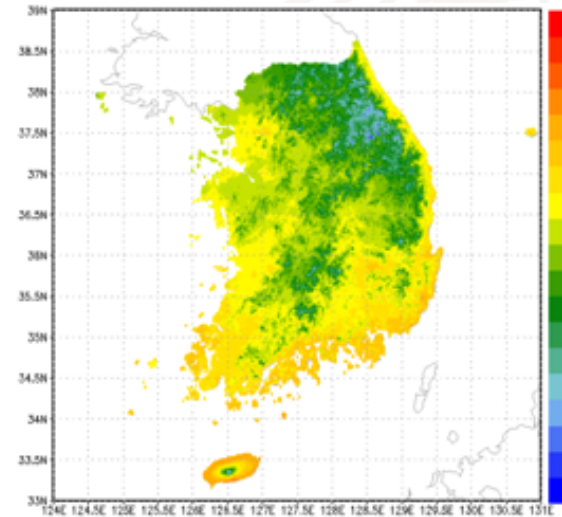
Climate Prediction over Korea



• By year 2050, the rate of SAT increase will be twice the change for the past 100 years (~3.2 degC)



SAT at 2050
RCP 4.5

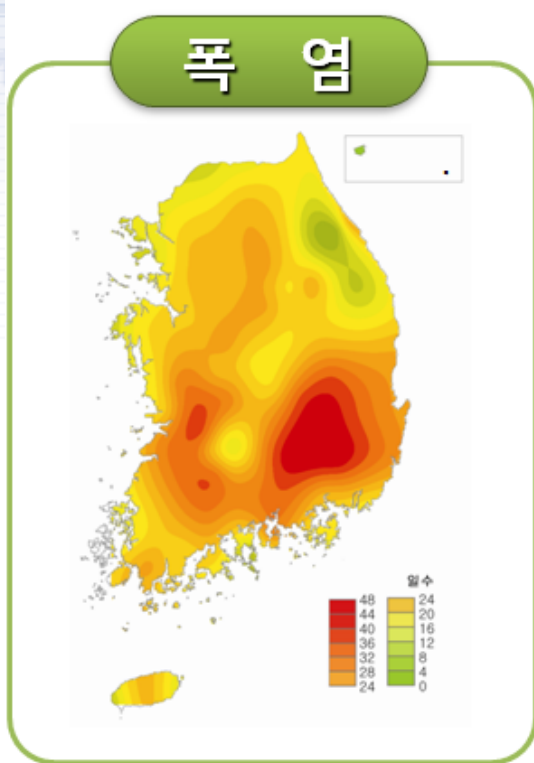


SAT at 2050
RCP 8.5



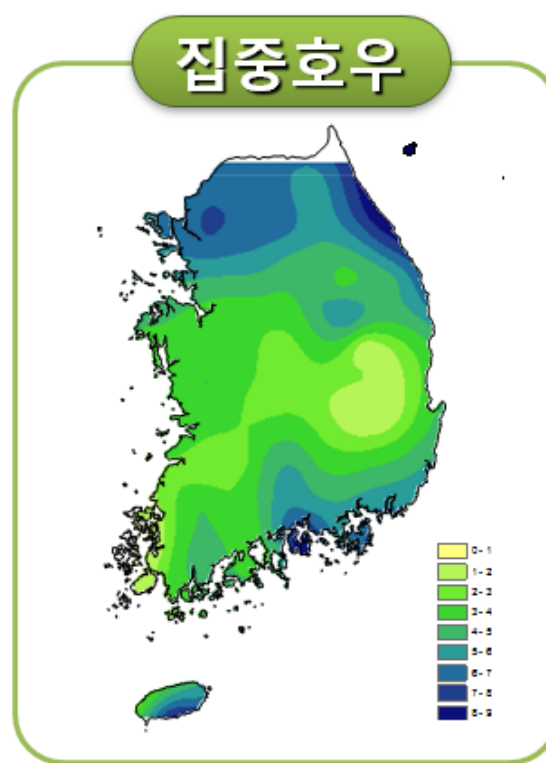
Climate Change at 2050

폭염

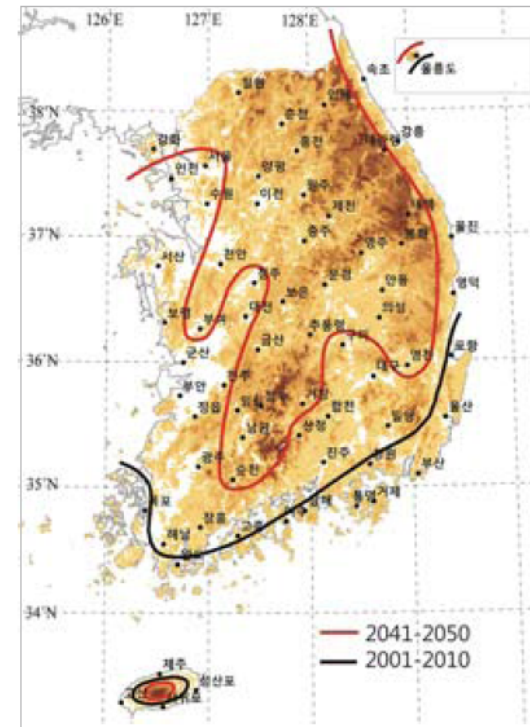


Heat Wave

집중호우



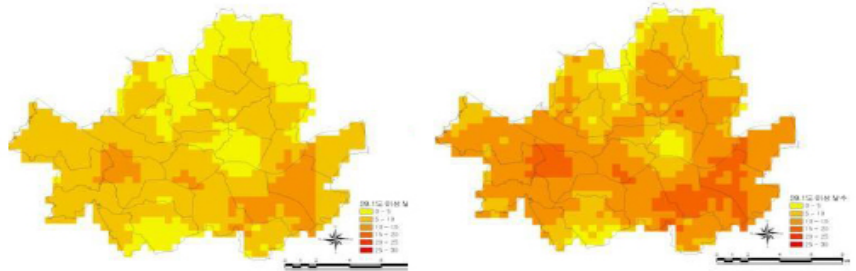
Heavy Rainfall



Climate Zonation

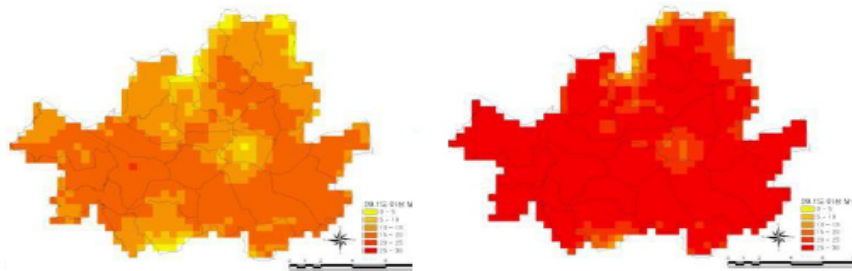


Climate Change Adaptation



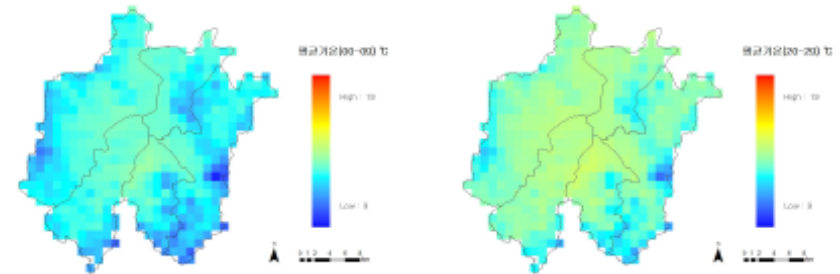
현재

2030년



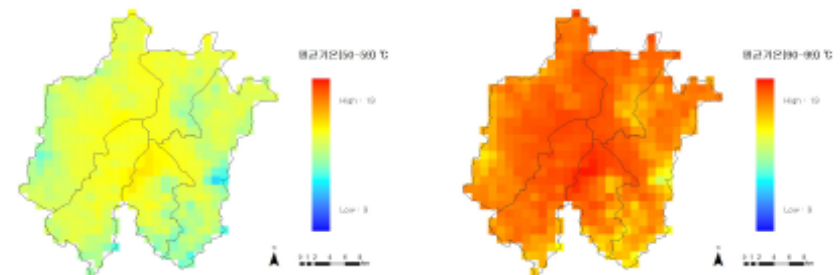
2050년

2090년



a) 현재 (2000년대)

b) 2020년대



c) 2050년대

d) 2090년대

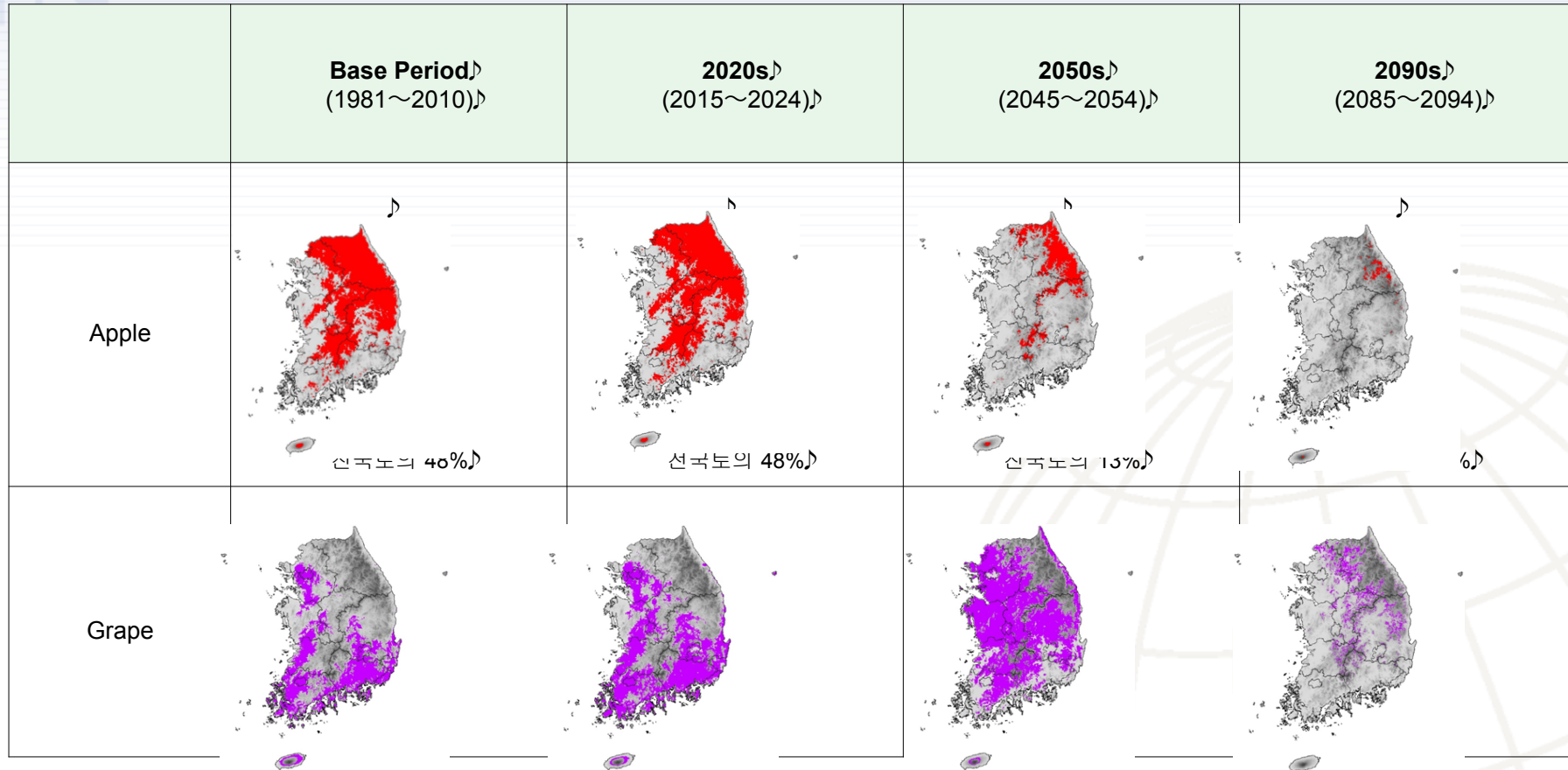
(그림 1-2-52) 기상청 RCP 8.5의 연대별 연평균 기온 전망

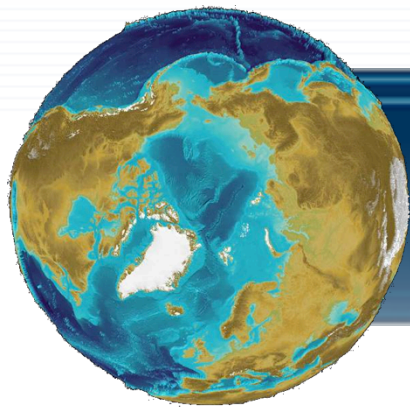
Future Heat Wave over Seoul

Future Rainfall over Daejeon



Projected Farming Areas

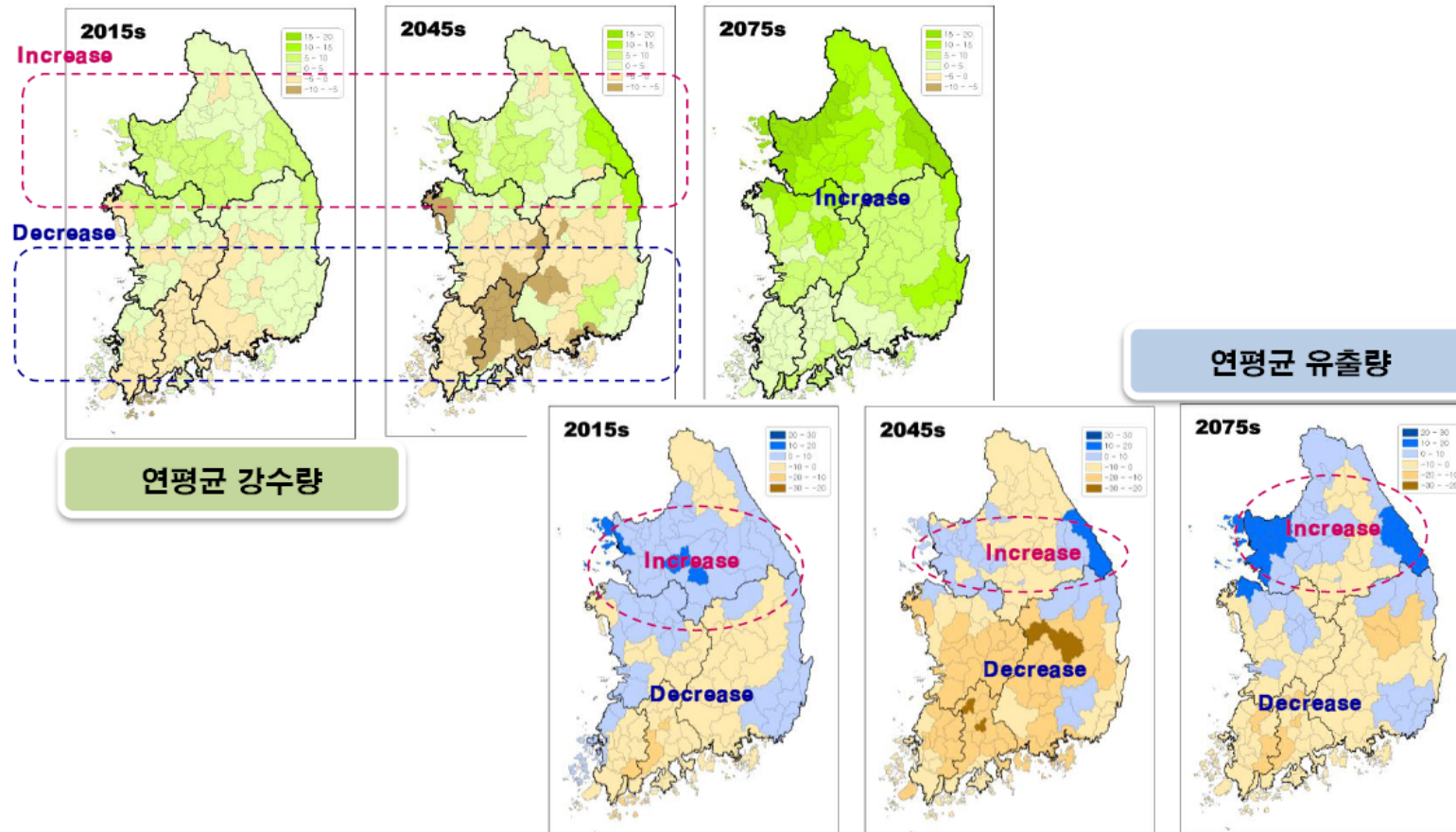




3. Water and Ecosystem Restoration



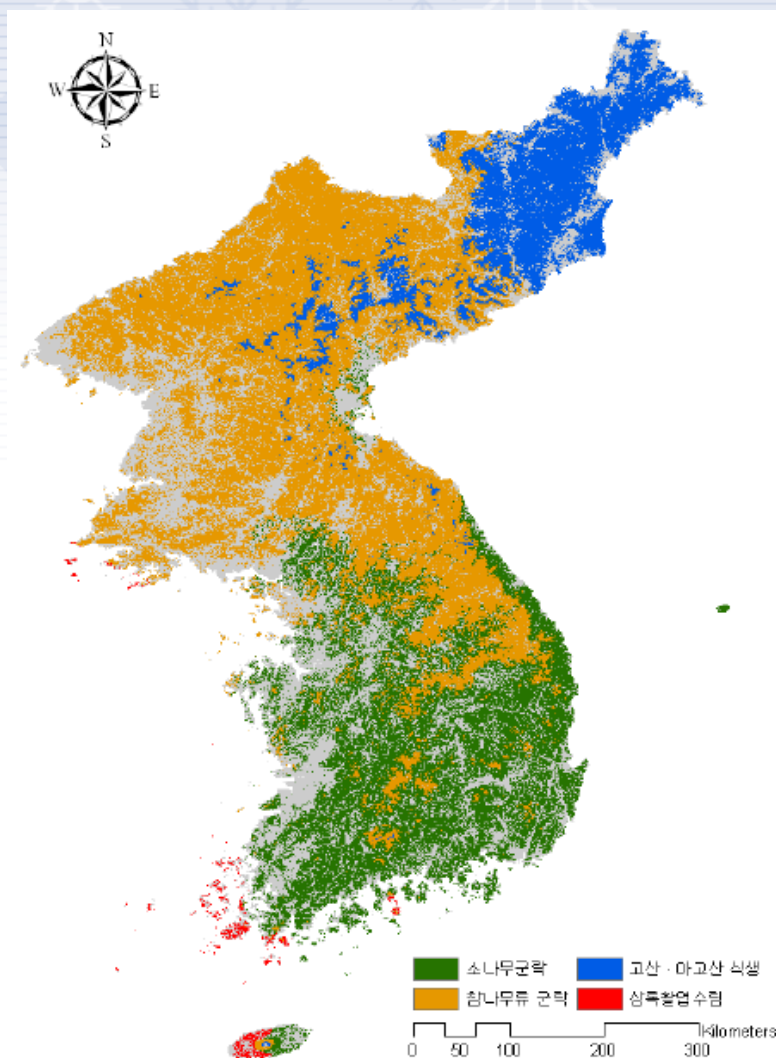
Water Storage



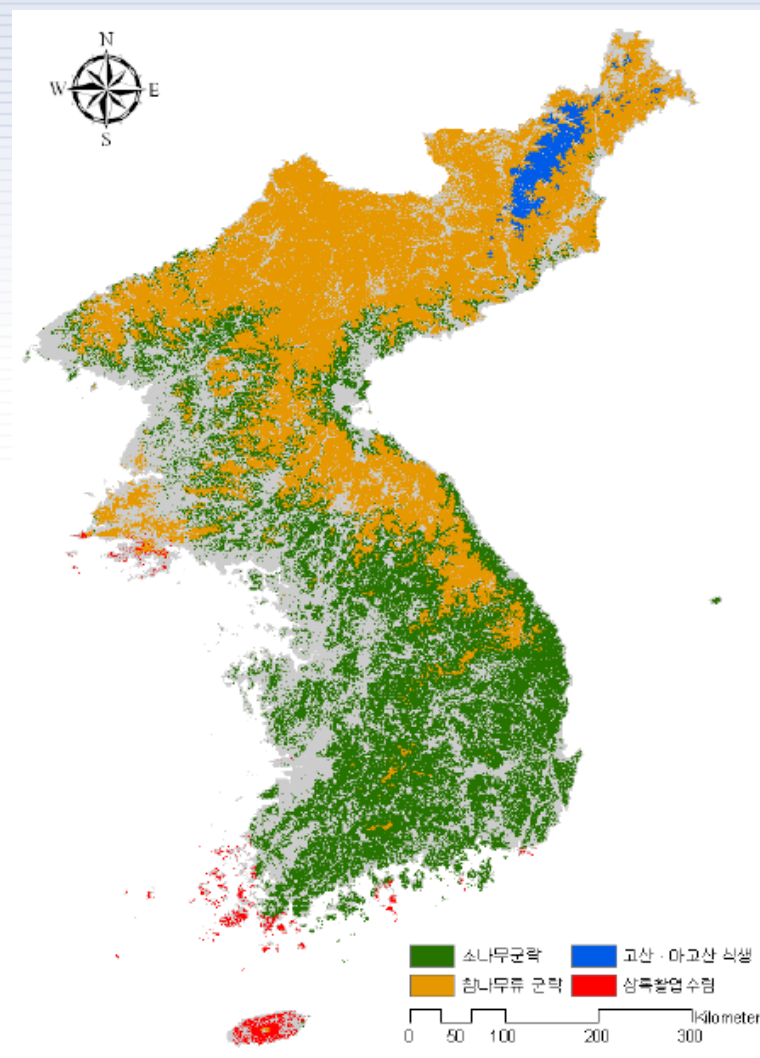
Bae et al. (2008) Potential changes in Korean water resources estimated by high-resolution climate simulation, Climate Research



Forestry and Vegetation



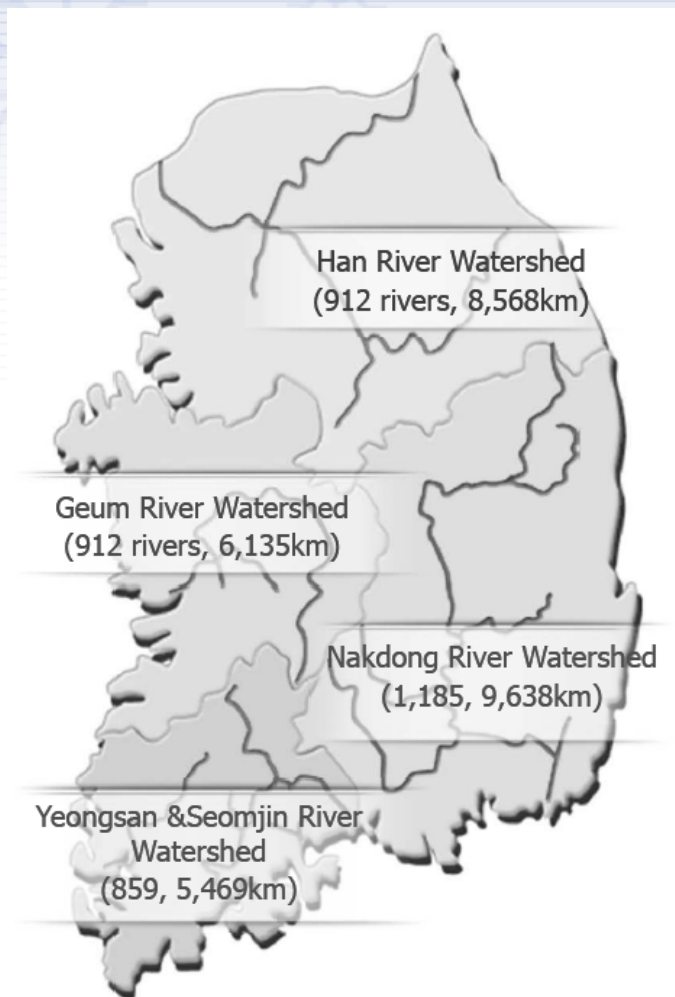
Present



2090



Major Rivers



- Sixty-one national rivers (total length 2,979km), 3,771 local rivers (26,831km) , and 22,414 small streams (34,705km)

Class	unit	Figures	Watershed			
			Han R.	Nakdong R.	Geum R.	Yeongsan & Seomjin R.
National R.	No.	61	18	17	17	9
	(km)	2,979	905	927	683	464
Local R.	No.	3,771	894	1,168	859	850
	(km)	26,831	7,663	8,711	5,452	5,005



National Aquatic Ecosystem

Monitoring Program

● Purpose

- ◆ To evaluate aquatic ecosystem (river) health
- ◆ To manage water environment comprehensively
- ◆ To provide basic information for river restoration and management

● Fields of monitoring

- ◆ Aquatic biota (diatoms, macroinvertebrates, fishes)
- ◆ Habitat-riparian condition
- ◆ Water chemistry

● **Period:** Biannually since 2007~

● **Monitoring sites :** 540 in 2007 → 960 in 2012 (nationwide)



Monitoring sites in Korea





Aquatic Ecosystem Health Assessment

Benthic diatoms

TDI

$TDI = 100 - [(WMS \cdot 25) - 25]$
 WMS: weighted mean sensitivity
 $WMS = \frac{\sum A_j \cdot S_j \cdot V_j}{\sum A_j \cdot V_j}$
 A_j: Relative abundance of j taxon (%)
 S_j: Sensitivity value of j taxon
 V_j: Indicator value of j taxon

Macroinvertebrate

BMI

$BMI = (4 - \sum S_i \cdot H_i \cdot G_i / \sum H_i \cdot G_i) \cdot 25$
 S_i: Saprobic value of i taxon
 H_i: Occurring frequency of i taxon
 G_i: Weighed indicator value of i taxon

Fish

FAI

Sum of 8 metric values
 Total no. number of ind.
 No. of benthic riffle-dwelling sp.
 No. pollution sensitive sp.
 % pollution tolerant sp.
 % omnivorous sp.
 % insectivorous sp.
 Total no. of endemic sp.
 No. of abnormal sp.

Habitat-riparia

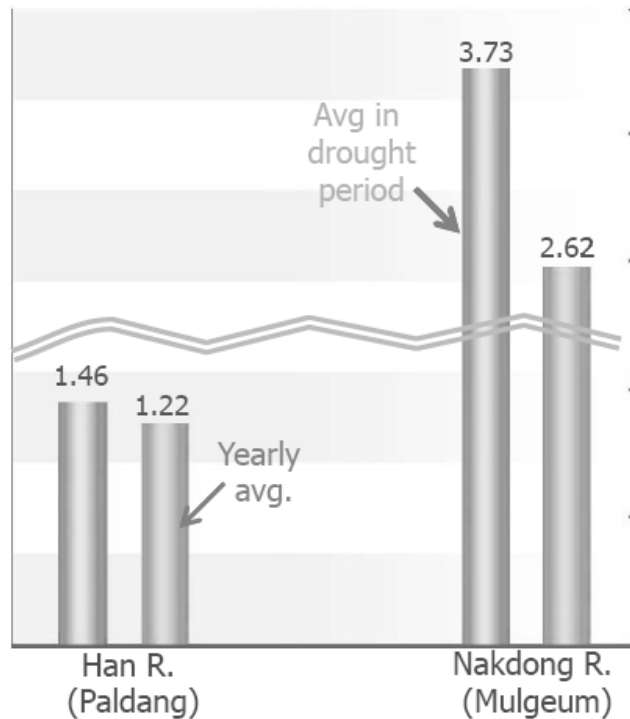
HRI

Sum of 10 metric values
 Naturality of sandbar
 Naturality of stream
 Diversity of flow
 Width of riparian zone
 Instream riverbank structure
 Material of riverbank
 Sediment condition
 Horizontal structure
 Instream land use
 Riparian land use

	Trophic Diatom Index (TDI)	Benthic Macroinvertebrate Index (BMI)	Fish Assessment Index (FAI)	Habitat Riparian Index (HRI)
Excellent (A)	60 ≤ ~ ≤ 100	80 ≤ ~ ≤ 100	87.5 ≤ ~ ≤ 100	75 < ~ ≤ 100
Good (B)	45 ≤ ~ < 60	60 ≤ ~ < 80	56.2 ≤ ~ < 87.5	50 < ~ ≤ 75
Fair (C)	30 ≤ ~ < 45	45 ≤ ~ < 60.1	25.0 ≤ ~ < 56.2	25 < ~ ≤ 50
Poor (D)	0 ≤ ~ < 30	0 ≤ ~ < 45.1	0 ≤ ~ < 25.0	0 ≤ ~ ≤ 25

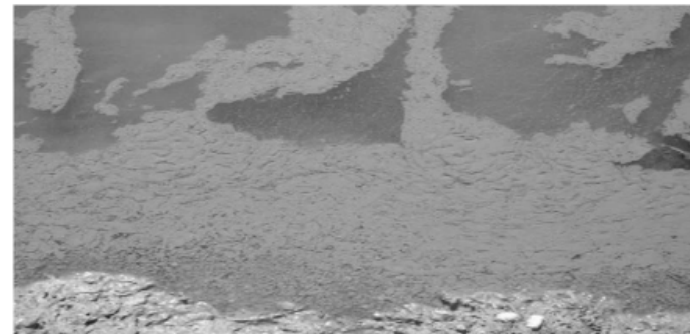
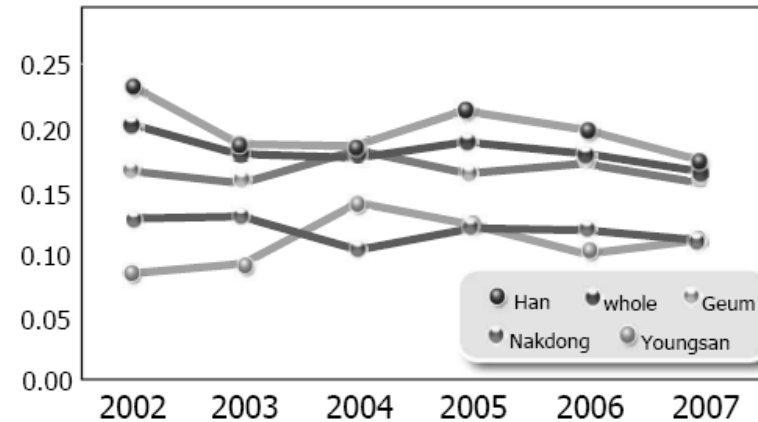


Water Quality



BOD (mg/L) (2005-2009)

TP (mg/L) changes in major rivers

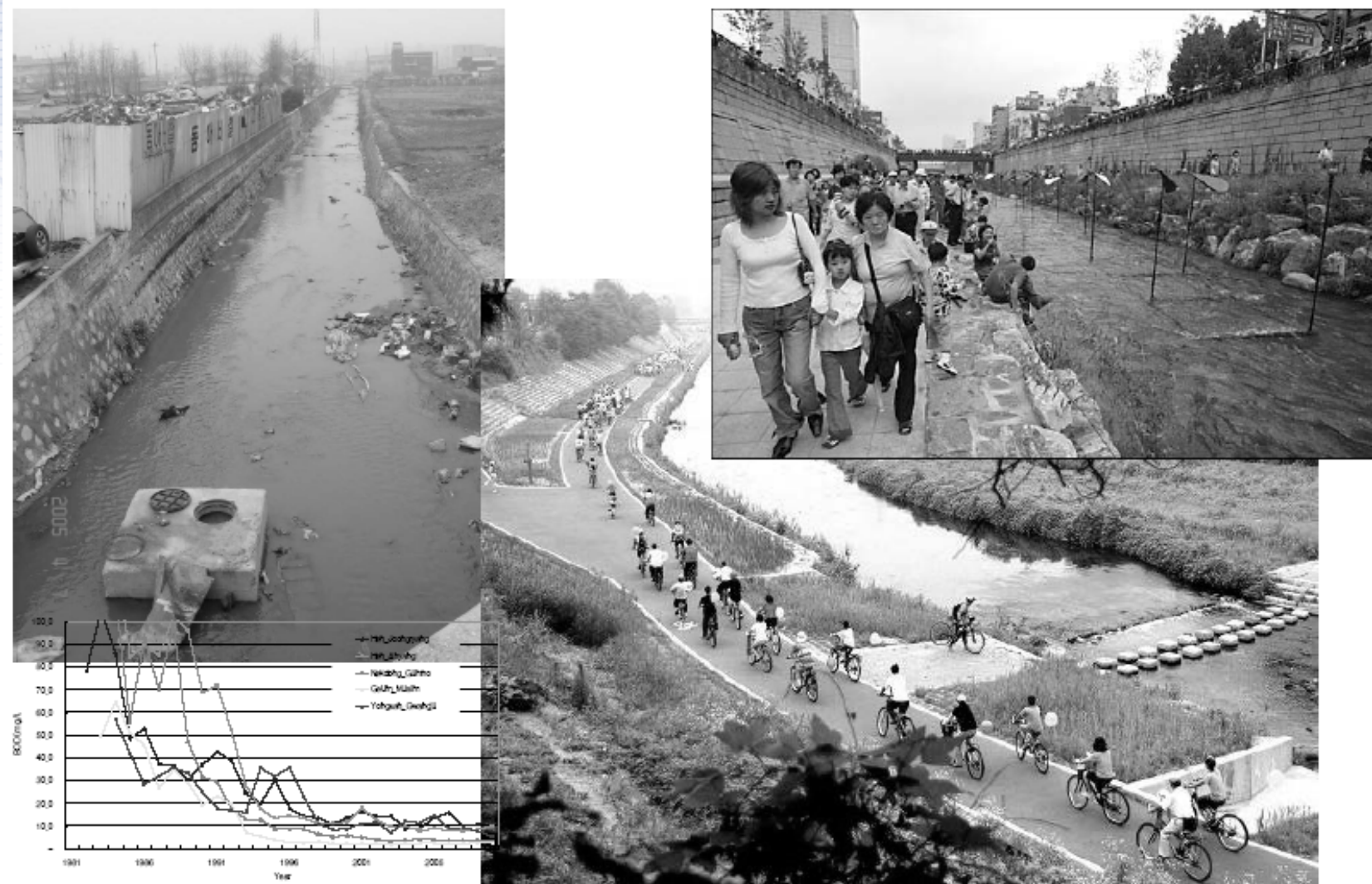


Algal bloom

- Generally good condition (BOD < 2mg/L) except for Nakdong River
- Continuous water quality deterioration with drought, high phosphate causes algal blooms



Urban Stream Restoration





Four River Restoration Project

The Four Rivers Restoration Project?

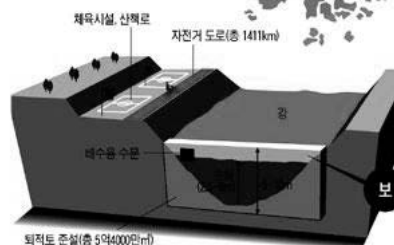
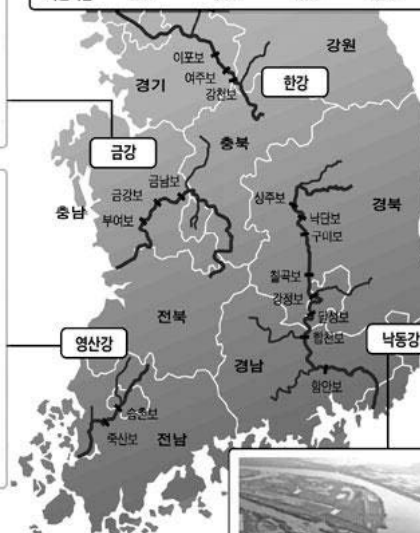
- building 16 weirs/2dams,
- dredging 570 million cubic meters of sand and gravel to deepen nearly 700 km of riverbed by 6 m on average,
- renovating two estuarine barrages,
- constructing bike trails(1700km), athletic fields, and parks along the waterways
- costing \$19billion
- carried out between Nov. 2009 and June 2012

restoration=renovation of natural rivers into manageable waterways?

4대강 살리기 개발 개념도



주요 사업 계획	한강	금강	영산강	낙동강
사업비	2조3000억원	2조4000억원	1조6000억원	7조6000억원
보 설치	3개	3개	2개	8개
저수지 확충	12개	31개	22개	31개
생태하천	178km	197km	89km	212km
자전거길	304km	248km	108km	539km



퇴적토 준설(총 5억4000만m³)



Why Restoration?

- **securing water quantity** (1.3 billion ton) and **quality** (level 2) against climate change -> **predictable control** of major rivers
- **beautification of rivers** -> improving the **utilitarian value** of rivers
- **boosting the regional economy** (generating \$35 billion in economic benefits) -> packed into the Green New Deal for Green Growth



From Controversy to Conflict

Pro	Con
a totally different project from Grand Waterway	the Grand Waterway resurrected
fixing a natural imbalance	unnecessary tinkering with nature
river restoration	river killing
an essentially green project	wrapping the project in a green mantle
a new concept of river management	a typical river engineering scheme

civil engineering bureaucrats vs. liberal academics



business groups vs. religious groups





Before

After





Riverwalk Tourism

Creating a new waterfront space with ecotourism and preventing development thoughtless for the environment



Buyeo Ecological Park Project

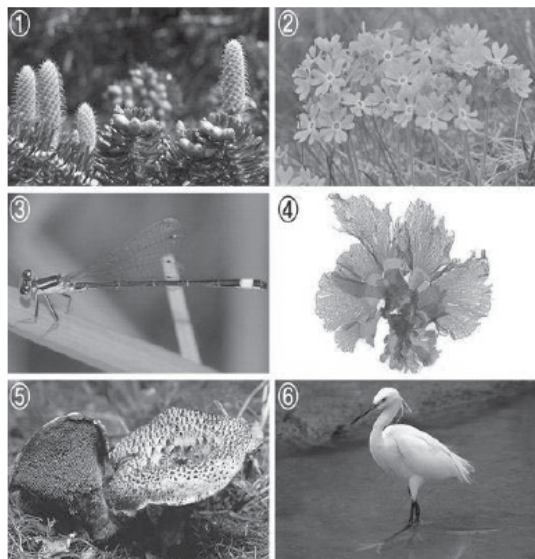
Sort	Contents
Period	2013 ~ 2022
Area	Buyeo district Guem River banks 1km, Reach 43.8km
Objects	3 zones (Preservation, Restoration, Experience), 24 projects
Budget	\$44 million
Riverside ecosystem	Providing recreation area by creating riverside forest Attracting tourists by building grassland community

Buyeo Ecological Park Project



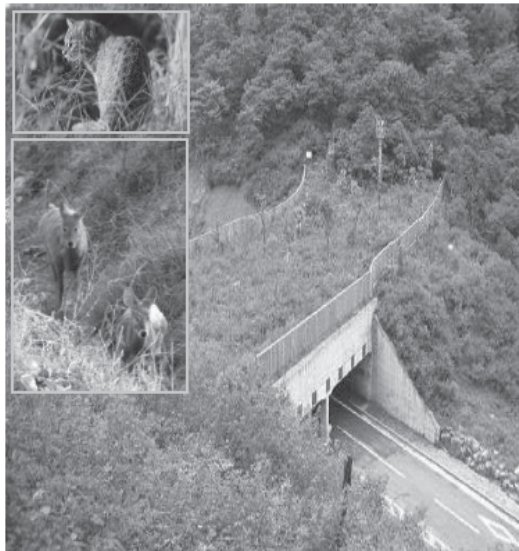
Ecosystem Monitoring and Restoration

- ecosystem and species monitoring and vulnerability assessment



▲ Climate-sensitive Biological Indicator Species 100

- Plant species and genetic resources conservation, restoration and advancement of ecosystem network project



▲ Guryongryeong Eco-corridor(Eco Journal, 2008)

- Damage prevention and management plan for alien species and unexpected outbreaks



▲ National Alien Species Integrated Management Plan (Bang et al., 2004)



Upo (Swamp) Ecological Park

Changnyeong-gun, Gyeongsangnam-do



- 1930~1940, a dam was built to reserve water for rice
- 1970, government tried to make it land
- 1990, waste dumping place was built, but stopped
- After the swamp was registered in the Ramsar convention, swamp was restored



Green Growth Policy

- (1) effective mitigation of greenhouse gas emissions**
- (2) reduction of the use of fossil fuels and the enhancement of energy independence**
- (3) strengthening the capacity to adapt to climate change**
- (4) development of green technologies**
- (5) “greening” of existing industries and promotion of green industries**
- (6) advancement of industrial structure**
- (7) engineering a structural basis for the green economy**
- (8) greening the land, water and building the green transportation infrastructure**
- (9) bringing green revolution into our daily lives**
- (10) becoming a role-model for the international community as a green growth leader**



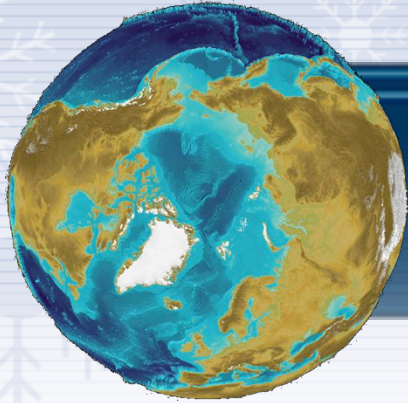
Some Achievements

- ◆ **Climate Change Adaptation Capacity Building:** National climate change adaptation center open, provincial level policy development, 4 river restoration project, water security policy, climate prediction accuracy improvement based on new scenarios
- ◆ **Environment-friendly Society:** National ecosystem road, ecological integrity restoration through river water quality improvement, urban atmosphere and water quality improvement
- ◆ **Green Architecture and Transportation:** Change from highways to express train
- ◆ **Green Life:** Green education, waste treatment, green card, eco-friendly car, green product, bicycle travel, etc.



Some Achievements

- ◆ **GCF (Green Climate Fund) Office Open:** to support mitigation and adaptation
- ◆ **GGGI (Global Green Growth Institute) Open:** 2012.10.23
- ◆ **International Network Buildup:** Korea-Denmark green growth partnership agreement (2011, 2), GGG Summit (Seoul), GGG Forum (Denmark)
- ◆ **Enlarge ODA Fund:** East Asia Climate Partnership project (2 billion USD), ODA to be increased by 30% with more than 5 billion USD



4. Conclusion

- ◆ Rapid climate change and its impact on disastrous weather is more common these days
- ◆ Regional climate prediction and adaption efforts are prime concern in Korea
- ◆ Diagnoses of environment problem in many regards are under way in academy and research institutes in a scattered manner
- ◆ Government drives green growth policy, which covers from environment restoration to green technology development
- ◆ An integration of these efforts through the future earth program is desirable under the umbrella of Future Earth

An aerial photograph of a fjord in a mountainous region. The water is a deep blue-grey color. The surrounding mountains are covered in patches of snow and ice. In the foreground, a small settlement with several red buildings is visible on a narrow peninsula. The sky is overcast and grey.

Thanks for your attention.

감사합니다.