Networking of Observations for Detecting and Adapting to Global Warming: A Korean Perspective

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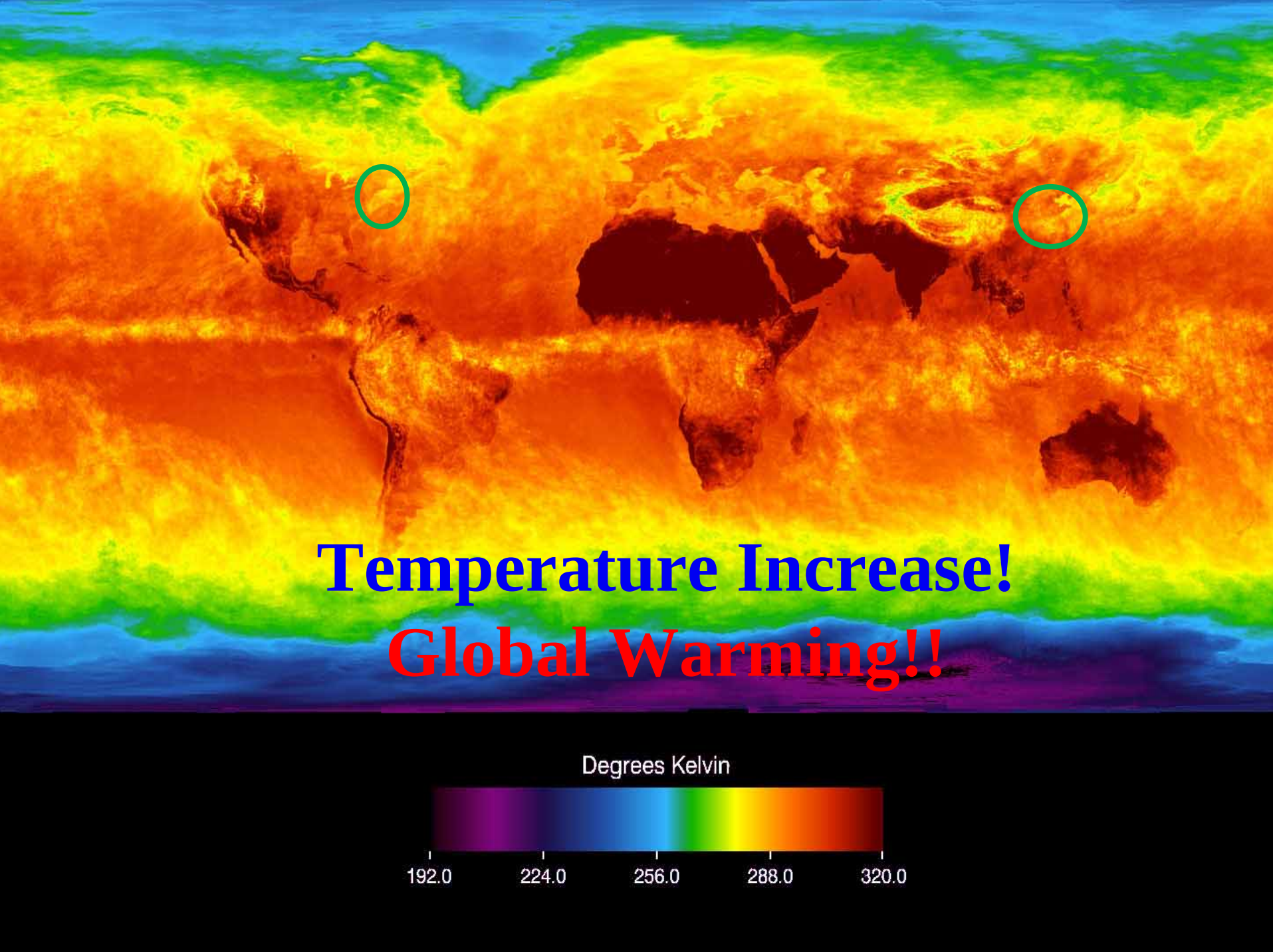
Sequence of Presentation

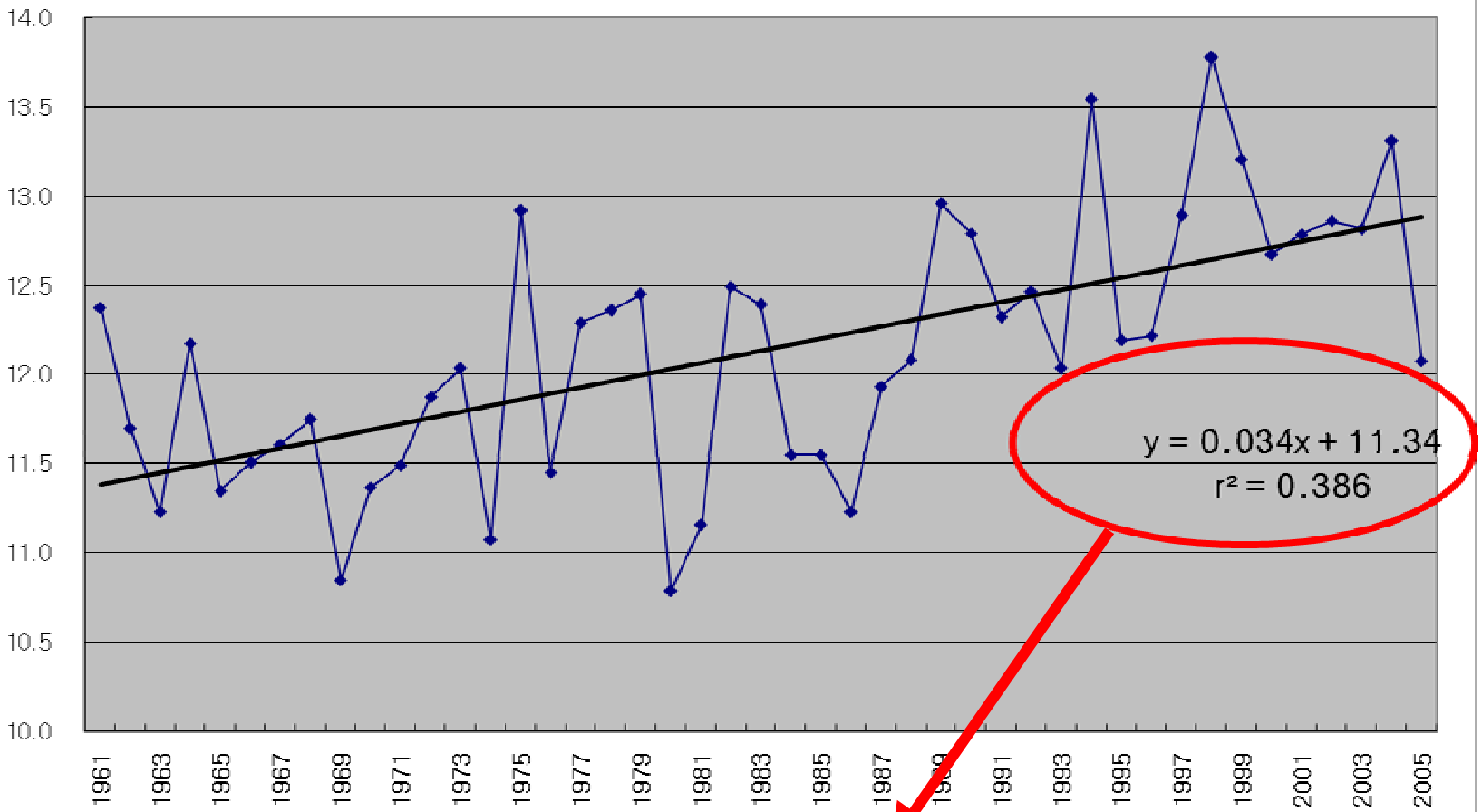
1. Challenges: Detecting and Adapting to Global Warming
2. Global Warming, Climate Change, and Ecosystem Change: Korea Perspective
3. GEOSS Perspective on Ecosystem Change
4. Opportunities: Networking Observations

1. Challenges:
Detecting and Adapting to Global Warming

Prediction of Geo-Cosmos at Miraikan, Japan

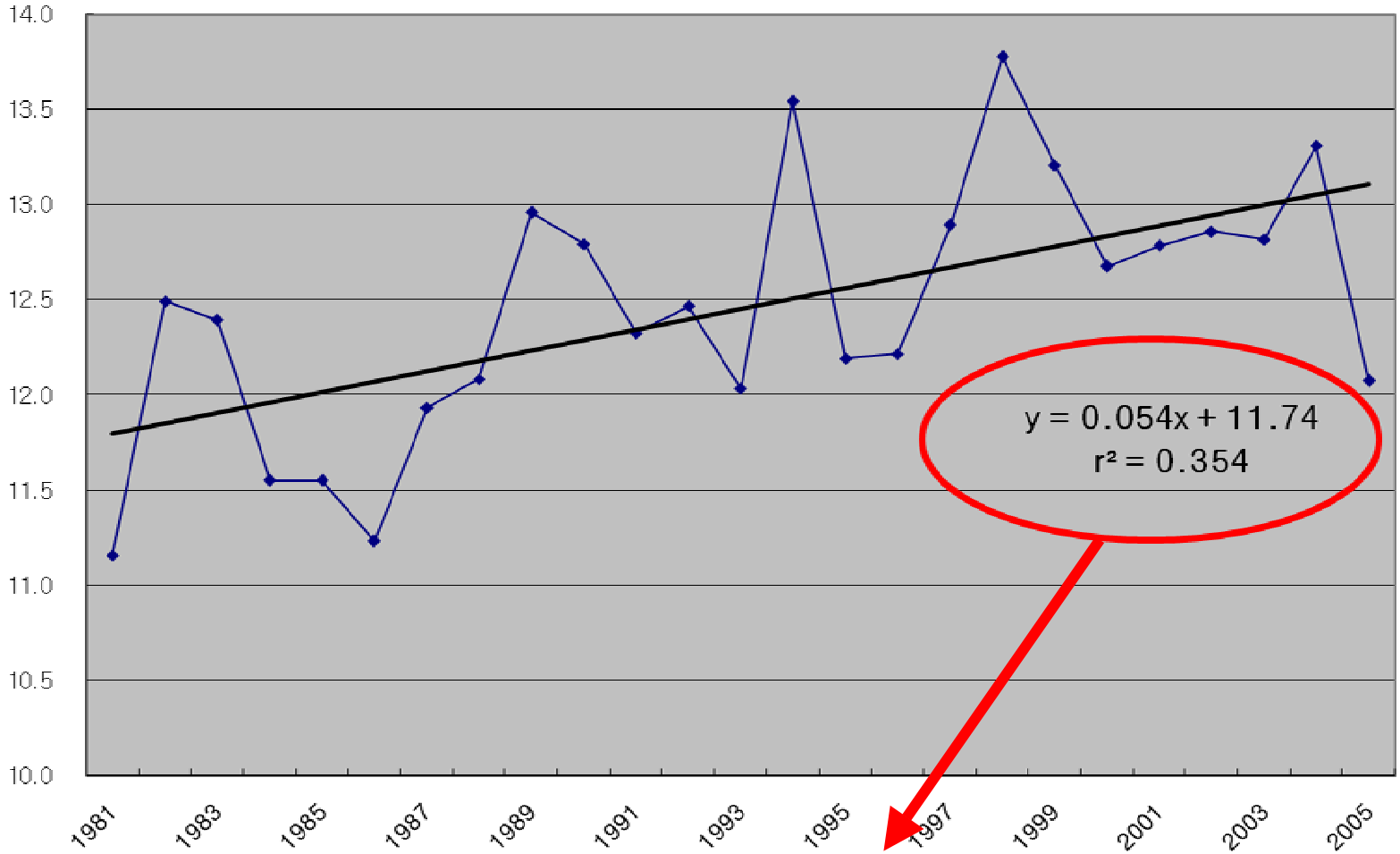

Temperature Increase!
Global Warming!!
Degrees Kelvin
192.0
224.0
256.0
288.0
320.0

Mean Temperature
Linear Trend in Seoul, Korea during1961-2005



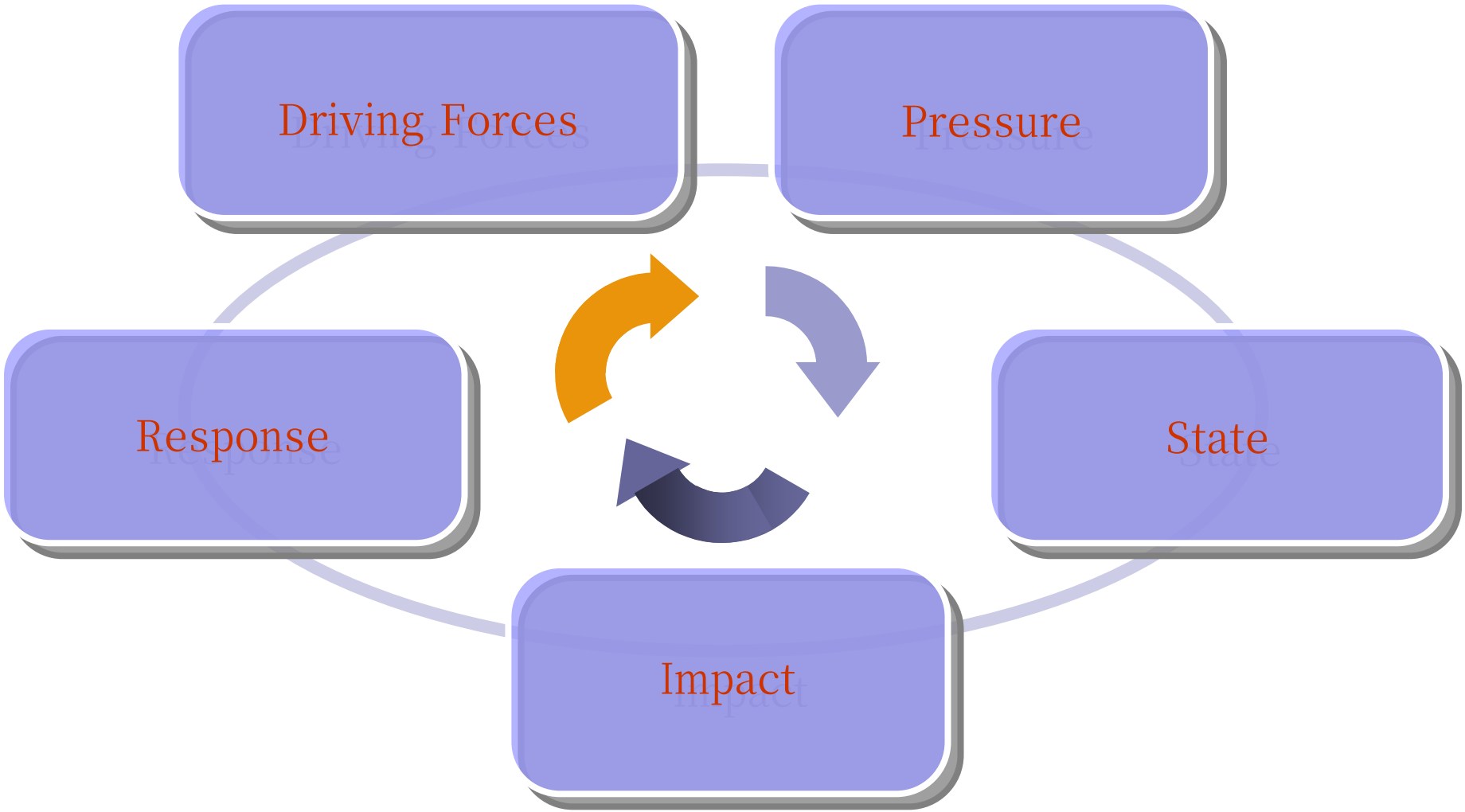
3.4 deg. C. increase per 100 years

Mean Temperature
Linear trend in Seoul, Korea during 1981-2005



5.4 deg. C. increase per 100 years!!!

A Background Model for the Understanding for Ecosystem Management (DPSIR)



Global Environment Outlook

GEO 4

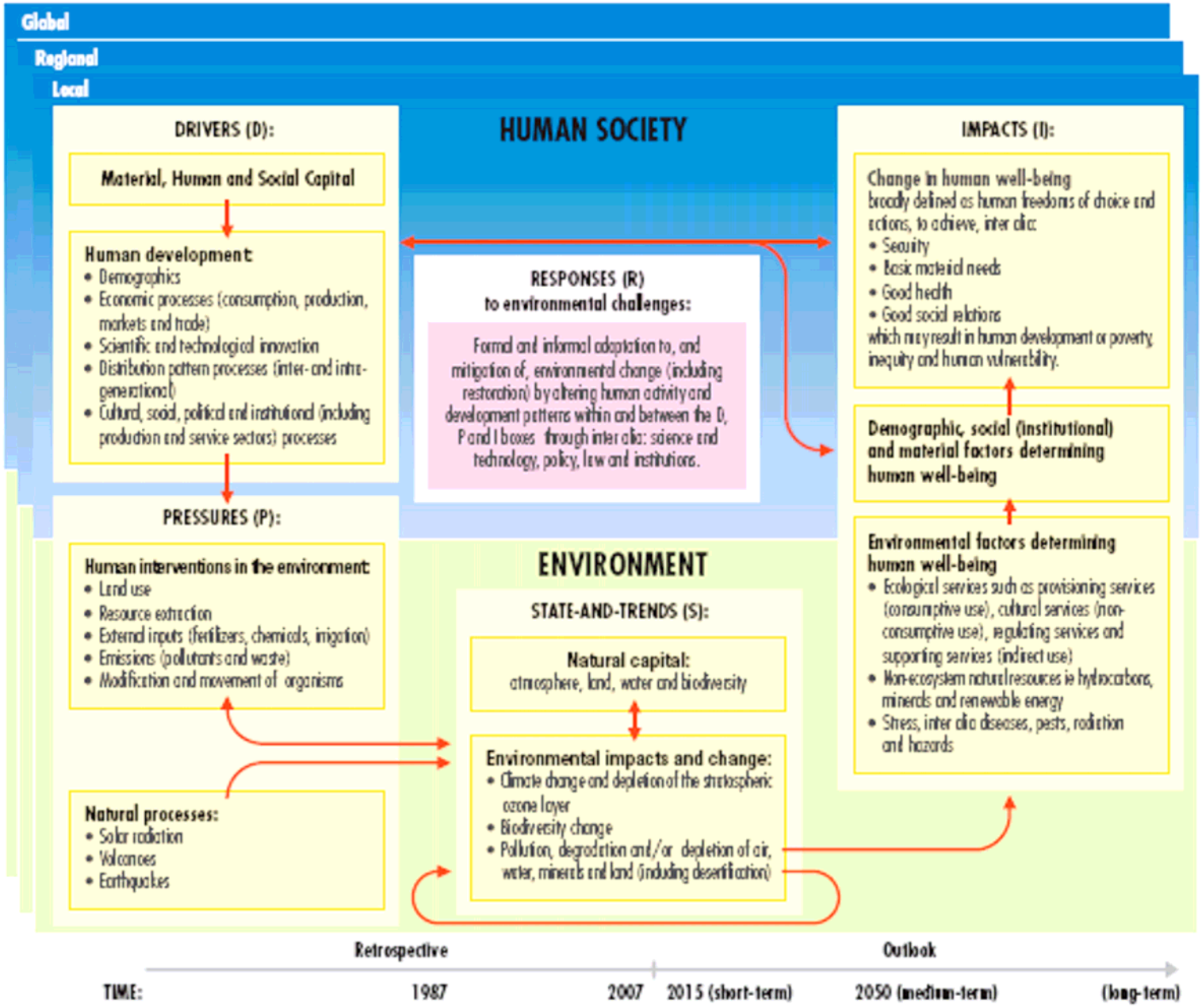
environment for development

UNEP

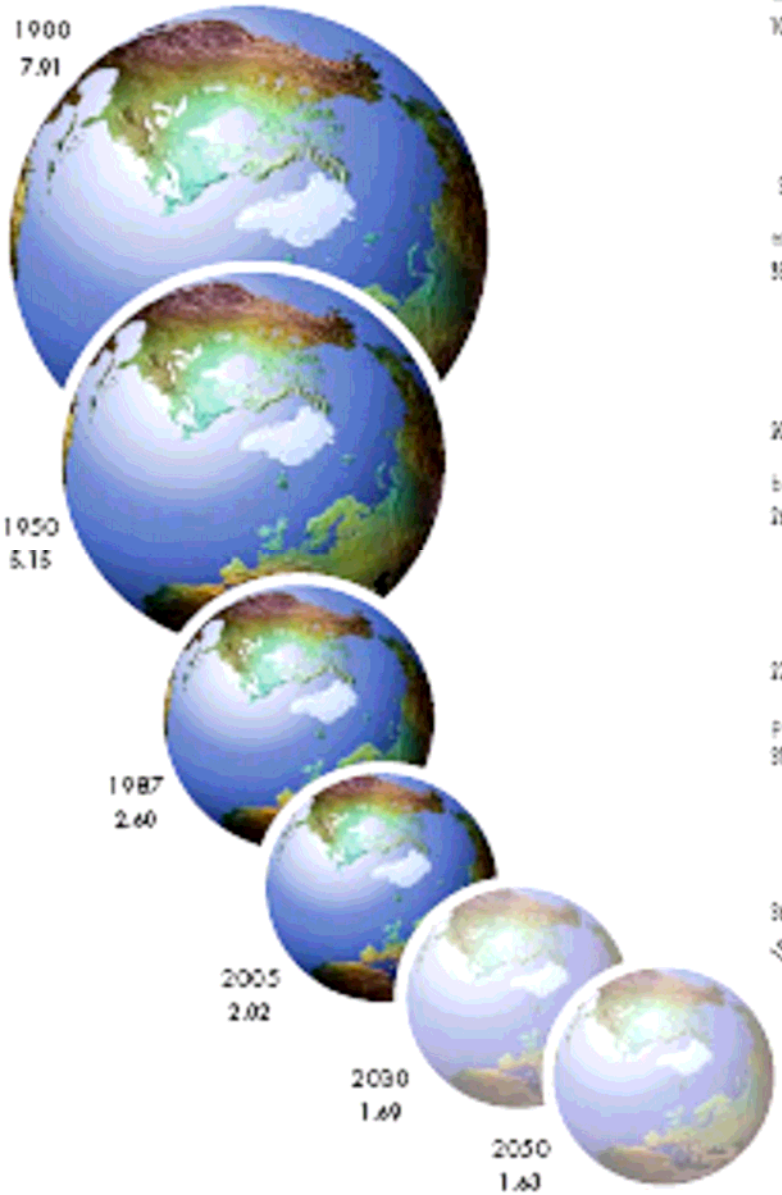
United Nations Environment Programme

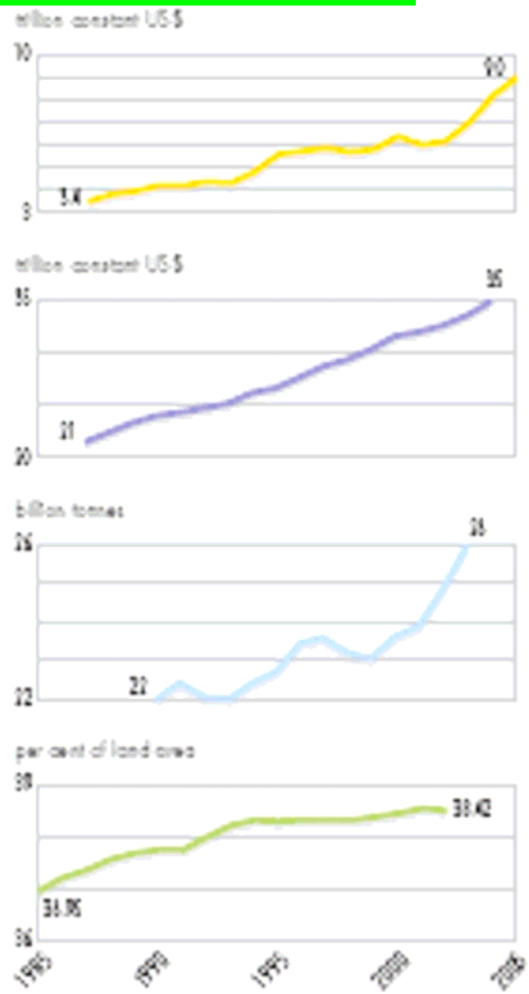
Contents

Figure 1 GEO-4 conceptual framework



Unit: land area per capita in ha





Notes: Numbers next to images of Earth reflect hectares of land per capita.

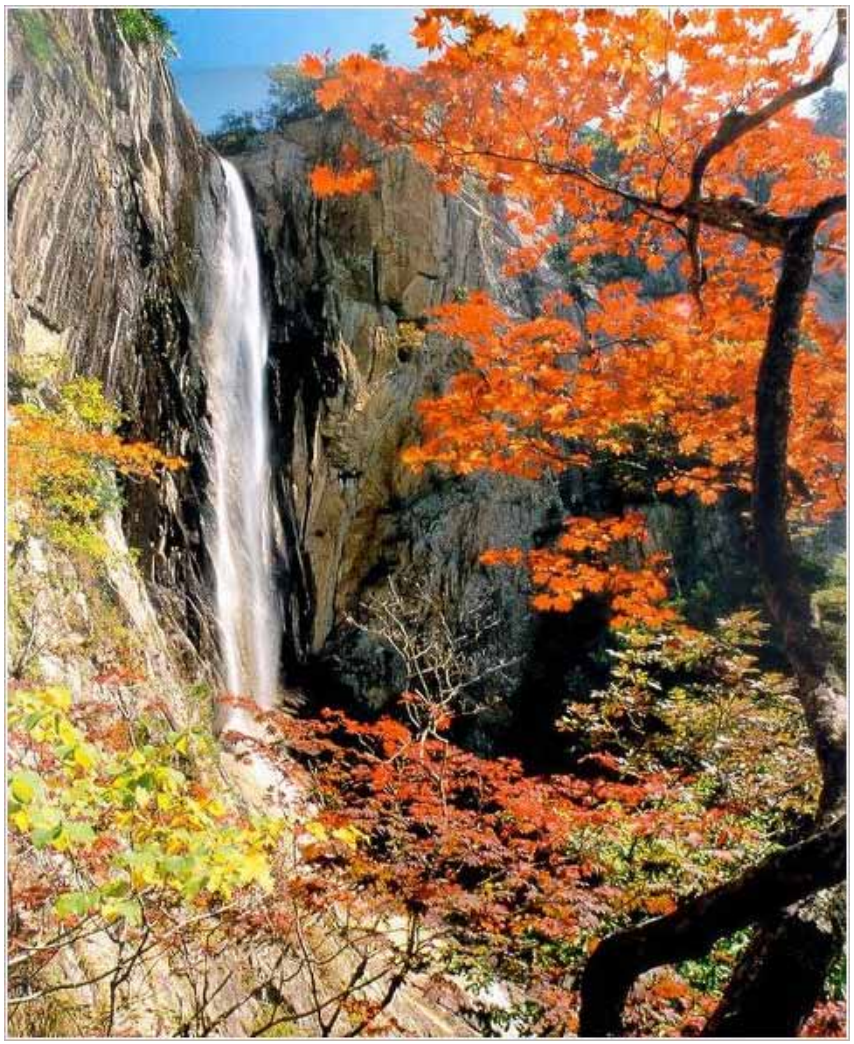
Graphs show changes in trade volume (1987–2005), GDP (1987–2004), CO_2 emissions (1990–2003) and agricultural land area (1987–2002).

Sources: FAOSTAT 2006, Chapter 9 population projection, WTO 2007, GEO Data Portal compiled from UNEP 2007low estimate, World Bank 2006a, UNFCCC/CDIAC 2006 and FAOSTAT 2006a

Organisms' Behaviors to Stresses

- **Migrate (Animals) / Invade (Plants)**
- **Adapt / Acclimate (Plants and Animals), Ultimately to Evolve**
- **Decline / Perish (Plants) Ultimately to Extinct**

Korean Pine (*Pinus koraiensis*) and Adaptation



http://comm.dreamdrug.com/data/blog/user_data/j0177/200708071350_JFEILR7I.bmp

http://yongso.gwjsed.go.kr/profile/Home_jas300.jpg

Korean Pine (*Pinus koraiensis*) Plantation at warmer sites

http://www.samna.co.kr/audtks/2004a/img/wnd09-04-2.jpg

Organisms' Behaviors to Stresses

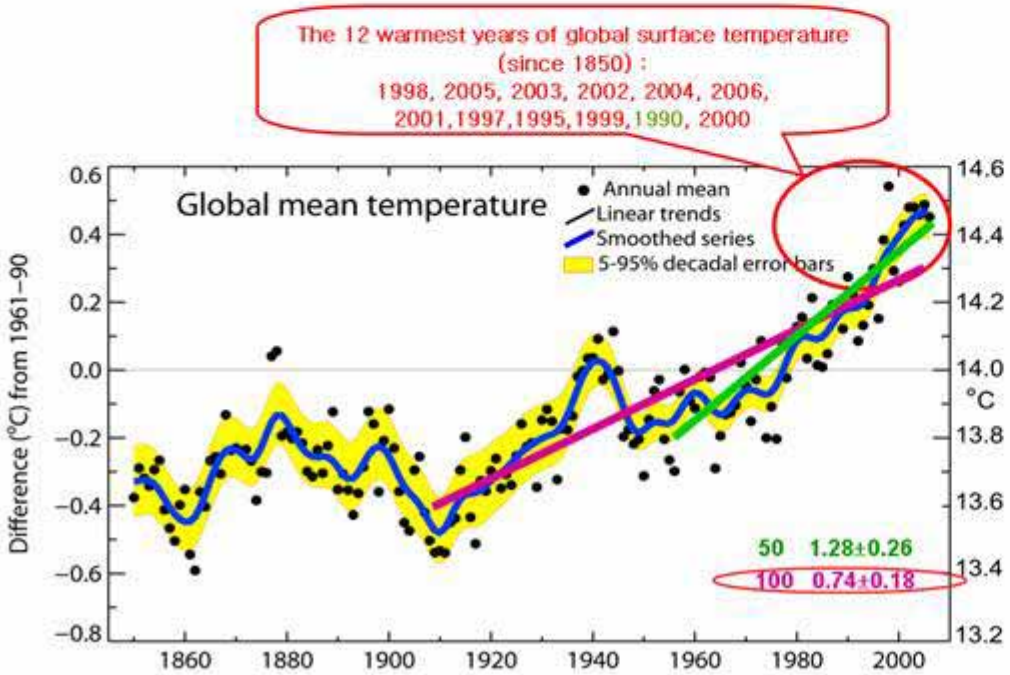
- Migrate (Animals) / Invade (Plants)
- Adapt / Acclimate (Plants and Animals),
  Ultimately to Evolve
- Decline / Perish (Plants)
  Ultimately to Extinct

2. Global Warming, Climate Change, and Ecosystem Change: Korea Perspective

This slide adopted from the Ministry of Environment, Republic of Korea

IPCC AR4

"Changes in the atmosphere, cryosphere, and ocean show unequivocally that the world is warming. (IPCC AR4, 2007)"



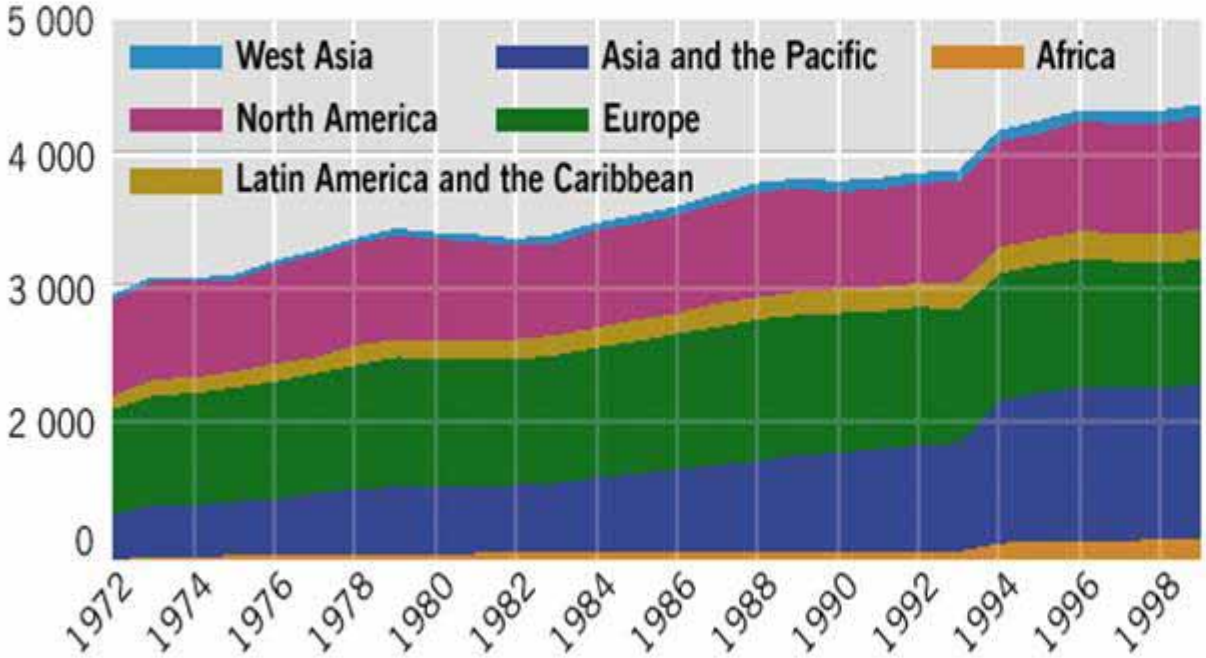
- **Temperature Increase : 100 year linear trend (1906–2005) of 0.74 [0.56 to 0.92]°C**
- **Eleven of the last twelve years rank among the 12 warmest years since 1850**

(Source: IPCC AR4 WG-I, 2007)

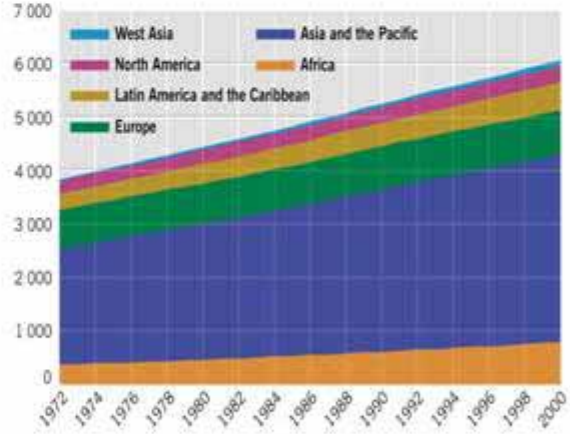
This slide adopted from the Ministry of Environment, Republic of Korea

Global energy consumption

(million tonnes of oil equivalent)



World Population

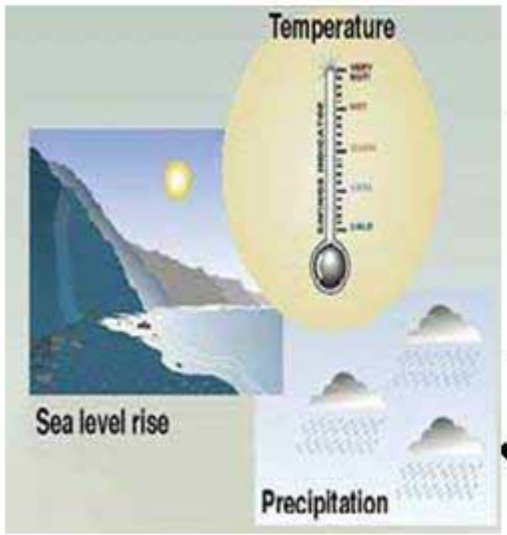


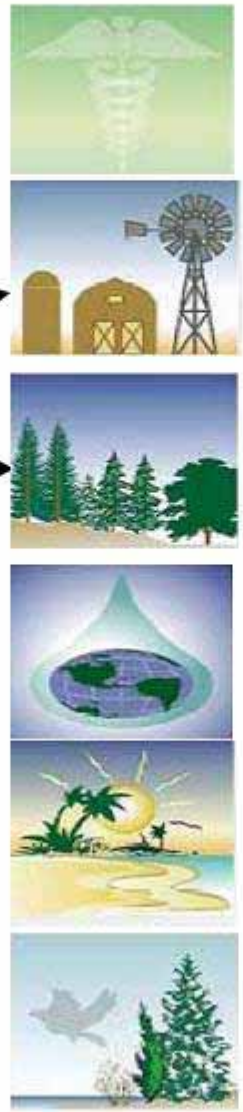
Averaged growth in energy use is 2% a year

(Source: Global Environment Outlook 3)

Climate Change : Current Status and Its Impact

This slide adopted from the Ministry of Environment, Republic of Korea





Health
Water-related mortality
Infectious diseases
Air-quality
Respiratory illnesses

Agriculture
Crop yields
Irrigation demands

Forest
Forest composition
Geographic range of forest
Forest health and productivity

Water resources
Water supply
Water quality
Competition for water

Coastal Areas
Erosion of beaches
Inundation of coastal lands
- additional costs to protect coastal communities

Ecosystem – biodiversity
Loss of habitat and species(20-30% loss expected with 2℃ increase in 2050)

Industry, Household, Ecosystem, Socio-economy

This slide adopted from the Ministry of Environment, Republic of Korea

Climate Change on the Korean Peninsula

- Annual mean CO_2 concentrations
  - Korea: 389 ppm ('05)
  - Global mean: 379 ppm ('05)

- Air temperature increases
  - Korea: 1.5 ℃ (1906-2005)
  - Global mean: 0.74 ± 0.18℃

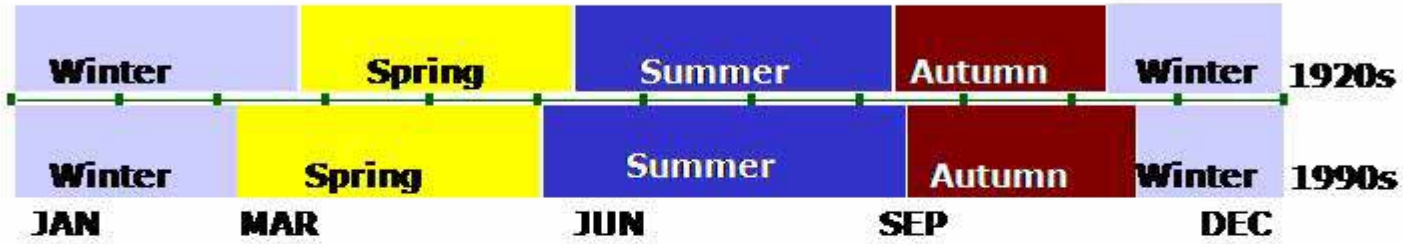
- Increases in annual precipitation
  - 1,166 mm (1920) → 1,501 mm (2006)

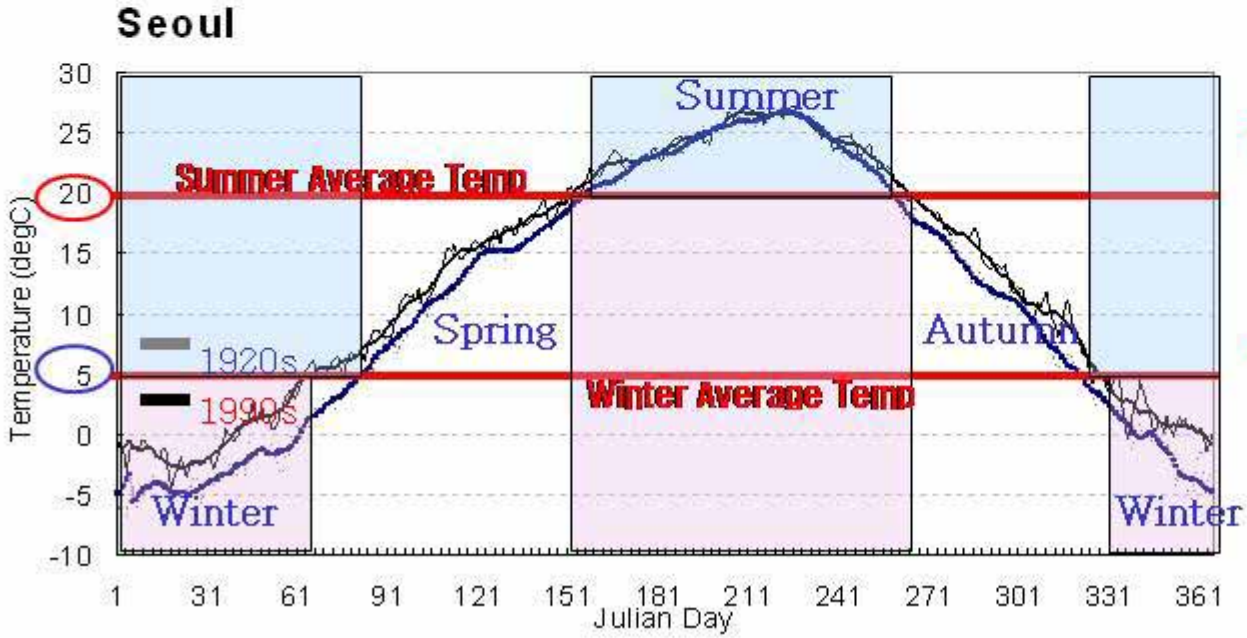
- Sea level rise
  - Korea: 1 – 6 mm/yr
  - Global mean: 1.3 – 2.3 mm/yr (1961-2003)

(Source: IPCC AR4 WG-I, 2007 for Global data
& Korea Meteorological Research Institute (METRI Korea), 2005 for Korea data)

This slide adopted from the Ministry of Environment, Republic of Korea

Seasons Shift on the Korean Peninsula





Summer Period
: Jun. 3 ~ Sep. 21 (1920s)
-> May 24 ~ Sep. 27 (1990s)
: 16 days increase

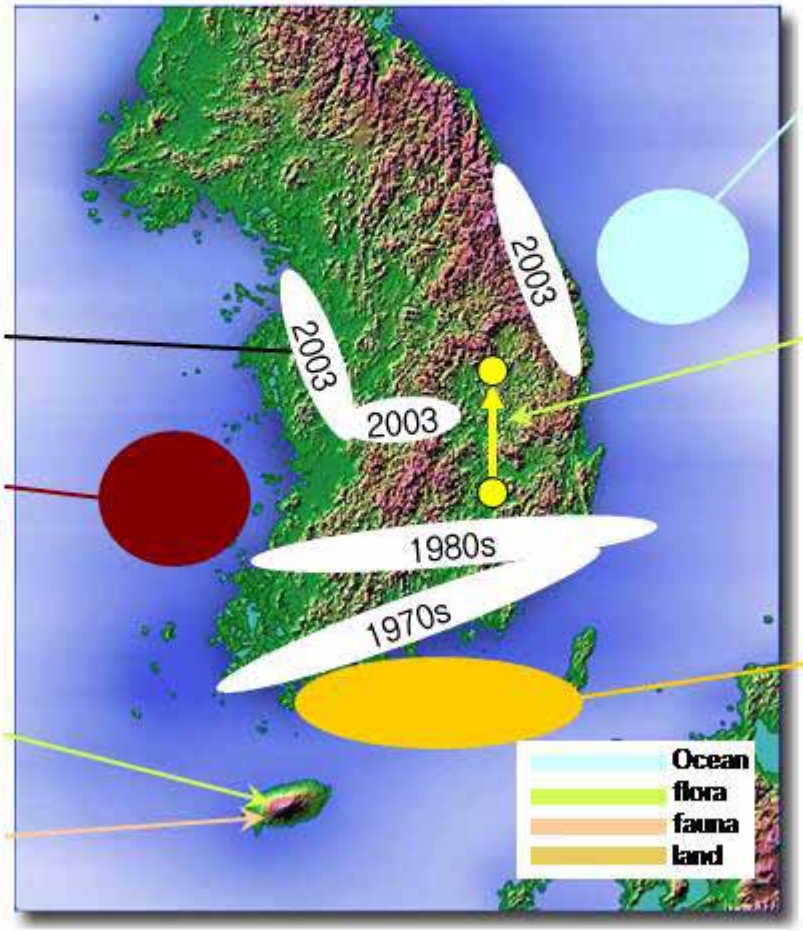
Winter Period
: Nov. 21 ~ Mar. 18 (1920s)
-> Nov. 29 ~ Mar. 8 (1990s)
: 19 days decrease

(Source: METRI Korea, 2006)

This slide adopted from the Ministry of Environment, Republic of Korea

Impacts of Climate Change on the Korean Peninsula

(Source: modified from reporting of several Newspaper)



Garlic habitat shift

Subtropical jellyfish

Early cherry blossom

Damage of pine forest by *Dendrolimus spectabilis*

Less cold water fish (Pollack, Cod, Sandfish)

More warm water fish (Squid, Bream, etc.)

Fruit cultivation area shift (i.e., Apple)

Coastal sea surface temp. ~ 0.02℃/year rise

Early red tide !!

Also, early outbreaks of summer epidemics !!

This slide adopted from the Ministry of Environment, Republic of Korea

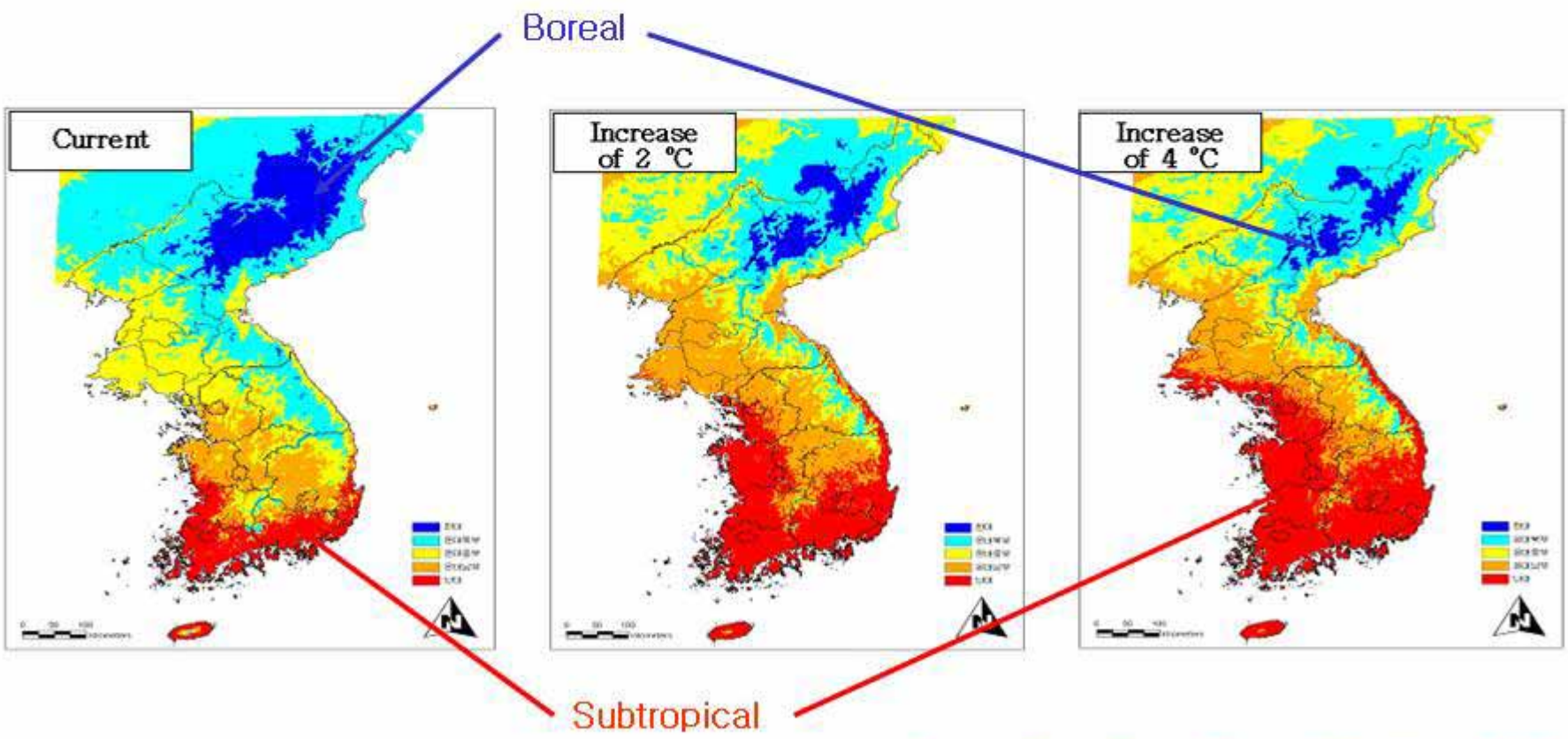
Projected Climate Change and Its Impacts in Korea

Temperature	2080	5 ºC increase
Precipitation	2050	17 % increase
Crop yields	2080s	15 % decrease
Sea level	2099	50 cm increase
Flood damage	2080s	3 times increase
Forest	2080s	Replaced by sub-tropical flora
Health	2051	Increase in mortality by heat wave (e.g., 640 persons in Seoul)

(Source: METRI Korea, 2006 and 2007)

This slide adopted from the Ministry of Environment, Republic of Korea

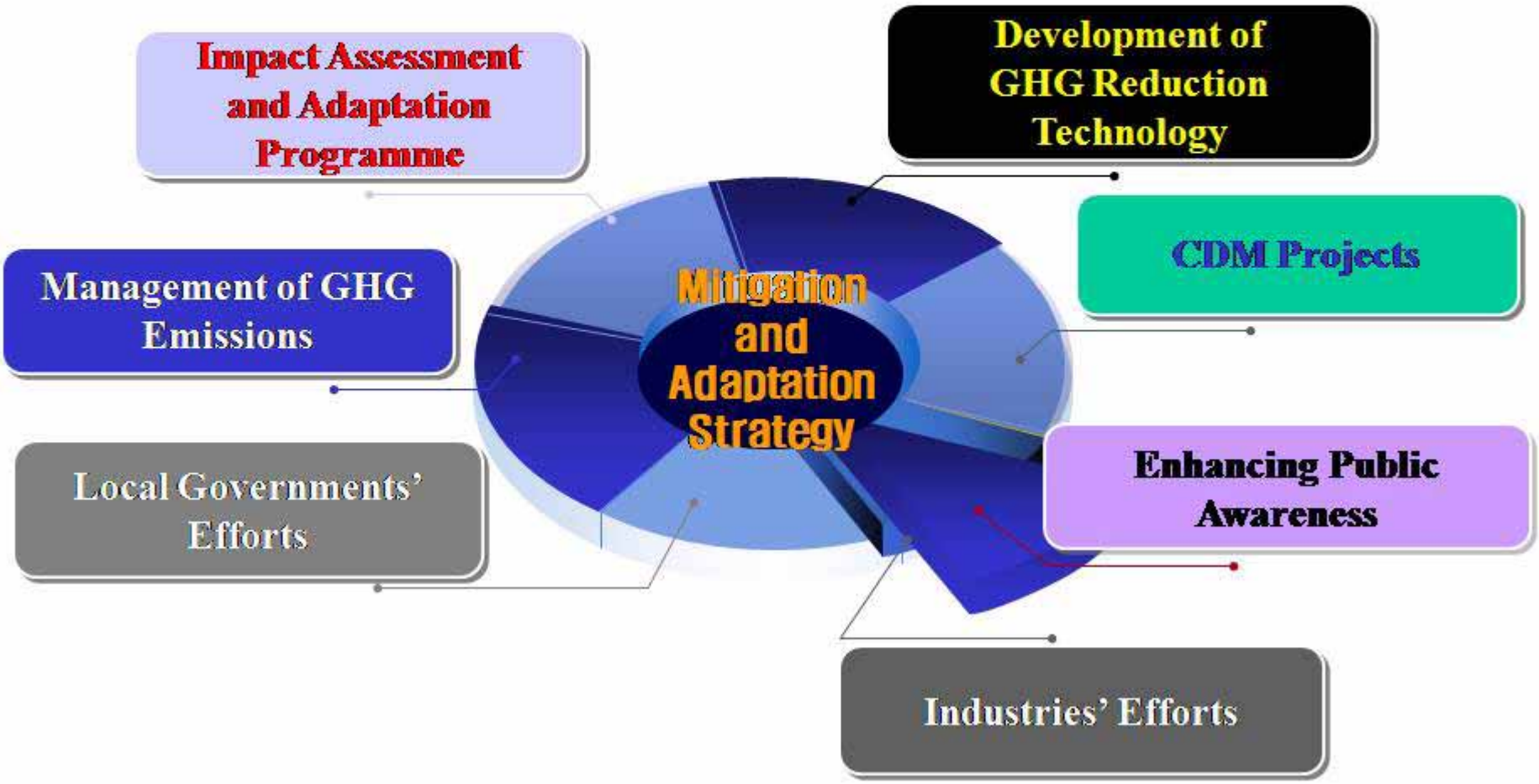
Change of Climate Zones in Korea



(Source: Korea Forest Research Institute, 2006)

This slide adopted from the Ministry of Environment, Republic of Korea

Action Plan

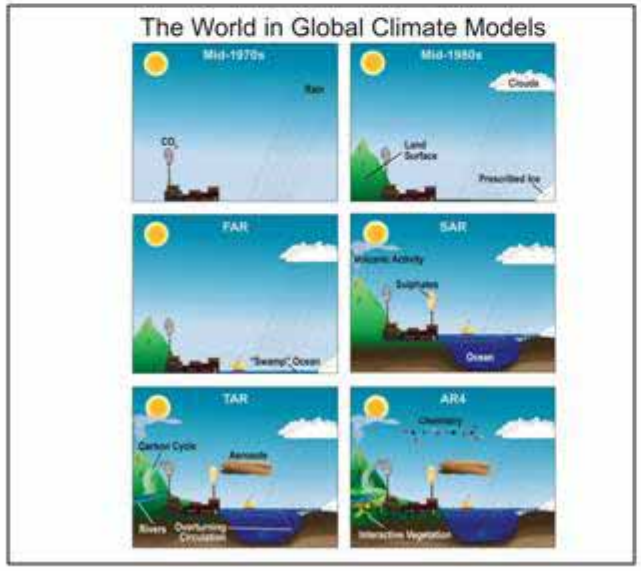


This slide adopted from the Ministry of Environment, Republic of Korea

Climate Change Science Program

1. Climate Change Prediction and Its Feedback

2. Assessment of Impacts and Adaptation Measures of Climate Change



This slide adopted from the Ministry of Environment, Republic of Korea

Directions

- Minimize adverse impact of climate change
- Contribute to global mitigation efforts
- Establish mid- to long-term national strategies

This slide adopted from the Ministry of Environment, Republic of Korea

Impacts and Adaptation

- Prediction of Climate Change in Korea
- Assessment of Vulnerability
- Implementation of the Adaptation Action Plan Based on the Assessment of Vulnerability
- Establishment of the Comprehensive National Master Plan :

  - water resources, air quality, rainfalls & typhoons, leisure & tourism , road infrastructure, ecosystem, agriculture, etc

Limitations :

This slide adopted from the Ministry of Environment, Republic of Korea

- **Lack of strategic goals and appropriate schemes based on the analysis of the impacts of climate change hinders aggressive policy-making and implementation.**

  Long-term effects of climate change on sustainable development and national competitiveness are not taken into account and incorporated in the policy-making.

- **Deficient infrastructure such as the legal framework, viable institutions, and supporting systems, leads to inefficiency in eliciting active participation.**

- **Inadequate awareness and participation on the part of the private sector, including business community and general public, and peripheral roles played by local governments present further challenges.**

3. GEOSS Perspective on Ecosystem Change

GEO Overview and GEO Plan for Ecosystems and related areas

2005 ILTER Coordinating Committee Meeting

October 27, 2005 in Colima, Mexico

Antti Herlevi

GEOSS Work Plan Team

GROUP ON EARTH OBSERVATIONS

This slide adopted from the GEOSS Work Plan Team Presented to 2005 ILTER Meeting

Earth Observation Summit II : Framework Document

Nine Societal Benefit Areas

1. Reduction and Prevention of Disasters
2. Human Health
3. Energy Management
4. Climate Change
5. Water Management
6. Weather Forecasting
7. Ecosystem
8. Agriculture
9. Biodiversity

GROUP ON EARTH OBSERVATIONS

This slide adopted from the GEOSS Work Plan Team Presented to 2005 ILTER Meeting

GEOSS Ecosystems objectives

- The vision for GEOSS is to allow repeated mapping of ecosystems extent and the quantification of ecosystems condition.

GROUP ON EARTH OBSERVATIONS

This slide adopted from the GEOSS Work Plan Team Presented to 2005 ILTER Meeting

GEOSS Ecosystems Priorities

- Initiate planning and investment for a global carbon observing system
- Develop a global operational scheme for ecosystem classification
- Pursue harmonization of ecosystem observing methods

GROUP ON EARTH OBSERVATIONS

This slide adopted from the GEOSS Work Plan Team Presented to 2005 ILTER Meeting

GEOSS Ecosystems Priorities

- Improve tools for space-based and in-situ ecosystem observations
- Develop a global network of organization-networks for ecosystems, and strengthen observing capacity in developing countries.
- Archive and rescue historical ecosystem data

GROUP ON EARTH OBSERVATIONS

This slide adopted from the GEOSS Work Plan Team Presented to 2005 ILTER Meeting

GEOSS Biodiversity objectives

- **Develop comprehensive classification and observing strategies that will allow both observational standards and interoperability to emerge from the current monitoring activities.**

4. Opportunities:
Networking Observations


N55°
N45°
N35°
N25°
N15°
N 5°
75°
E 85°
E 95°
E105°
E115°
E125°
E135°
E145°
E155
북회귀선
China
Taiwan
Hong Kong
Laos
Vietnam
Paracel Islands
Philippines
Image NASA
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Google™
포인터 N 27°15'05.57" E 115°59'13.29"
스트리밍 100%
내려다보는 높이 5278.90km

- Australia
- China
- China-Taipei
- Mongolia
- South Korea

North American Regional LTER Network
- Canada
- Mexico
- United States

Central/Eastern European Regional LTER Network
- Czech Republic
- Hungary
- Latvia
- Poland
- Slovak Republic
- Ukraine

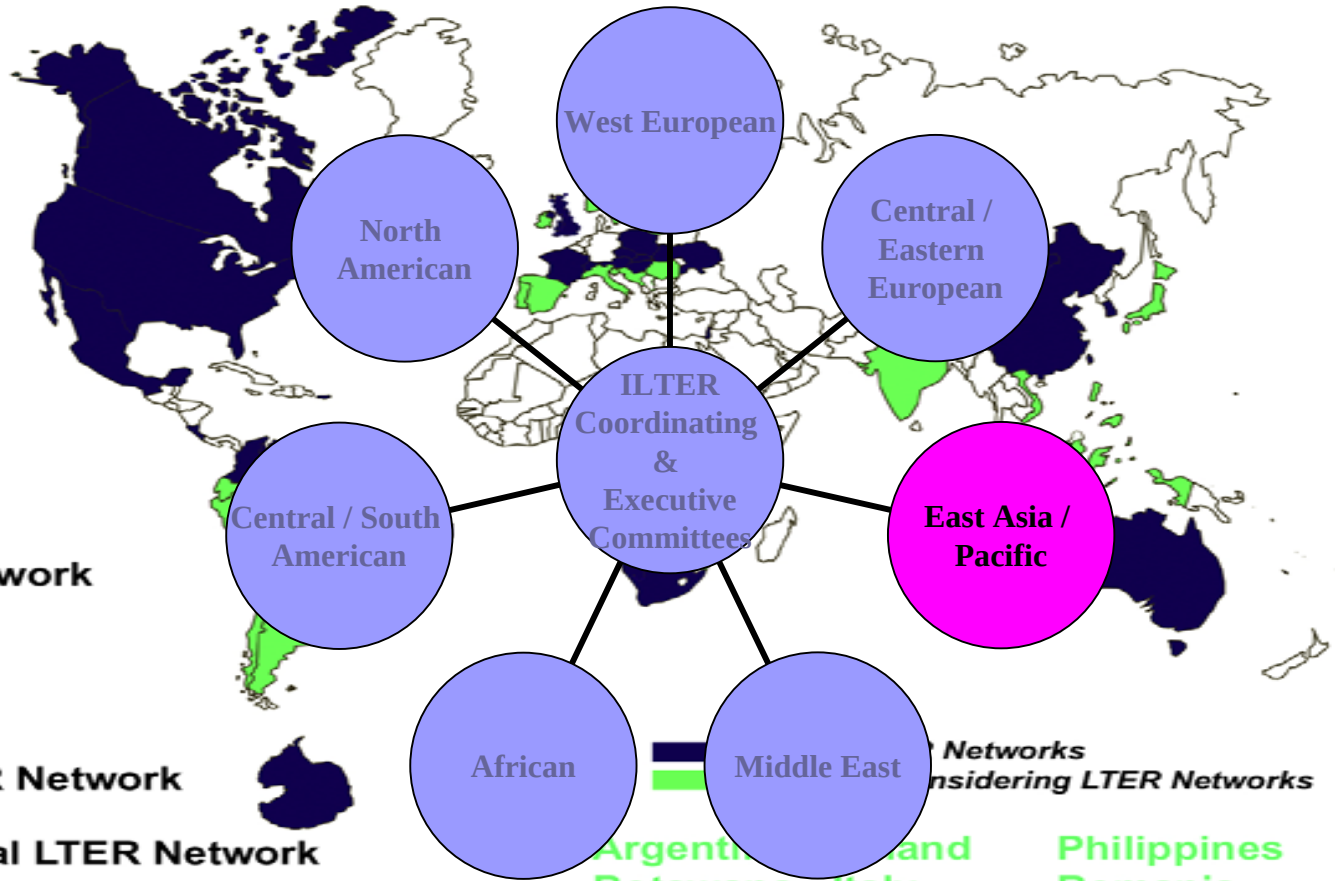
African Regional LTER Network
- Mozambique
- Namibia
- South Africa
- Zambia

Middle East Regional LTER Network
- Israel

Western European Regional LTER Network
- Austria
- France
- Switzerland
- United Kingdom

Central/South American Regional LTER Network
- Brazil
- Colombia
- Costa Rica
- Uruguay
- Venezuela

The International Long Term Ecological Research Network



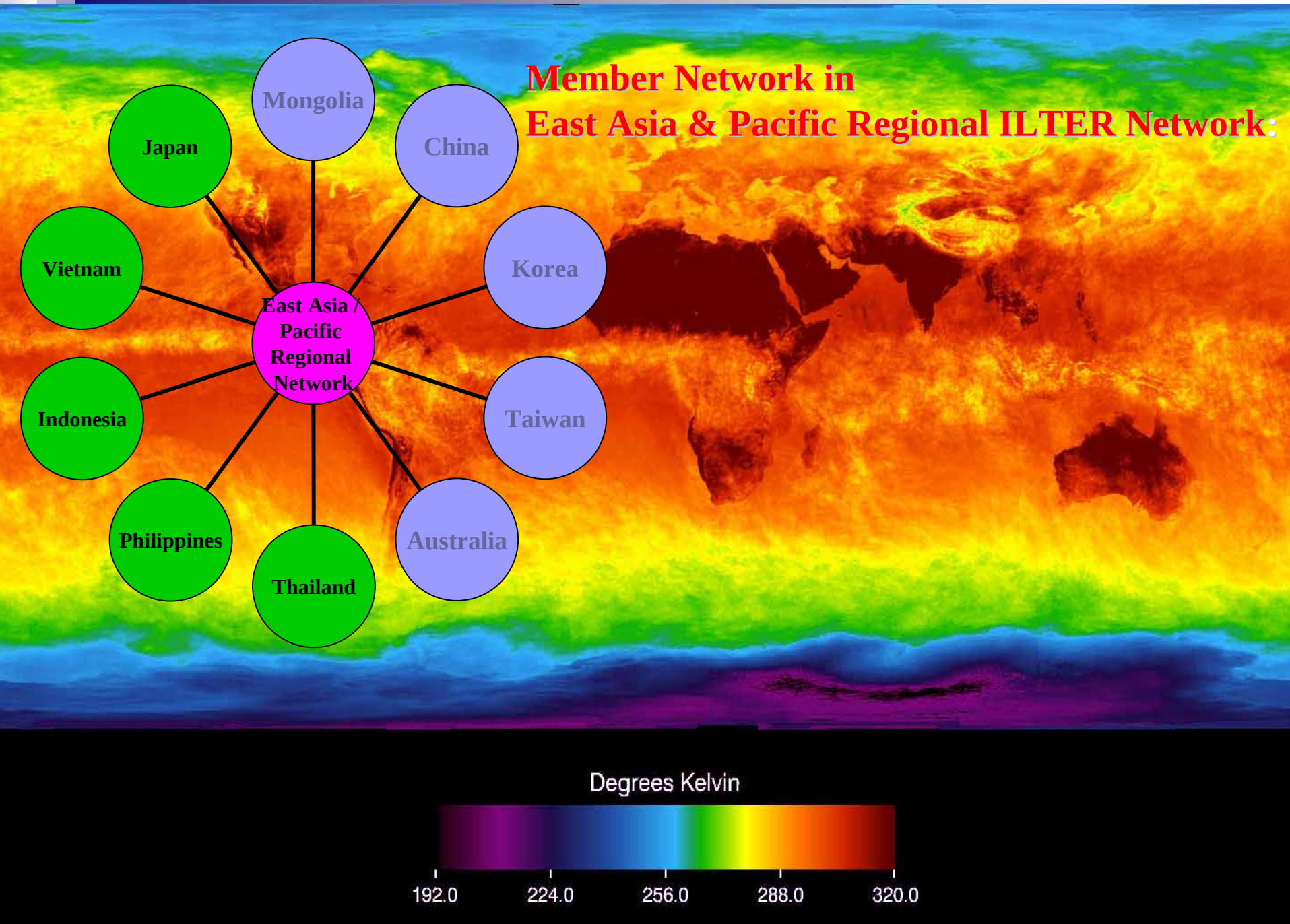
Networks
nsidering LTER Networks

Argenti land
Botswana Italy
Chile Japan
Ecuador Lithuania
Estonia Norway
India Portugal
Indonesia Peru
Philippines
Romania
Slovenia
Sweden
Tanzania
Vietnam
Zimbabwe

Framework of International LTER Network

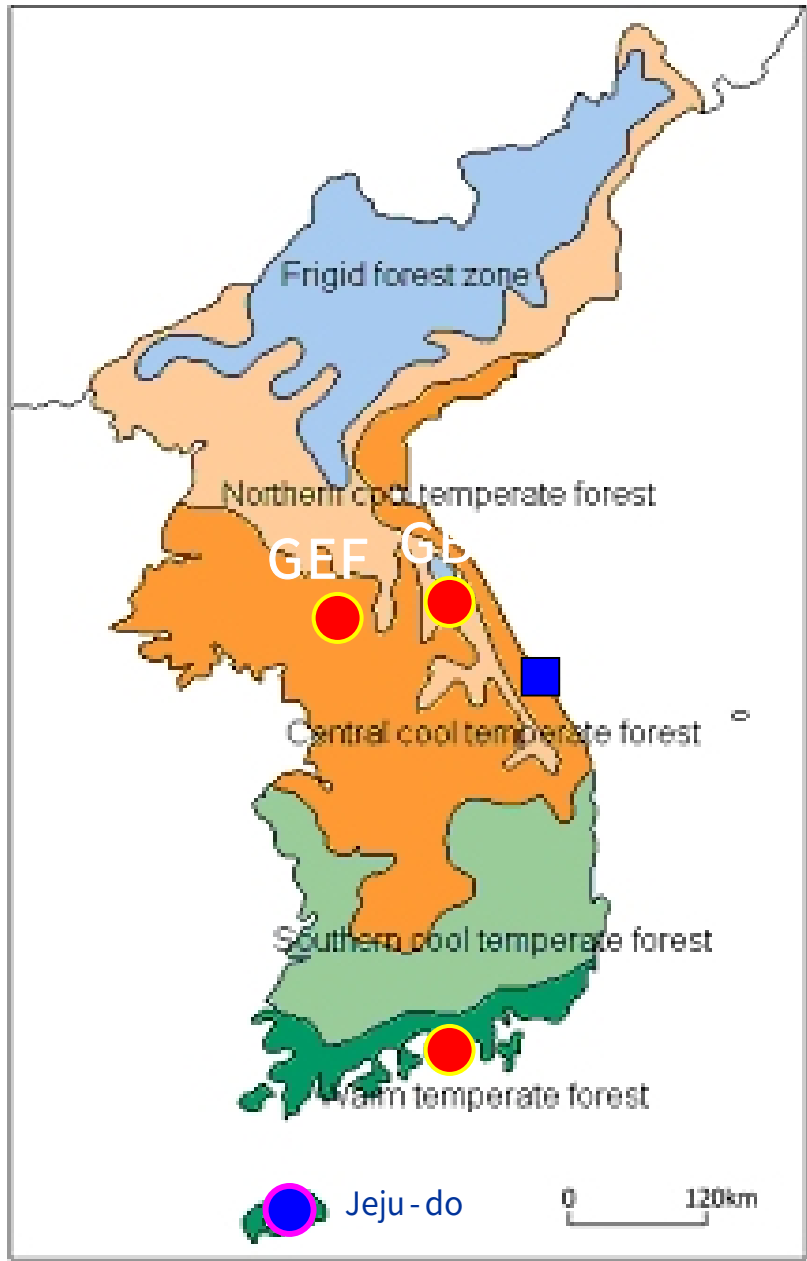
Updated November 04

Member Network in East Asia & Pacific Regional ILTER Network:



Korea LTER Sites in Forests (climate and vegetation)

1. Gwangnung Exp. Forest (GEF)
   - Central cool-temperate
2. Mt. Gyebangsan Forest (GBF)
   - Northern cool-temperate
3. Mt. Geumsan Forest (GSF)
   - Southern cool-temperate to Warm-temperate
4. Samchuk Forest (SCF)
   - Fire-damaged forest
5. Jeju-do Island (JJF)
   - Evergreen and deciduous broadleaved forest



Environmental Changes

- Forest micrometeorology
- Flux measurements:
  CO_2, energy and water vapor
- Soil properties and site characteristics
- Stream water quality
- Carbon and nutrient cycling:
  litterfall, decomposition etc.
- Air pollution:
  pH of rainfall, SOx and NOx in air

Future Research

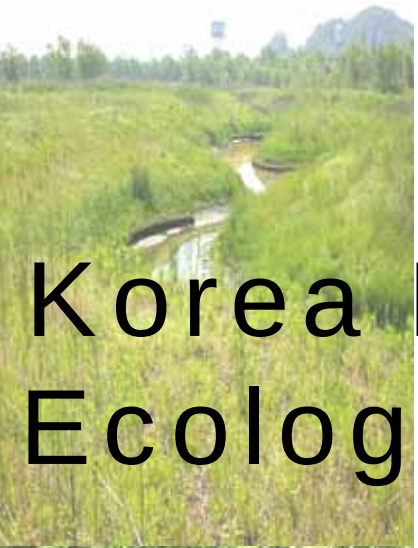
- **Long-Term Monitoring**
- **Networking of the Intensive Ecosystem Researches**
- **Analysis, Synthesis and Integration of Data**
- **Modeling of Forest Ecosystem Dynamics**

- Predict and estimate ecosystem processes

- Scale up to landscape or regional level

-> integration into GIS and linkage to RS data

- Estimate ecosystem changes by the environmental change including human activities



Korea National Long-Term Ecological Research (KNLTER)

Jae Chun Choe, Chang Seok Lee, Gea Jae Joo, Jeom Sook Lee, Woo Seok Kong, Eun Shik Kim, Nam Sin Kim, Do Soon Cho, Hyun Je Cho, Byung Mee Min, Woo Shin Lee, Yeon Sook Choung, Hee Chun Park, Yeon Jae Bae, Won Ho Lee, Jun Ho Lee, Sang Ho Nam, O Suk Kwon, and Yong Jin Won

Outline of KNLTER project

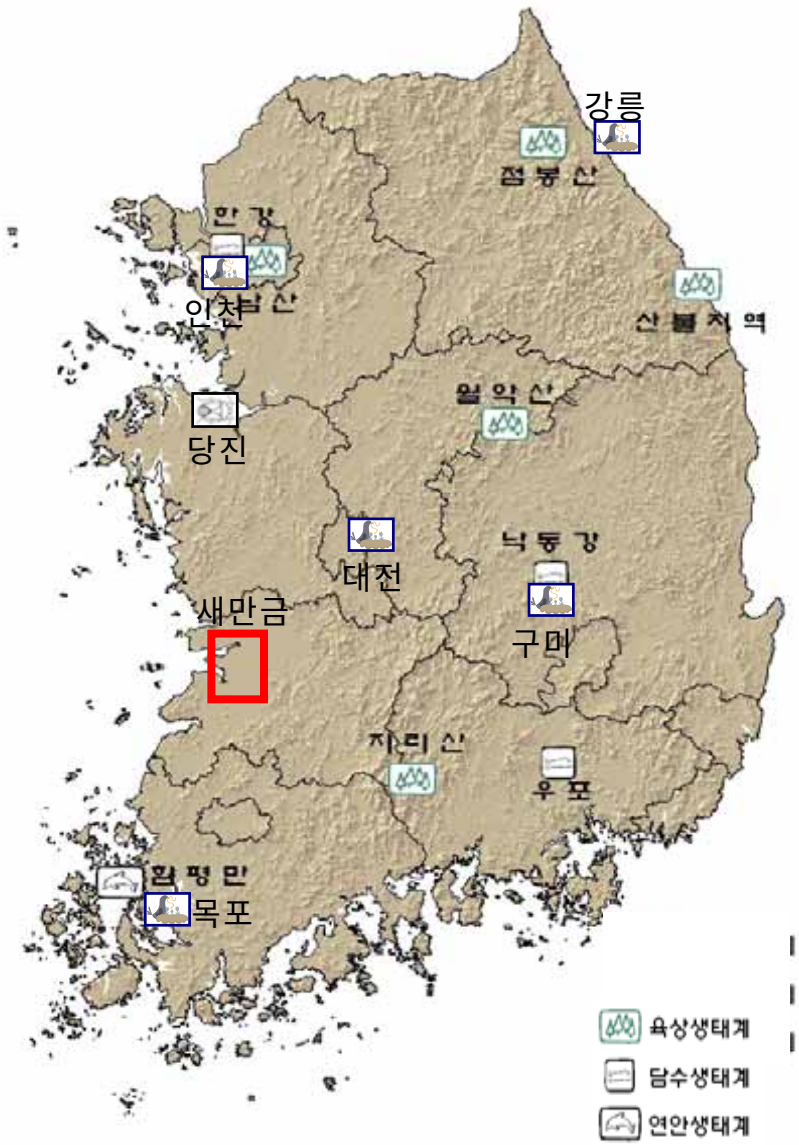
Study period: 2004. 12 – 2014. 3

- 1st stage: 2004.12 - 2007.3.
- 2nd stage: 2007.4.1. - 2009.12.31
- 3rd stage: 2010.4 – 2014.3

Objectives

- Elucidate the effects of climate change on ecosystems
- Establish ecologically sound management plan of natural resources and land use
- Construct national ecosystem database

10 more Study Areas from KNLTER Group



Terrestrial Ecosystem
4 mountains and 1 forest fire region
Meteorological towers

Freshwater Ecosystem
2 lotic systems, 1 wetland, and 1 reclaimed area

Coastal Ecosystem
1 coastal area

3rd ILTER-EAP EIM Workshop, Seoul, Korea – October 2008

- **An IM workshop focused on ways of <u>using</u> ecological information, metadata and data**

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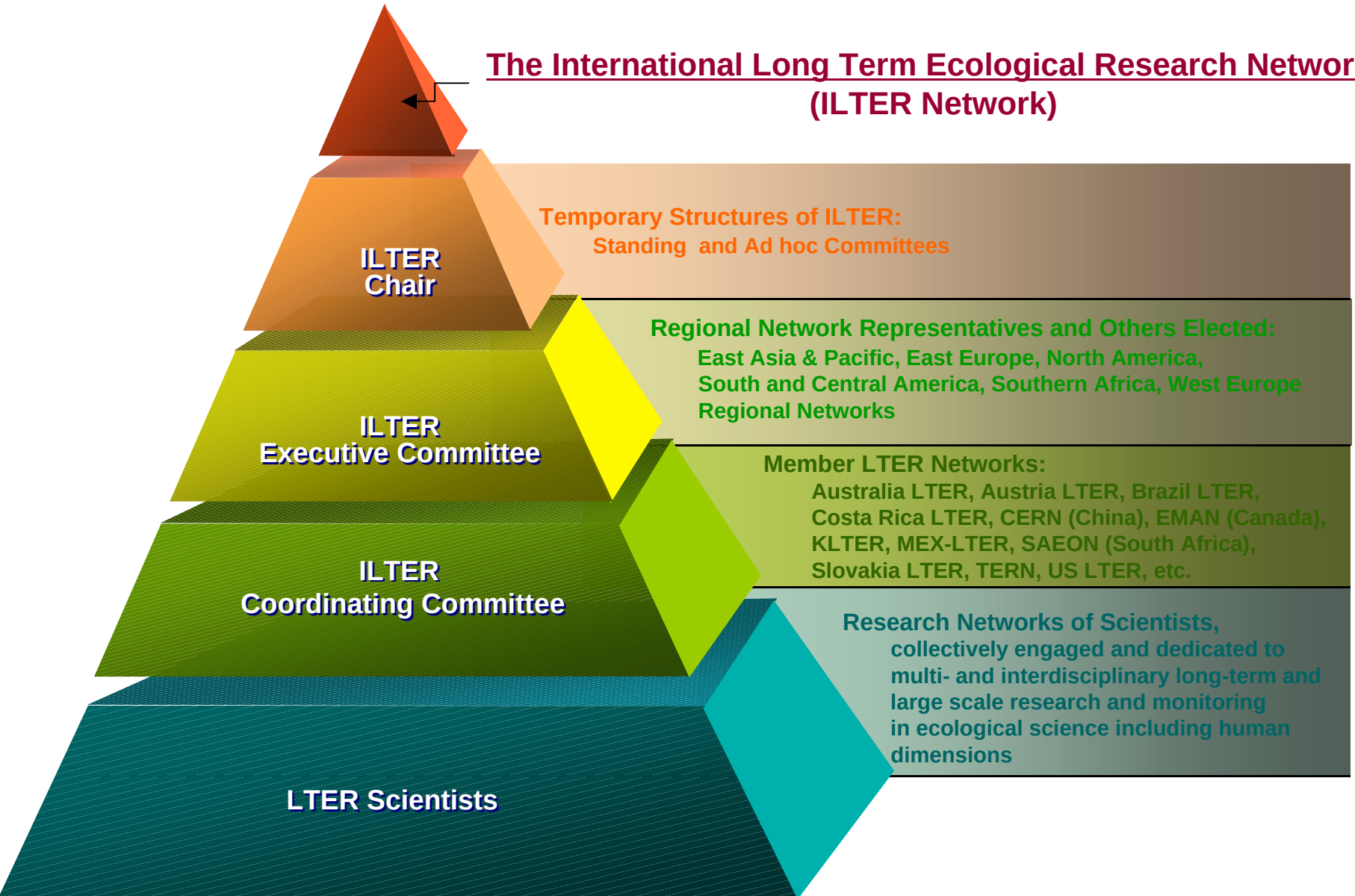
ILTER Organizational Chart



Main Characteristics of LTER Activities

- Site-based Study (Ecosystem)
- Networks of Sites on Local, Regional, and Global Level
- Long-Term Research and Monitoring
- Data Sharing and Archiving as Key Activities
- Standardization for Providing Comparability of Results
- Addressing Environmental Problems for Decision Makers
- Ecological Data for Future Generations

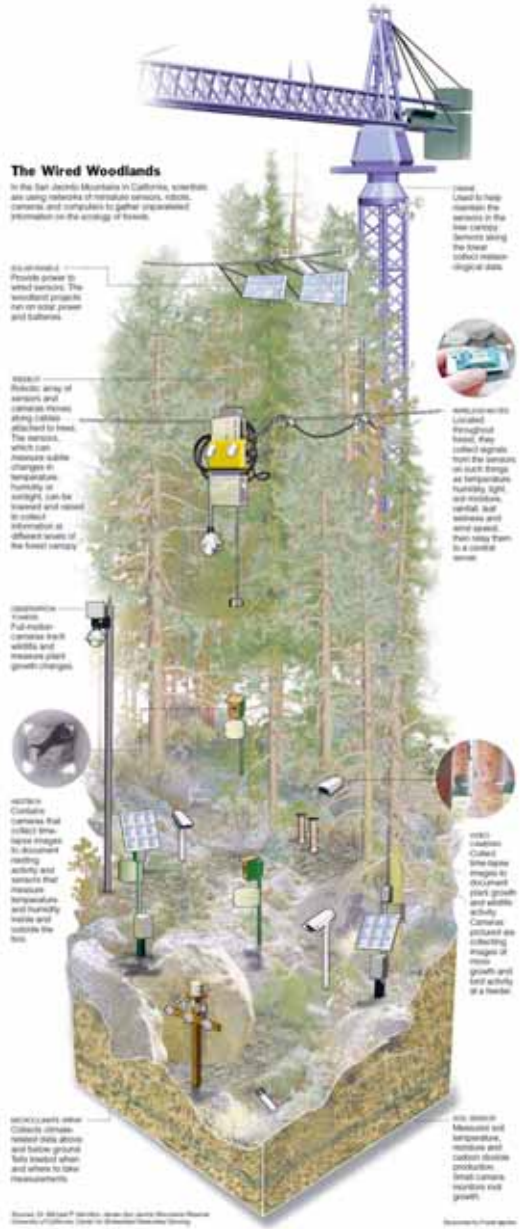
LTER Goals

- ***Understanding*: Gaining ecological understanding of a diverse array of ecosystems**
- ***Synthesis*: Using the network of sites to create general ecological knowledge through the synthesis of information gained from long-term research**
- ***Information Dissemination*: Creating well designed, documented, accessible databases**
- ***Legacies*: Creating a legacy of well designed and documented observations and experiments**
- ***Training*: Developing a cadre of scientists equipped to conduct long-term, collaborative research**
- ***Outreach*: Providing knowledge to the broader ecological community, general public, resource managers, and policy makers**

Benefits of Collaboration

- **Achieve works that an individual cannot do independently**
- **Share good ideas**
- **Share sophisticated equipments**
- **Share data**
- **Broaden spatial scale**
- **Shorten research time**
- **Advance knowledge**

US NEON Images on the web



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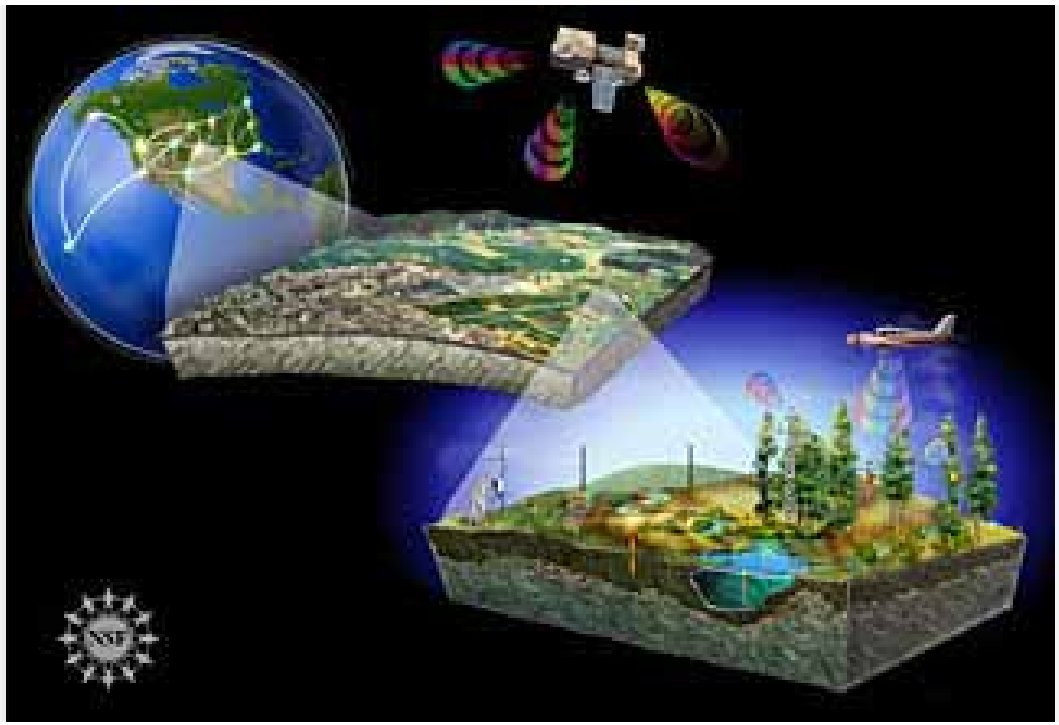


http://www.nsf.gov/news/mmg/media/images/agu_research3_f.jpg

NEON's Central Scientific Questions: Interactions of Ecosystems, Climate, and Land Use

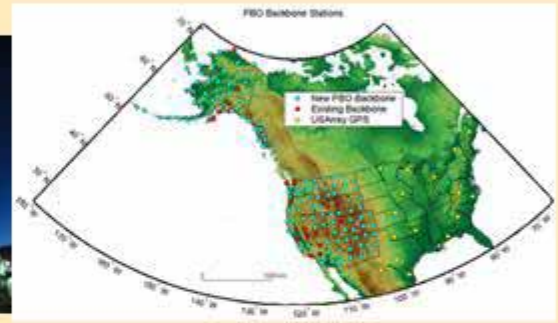
How will ecosystems and their components respond to changes in natural- and human-induced forcings such as climate, land use, and invasive species across a range of spatial and temporal scales?

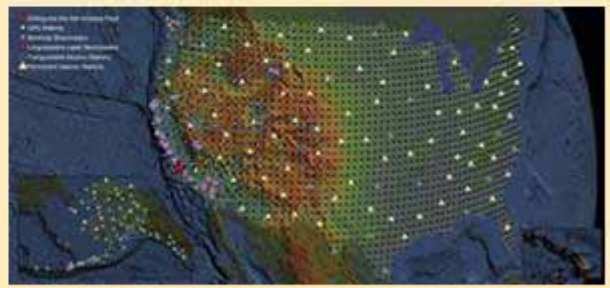
And, what is the pace and pattern of the responses?

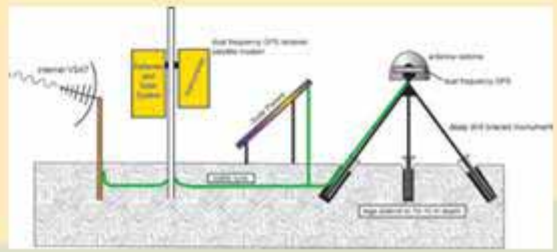
How do the internal responses and feedbacks of biogeochemistry, biodiversity, hydroecology, and biotic structure and function interact with changes in climate, land use, and invasive species? And, how do these feedbacks vary with ecological context and spatial and temporal scales?

Big Science & MREFC

scientific research that requires a massive capital investment, that involves large teams of scientists, and that is expected to yield very significant results—i.e., transform the science

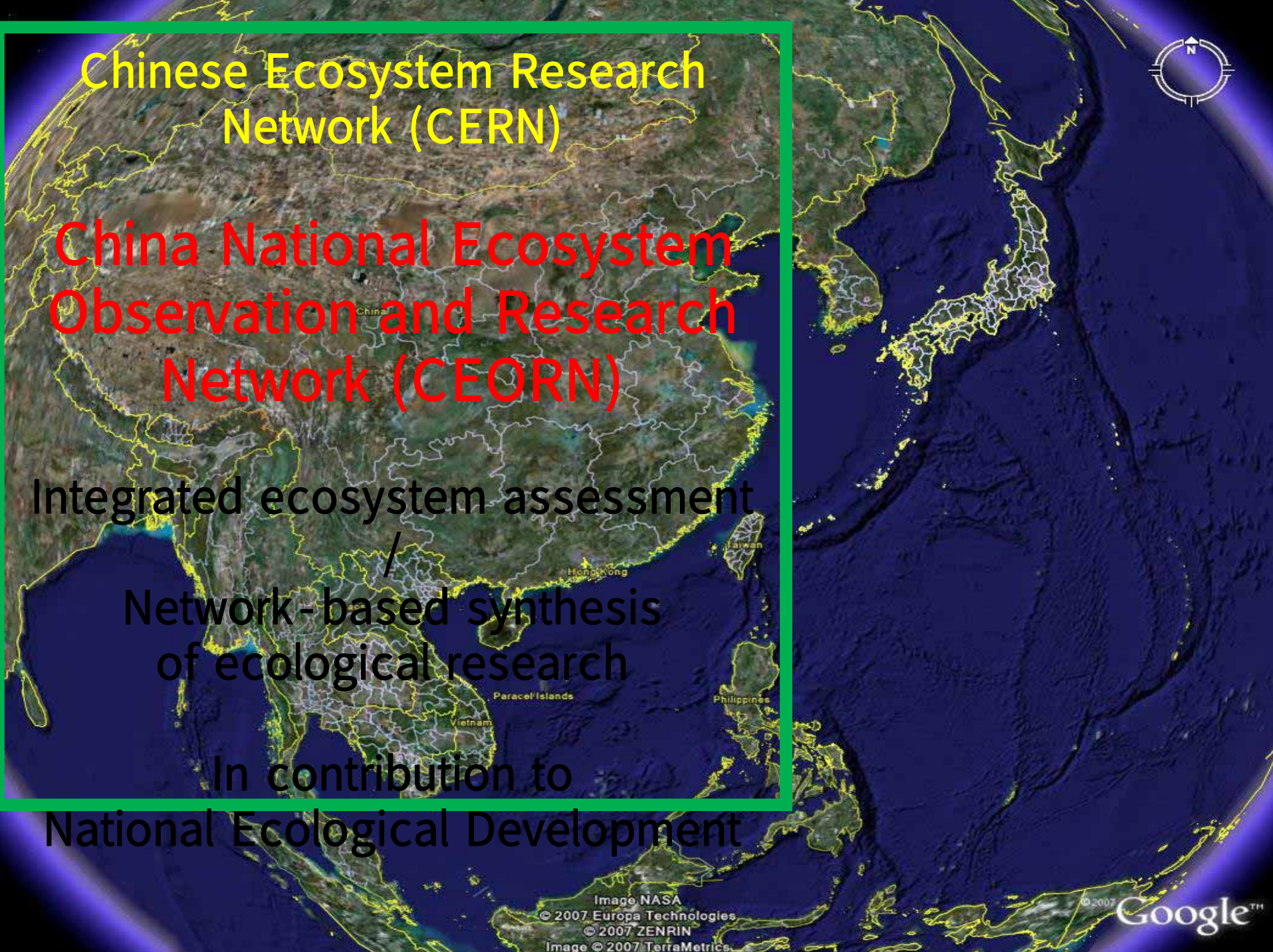






Relationship between LTER and NEON

- Both sponsored by US NSF
- NEON, with bigger size in operation
- NEON for forecasting the future of nature
- LTER sites, being the cores sites of NEON
- Roles of ecologists being expanding


Chinese Ecosystem Research Network (CERN)
China National Ecosystem Observation and Research Network (CEORN)
Integrated ecosystem assessment
/
Network-based synthesis of ecological research
In contribution to National Ecological Development
China
Taiwan
Hong Kong
Paracel Islands
Vietnam
Philippines
Image NASA
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Yes, Opportunities for Ecologists around the Globe for Networking of Ecological Observations

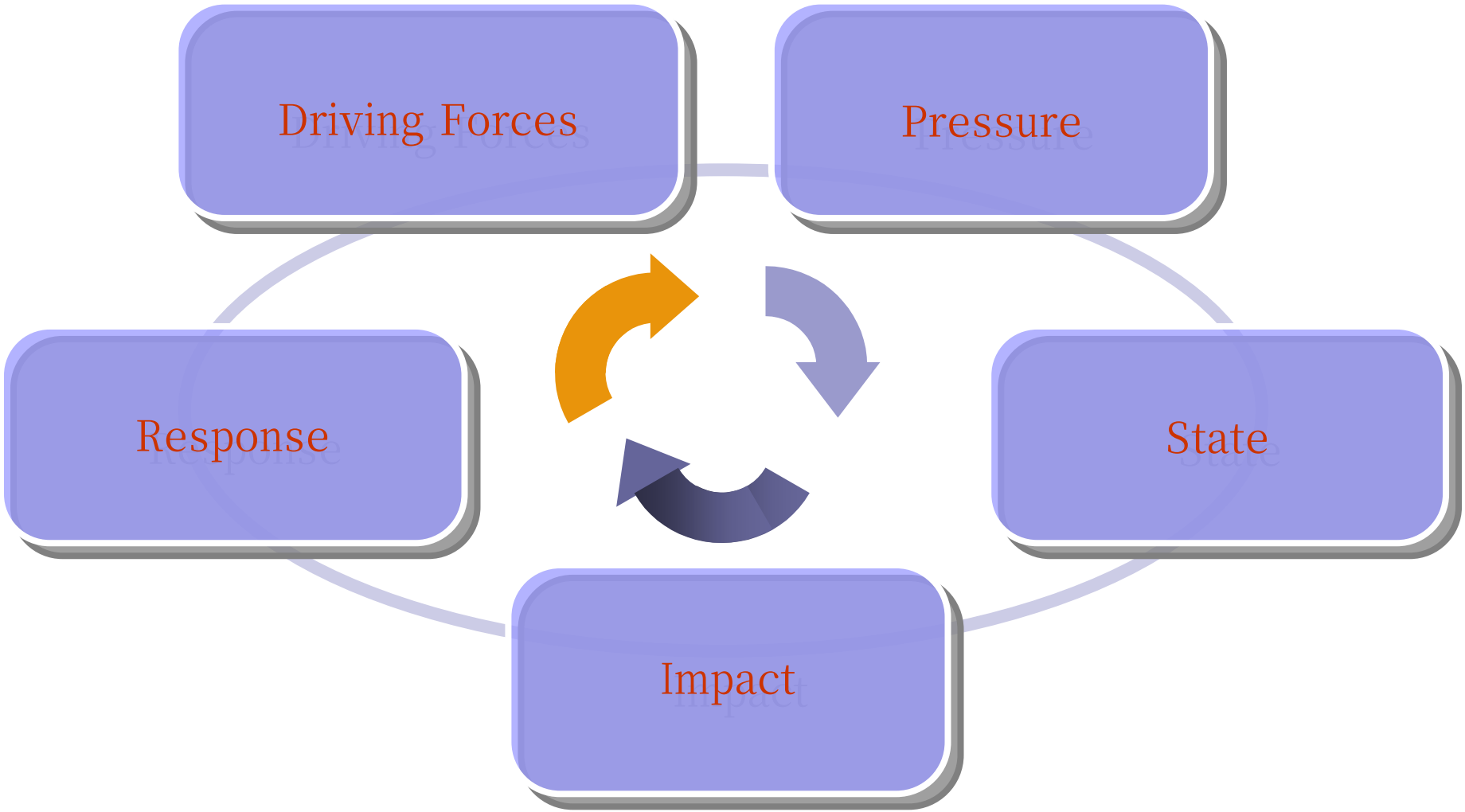
Requirement for success

- Effective Organization
  - Sites
  - Committee
  - Coordination
- Excellence in Scientific Contribution
- Scientific service to General Public
- Devoted to Data Sharing System
- Budget from/and Governmental Support
- Good Facility and Site Conditions
- Sharing Vision and Cooperation
- Structure for International Cooperation

Sequence of Presentation

1. Challenges: Detecting and Adapting to Global Warming
2. Global Warming, Climate Change, and Ecosystem Change: Korea Perspective
3. GEOSS Perspective on Ecosystem Change
4. Opportunities: Networking Observations
5. Further Steps???

Networking and Focused Ecosystem Studies on DPSIR Model for Ecosystem Management



Recommendations

1. **Scientists: Formulate questions, prepare protocols, and establish infrastructure for network activities at local, regional, and global levels**
2. **Governments: Identify and support action groups for networking global ecosystem sciences**
3. **GEOSS: Provide the linkage between scientists and governments and INGOs and provide societies with relevant information for action and decision making on ecosystem change.**

“Acknowledgements”

1. The Ministry of Environment, Republic of Korea
2. GEOSS Work Plan Team, 2005 (Mr. Antti Herlevi; Colima, Mexico)
3. Korea Forest Research Institute (KFRI)
4. Korea National LTER (KNLTER) Group
5. Global Environment Outlook (GEO) - 4

Thank you
for your kind attention!