

PRAGMA 36
22-27 April 2019
Phoenix Hotel
Seopjikoji, Jeju
Korea



Opportunities and Challenges of Ecological Observation in East Asia-Pacific Region

Eun-Shik Kim, PhD
Professor, Kookmin University
President, International Association for Ecology (INTECOL)

A large, dark rock formation with distinct vertical columns and horizontal sedimentary layers. In the foreground, a group of about 15 tourists in colorful outdoor gear are walking across a field of large, light-colored boulders.

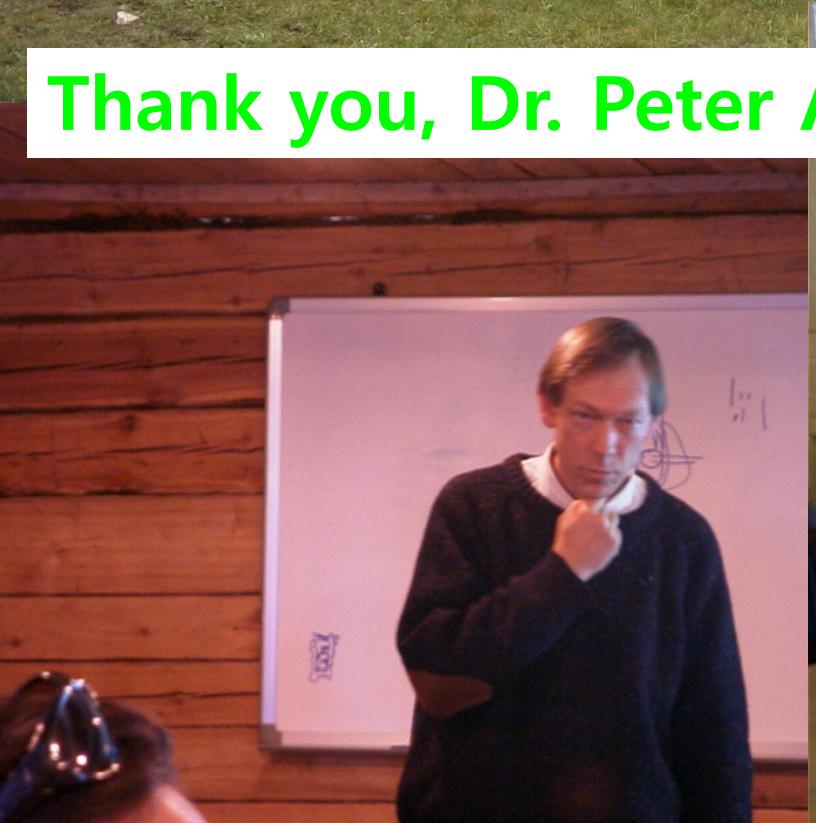
A photo © The Jeju World Natural Heritage Center
Columnar Joint

**UNESCO's Triple Crown
Biosphere Reserve
World Natural Heritage
Global Geopark**

**Jeju Island in the Past
The Island of Stones, Wind, and Women**



Thank you, Dr. Peter Arzberger!!!



Visionary Messages

Stockwell, Arzberger, Fountain, and Helly
at the
3rd ILTER-EAP Regional Meeting

October 1999

Seoul, Korea

An Interface between Computing, Ecology and Biodiversity: Environmental Informatics

Stockwell, David, Peter Arzberger, Tony Fountain, and John Helly
San Diego Supercomputer Center
National Partnership for Advanced Computational Infrastructure, USA

The Motivation

The grand challenge for the 21st century is to harness knowledge of the earth's biological and ecological diversity to understand how they shape global environmental systems. This insight is critical for managing natural resources, sustaining human health, ensuring economic stability, and improving the quality of human life. As the conversion of natural systems to agriculture and urban systems decreases biological and ecological diversity, the need for this information becomes more urgent. In fact, at the current rate of environmental degradation and species extinction, the worldwide biological science community, working with society-at-large, has approximately 50 years or so to answer the challenge of declining diversity and its ramifications, leading Wilson to predict that the coming century will be the century of the environment.

In Pursuit

To progress toward the grand challenge, existing knowledge must first be successfully inventoried. There are several key interrelated strategies for doing so:

- developing a research framework;
- establishing collaborations;
- harnessing technology and;
- aggressively creating educational opportunities.

Areas needed for strategy:

- fundamental research
- cross-domain, interdisciplinary approaches;
- computational and information technologies;
- education

Why is a supercomputing center interested in environmental issues?

Grand Challenges

- Computational Ecology
- Biodiversity Informatics
- Maintaining and Providing Access to Data

Partnerships

- LTER Network Office
- National Partnership for Advanced Computational Infrastructure
- LTER Biological Scale Process Modeling
- Knowledge and Distributed Intelligence (KDI):

Partnership for Biodiversity Informatics:



Thank you, Dr. Bill Chang!!!





October 2013
Seoul, Korea

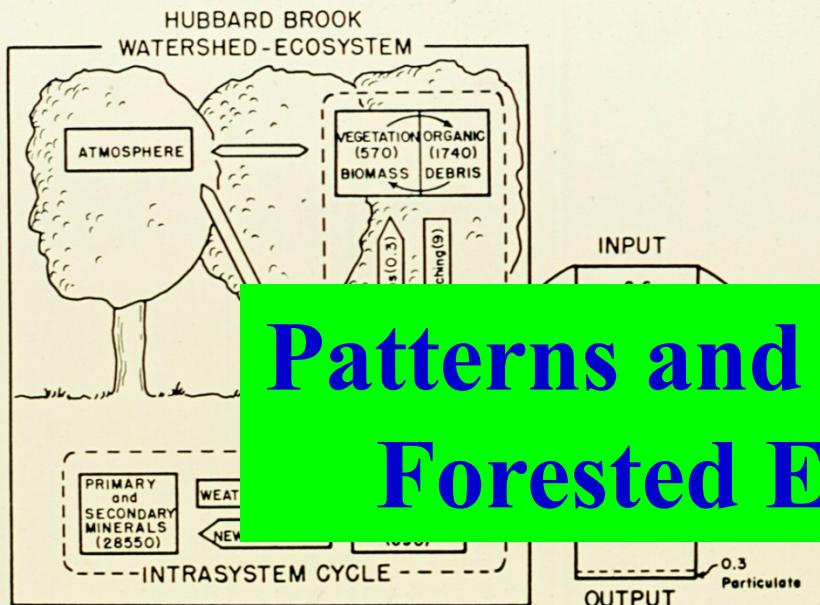
21st
ILTER Annual Meeting

Thank you, Dr. Bill Chang!!!



Sequence of Presentation-1

- **Observation of Biodiversity & Ecosystems in East Asia-Pacific Region**
- **A Case-study Report from Korea LTER Network - A Real-time Observation Platform to Monitor the Changes of a Forest Ecosystem aided by Information and Communication Technology (ICT)**
- **Challenges and Opportunities in Observation of Biodiversity, Ecosystems, and Ecological Sustainability**



Patterns and Processes of Forested Ecosystems



Structure, Function, and Development of Diverse Ecosystems

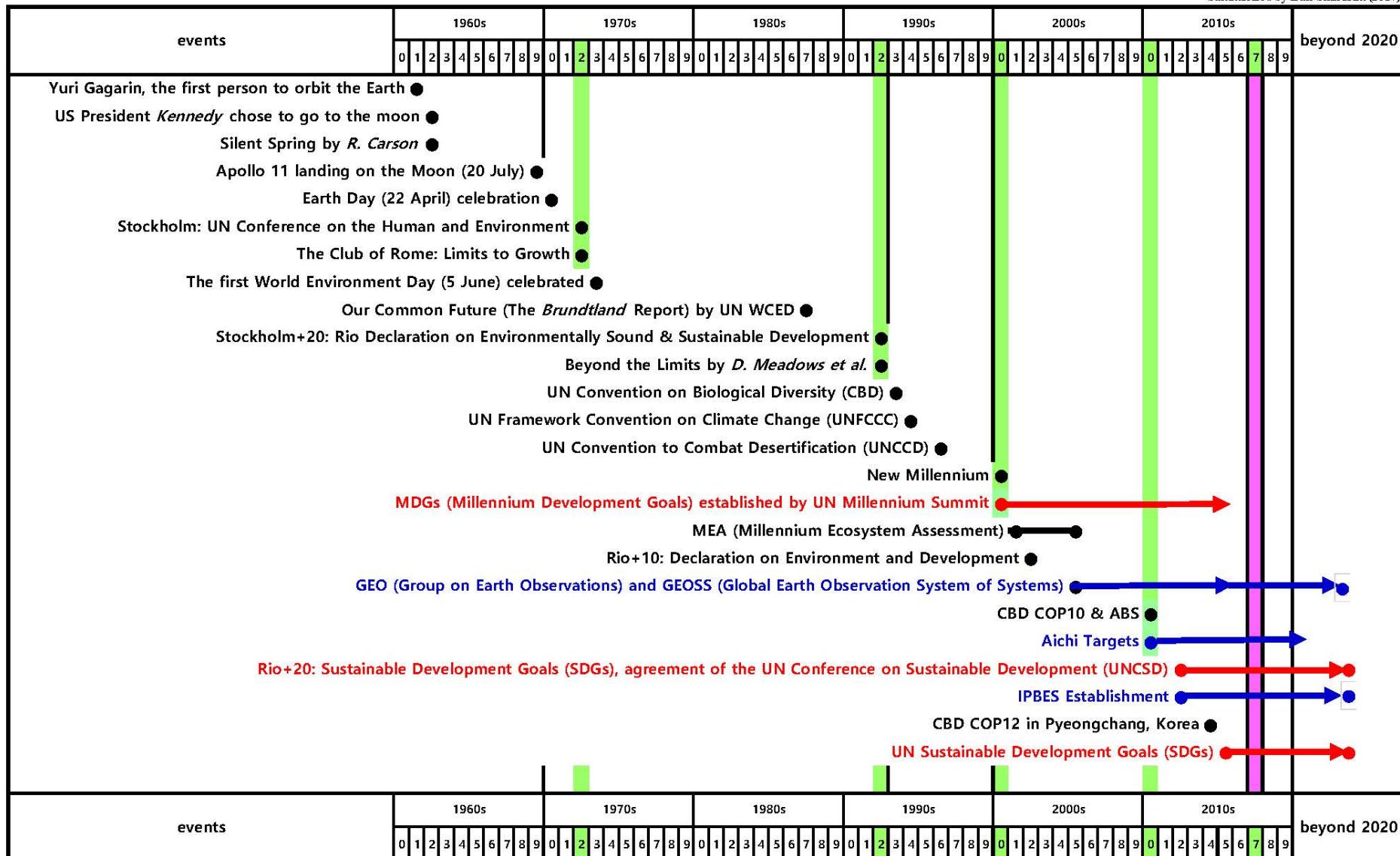


Ecological parameters to consider for sound ecological integration

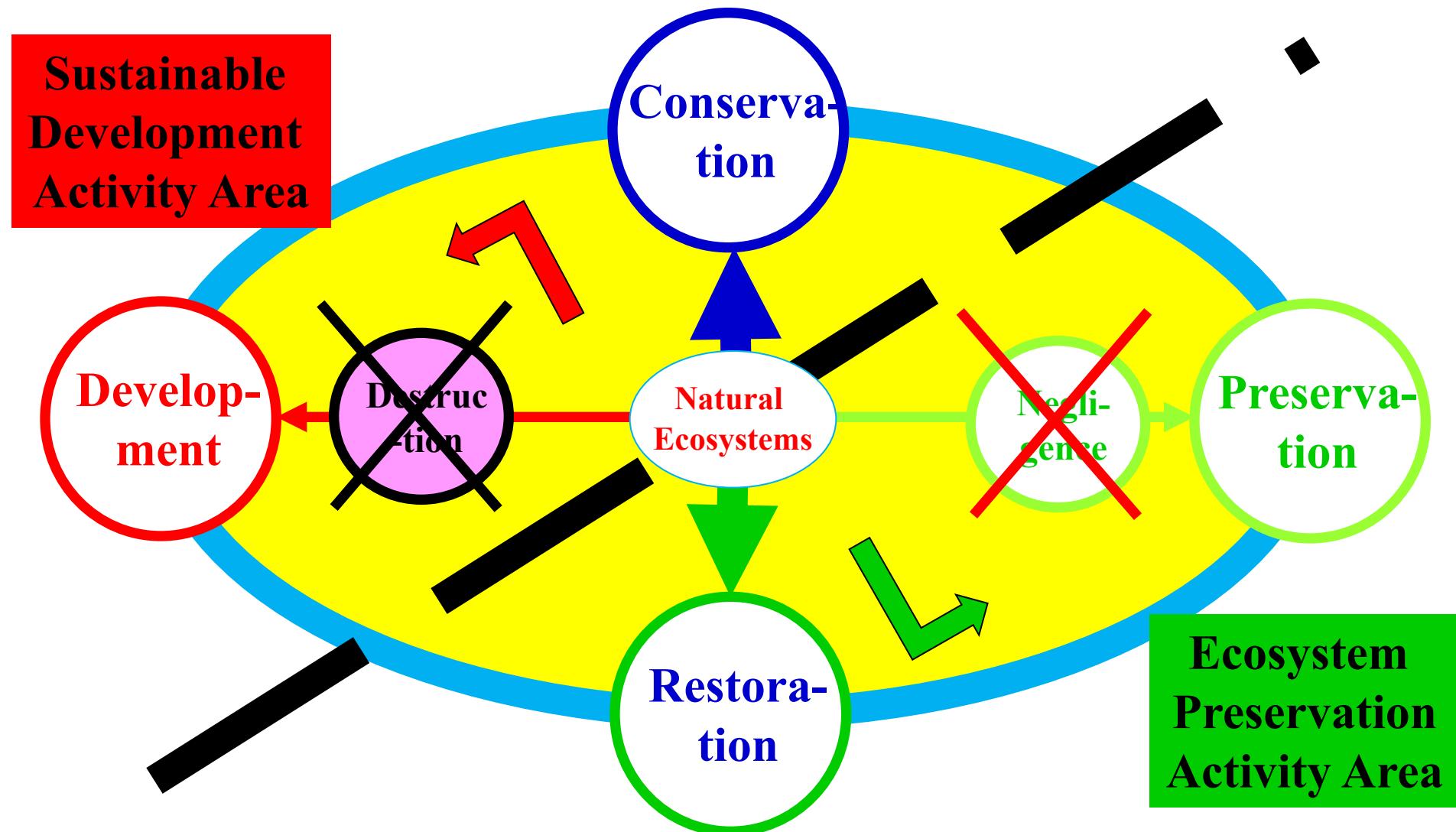
Ecosystems and habitats	Biota and ecosystem components	Ecosystem services	Ecological fields	Ecological impacts on society
<ul style="list-style-type: none"> ✓ Oceans ✓ Tidal flats and coasts ✓ Rivers & streams ✓ Lakes and marshes ✓ Forests ✓ Grasslands ✓ Deserts ✓ Alpine mountains ✓ Tundra ✓ Agro-ecosystems ✓ Urban environments ✓ Industrial environments ✓ ... 	<ul style="list-style-type: none"> ➤ Biotic Components <ul style="list-style-type: none"> - Plants - Animals - Microbes ➤ Abiotic Environment <ul style="list-style-type: none"> - Soil - Atmosphere - Hydrosphere 	<ul style="list-style-type: none"> ❖ Water quality ❖ Food production ❖ Climate regulation ❖ Recreation ❖ Flood prevention ❖ Land protection ❖ Eco-engineering ❖ Air quality 	<ul style="list-style-type: none"> ✓ Biogeography ✓ Population dynamics ✓ Element cycling ✓ Plant-animal interactions ✓ Plant-microbe interactions ✓ Species diversity ✓ Functional diversity ✓ Global change ✓ Trophic interactions ✓ Energy flow ✓ Primary production ✓ Decomposition ✓ Development and succession ✓ Habitat fragmentation ✓ Invasions ✓ Ecophysiology ✓ Theory and modeling ✓ Molecular ecology ✓ Ecotoxicology 	<ul style="list-style-type: none"> <input type="checkbox"/> Decision making <input type="checkbox"/> Education <input type="checkbox"/> Policy development <input type="checkbox"/> Ethics <input type="checkbox"/> NGO activity <input type="checkbox"/> EIA
landscape elements	biodiversity	ecosystem functions	ecological science	ecological sustainability

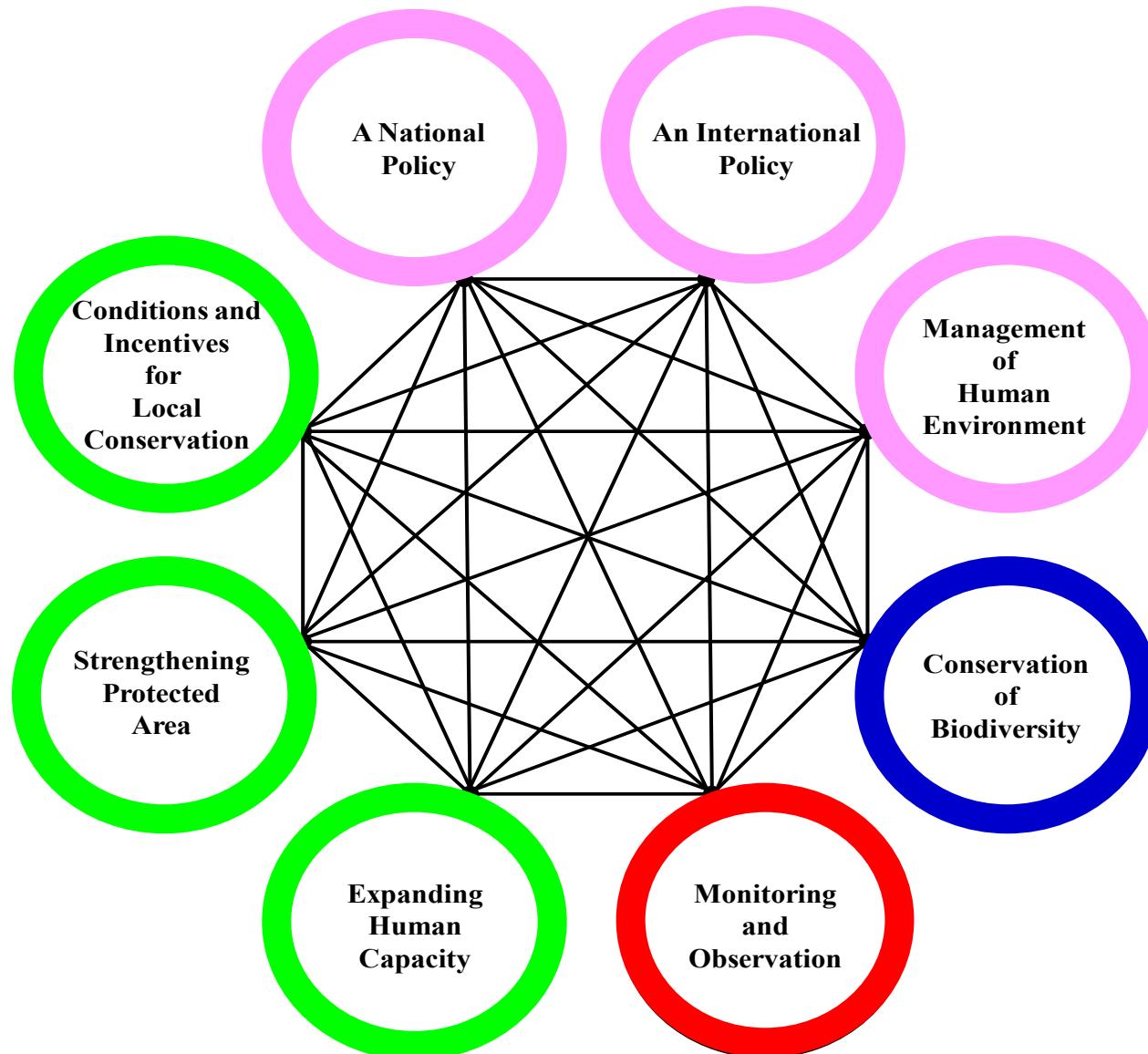
Historical Development of International Initiatives for Biodiversity, Ecosystems and Ecological Sustainability (BEES)

Summarized by Eun-Shik Kim (2017)



Sustainable Management Model on Natural Ecosystems for RUDL





Eight strategy areas for catalyzing action for the conservation of biodiversity

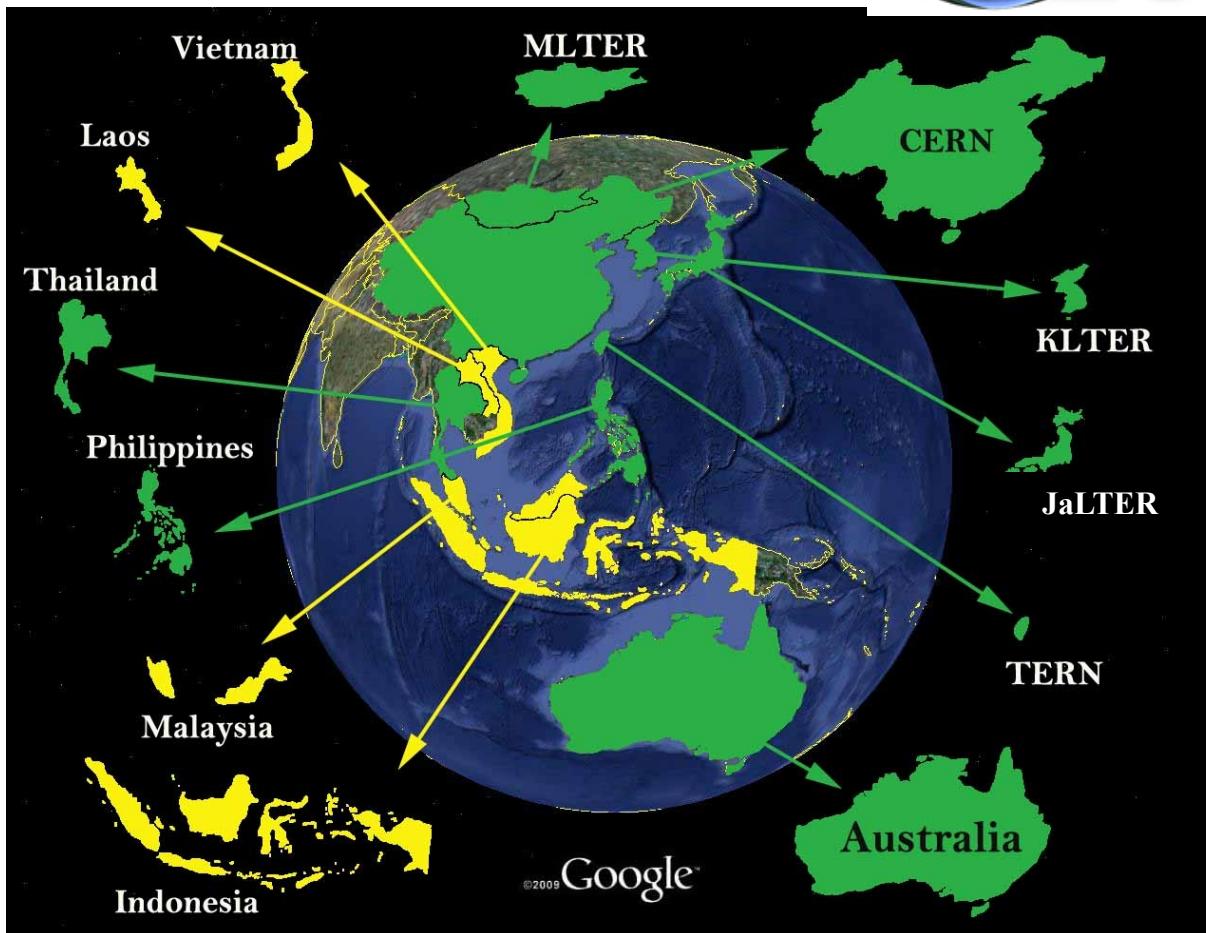
-

(ES Kim, 2012)



Thank you, Dr. Hen-biau King!!!

ILTER East Asia-Pacific Region



9 Formal ILTER members

3 Associate ILTER members

Science Committee

Information Management
Committee

Key data: current network status

- **Members**
 - **9 formal ILTER member networks**
 - **3 associate ILTER regional member networks**
- **Facilities**
 - **137/178 LTER sites (accredited sites/total sites)**
Australia TERN 26/28 sites (1000+); China CERN 42/44 sites (2,000+); JaLTER 42/57 sites (200+);
Korea LTER 10/22 sites (250); **Laos 1**; Malaysia LTER 1/4 sites (60+); Mongolia LTER 1 site (50);
Philippines 14 sites (30+); Taiwan TERN 9 sites (20+); Thailand 2 sites (30); **Vietnam LTER 0/2 sites (30+)**
- **Size of community**
 - $\approx 3,600$
- **Key Strength**
 - **CERN showcases strong membership development**
 - **JaLTER showcases the advances in science and steadiness in promotion of the network**
 - **Australian LTER Network-TERN needs to be developed to a secure & advanced network**

Regional Network of ILTER/EAP

Intl. Conferences

since its Establishment

12th Taiwan LTER
14-19 October 2018





Participants to the 10th Biennial Conference of the ILTER EAP

Information Management Workshops ILTER-EAP Regional Network (Photos: Chau Chin LIN)



Beijing, China 2005



Taipei, Taiwan 2006



Seoul, Korea 2007



Manila, Philippines 2014

Host Networks of ILTER Annual Meetings

2013, 21st ILTER Annual Meeting held in Korea

1993	US	1994	UK	1995	Hungary
1996	Panama/ Costa Rica	1997	Taiwan	1998	Italy
1999	South Africa	2000	US	2001	UK
2002	Canada	2003	US	2004	Brazil
2005	Mexico	2006	Namibia	2007	China
2008	Slovakia	2009	Australia	2010	Israel
2011	Japan	2012	Portugal	2013	Korea
2014	Chile	2015	Italy	2016	South Africa
2017	France	2018	Taiwan	2019	Germany

Asia-Pacific Biodiversity Observation Network (AP BON)



APBON

- Link and relationship with Group on Earth Observation and GEOBON
- History of APBON and Network Activities, Publications, resolution in Jeju WCC
- Concept of Implementation through a network
- APBON Visions: coordinated network that promotes data sharing, provides tools to enable biodiversity observations and contribute to BD management, sustainable use
- Next steps: improve and support governance and collaboration, products
 - Project S9 is concluding, New GEO Strat plan 2016-2025
 - APBON's Niche: why, what, where questions, alignments with IPBES, SDGs
 - Promoting national BONs, strengthening of cooperation
- Future and Potential Products
 - IPBES assessments
 - Monitoring by citizen scientists
 - Distribution modelling

History of AP BON and Other Network Activities						
Year	GEOSS AP Symposia	GEO BON	AP BON Meetings	National BONs	CBD COPs	IPBES
2007	1st GEOSS AP					
2009	2nd GEOSS AP	GEO BON Conference			COP9	
2009	3rd GEOSS AP (Doha, Qatar)	1st AP BON (Doha, Japan) and AP BON (Doha, Qatar)			Japan BON (May)	
2010	4th GEOSS AP (Session: Bali, March)	GEO BON Meeting (February, USA)	1st AP BON (COP10, Doha, Qatar) and AP BON (Doha, Qatar)		COP10 (Japan, Side-event)	
2011	5th GEOSS AP (Tokyo, April)		4th AP BON (Daejeon, Korea)	Korea BON; Nepal BON; Bangladesh BON	COP11 (India, Side-event)	
2012	6th GEOSS AP (Abu Dhabi, February)		5th AP BON (Nagoya, ACS, Japan)	Philippines BON	Plenary-1	
2014	7th GEOSS AP (Tokyo, May)	IC and AB (Ume, Germany)	6th AP BON (Kwonsan, Korea)		COP12 (Korea, Side-event)	Plenary-2
2015	8th GEOSS AP (Beijing, September)	IC and AB (Ume, Germany)		Sime BON, Indonesia BON		Plenary-3
2016	A new AP BON Strategic Plan Initiated	All-Hands Meeting (Görl, Germany)	7th AP BON (Aege, Thailand)	IUCN of IUCN (September, USA)	COP13 (December, Mexico)	Plenary-4

Publications of AP-BON Book



Source: Dr. Sheila Vergara of ASEAN Centre for Biodiversity

Asia-Pacific Biodiversity Observation Network (AP BON)



Biodiversity for Sustainable Development

AP-BON
Asia Pacific Biodiversity Observation Network

7th Meeting
of the Asia-Pacific
Biodiversity
Observation
Network



19-20 February 2016
Centara Watergate Pavilion Hotel Bangkok



7th Meeting of the Asia-Pacific Biodiversity Observation Network

Source: Dr. Sheila Vergara of ASEAN Centre for Biodiversity

Freshwater monitoring research in Korea

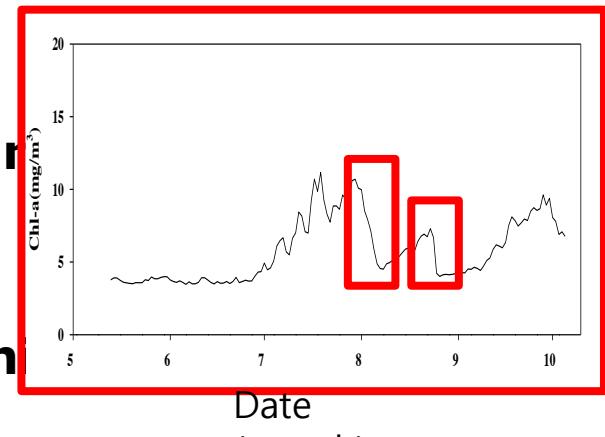
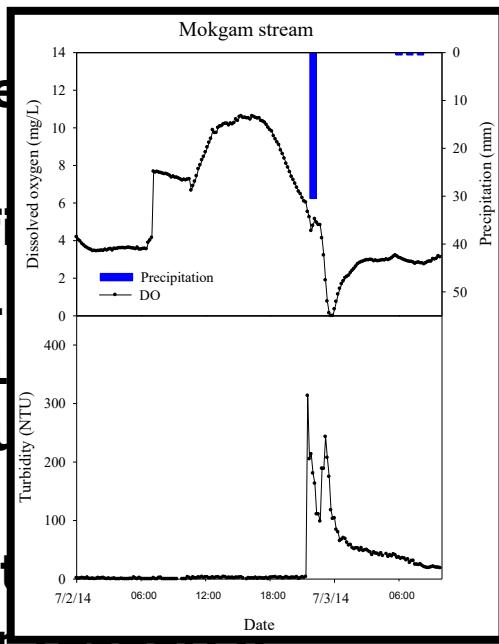
Sensor monitoring in freshwater

- Reservoirs – algal blooms
- Urban streams – flow
- Encouraged by GLONET

GLEON 17 meeting (2015)

- Hosted by Bomchul Kim

New paradigms of aquaculture topics for further research



Term variation

Source: Prof. B. Kim, Kangwon National University, Korea



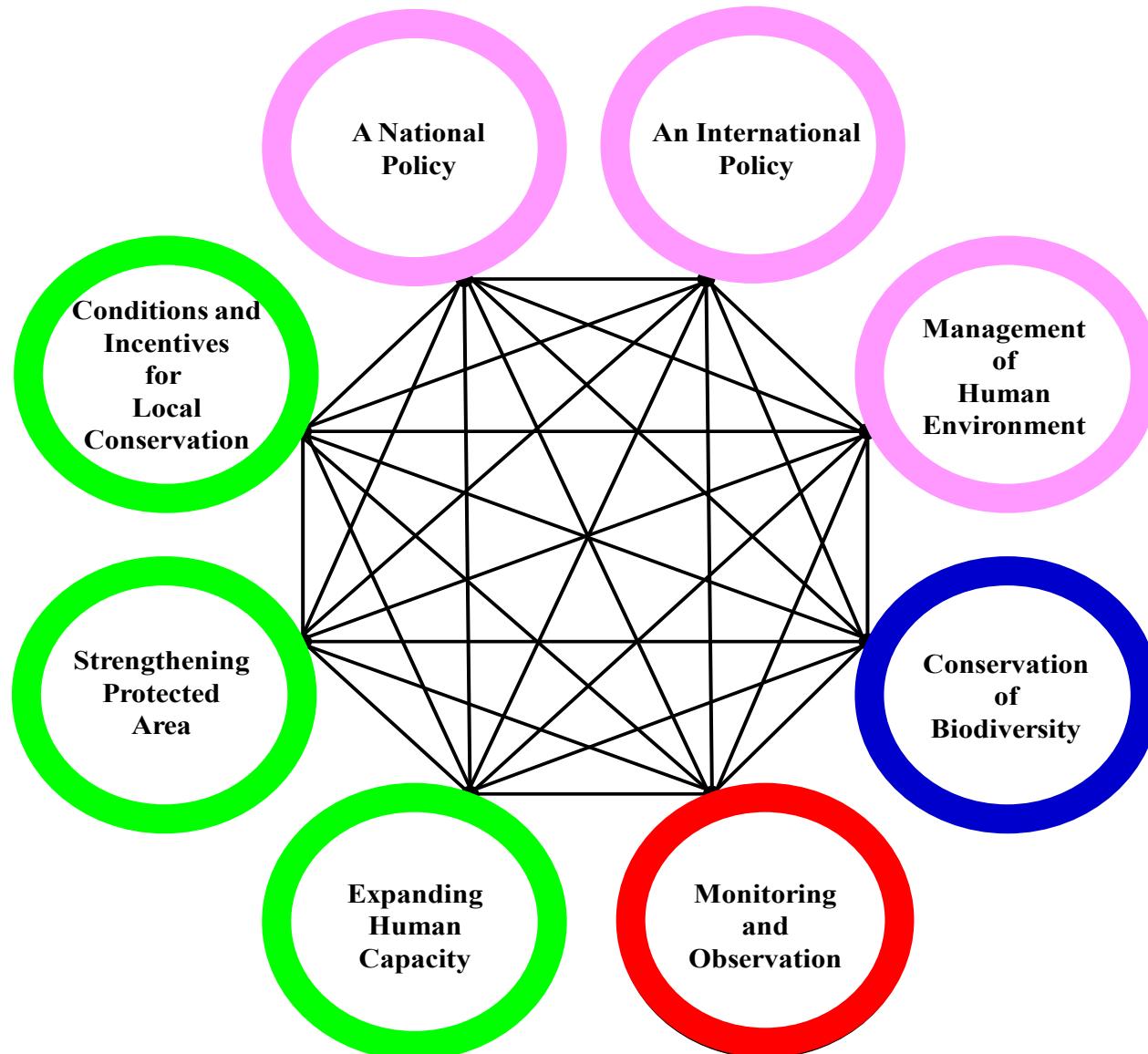


Source: Dr. B. Ahn, KISTI, Korea

Korea e-Science Forum

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Eight strategy areas for catalyzing action for the conservation of biodiversity

- (ES Kim, 2012)

Mt. Hallasan and Korean fir trees

Photos taken in 1994 by ES Kim



Trees fallen by wind growing on shallow soils

A photo taken in 2013 by ES Kim





A photo taken in 2013 by ES Kim



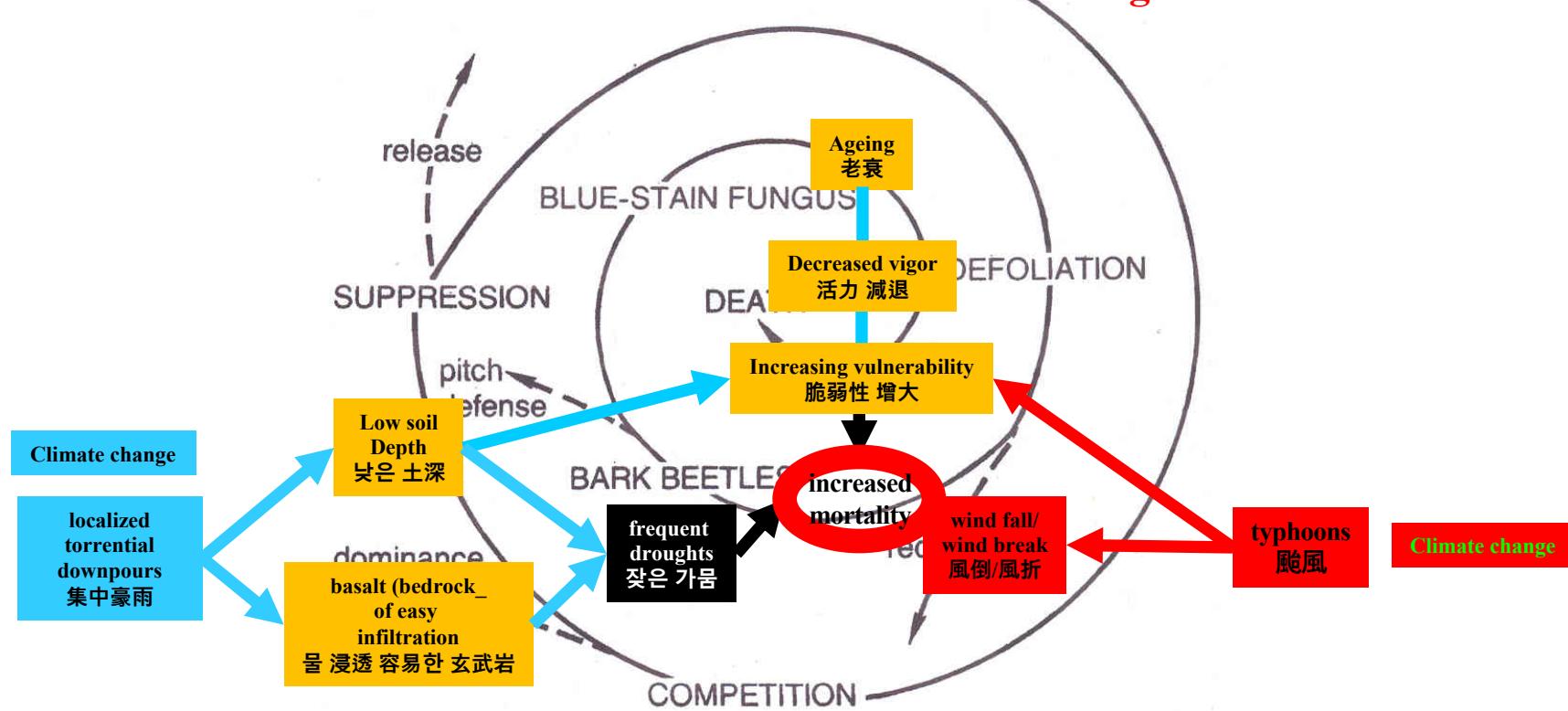
Photo: Eun-Shik Kim

Further Understandings are needed on the Decline Mechanism of old Korean fir trees under changing climate regimes

素因: Predisposing factors

誘因: Inciting factors

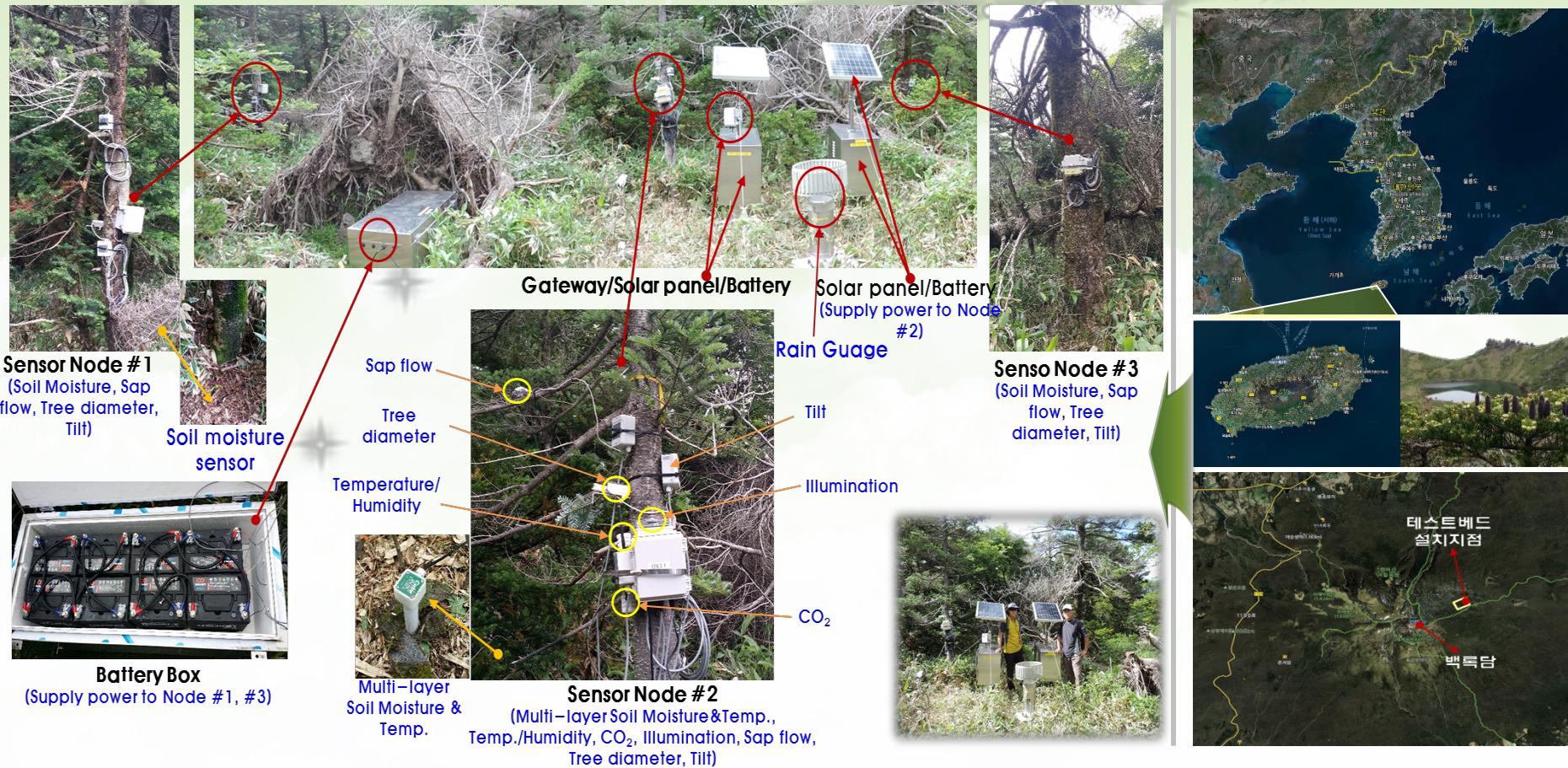
動因: Contributing factors



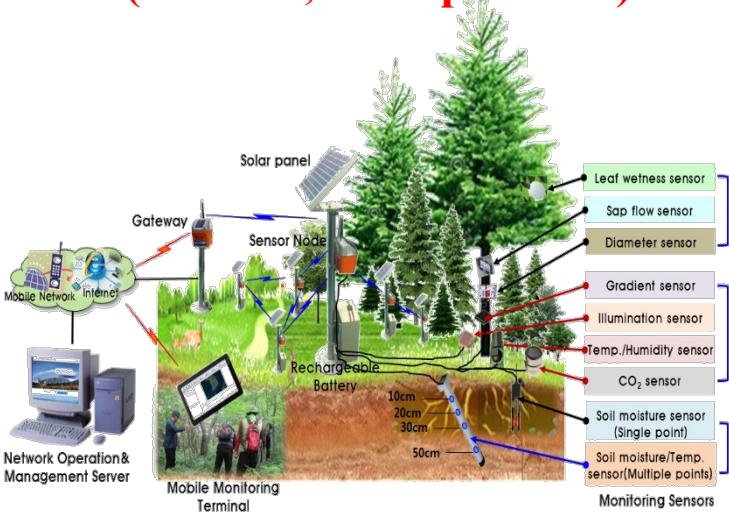
Conceptual Image



IoT based monitoring system development



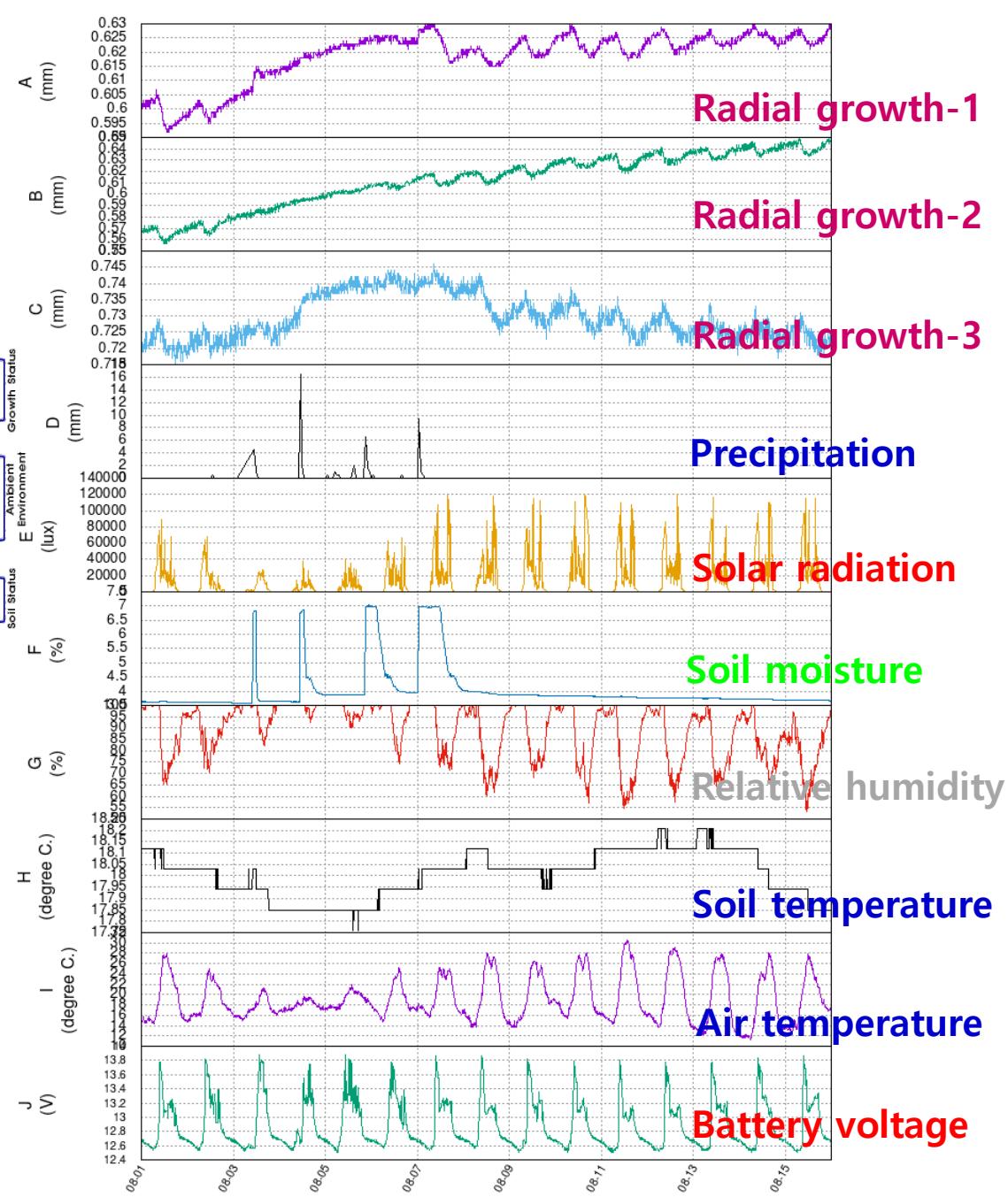
Real-time Monitoring System and the Sensor Network (wireless, solar powered)



Questions to Address

- the time when the radial growth initiated for the season;
- the time when the radial growth ceased for the season;
- the length of days for the radial growth for the season;
- the factors that are related to the initiation of radial increment for the season;
- the factors that are related to the fluctuation of radial increment for the season; and
- the factors that are related to the cessation of radial increment for the season.

- The relationships among the factors at the forest site



Real-time Monitoring System and the Sensor Network (wireless, solar powered)

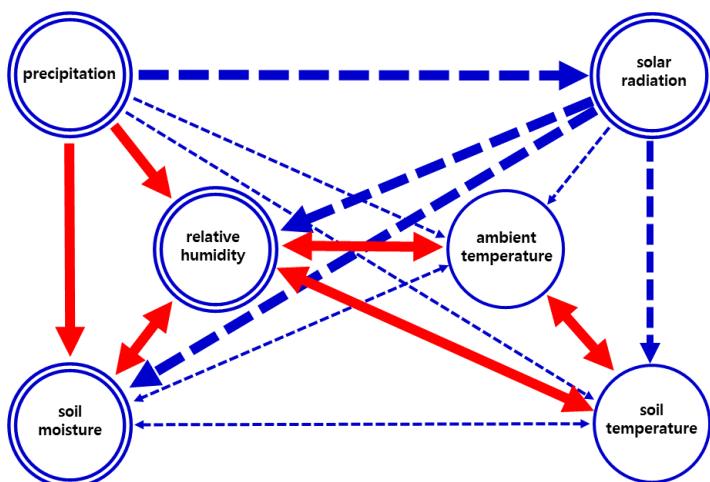
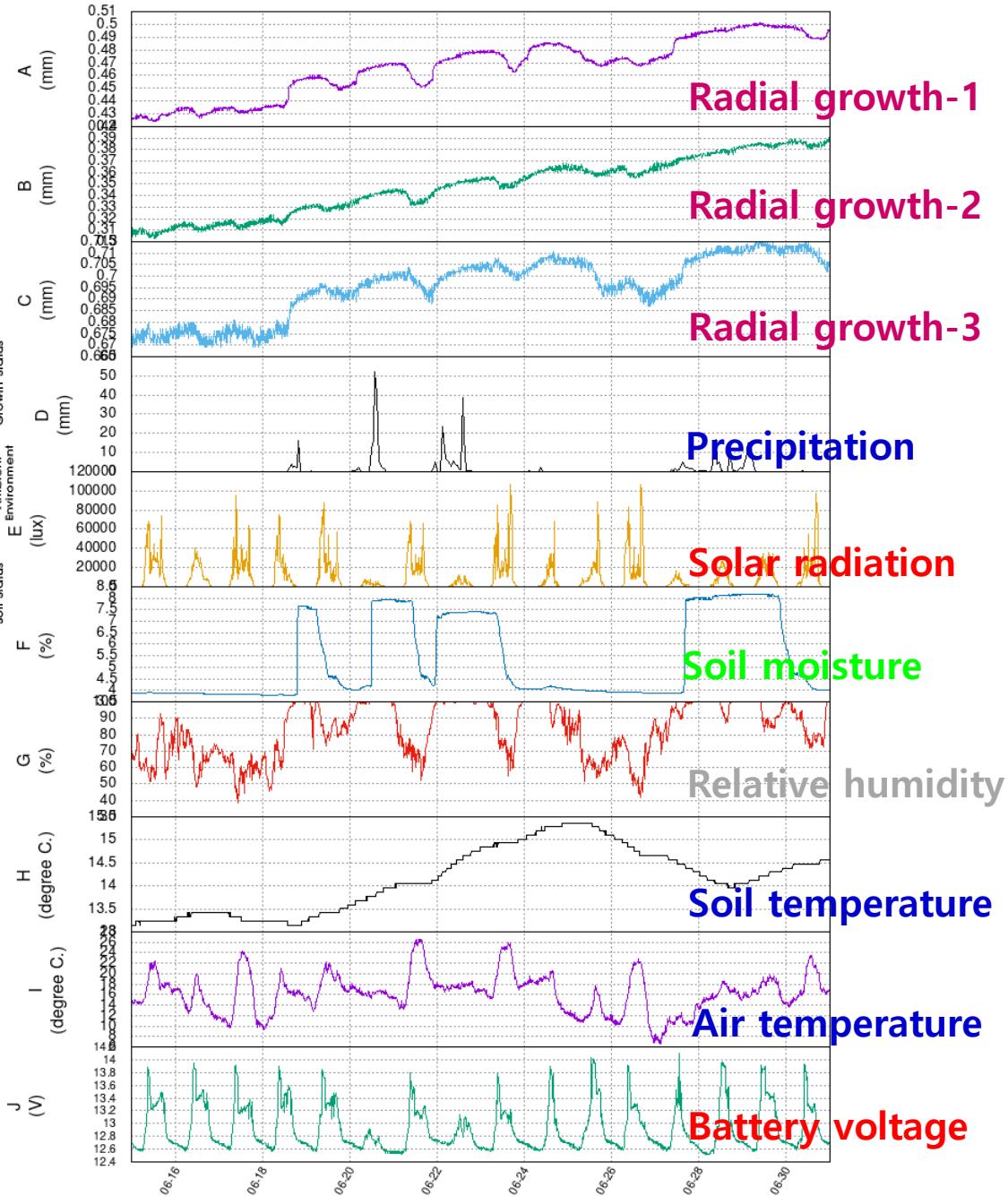
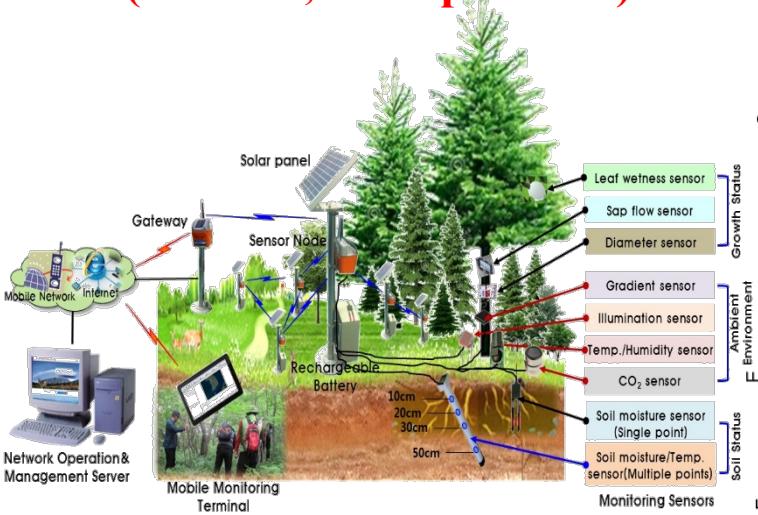
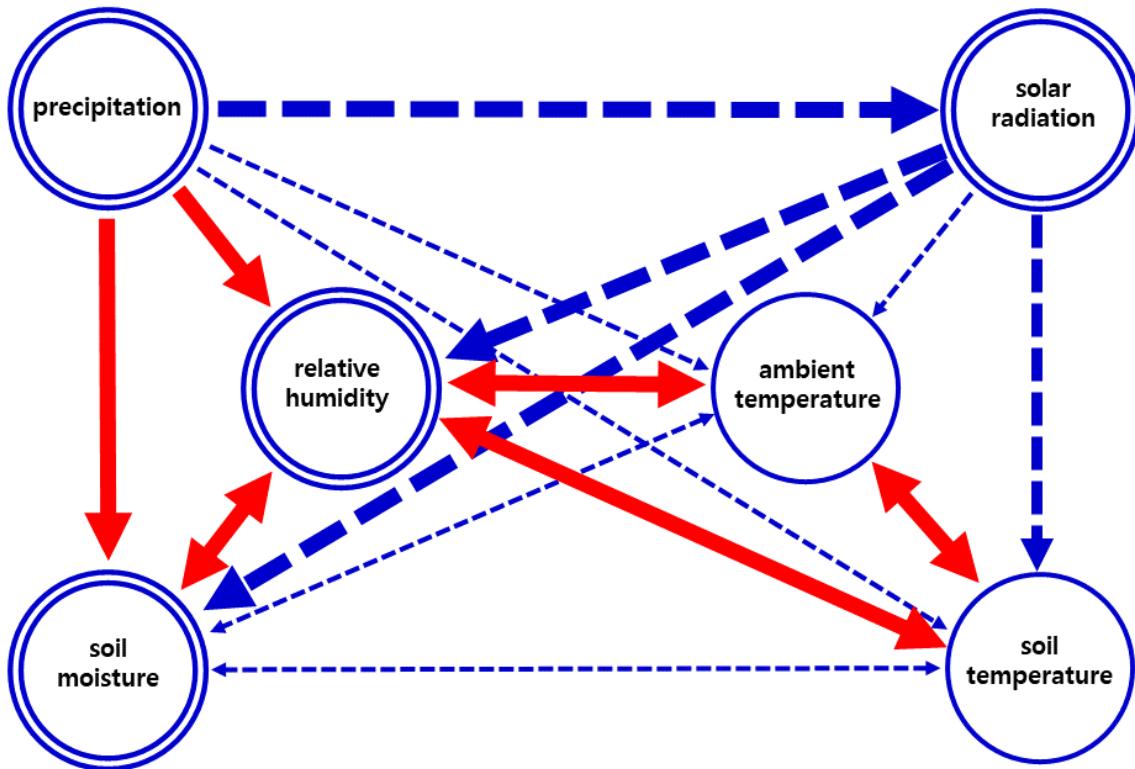


Diagram showing the interrelationships among the environmental factors that affect the radial growth of trees at the study site, Jeju, Korea.



circles with double lines indicate abruptly fluctuating environmental factors;
circles with single line indicate gradually changing environmental factors;

solid lines (in red) indicate positive effects;
dashed lines (in blue) indicate negative effects;

thick lines indicate major and/or direct effects; thin lines indicate minor and/or indirect effects;

arrows show the directions of the affecting natures between the factors.

Real-time Monitoring System and the Sensor Network
(wireless, solar powered)

Sequence of Presentation-3

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Visionary Messages

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October 1999 , Seoul, Korea**

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Stockwell, David, Peter Arzberger, Tony Fountain, and John Helly

San Diego Supercomputer Center

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In Pursuit

To progress toward the grand challenge, existing knowledge must first be successfully inventoried. There are several key interrelated strategies for doing so:

- developing a research framework;
- establishing collaborations;
- harnessing technology and;
- aggressively creating educational opportunities.



새천년 생태계 영향평가 요약

Millennium Ecosystem Assessment Findings

www.millenniumassessment.org | Strengthening Capacity to Manage Ecosystems Sustainably for Human Well-Being

Focus: Ecosystem Services

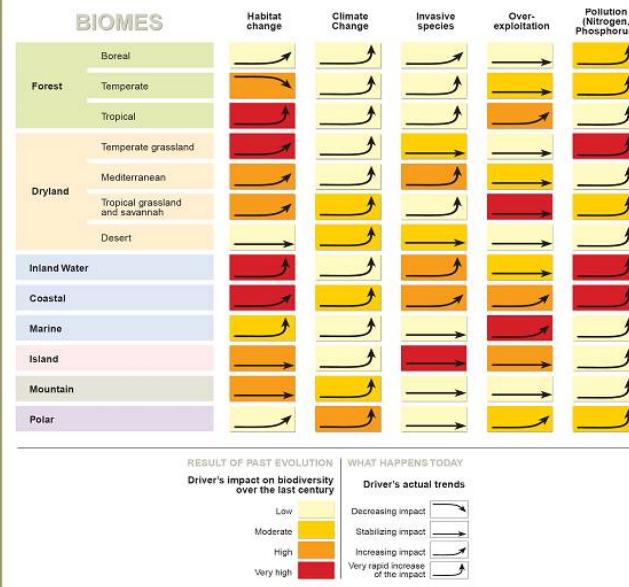
The benefits people obtain from ecosystems:



MA Findings - Outline

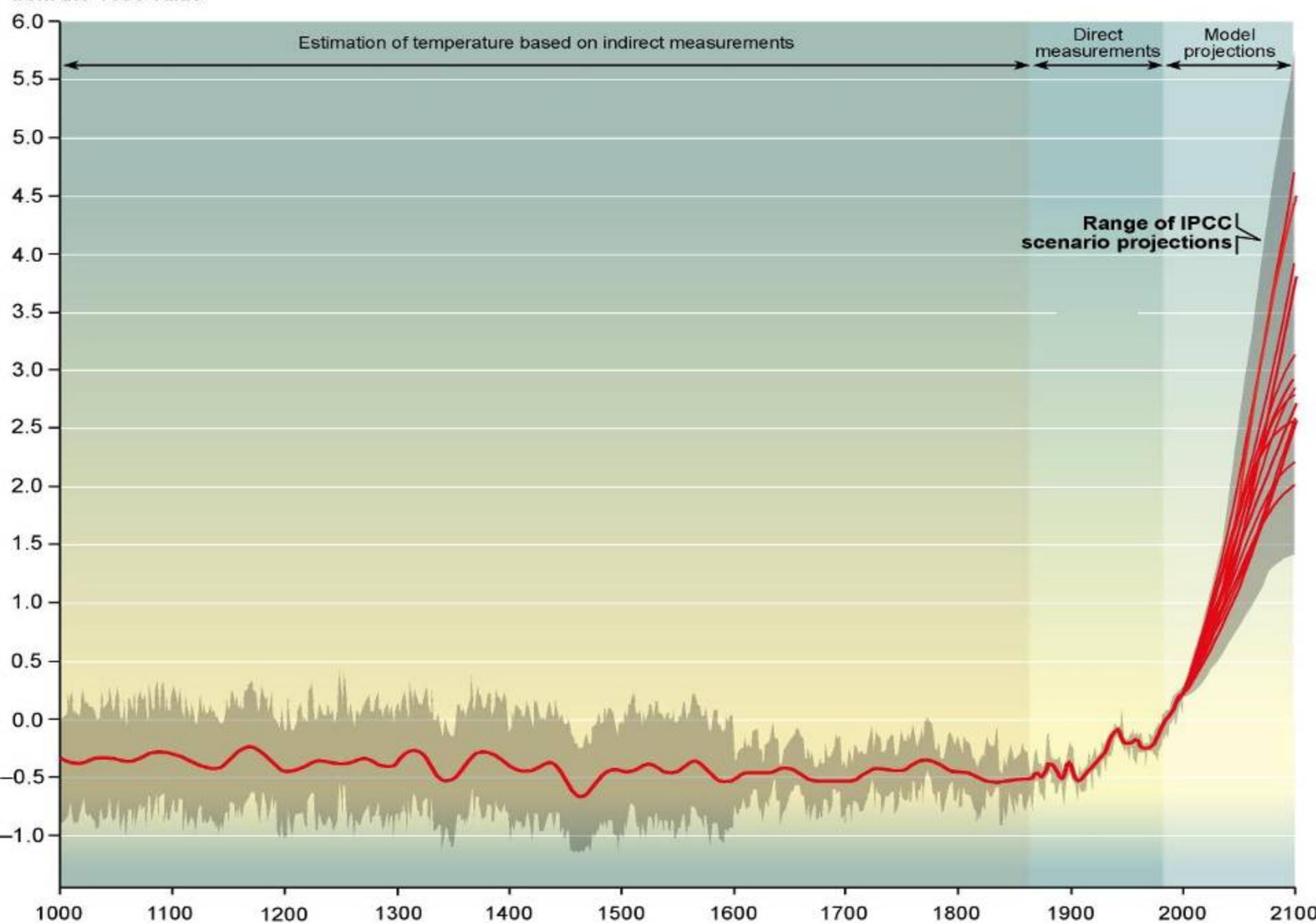
1. Ecosystem Changes in Last 50 Years
2. Gains and Losses from Ecosystem Change
- Three major problems will decrease long-term benefits
 - Degradation of Ecosystem Services
 - Increased Likelihood of Nonlinear Changes
 - Exacerbation of Poverty for Some People
3. Ecosystem Prospects for Next 50 Years
4. Reversing Ecosystem Degradation

Direct drivers growing in intensity



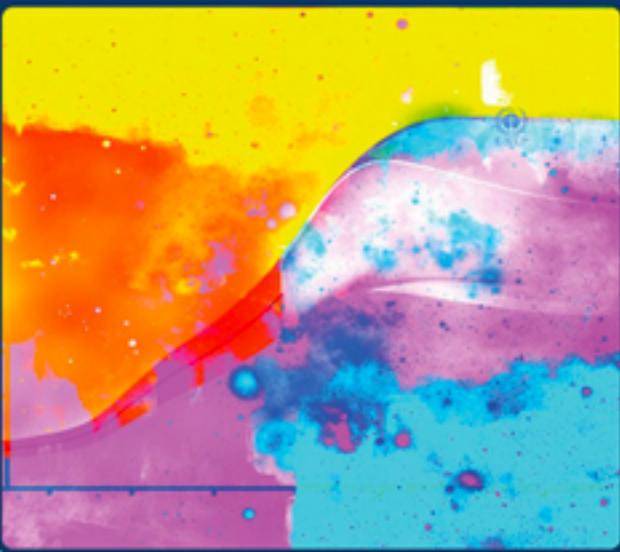
Most direct drivers of degradation in ecosystem services remain constant or are growing in intensity in most ecosystems

Differences in temperature in °Celsius from the 1990 value



Global Warming of 1.5°C

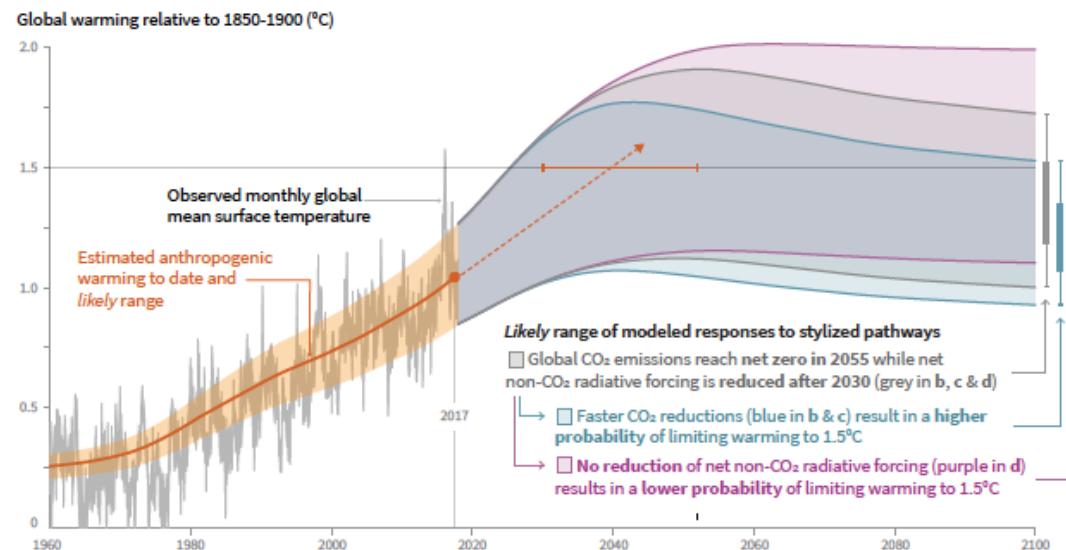
An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.



IPCC says limiting global warming to 1.5 °C will require drastic action

Cumulative emissions of CO₂ and future non-CO₂ radiative forcing determine the probability of limiting warming to 1.5°C

a) Observed global temperature change and modeled responses to stylized anthropogenic emission and forcing pathways



The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015

1 NO POVERTY



2 ZERO HUNGER



3 GOOD HEALTH AND WELL-BEING



4 QUALITY EDUCATION



5 GENDER EQUALITY



6 CLEAN WATER AND SANITATION



7 AFFORDABLE AND CLEAN ENERGY



8 DECENT WORK AND ECONOMIC GROWTH



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



10 REDUCED INEQUALITIES



11 SUSTAINABLE CITIES AND COMMUNITIES



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



13 CLIMATE ACTION



14 LIFE BELOW WATER



15 LIFE ON LAND

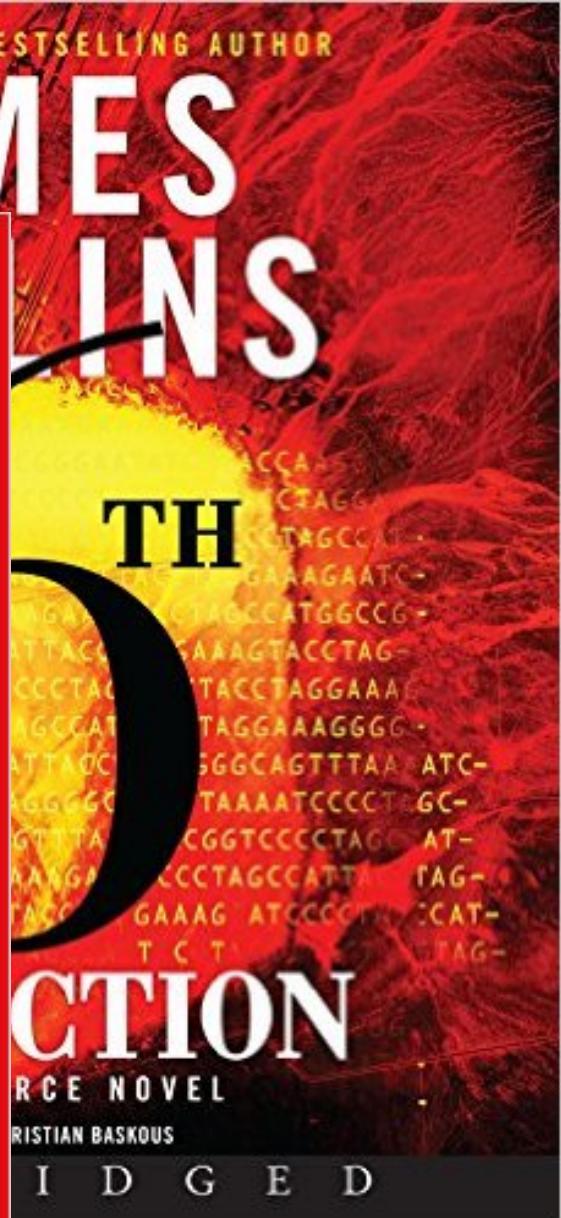
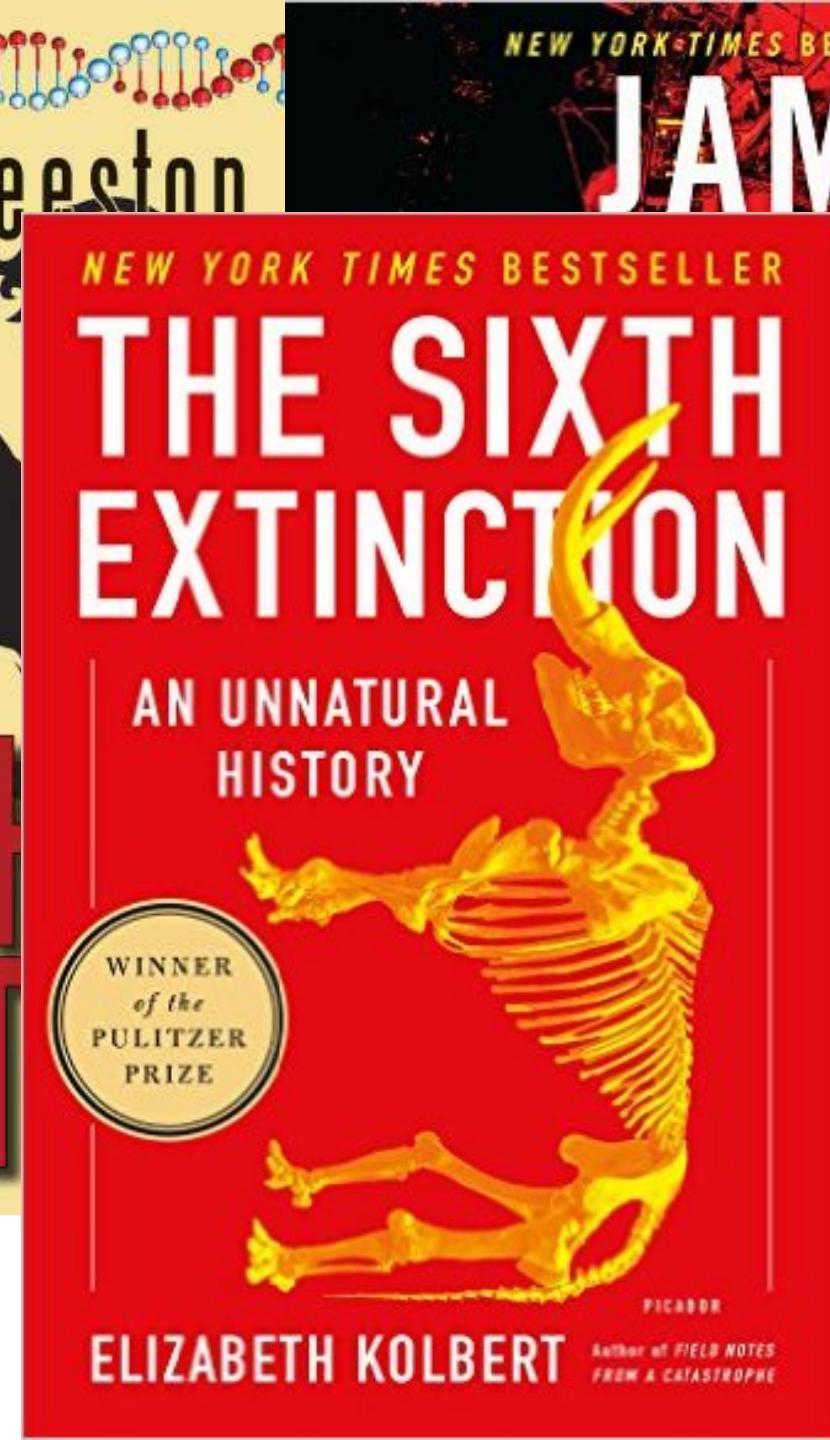
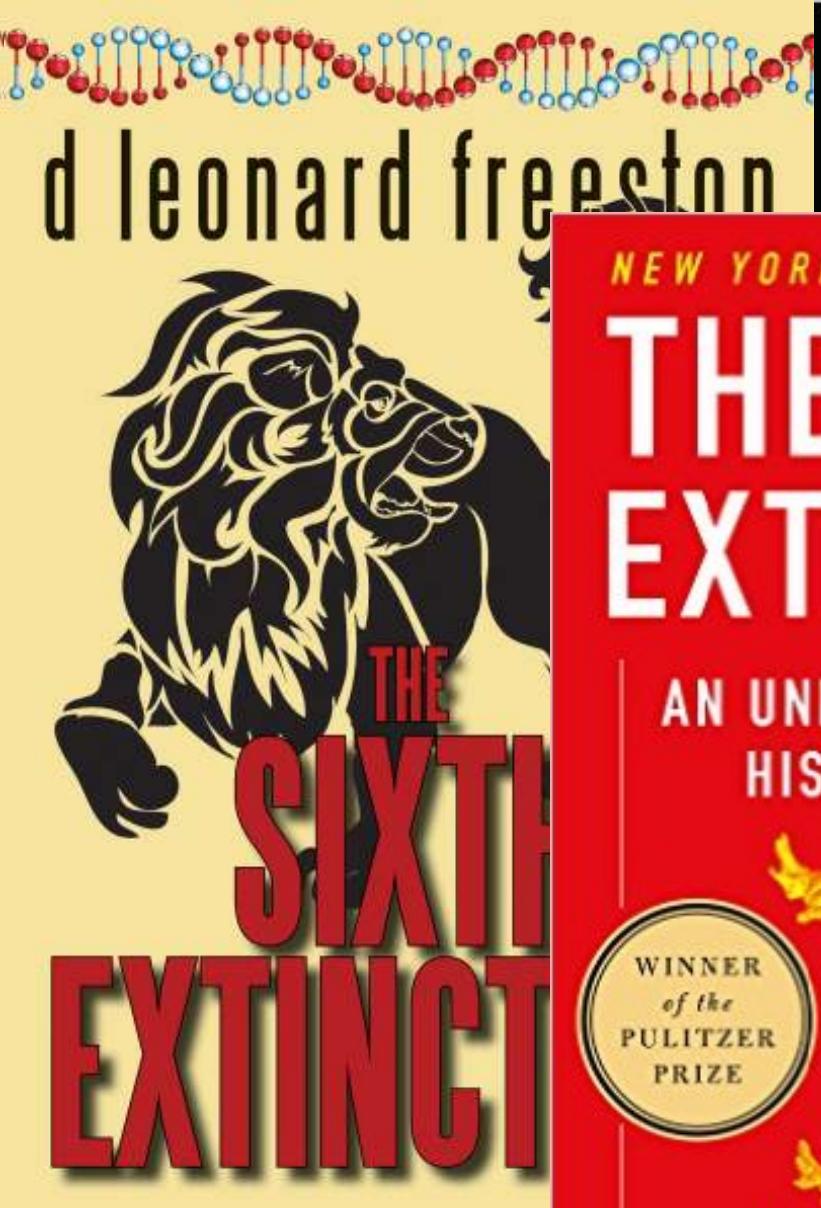


16 PEACE, JUSTICE AND STRONG INSTITUTIONS



17 PARTNERSHIPS FOR THE GOALS

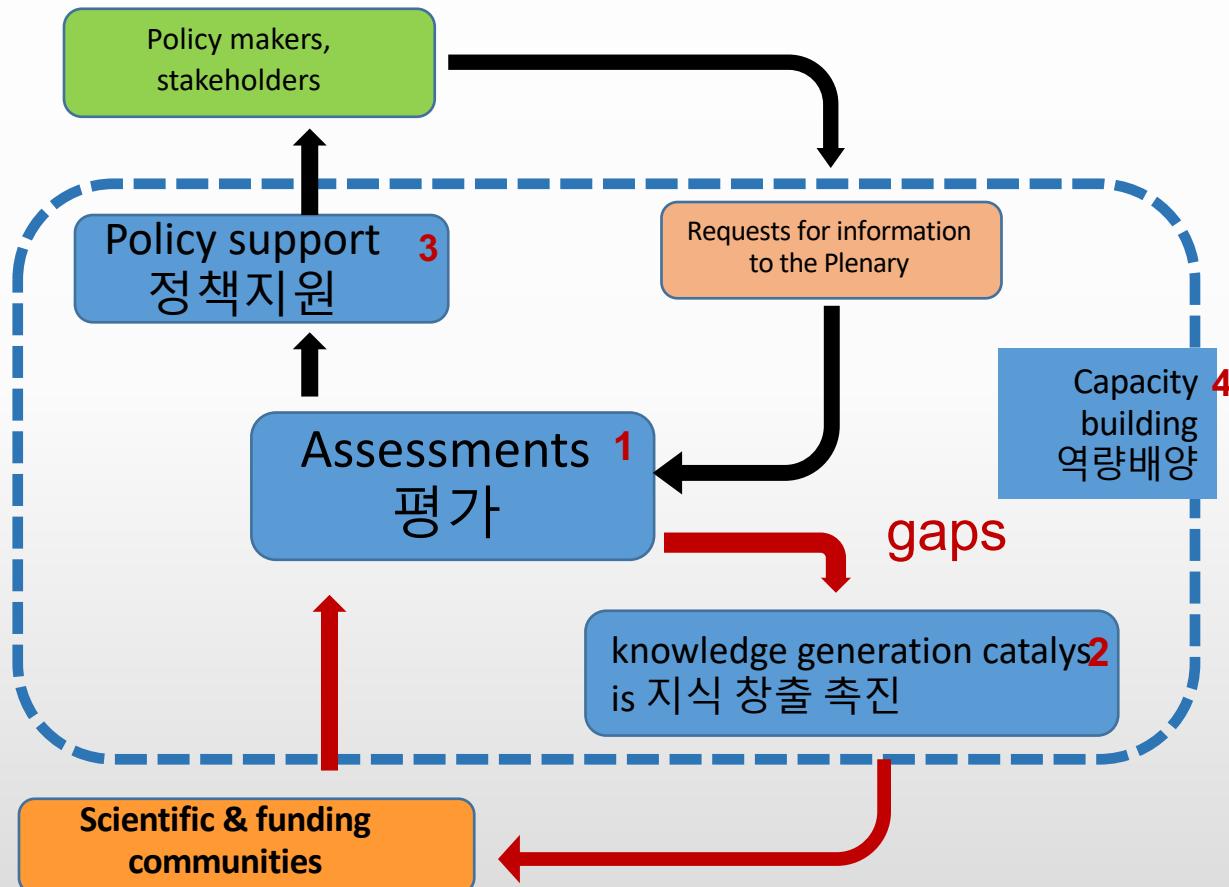




Disasters Human Species Faces

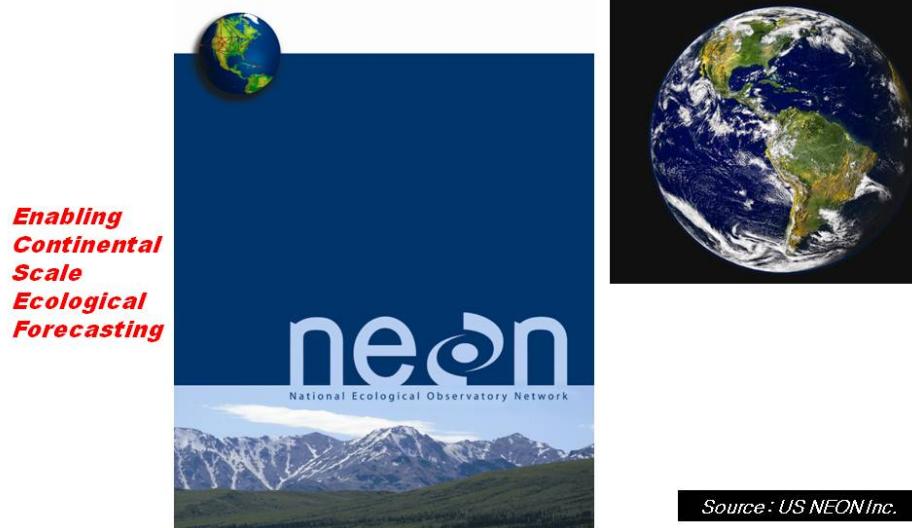


The 4 Functions of IPBES



Intergovernmental
Science-Policy
Platform on
Biodiversity and
Ecosystem Services

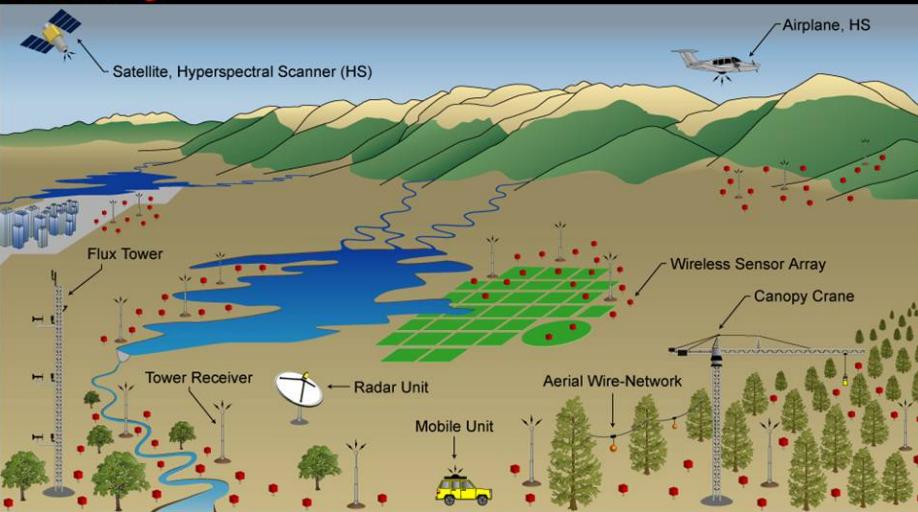
US NEON Science Strategy



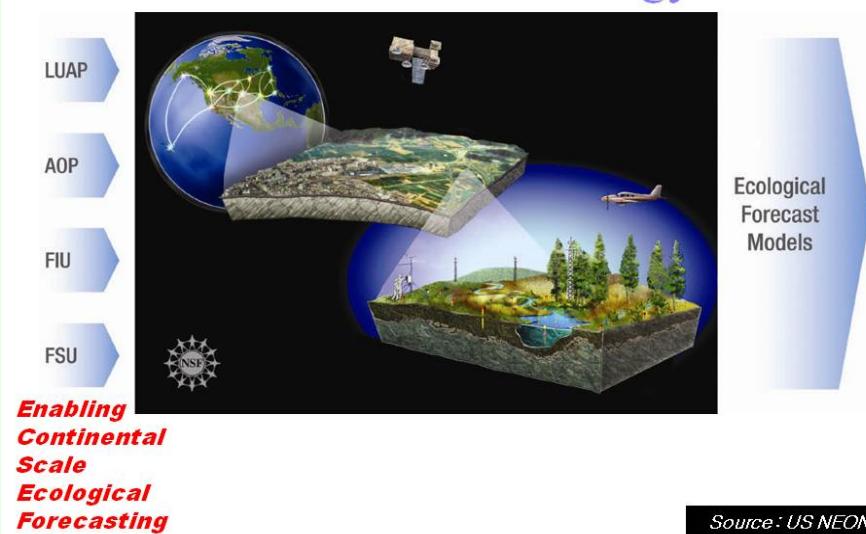
US NEON Science Strategy

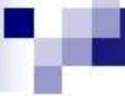


NEON Infrastructure Overview



US NEON Science Strategy





Forecasting

Goal



Science Question

*Enabling
Continental
Scale
Ecological
Forecasting*

Infrastructure



Need

Source: US NEON Inc.

Challenges to overcome!

Opportunities to follow!!!

An International Ecological Observatory Network (IEON)

- ✓ *Formulating and answering questions of global significance on ecology and society*
- ✓ *Leveling up of ecological network activities such as IEON at local and regional levels*
- ✓ *Ambitious niche establishment of IEON at global levels*
 - ✓ *Governance & infrastructure*
 - ✓ *Standardized protocol in IEON Science and research*
 - ✓ *Service to society including communication, outreach, education, public awareness, etc.*
 - ✓ ...

Challenge 1 Global networking of ecological societies and ecologists



INTECOL 2017 Beijing

International Congress of Ecology

INTECOL 2017 Beijing
Ecology and Civilization in a Changing World

Ecology and Civilization in a Changing World

12th

August 20-25, 2017

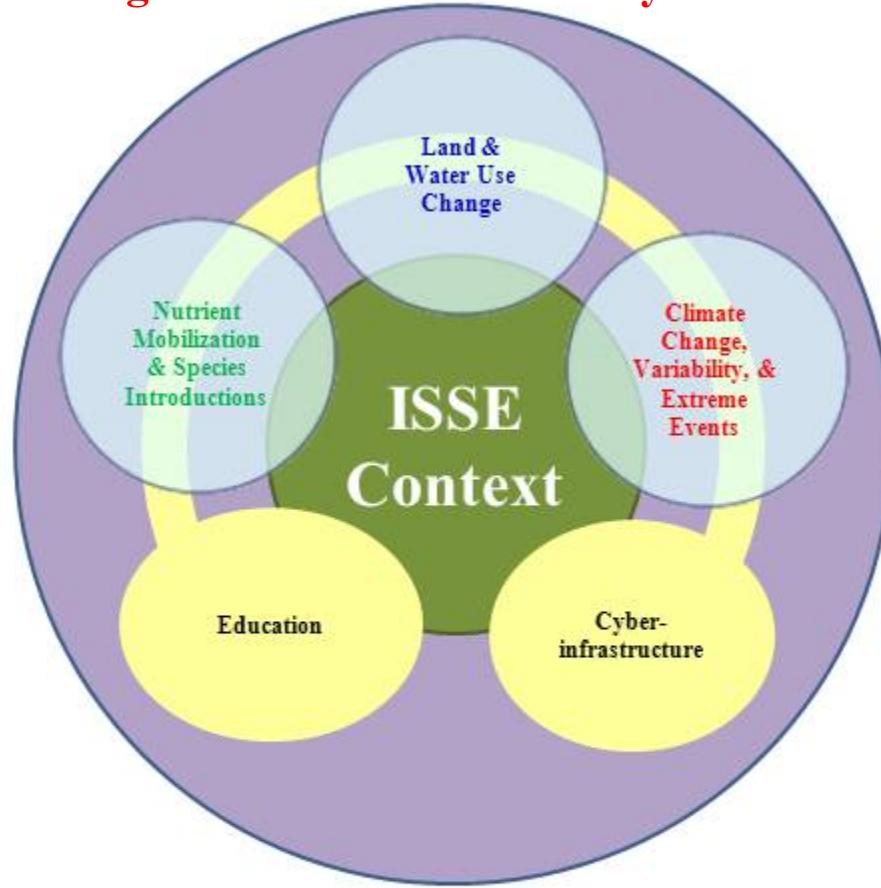
Personal impressions by
Prof. Dr. Bernd Markert & Dr. Simone Wünschmann, Germany



Photos: Courtesy of Bernd Markert, Germany

Challenge 2

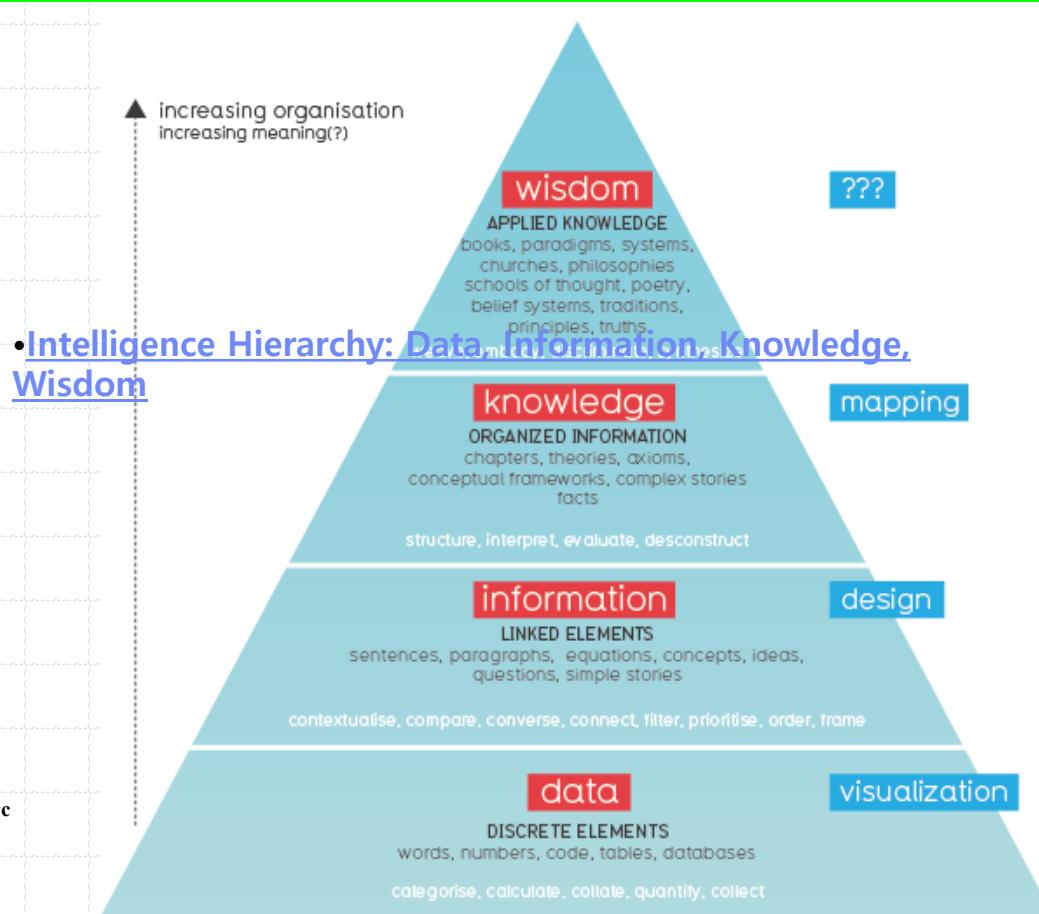
: Integrative Science for Society and the Environment



US LTER Network. 2007. The Decadal Plan for LTER: **Integrative Science for Society and the Environment**: A plan for research, education, and cyberinfrastructure in the US Long-Term Ecological Research Network. US LTER Network Office.

Challenge 3

Challenge: Bottom Up Scheme of Intelligence Hierarchy: Data -> Information -> Knowledge -> Wisdom





Sequoia sempervirens (Coast Redwood)

Photo: Eun-Shik Kim

Challenge 4 Identifying and sharing the vision and strategies

Male and female redwood cones

creating hundreds or thousands or even millions
of seeds during their long lifetimes.

Please leave all cones for others to enjoy.



Female cone—
actual size

Photo: Eun-Shik Kim

World without GREEN

The World of Red Ocean and Blue Ocean without Green Ocean

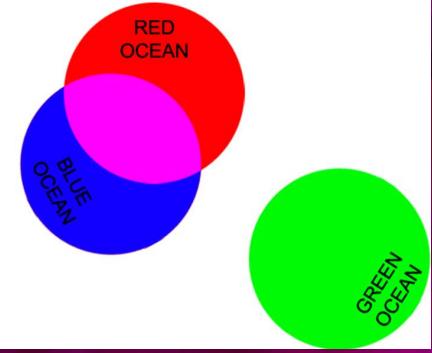


Photo: Eun-Shik Kim

Challenge 5

Vision of Real World with Green: New Leaves of Mongolian Oak



Fusion of Red Ocean and Blue Ocean
with Green Ocean

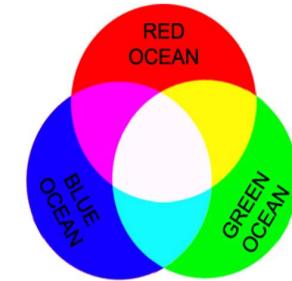
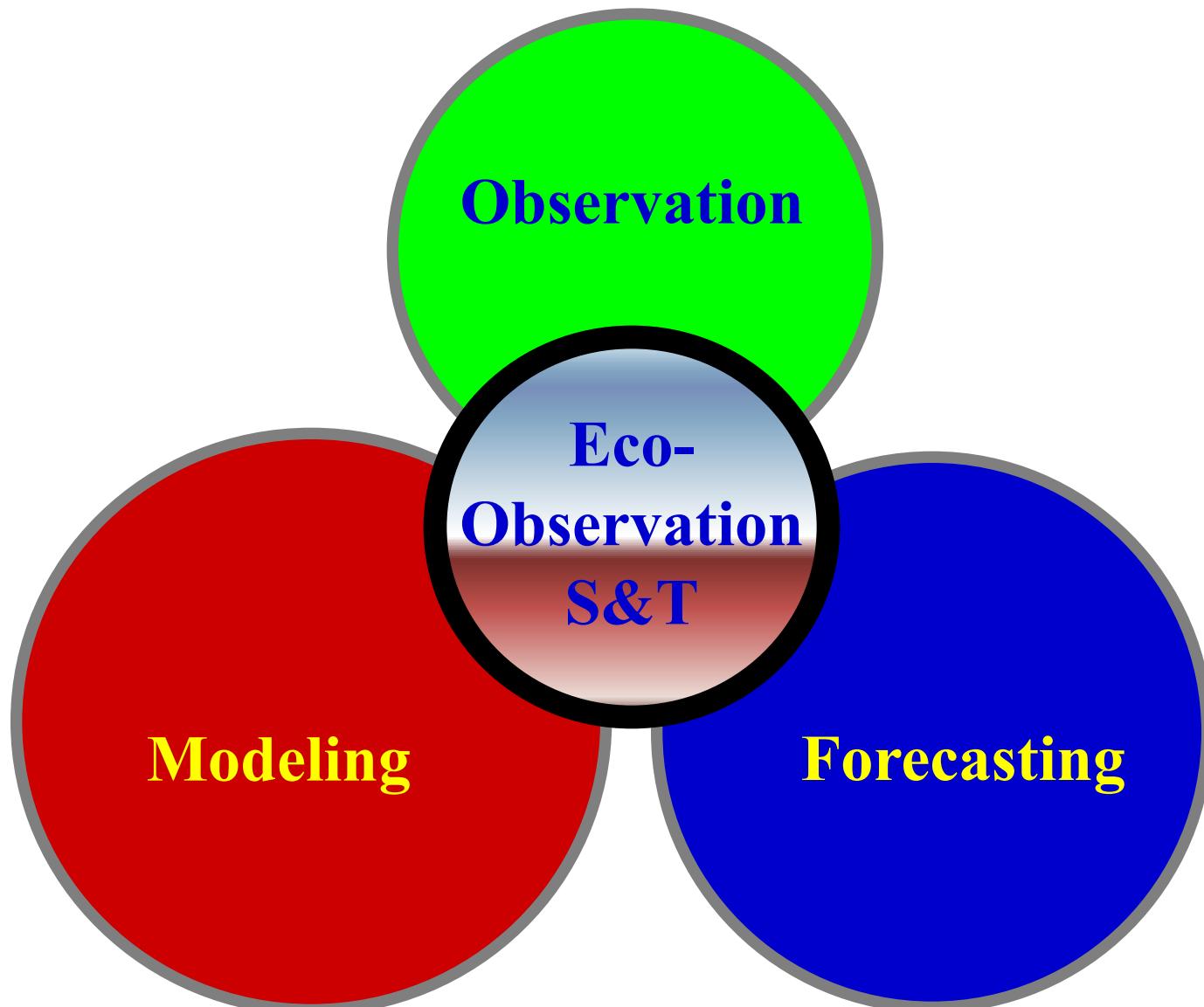


Photo: Eun-Shik Kim

Global Leadership in Science & Technology



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An ecological issue to share in Jeju: **Restoration and conservation of Jeju's Hanon Maar Crater**

IUCN Recommendation Restoration and conservation of Jeju's Hanon Maar Crater

Current Status of
WCC-2012-Rec-155

Eun-Shik Kim, Suk-Chang Lee, Young-Bae Suh & Choong-Suk Ko
National Promotion Committee for Restoring Hanon Crater

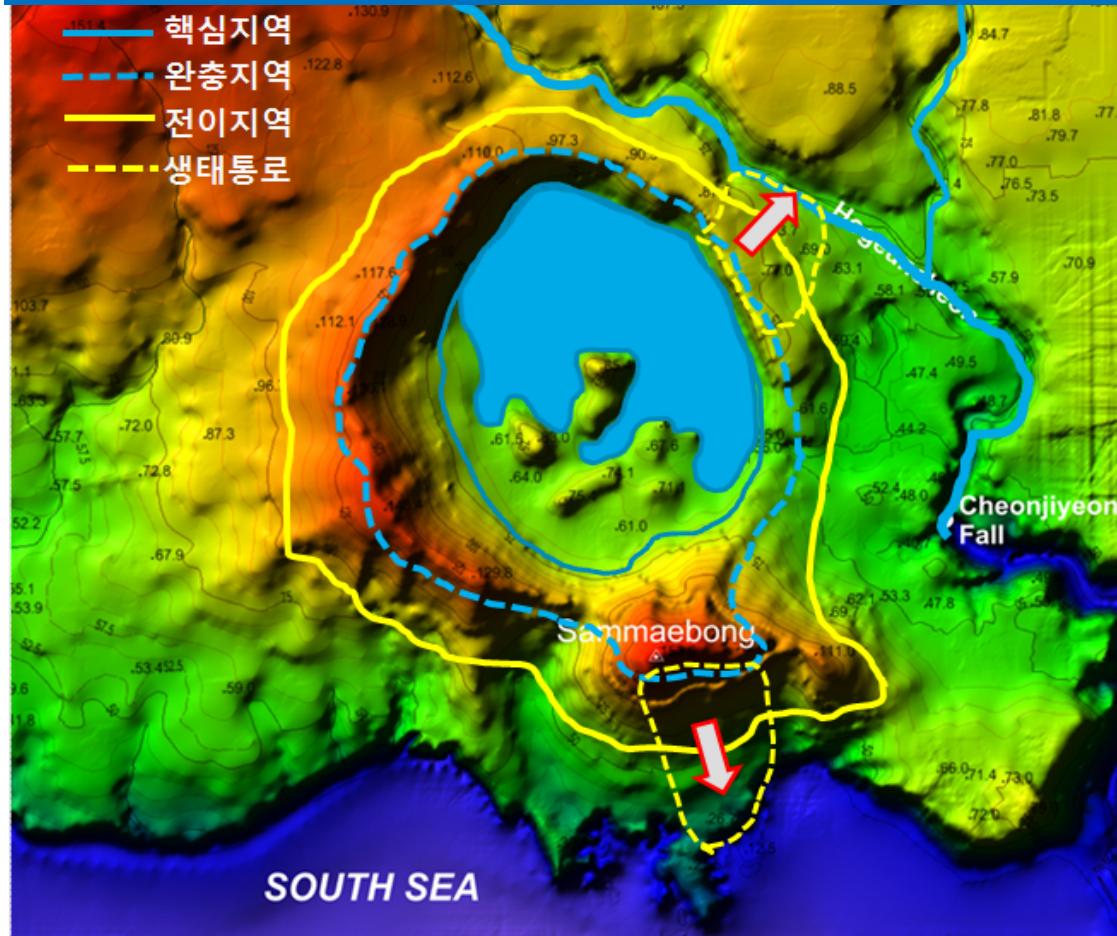
An ecological issue to share in Jeju: Restoration and conservation of Jeju's Hanon Maar Crater

Hanon Maar Crater as of Now



An ecological issue to share in Jeju: Restoration and conservation of Jeju's Hanon Maar Crater

Direction for the Restoration of the Hanon Maar Crater



Do we have any
MONUMENT for the New
SAMDA Island that the
people in Jeju can be proud of?

Stones => Geological/Natural
resources

Wind => Clean energy as new
environment

Women => Conservationists
caring for nature &
future generations

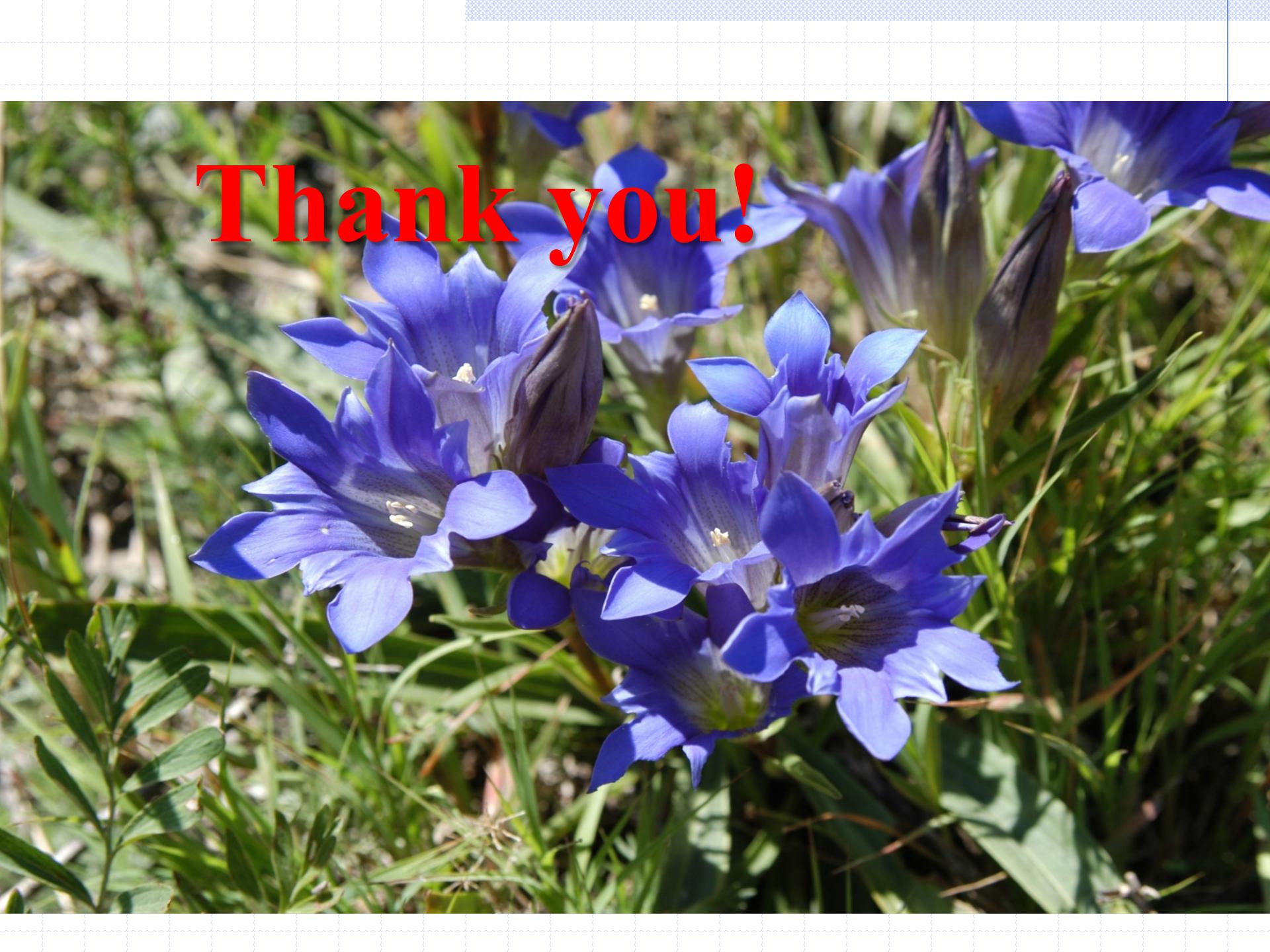
Restoration and
conservation of Jeju's Hanon
Maar Crater
The Monument for the
New SAMDA Island in Jeju

Acknowledgements

- KISTI and Organizers of PRAGMA 36
- NRF (National Research Foundation) of Korea, formerly KOSEF (Korea Science and Engineering Foundation) & Professor BW HO
- US National Science Foundation
- The Ministry of Environment, Korea
- Colleagues of KLTER, ILTER-EAP, ILTER, & AP BON
- Cooperators of EEMICF (formerly KEON)
- Jeju Special Self-Governing Province
- ECO-COPs & Friends

Final Message

Realize the
powers of networking
by participation
and
contribution



Thank you!