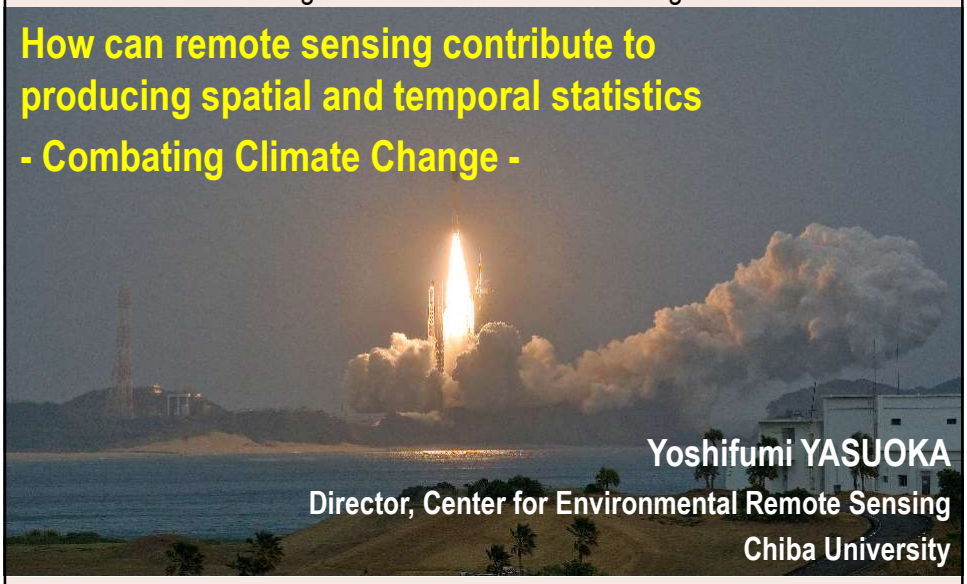
SIAP Group Training Program on Improving Capability in Producing Official Statistics for Monitoring the Post-2015 SDGs

How can remote sensing contribute to producing spatial and temporal statistics

- Combating Climate Change -



Yoshifumi YASUOKA
Director, Center for Environmental Remote Sensing
Chiba University

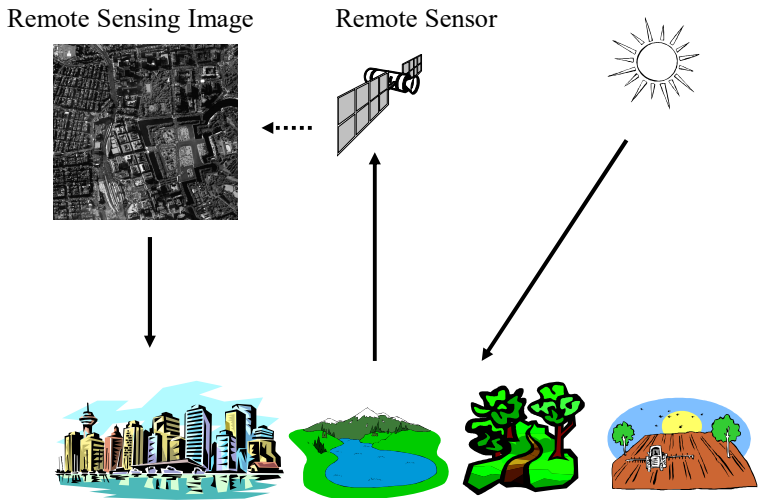
Launch of GOSAT ("IBUKI") on January 23, 2009

October 27, 2017

Topics

1. Understanding of our world
2. Remote sensing of our world
3. Towards sustainable world

What is Remote Sensing ?



A tool to observe earth surface conditions from space

Remote Sensing

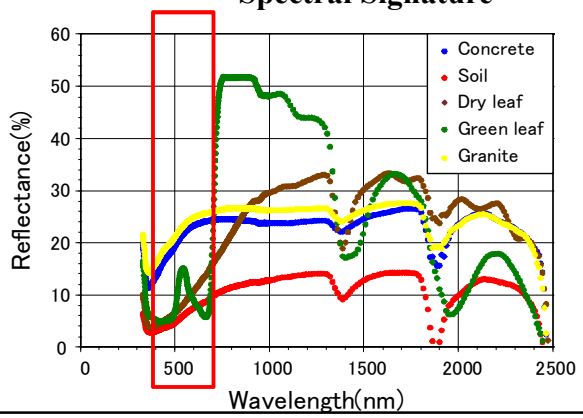
is a measurement tool to
to characterize land, ocean and atmosphere conditions
without directly contacting the objects.

- It utilizes electromagnetic waves as a medium throughout optical to microwave range.
- It usually utilizes so-called remote sensors on board satellite, aircraft, ship or UAV.

Spectral Signature

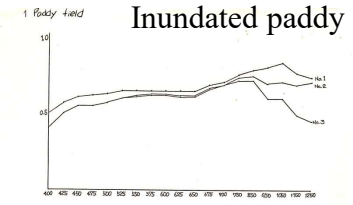
* All matter reflects, absorbs, transmits and emits electromagnetic radiation in a unique way with respect to wavelength.

--- **Spectral Signature**

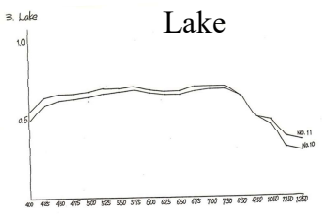


Spectral data observed at Khon Kaen in 1987

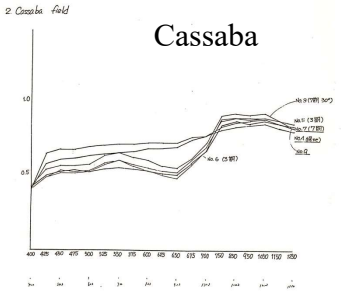
Inundated paddy



Lake

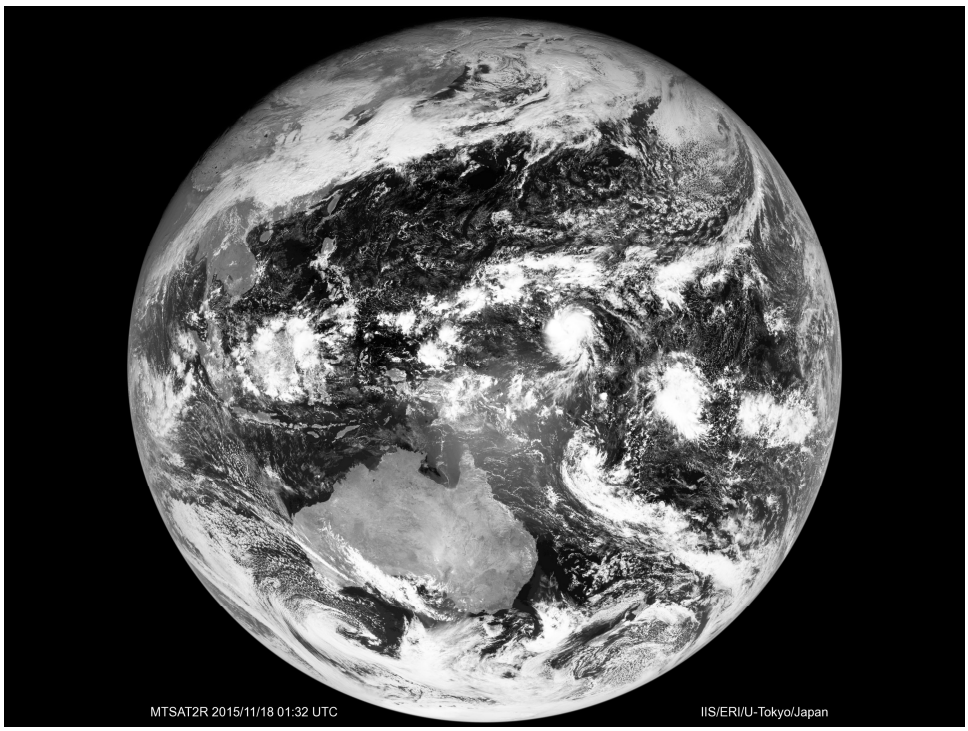


Cassaba

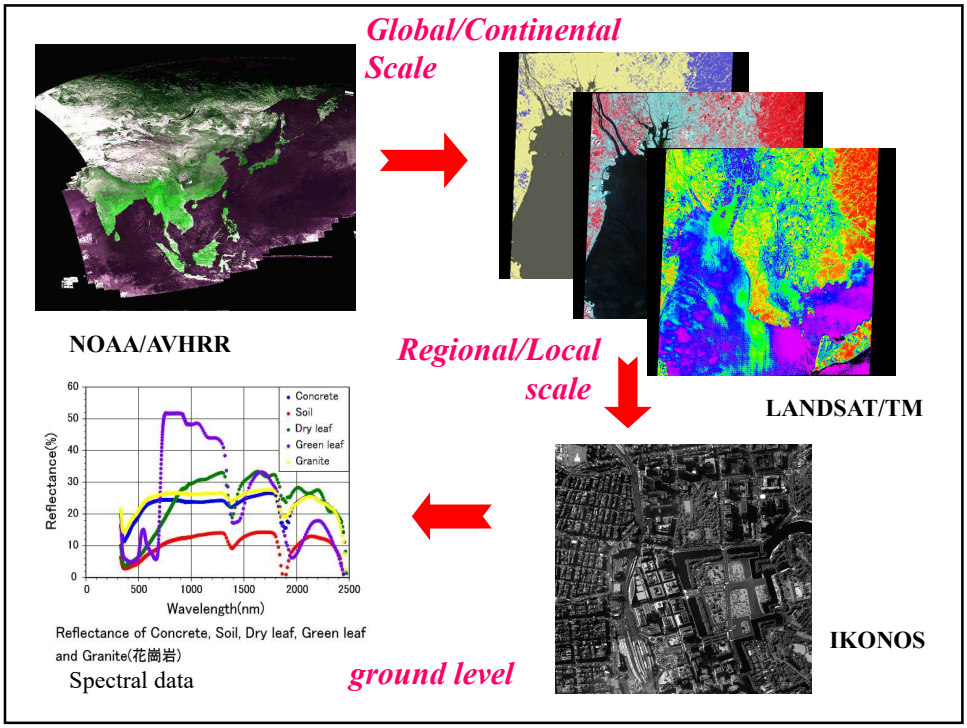


Spectrometer:
Abe2703MM 17 channels
(400nm-1100nm)

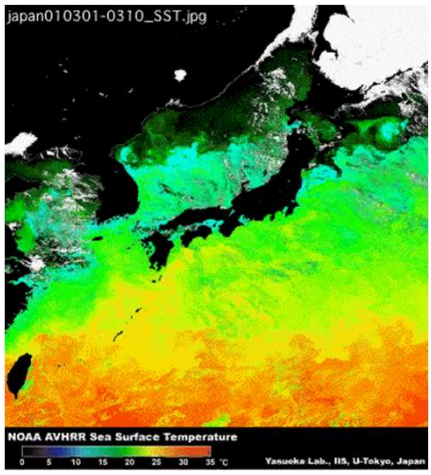
Spectral measurement
(Khon Kaen, 1990/2/18）

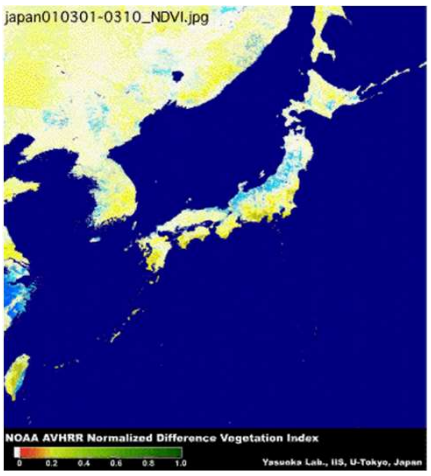


Worldview-3 images over Fukushima Nuclear Power plant (31cm resolution)



Land and ocean surface condition over Japan



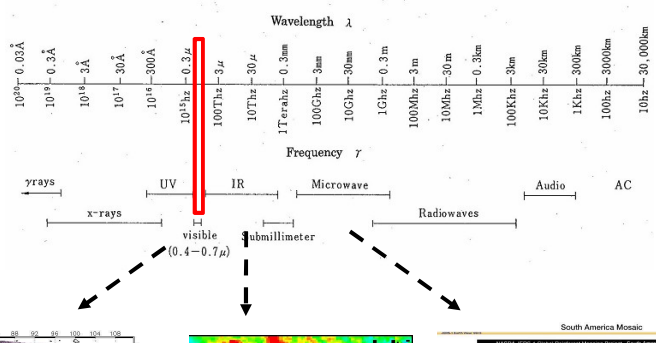


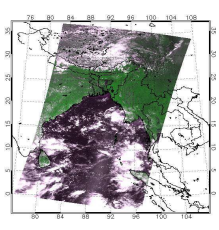
Sea surface temp. (from AVHRR)

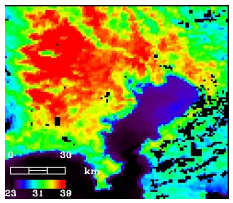
2001 Monthly

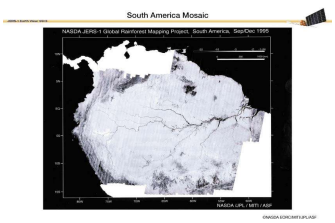
Vegetation index (from AVHRR)

Remote sensing in different wavelength range









Visible thermal IR microwave

What is remote sensing?

Remote sensing is a part of earth observation

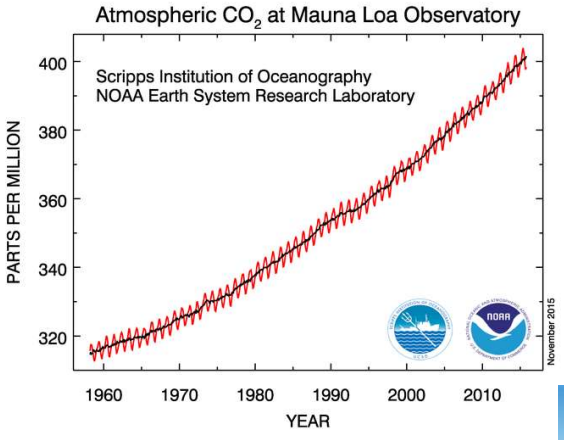
Earth observation is a part of understanding our world

Understanding of our world is a part of improving our world

Improving our world is a part of realizing sustainable world

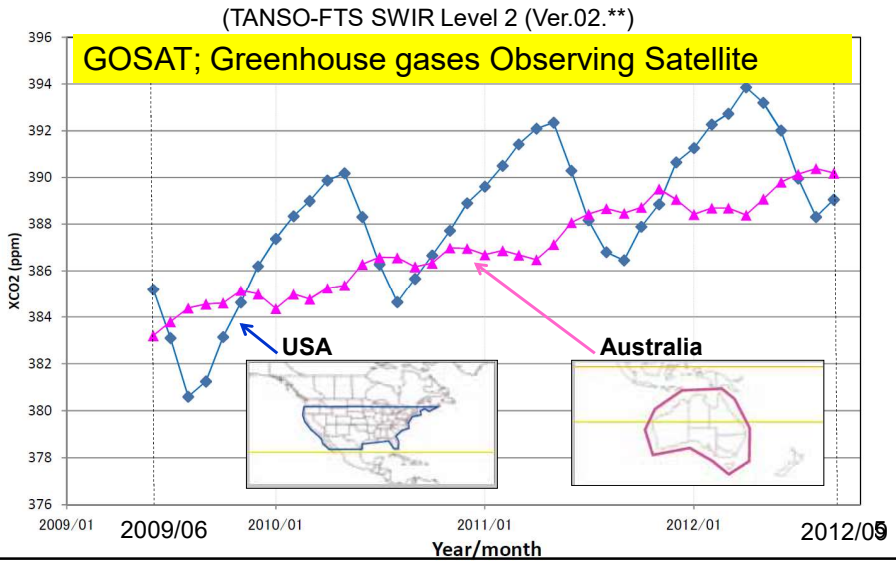
Policy

Increase of CO2 concentration observed at Mauna Loa



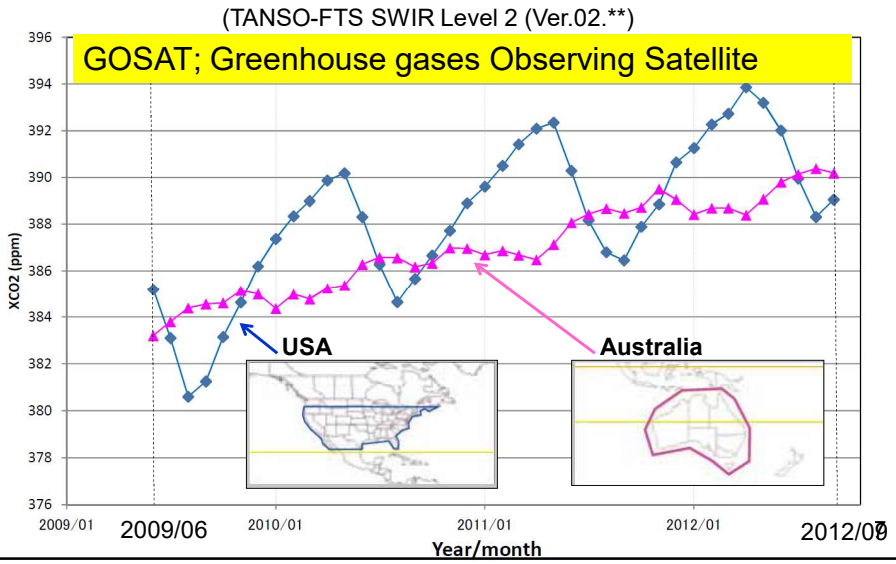
Keeling Curve
(Mauna Loa Observatory)

Comparison of monthly average XCO2 (CO2 column density) over US and Australia

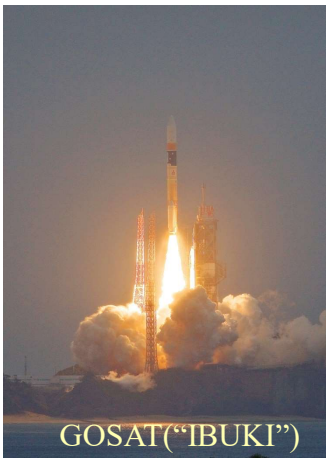


Launch of GOSAT (“IBUKI”) on January 23, 2009

Comparison of monthly average XCO2 (CO2 column density) over US and Australia



Integration of different science and technologies



How to integrate?

@ Climate change is an urgent threat to us.

Mitigation tools for global warming

@ Electric car (EC) &
Fuel cell vehicle (FCV)
@ Solar power generation system &
Wind power generation system
@ etc.

Topics

1. Understanding of our world
2. Remote sensing of our world
3. Towards sustainable world

Topics

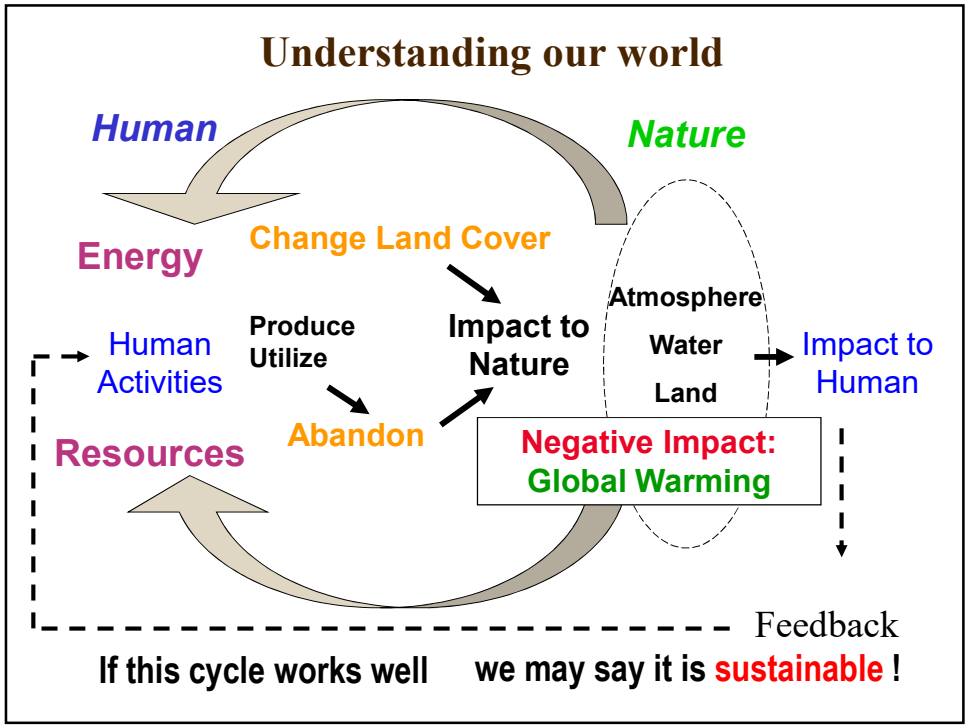
1. Understanding of our world

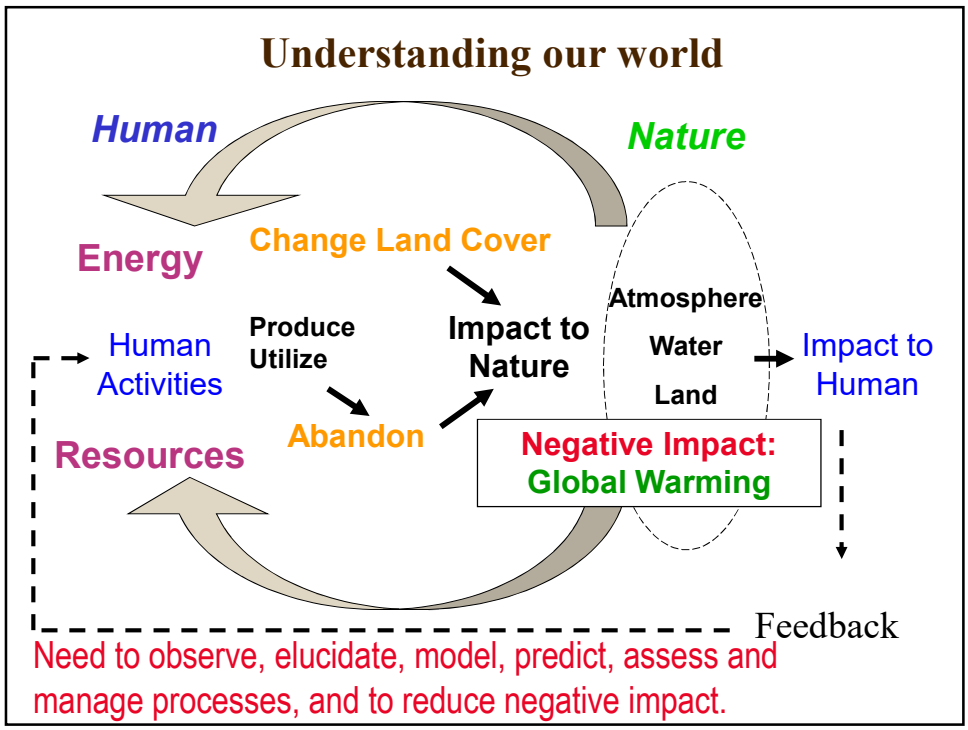
   Three cycles in sustainability research
   - @ Man and environment interaction cycle
   - @ Causality cycle (DPSIR cycle)
   - @ Action cycle

2. Remote sensing of our world

3. Towards sustainable world

   SATREPS, Future Earth and SDGs





Remarks

1. Boundary condition

   Spatial boundary; region, country, …, globe

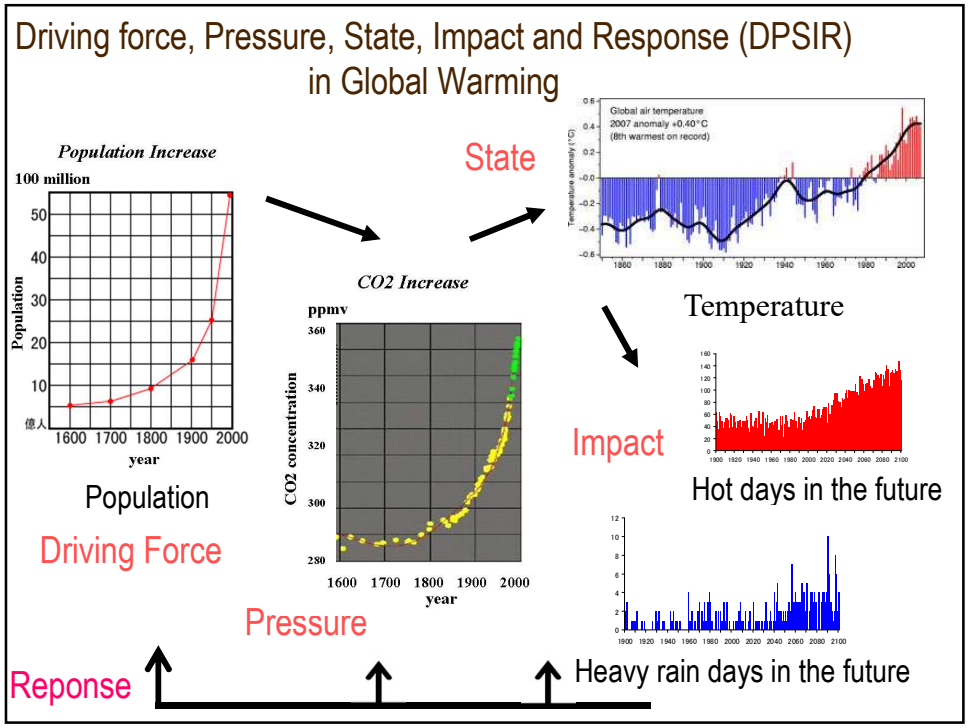
   Temporal boundary; 1yr, 10yrs, …, 100yrs

2. Human dimension

   Current generation vs next generation

   Developed country vs developing country

   Country A vs Country B



Topics

1. Understanding of our world

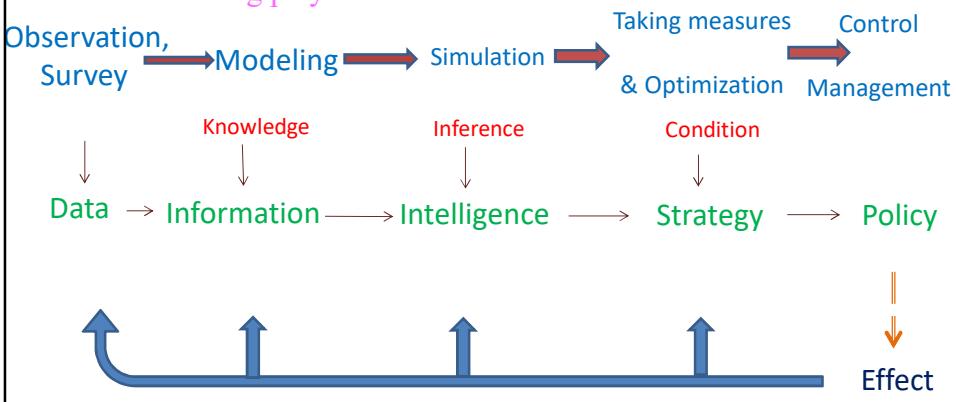
   Three cycles in sustainability research
   - @ Man and environment interaction cycle
   - @ Causality cycle (DPSIR cycle)
   - @ Action cycle

2. Remote sensing of our world
3. Towards sustainable world

   SATREPS, Future Earth and SDGs

From data, information, intelligence to strategy and policy

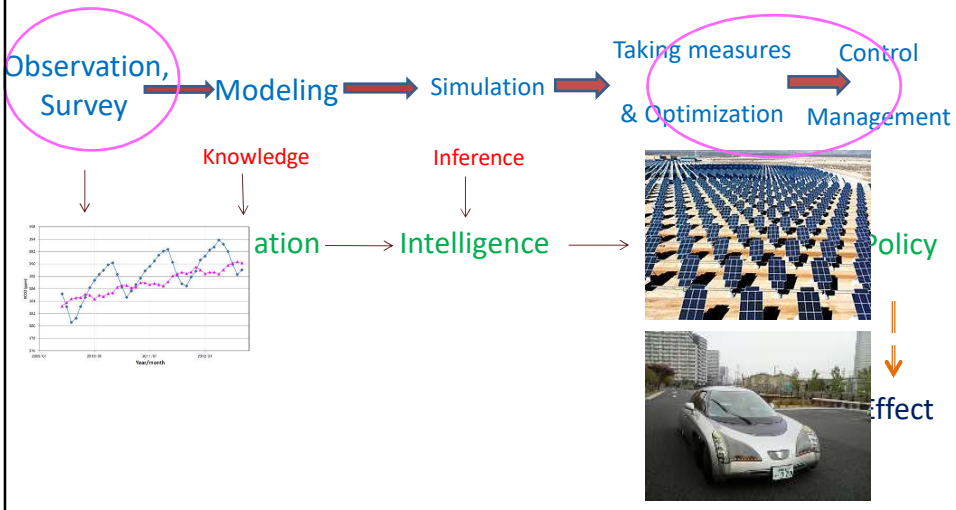
Statistical thinking plays vital role.



Observation and evaluation of effect of policy is important.

Backcasting from policy to up-sream is also very important.

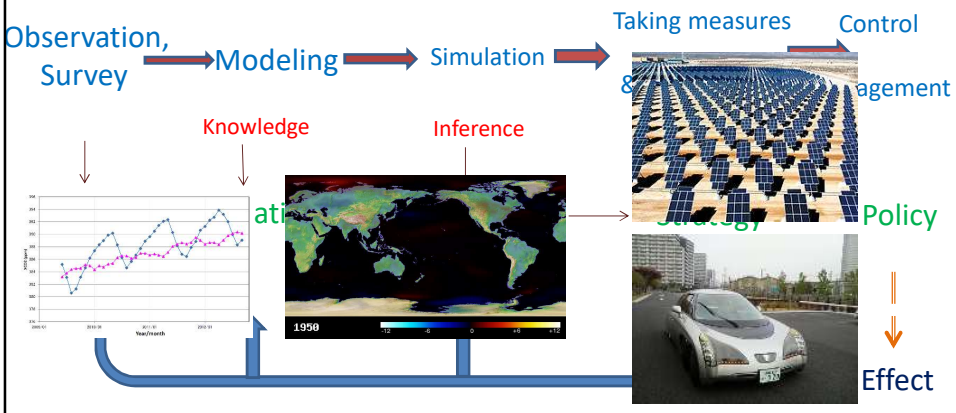
From data, information, intelligence to strategy and policy



Observation and mitigation measures are independent so far.

From data, information, intelligence to strategy and policy

Global scale observation assessment is not easy.



Observation and assessment of effect of policy is important.

Topics

1. Understanding of our world
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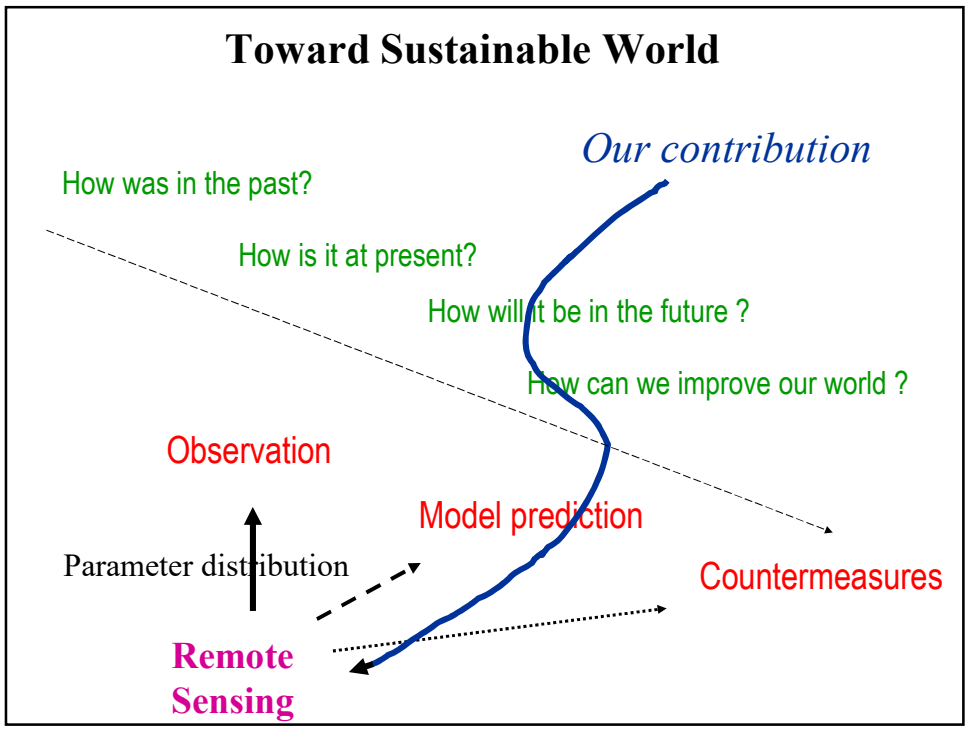
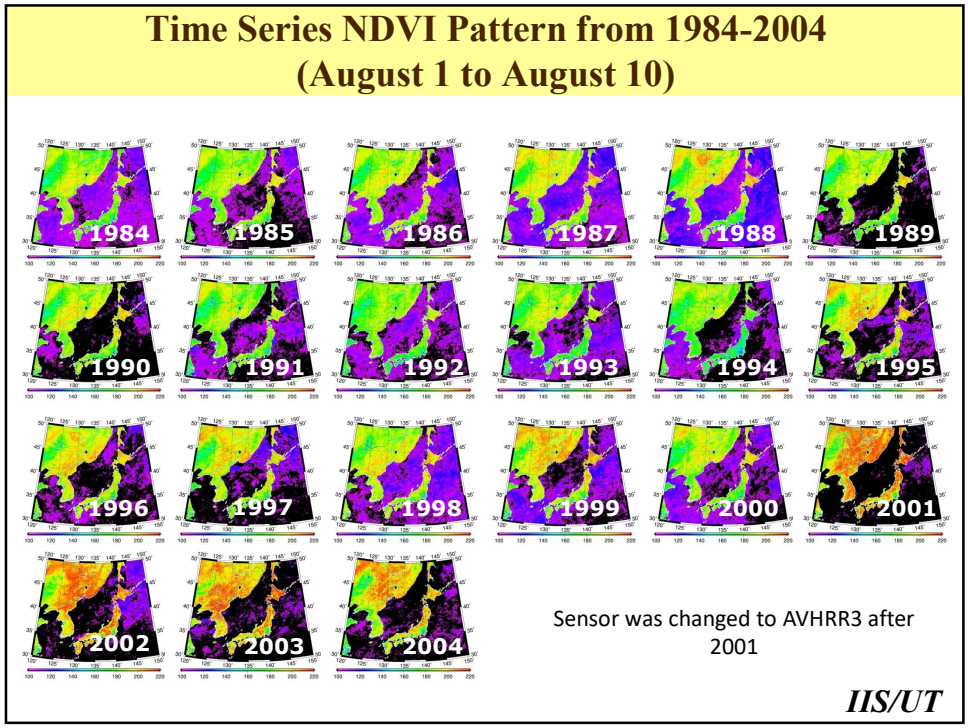
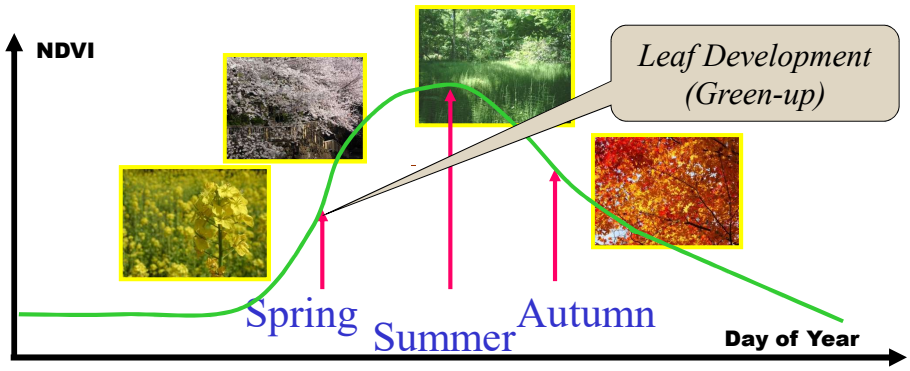

Toward Sustainable World
Our contribution
How was in the past?
How is it at present?
How will it be in the future ?
How can we improve our world ?
Observation
Model prediction
Parameter distribution
Countermeasures
Remote Sensing


Time Series NDVI Pattern from 1984-2004
(August 1 to August 10)
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Sensor was changed to AVHRR3 after 2001
IIS/UT

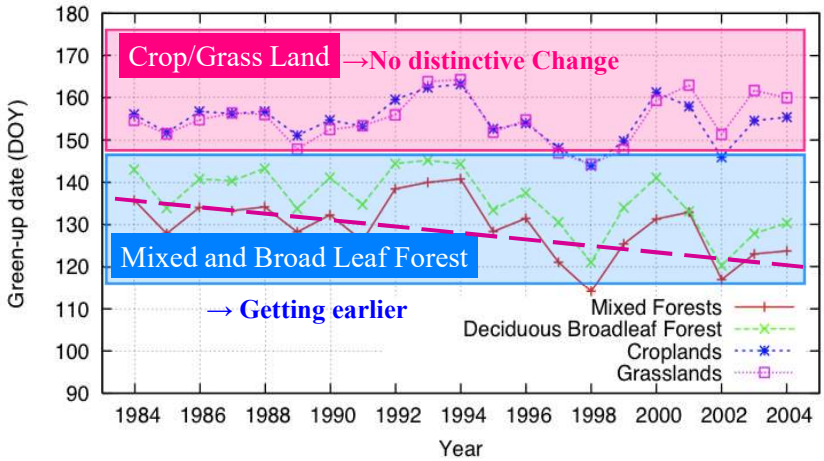
Plant Phenology in NDVI Change

- DOY Spring = Max { DOY t – DOY t-1 }
- DOY Summer = Max { DOY t }
- DOY Autumn = Min { DOY t – DOY t-1 }
- DOY Active = DOY autumn – DOY spring



Extraction of Phenological Features from NDVI Changes

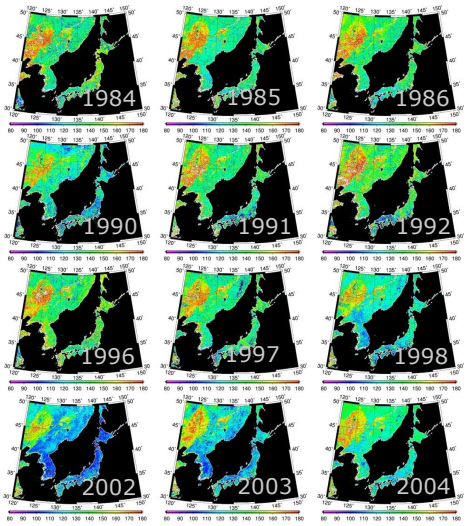
Leaf development is getting earlier for some biome types



Mixed forest:12 days, Deciduous broad leaf forst:14days in 21years

Dr. Ooyoshi, IIS/UT

Distribution of DOY in Leaf Development

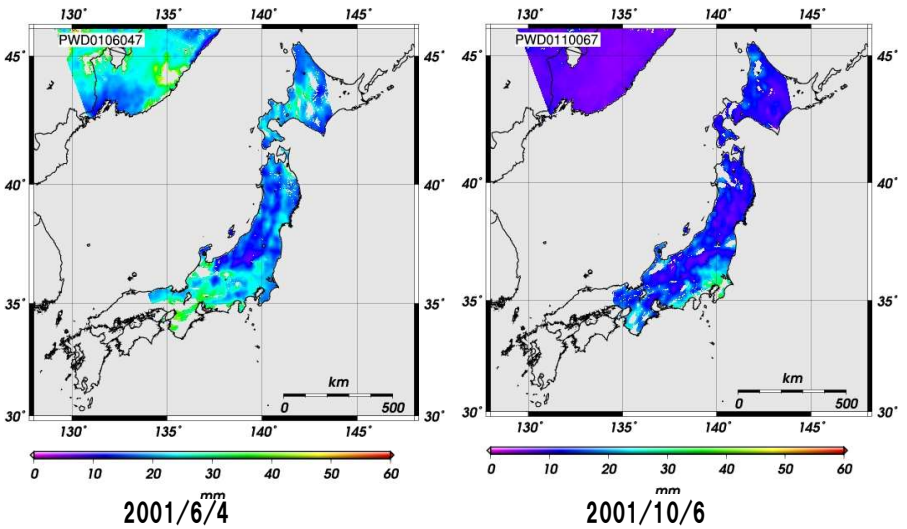


DOY for Leaf Development

Dr. K Ohyoshi

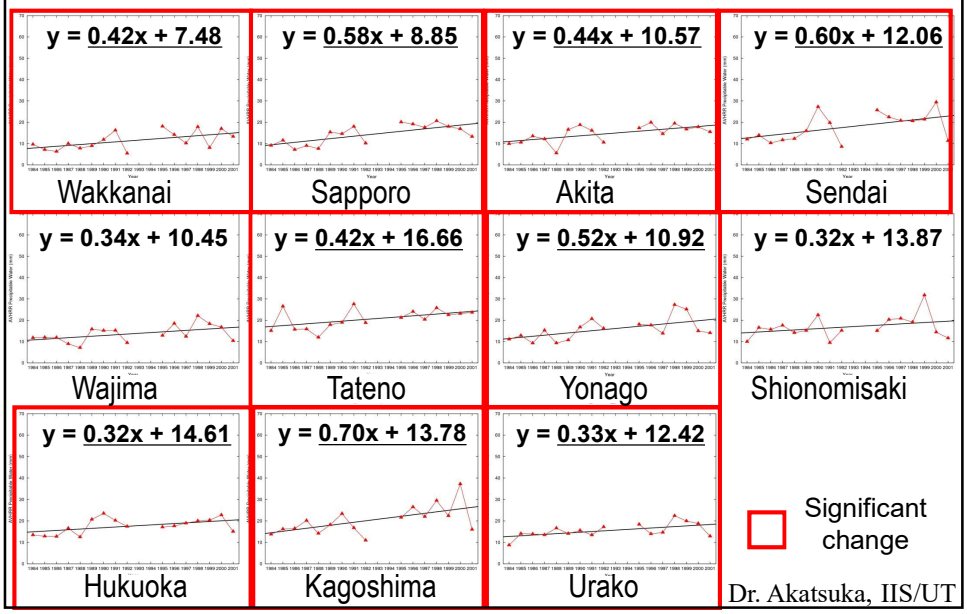
Precipitable Water

AVHRR PW: Precipitable Water estimated from NOAA/AVHRR



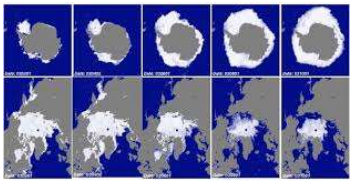
Dr. Akatsuka, IIS/UT

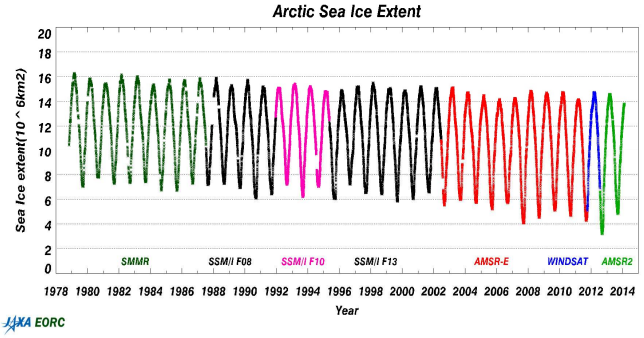
Trend of Precipitable Water (October)



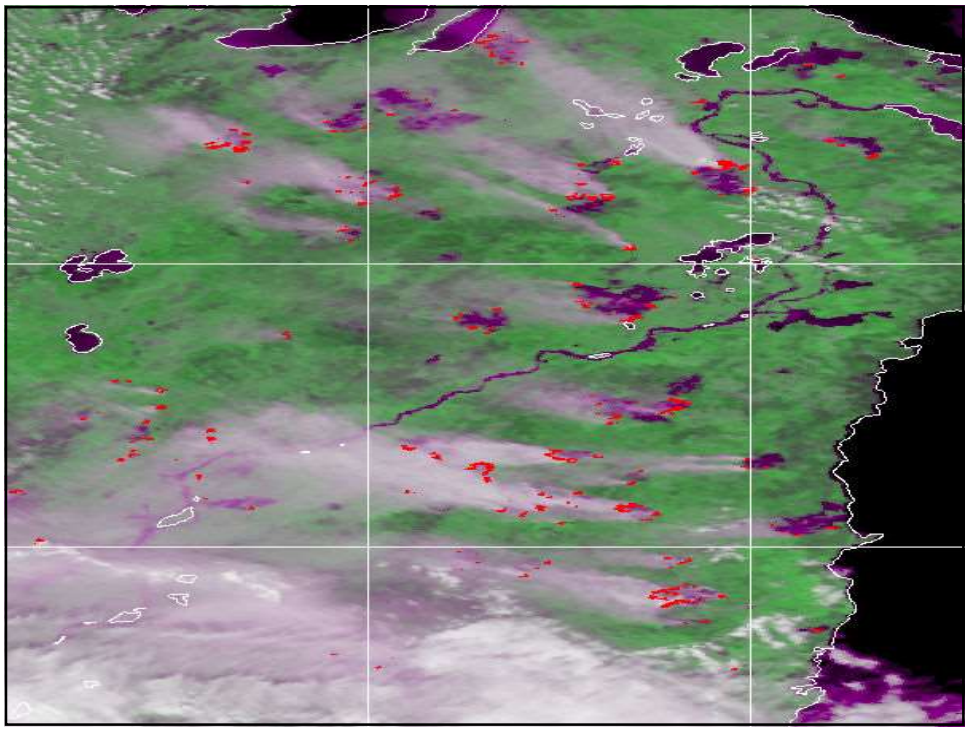
Dr. Akatsuka, IIS/UT

Decrease of Arctic sea ice extent (1978-now)





Advance Microwave Scanning Radiometer (AMSR)

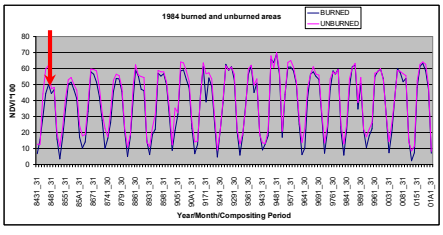


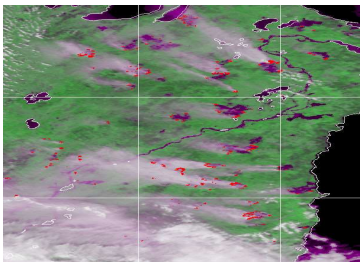
DISASTERS

Forest fire monitoring

Year	Amur	Biro.	Khab.	Prim.	Heil.	Jilin	Nei M.	Total
1984	843.6	8.2	4569.8	45.2	298.8	16.0	66.8	**5848.4**
1985	451.5	111.1	767.0	158.2	632.3	102.9	44.7	**2267.7**
1986	4385.6	392.8	1580.4	236.6	1871.9	26.5	222.0	**8715.8**
1987	8082.2	364.2	2146.0	672.7	6703.2	23.8	204.4	**18196.5**
1988	520.5	120.1	4480.9	344.1	377.1	135.2	156.8	**6134.6**
1989	4173.3	262.5	582.0	219.5	433.0	59.7	31.7	**5761.5**
1990	764.4	182.2	223.7	75.3	217.5	4.8	79.5	**1547.4**
1991	356.9	577.2	232.0	209.8	715.0	17.5	53.8	**2162.1**
1992	4823.1	425.7	5597.7	1999.4	4957.2	686.9	2250.2	**20740.2**
1993	2385.8	831.9	2067.1	508.3	879.7	171.6	255.6	**7100.2**
1994	1390.1	55.9	1020.7	522.7	879.1	642.4	756.4	**5267.2**
1995	145.0	4.3	236.4	2.8	108.7	1.2	58.0	**556.4**
1996	15061.1	425.0	3781.3	98.2	1537.3	7.8	54.0	**20964.8**
1997	69.3	46.2	383.7	129.3	49.5	10.3	1.1	**689.4**
1998	2722.6	144.0	17677.4	398.9	516.2	16.7	34.1	**21509.9**
1999	1170.3	681.2	1475.9	378.2	773.7	0.0	74.4	**4553.8**
2000	9520.3	450.7	1682.8	4182.1	22333.2	8794.1	5165.1	**52128.3**
2001	8123.0	235.1	1864.1	797.9	16994.4	1495.8	3679.5	**33189.8**

Biro. (Birobidzhan), Khab. (Khabarovsk), Prim. (Primorye), Heil. (Heilongjiang), Nei M. (Nei Mongol)

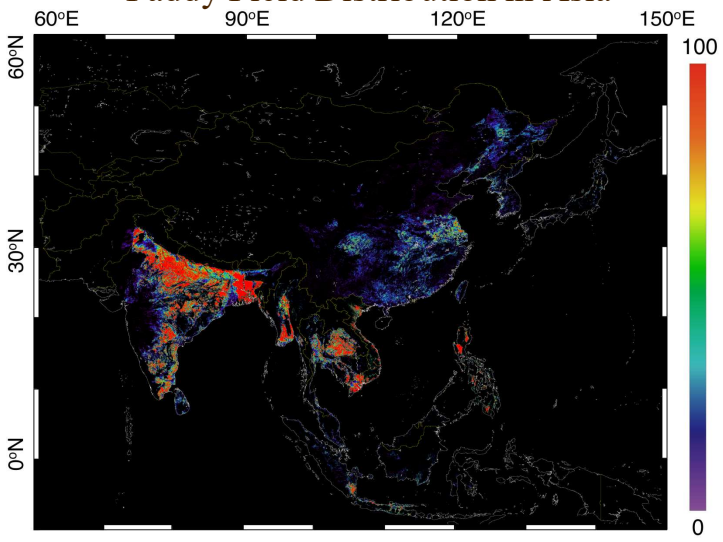




Dr. J. Kucera, IIS/UT

FOOD

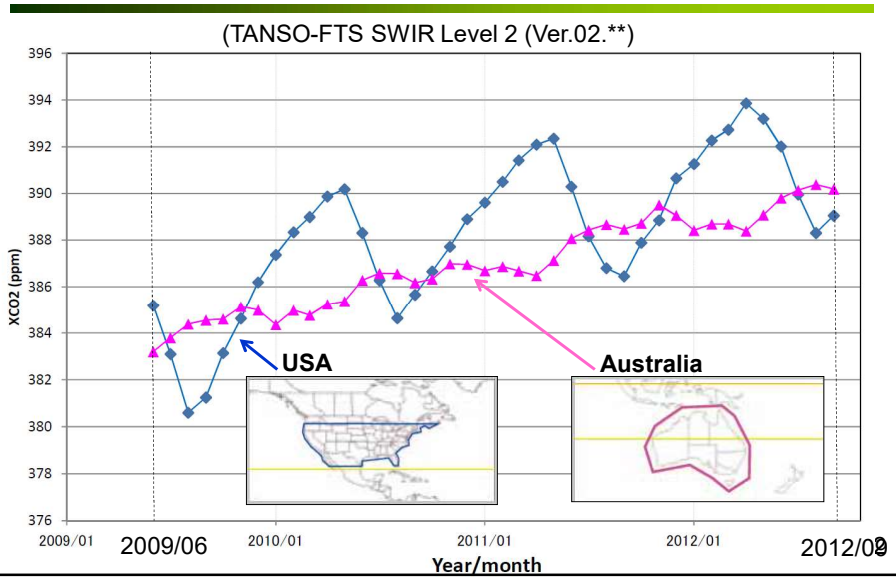
Paddy Field Distribution in Asia



Percentage (fraction) of paddy field in one square kilometer

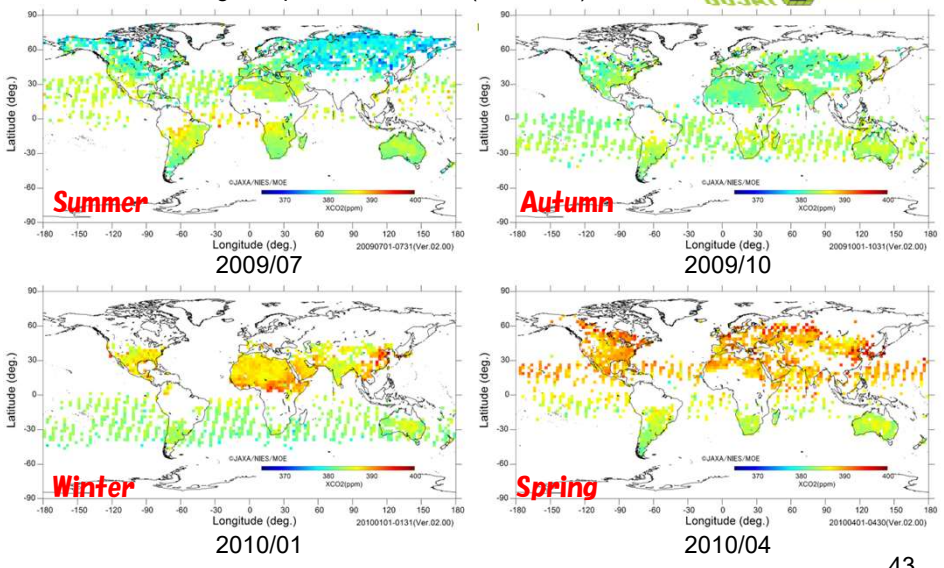
Dr. W. Takeuchi, IIS/UT

Comparison of monthly average XCO2 (CO2 column density) over US and Australia



Seasonal Variation of CO_2 Distribution Observed by GOSAT (Ibuki)

2.5 ° mesh average map of CO2 column (Ver.02.00)



DR. YOKOTA, NIES

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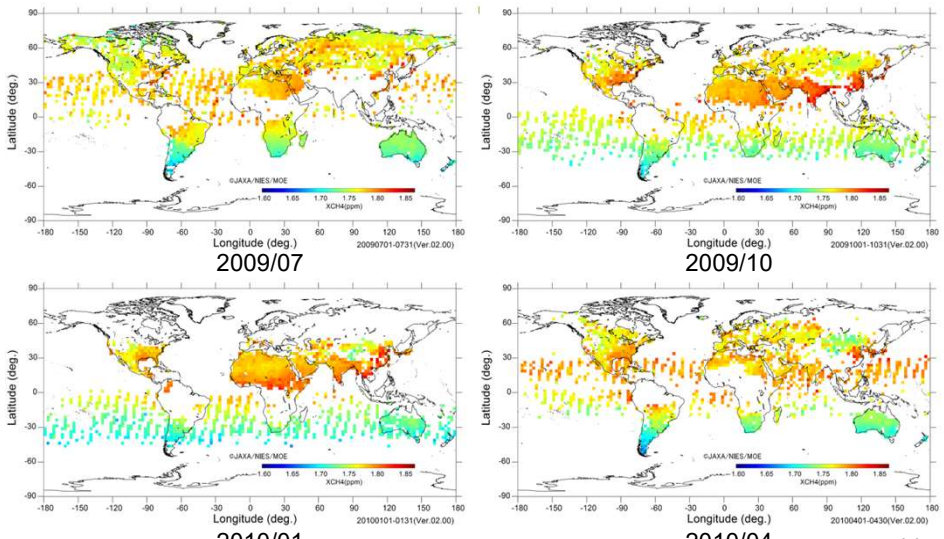
FTS SWIR L2 XCO_2 V02.00

Seasonal Variation of CH4 Distribution Observed by GOSAT (Ibuki)

2.5 ° mesh average map of CH4 column (Ver.02.00)



DR. YOKOTA, NIES

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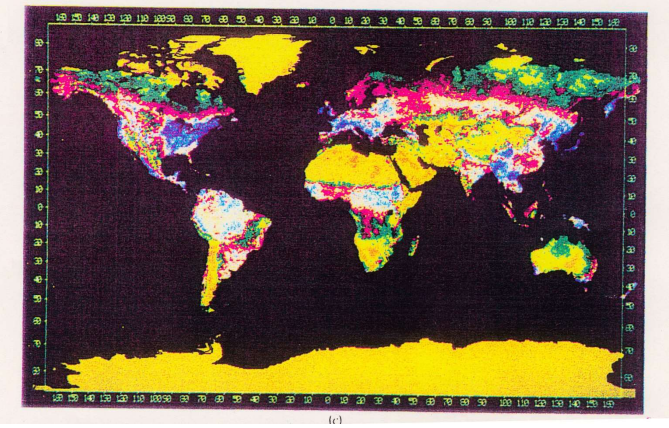
FTS SWIR L2 XCH_4 V02.xx

Satellite observation of forest cover

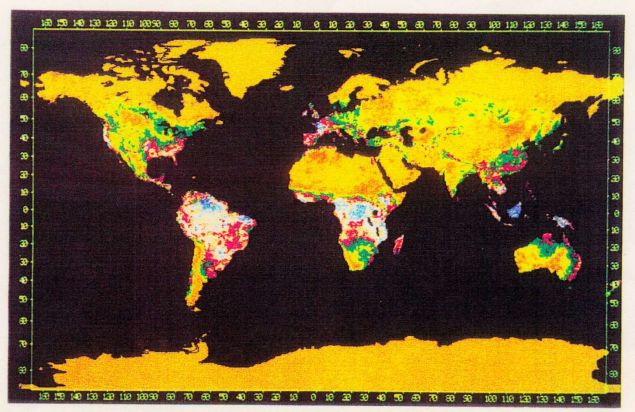
Vegetation Index; summer



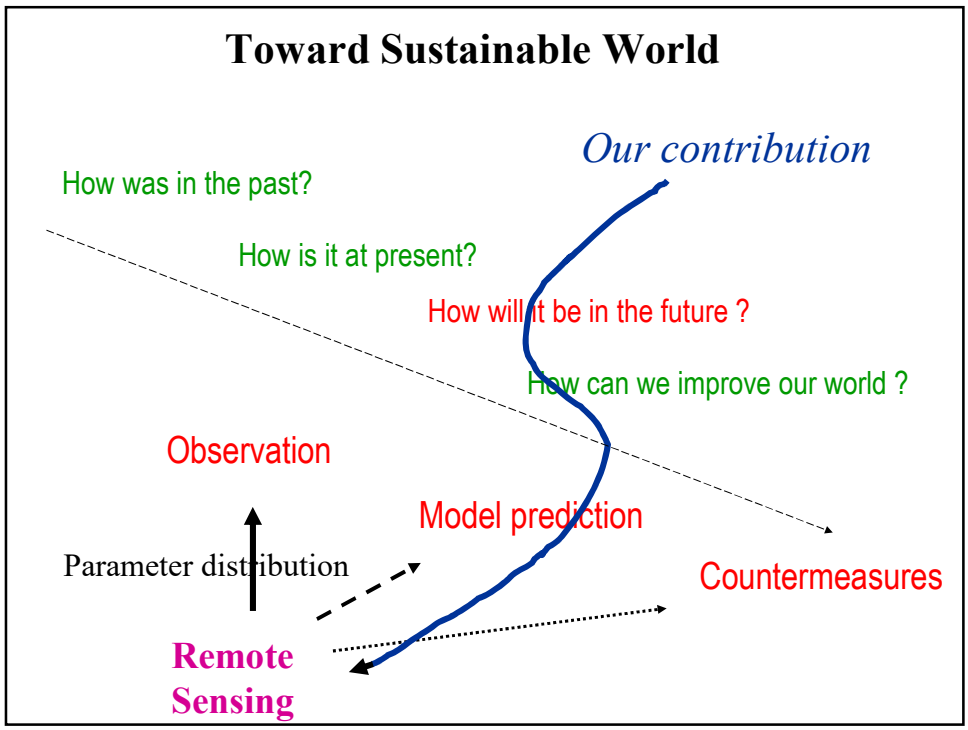
June - July

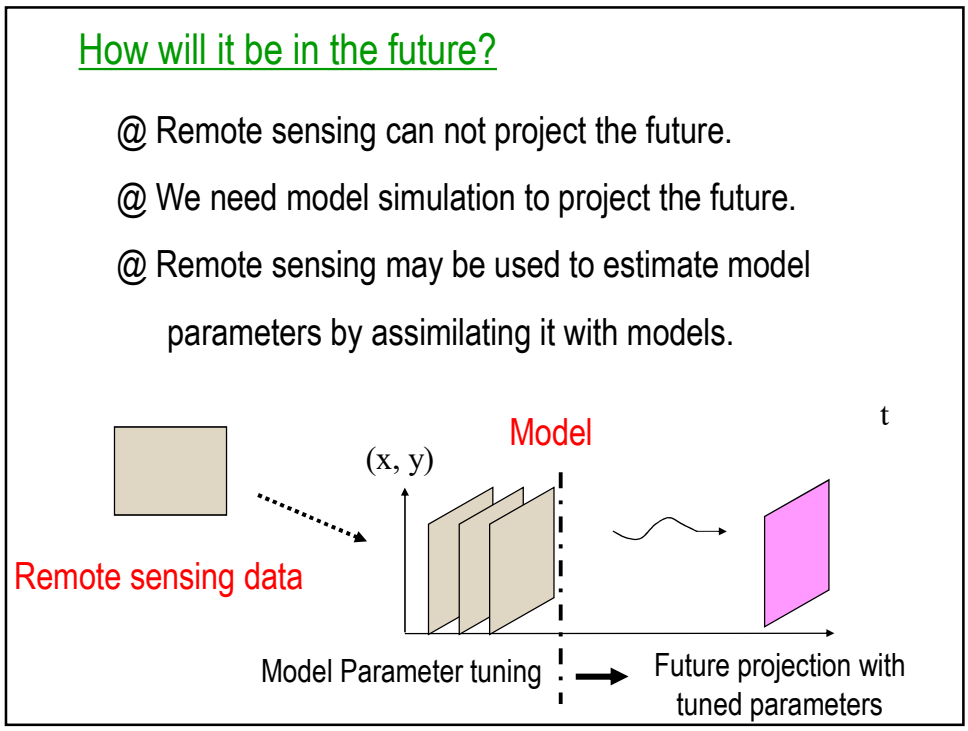
Satellite observation of forest cover

Vegetation Index; winter

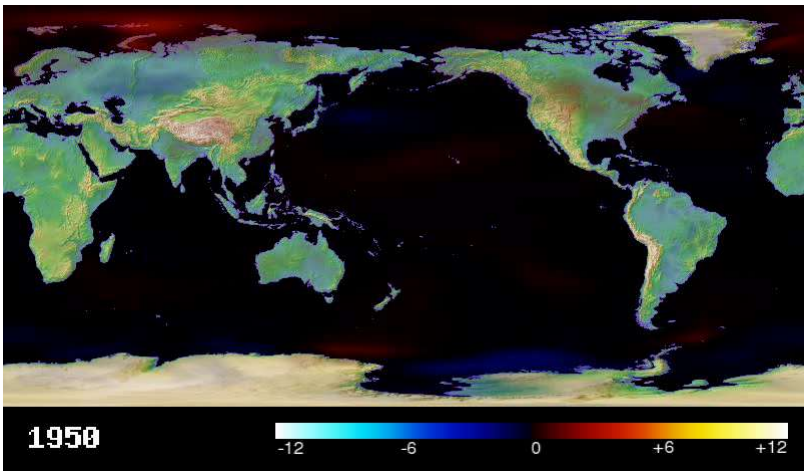


Dec. – Jan.


Toward Sustainable World
Our contribution
How was in the past?
How is it at present?
How will it be in the future ?
How can we improve our world ?
Observation
Model prediction
Parameter distribution
Countermeasures
Remote Sensing

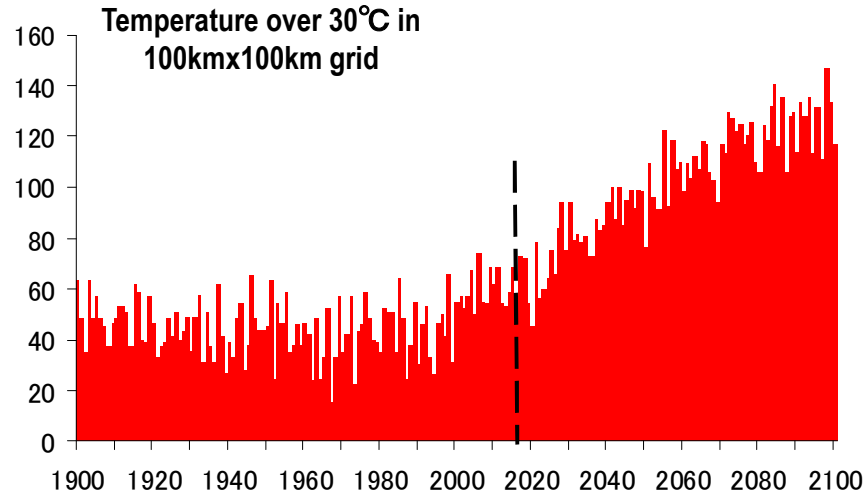

How will it be in the future?
@ Remote sensing can not project the future.
@ We need model simulation to project the future.
@ Remote sensing may be used to estimate model parameters by assimilating it with models.
Model
t
(x, y)
Remote sensing data
Model Parameter tuning
Future projection with tuned parameters

Climate Projection （NIES-CCSR-FRCGC model）

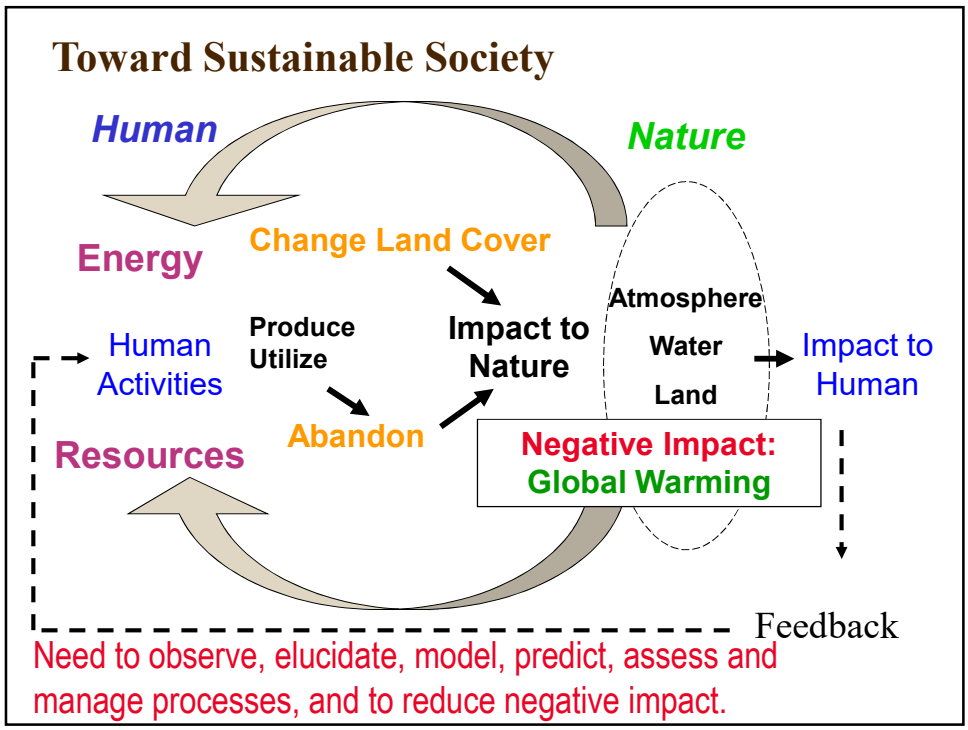


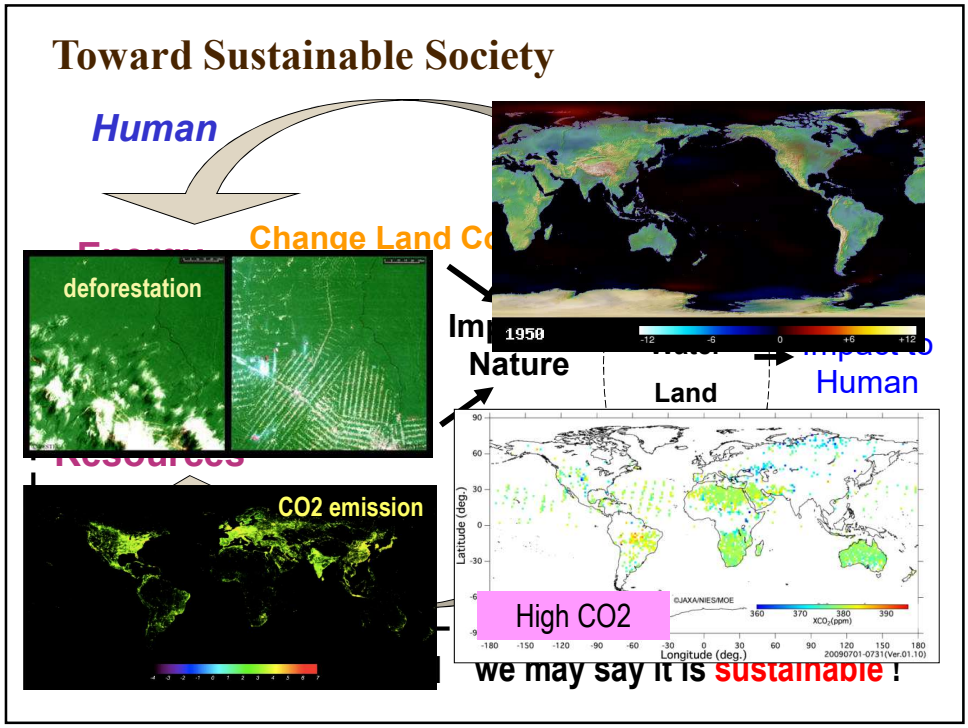
スーパーコンピュータを用いた将来の気候変化予測の結果
文部科学省「人・自然・地球共生プロジェクト」
国立環境研究所/ 東京大学気候システム研究センター/ 地球環境フロンティア研究センター

Trend in Number of Hot Days in Japan



NIES-CCRS/UT-FRSGC K-1, A1B（After CCSR/UT）


Toward Sustainable Society
Human
Nature
Energy
Change Land Cover
Atmosphere
Water
Land
Produce
Utilize
Impact to
Nature
Human
Activities
Impact to
Human
Abandon
Resources
Negative Impact:
Global Warming
Feedback
Need to observe, elucidate, model, predict, assess and
manage processes, and to reduce negative impact.


Toward Sustainable Society
Human
deforestation
1950
Nature
Land
Human
CO2 emission
High CO2
we may say it is sustainable !

Topics

1. What's going on in the world?
2. Remote sensing of our world
3. Towards sustainable society

   SATREPS, Future Earth and SDGs

Collaboration between S&T and Society

@ "SATREPS" by JST and JICA (2008)
--- International (bi-lateral) collaborative research program to solve social problems in counter country

@ "Future Earth" by ICSU and Vermont Forum (2012)
--- Integration of WCRP, IGBP, IHDP and DIVERSTAS to solve the wicked problems

@ SDGs by UN (2015)
--- 17 goals and 169 targets to transform our world with concept of "no one left behind"

SATREPS
Science and Technology Research Partnership for Sustainable Development Program

SATREPS

Science and Technology Research Partnership for Sustainable Development

Japan Science and Technology Agency (JST)

&

Japan International Cooperation Agency (JICA)

SATREPS

SATREPS
Science and Technology Research Partnership for Sustainable Development Program

SATREPS Projects

In total (since 2008) : 115 projects with 46 countries

As of March, 2017

SATREPS

SATREPS
Science and Technology Research Partnership for Sustainable Development Program

Program Description

(1)Research fields

- **Environment**
- **Energy**
- **Bio Resource Utilization**
- **Disaster Prevention and Mitigation**
- **Infectious Disease Control**

(2)Research period: 3-5 years

(3)Research budget: 1M USD/Project/year

SATREPS

SATREPS
Science and Technology Research Partnership for Sustainable Development Program

SATREPS

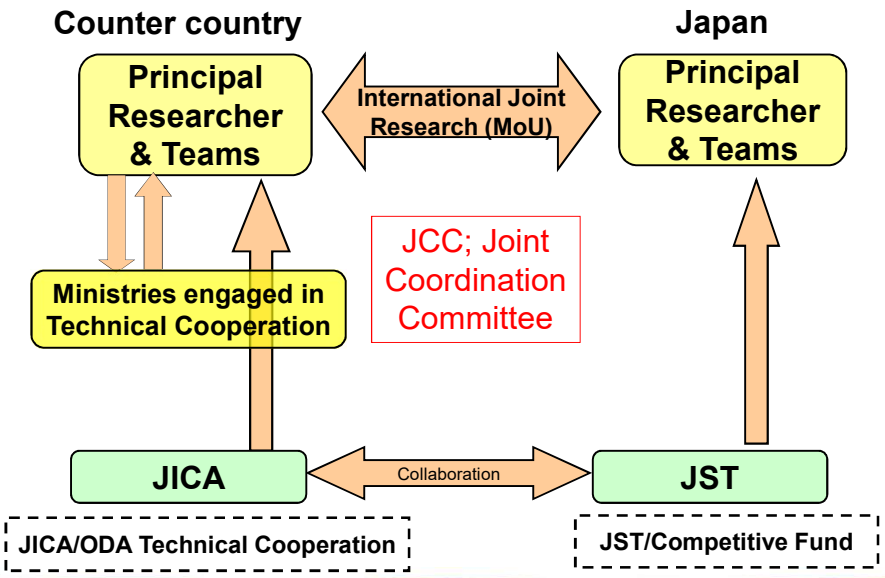
Science and Technology Research Partnership for Sustainable Development

Science and Technology	x	International Cooperation (Bi-lateral collaboration)
Global Issues	x	Local Needs (Social Implementation)
Japan's Capability	x	Counter Country' Capability

SATREPS

SATREPS
Science and Technology Research Partnership for Sustainable Development Program

Framework of SATREPS



SATREPS

SATREPS
Science and Technology Research Partnership for Sustainable Development Program

Stakeholder's involvement in SATREPS Project

1. Joint Coordination Committee (JCC) is organized in each project to promote research and to watch the progress.
2. Stakeholders in the counter country are involved in the JCC to co-design the project from the beginning.
3. In particular, policy makers are involved in the JCC to realize social implementation of the research results.

SATREPS

SATREPS
Science and Technology Research Partnership for Sustainable Development Program

New Project between Indonesia and Japan from 2017

Development and Implementation of New Damage Assessment Process in Agricultural Insurance as Adaptation to Climate Change for Food Security

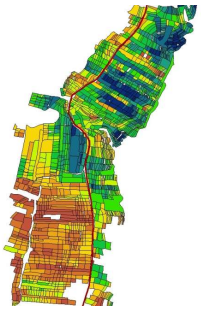
Principal Investigators
Japan side;
Prof. Chiharu HONGO
Center for Environmental Remote Sensing, Chiba University
Indonesian side;
Prof. Baba Barus
Bogor Agricultural University

SATREPS

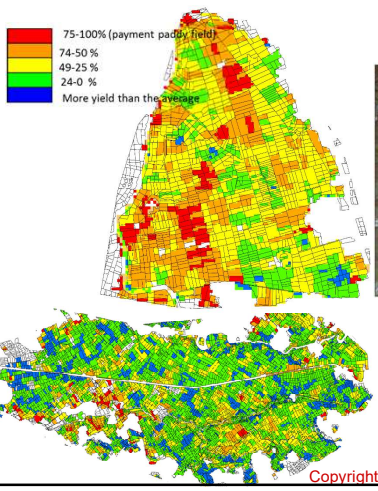
Seeds research (in Indonesia)

Practical application of satellite data to Agricultural Insurance (2013-2016)

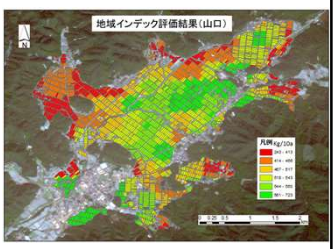
Yield estimation on individual field (Bali)



Decrease in yield of 2014 against average yield of last 10 years (west Java)



Yield estimation on area (Japan)



United Nations (UN) adopted the 17 SDGs of the 2030 Agenda for sustainable development in September 2015, and it entered into force in January 2016.

The Sustainable Development Goals (SDGs)

A. 17 SDGs and 169 targets

B. All UN countries including developing and developed countries

C. Indicators and monitoring framework in each country

D. Monitoring by UN

E. In Japan, Prime Minister's Office leadership in promoting SDGs

ST&I may play a vital role in promoting SDGs.

UNESCO & ICSU Budapest declaration

"Science for Society and Science in Society"
is added besides
Science for Knowledge,
Science for Peace and
Science for Development
as a new theme (1999)

Still we have many unsolved problems although many scientific papers have been published, and many new knowledges have been developed.

What is missing, and what should be added?

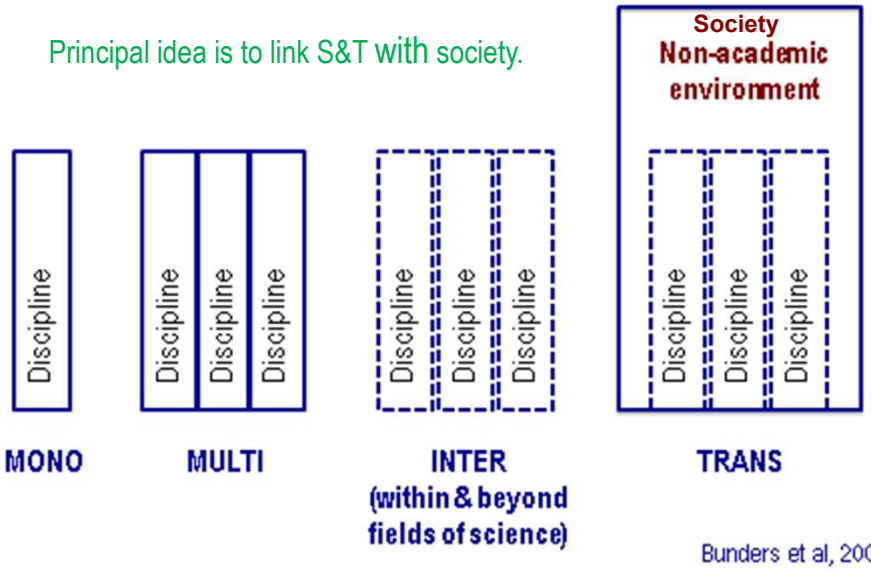
What is Future Earth?

- Is a global platform for international research collaboration on global environmental change and sustainable development
- Provides integrated research on major global change challenges and transformations to sustainability
- Strengthens partnerships between researchers, funders and users of research through co-design/co-production of research
- Is solutions-oriented, aiming to generate knowledge that contributed to new more sustainable ways of doing things

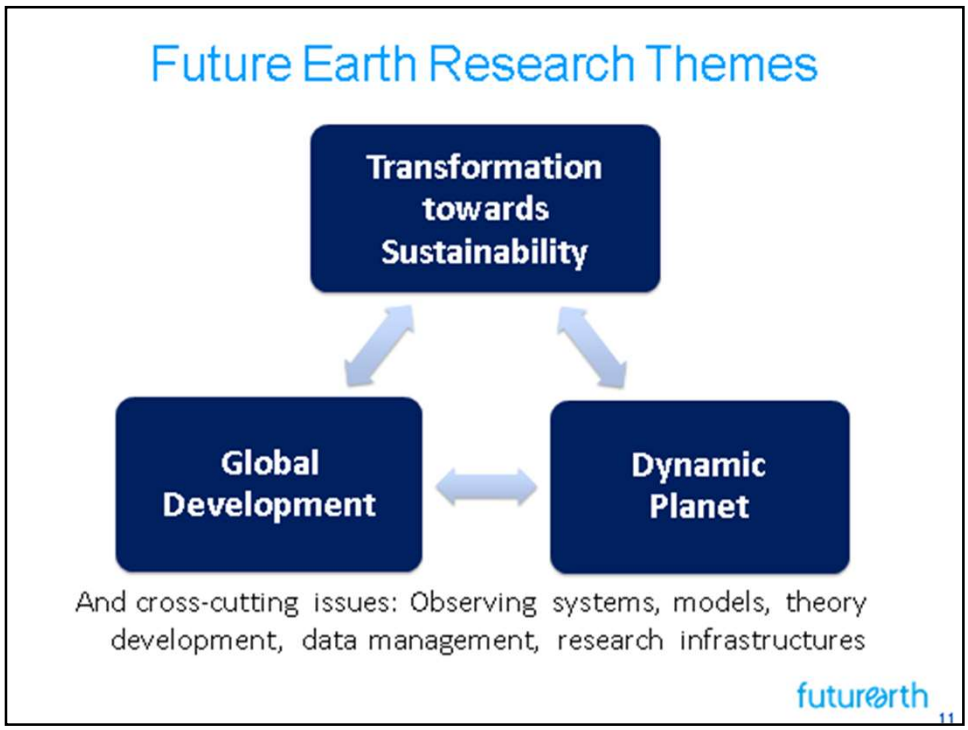
futureearth

Trans-disciplinary Approach

Principal idea is to link S&T with society.



Bunders et al, 2009



Common aspects among SATREPS, Future Earth and SDGs

@ Addressing global sustainability

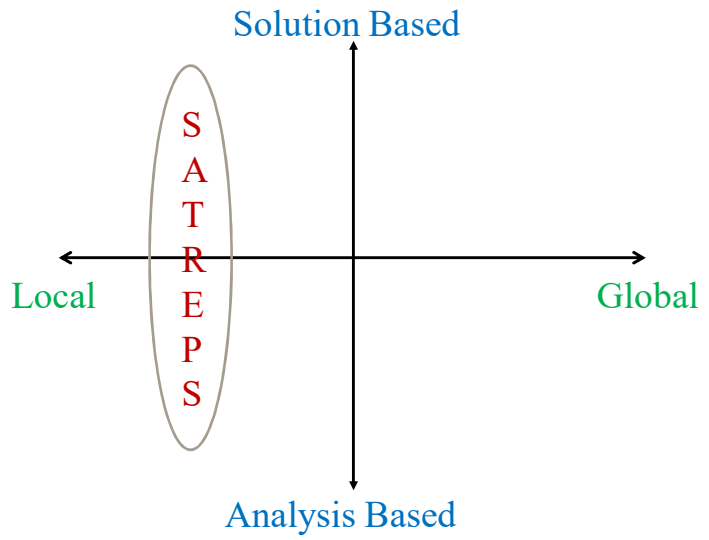
@ Solution oriented approach

@ Social implementation

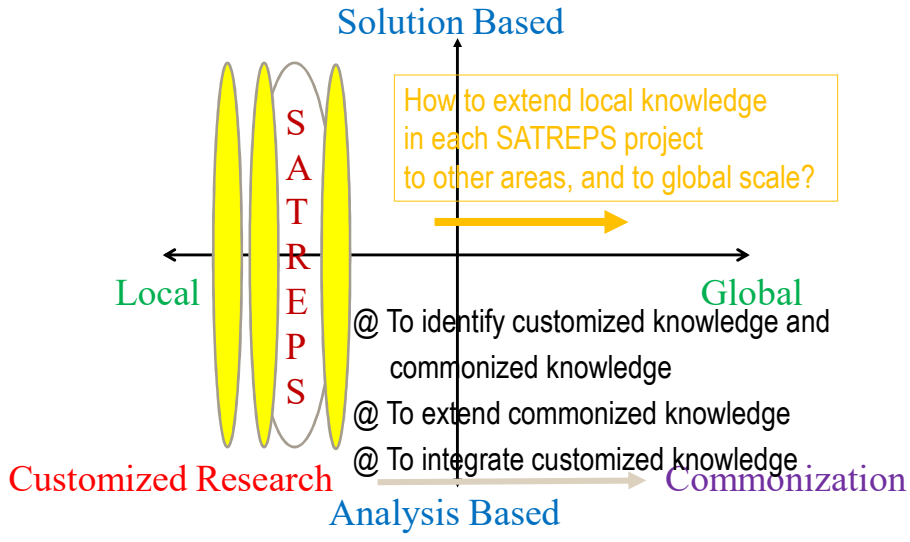
@ Stakeholders involvement

@ SATREPS and FE; in Academia
SDGs; not limited to Academia

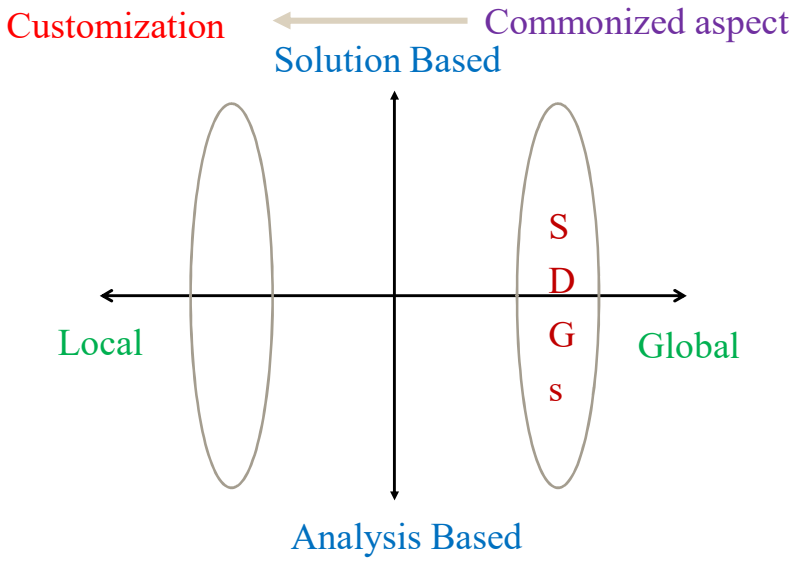
Global and Local Aspect in SATREPS



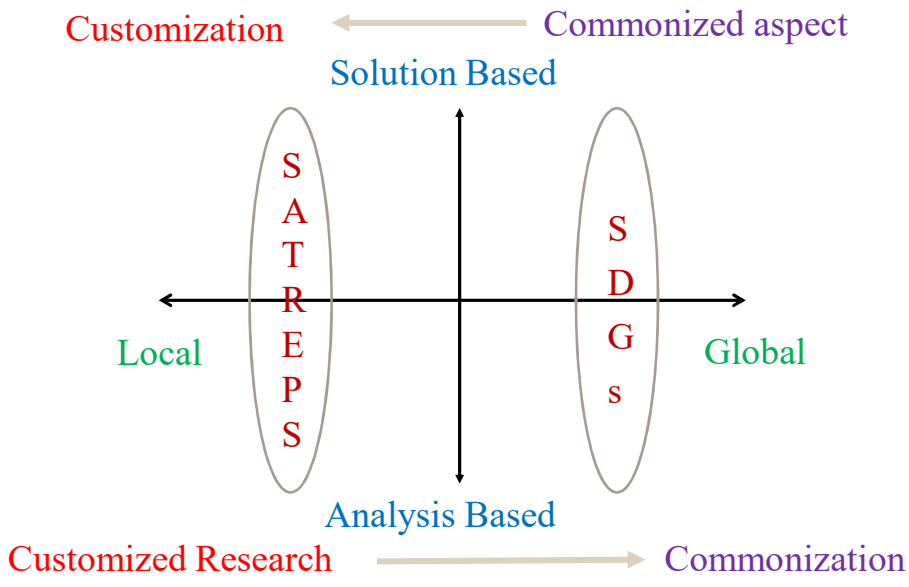
Extension of SATREPS Local Knowledge to Global



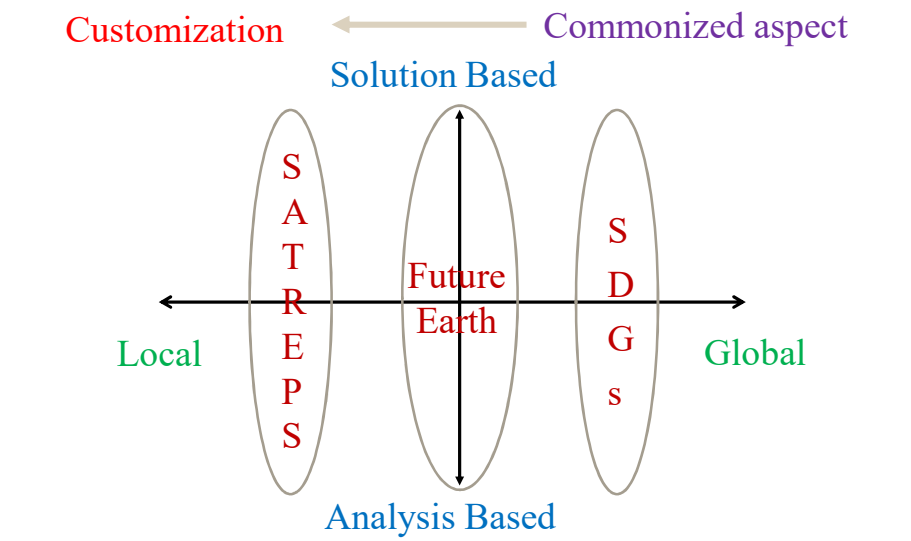
Customization of Country Level Criteria in SDGs



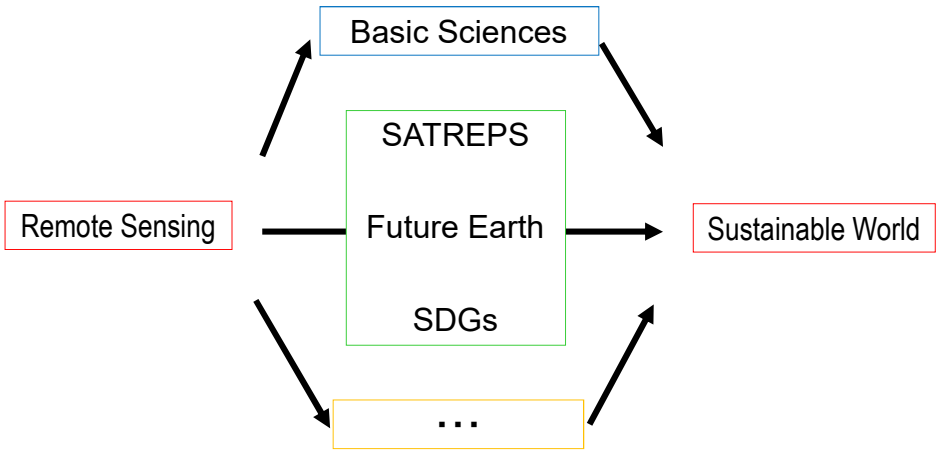
Customization and Commonization in SATREPS and SDGs



Customization and Commonization in SATREPS and SDGs



Pathways from Remote Sensing toward Sustainable World



SATREPS, Future Earth and SDGs are all international programs addressing global sustainability.

Conclusions

Combating climate change

needs to cover from urban scale (local/regional)
to global --- spatial dimension

needs to cover from short-term to long-term
--- temporal dimension

needs to cover a variety of variables
--- variable dimensions

needs to integrate monitoring, modeling and assessment
with management

Remote Sensing can contribute a lot!