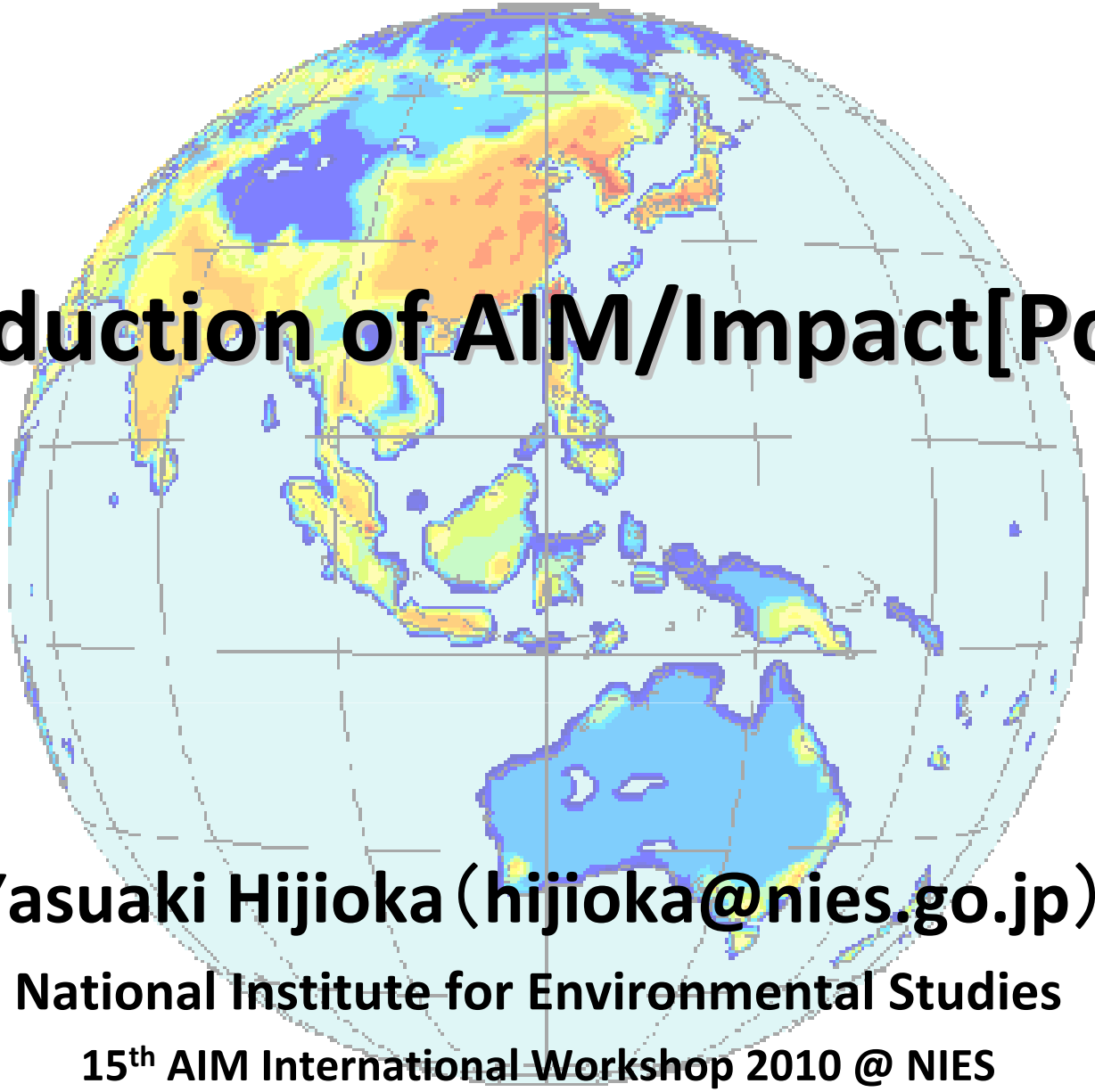
Introduction of AIM/Impact[Policy]



Yasuaki Hijioka（hijioka@nies.go.jp）

National Institute for Environmental Studies

15th AIM International Workshop 2010 @ NIES

Presentation Outline

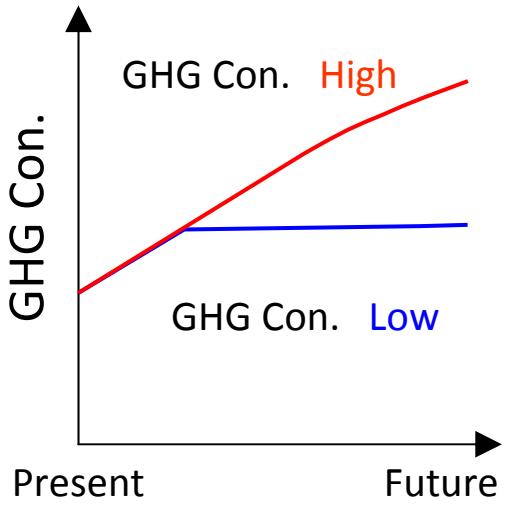
1. Outline of AIM/Impact[Policy]
2. Application of AIM/Impact[Policy]
   - The Project for Comprehensive Projection of Climate Change Impacts (S-4 project)
   - The Comprehensive Research Project of Climate Change Impact Assessment and Adaptation Strategies (S-8 project)

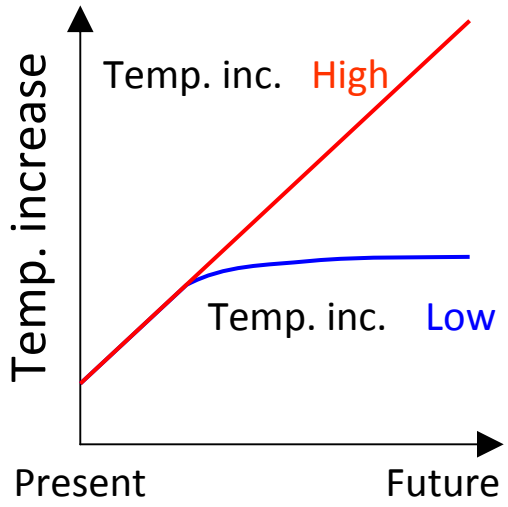
AIM/Impact[Policy]

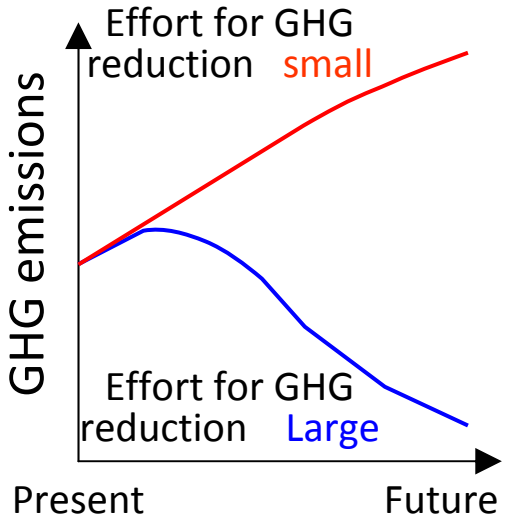
- Development of ***integrated assessment model***, AIM/Impact[Policy], for comprehensive analysis and assessment of GHG stabilization concentration targets and emission pathways for realizing them, as well as impacts and risks under such targets
- Assist policymakers'decision in action programs to arrest global warming

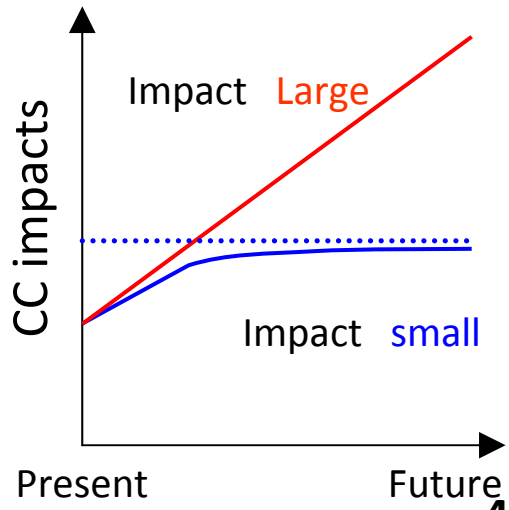
Development of Integrated Assessment model

- Integrated assessment model, AIM/Impact[Policy]
  - Projection of future GHG emissions and climate change impacts under stabilization scenarios



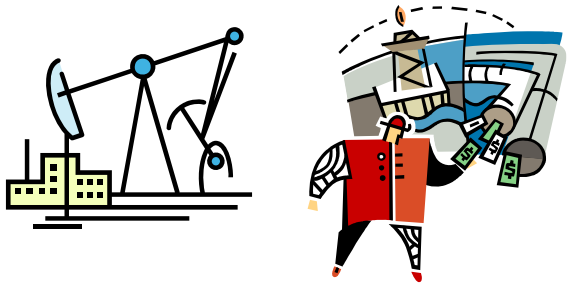






Overview of AIM/Impact[Policy]

GHG Emissions



Energy-economic model

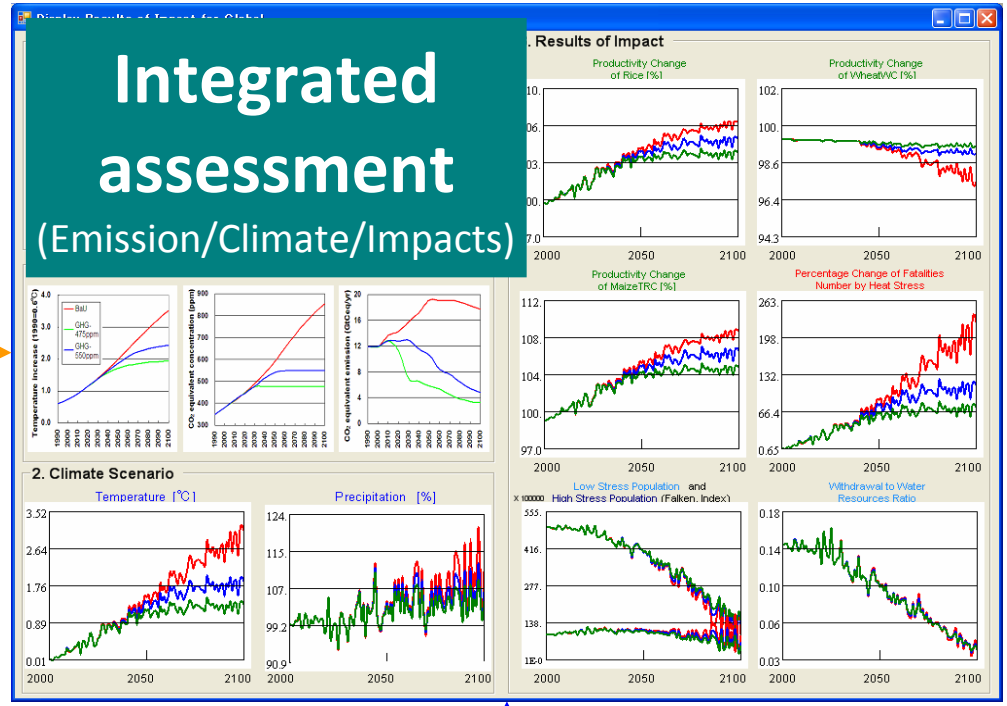
Global GHG emission path

Simple climate model

GMTI

Integrated assessment

(Emission/Climate/Impacts)



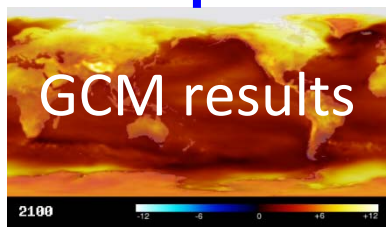
Impact/ Adaptation

National/ Sector-wise impacts

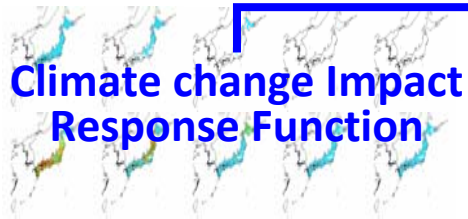
Pattern scaling module

Climate Scenario by country

Potential impact estimation module



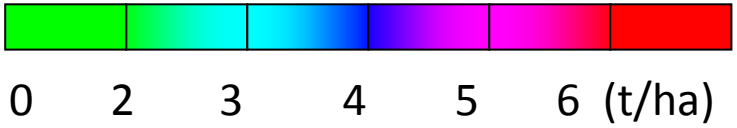
GCM results



Climate change Impact Response Function

Adaptation

Change of potential crop productivity (rice)



Precipitation 50% | Precipitation 100% | Precipitation 200%

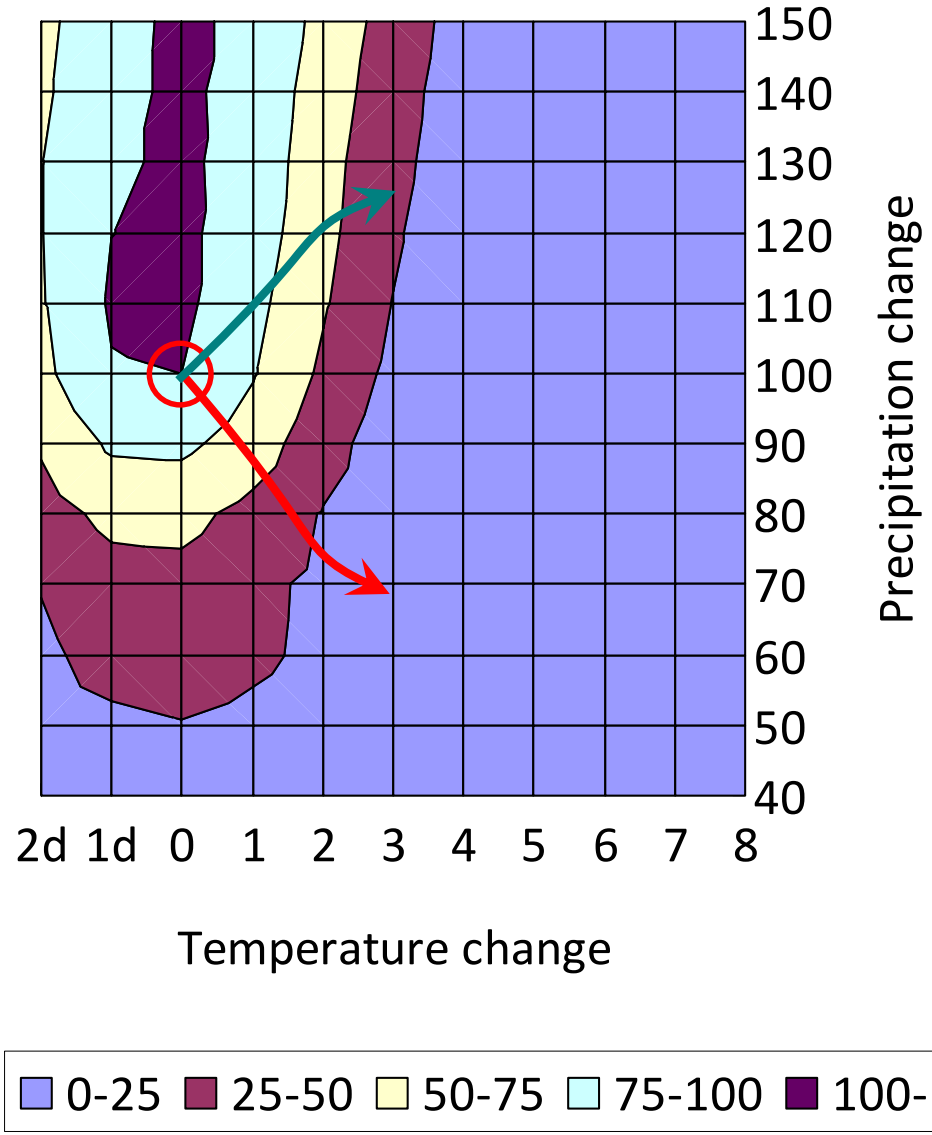
Temperature +0°C

Temperature +3°C

Temperature +6°C

Temperature +9°C

Example of Impact Response Function



Display Results of Impact for Global

Selected Stabilization Scenario

Work Directory: pka\2007\AIM\IP\AIP_REAL41yk\AIP\bin\test

Case Name: 475 — Change Directory

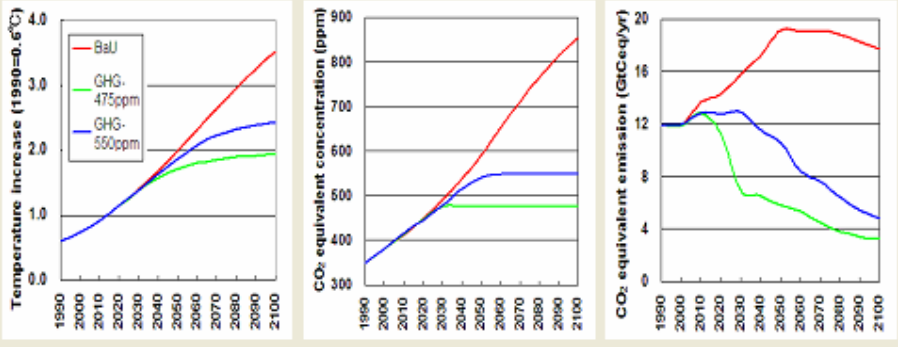
Climate Scenario: MIROC_A1B

Country: 113.Japan

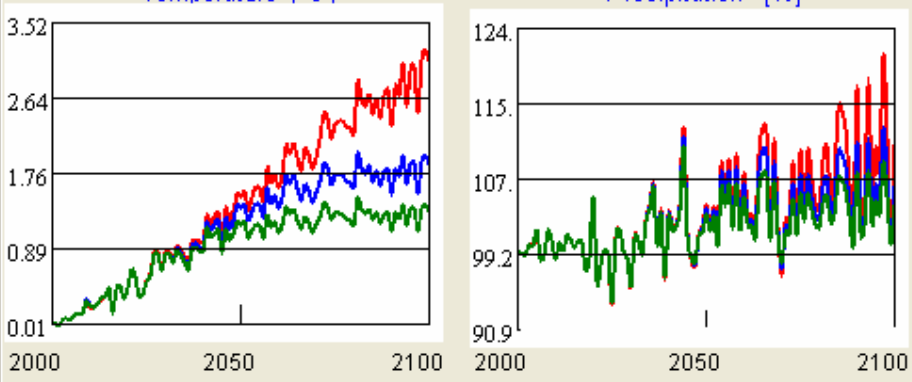
Time Slice: (•) 1 Year x 100 Periods ( ) 10 Years x 10 Periods

Data Display: Display — Reset — Close

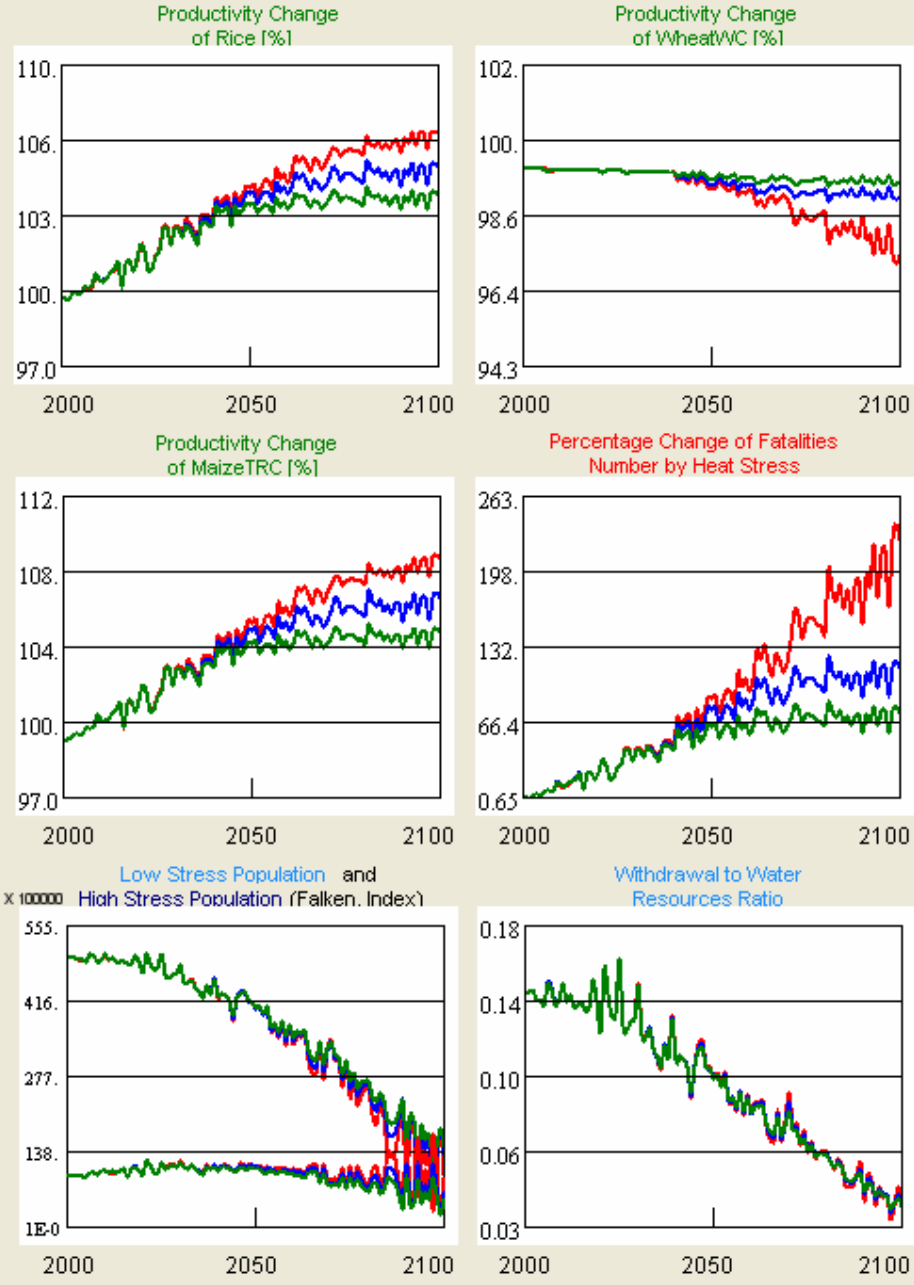
1. Stabiliaztion Scenario



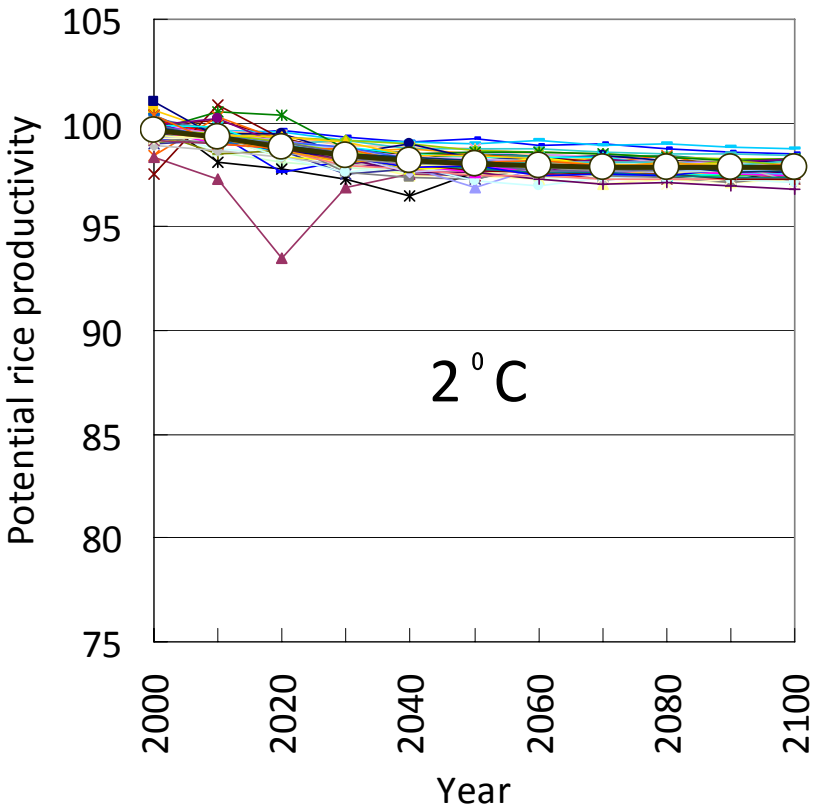
2. Climate Scenario

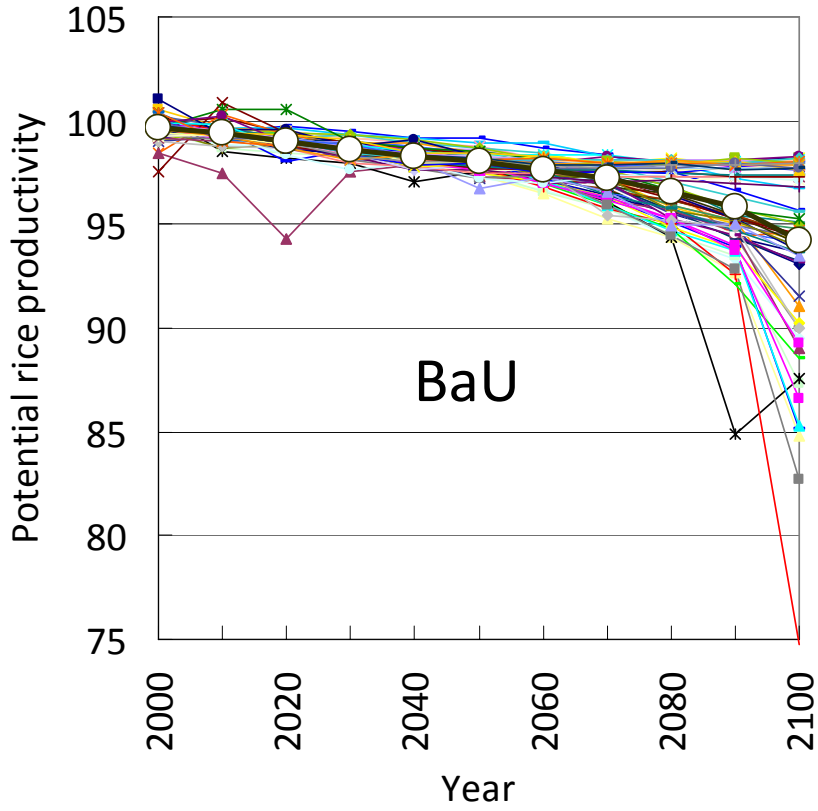


3. Results of Impact



Example of uncertainty analysis





BCCRbcm2-PCM_A2, BCCRbcm2-PCM_B1, CCCm_A2, CCCm_B2, CCCma-PCMA1B, CCCma-PCMA2, CCCma-PCMB1
CCCmat63-PCMA1B, CCCmat63-PCMB1, CCSR_A1, CCSR_A1T, CCSR_A2, CCSR_AF, CCSR_B1
CCSR_B2, CGCM-PCMA1B, CGCM-PCMA2, CGCM-PCMB1, CNRMcm3-PCMA1B, CNRMcm3-PCMA2, CNRMcm3-PCMB1
CSIRO_A1, CSIRO_A2, CSIRO_B1, CSIRO_B2, CSIROmk3-PCMA1B, CSIROmk3-PCMA2, CSIROmk3-PCMB1
ECHAM4-PCM_A1B, ECHAM-PCM_A1B, ECHAM-PCM_A2, ECHAM-PCM_B1, ECHO-PCM_A1B, ECHO-PCM_A2, ECHO-PCM_B1
FGOALS-PCM_A1B, FGOALS-PCM_B1, GFDL_A2, GFDL_B2, GFDLcm20-PCM_A1B, GFDLcm20-PCM_A2, GFDLcm20-PCM_B1
GFDLcm21-PCM_A1B, GFDLcm21-PCM_A2, GFDLcm21-PCM_B1, GISSaom-PCM_A1B, GISSaom-PCM_B1, GISSeh-PCM_A1B, GISSer-PCM_A2
GISSer-PCM_B1, HADCM3_A2, HADCM3_A2b, HADCM3_A2c, HADCM3_B2, INMCM3-PCM_A1B, INMCM3-PCM_A2
INMCM3-PCM_B1, IPSLcm4-PCM_A1B, IPSLcm4-PCM_A2, IPSLcm4-PCM_B1, MIROC_A1B, MIROCh-PCM_A1B, MIROCh-PCM_B1
MIROCm-PCM_A1B, MIROCm-PCM_A2, MIROCm-PCM_B1, MIROCold_A1B, NCARccsm3-PCM_A1B, NCARccsm3-PCM_A2, NCARccsm3-PCM_B1
NCARpcm1-PCM_A1B, NCARpcm1-PCM_A2, UKMOhadcm-PCM_A1B, UKMOhadcm-PCM_A2, UKMOhadcm-PCM_B1, UKMOhadgem1-PCM_A1B, UKMOhadgem1-PCM_A2
Ave.

The Project for Comprehensive Projection of Climate Change Impacts (S-4)

- Global Environment Research Fund **S-4** by Ministry of the Environment
- Targeted area: **Asian region** including **Japan**
- Targeted fields: **Water resources**, **forests**, **agriculture**, **coastal zones**, **human health**
- Research period:
  - Period I (**2005**-2007) + Period II (2008-**2009**)
- Project leader: **Nobuo MIMURA**, Ibaraki University
- Research budget: around **0.2** billion yen per year
- Number of sub-themes: **Seven**
  - Number of participating research institutions: **14** (2008)
  - Number of participating researchers: **42** (2007)

Objectives of the research project

- To obtain quantitative knowledge on climate change impacts in key fields in the Asian region including Japan, targeting the period up to the end of the present century while focusing on the period up to around 2050.
  - Water resources, Forests, Agriculture, Coastal zones, and Human health

- To comprehensively grasp the impacts on Japan and elucidate the relationships with the level of global warming.

11

S-4 research method

Improvement of Impact Projection

Water

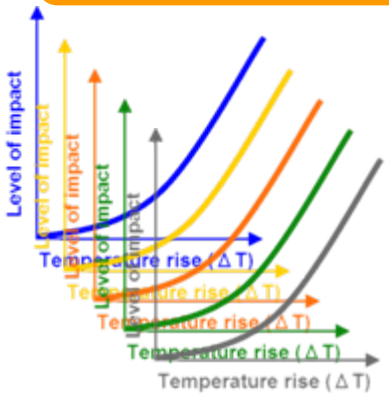
Health

Agri.

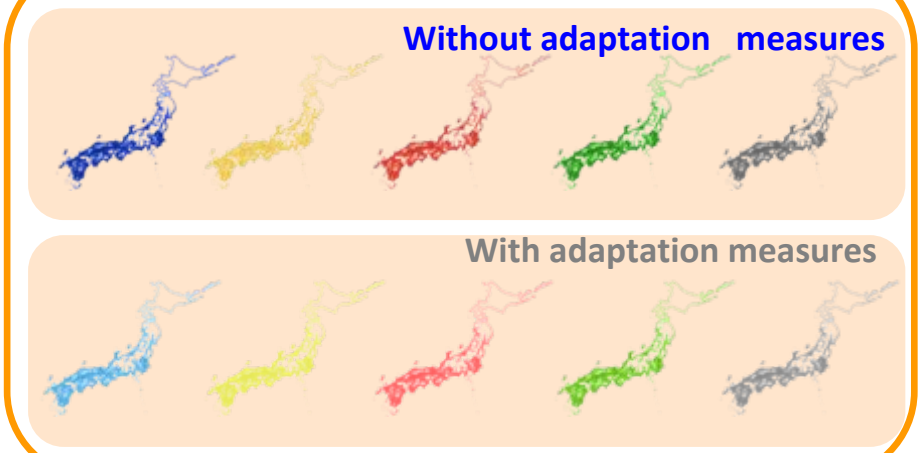
Forests

Coasts

Development of Impact Functions



Risk Map



Adaptation measures

Common scenario

Climate scenario

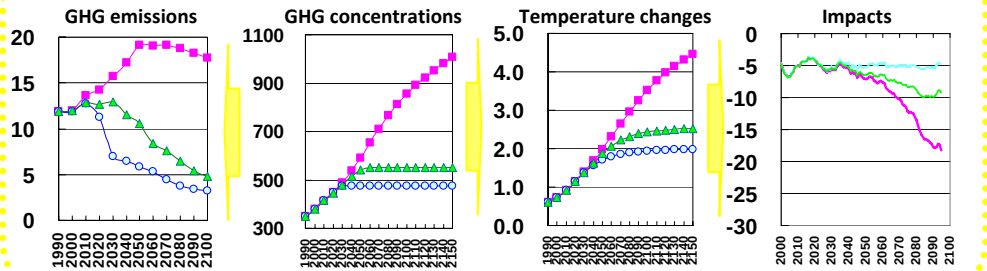
Population scenario

Economic assessment

Proposal of economic assessment method

Development of monetary assessment basic unit

Integrated assessment model



Integrated Assessment

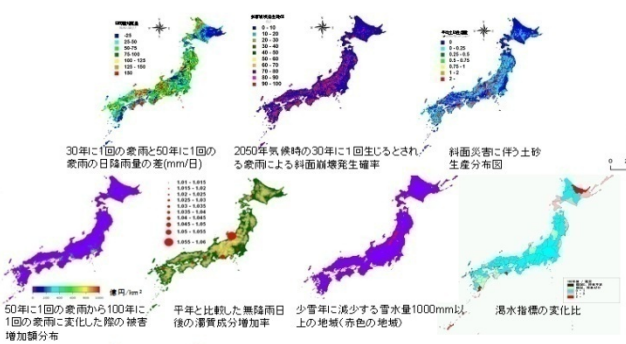
Key research products

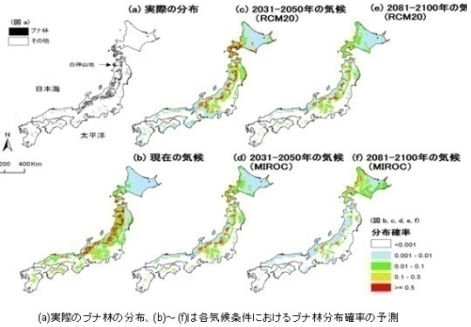
1. The development of **quantitative assessment methods by field** and **projection of the impacts** on whole **Japan**
   - **Risk maps** (nationwide as well as regional assessments)
     - ✓ Full report: **94** pages, Brief summary: **15** pages
     - ✓ Press Release: **29th May, 2008,** Results for the **first three years**

2. **Impact assessments by stabilization level** of atmospheric GHG concentration using an integrated assessment model
   - Assessments of **damage costs** as well as **physical impacts**
     - ✓ Full report: **38** pages, Brief summary: **26** pages
     - ✓ Press Release: **29th May, 2009**

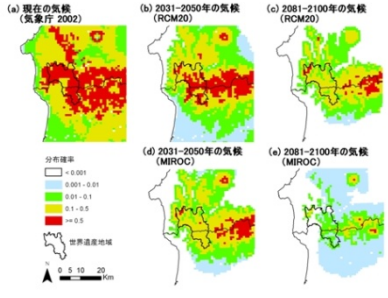
Reported risk maps

http://www-cger.nies.go.jp/climate/rrpj-impact-s4report.html

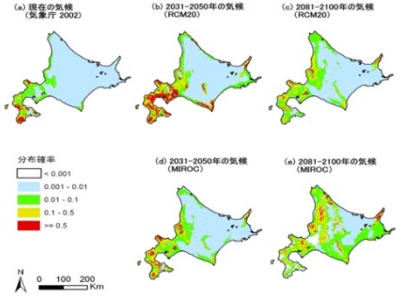




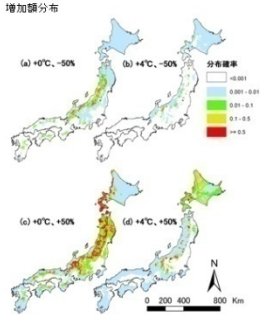
(a)実際のブナ林の分布、(b)~(f)は各気候条件におけるブナ林分布確率の予測



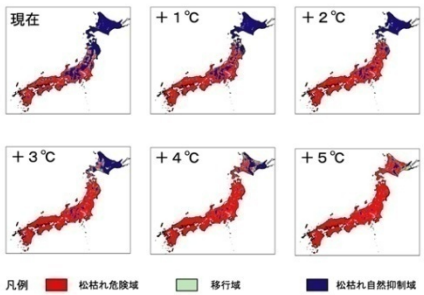
温暖化に伴う白神山地のブナ林分布確率の変化予測



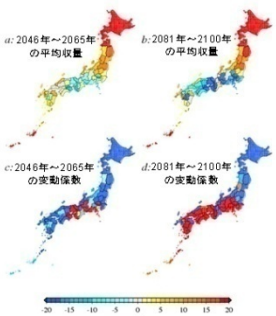
温暖化に伴う北海道のブナ林分布確率の変化



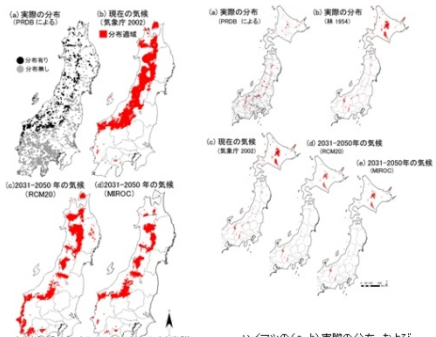
(a)実際のブナ林の分布、(b)~(f)は各気候条件におけるブナ林分布確率の予測



現在と温暖化時(+1~+5℃)におけるマツ枯れ危険域の予測

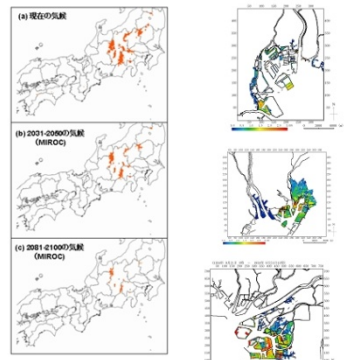


気候シナリオ(MIROC、A1B)によるコメ収量の変化推計結果



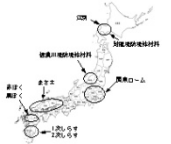
本州東部におけるチシマザサの(a)実際の分布と、(b)現在の気候と(c,d)温暖化後における分布適域の予測

ハイマツの(a, b)実際の分布、および(c)現在の気候と(d, e)温暖化後における分布適域の

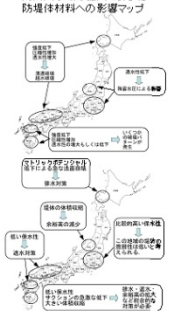


シラベの分布適域の変化(赤色)
現在の気候、気候変化シナリオMIROCの2031-2050年と2081-2100年における予測

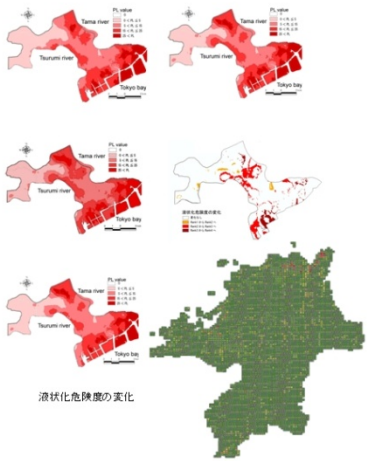
2100年気候時における三大湾奥部における高潮浸水深



河川氾水域の拡大による堤防堤体材料への影響マップ

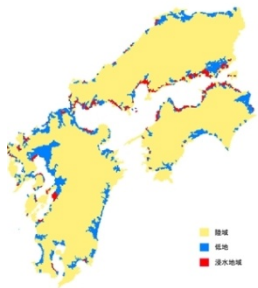


河川堤防堤体材料の降雨に対する脆弱性評価と対策マップ

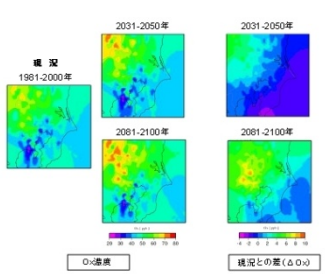


液状化危険度の変化

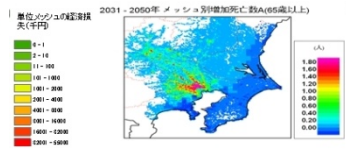
温暖化による福岡県における斜面災害リスクマップ



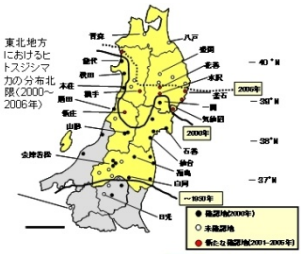
2100年気候時における西日本の高潮浸水

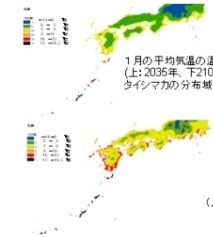


関東地方のOx濃度予測と現況との濃度差(ΔOx)

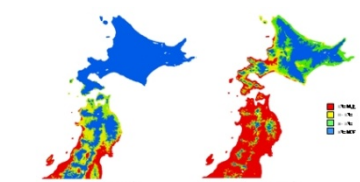


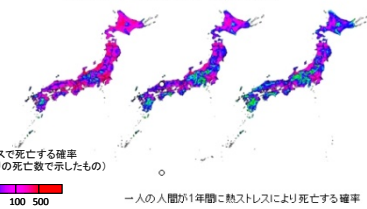
関東地方の影響予測





1月の平均気温の温度分布(上:2035年、下2100年)(ネッタイシマカの分布域拡大予測)





Outline of Stabilization Scenarios

- Including GHGs and cooling effects of aerosol
- Overshooting of GHG concentrations occurs (450s, 550s)
  - **450s**: 450 ppm GHG concentration (CO_2 equivalent concentration) stabilization scenario
    - ✓ Equilibrium temperature increase of approx. 2.1°C (compared with pre industrial period)
  - **550s**: 550 ppm GHG concentration (CO_2 equivalent concentration) stabilization scenario
    - ✓ Equilibrium temperature increase of approx. 2.9°C (compared with pre industrial period; approx. 2.7°C in 2100 in the present analysis)
  - **BaU** (Business as Usual scenario)
    - ✓ Temperature increase of approx. 3.8°C in 2100 (compared with pre industrial period)
    - ✓ Corresponding to IPCC SRES B2

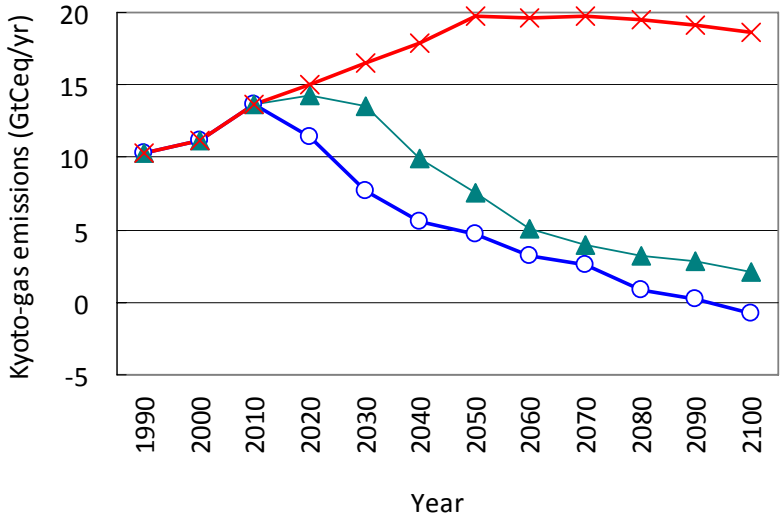
8 indicators for impact assessment

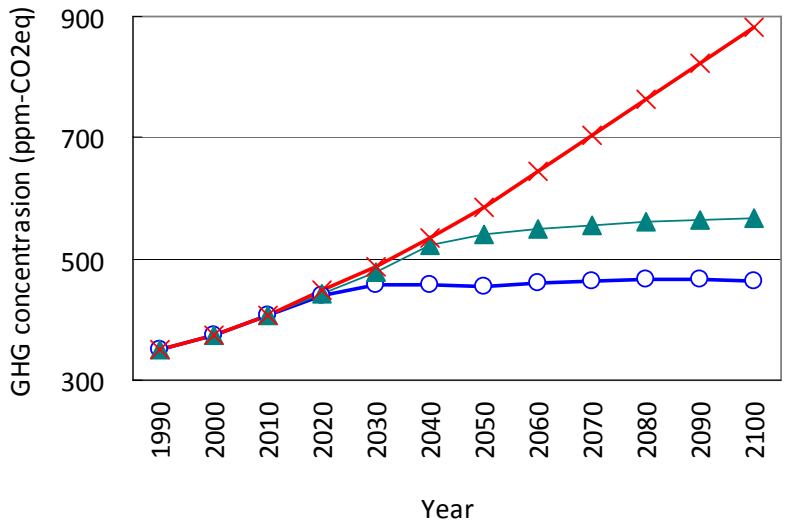
- Flooded area and cost of damage due to **floods**
- Probability of **slope failure** and cost of damage due to landslide disasters
- Impacts on **suitable habitats for Fagus crenata** (Japanese beech) forests and cost of damage
- Expansion of areas at risk of **pine wilt**
- Impacts on **rice yield**
- Expansion of area of **sand beach loss** and cost of damage
- Expansion of area of **storm-surge flooding**, affected populations, and cost of damage
- **Heat stress mortality risk** and cost of damage

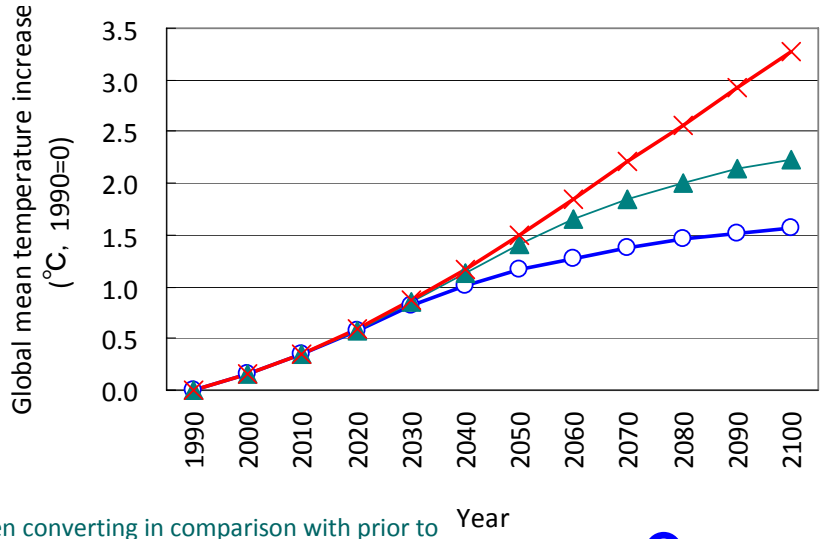
Outline of Integrated Assessment

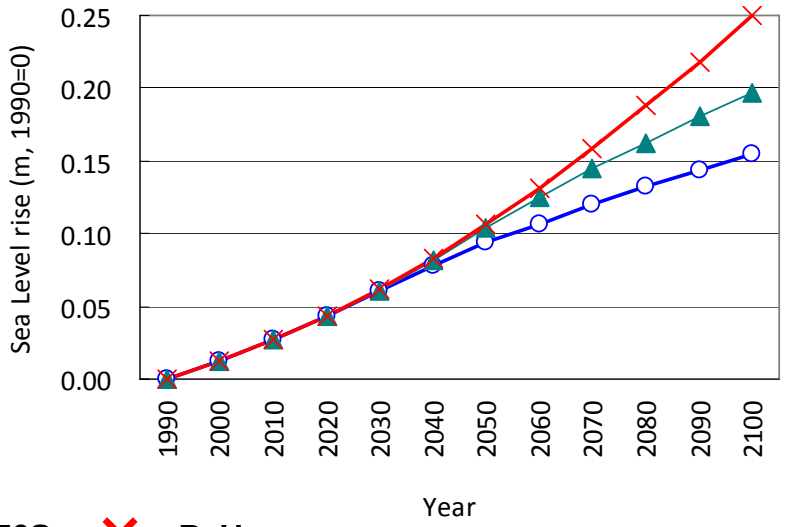
- Equilibrium climate sensitivity: **3°C**
- The **carbon feedback** effect is **not** taken into **consideration**
- GCM used for preparation of climate scenarios (pattern scaling) by region from global mean temperature changes: **MIROC3.2-hires**
- The impacts of global warming are the **increment** when **1981-2000** (or **1990**) is taken the base period or year
- **Without** considering **adaptation** to climate change

Global GHG Emissions (Six Types of GHGs Established under the Kyoto Protocol), GHG Concentration, Global Mean Temperature Increase, and Sea Level Rise by Scenario







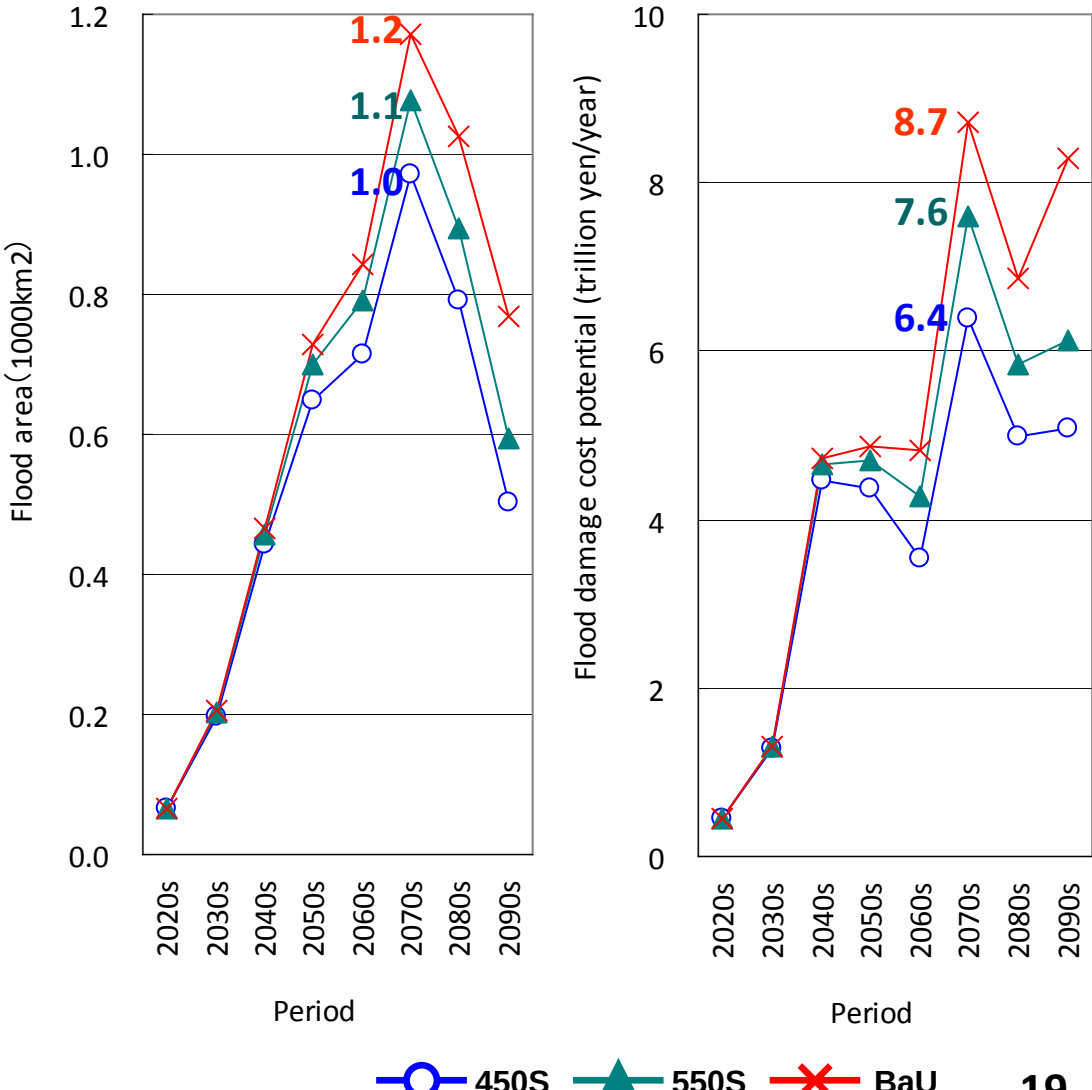


When converting in comparison with prior to the industrial revolution: +0.5° C

450S 550S BaU

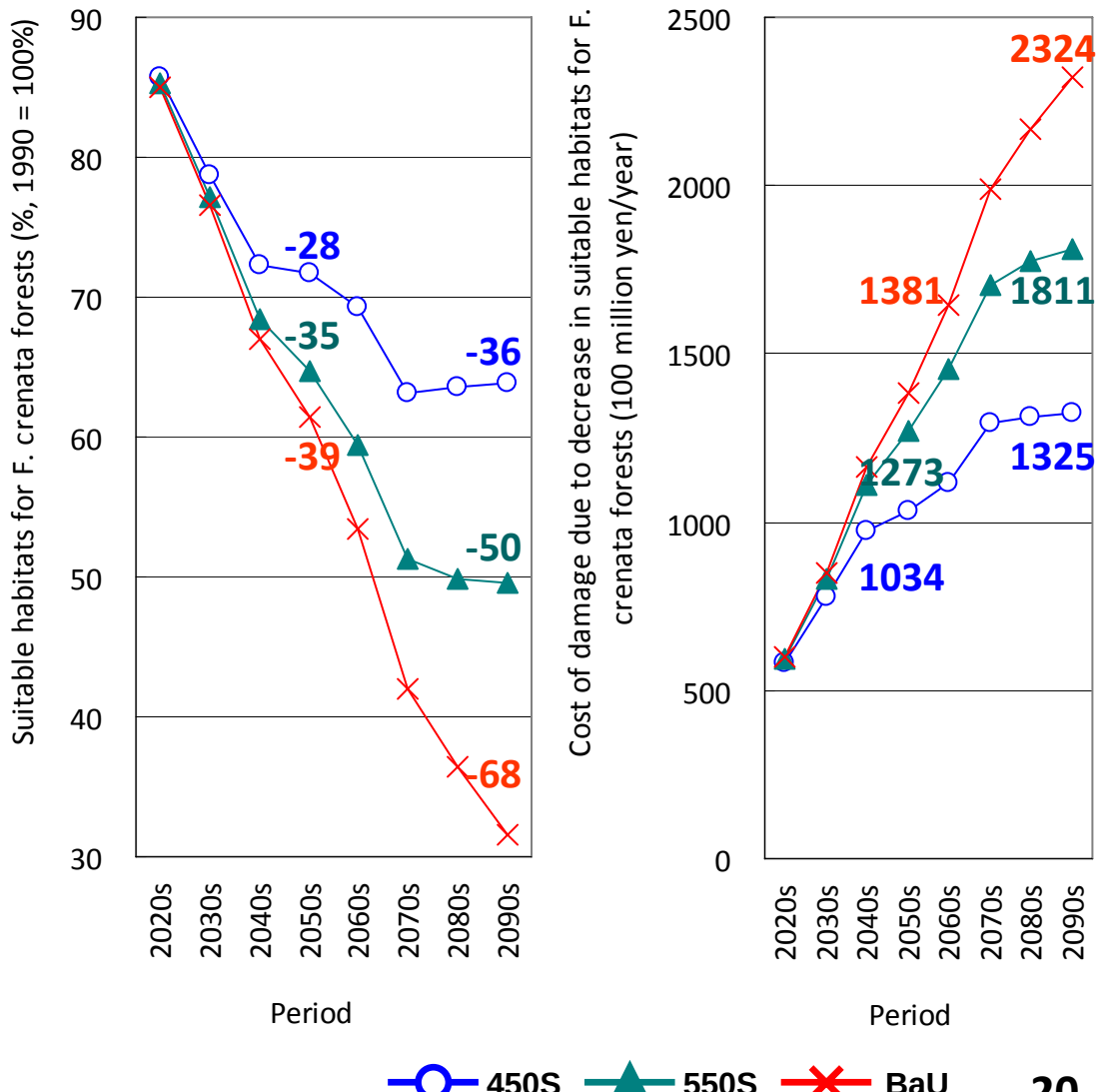
Impacts of Floods

- Present protection level
  - Heavy rain (HR) occurring once every 50 years.
- Future protection level
  - HR occurring once every 50 years in every prefecture
  - HR occurring once every 150 years in the three major metropolitan areas
- Protection level remains unchanged in the future.
- NO depreciation of asset values due to damage



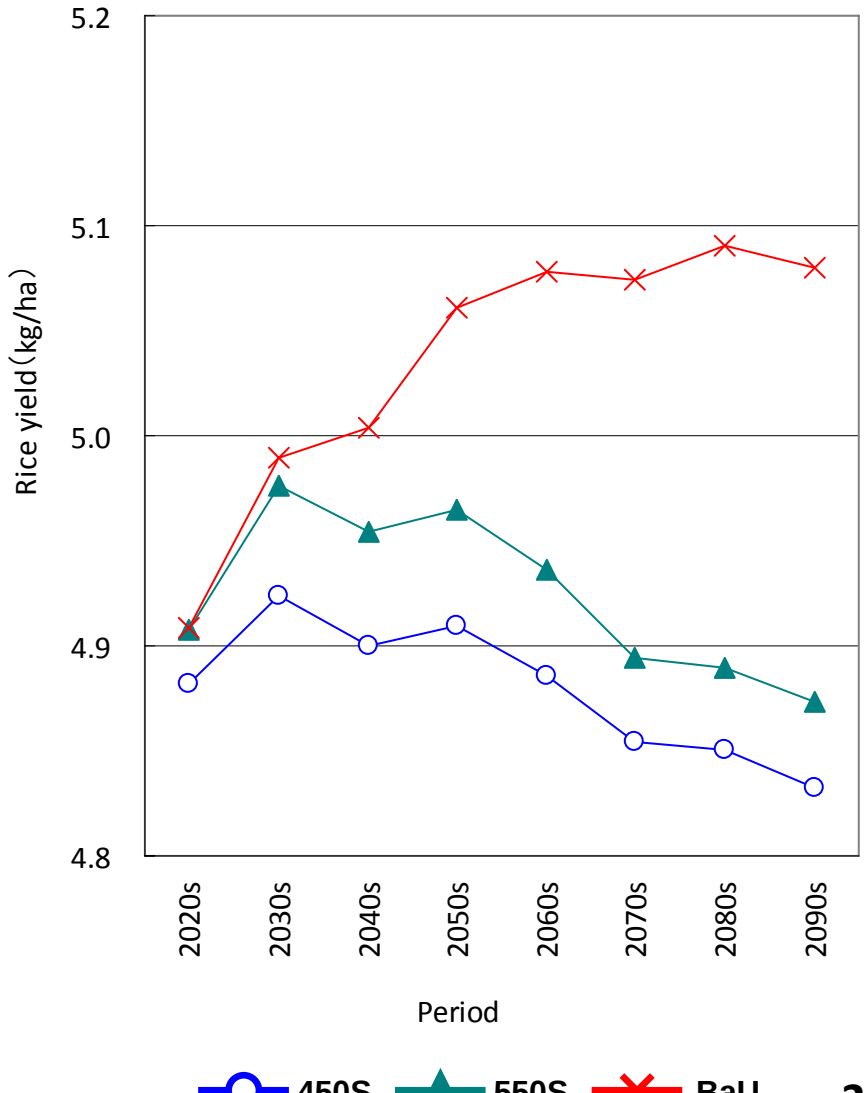
Impacts on Forests

- Climate variables
  - Changes in cumulative temperature (warmth index),
  - Changes in daily minimum temperature of the coldest month,
  - Changes in winter precipitation (December-March),
  - Changes in summer precipitation (May-September)
- Application of CVM (contingent valuation method).
- Smoothly migration
- No land use change
- Non-market value

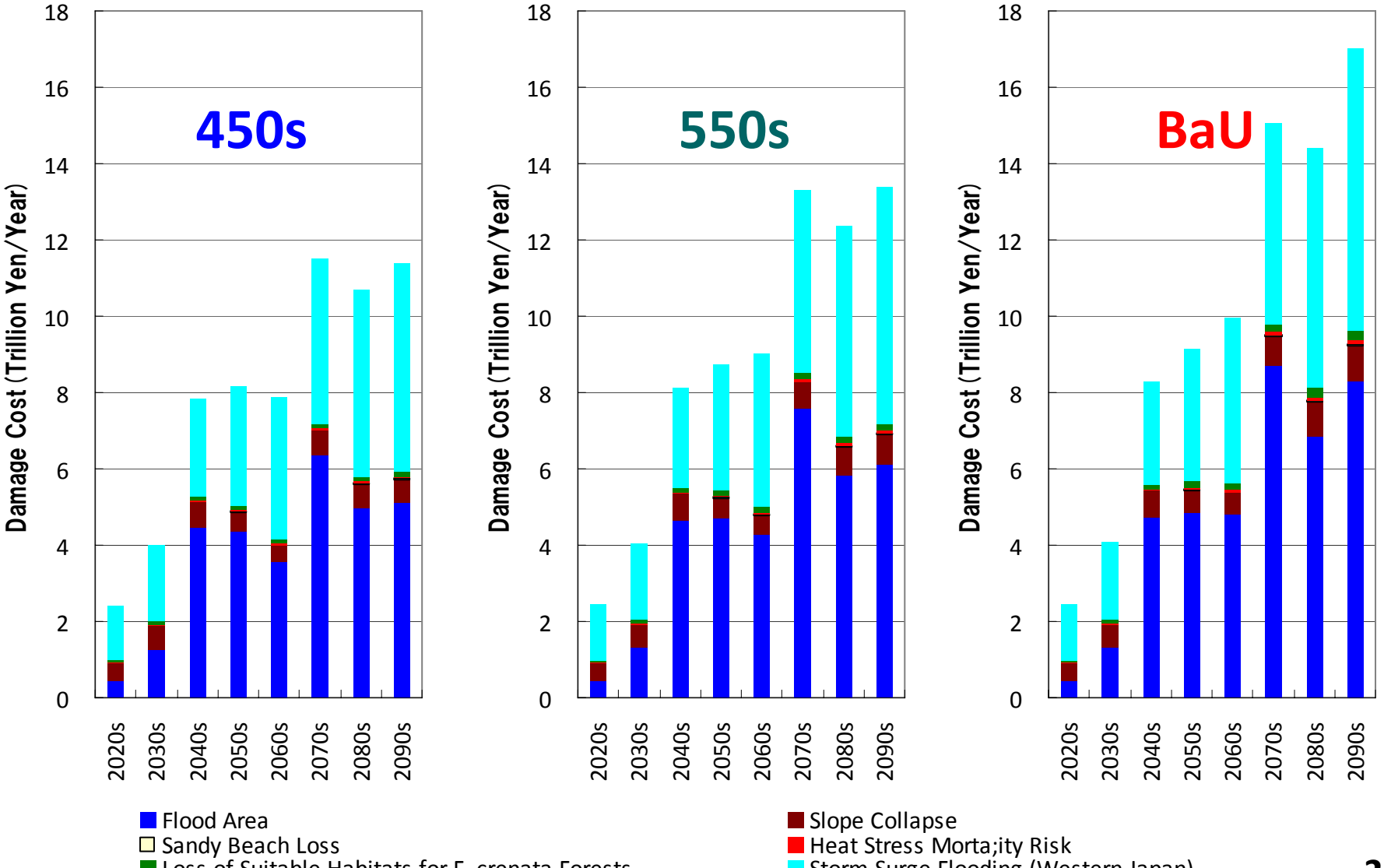


Impacts on Agriculture (Rice Yield)

- Climatic variables
  - Changes in accumulated insolation in the warm season (May-October)
  - Mean temperature change in summer (July, August)
  - Mean temperature change in the warm season excluding summer (May, June, September, October)
  - CO_2 concentration
- Important factors to determine the rice yield
  - Positive effect due to the reduction in cold weather damage in currently cool regions
  - Positive effect due to the CO_2 fertilization
  - Negative effect due to high-temperature-induced sterility in currently warm regions



Damage Costs by Scenarios



Key Findings of Second Report

- In Japan as well, even greater impacts of global warming are expected in the future in a broad range of fields related to people's lives.
- Even when the GHG concentration is stabilized at low level (ex. 450 ppm-CO_2eq), the occurrence of a certain amount of damage is unavoidable.
- It is necessary to study and implement adaptation measures from the long-term viewpoint

Outline of S-8 project

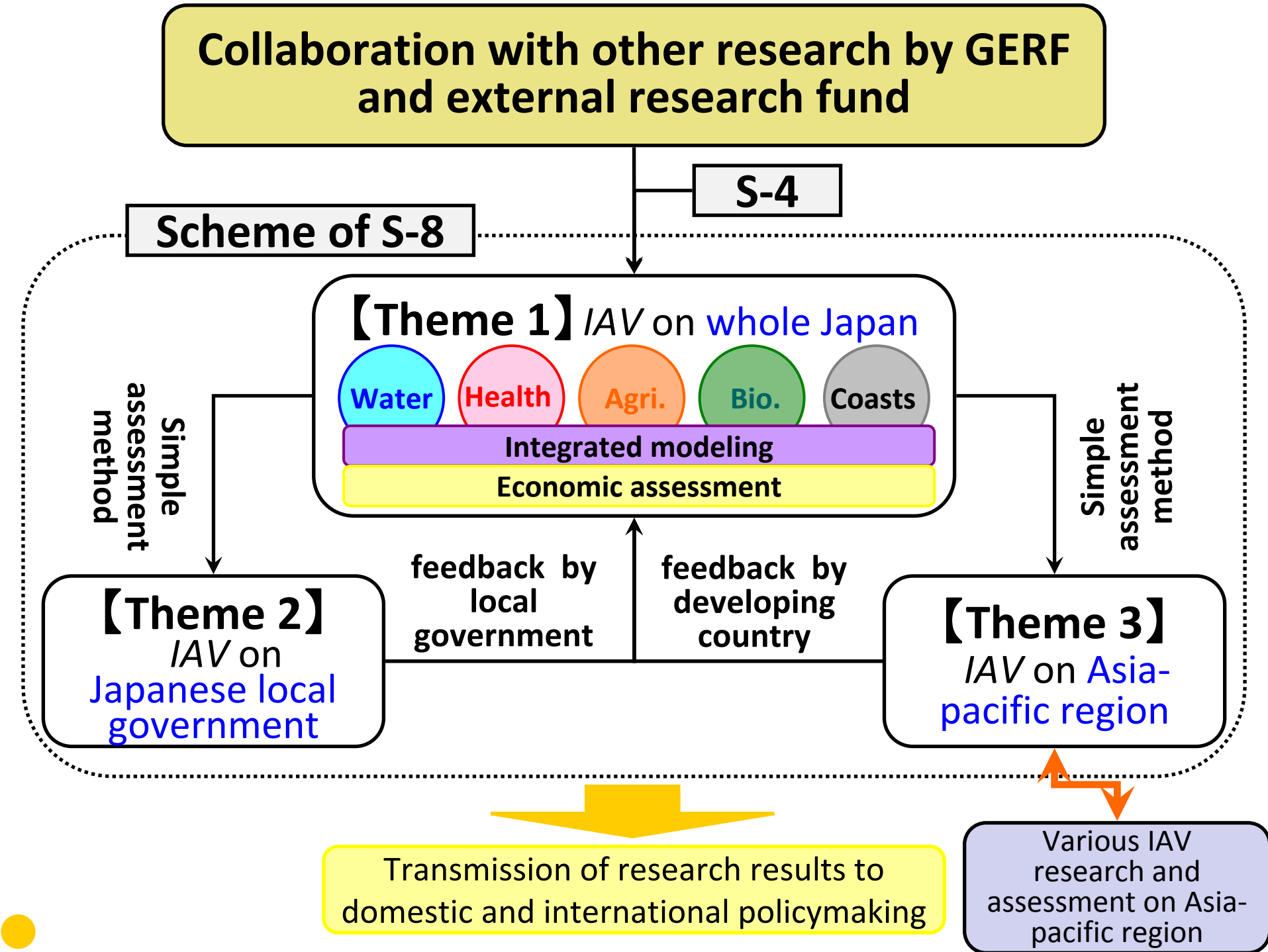
- Global Environment Research Fund **S-8** by Ministry of the Environment
- Targeted area : **Whole** and **regional** area in Japan and **Asia-Pacific region**
- Targeted fields: **Water resources**, **forests**, **agriculture**, **coastal zones**, **human health**
- Research period:
  - Period I (**2010**-2012) + Period II (20013-**2014**)
- Project leader: **Nobuo MIMURA**, Ibaraki University
- Research budget: around **0.35** billion yen per year
- Number of sub-themes: around **10**
  - Impact assessment in whole Japan: around 7
  - Impact assessment in Japanese regional area: around 2
  - Impact assessment in Asian developing countries: around 1

Comparison between S-4 and S-8

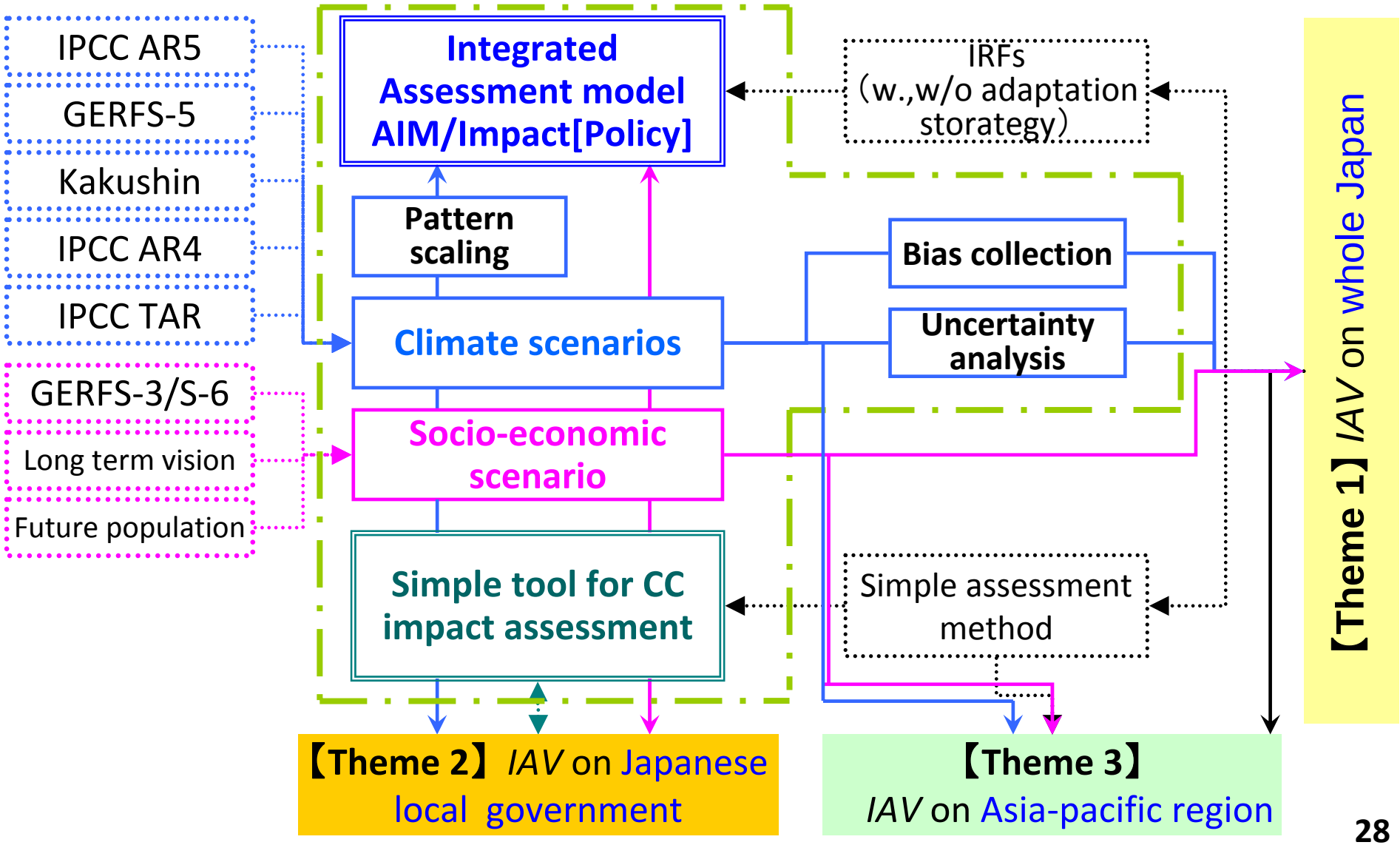
	S-4	S-8
Targeted area	Whole Japan	Whole and regional Japan, Asia-Pacific
Targeted fields Research	**Water resources**, **forests**, **agriculture**, **coastal zones**, **human health, economic**	
Period:	Period I (FY**2005**-2007) + Period II (FY2008-**2009**)	Period I (FY**2010**-2012) + Period II (FY2013-**2014**)
Project leader	**Nobuo MIMURA**, Ibaraki University	
Budget:	Around **0.2** billion yen per year	Around **0.35** billion yen per year
Number of research team	7	Around 10

Objectives of S-8 project

- To assess climate change impact assessment focusing on whole Japan under different GHG concentration stabilization scenarios and adaptation strategies
  - Utilization of new climate scenario with high accuracy and resolution
  - Development of advanced model for assessment of climate change impacts and adaptation strategy
- To develop a planning method for adaptation strategy focusing on Japanese local government and developing countries
  - Development of simplified tool to assess the impacts of, and vulnerabilities and adaptation to, climate change
  - Consideration of uncertainty in the assessment


Collaboration with other research by GERF and external research fund
S-4
Scheme of S-8
【Theme 1】 IAV on whole Japan
Water
Health
Agri.
Bio.
Coasts
Integrated modeling
Economic assessment
Simple assessment method
Simple assessment method
feedback by local government
feedback by developing country
【Theme 2】 IAV on Japanese local government
【Theme 3】 IAV on Asia-pacific region
Transmission of research results to domestic and international policymaking
Various IAV research and assessment on Asia-pacific region

AIM activity to S-8 project



Future Plan

- Improvement of AIM/Impact[Policy]
  - Revision of energy-economic model
  - Extension of assessment field
    - ✓ Incorporation of adaptation strategy
  - Collaboration with Asia-Pacific researchers
- Shift from S-4 to S-8 project
  - Focus on adaptation strategy
- Impact assessment in Tokyo