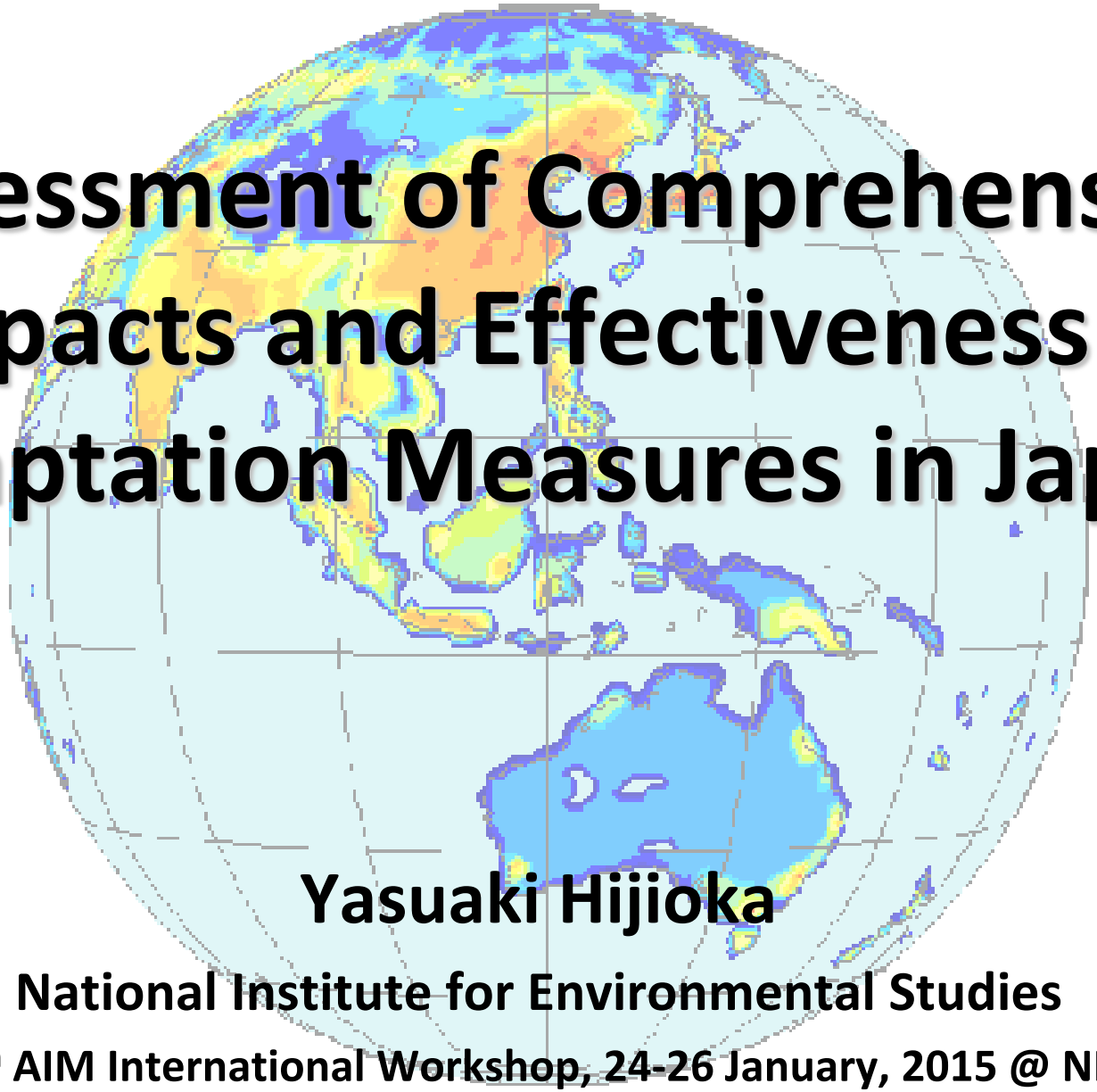
Assessment of Comprehensive Impacts and Effectiveness of Adaptation Measures in Japan



Yasuaki Hijioka

National Institute for Environmental Studies

20th AIM International Workshop, 24-26 January, 2015 @ NIES

Environment Research & Technology Development Fund "S-8"

- **Ministry of the Environment, Japan**
- 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 (2013-**2014**)
- Project leader: **Nobuo MIMURA**, Ibaraki University
- Number of sub-themes: **12**
  - Impact assessment in whole Japan: **9**
  - Impact assessment in Japanese regional area: **2**
  - Impact assessment in Asian developing countries: **1**

Socio-Economic Scenarios

Climate Scenarios

【Theme 1】 Research on highly reliable quantitative assessment of climate change impacts throughout Japan

Climate Scenario downscaler

Economic assessment

Integrated assessment model

Simplified assessment method

Regional assessment method

Feedback from local government

Feedback from developing country

【Theme 2】

Research on impact assessment and comprehensive adaptation policies at the local government level

Local government consortium

【Theme 3】

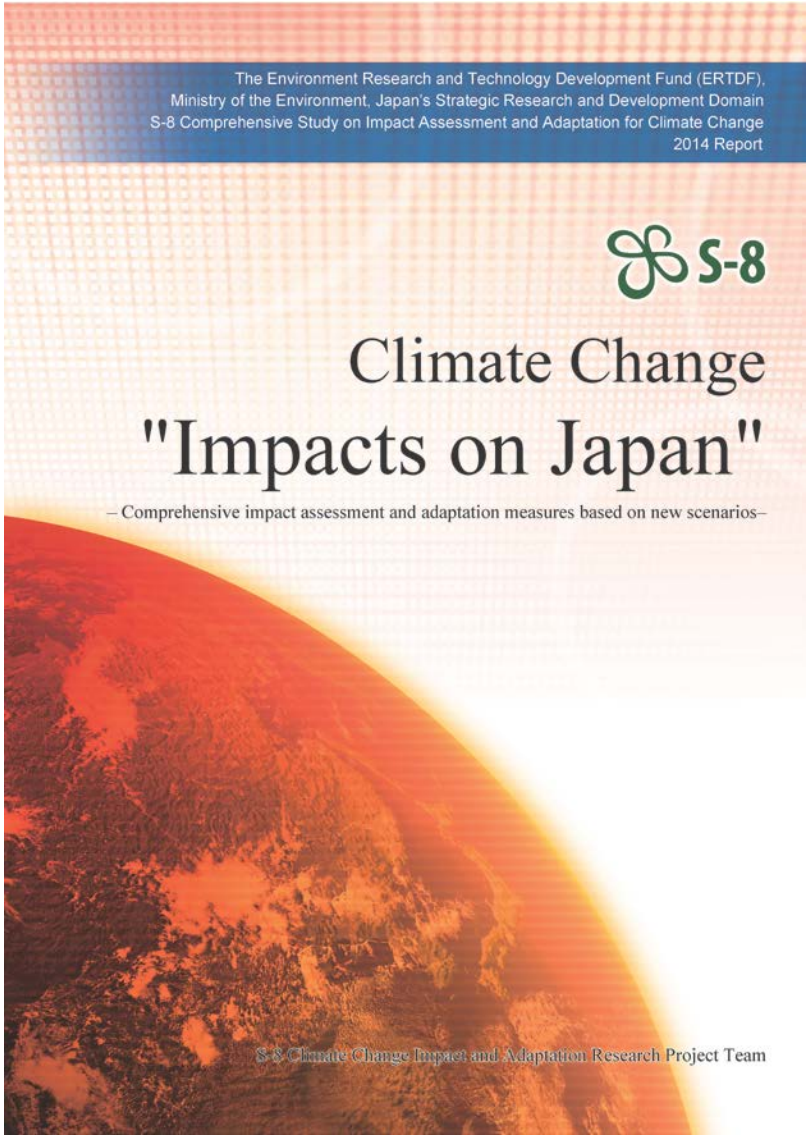
Research on indexes of vulnerability and adaptation effects in the Asia-Pacific Region

Various impact and adaptation studies in the Asia-Pacific region

Transmission of research results to domestic and international policymaking

ERTDF S-8 project report (2014)

- Published on 17 March, 2014
- Summary report of ERTDF S-8 project from FY2010 to FY 2013
- 12 sub projects
- 28 (34) research institutes and universities
- 93 (over 140) researchers



Comprehensive impacts and effectiveness of adaptation measures in Japan

- **Objectives**
  - Assessment of various distinct climate stabilization levels, impact level according to adaptation policy, and its adaptation effect using a state-of-the art climate scenario utilized in IPCC Fifth Assessment Report.
- Stabilization scenarios: RCP2.6, 4.5, 8.5
- 4 GCMs
  - MIROC5 (Japan), MRI-CGCM3.0 (Japan), GFDL CM3 (USA), HadGEM2-ES (UK)
- Target periods: Base period (1981-2000) and two future periods (mid-21st century: 2031-2050, end of the 21st century: 2081-2100)

Quantitatively assessed indicators for climate change impacts

● Indicators

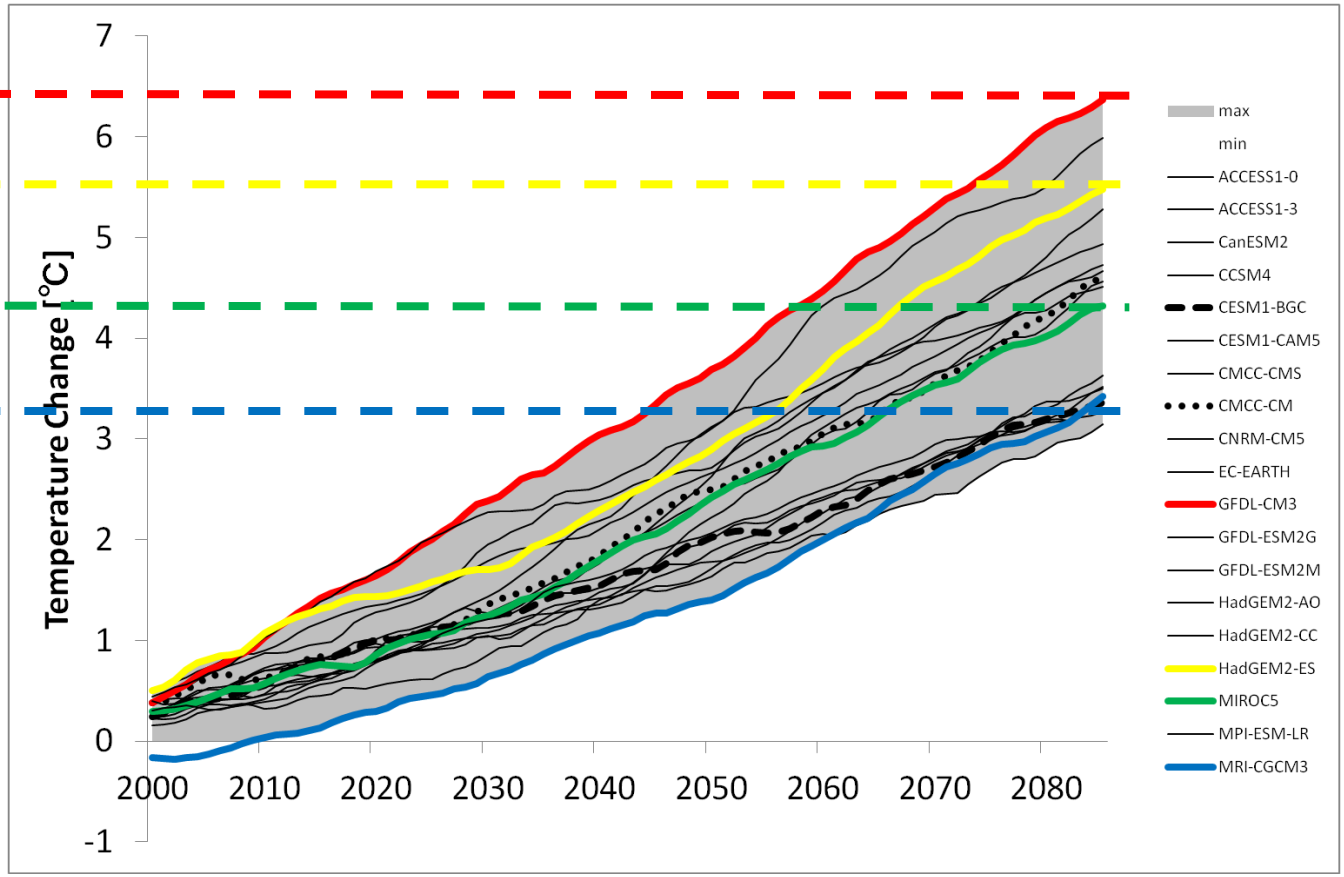
□ **Blue color**: Quantitatively assessed indicators of adaptation effect

- **Water resources** (Quantity: River flow, Quality: Chlorophyll-a)
- **Coast/Disaster prevention** (Food damage cost, Landslide probability, Landslide damage cost, Storm surge damage cost, Sand beach damage cost, Tidal flat loss rate, Tidal flat damage cost)
- **Ecosystem** (*Pinus pumila* potential habitat, *Abies veitchii* potential habitat, *Fagus crenata* potential habitat, *Fagus crenata* damage cost, *Quercus acuta* potential habitat)
- **Agriculture** (Rice yield, Persistence rate of suitable cultivation area for Citrus unshiu, Distribution rate of suitable cultivation area for Citrus tankan ）
- **Health** (Heat stress excess mortality, Damage cost due to heat stroke death, Number of heat stroke patients taken to hospital, *Aedes albopictus* distribution

2nd S-8 common scenario

- Annual average temperature in and around Japan-

GFDL CM3
+6 degree C
HadGEM2-ES
+5 degree C
MIROC5
+4 degree C
MRI-CGCM3
+3 degree C



2nd S-8 common scenario

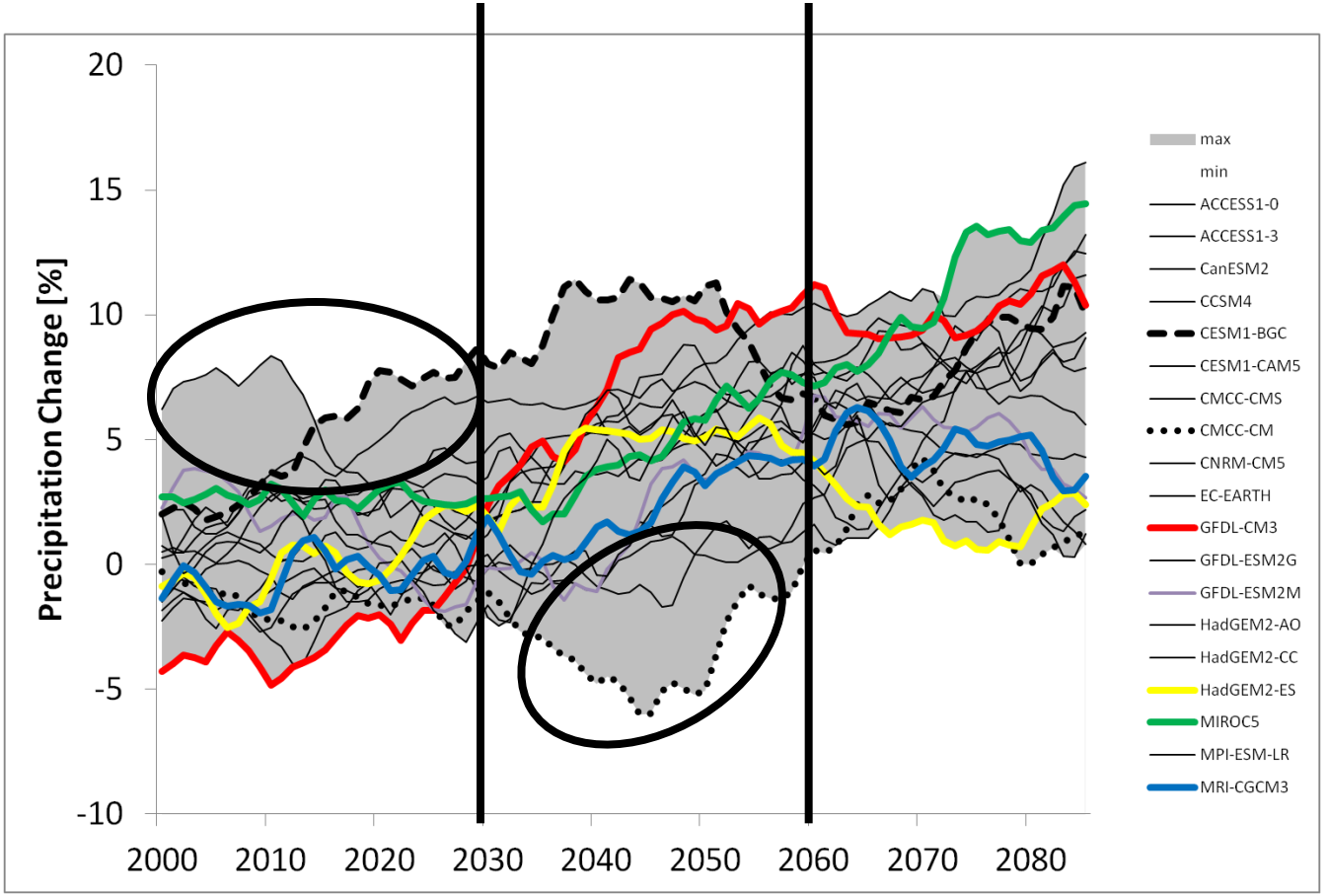
- Annual average precipitation in and around Japan-

GFDL CM3
Low⇒High

HadGEM2-ES
Medium low⇒Low

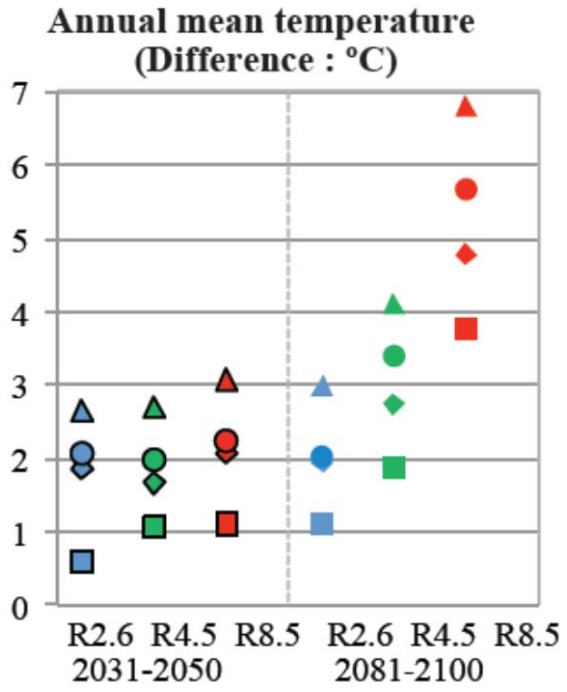
MIROC5
Medium high

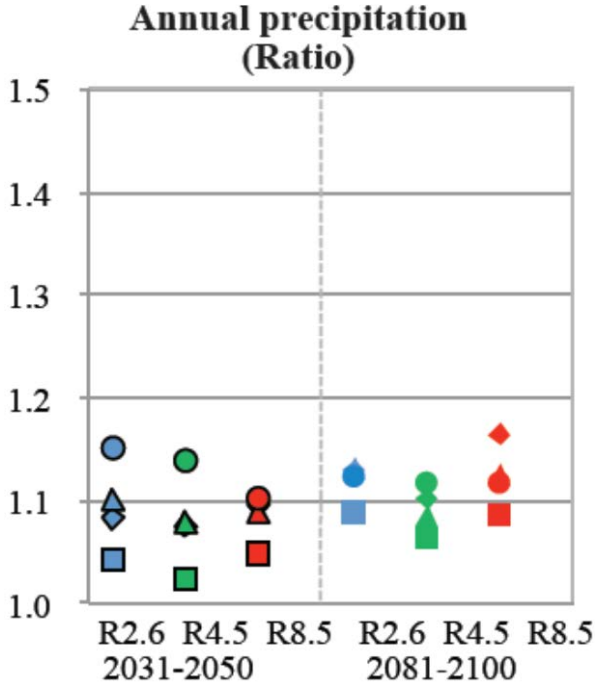
MRI-CGCM3
Medium low

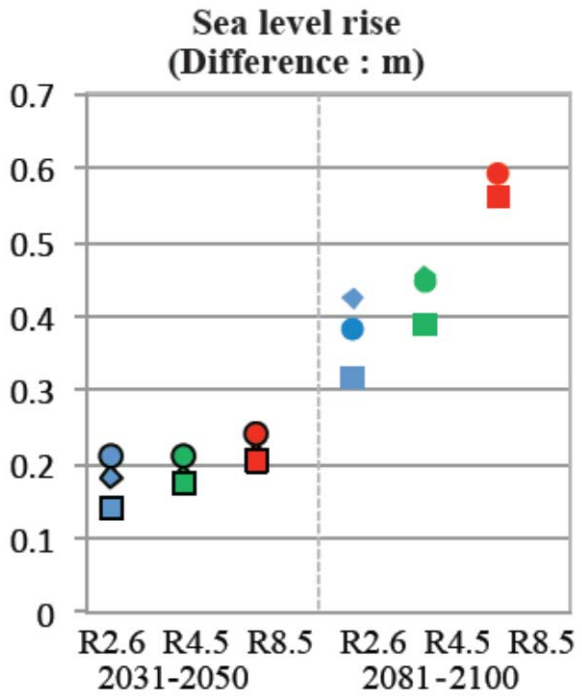


Example of climate scenarios

-Japanese average-

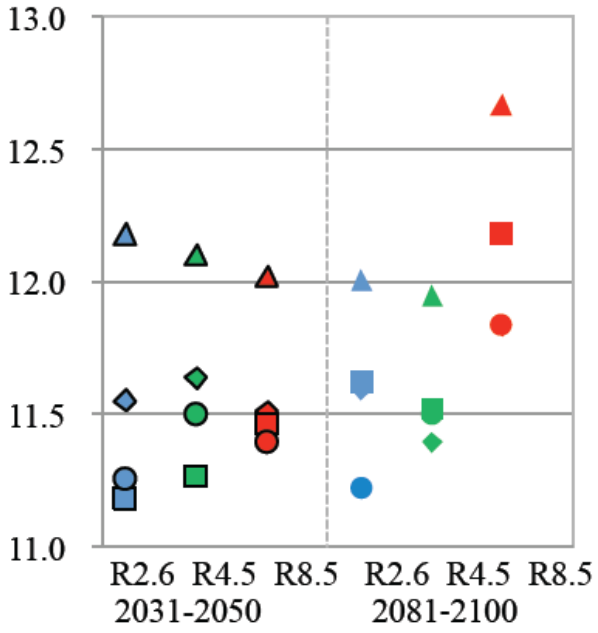


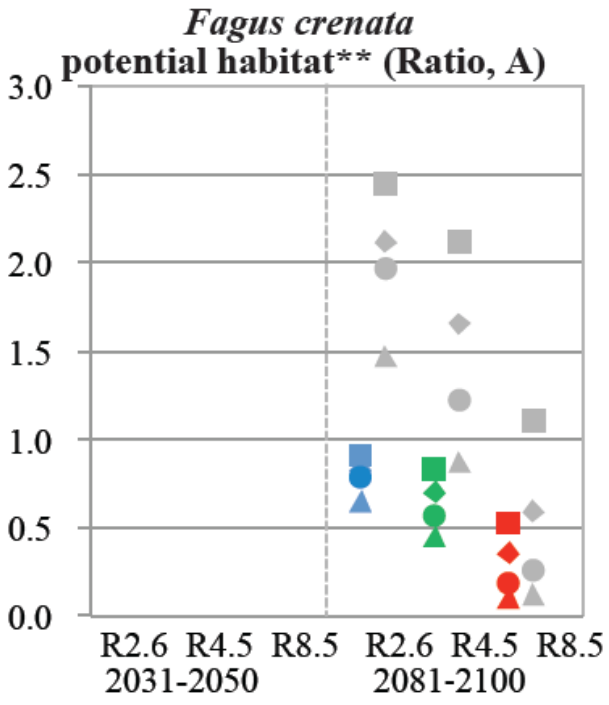


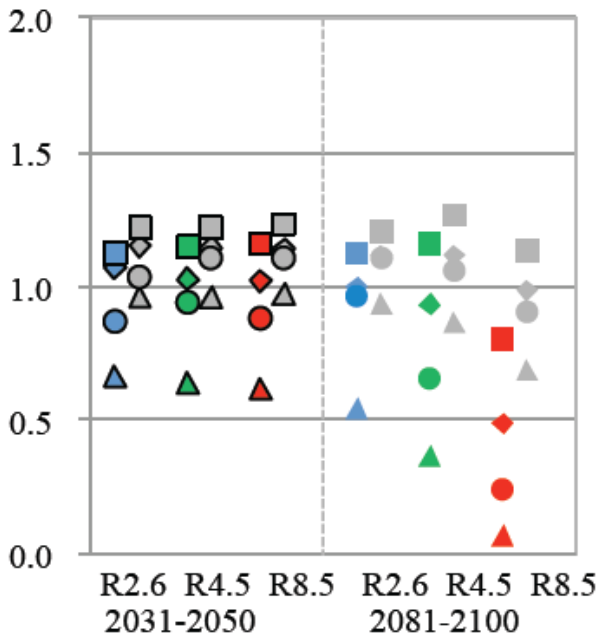


- **RCP scenarios**
  - R2.6：RCP2.6 (Blue), R4.5：RCP4.5 (Green), R8.5：RCP8.5 (Red)
- **Climate scenarios**
  - MIROC5:◆, MRI-CGCM3.0:■, GFDL CM3:▲, HadGEM2-ES:●
- Meaning of values
  - Difference: Future value (2031-2050 or 2081-2100) – Base year value (1981-2000)
  - Ratio: Future value (2031-2050 or 2081-2100) Base year value (1981-2000)

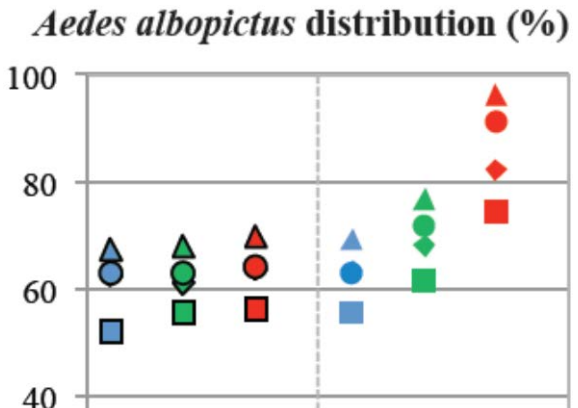
Example of impact assessment with/without adaptation under RCP scenarios





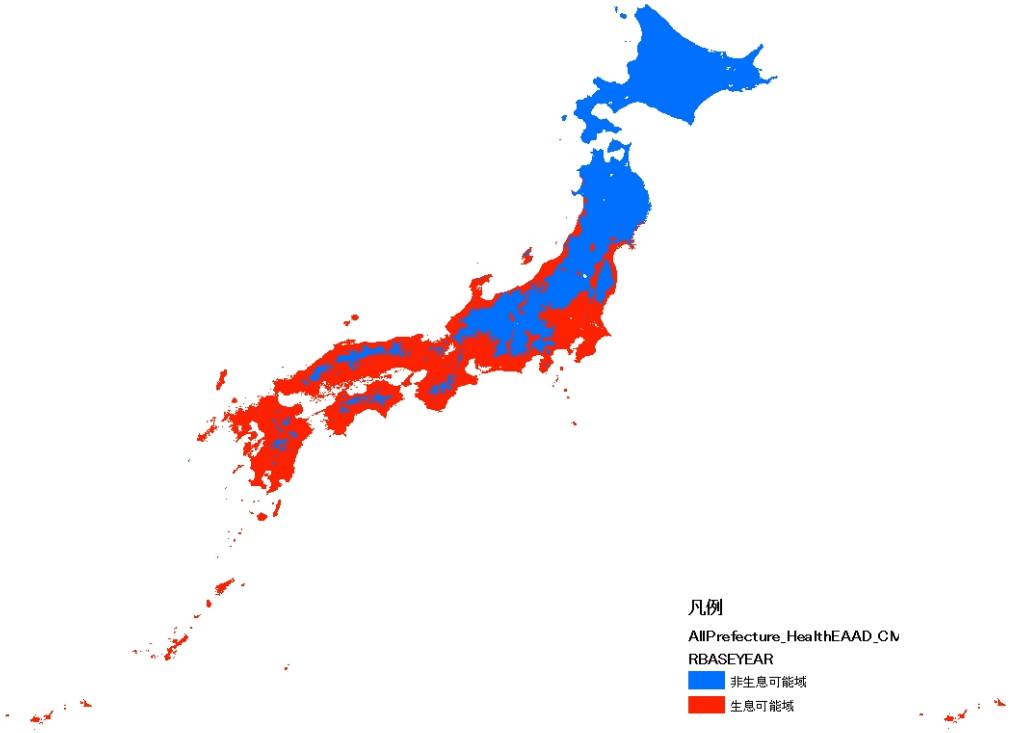


- **Without marker: no assessment**
- **Gray color: with adaptation**
- **Caution points**
  - Various display methods: difference, ratio, change, etc.
  - Meaning of different marker

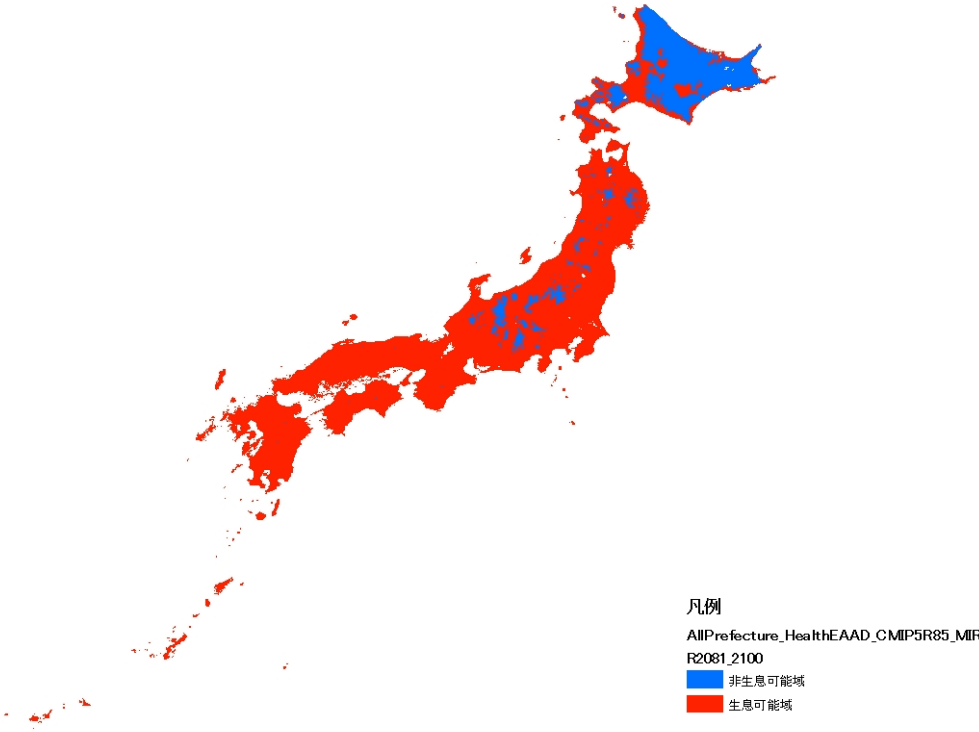


Example of climate change impact assessment

- *Aedes albopictus* distribution (RCP8.5, MIROC5)-

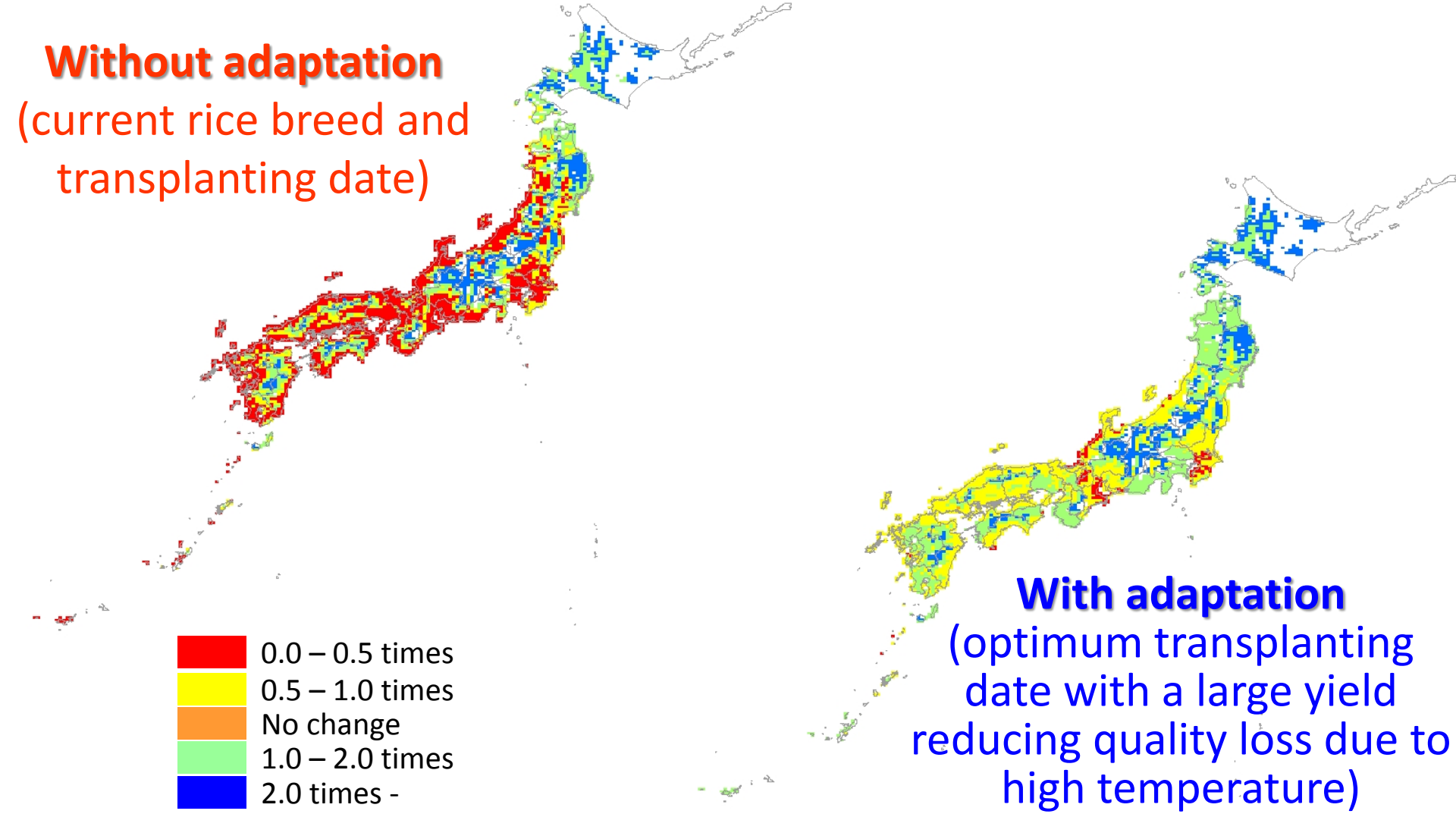


1981-2000

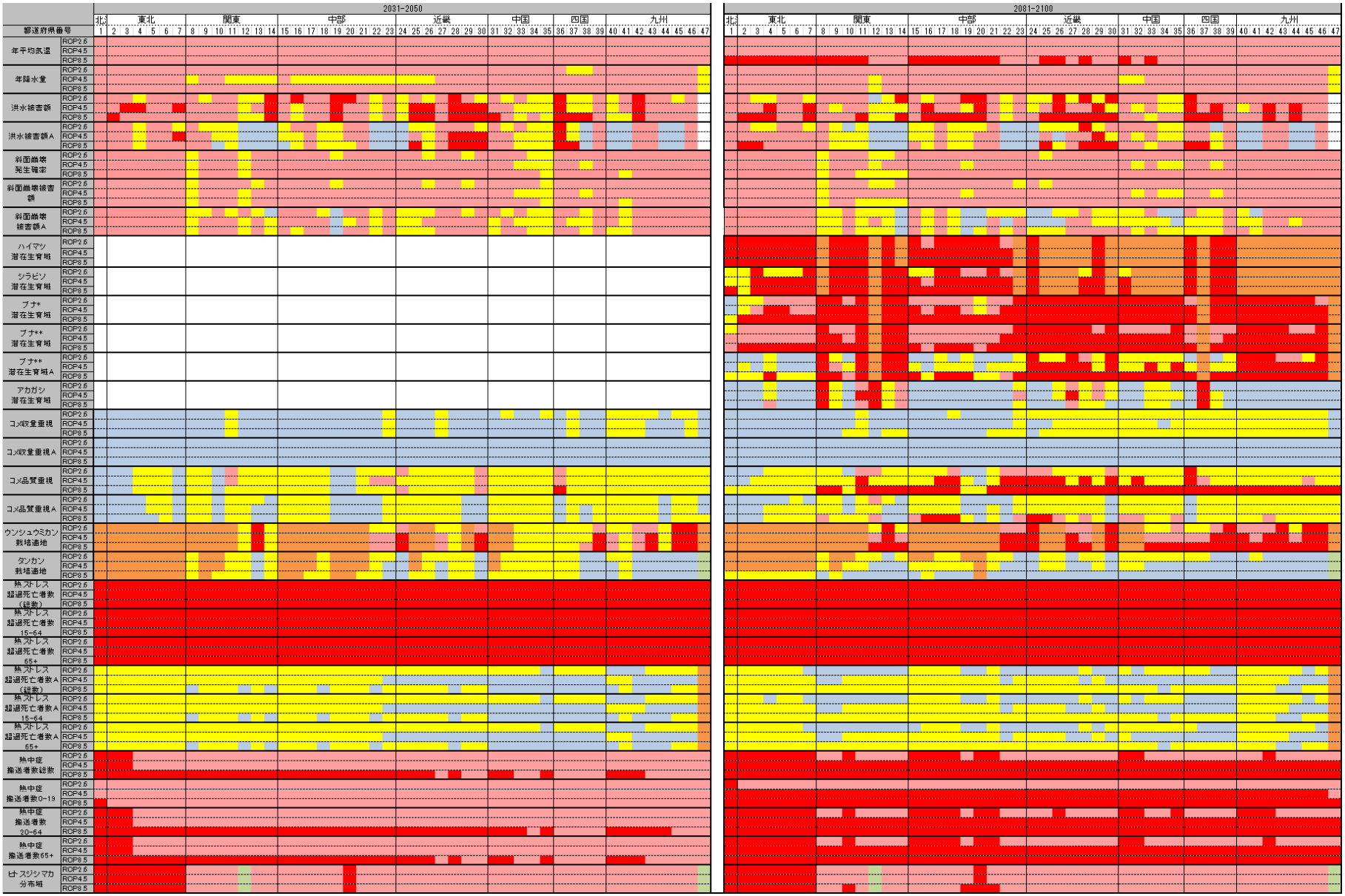


2081-2100

Example of climate change impact assessment
- Rice yield considering quality (RCP8.5, MIROC5)-



Summary of prefecture-wise impact assessment

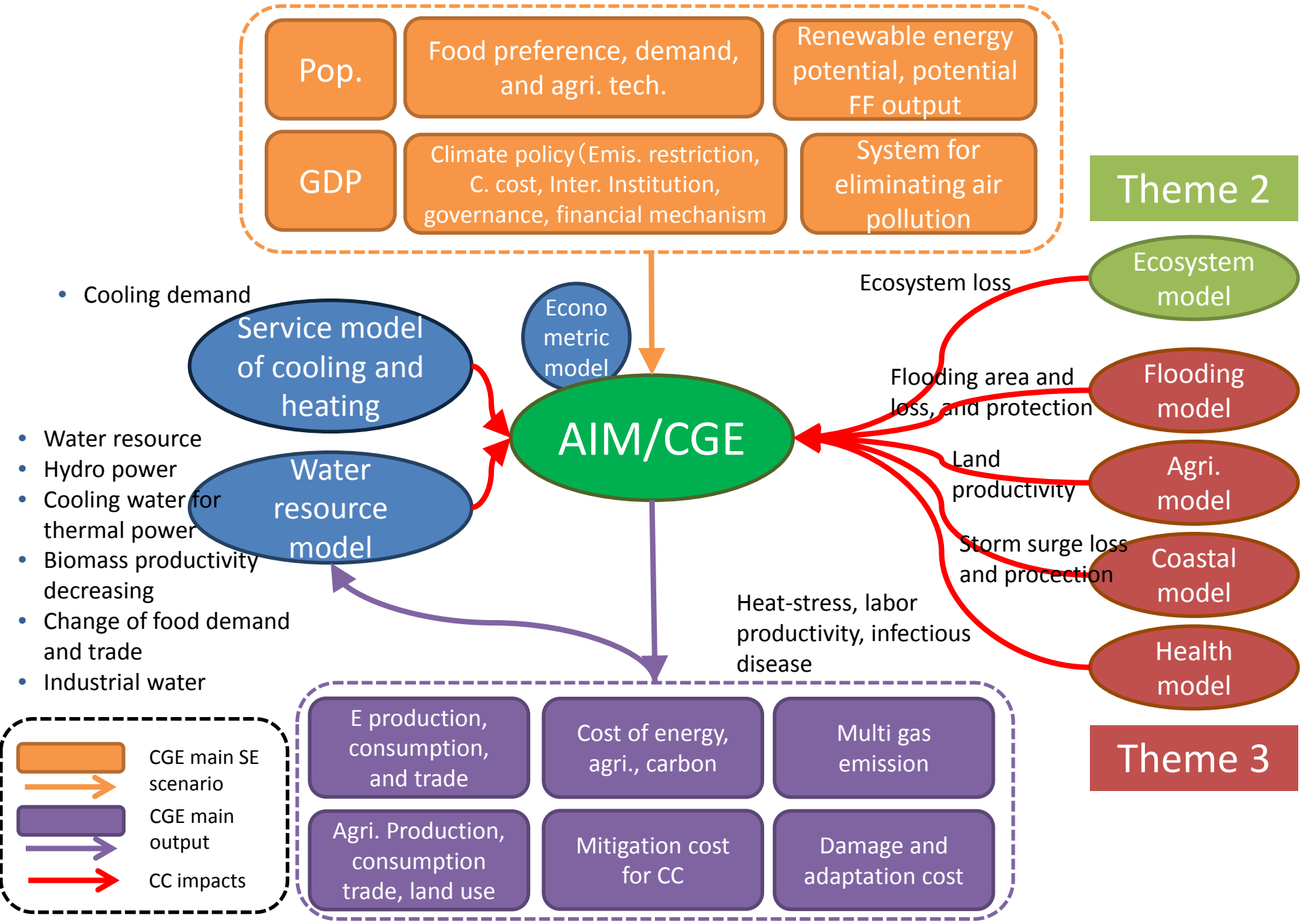


Research outcomes

1. This research systematically assesses impacts on Japan on the basis of RCP. It identified projections relevant to greenhouse gas concentration pathway and climate scenarios, and subsequently forecasted impacts on the country in the middle of 21st century (2031-2050) and the end of the century (2081-2100), respectively.
2. It is assessed that global warming exerts impacts on a variety of fields in Japan throughout 21st century.
3. Climate change impacts depend on the degree of warming as measured in temperature rise. Accordingly, if mitigation measures advance on a worldwide scale, the adverse impacts on Japan can be greatly prevented. In such case, it is expected that adverse impacts will occur in the absence of implementing adaptation.

Next step

- **"Strategic Research Project on the Best-mix of Mitigation and Adaptation for Climate Change" (S-14, FY2015-2019)**
  - Provide quantitative and basic information for effective and efficient implementation of mitigation and adaptation for climate change in Japan and in the world.
    - Best-mix of M&A for developing resilient and sustainable society
    - under limited economic, human, and institutional resources available
- 5 Themes: **1**: Multi-dimensional Evaluation with various indices with, **2**: Ecosystem, **3**: Sectoral Impact assessment at globe, **4**: Pilot Study in Mega City in Asia, **5**: CGE
- **S-14-5: Research on development of an integrated assessment model incorporating global-scale climate change mitigation and adaptation**


Pop.
Food preference, demand, and agri. tech.
Renewable energy potential, potential FF output
GDP
Climate policy（Emis. restriction, C. cost, Inter. Institution, governance, financial mechanism
System for eliminating air pollution
Theme 2
Ecosystem model
Ecosystem loss
Cooling demand
Service model of cooling and heating
Econo metric model
AIM/CGE
Flooding area and loss, and protection
Flooding model
Land productivity
Agri. model
Storm surge loss and procection
Coastal model
Health model
Water resource
Hydro power
Cooling water for thermal power
Biomass productivity decreasing
Change of food demand and trade
Industrial water
Water resource model
Heat-stress, labor productivity, infectious disease
E production, consumption, and trade
Cost of energy, agri., carbon
Multi gas emission
Agri. Production, consumption trade, land use
Mitigation cost for CC
Damage and adaptation cost
Theme 3
CGE main SE scenario
CGE main output
CC impacts

Conclusion

- **AIM Impact Team has been contributing to development of Japanese National Adaptation Plan through attending subcommittee "climate change impact assessment" and promoting the S-8 project**
  - National Adaptation plan will be approved by the Japanese cabinet (summer, 2015)

- **Though new ERTDF S-14 project, CGE and global impact assessment model will be integrated not only within AIM team but also under collaboration with Japanese IAV researchers**

Thank you for your kind attention!