Recent Improvement and Future Direction of AIM/Impact

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Activities in FY2004

- Impact assessment considering extreme climate events
  - Impact assessment using daily outputs of climate models including Earth Simulator's
    - Global crop impact using NIES-T106-AGCM's daily output
    - Asian crop impact using NIES-RCM's daily output
    - Global water stress assessment using NIES-T106-AOGCM's
- Towards the discussion on dangerous anthropogenic interference and stabilization target
  - Development of AIM/Impact [Policy]
    - Stabilization target-Optimal emission path model (Explained in Dr. Hijioka's presentation)
    - Simplified impact estimation module

1st issue: Impact assessment considering extreme climate events

- Collaborative research project with NIES/CCSR climate modeling team from FY2004.
- Backgrounds of the project
  - Extreme climate events (hot summer, heavy rain, dry spell etc.) are expected to increase in frequency and/or severity, so the severity of their impacts will also increase.
  - Availability of climate model outputs more suitable for extreme event analysis is increasing.
- Research objective of the project
  - Validation of recent climate model's ability to reproduce frequency and magnitude of extreme events
  - Refinement and development of impact assessment models for considering extreme events
  - More realistic impact assessment considering extreme events

1st issue: Impact assessment considering extreme climate events

- First year's research plan was…
  - To understand the change in results of impact assessment by using recent higher-resolution daily climate model outputs (which are expected to have more ability to depict extreme climate events).
- Three studies done in 2004
  - Global crop impact using NIES-T106-AGCM's daily output by Mr. Murai in TIT and Takahashi
  - Asian crop impact using NIES-RCM's daily output by Mr. Masutomi in Kyoto University
  - Global water stress assessment using NIES-T106-AOGCM's by Mr. Saitoh in Kyoto University

New climate model outputs used for impact assessment (GCM)

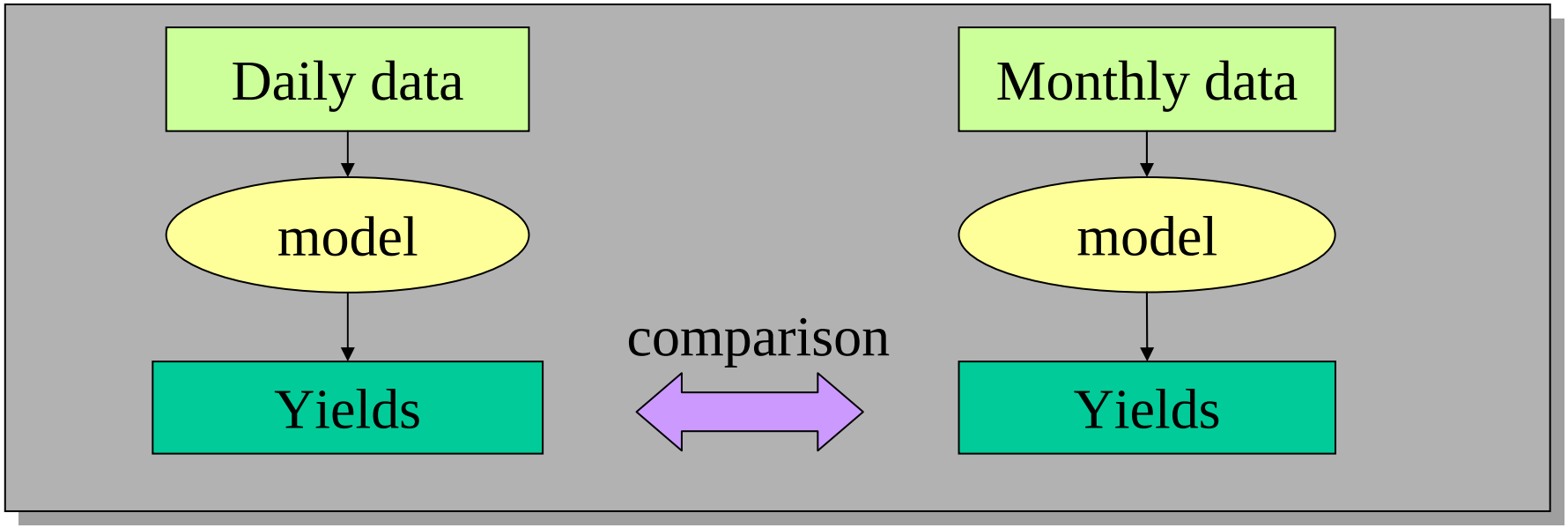
- NIES-T106-AOGCM
  - Daily data with 100km x 100km resolution
  - Scenario: (1)100-yr control,(2) 20C-reproduce, (3)A1B (2000-2100)
  - Provided by CCSR/NIES team in December
- NIES-T106-AGCM
  - Daily data with 100km x 100km resolution
  - Scenario: Time-slice experiments using (1)observed monthly SST for 1979-1998 (current) and (2) the same SST + temperature increase projected by AO-GCMs distributed at IPCC-DDC (future; 2070).

New climate model outputs used for impact assessment (RCM)

- NIES-RAMS
  - Region: Whole Asia
  - 6-hourly data with 60km x 60km resolution
  - Target period: 1981-90 and 2041-50
  - Boundary condition: CCSR-NIES T42 AO-GCM (SRES-A2)
- JMA-RCM
  - Region: Around Japan (incl. Korea)
  - Daily data with 20km x 20km resolution (double nesting via RCM simulation with 60km x 60km resolution)
  - Target period: 1981-2000, 2031-2050, 2081-2100
  - Boundary condition: JMA-CGCM2 (SRES-A2)

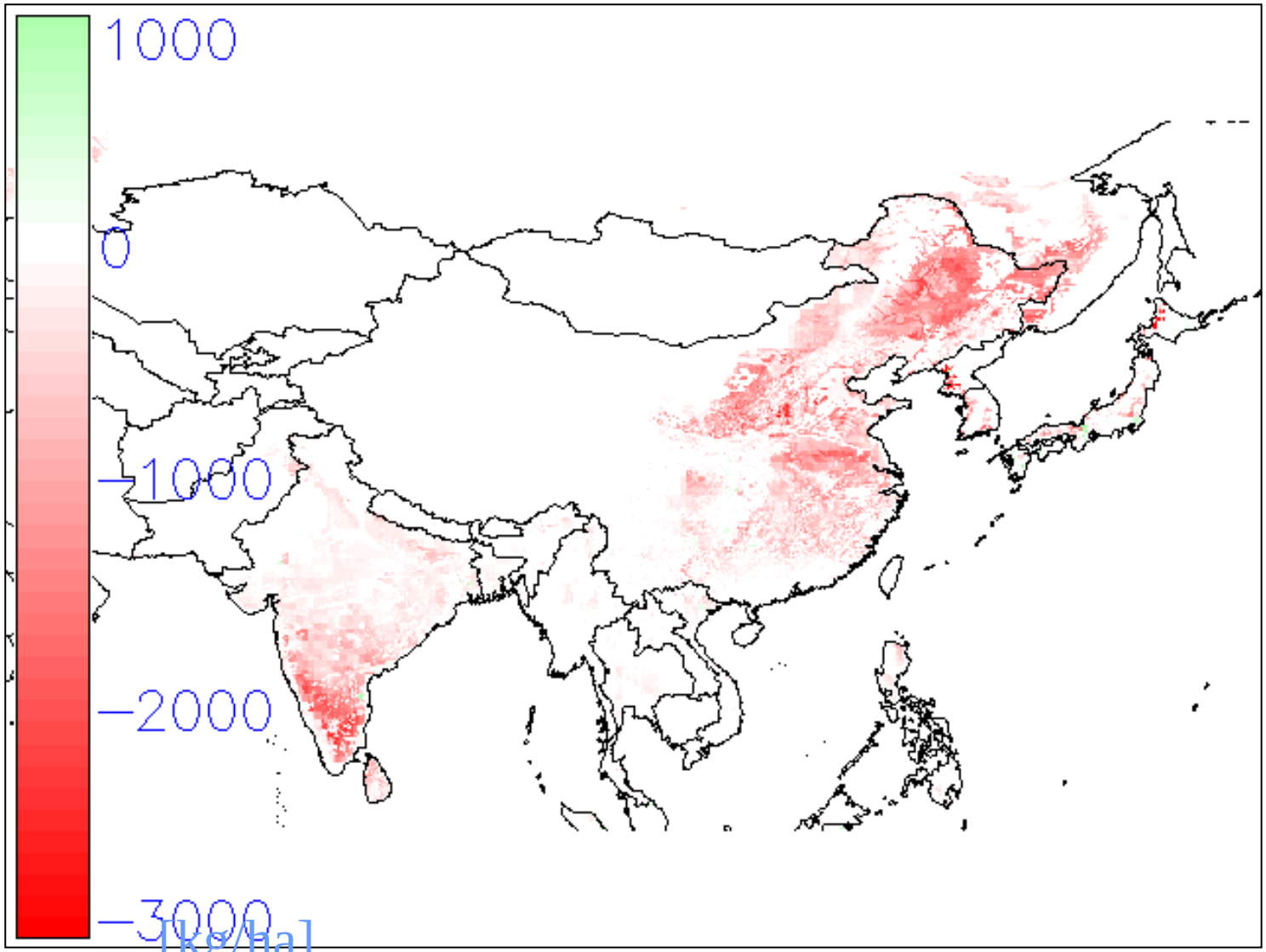
Asian crop impact using NIES-RAMS's daily output

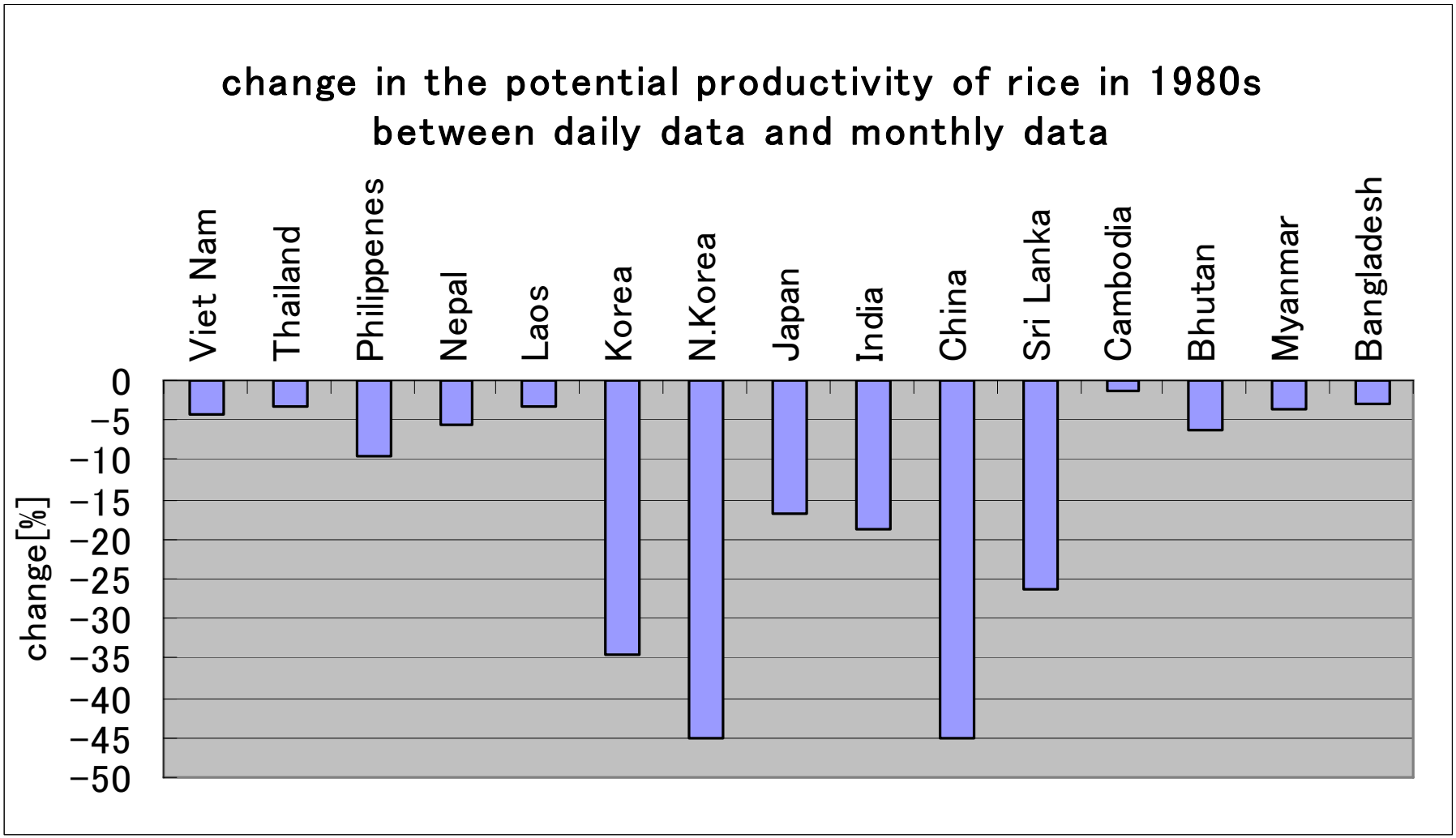
- Estimation of potential productivity of rice (1) with daily climate data and (2) with monthly climate data in 1980s.
- Comparison of estimated productivity between (1) and (2) for showing the necessity and importance of daily climate data in impact assessment of agriculture.



Difference in the potential productivity of rice between (1) with daily data and (2) monthly data in 1980s.

((1)-(2))





The potential productivity of rice with daily data is lower than one with monthly data for all countries

Summary and Future Plan

- Summary of this year's work
  - Necessity of using daily climate model output has been confirmed.
    - Estimated potential productivity with daily data is much lower than one with monthly data for all Asian countries.
    - Temporal pattern of precipitation affects the result significantly.
- Next step
  - Parameter tuning of crop model for using daily input data
  - Impact assessment of the sectors which are expected to be more sensitive to change in extreme condition.
    - Heat stroke
    - Drought and Flood
  - Detection of "hot spots" from the viewpoint of future change in extreme event.

2nd Issue: Toward the discussion of stabilization target

- Backgrounds
  - Heated discussion on “Dangerous Anthropogenic Interference (DAI)” both domestically and internationally.
  - New large impact research project for investigating DAI and stabilization target will start from April 2005.
- Research Demand
  - For more clear process of judgment of DAI and stabilization target, it is preferable that anyone (incl. policymakers) can easily grasp the consequence of the choice of stabilization target such as climate change impacts and required emission path to achieve the target.
- Efforts by AIM team
  - Development of a tool for the discussion of DAI and stabilization target (AIM/Impact[Policy])

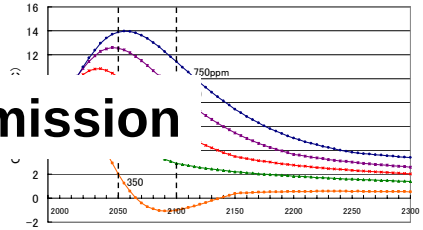
UNFCCC Article2 type

Scenario analysis type

CL of impact (Inverse) type

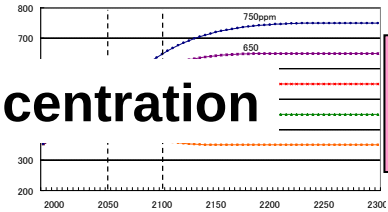
CL of climate change type

GHGs emission



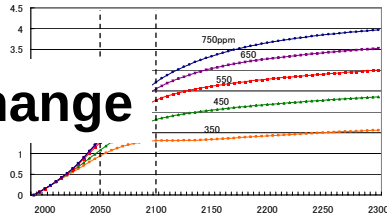
C-cycle model

GHGs concentration



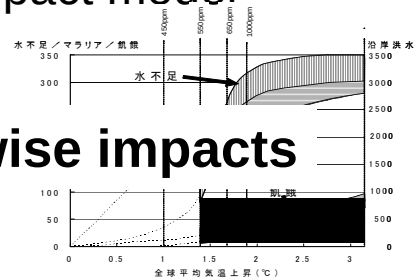
Climate model

Climate change



Impact model

Sector-wise impacts



Investigation of emission path to achieve concentration target

Emission scenarios

Concentration target

Estimation of impacts as consequences of the choice of concentration target

Estimation of concentration, climate change and impacts as consequences of the choice of emission scenario

Investigation of emission path, concentration, climate change to achieve avoiding intolerable impacts listed up.

List of intolerable impacts

Investigation of emission path and concentration to achieve climate change target

Climate change target

Estimation of impacts as consequence of the choice of climate change target

Investigation of stabilization target using AIM/Impact[Policy]

Economically optimal path of GHGs emission

Discussion of burden sharing

Dynamic optimization model linked with simple climate model

Stabilization target (GHG concentration)

Stabilization target (Global mean temp. change)

GHG concentration & GMT change (ΔGMT)

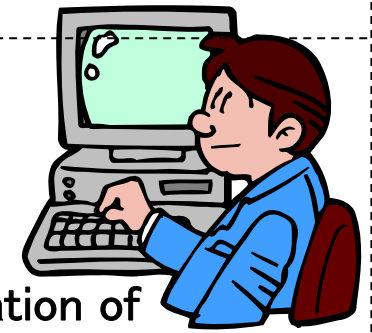
Spatial pattern of C.C. derived from GCM results

Climate model studies

Country-mean change in Temperature and precipitation

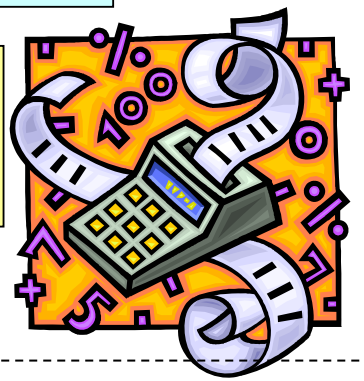
Impact functions

Impact model studies

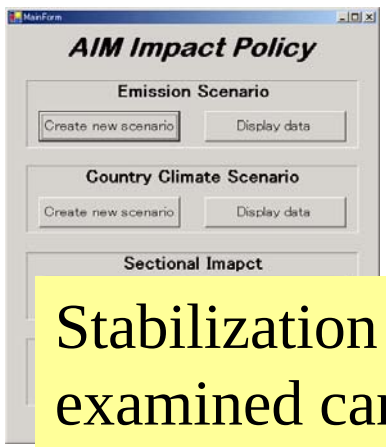


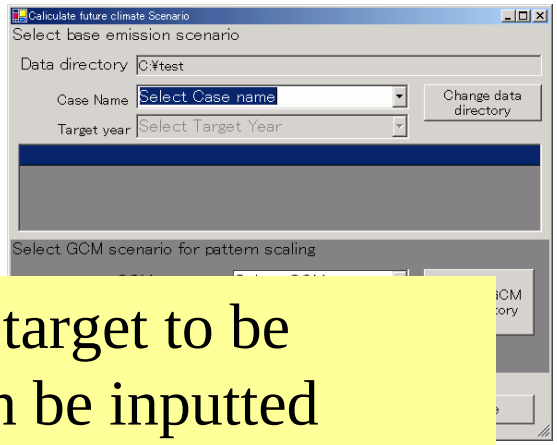
Iteration of assessment and judgment

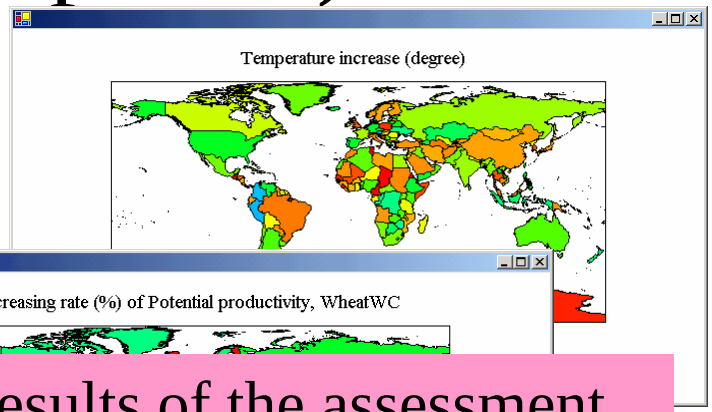
Country-average of climate change impact on sensitive sectors

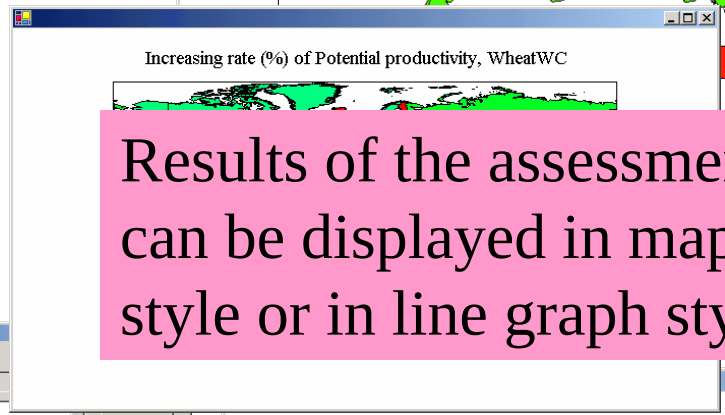


Snapshots of AIM/Impact[Policy]'s GUI (under development)



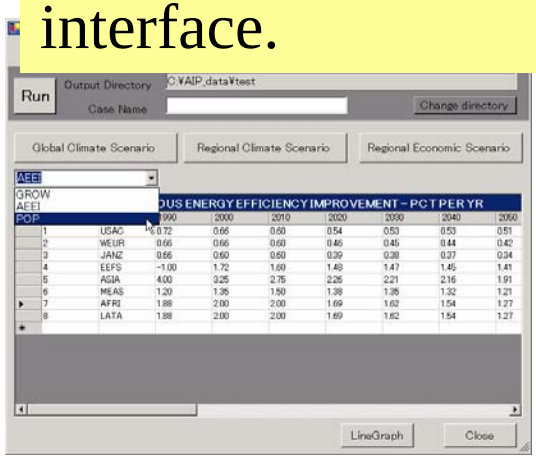


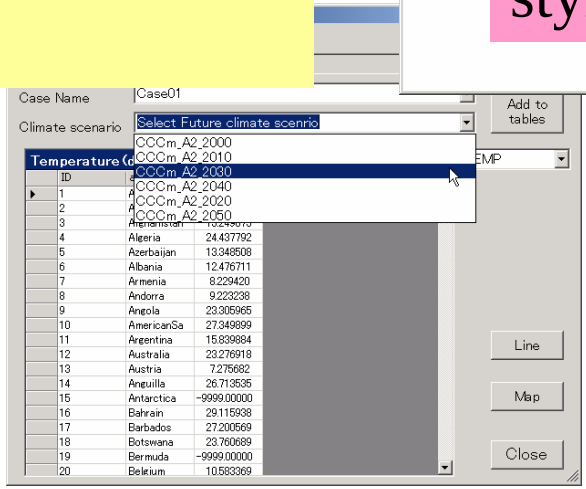


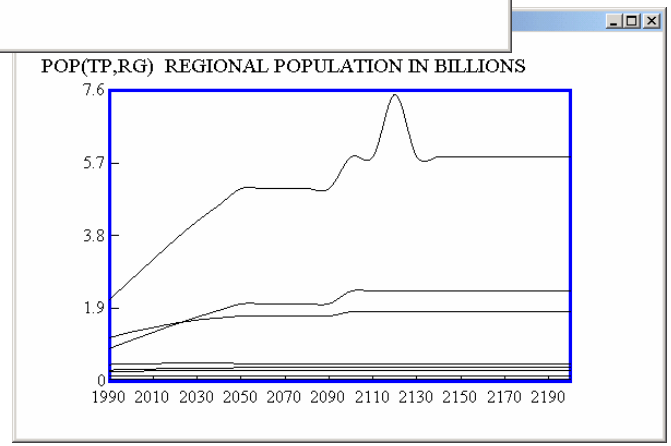


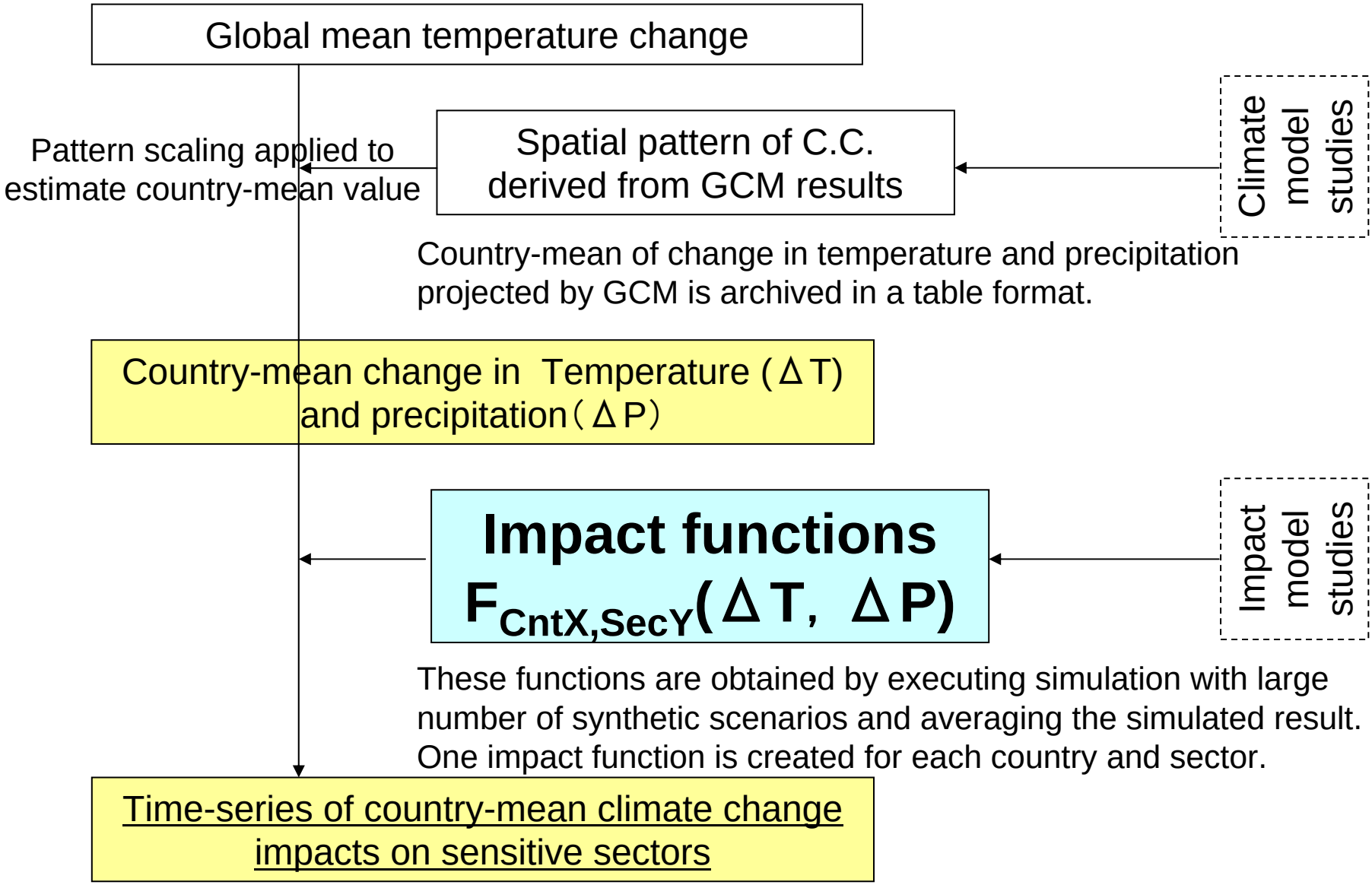
Stabilization target to be examined can be inputted through graphical user interface.

Results of the assessment can be displayed in map style or in line graph style.





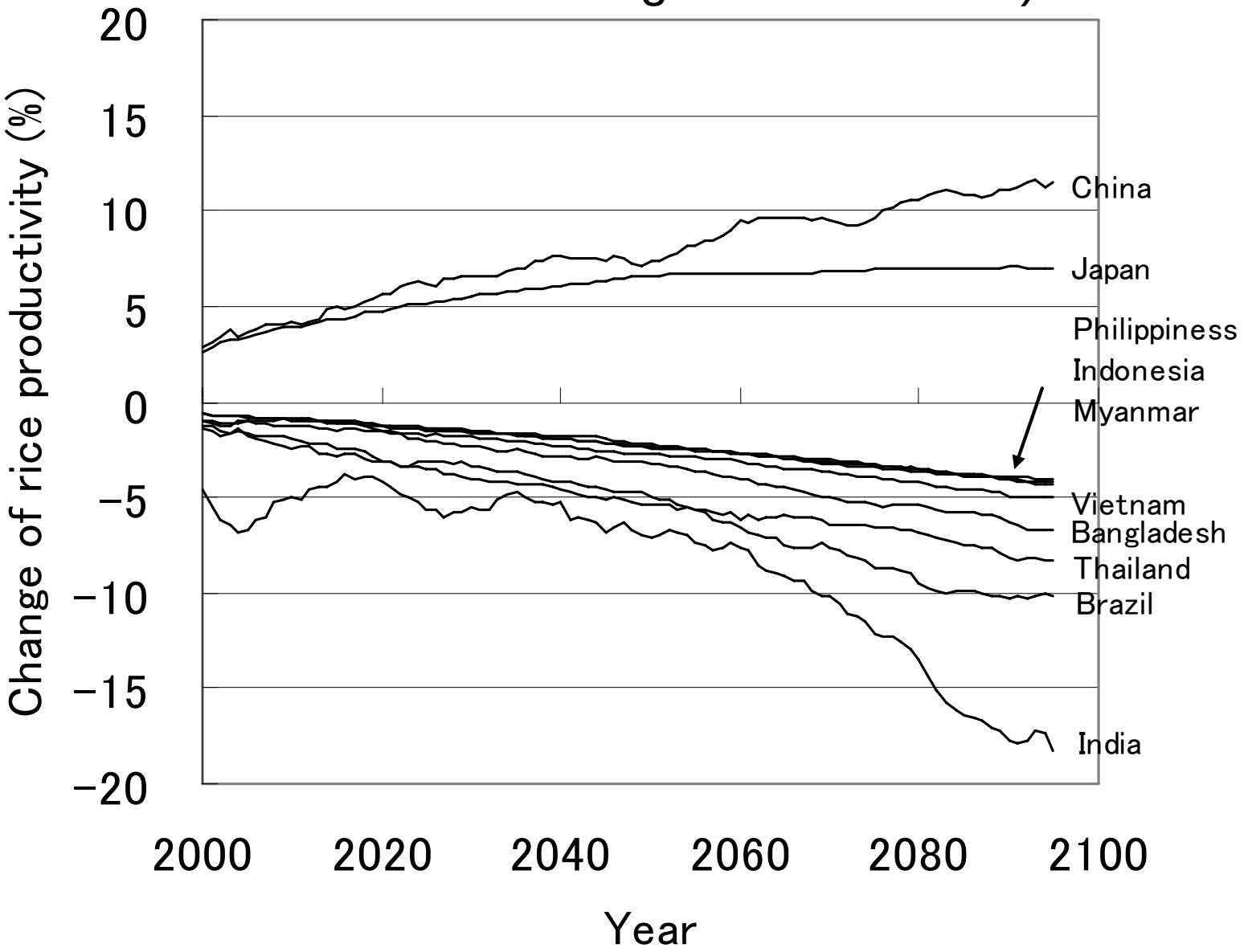



Global mean temperature change
Pattern scaling applied to estimate country-mean value
Spatial pattern of C.C. derived from GCM results
Climate model studies
Country-mean of change in temperature and precipitation projected by GCM is archived in a table format.
Country-mean change in Temperature (ΔT) and precipitation (ΔP)
Impact functions
$F_{CntX,SecY}(\Delta T, \Delta P)$
Impact model studies
These functions are obtained by executing simulation with large number of synthetic scenarios and averaging the simulated result. One impact function is created for each country and sector.
Time-series of country-mean climate change impacts on sensitive sectors

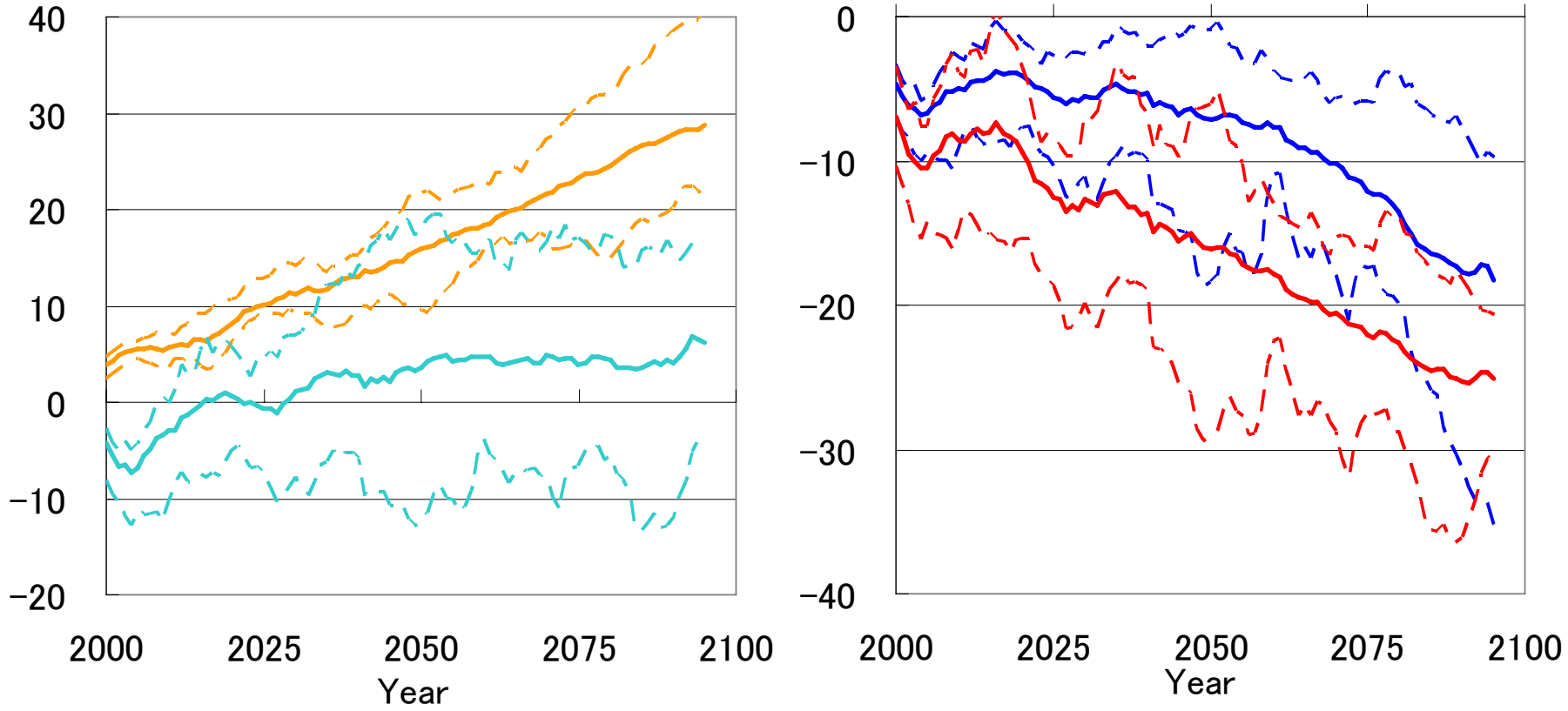
Impact Function

- Procedure to develop impact function
  - Simulation of impacts using existing impact assessment models for synthetic scenarios of climate change
  - Making country-mean of estimated impact to make a “impact table”
- Feature of impact function
  - Country-average of sensitivity analysis result
  - Less spoil of non-linearity in the relationship between climate change and impact
  - Publicizing impact model is often difficult, but result database can be more easily publicized
  - Interface between precise impact study and policy discussion tool

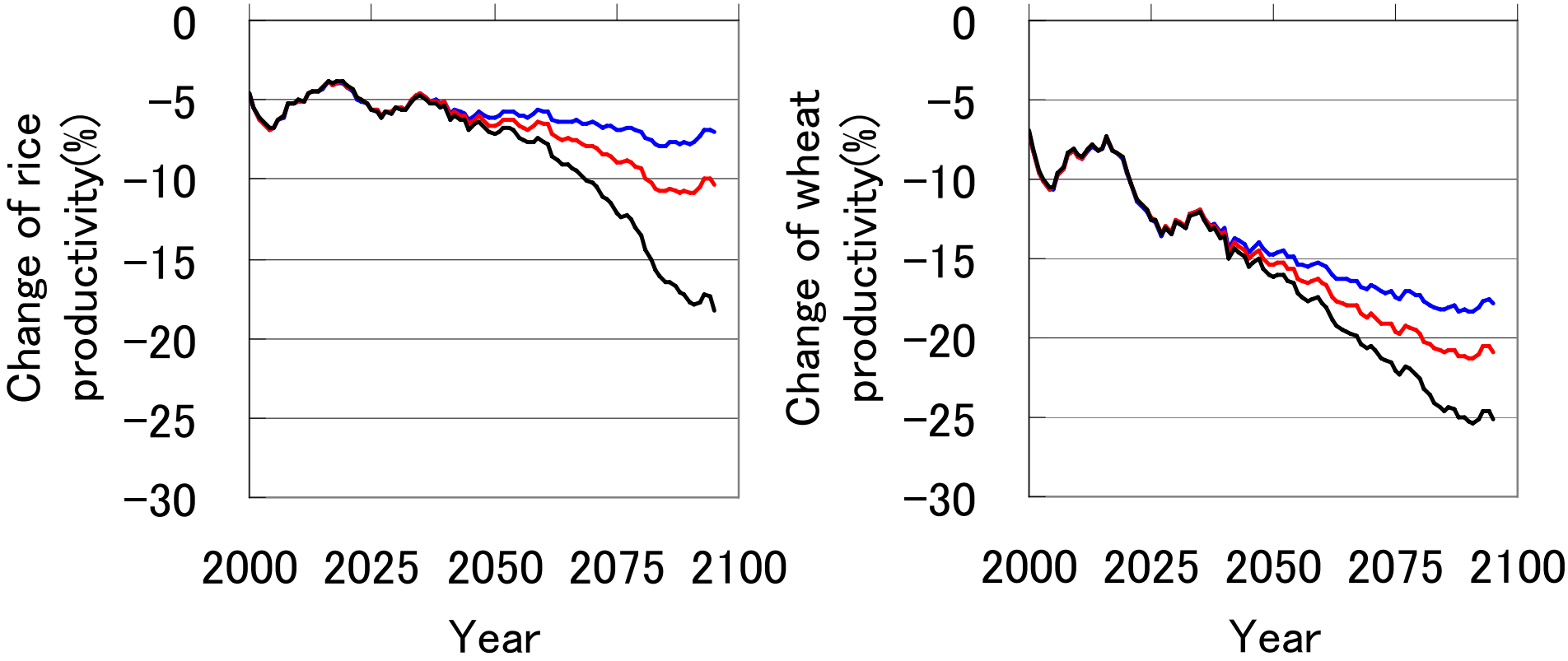
Change of rice potential productivity in major 10 producer countries in the world (SRES-B2, 6-GCM mean, using the impact functions based on AIM/Agriculture model)



Changes in climate and crop productivities in India with uncertainty range (SRES-B2 scenario)



Climate change impact on potential productivity of Rice and Wheat in India under alternative stabilization targets



BaU — No reduction policy (SRES-B2 scenario)

GHG-600ppmv — GHGs concentration does not exceed 600ppmv (CO2eq)

GHG-500ppmv — GHGs concentration does not exceed 500ppmv (CO2eq)

Tasks to be done in next year regarding AIM/Impact[Policy]

- Expansion of Impact Function
  - Preparation of global (country-wise) impact function using AIM/Impact model and other existing impact assessment model
  - Development of more precise impact function for Japan and Asian region by experts of each sensitive sector. (This work will be done outside AIM)
  - Impacts of non-linear irreversible event
- Refinement of graphical user interface
  - Linking modules developed individually

More issues (difficult but important)

- Adaptation
  - Next question from governmental officials will be "what should we do as adaptation options and/or how should we contribute to the enhancement of adaptive capacity in developing countries?"
- Millennium Development Goal and C.C.
  - Next main issue in AIM project.
- Probabilistic expression of impact risk
  - Headache….

Thank you.