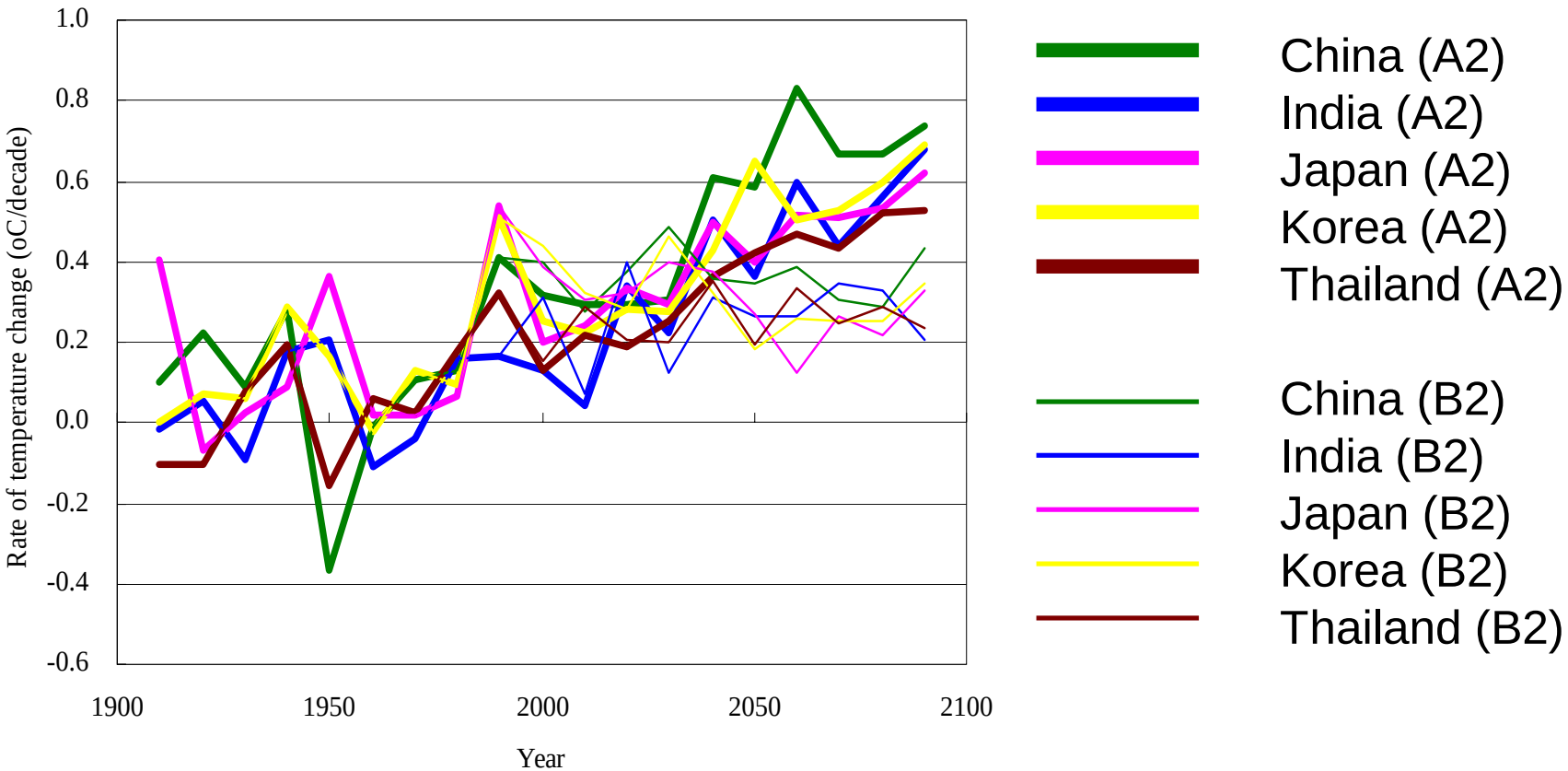
Impact assessment in AIM framework

Kiyoshi Takahashi

Projected rate of temperature increase in some Asian countries

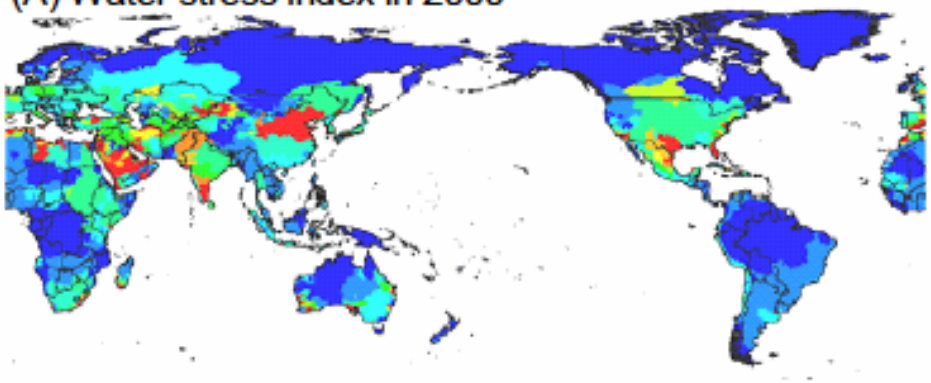


CSIRO-mk2 model

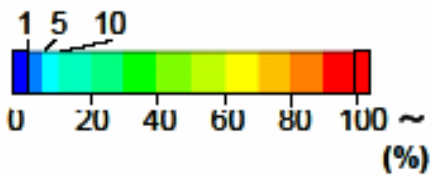
Global-scale assessment

Water stress under climate change

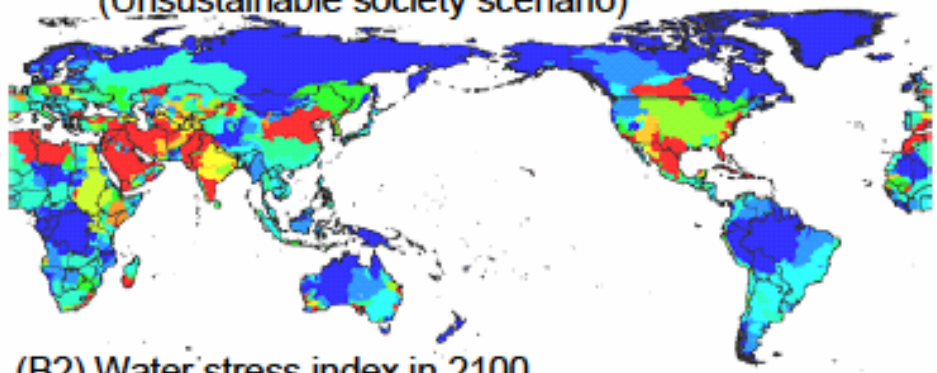
(A) Water stress index in 2000



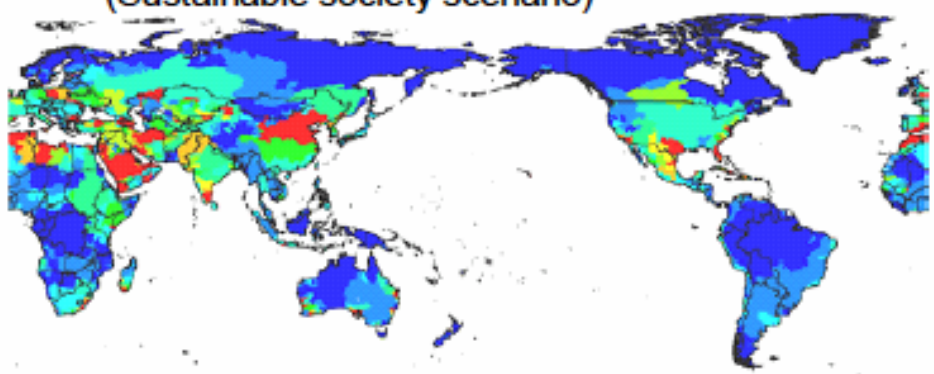
"Water stress index" is defined as the ratio between water withdrawal and renewable water resource in a river basin (figure's case), region, country or other boundaries. High value implies the higher risk of water shortage.



(B1) Water stress index in 2100
(Unsustainable society scenario)



(B2) Water stress index in 2100
(Sustainable society scenario)



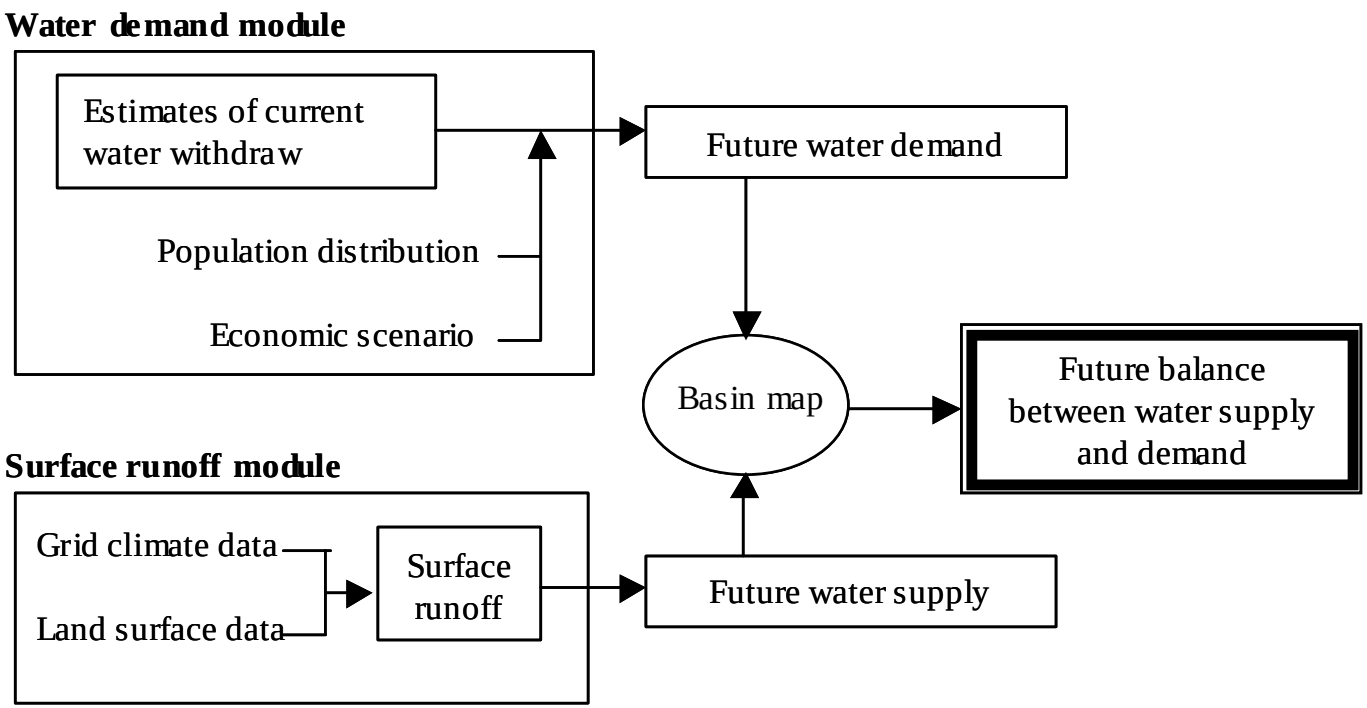
Outline of water resource assessment

Increasing demand on water

Industry
(Economic development, Industrialization)
Agriculture
(Irrigation, Increasing population)
Household
(Access to water supply system)

Spatial and temporal pattern of water resources altered by climate change

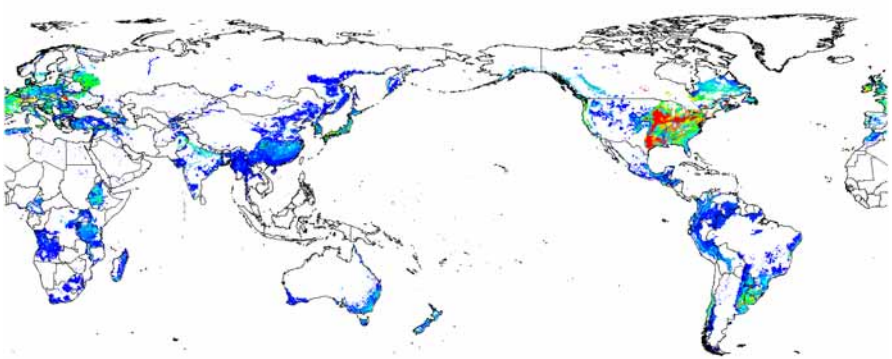
Spatial analysis of water balance at global scale considering natural and social aspect of the problem



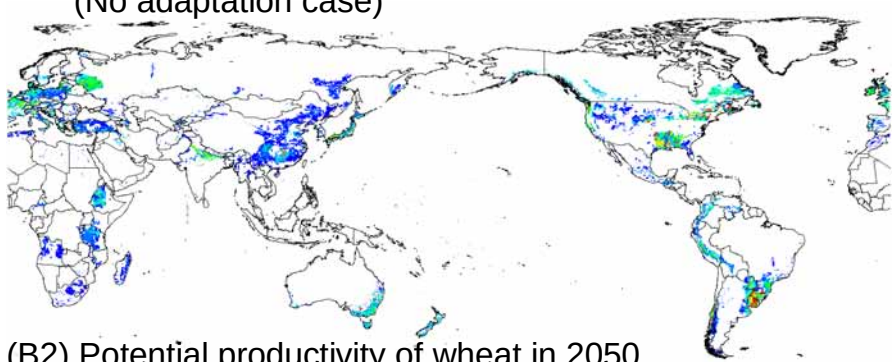
Global-scale assessment

Potential wheat productivity under climate change

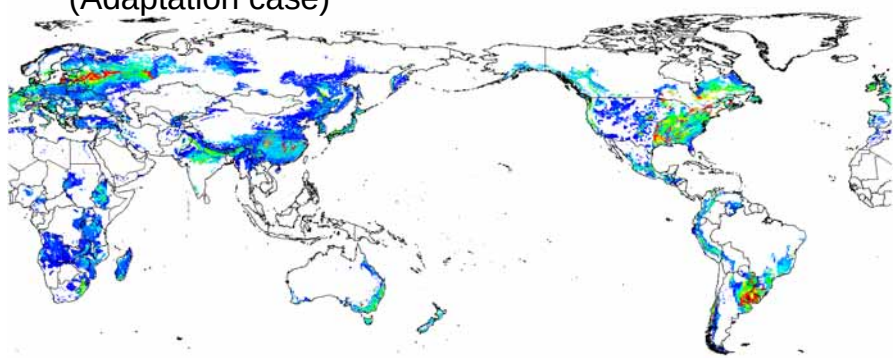
(A) Potential productivity of wheat in 2000



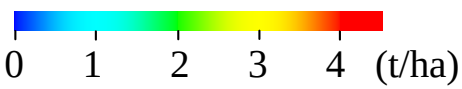
(B1) Potential productivity of wheat in 2050
(No adaptation case)



(B2) Potential productivity of wheat in 2050
(Adaptation case)

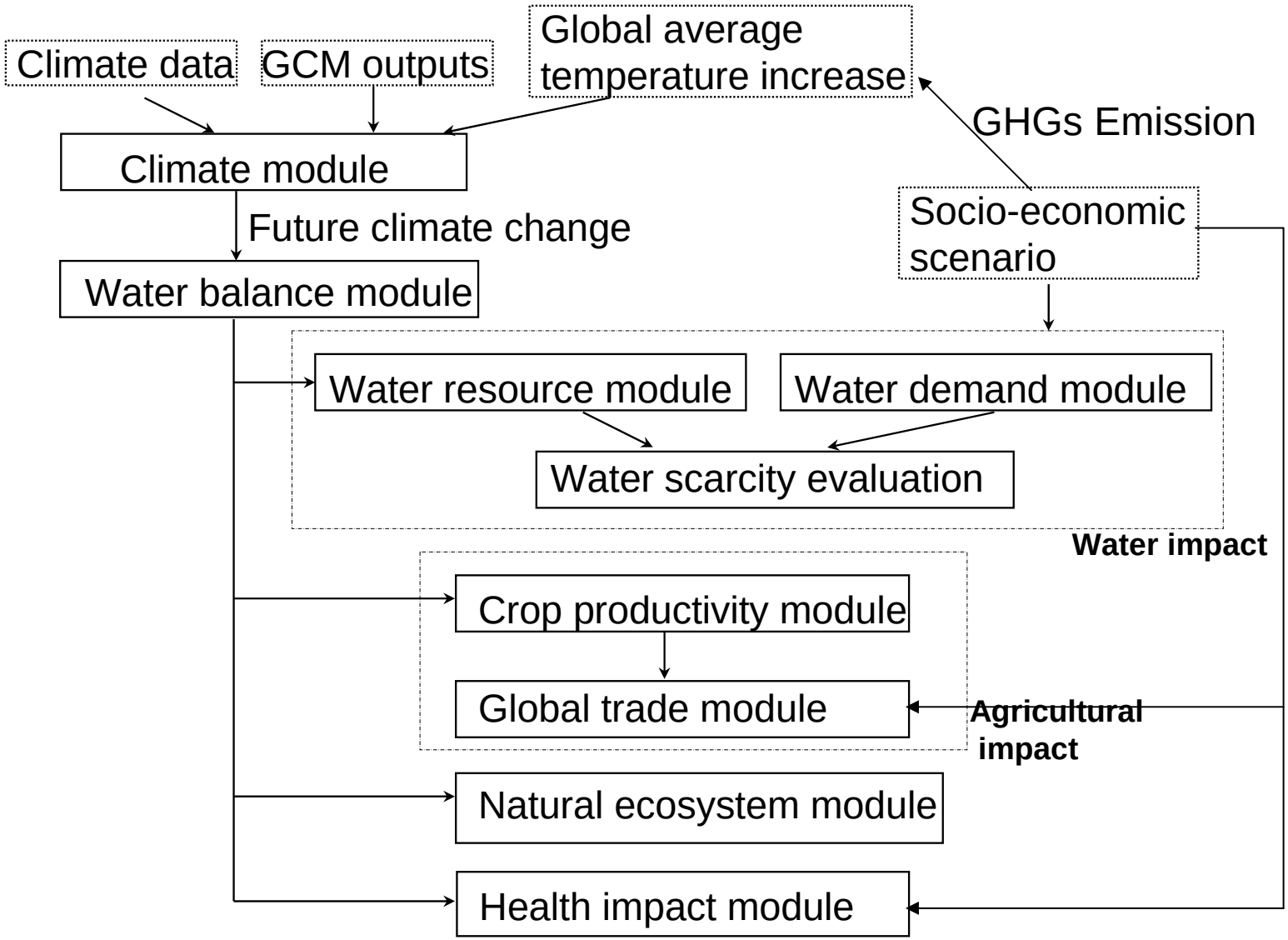


No adaptation case assumes that farmer will continue to plant the wheat variety which suits well current climate even under the altered future climate. It also assumes that the planting date will not be changed in future. On the other hand, adaptation case assumes that farmer can adapt to climate by changing wheat variety and planting date.



Assumed climate change scenario: CCSR/NIES (SRES-A1B)

Simplified framework of global scale impact assessment



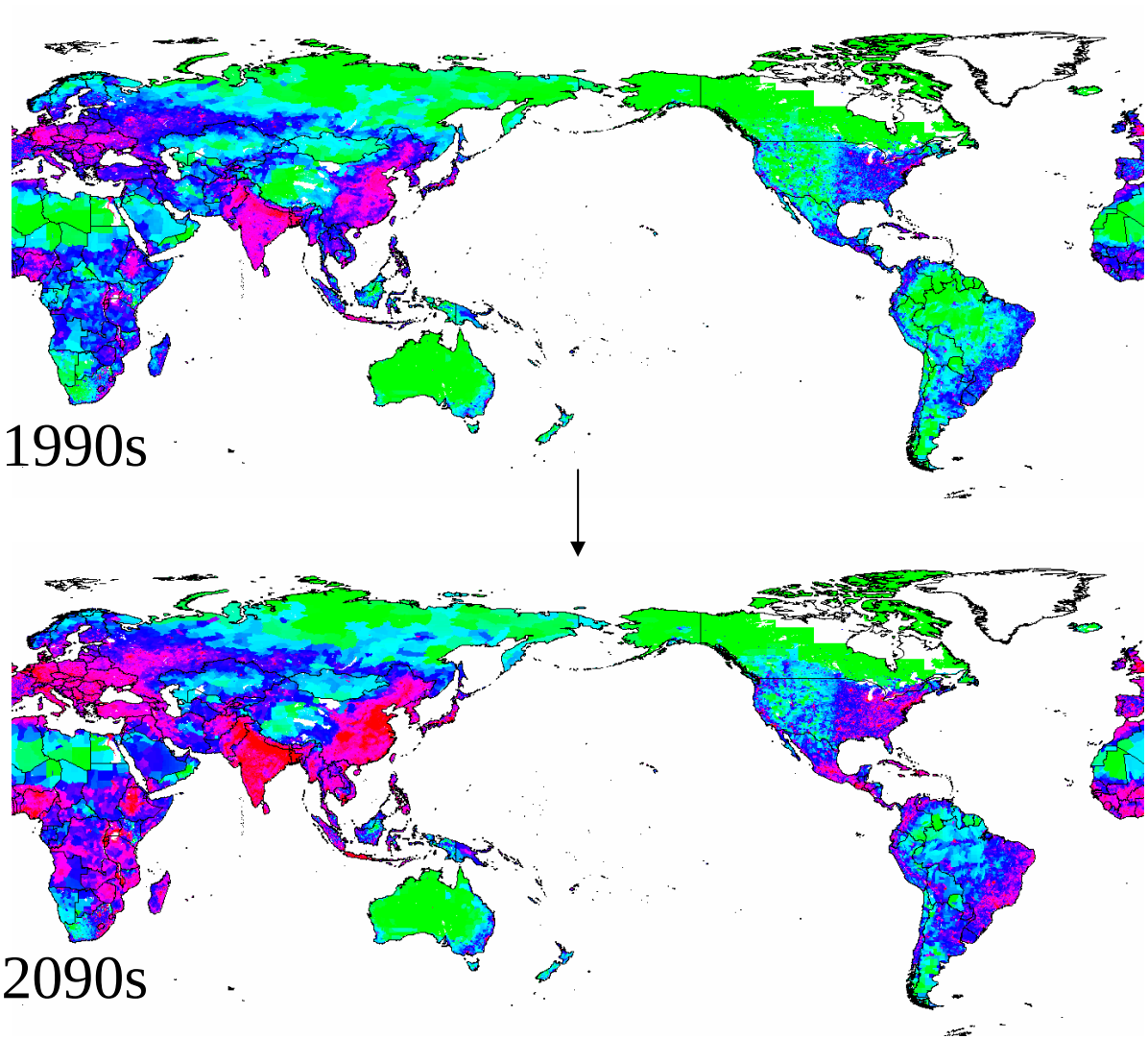
Transition of roles expected to impact assessment

- Roles expected in the 1st phase (- 2000)
  - Justification of discussing and implementing mitigation/adaptation strategies
  - Indication of potential severe impact
- Roles recently expected to impact assessment
  - Contribution to the discussion of long-term stabilization target (Identification of dangerous climate change which causes unacceptable degree of negative impact)
  - Provision of elaborated information for discussing the implementation of concrete adaptation strategies at various scales.

Sophistication of impact assessment

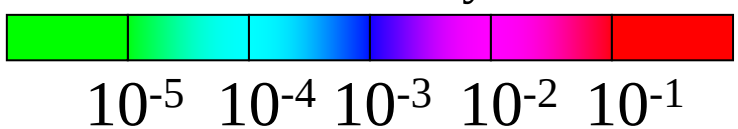
- Regional/National scale assessment using high-resolution climate model output.
  - For considering concrete adaptation strategies, result of global impact assessment is not sufficient.
- Impact of the change in extreme climate event such as strong wind, heavy rain and long duration of hot/dry day.
  - Adaptation strategies to be urgently adopted in early 21st century should be the ones for alleviating extreme climate events which often occur even under the current climate.

Density of extra mortality by heat stress (1990s vs 2090s)



Number of death related to heat stress drastically increases on days when daily maximum temperature is much higher than mean condition.

To estimate future change in heat stress death, the use of daily climate projection is preferable. (Even if annual mean temperature increases moderately, the number of days whose maximum temperature is higher than the critical level may increase.



Questions to be answered by linking CGE with impact models

- How much is the monetary cost of climate change impact with considering propagation effect? (, if we don't take any adaptation actions.)
  - Most impact studies estimate impact using physical unit, some of them also use monetary unit, and very few of them consider propagation effect.
- How much should we invest in adaptation options to alleviate negative damage of impact?
  - Overabundant invest in adaptation will cause shortage of budget to be used for capital accumulation and goods consumption.

Example of CGE-impact model linkage

Economic impact of climate change through the change in crops productivity

	JPN	CHN	IDI	CAN	USA	E_U
Producer price change (%)						
Rice	-0.01	-1.58	17.96	-40.16	-0.06	-4.93
Wheat	4.91	8.47	125.11	-13.10	4.76	8.92
Other grains	1.81	0.79	1.80	-43.59	-1.46	-3.36
Other crops	-0.01	-0.28	1.90	2.76	-0.10	-0.05
Livestock	-0.19	-0.09	2.34	-1.22	-0.59	-0.04
Other agricultural products	-0.15	-0.01	0.30	-0.35	-0.07	0.04
Manufacture	0.03	-0.12	-1.10	0.61	0.03	-0.02
Services	0.03	-0.16	-0.93	0.69	0.02	-0.02
Production change (%)						
Rice	[illegible]	-0.25	-1.76	105.99	0.23	2.03
Wheat	-6.60	-3.97	-7.64	115.07	2.87	-3.64
Other grains	15.56	-1.39	-1.33	89.41	-4.04	-6.50
Other crops	0.11	-0.07	-4.25	-2.26	0.25	-0.03
Livestock	0.09	-0.24	-2.27	0.94	0.03	-0.22
Other agricultural products	0.11	-0.27	-1.76	0.69	0.04	-0.22
Manufacture	-0.01	0.31	-0.37	-1.62	0.03	0.05
Services	0.00	0.00	-2.62	-0.02	0.01	0.01
Consumer price index (%)	0.001	0.001	6.047	0.313	0.017	-0.010
Income change per capita (%)	0.026	-0.236	-0.617	0.833	0.026	-0.009
Social welfare change (%)	0.022	-0.219	-4.892	0.343	0.009	0.003

Production

Crop productivity change

Tech. Improve

Labor

Land

Demand

Population

Consumer preference

Trade

Tariff etc.

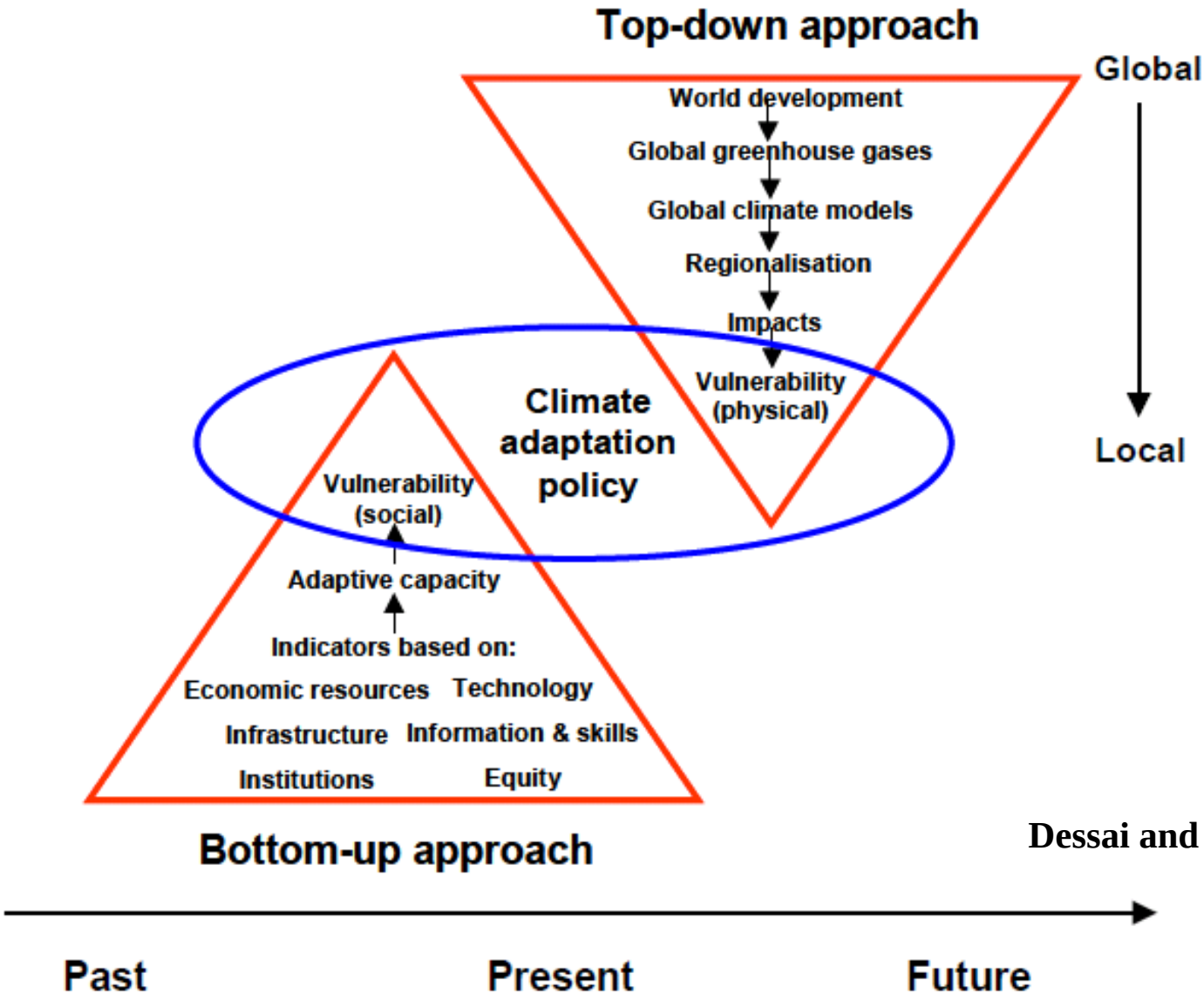
Linking CGE with impact model

- How climate change impacts give a shock to CGE world?
  - Change in technology parameters of production function caused by climate change
  - Loss of accumulated capital in production sectors
  - Loss of budget forcefully used for compensating for damaged sectors/areas
- How adaptation can be taken into account?
  - Economic adaptation through the transformation of global/domestic trade is automatically taken into account.
  - Adaptation has a possibility to mitigate changes/losses described above. If cost/effect of adaptation is known, optimal level of adaptation can be suggested.

Limitation of CGE-impact model for proposing concrete adaptation options

- Difficulty in collecting reliable information on cost/effect of adaptation options
- Whether specific adaptation options can be actually adopted or not cannot be determined only by the level of financial resource. It is also related to social circumstances such as institution and governance. Generally, they cannot be described under CGE.

Impact assessments' roles in vulnerability and adaptation assessment



Dessai and Hulme (2003)

Opportunity for collaboration regarding impact assessment studies

- Critical check of the assessment result by persons who have a good sense of locality.
  - Global scale simulation often fails to describe local situations realistically because of omitting local peculiar conditions.
- Collection of local data for validating / adjusting model parameters
- Investigation and proposition of promising adaptation options with referring to results of impact assessment

As a last slide…

- Thank you for your kind attention !

- Impact, vulnerability, and adaptation assessment will definitely attract attention of various stakeholders, especially in developing countries negatively affected by climate change, in the coming years.