NIES Socio-Economic Scenarios

S. Fujimori, N. Hanasaki, M. Kainuma and Y. Hijioka
National Institute for Environmental Studies

ENERGY MODELING FORUM

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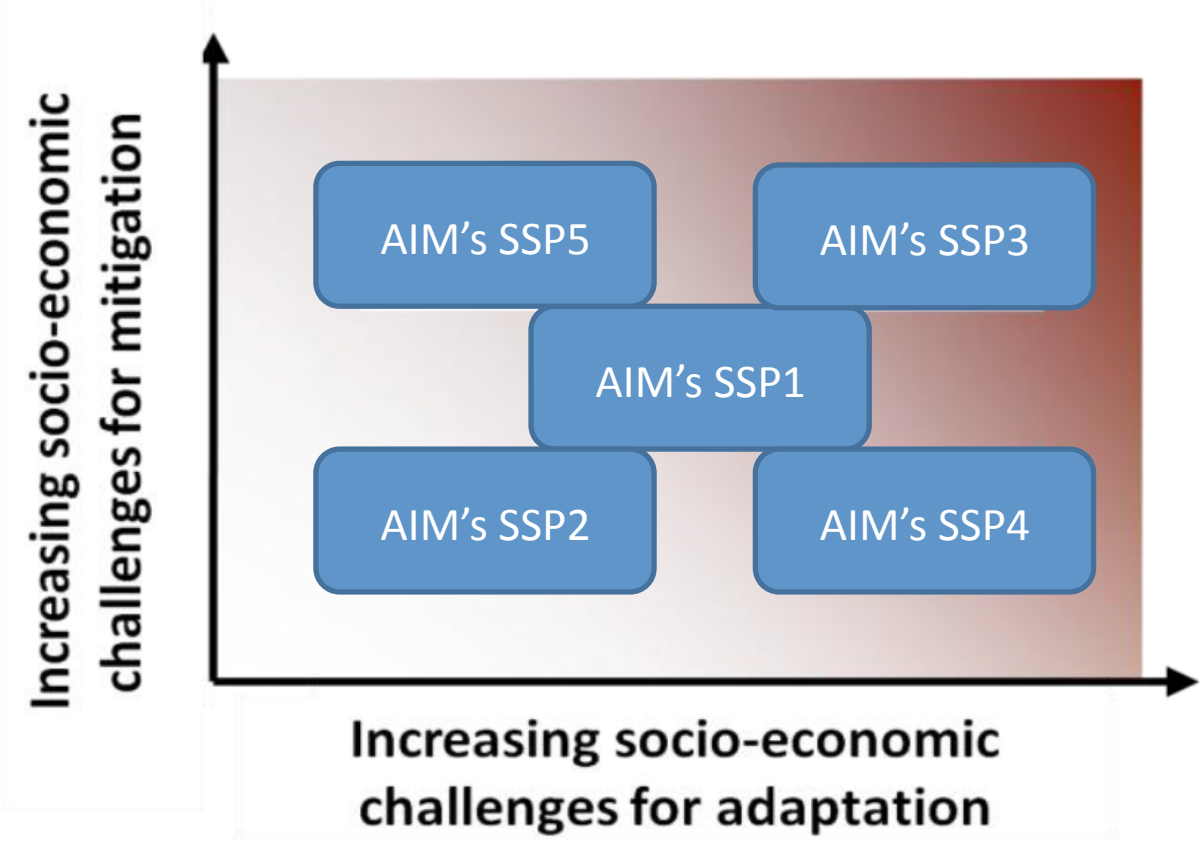
Outline

- NIES SSP numerical trial
- Application of SSP with a global water assessment
- Discussion points arisen from current trials

Scenario spaces



- SSP1 is the reference scenario
- Equity could be one of the indicators of adaptation capacity

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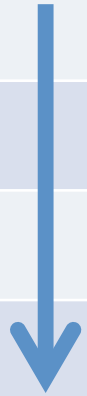
Concepts of the AIM SSP

	population	Economy	Technology	Equity	Environment	Globalization
SSP1 (base)	Middle	Middle	Middle	Middle	Middle	Middle
SSP2	Low	High	High	High	Middle	High
SSP3	High	Low	Low	Low	Middle	Low
SSP4	High	Low	Middle	Low	Middle	Low
SSP5	Low	Low	Middle	High	Middle	Low

- Population and economic growth assumption has one more dimension like industrialized and developing countries.
  - Related to equity

Shared Policy Assumptions (SPAs)/ Shared Socio-economic Pathways (SSP)

Climate forcing	SSP1	SSP2	SSP3	SSP4	SSP5
8.5 W/m2					
Non intervention					
6.0 W/m2					
4.5 W/m2					
2.6 W/m2					



- RCP climate forcing targets are applied

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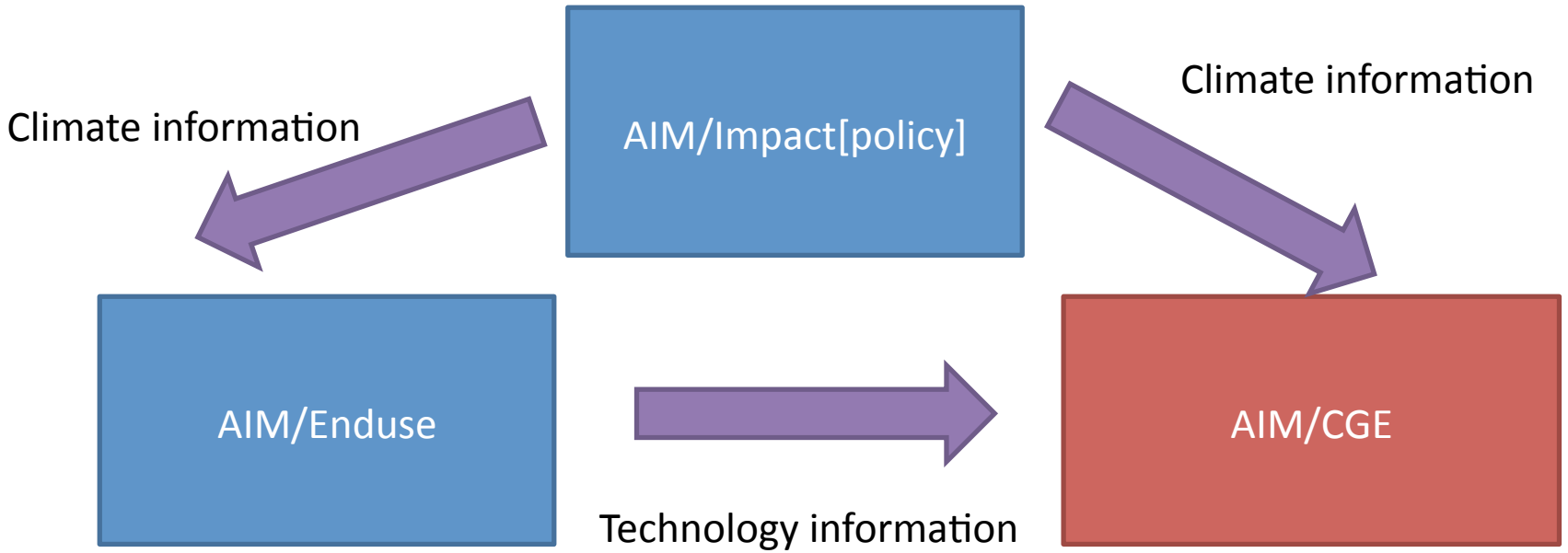
Model used for SSP



- Exchange information among AIM models
- AIM/CGE model is the main tool for SSP's
  - Last year the model was renewed

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Main features of a new CGE model

	New model	Previous model
region	35 (Asian countries; 14)	24 (Asian countries; 8)
Industry	38 (manufacture sector is disaggregated in detail)	20
Emissions	CO2, CH4, N2O, NH3, SOx, NOx, BC, OC	
Institution	Household, government, Enterprise	Representative household
Dynamics	Recursive dynamic (1 year step)	Recursive dynamic (10 year step)
Base year	2005	2001
Base data	Original energy balance and SAM (data reconciliation system, Fujimori et al., 2011)	GTAP and IEA energy balances
Program	GAMS / MCP	GAMS / MPSGE

Model Output (+ Assumptions)

- Population
- GDP
  - GDP share by industry
- Energy supply
- Mitigation cost (carbon price)

- Under preparation
  - Land use
  - Crop and food demand and supply

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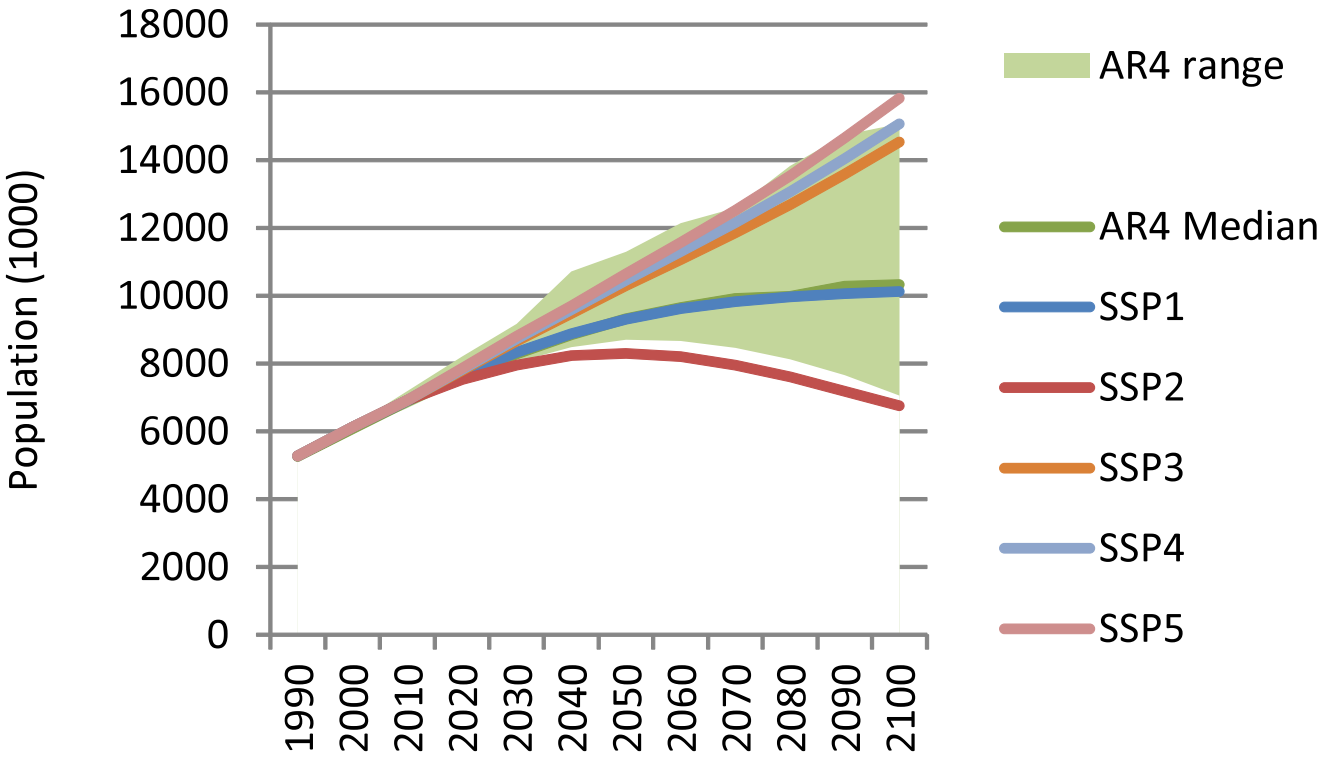
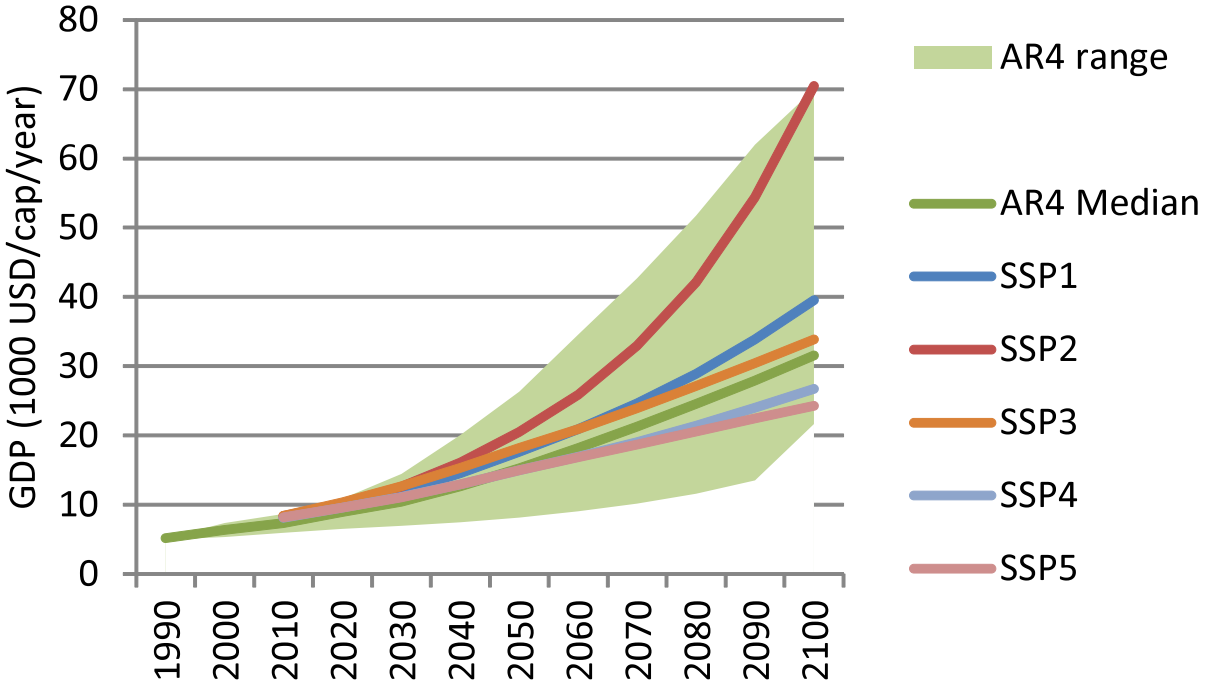
Population



- The range of the AR4 is almost covered

GDP per capita



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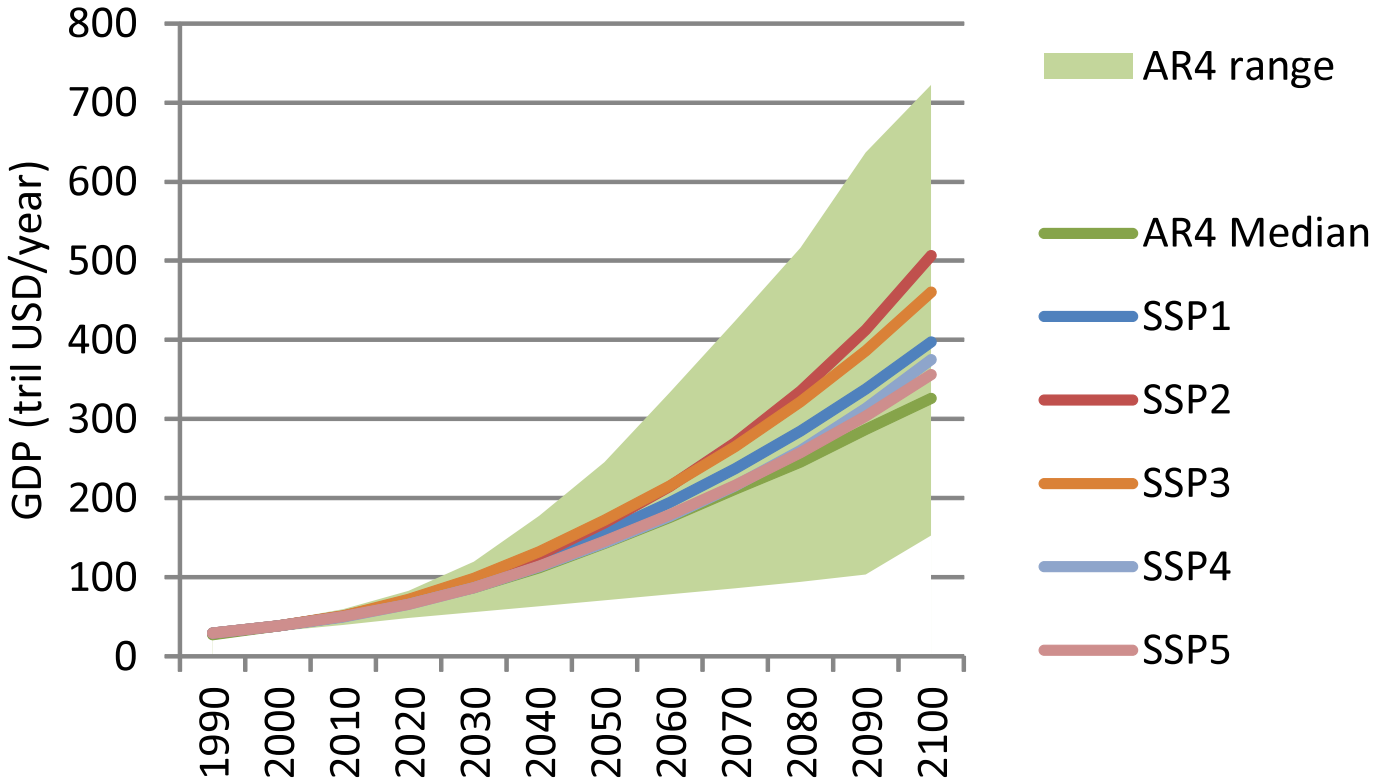
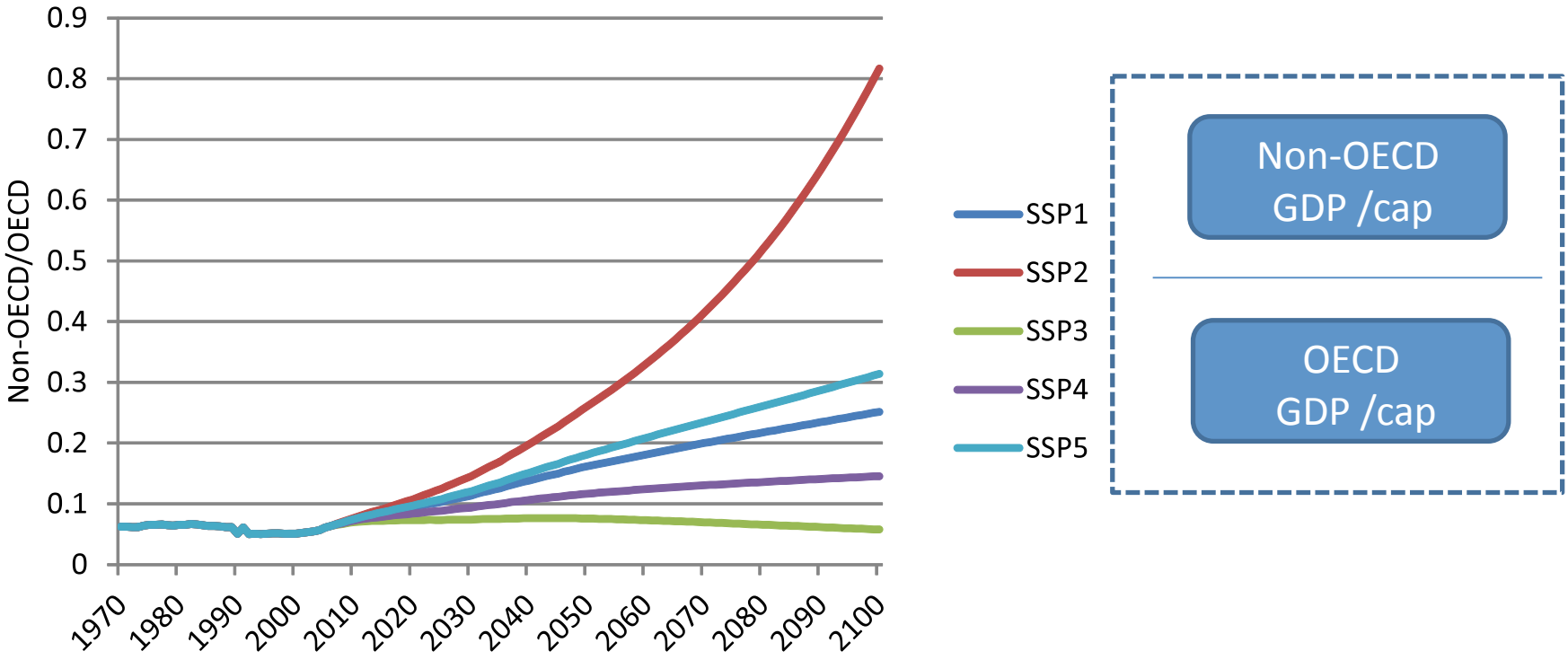


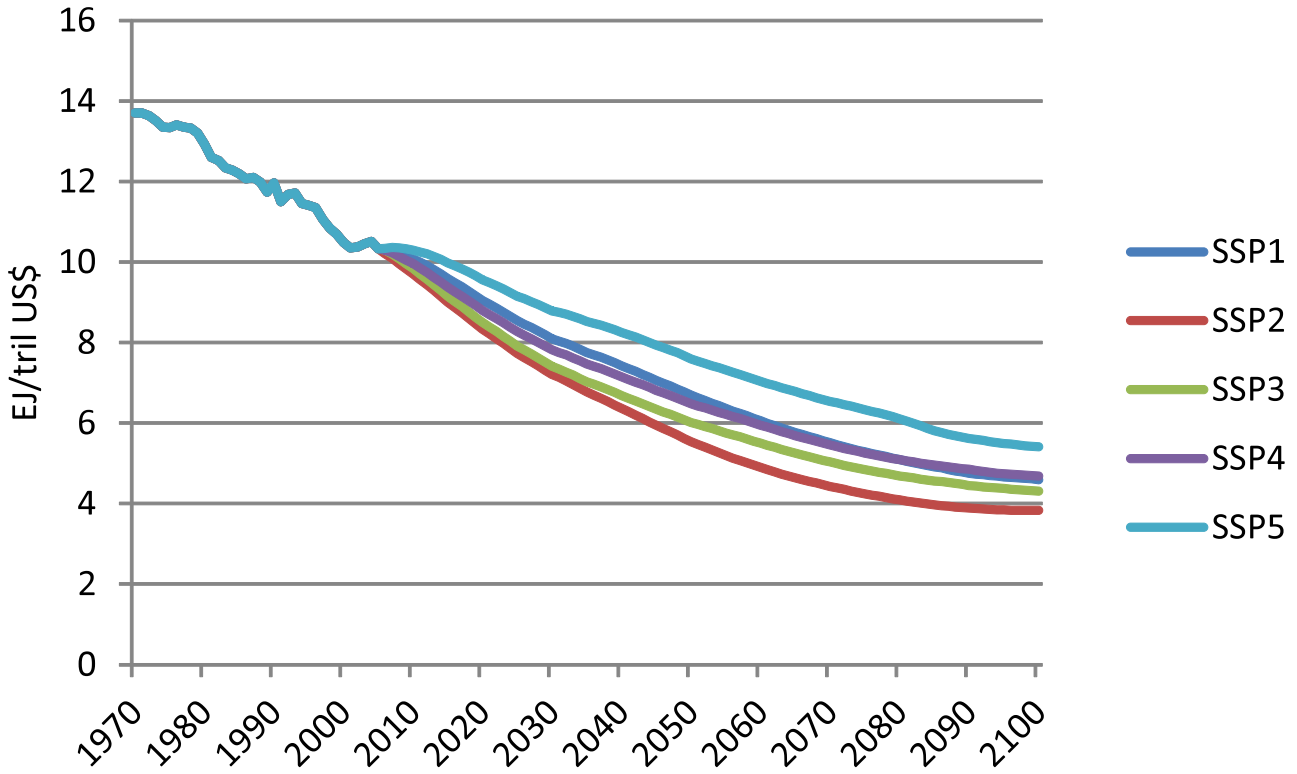
- The range is smaller than GDP/cap and Population
- Consequence of the combination of GDP/cap and population
  - High economic growth has low population
  - Opposite are adopted

Equity – GDP/cap



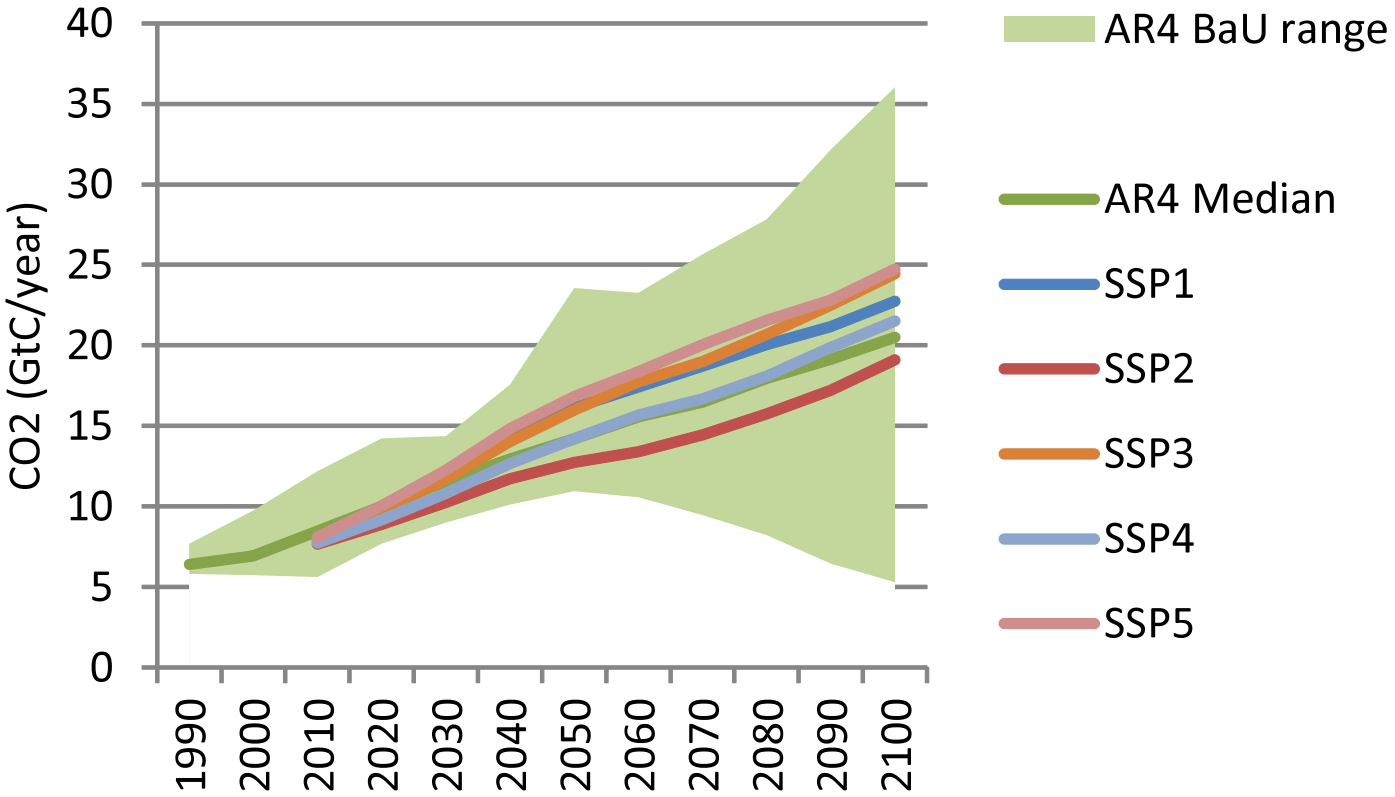
- Compare GDP/cap gap between OECD and non-OECD
- SSP2 has strong equity improvement

Energy Intensity Improvement



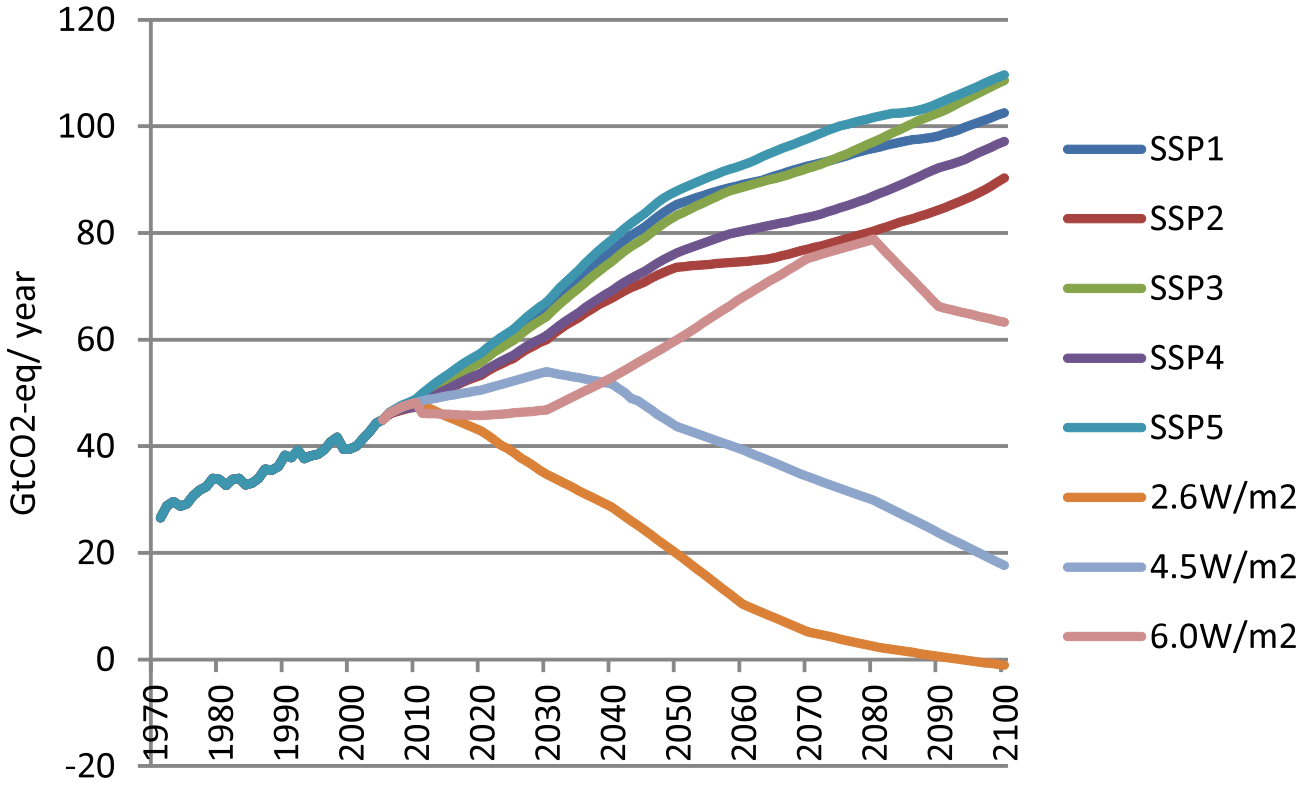
- Energy intensity is expected to be improved
- The degree has variety

Energy related emissions



- Energy related emissions are also similar to GDP
  - GDP is one of the key parameters for emissions

Emission pathways
- SSP with SPA -



- GHG emissions are forced to achieve climate target
- The emission pathways are borrowed from RCP

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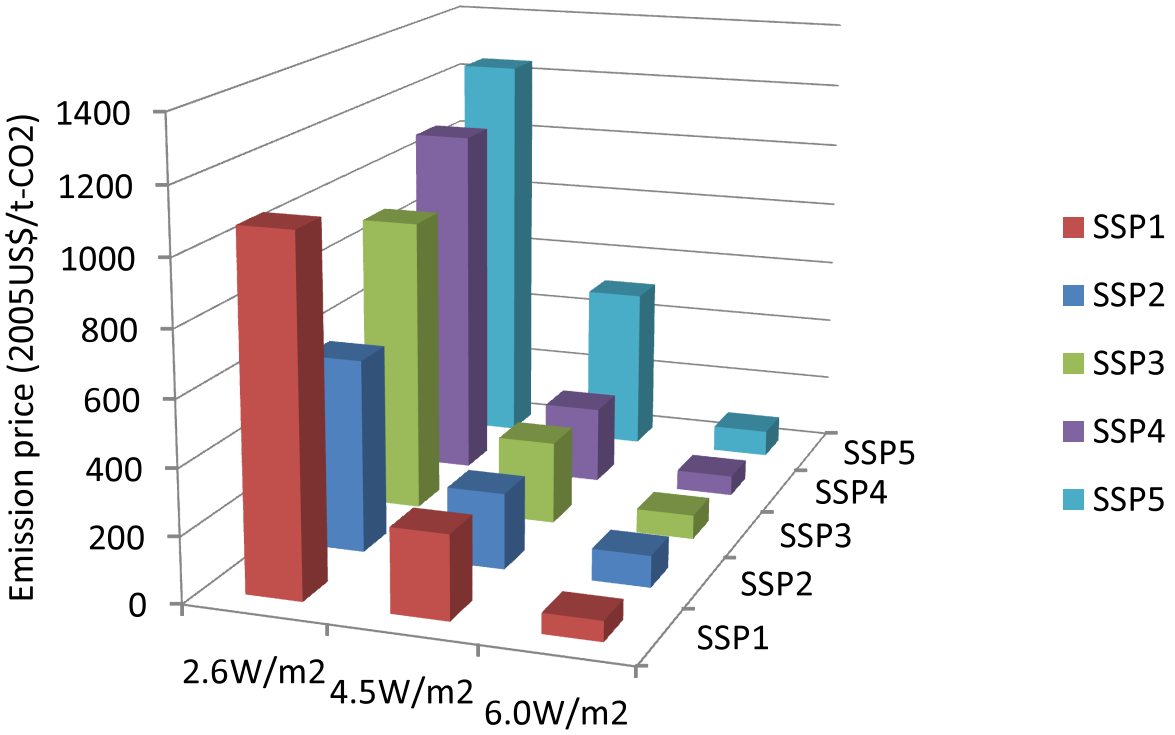
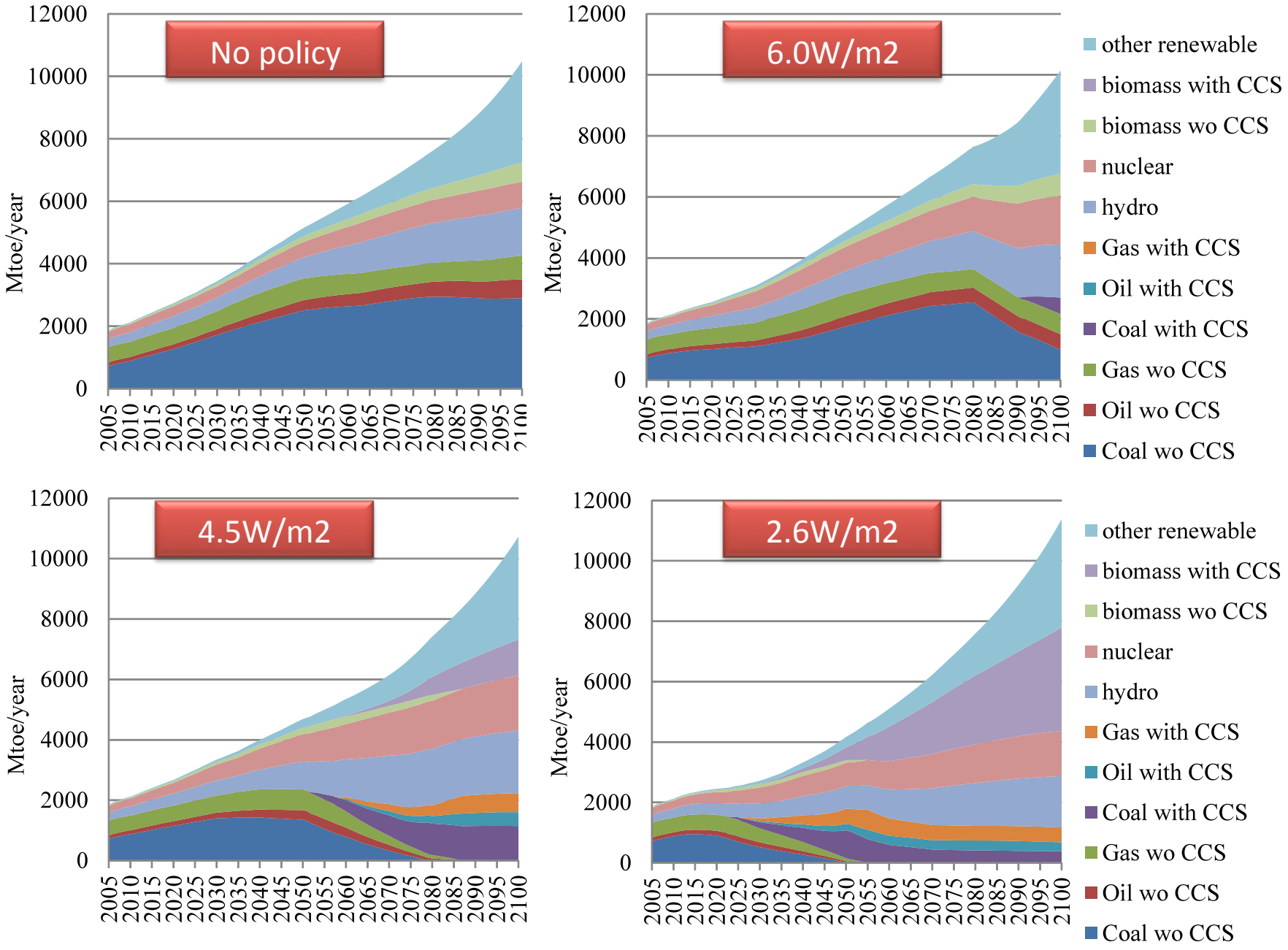
Carbon price in 2100



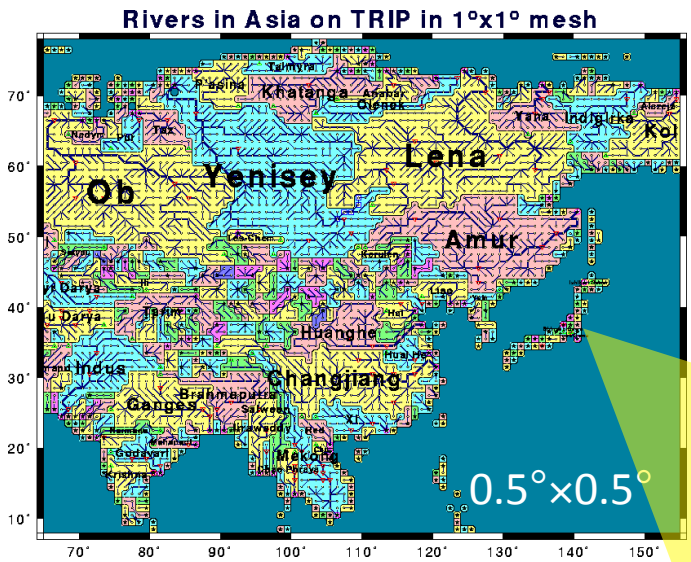
- GHG emission prices of strict climate target are large
- Each SSP has different price

Power structure of SSP1



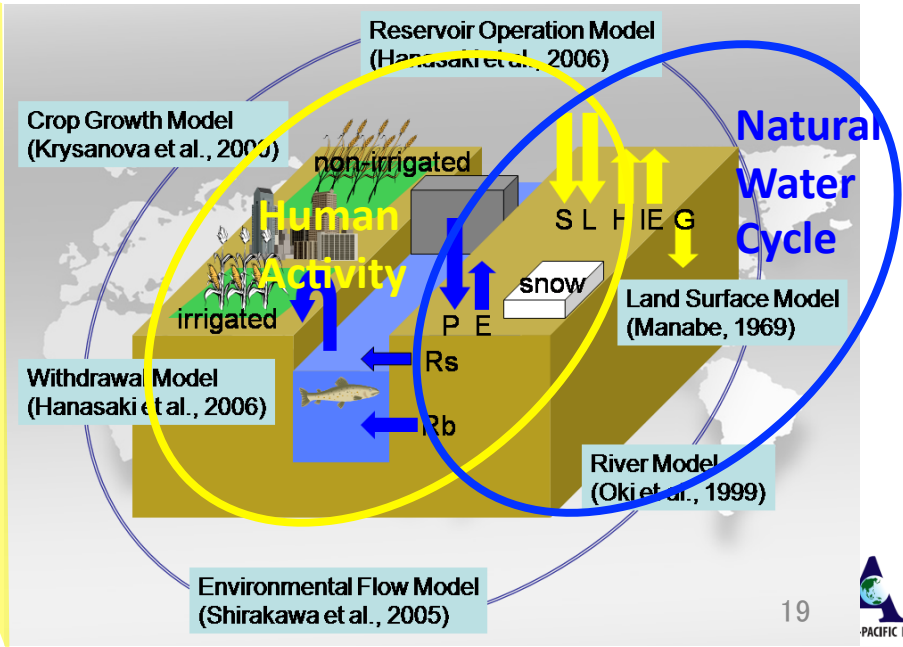
Global water assessment

Global water resources model H08



- Characteristics

1. Simulate both water availability (streamflow) and water use at sub-annual basis
2. Deal with interaction between natural hydrological cycle and anthropogenic activities



Hanasaki et al., 2006, J. of Hydrol.
Hanasaki et al. ,2008a,b, Hydrol. Earth Sys. Sci.

Input data requirement of H08

Meteorological (0.5°×0.5°, daily)	
Temperature	Climate model community provides
Relative humidity	
Air pressure	
Wind speed	
Short-wave radiation	
Long-wave radiation	
Precipitation	

Geographical (0.5°×0.5°)		
Population		SSPs provide
Agricultural water	Irrigated area	SSPs provide? If not, refer to published reports that is consistent with storylines.
	Crop intensity	
	Irrigation efficiency	
Industrial water		
Domestic water		
Reservoirs		
Crop type		

Experiment setting

- Period
  - benchmark: Climate 1961-1990; Socio-economy 2005
  - Future: Climate 2041-2070; Socio-economy 2055
- 2 climate scenarios are used corresponding to the climate target

Socio-economic scenarios	Population	GDP
SSP1	9.48 billion	211.1 trillion USD

Climate scenarios	Temperature change	Precipitation change
No clinate policy (Reference; MIROC medres A2)	+2.6 degree C	+1.8%
Climate policy (MIROC medres B1)	+2.2 degree C	+2.0%

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Scenarios: Agricultural water

Scenarios	Irrigated area	Crop intensity	Irrigation efficiency
Present	271×10^6ha	0.8-1.5	0.35-0.6
SSP1	+39% (+0.6%/yr)	+25% (+0.4%/yr)	+18% (+0.3%/yr)

- Source
  - FAO (2003) is a regional scenario for developing countries up to 2030, but in this study, we extend it

- If we could not provide such information, detailed and model-specific scenarios should be prepared by IAV community by themselves. Clear and concrete SSP storylines would help IAV community.

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Scenarios: Industrial and domestic water

Scenarios	Industrial water	Domestic water
Present	690 km^3/yr	391 km^3/yr
BAU	3769 km^3/yr	722 km^3/yr

- Water demand model by Takahashi et al. (2000)

$$IW_{n,f} = IW_{n,i} \times \frac{GDP_{n,f}}{GDP_{n,i}} \times (1-\eta_n)^{f-i}$$

$$DW_{n,f} = DW_{n,i} \times \frac{POP_{n,f}}{POP_{n,i}} \times (1-\eta_n)^{f-i}$$

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Results: Water stressed population

Scenarios	Simulated agricultural water	Per capita water resources < 1000m3/cap/yr	Withdrawal to water resources > 0.4
Present	3594 km^3/yr	1.25 billion	2.59 billion
No climate policy	5382 km^3/yr	1.67 billion	2.71 billion
Mitigation	5311 km^3/yr	1.61 billion	2.55 billion

- Water scarcity assessment using well-known water indices
  - influenced by precipitation projections
- The stressed population is depending on the Indicators.

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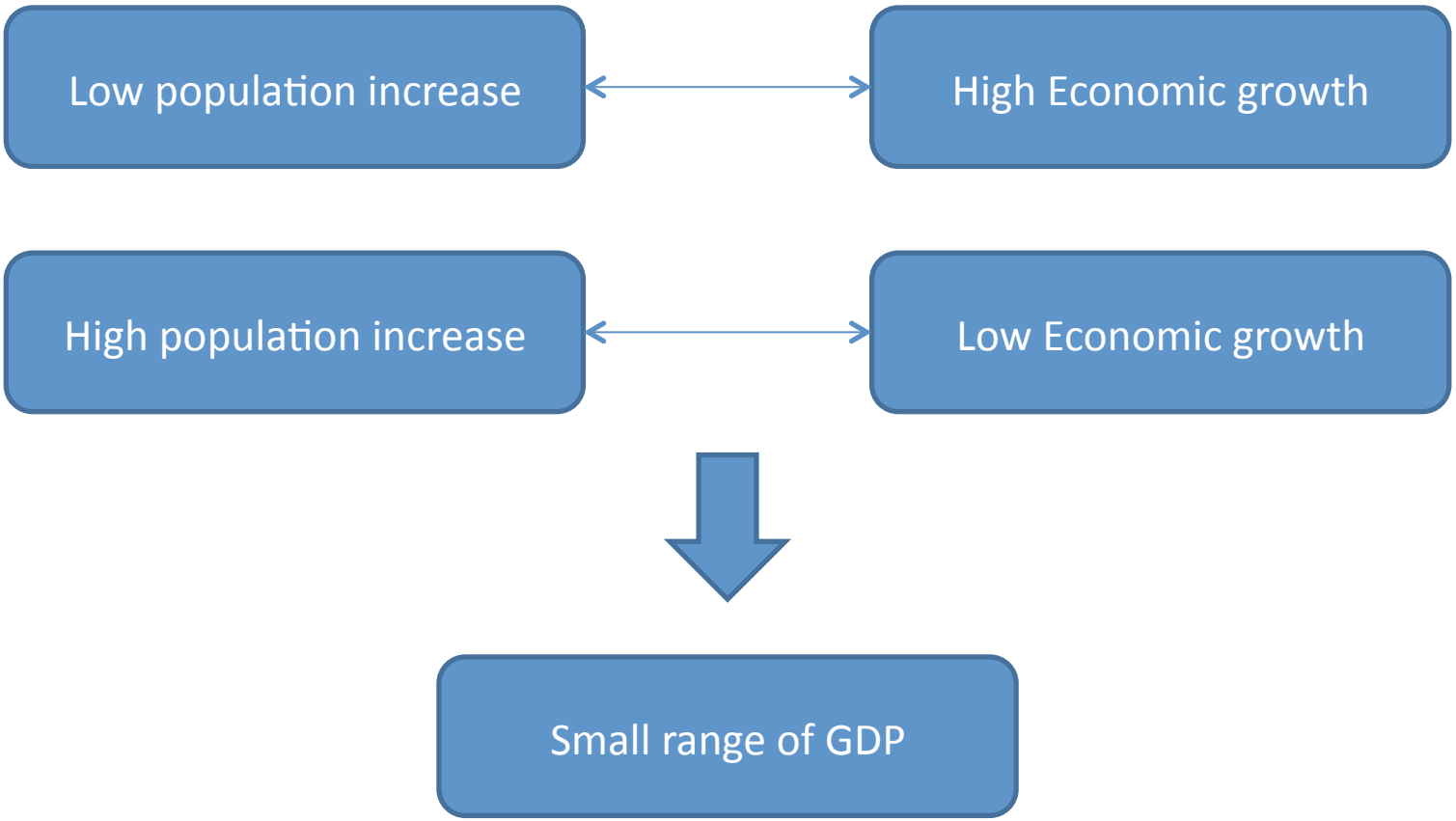
Discussion points

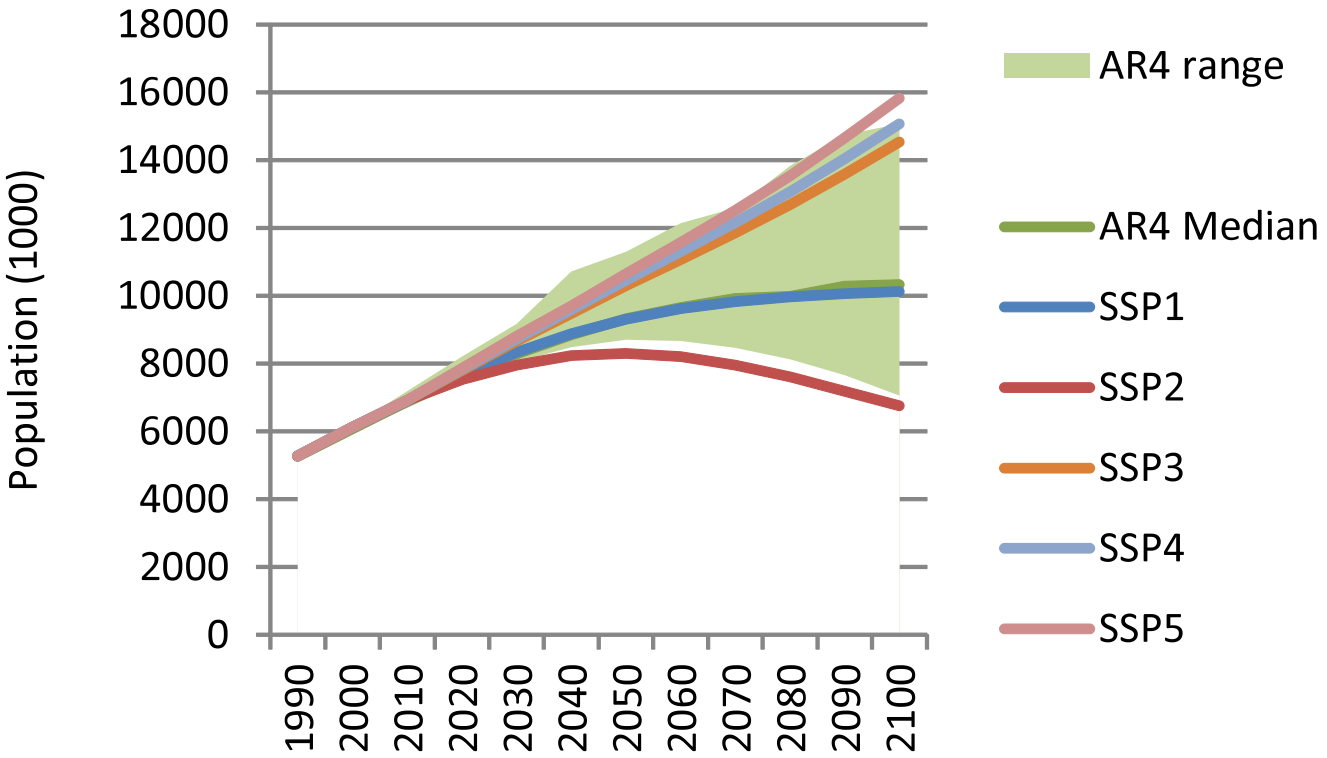
- Consistency could make the range of the emissions smaller
  - Reality of the scenarios

- Are we really answering to the IAV's requests?

Consistency could make the range of the emissions small



Population



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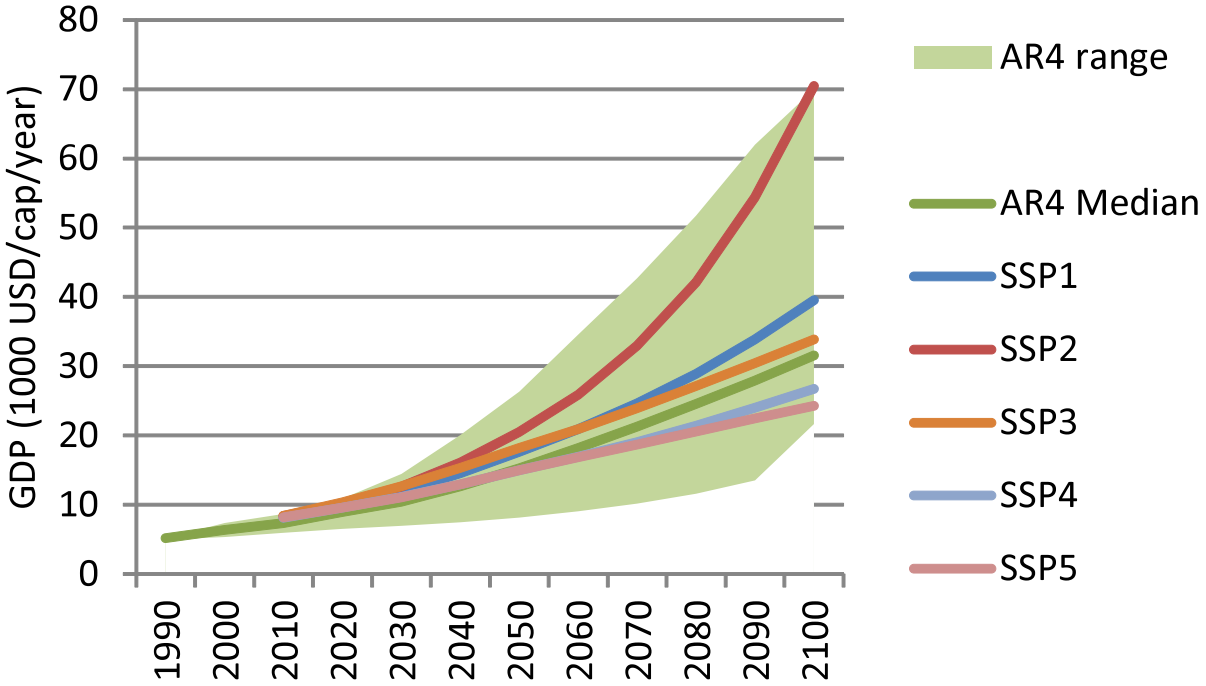

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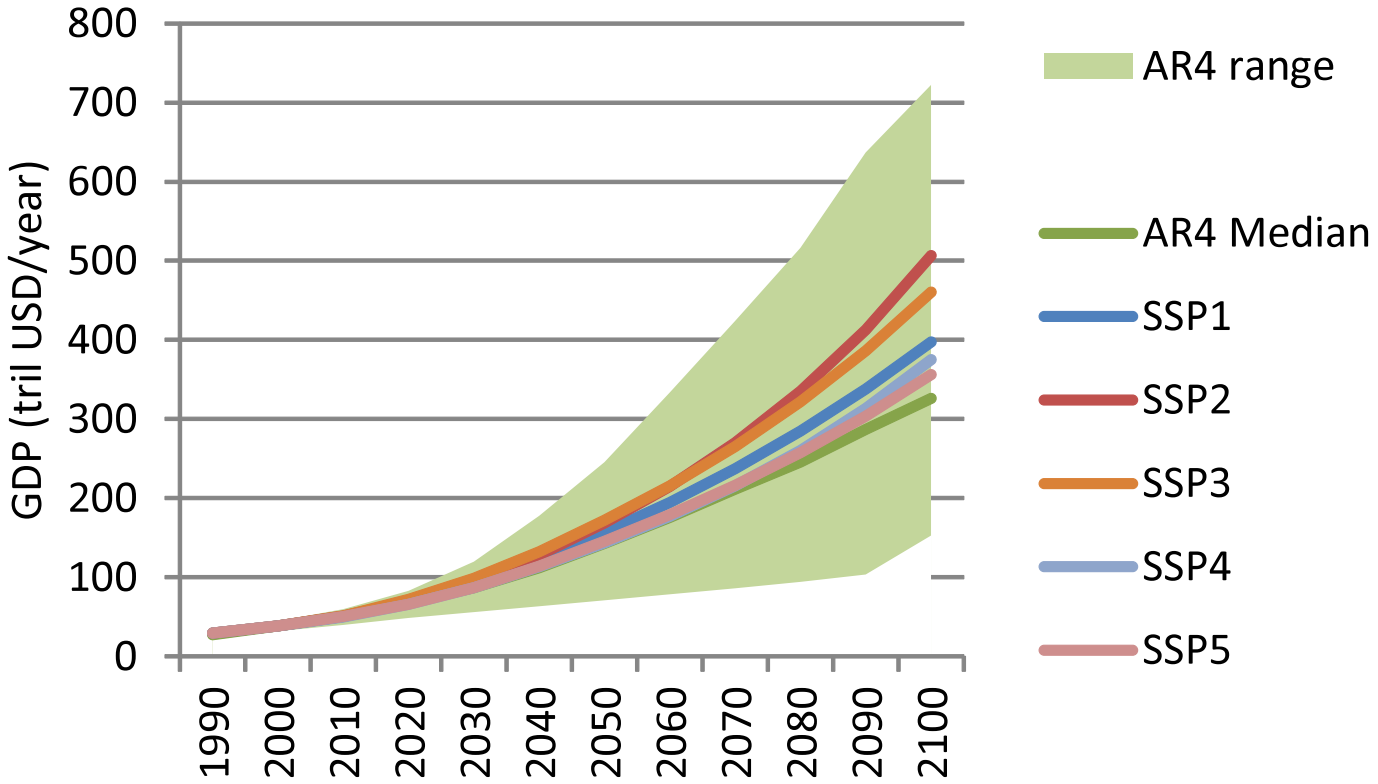

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Consistency could make the range of the emissions small

- The more wider range of the emission pathways can be drawn
  - It can be the “unrealistic” scenario
  - Does it really beneficial?

Are we really answering to the IAV's requests?

- Hallegatte et al.(2011)
  - Vulnerability is one of the key features for IAV
  - Poverty and equity
  - Environmental aspects not related to emissions
    - Land degradation and so on

- From the water assessment examination
  - The irrigation technology, yield and crop intensity are fundamental
  - Biomass and land use are also key drivers of the water demand.

- Deep communication is required