

Climate change cost: A CGE bottom-up approach MiLAI Project

Shinichiro Fujimori, Jun'ya Takakura, Tomoko Hasegawa,
Naota Hanasaki, Kiyoshi Takahashi and Yasuaki Hijioka

National Institute for Environmental Studies

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Climate change impact economics

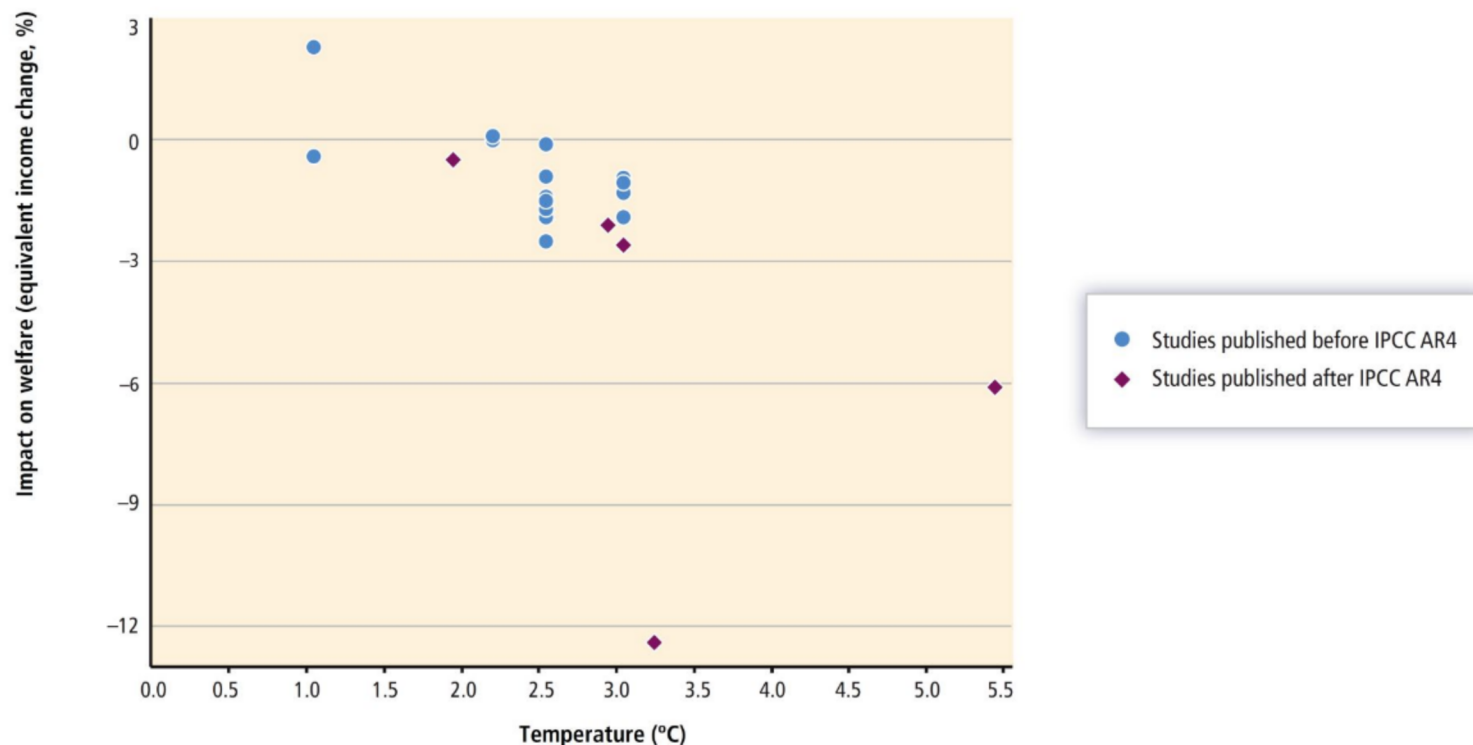
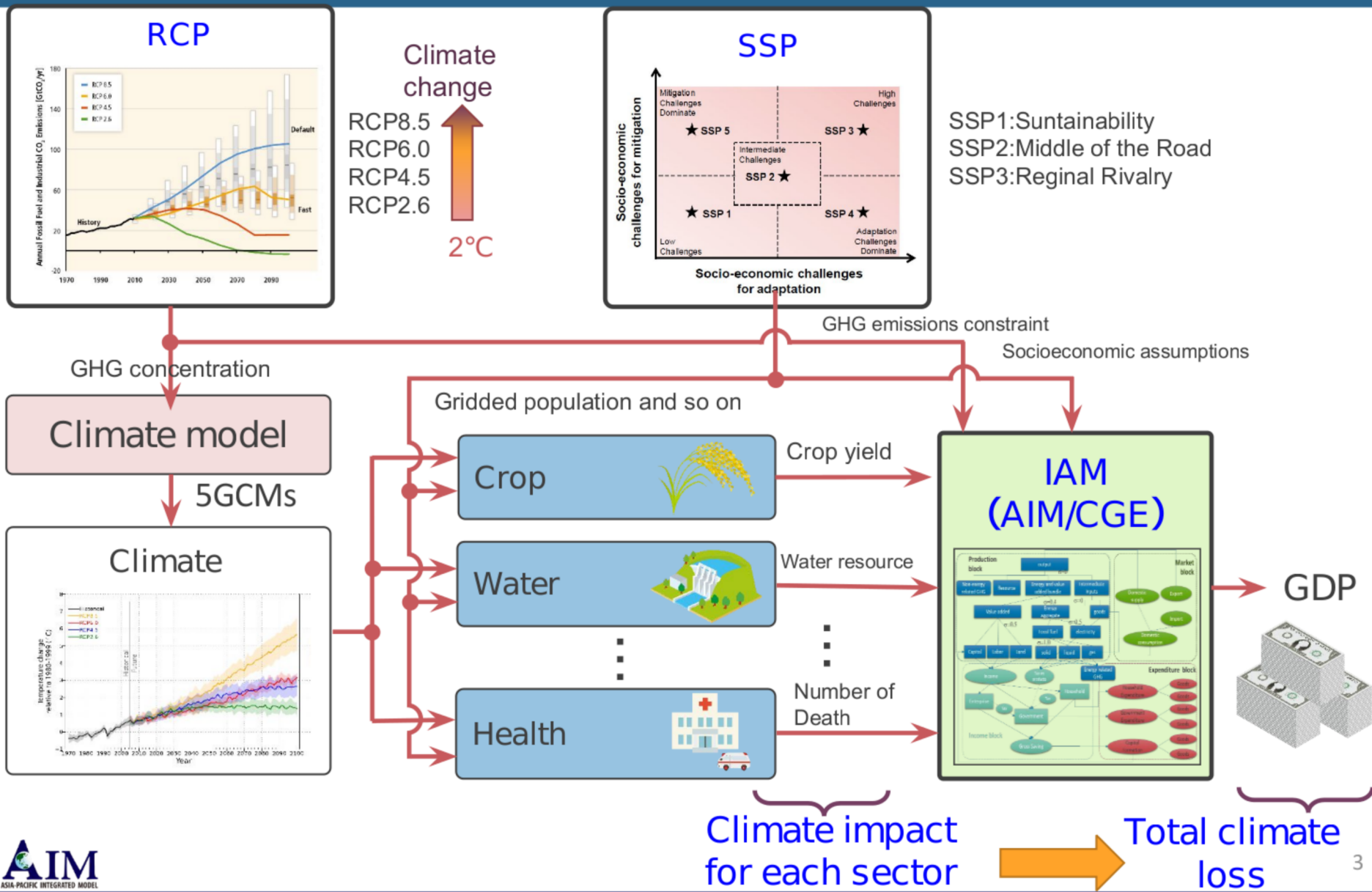


Figure 10-1 | Estimates of the total impact of climate change plotted against the assumed climate change (proxied by the increase in the global mean surface air temperature); studies published since IPCC AR4 are highlighted as diamonds; see Table SM10-1.

- Enrich the damage function information
- Global and multi-sectoral assessment
- RCP/SSP framework
- AIM/CGE (General Equilibrium model) + other physical models (e.g. hydrology model)

Overview of the study





ARTICLE

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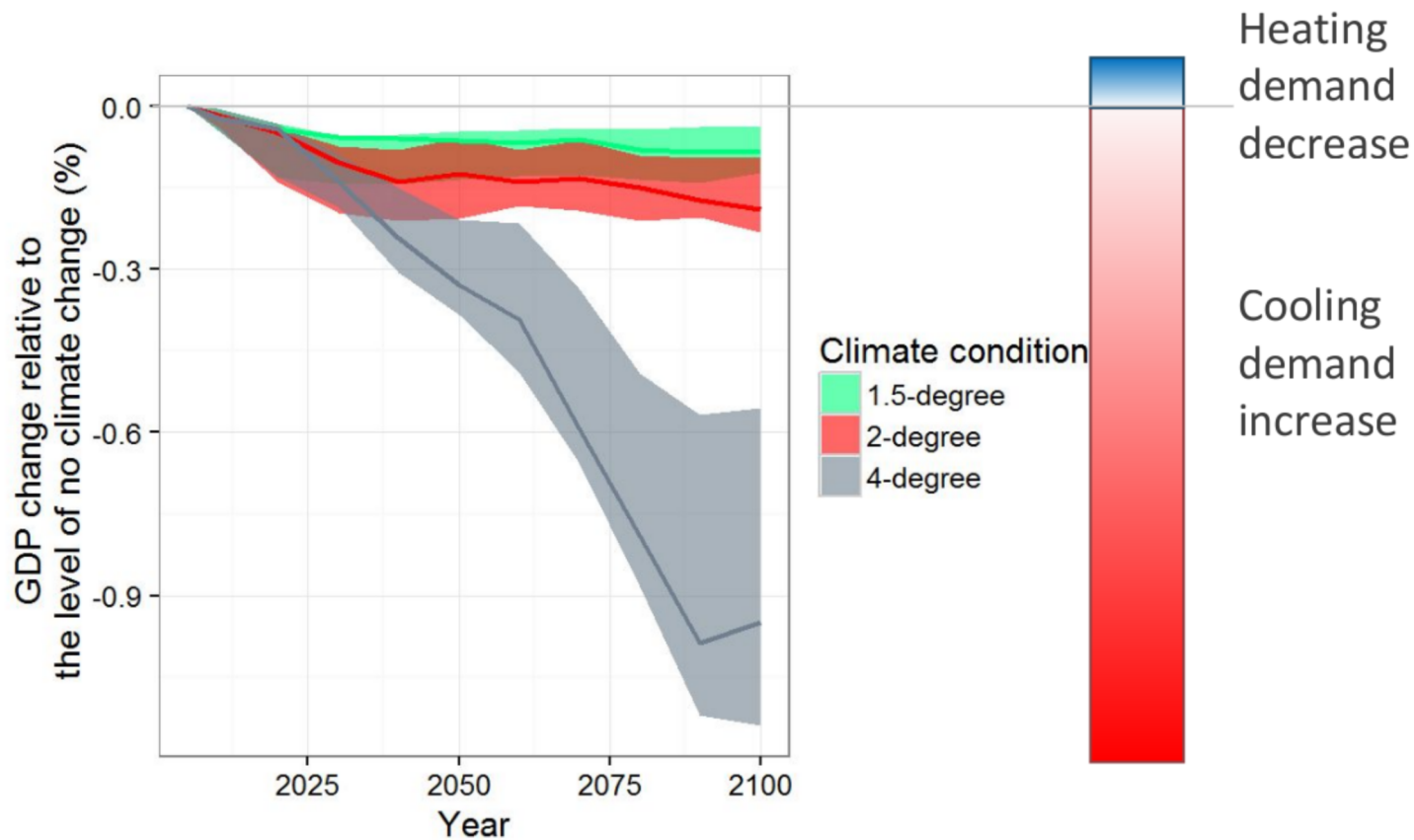
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Quantifying the economic impact of changes in energy demand for space heating and cooling systems under varying climatic scenarios

Tomoko Hasegawa¹, Chan Park², Shinichiro Fujimori¹, Kiyoshi Takahashi¹, Yasuaki Hijioka¹ and Toshihiko Masui¹

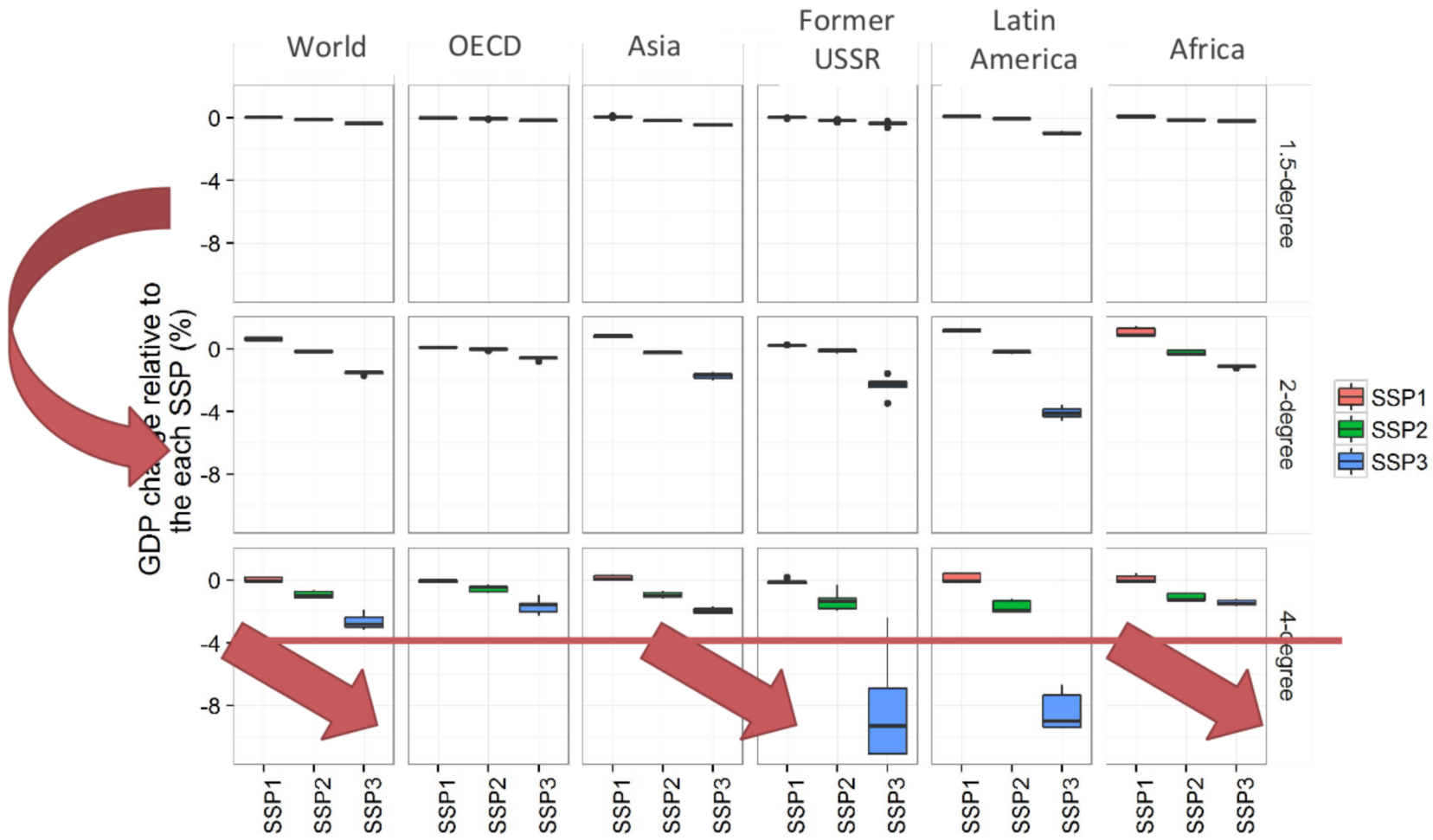
Energy demand

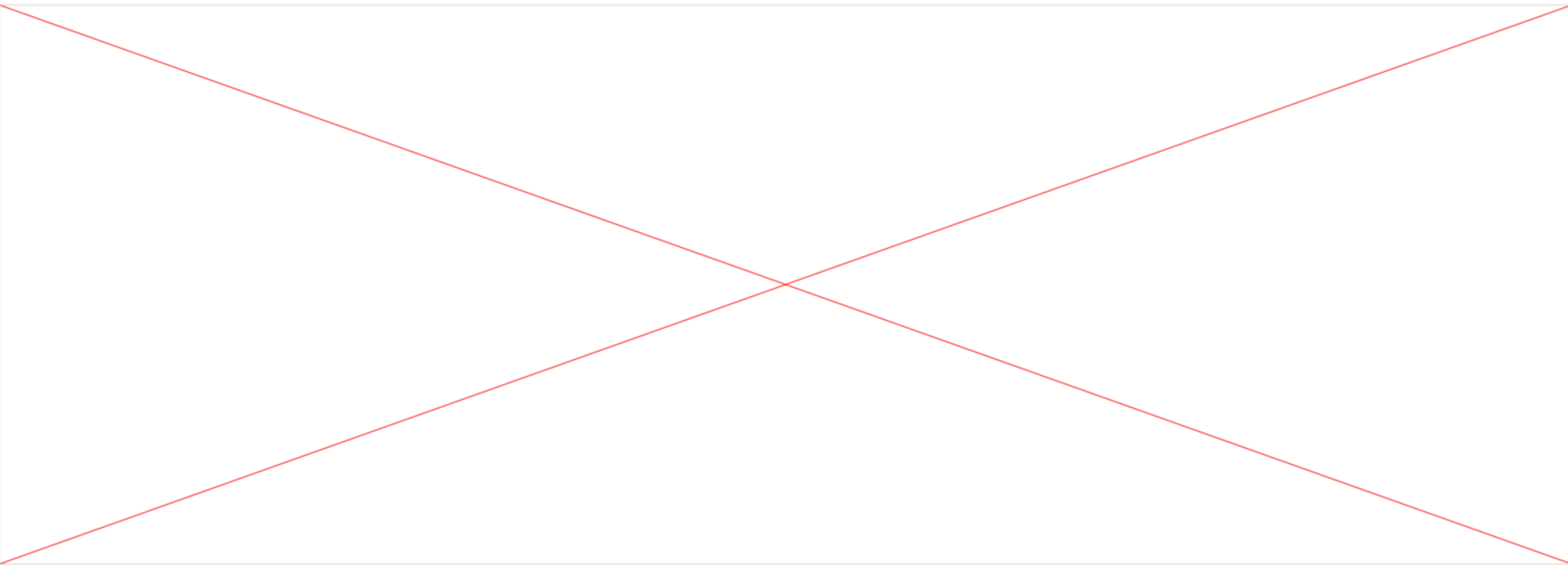
SSP2 global total



- 0.9% GDP loss in RCP8.5
- 0.1-0.2% loss in low emissions scenarios
- The negative impact mainly comes from cooling demand increase

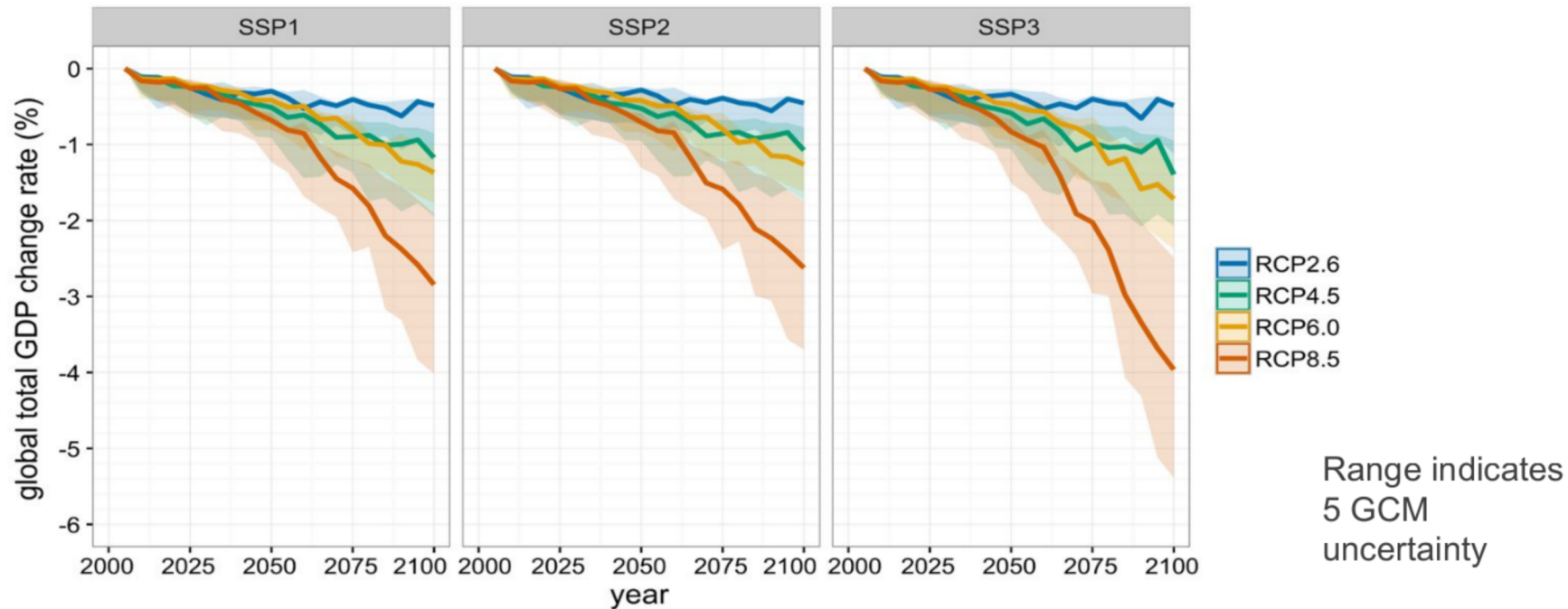
How does socioeconomic development influence





Labor productivity

GDP loss associated with labor productivity loss



- Regardless socioeconomic conditions, economic loss is large (2.6~4.0% of GDP)
- Magnitude is comparable with climate mitigation cost

Economic implications of climate change impacts on human health through undernourishment

**Tomoko Hasegawa¹ · Shinichiro Fujimori¹ ·
Kiyoshi Takahashi¹ · Tokuta Yokohata² ·
Toshihiko Masui¹**

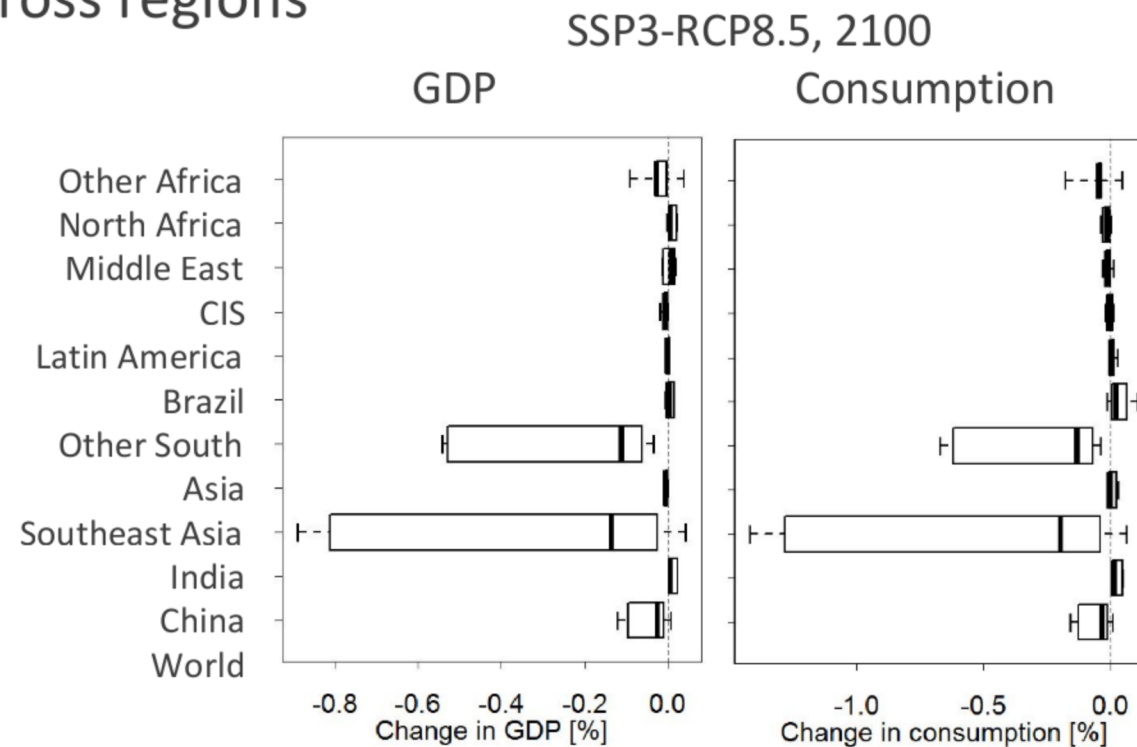
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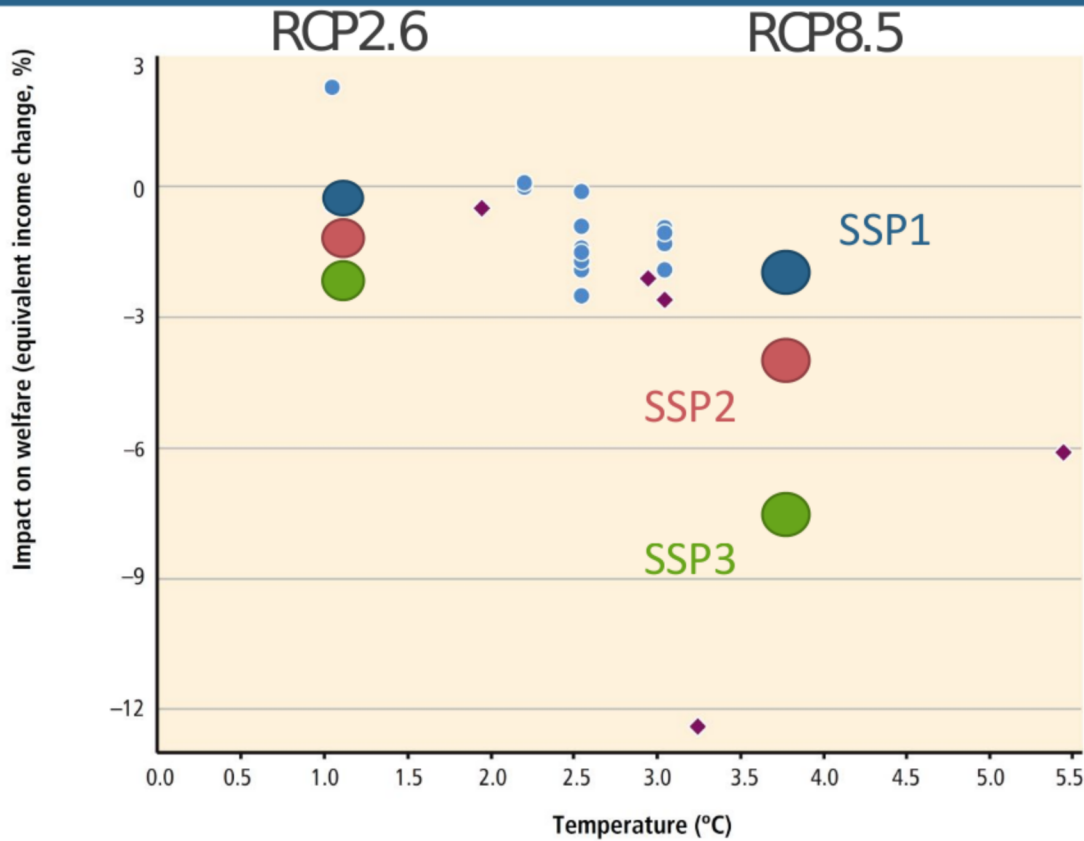
Undernourishment

Economic impacts of additional medical expenditure, decrease in population and labor force

- 4 Crop models are considered
- Within the CGE, undernourished people, medical cost and labor loss are endogenized
- Global GDP change is small
- Large heterogeneity across regions



Preliminary results



- Included up to now
 - Energy demand,
 - Labor productivity
 - Crop yield change
 - Hydropower
 - Undernutrition
 - Will be included
 - River Flood
 - Coastal damage
- In AR4
◆ Added after AR4

- The magnitude is almost similar or slightly bigger
- RCP8.5 is more than mitigation cost.
- Extreme and catastrophic events are not

Discussion

- The need for considering regional variety
- Offset issue
 - ✓ region and sector negative and positive values are aggregated
- Temporal and generation aggregation issue
- Extreme and catastrophic events are not included

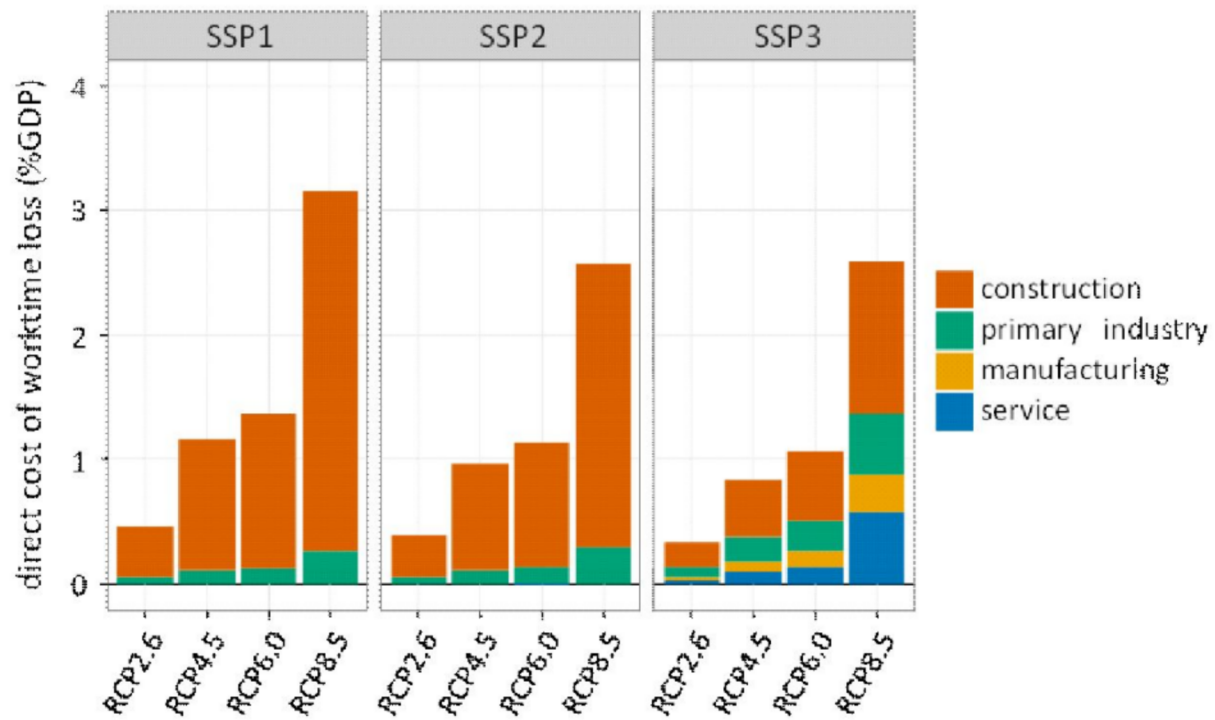
ご清聴ありがとうございました
Thank you for your attention

About MiLAI

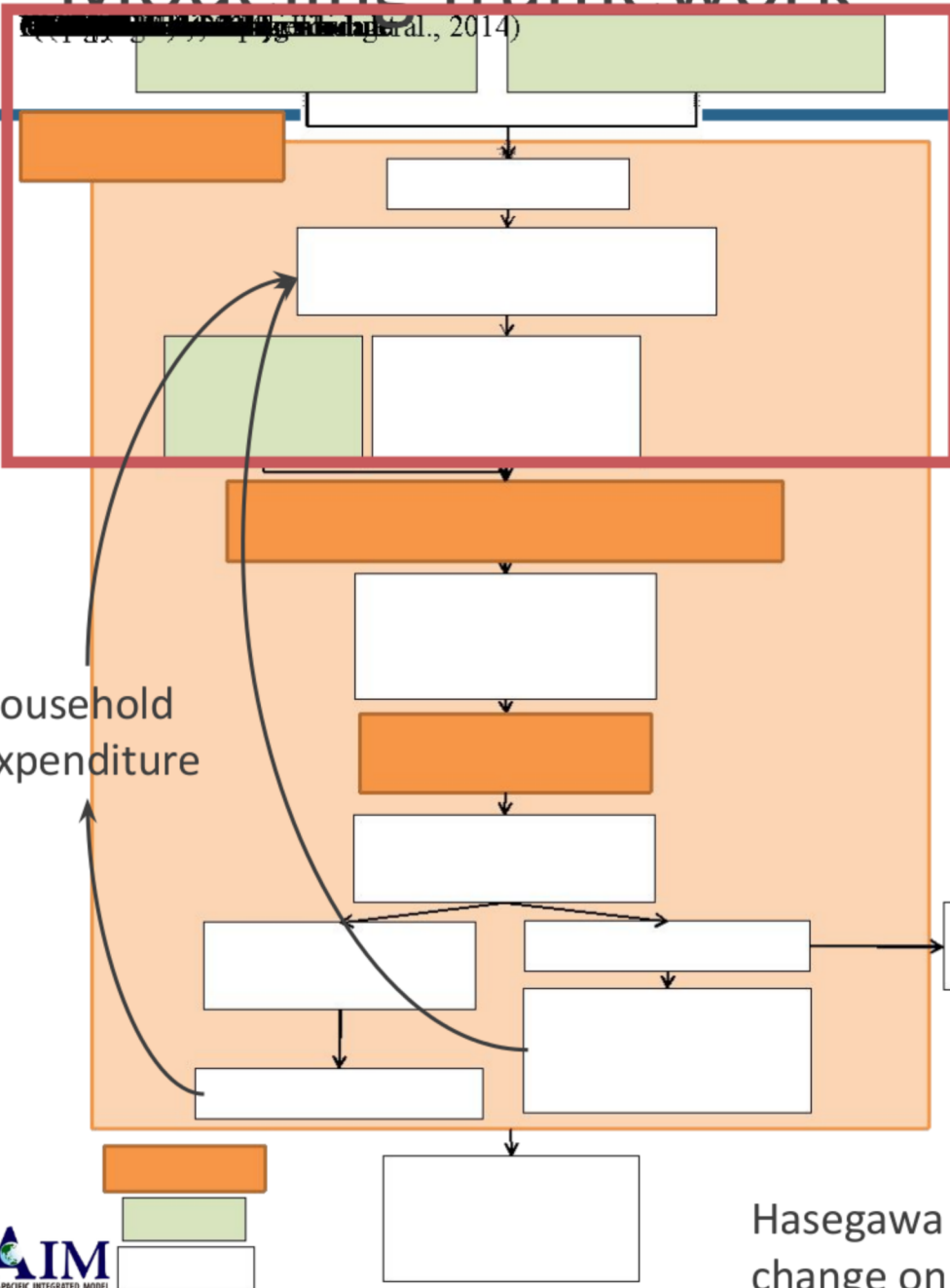


<http://s-14.iis.u-tokyo.ac.jp/eng/>

Backup



Modeling framework



Model improvements

- Calculate **Disability-Adjusted Life Years (DALY)**, **Medical expenditure**, **mortality**, **Economic value of life lost** from population at risk of hunger.

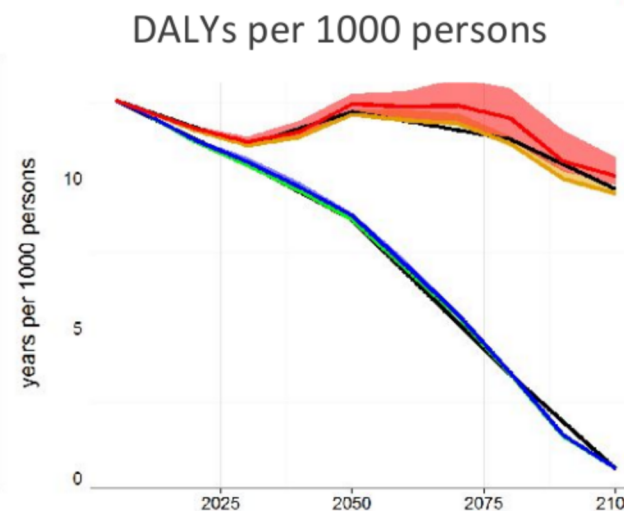
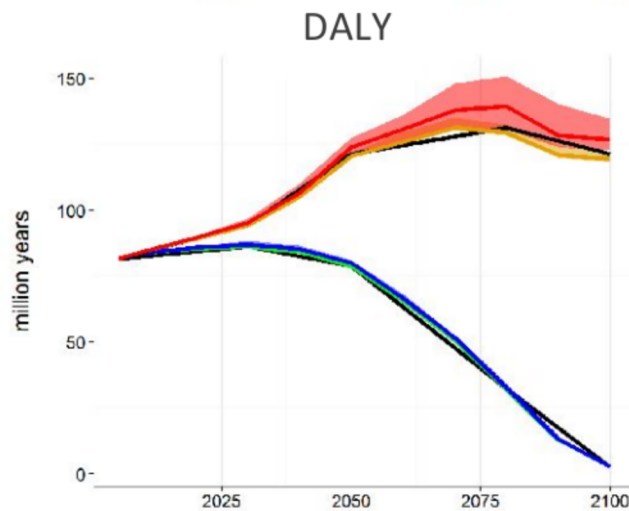
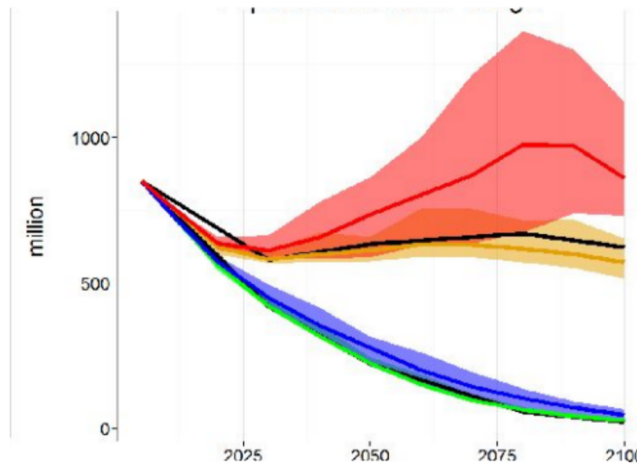
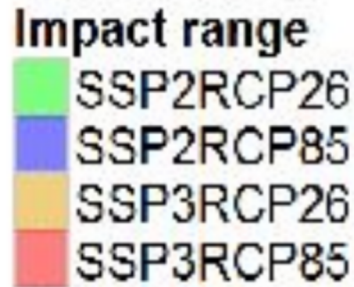
Two feedback

- 1) Mortality to changes in population and labor force
- 2) Medical expenditure to changes in household expenditure.

Hasegawa et al. (2016) Economic impacts of climate change on human health through undernourishment¹⁶

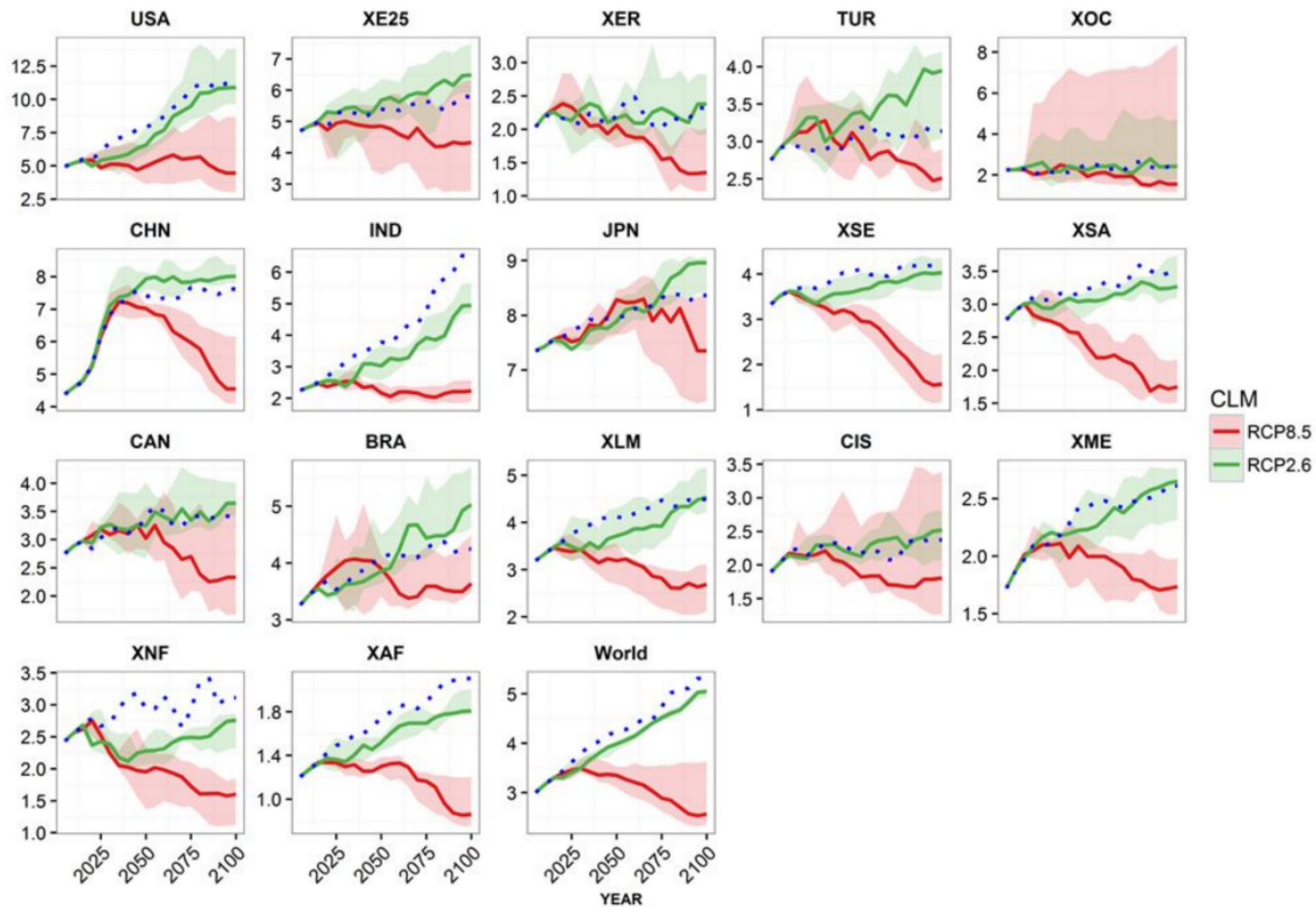
Effects of climate change to food and human health

Prevalence of Undernourishment



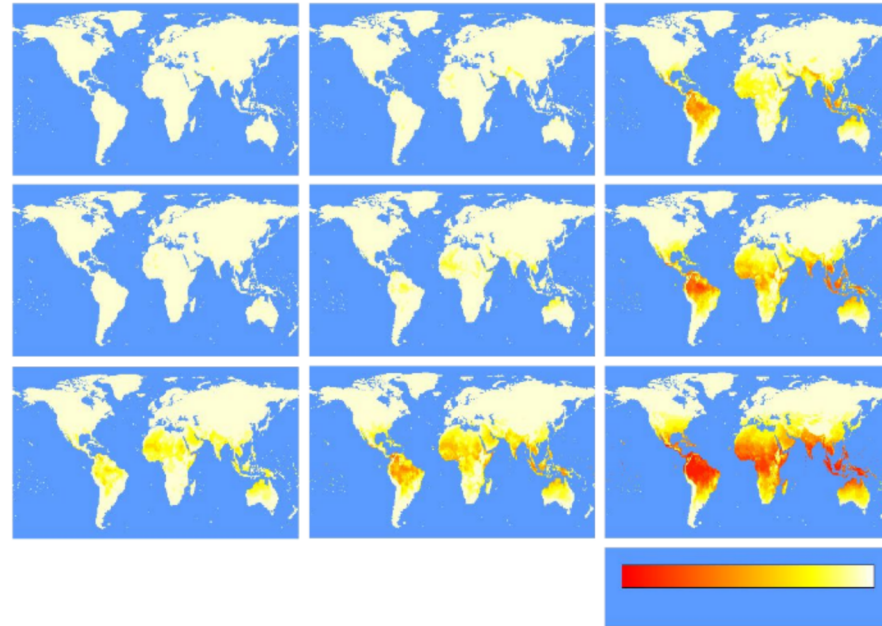
- Food consumption will decrease; PoU and DALY will increase in RCP8.5.
- The effects are small in RCP2.6.

Crop yield change (Aggregated major 5 crops): CYGMA model output



Fujimori et al.
(Under review)

Work time loss based on WBGT change (outside works)



Cooling and Heating demand: Residential

$$\text{(Energy service demand)} = \text{(Population)} * \text{(floor area/cap)} * \text{(degree day)} * \text{(Device penetration rate)}$$

- Population : SSP2
- Per capita floor area (McNeil et al)

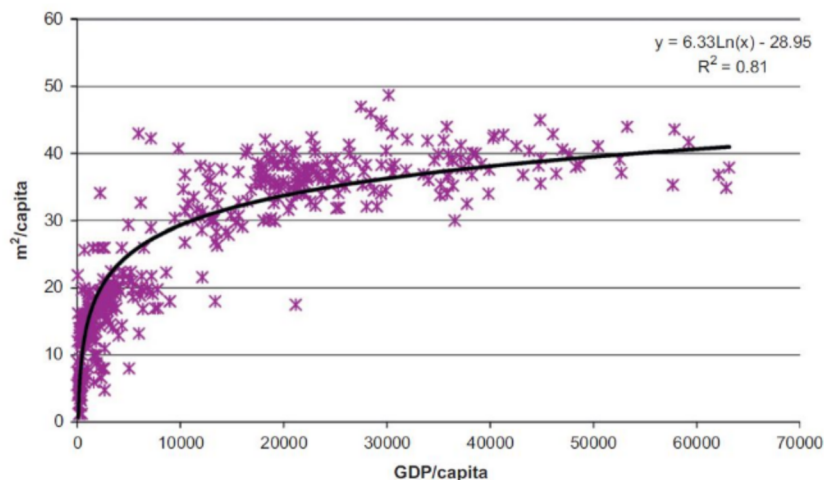
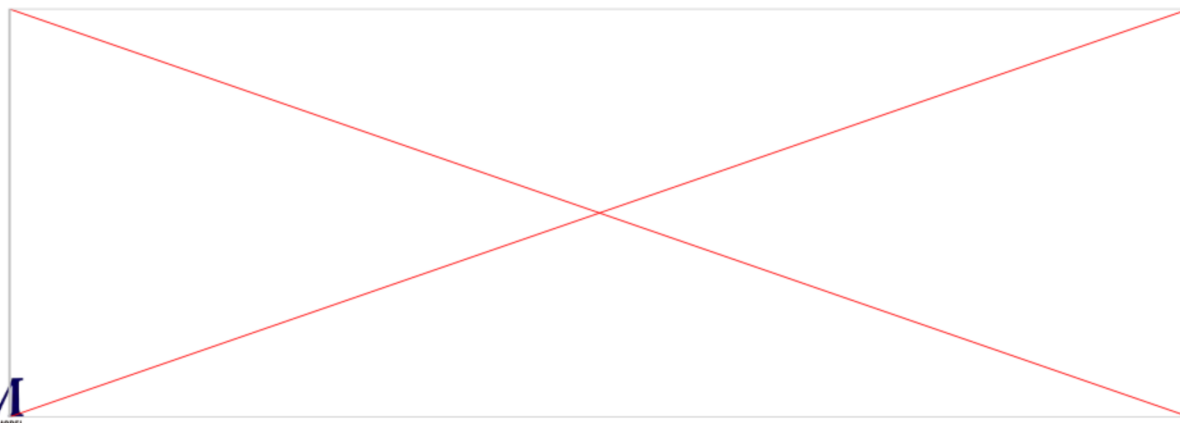


Fig. 1. Residential floor area per capita vs. GDP per capita: data points and fit to data.

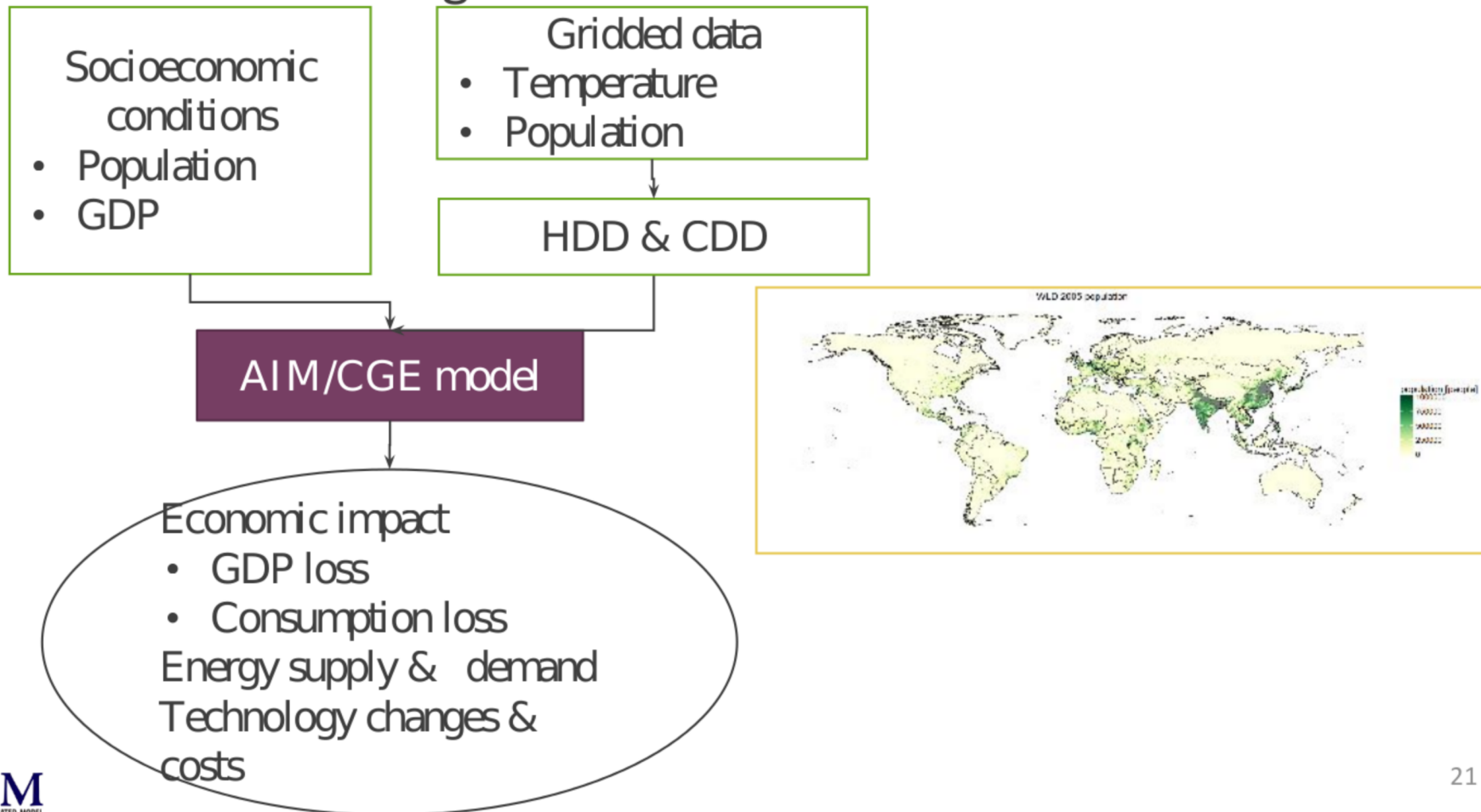
$$\text{Device penetration} = \text{(climate condition)} * \text{(air conditioner availability)}$$



(Isaac and van Vuuren, 2009)

Methodology

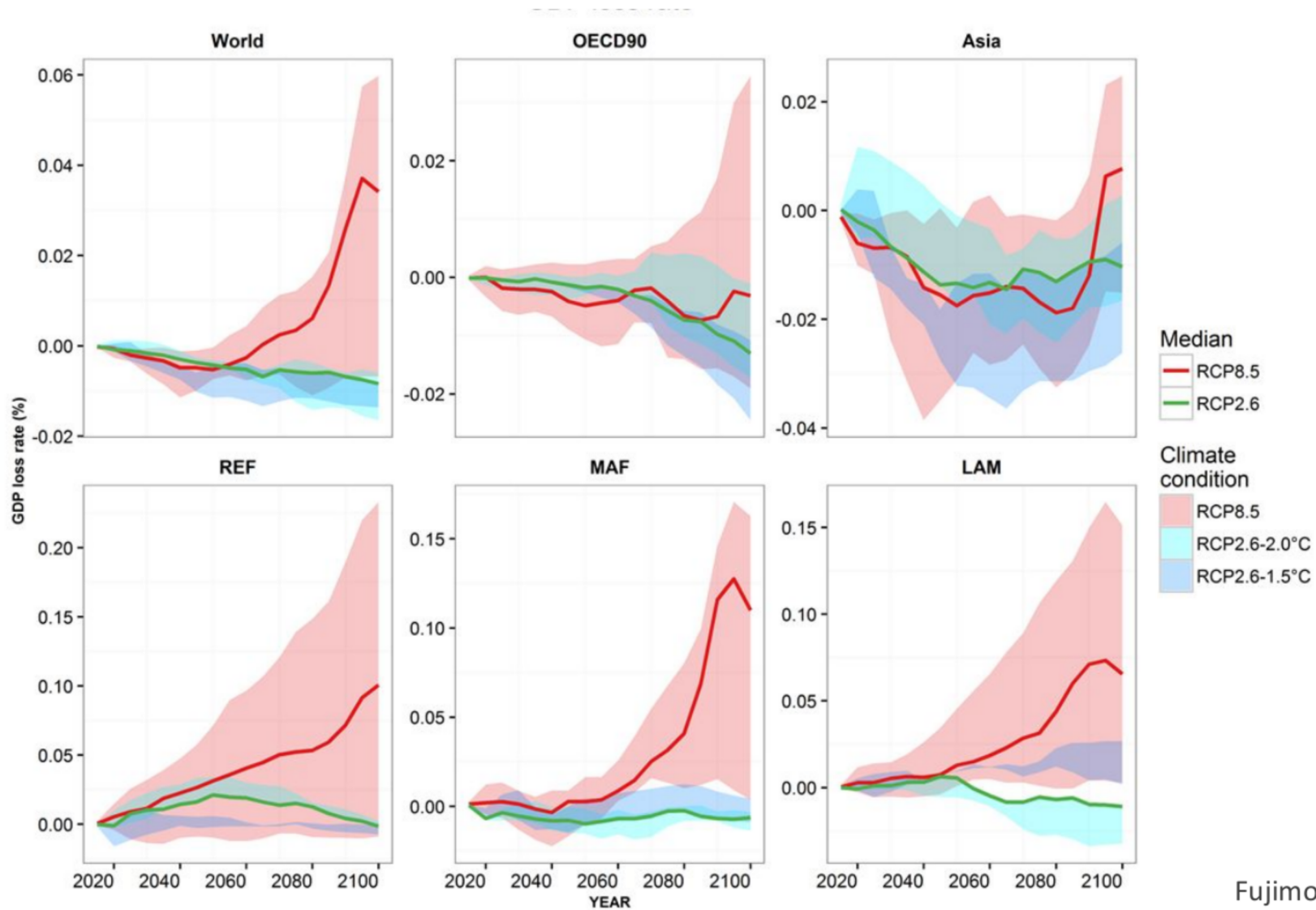
- AIM/CGE coupled with an end-use type model
- In the model, energy demand is changed according HDD&CDD changes.



Crop yield change

S Fujimori, T Iizumi, T Hasegawa, J Takakura, K Takahashi, Y Hijioka,
Macroeconomic impacts of climate change associated with changes in
crop yields, Climatic Change, Under review

Crop yield change effect



Fujimori et al.
(Under review)