

Research on Global Climate Policies in NIES

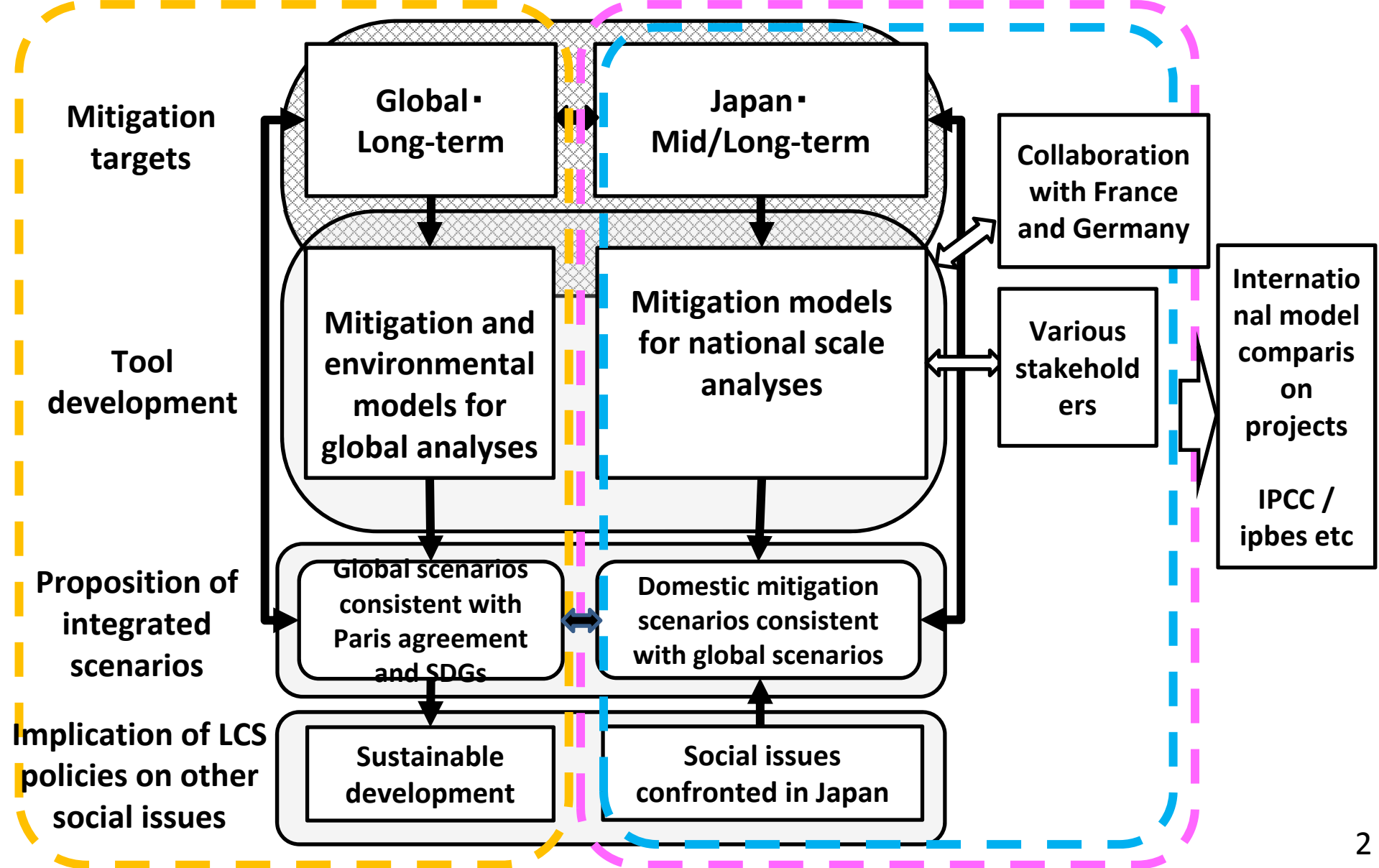
Kiyoshi Takahashi

The 25th AIM workshop @ National Institute for Environmental Studies
20 November 2019

Framework of “Integrated Analyses of Climate Policies for Simultaneous Realization of the Paris Agreement and the SDGs”

Theme1: Global climate policy analyses

Theme2-3: Japanese mitigation policy analyses



持続可能な開発目標

Sustainable Development Goals



トレードオフ関係? 共便益関係?

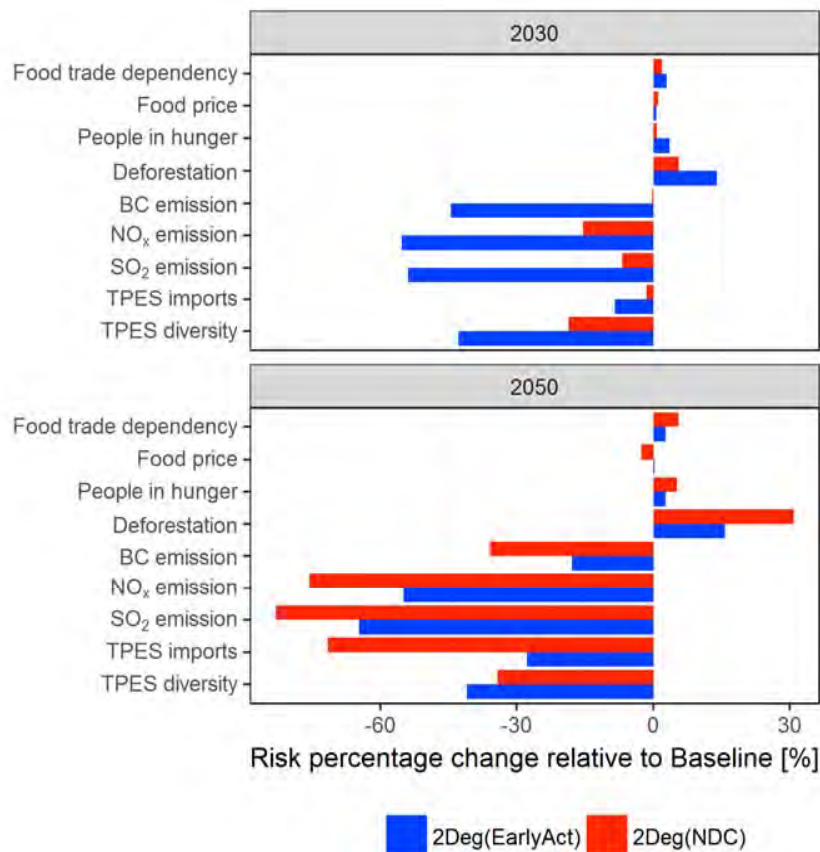
Trade-off? Co-benefit?

中国を対象とした2°C気候政策と複数SDGsの同時達成分析

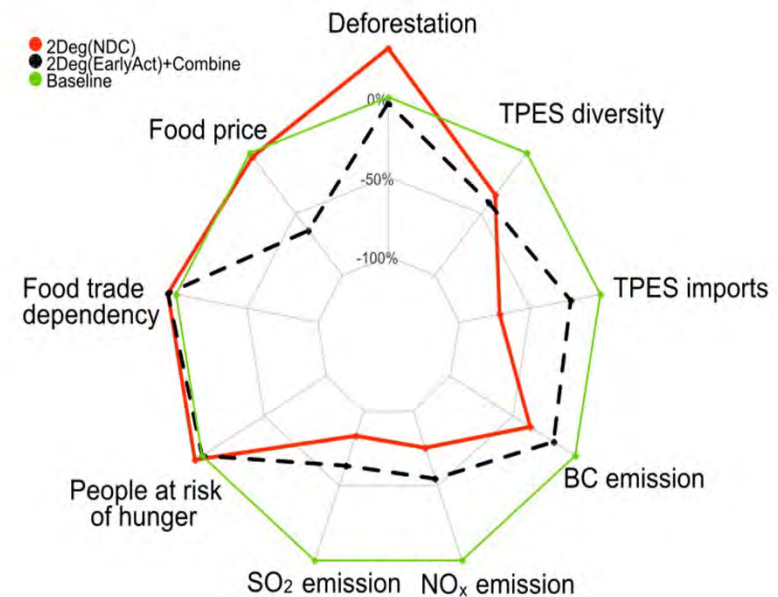
Align climate policies with multiple SDGs in China for the 2 ° C goal



Liu et al.,
Under review



- Early climate action + complementary policy package (food subsidy and forest land rent subsidy) successfully diminished the negative side effects while maintaining the co-benefits.

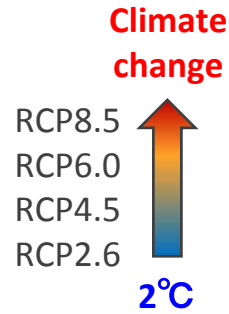
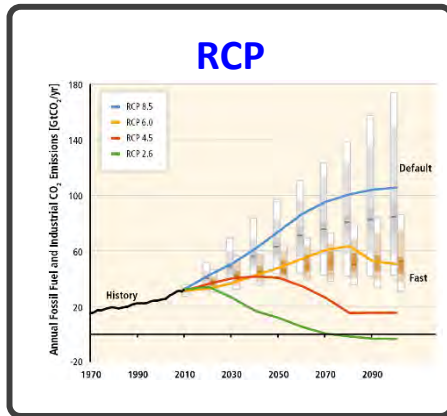


- Energy security and air pollution can have great co-benefits from climate actions
- Food security and land resources experience trade-offs.

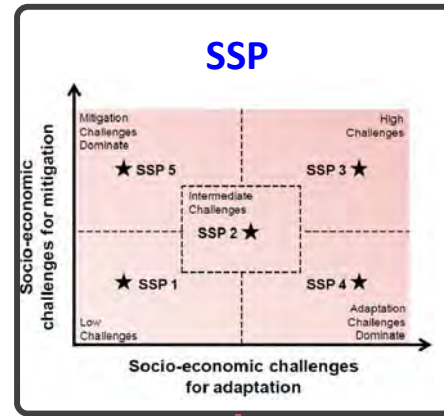
Economic impact of climate change: Research Framework

S-14-5
2015-2019

Emission scenario



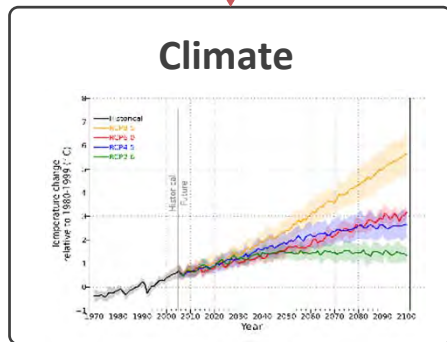
Socioeconomic scenario



- SSP1:** Sustainability
- SSP2:** Middle of the Road
- SSP3:** Regional Rivalry
- SSP4:** Inequality
- SSP5:** Fossil-fueled Development

GHG concentration

Climate model



Gridded population and so on

Crop model

Crop yield

Water model

Water resource

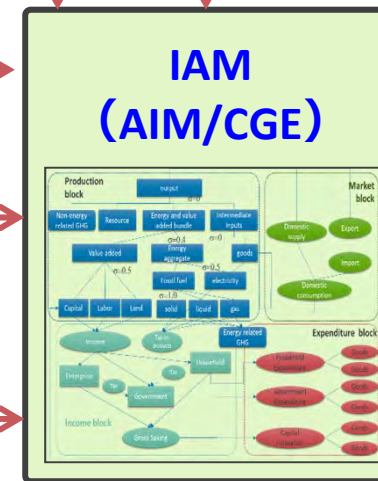
Health model

Number of Death

Climate impact for each sector

GHG emissions constraint

Socioeconomic assumptions



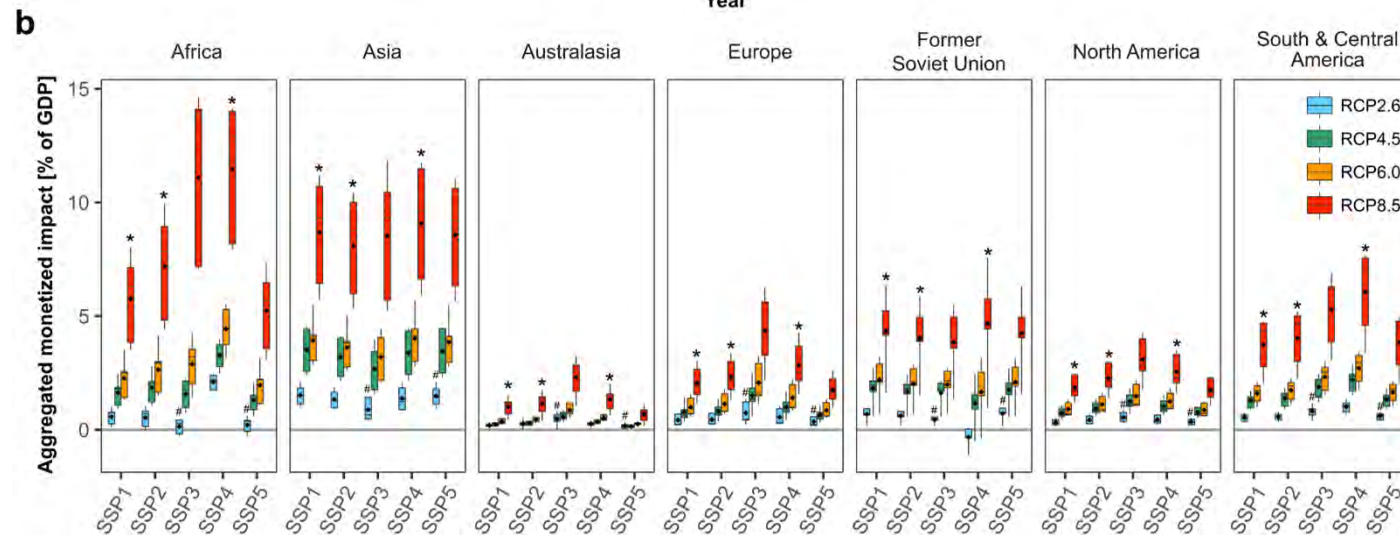
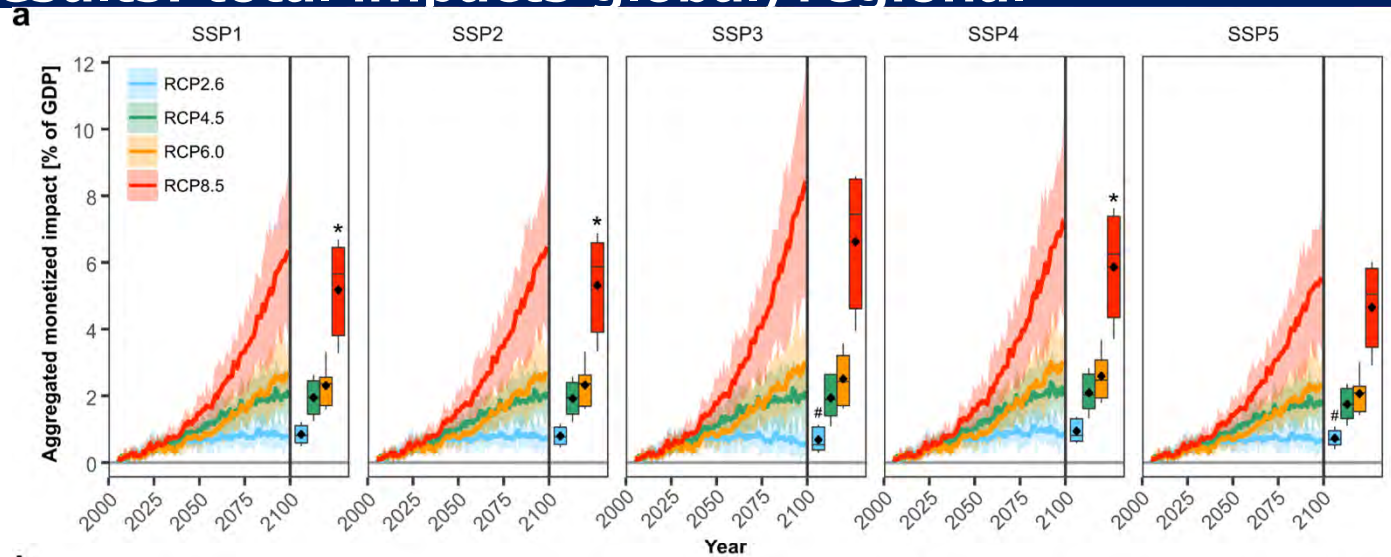
GDP

Total climate loss



Economic impact of climate change: Results: total impacts global/regional

S-14-5
2015-2019



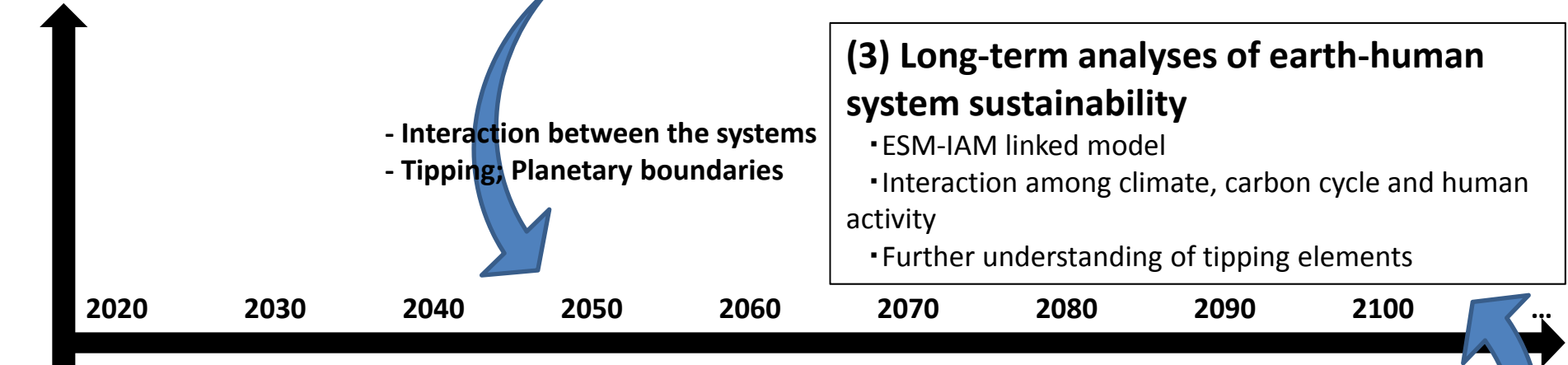
Takakura et al. (2019)
Nature Climate Change

There is a great divergence in the projected economic impact ranging from 0.4% to 8.6% of GWP at the end of the century depending on scenarios.

Global analyses of decarbonization and sustainable development

Proposed
2021-2025

Detailed description
of natural system



- Interaction between the systems
- Tipping; Planetary boundaries

(3) Long-term analyses of earth-human system sustainability

- ESM-IAM linked model
- Interaction among climate, carbon cycle and human activity
- Further understanding of tipping elements

- Long-term socio-economic scenario
- Emission pathways toward the long-term climate target
- Assumed availability of BECCS etc.

(2) Long-term mitigation and SD

- Extended CGE model for SD indicators analyses
- GHG pathways towards the achievement of PA
- Analyses of knock-on effects of mitigation on SD
- Climate risks under the GHG pathways and their implication to equality

(1) Near-/Mid- term mitigation and SD

- Mitigation analyses based on the end-use models
- GHG pathways for 2030- 2050 towards the 2050 target
- Effects of climate policy on SD issues such as air pollution and natural resource management
- Evaluation of NDCs achievements under the PA

- Spatial socio-economic scenarios
- Model modules of CGE/IAM

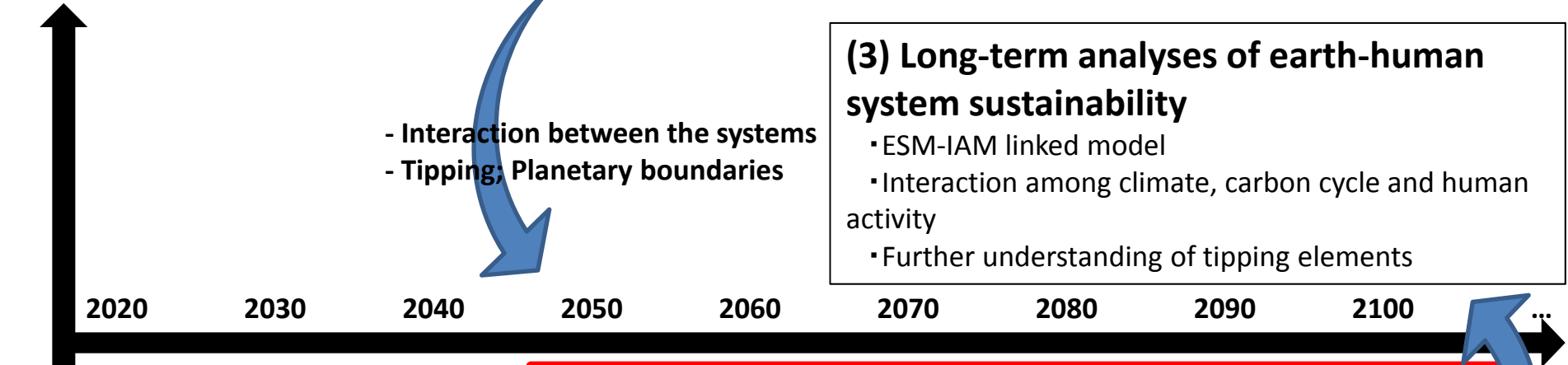
Detailed description
of human system

- Political/technical constraints for the near-term period
- International process of stocktaking

Global analyses of decarbonization and sustainable development

Proposed
2021-2025

Detailed description
of natural system



(3) Long-term analyses of earth-human system sustainability

- ESM-IAM linked model
- Interaction among climate, carbon cycle and human activity
- Further understanding of tipping elements

- Long-term socio-economic scenario
- Emission pathways toward the long-term climate target
- Assumed availability of BECCS etc.

(2) Long-term mitigation and SD

- Extended CGE model for SD indicators analyses
- GHG pathways towards the achievement of PA
- Analyses of knock-on effects of mitigation on SD
- Climate risks under the GHG pathways and their implication to equality

(1) Near-/Mid- term mitigation and SD

- Mitigation analyses based on the end-use models
- GHG pathways for 2030- 2050 towards the 2050 target
- Effects of climate policy on SD issues such as air pollution and natural resource management
- Evaluation of NDCs achievements under the PA

- Spatial socio-economic scenarios
- Model modules of CGE/IAM

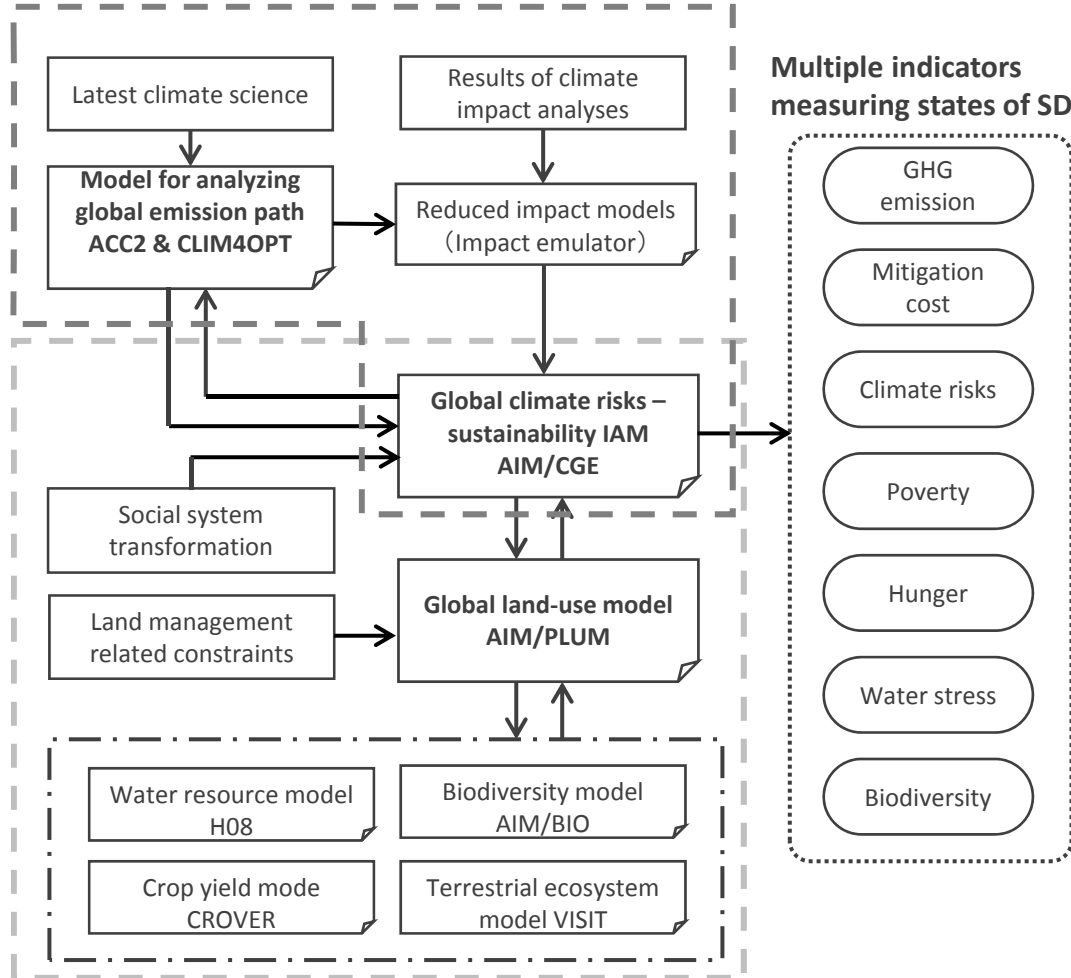
Detailed description
of human system

- Political/technical constraints for the near-term period
- International process of stocktaking

Global analyses of net-zero emission mitigation and its implications for sustainable development

Proposed
2020-2022

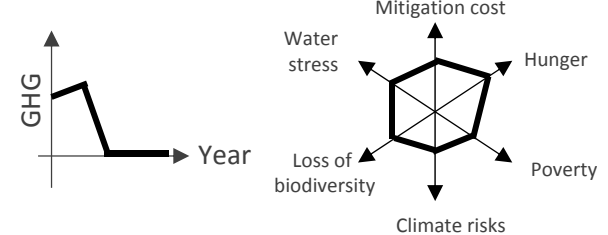
(1) Emission pathways toward long-term climate target and subsequent climate risks



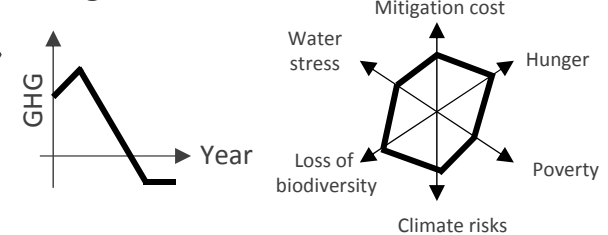
(2) Mitigation strategies considering global sustainability

Integrated scenarios for global sustainability

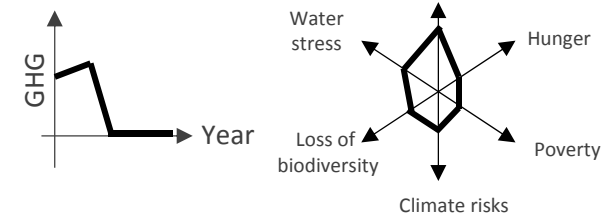
Zero emission



Negative emission



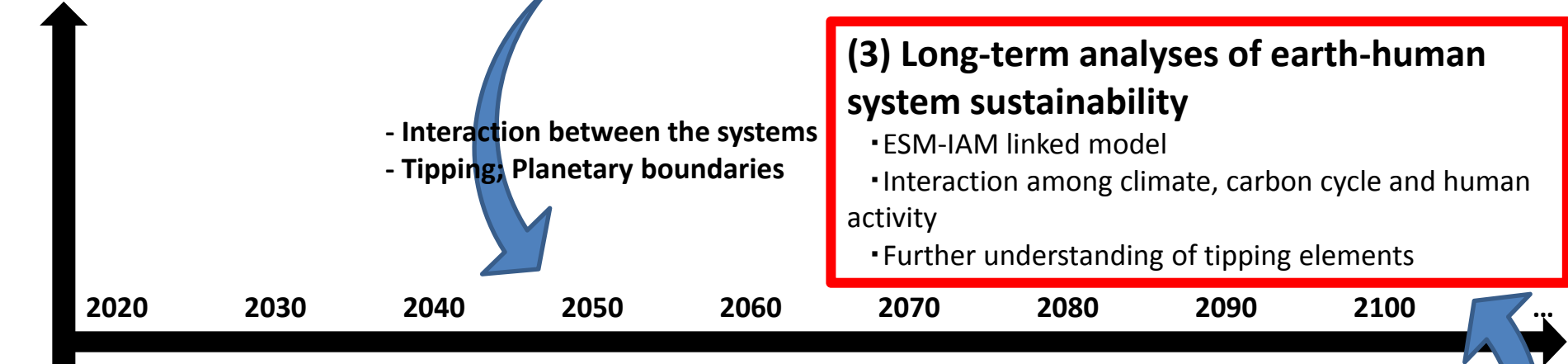
Zero emission + intervention



Global analyses of decarbonization and sustainable development

Proposed
2021-2025

Detailed description
of natural system



- Interaction between the systems
- Tipping; Planetary boundaries

(3) Long-term analyses of earth-human system sustainability

- ESM-IAM linked model
- Interaction among climate, carbon cycle and human activity
- Further understanding of tipping elements

- Long-term socio-economic scenario
- Emission pathways toward the long-term climate target
- Assumed availability of BECCS etc.

(2) Long-term mitigation and SD

- Extended CGE model for SD indicators analyses
- GHG pathways towards the achievement of PA
- Analyses of knock-on effects of mitigation on SD
- Climate risks under the GHG pathways and their implication to equality

(1) Near-/Mid- term mitigation and SD

- Mitigation analyses based on the end-use models
- GHG pathways for 2030- 2050 towards the 2050 target
- Effects of climate policy on SD issues such as air pollution and natural resource management
- Evaluation of NDCs achievements under the PA

- Spatial socio-economic scenarios
- Model modules of CGE/IAM

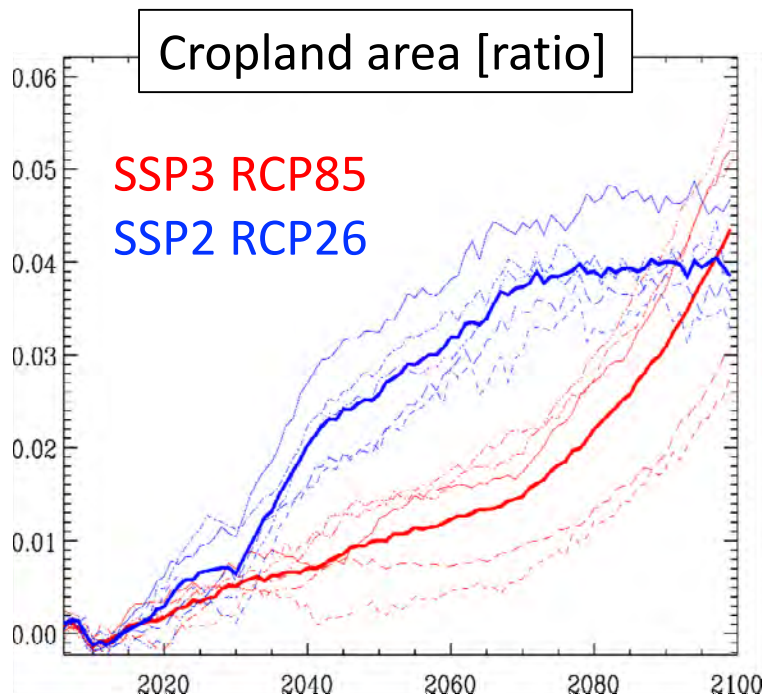
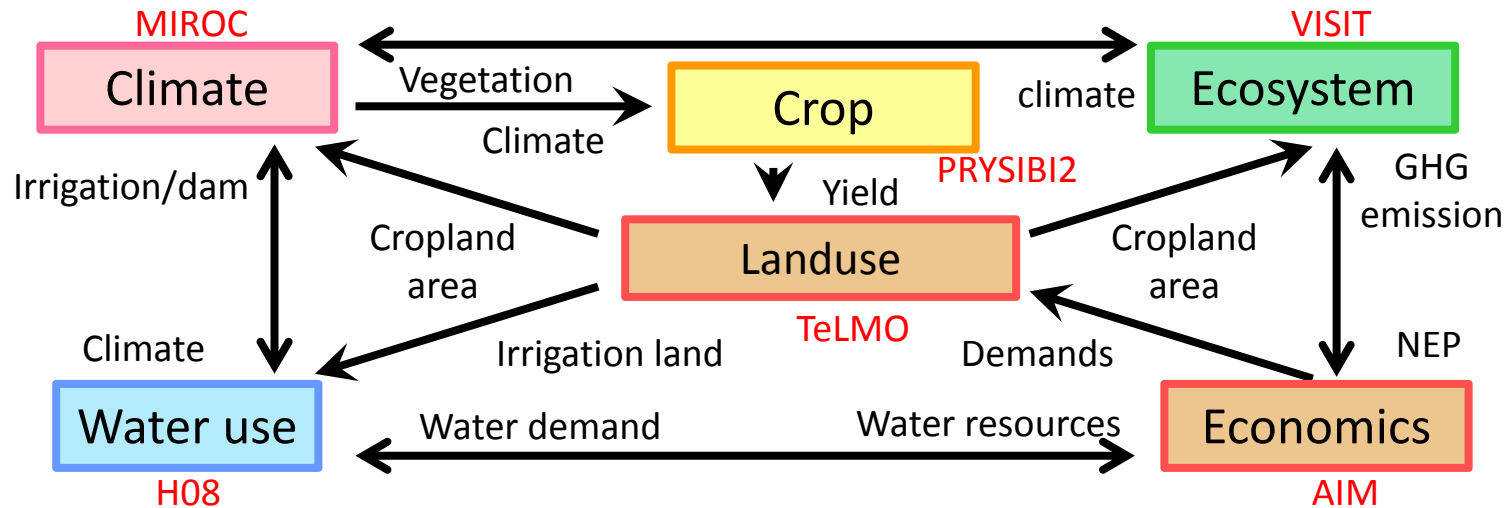
Detailed description
of human system

- Political/technical constraints for the near-term period
- International process of stocktaking

Modelling of interaction in earth-human systems

Ongoing
2016-2020

MIROC-INTEG (integrated terrestrial model), Yokohata et al. 2019 (Geosci Model Dev, in review)



- State-of-the-art GCM is coupled to human process models (water, crop, land use)
- Climate change -> impacts on water, food, energy -> land use change -> climate change
- Large future demands (SSP3) -> large impacts on water resources and land use
- Coupling of ESM – IAM to investigate the interactions of earth-human systems (contributing to AIMES project in Future Earth)