Climate Change Impacts, Food System, and Biodiversity in AIM Global Modeling

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AIM model development and applications

- **National Land-based Climate Mitigation Scenario Dataset (Hasegawa et al.)**

- Biodiversity impacts of afforestation and reforestation (Wijenayake et al.)

Multi-model intercomparisons (AgMIP-GlobEcon)

- Mitigation, ozone reduction co-benefit and food security (Xia et al.)

Dataset of AFOLU mitigation pathways released July 2025

www.nature.com/scientificdata

scientific **data**

OPEN

DATA DESCRIPTOR

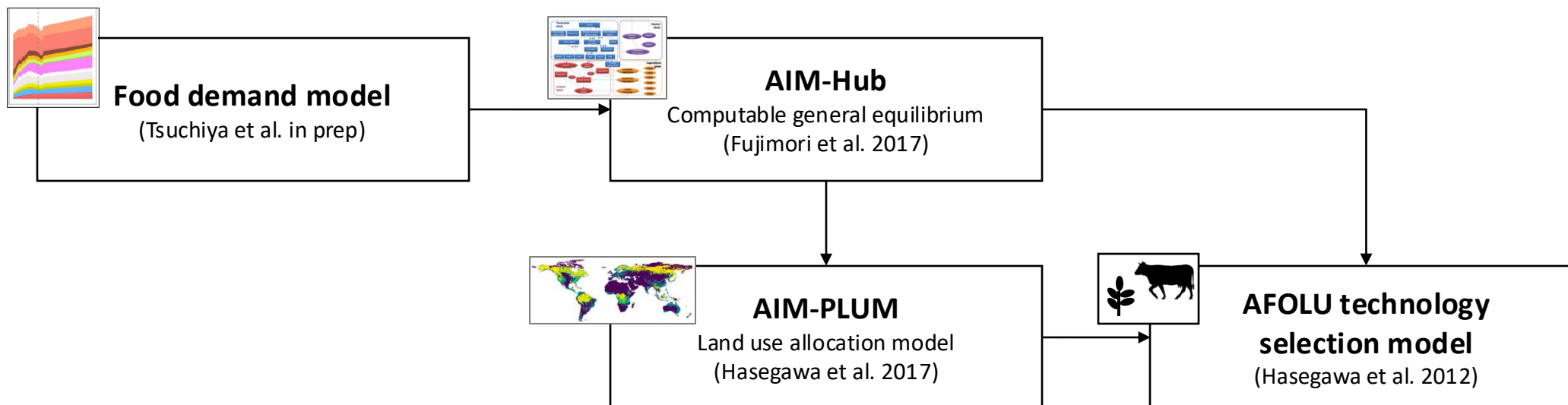## National Land-based Climate Mitigation Scenarios Dataset

Tomoko Hasegawa [1,2,3], Shinichiro Fujimori [2,3,4], Kazuaki Tsuchiya [3], Akihiko Ito [5] & Kiyoshi Takahashi [3]
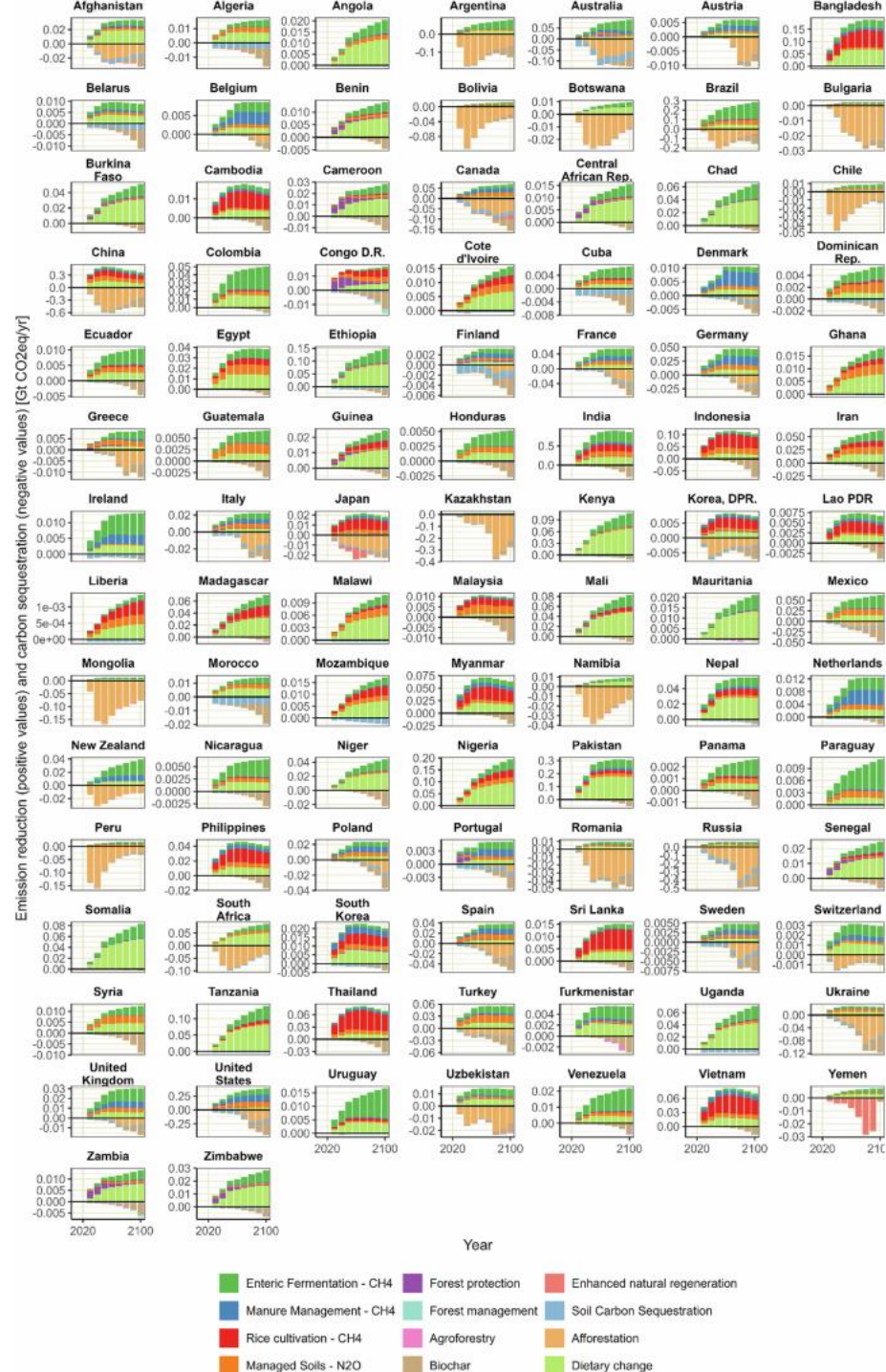
Given the need to reduce greenhouse gases emissions to meet the 2 °C or 1.5 °C target of the Paris Agreement, over 150 countries currently have net-zero targets. National inventories and projections of land-based emissions and mitigation strategies have not been well developed and remain limited compared to energy sectors. Here, we provide worldwide national land-based emission and mitigation scenario data with a detailed portfolio of mitigation options. This information contributes to filling the gap between integrated assessment model estimates and national greenhouse gas inventories for land-based emissions through estimation of carbon sequestration in managed forests. Second, these data can be used as a benchmark for countries developing national targets or strategies for agriculture, forestry, and other land use sectors as well as for reviewing national contributions in global assessments in a manner consistent with integrated assessment model estimates.

- Country-level information of AFOLU sector mitigation is limited

- We provided 2℃ / 1.5℃ mitigation scenarios up to 2100 for the AFOLU sector of 187 countries

- Scenario data available for download

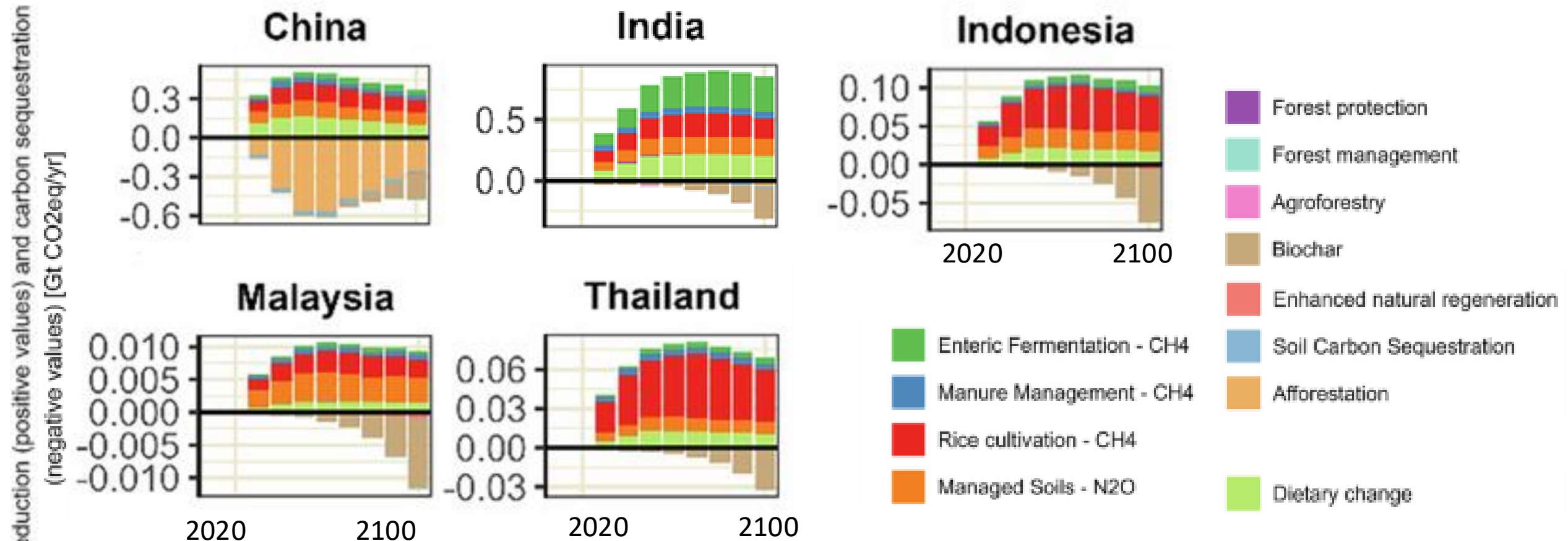Hasegawa et al., 2025

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AIM model framework

Food demand model
(Tsuchiya et al. in prep)

AIM-Hub
Computable general equilibrium
(Fujimori et al. 2017)

AIM-PLUM
Land use allocation model
(Hasegawa et al. 2017)

AFOLU technology selection model
(Hasegawa et al. 2012)

Mitigation potential in selected top 100 emitting countries with breakdown by mitigation options for the 1.5-deg scenario

Hasegawa et al., 2025

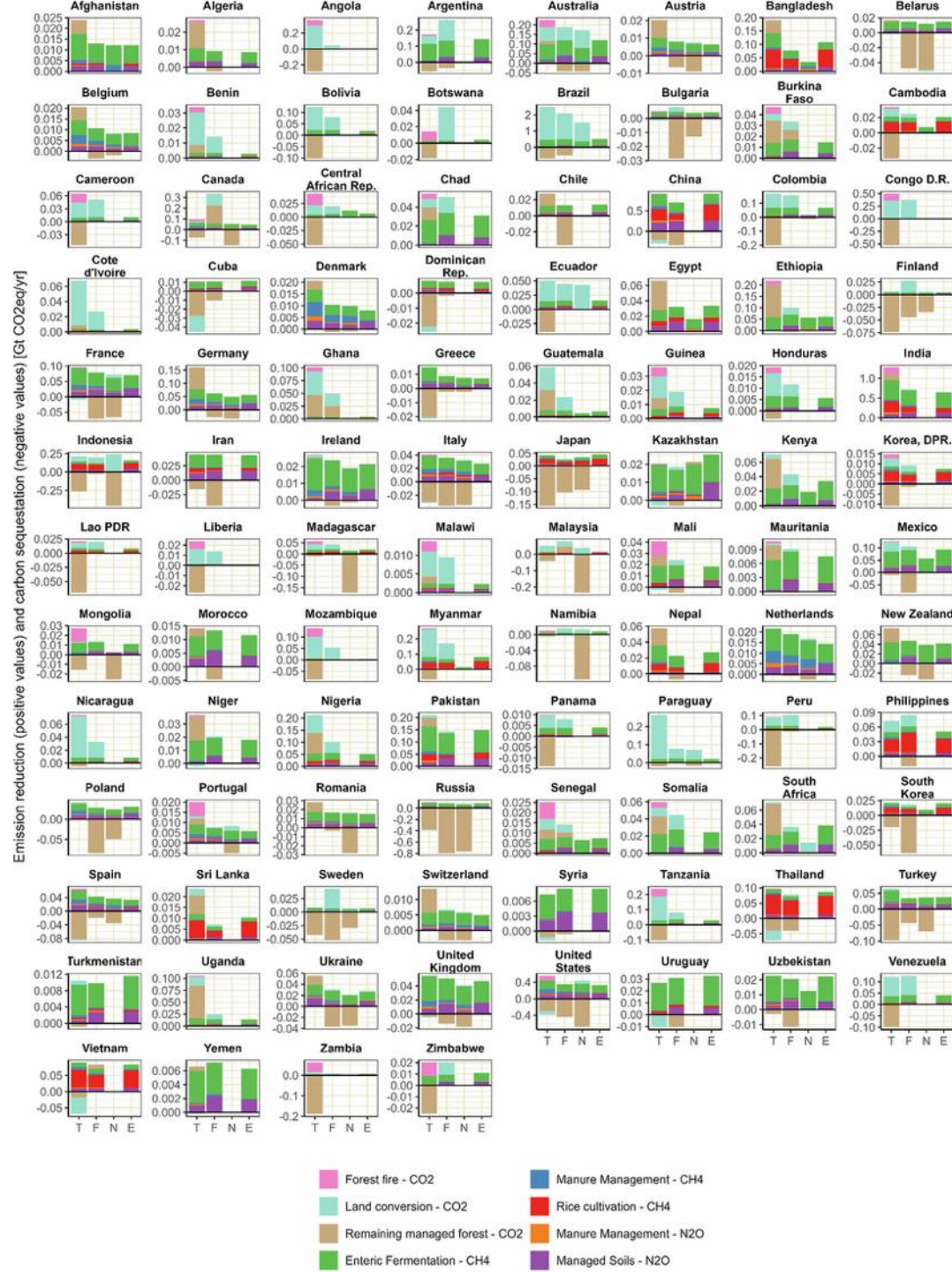**AFOLU mitigation potential for selected countries.**
Positive values: GHG emission reduction
Negative values: carbon sequestration

Hasegawa et al., 2025

Comparison of base-year GHG emissions of this dataset (T) with data from FAOSTAT (F), NGHGI (N), and EDGAR (E)

Hasegawa et al., 2025

Legend:
- Forest fire - CO2
- Land conversion - CO2
- Remaining managed forest - CO2
- Enteric Fermentation - CH4
- Manure Management - CH4
- Rice cultivation - CH4
- Manure Management - N2O
- Managed Soils - N2O

National AFOLU scenario database

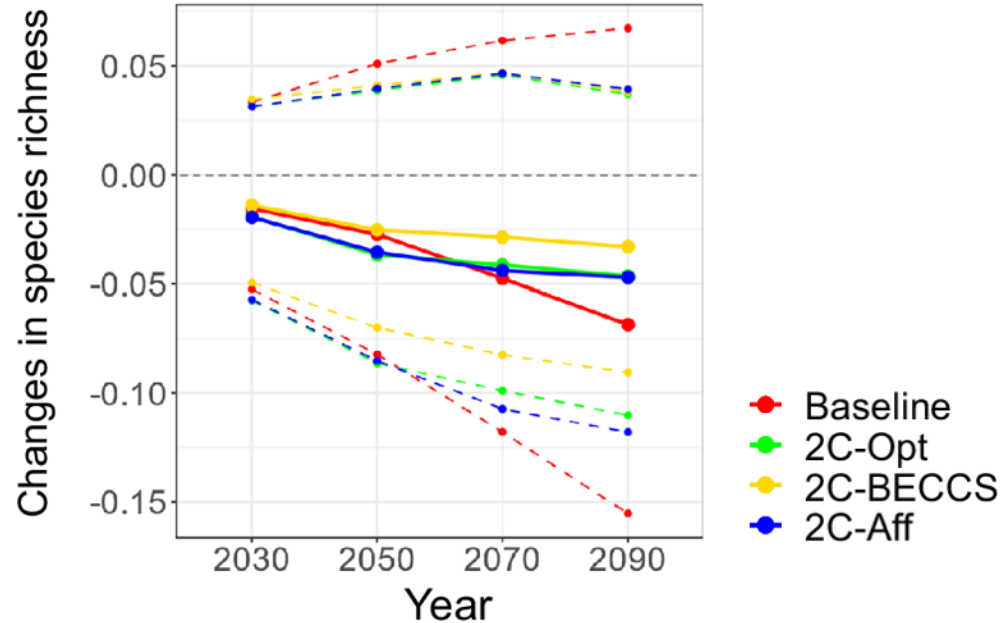# AIM's team activities on land use, biodiversity, and climate change impacts

AIM model development and applications

- National Land-based Climate Mitigation Scenario Dataset (Hasegawa et al.)
- **Biodiversity impacts of afforestation and reforestation (Wijenayake et al.)**
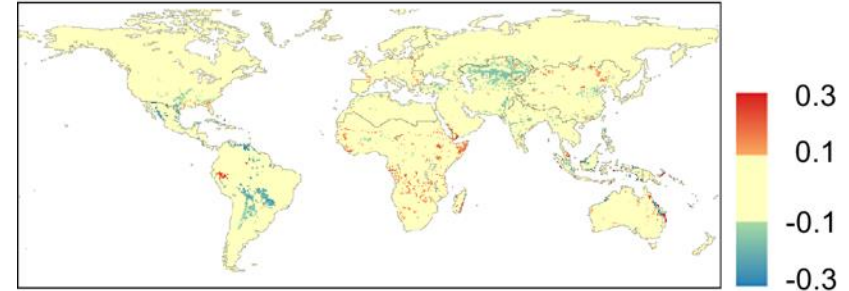
Multi-model intercomparisons (AgMIP-GlobEcon)

- Mitigation, ozone reduction co-benefit and food security (Xia et al.)

Impacts of afforestation and reforestation on biodiversity can be positive or negative
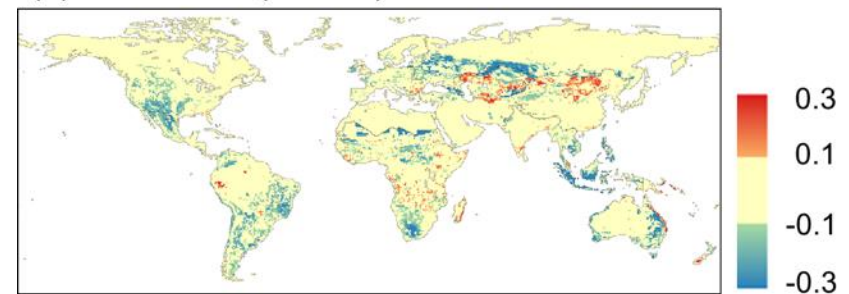

Impacts of land use change on species richness in 2090, compared to baseline
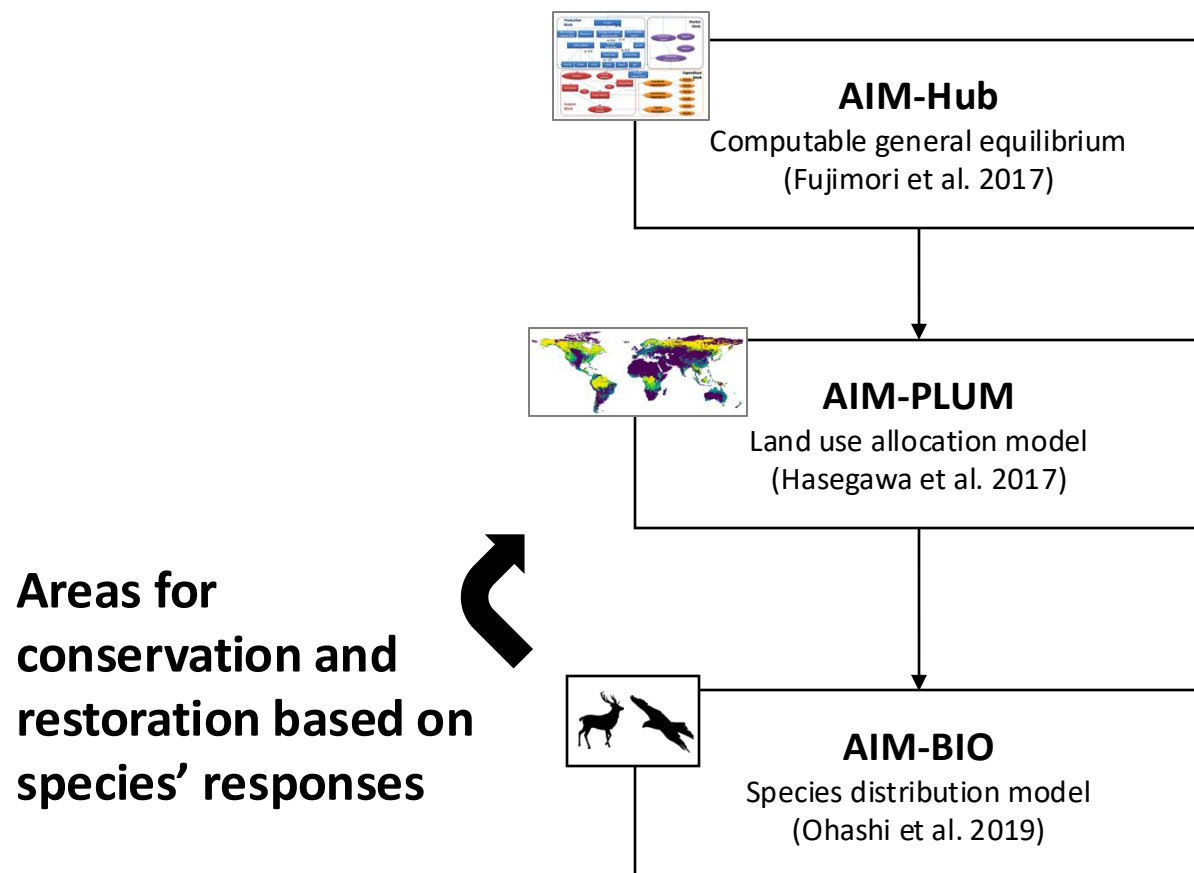

Impacts of land use change on species richness in 2090, compared to baseline

Hirata et al., 2024

We introduced a novel approach for assessing the strategic potential of afforestation and reforestation using a species distribution model framework that considers both favorable and unfavorable effects on species in a forest landscape

AIM model framework

AIM-Hub
Computable general equilibrium
(Fujimori et al. 2017)

AIM-PLUM
Land use allocation model
(Hasegawa et al. 2017)

AIM-BIO
Species distribution model
(Ohashi et al. 2019)

Areas for conservation and restoration based on species' responses

# AIM's team activities on land use, biodiversity, and climate change impacts

AIM model development and applications

- National Land-based Climate Mitigation Scenario Dataset (Hasegawa et al.)

- Biodiversity impacts of afforestation and reforestation (Wijenayake et al.)

Multi-model intercomparisons (AgMIP-GlobEcon)

- **Mitigation, ozone reduction co-benefit and food security (Xia et al.)**

Ozone reduction co-benefits of mitigation efforts for food security?

Hasegawa et al., 2018
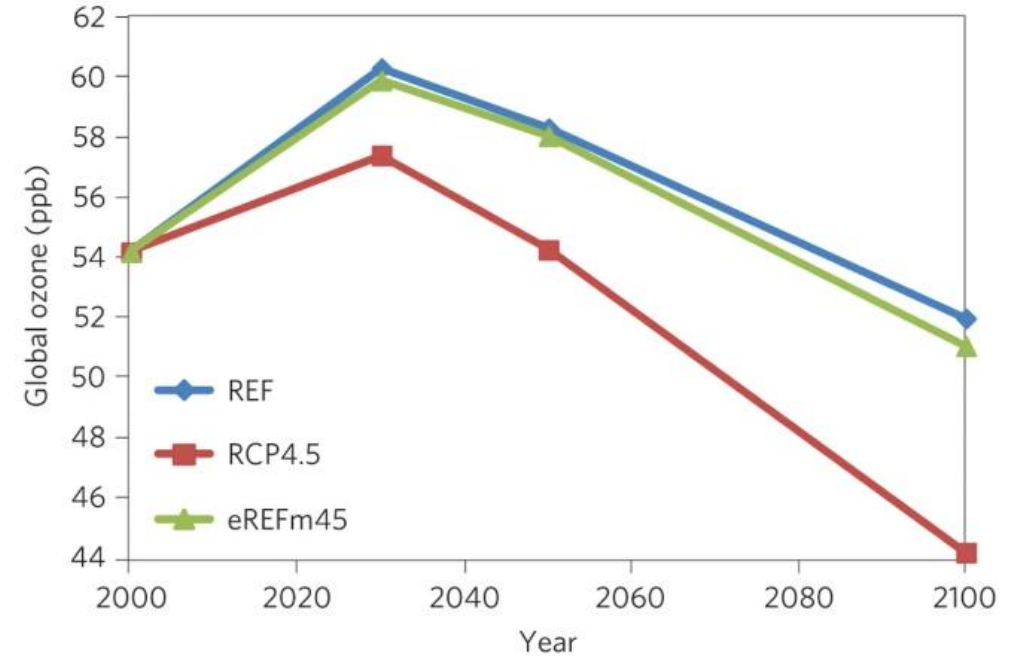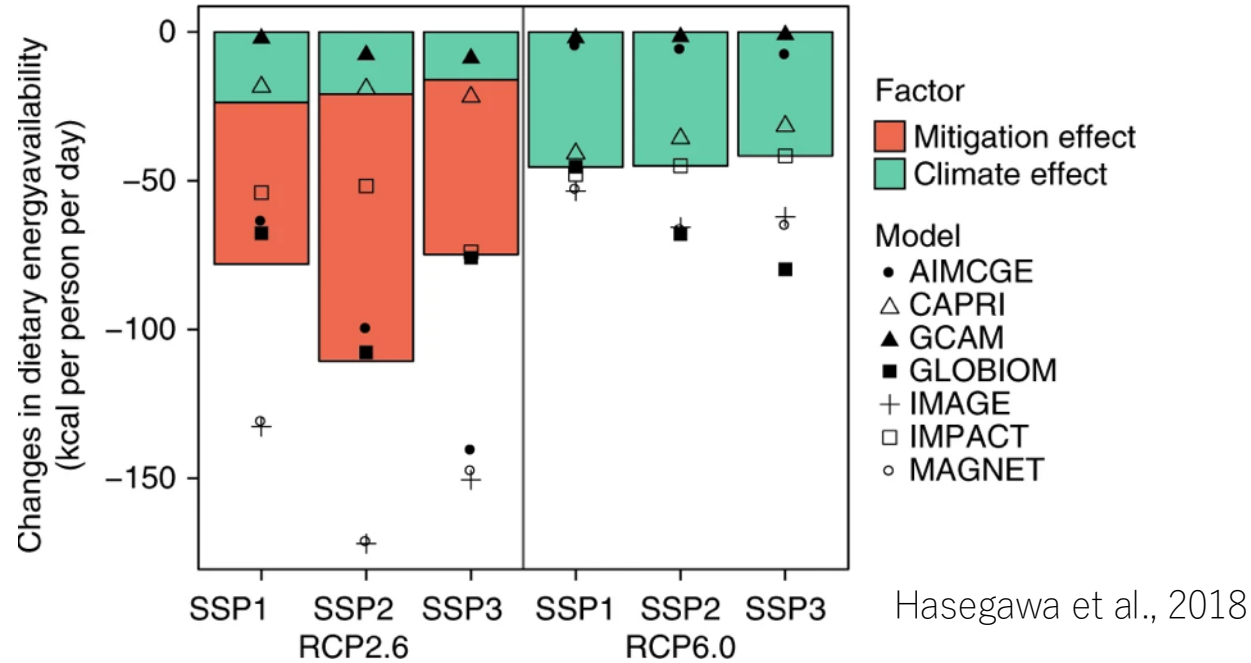
Climate change impact reduces food availability, but climate change mitigation efforts may also threaten food security

Mitigation measures to reduce GHG emissions often lower co-emitted air pollutants, which in turn reduce surface ozone concentration

The co-benefit of ozone reduction could boost crop yield and improve food security but has been overlooked in previous assessments:

(1) If ozone reduction is considered, how will it affect food prices and food security?
(2) Could this co-benefit offset the negative impacts of mitigation?