Structure of Model for the APEIS Project

Yuzuru Matsuoka
Kyoto University, Japan

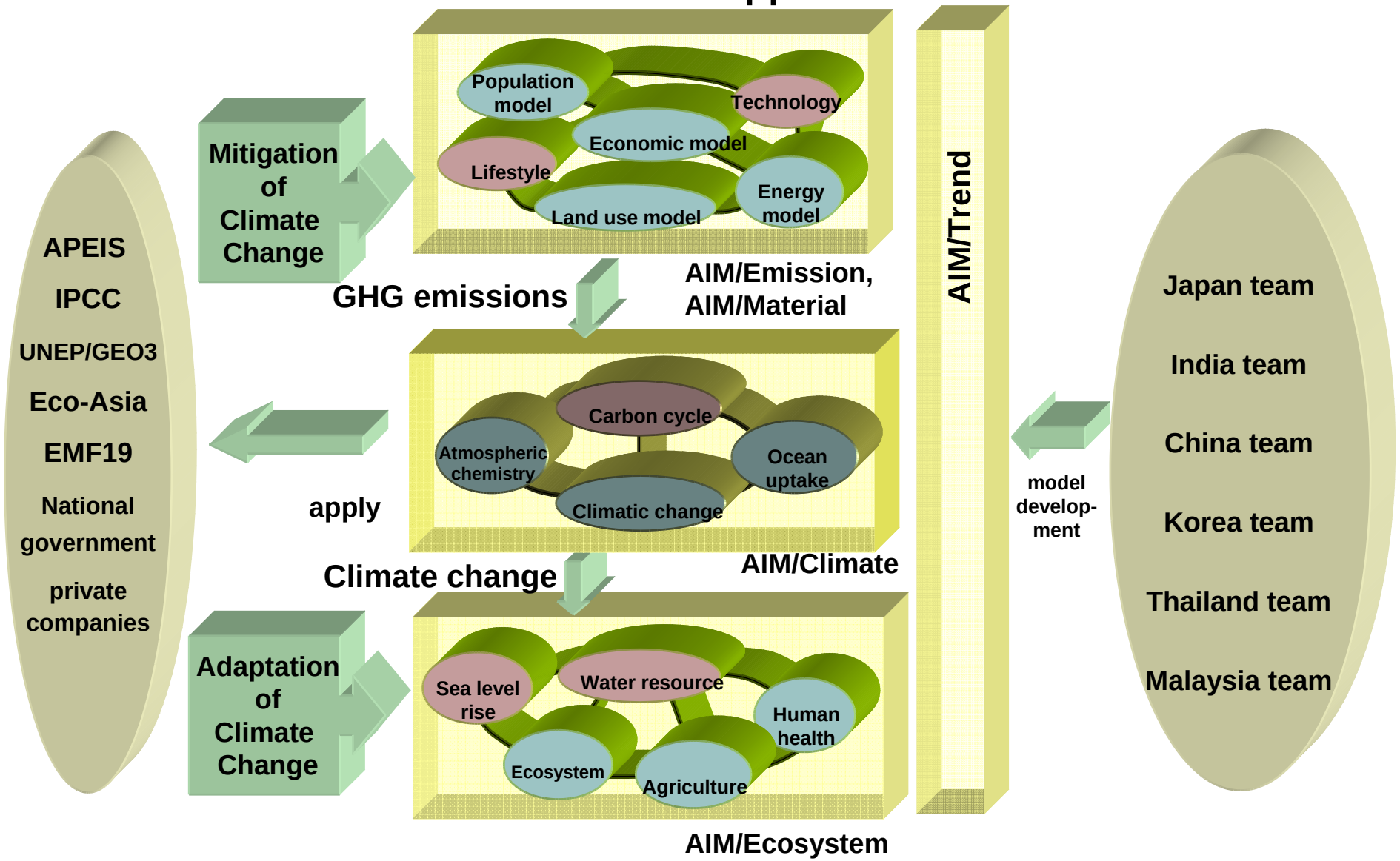
1. **Brief introduction of the AIM**
2. **Models used for APEIS Project**
3. **AIM/Emission, Ecosystem, Material and AIM/Trend**

The Asia-Pacific Integrated Model

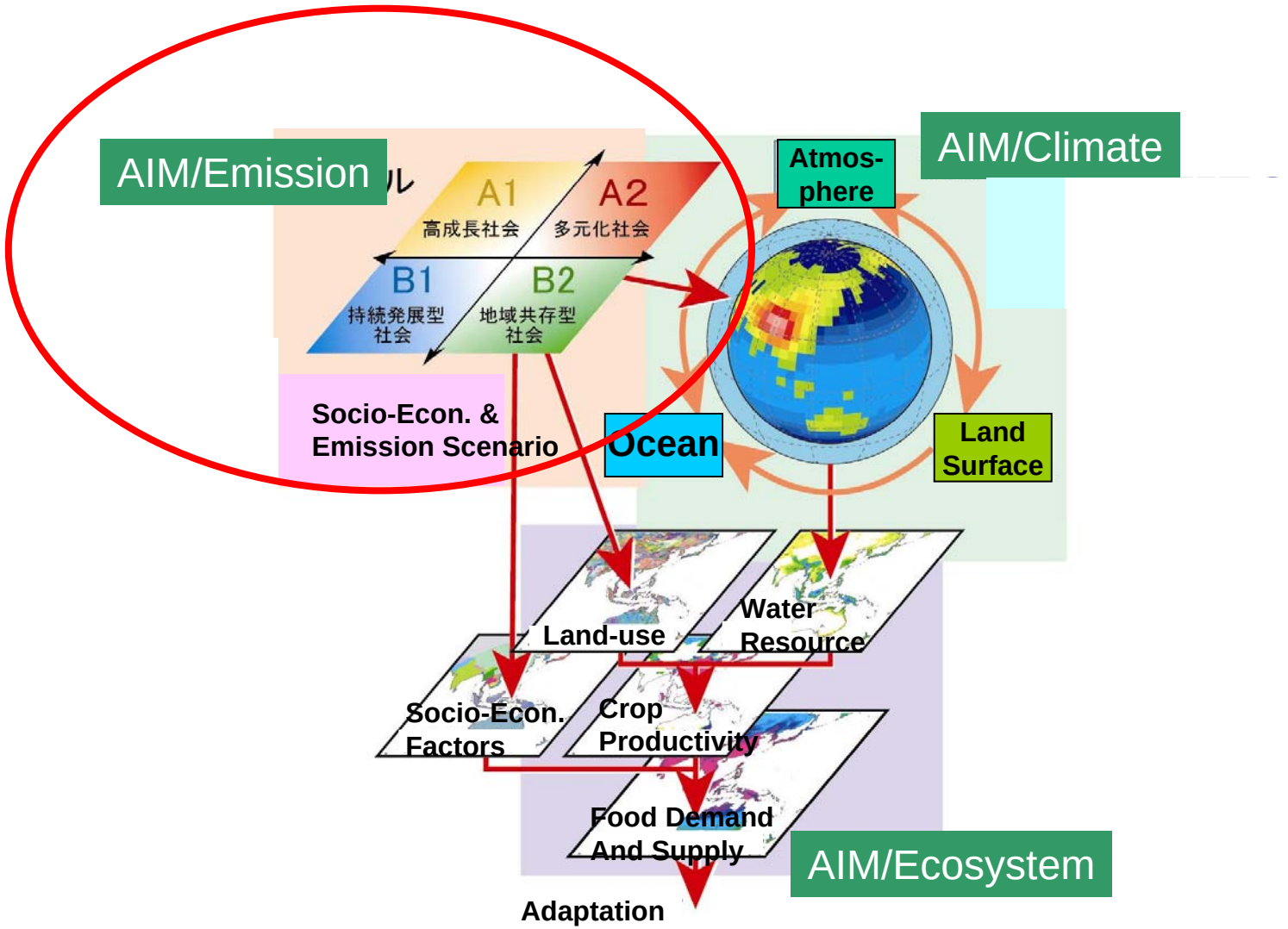
- **AIM is an abbreviation of Asia-Pacific Integrated Model.**
- **It is one of Integrated Assessment Models (*IAM*), and a large-scale computer simulation model developed to promote the integrated assessment process in the Asia-Pacific region**
- **Collaborated study by Japan, China, India , Korea, Thailand and Malaysia members.**
- **The AIM project is started in July 1990, and began an international collaboration system from 1994.**

Integrated Assessment Model of Climate Change:

The AIM Approach



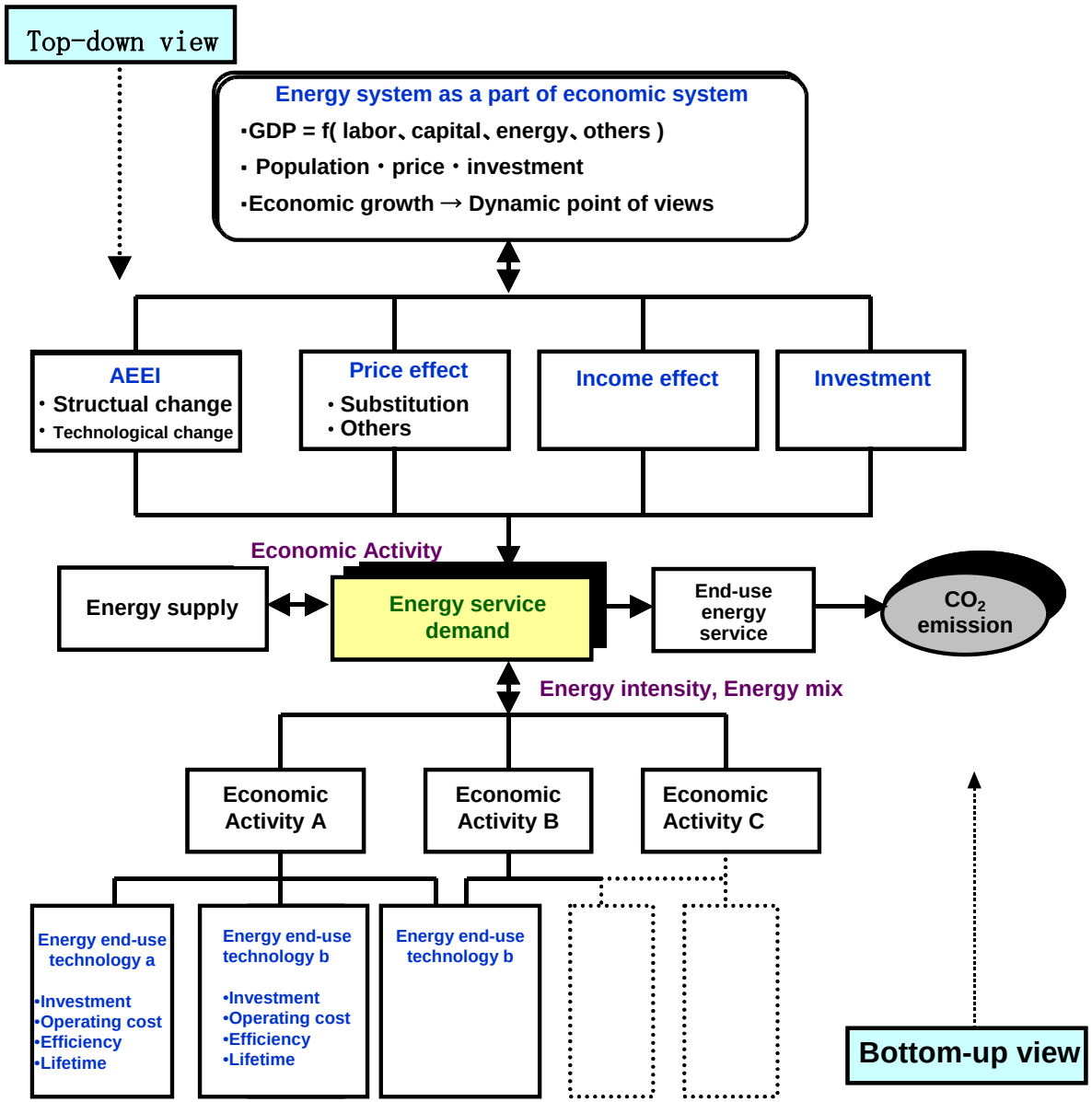
Linkages of AIM models



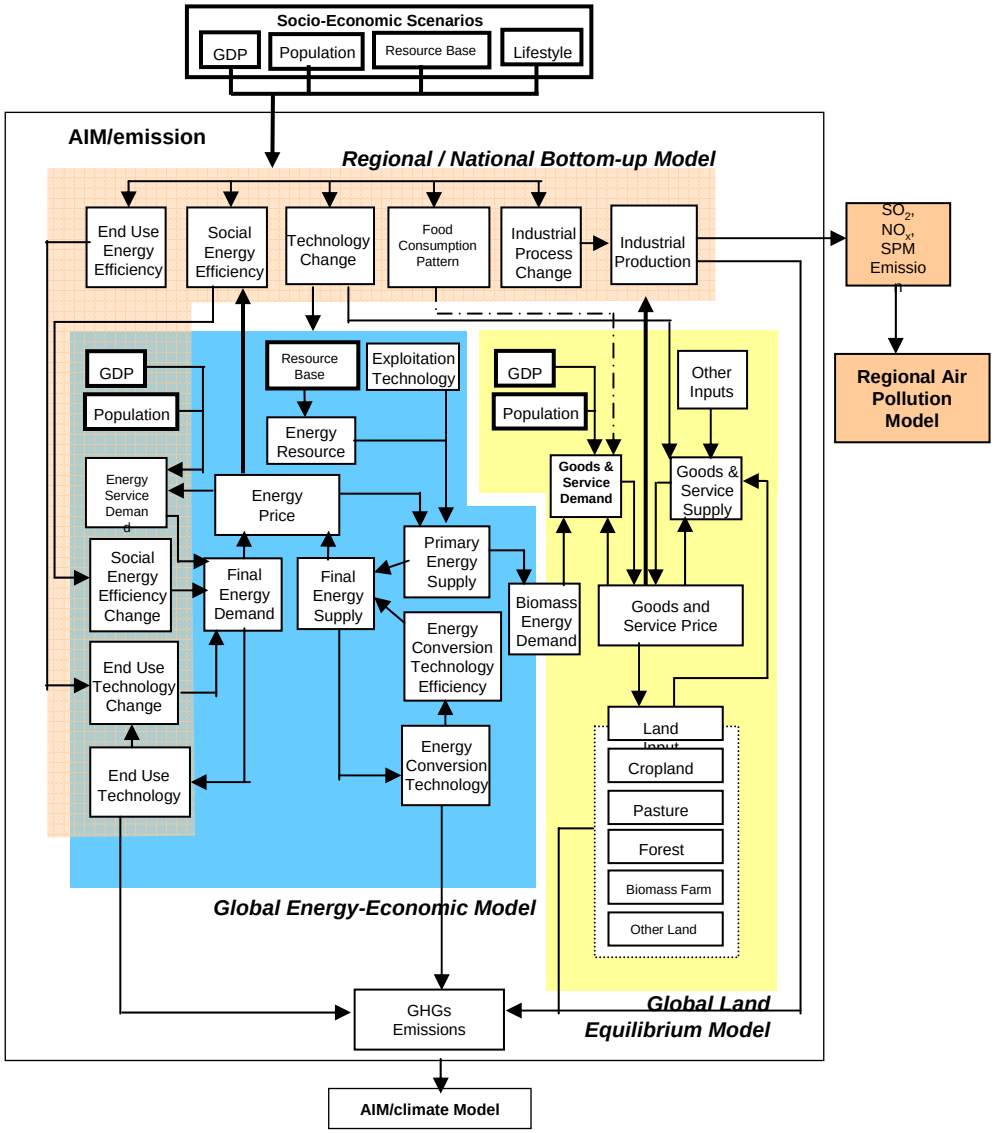
AIM/Emission
Bottom-up and Top-down

- **The AIM/Emission has two types of models, i.e. Bottom-up type energy models and Top-down type energy models.**
- **Bottom-up type energy models : Energy demand is calculated by multiplying energy service and energy efficiency. Energy efficiency is calculated with the diffusion of new technologies, and energy prices. Within the model, recruit processes of energy technologies, choice and operation of energy devices are described in detail.**

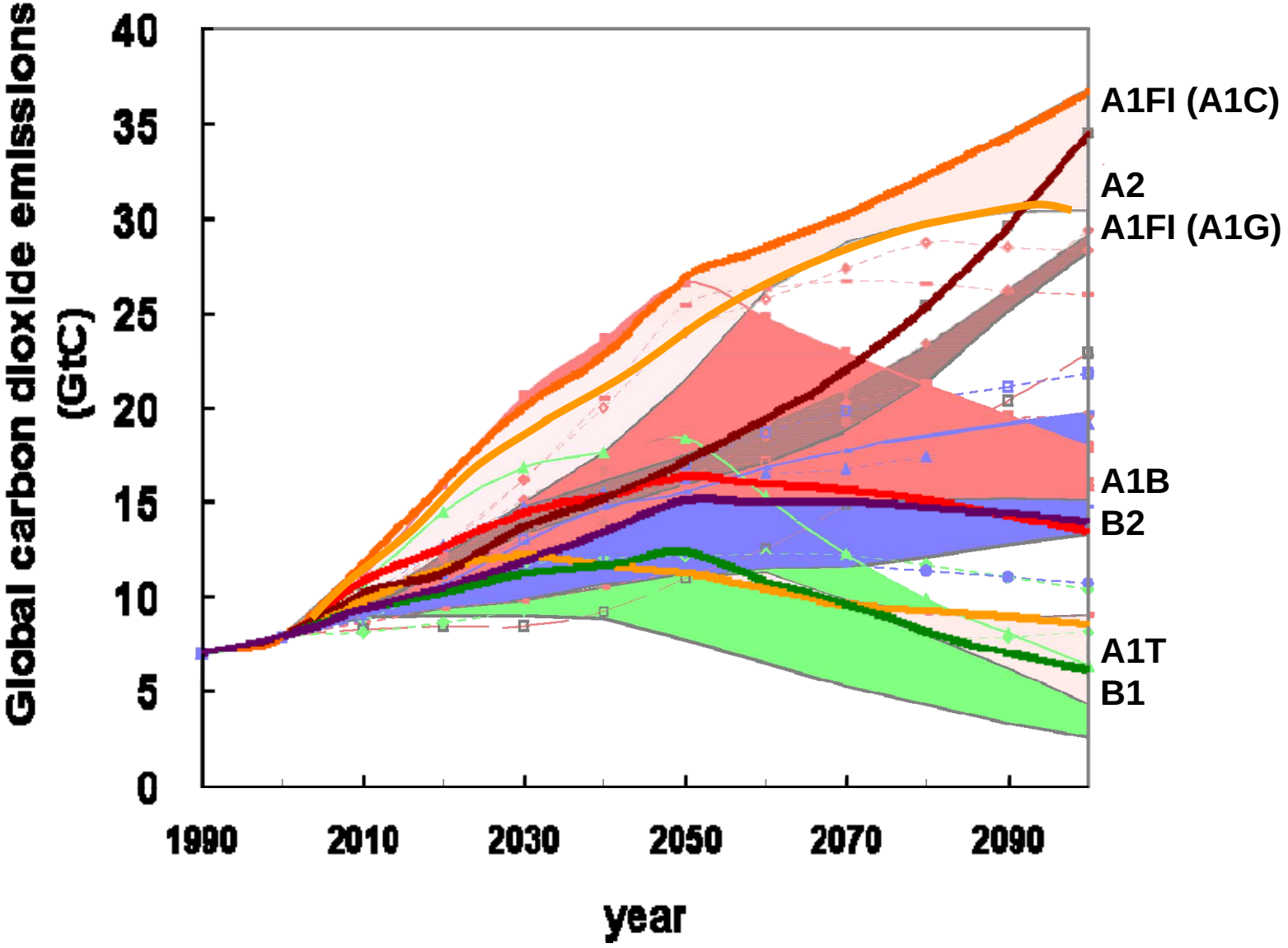
Top-down and Bottom-up Energy models in AIM Family



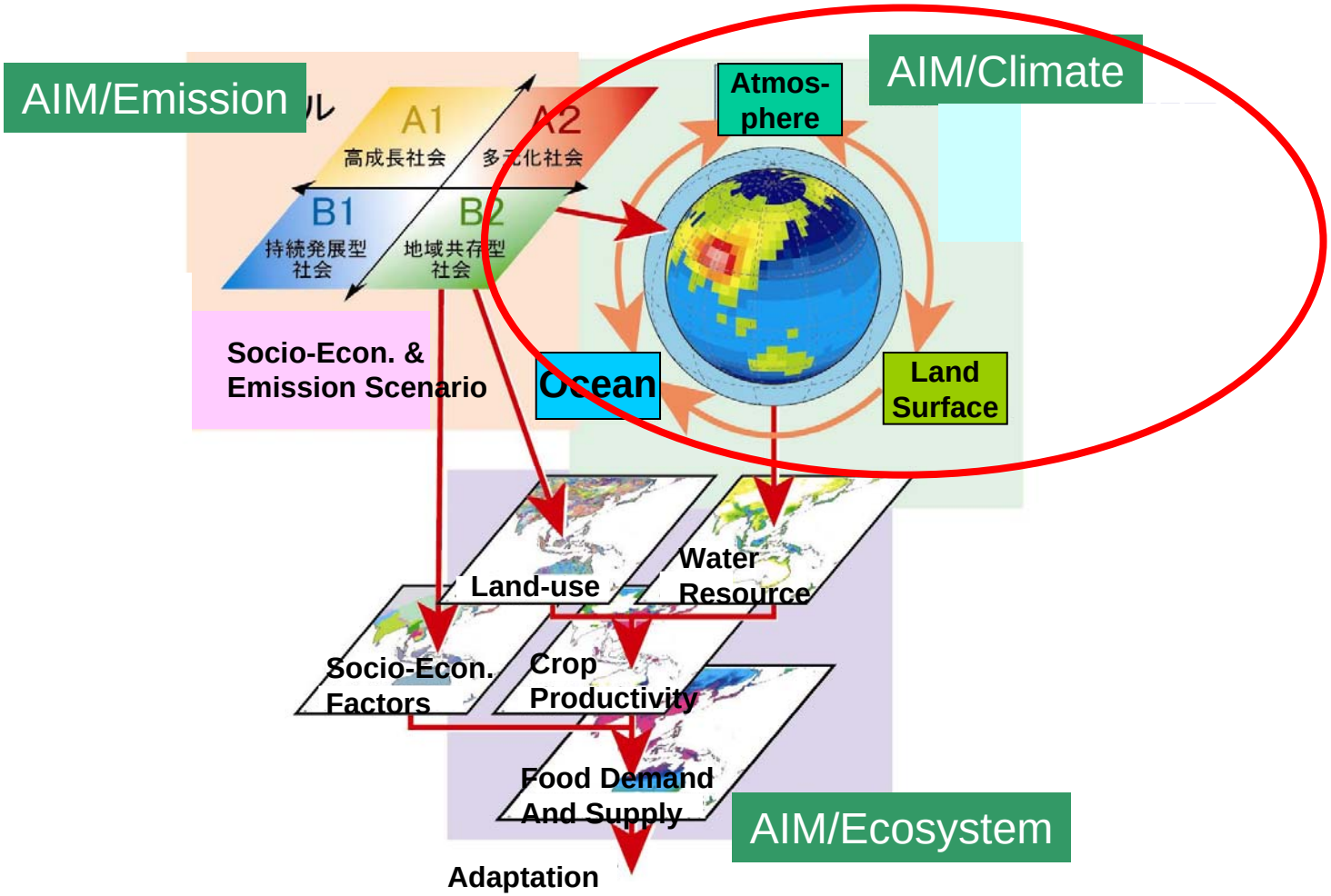
AIM/Emission
- Coupling of models -



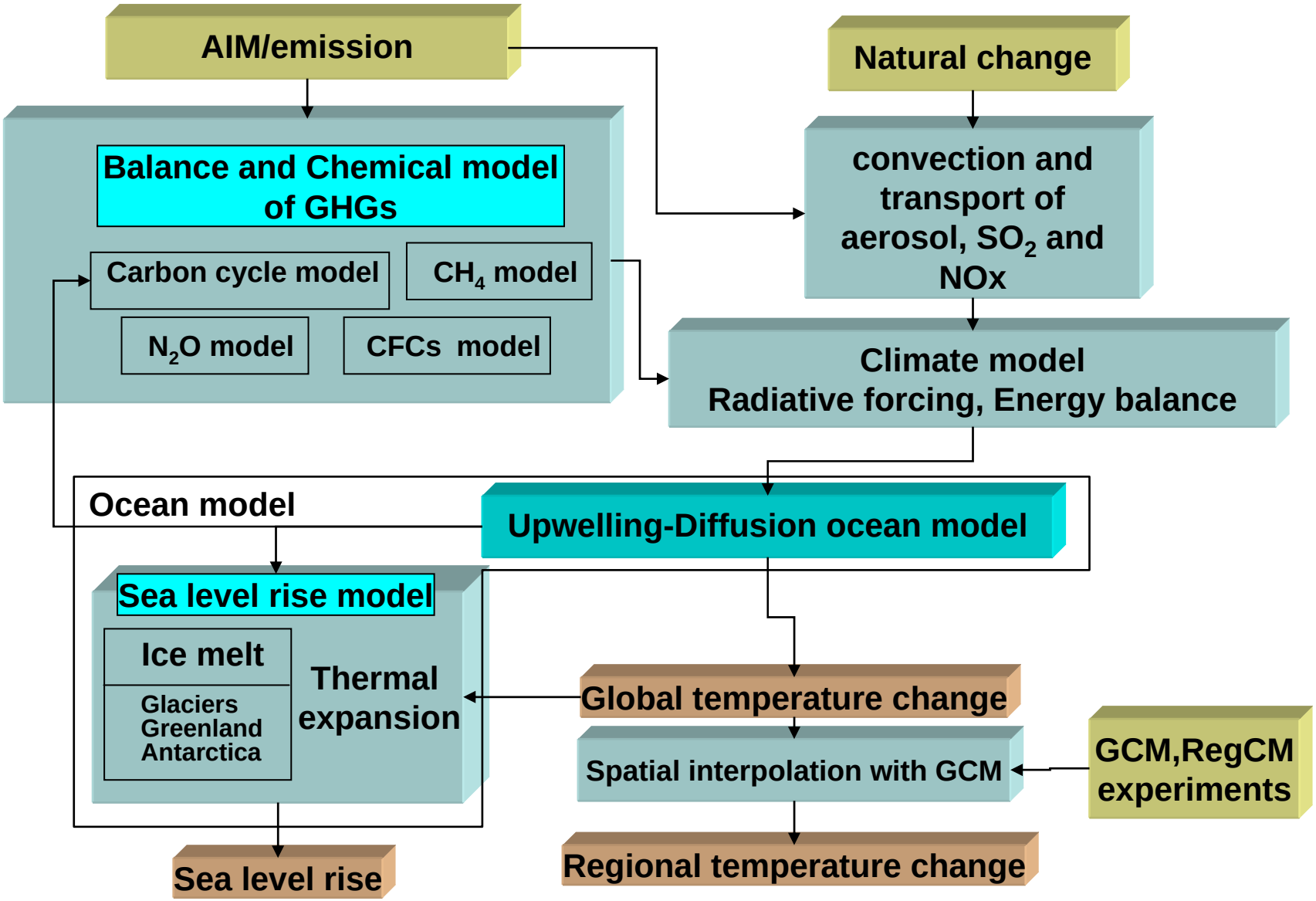
CO_2 Emission Scenarios



Linkages of AIM models

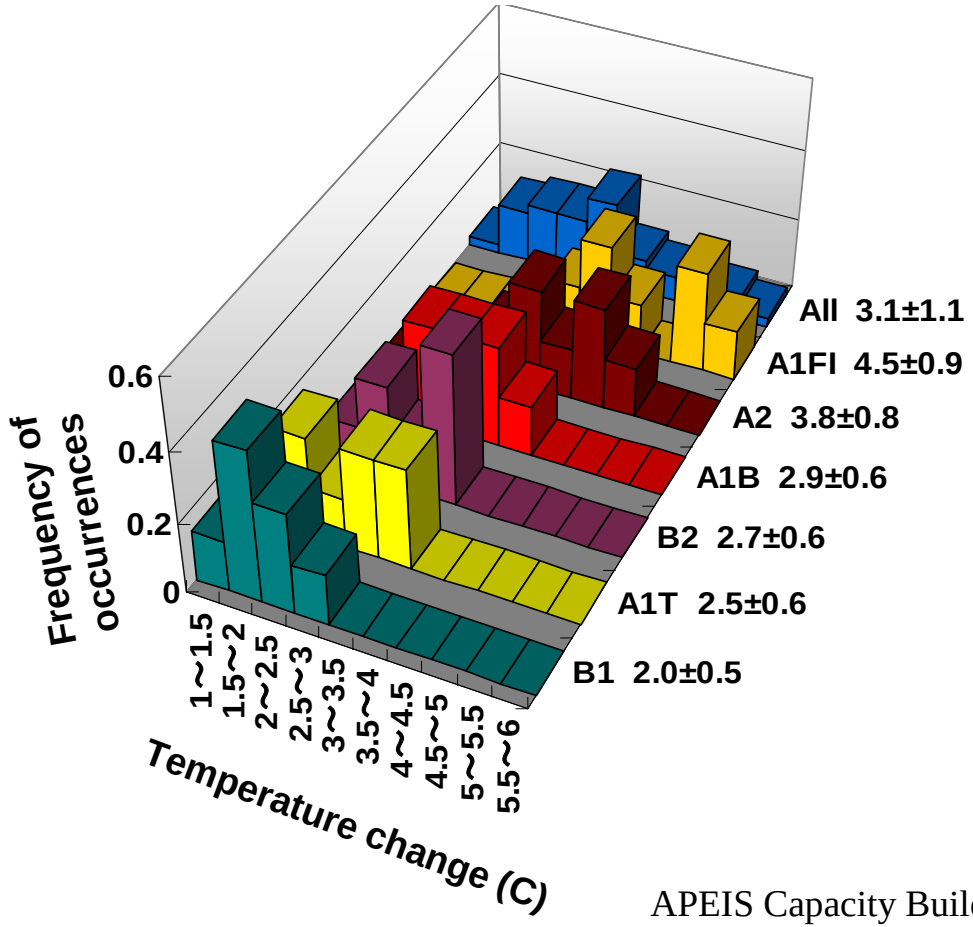


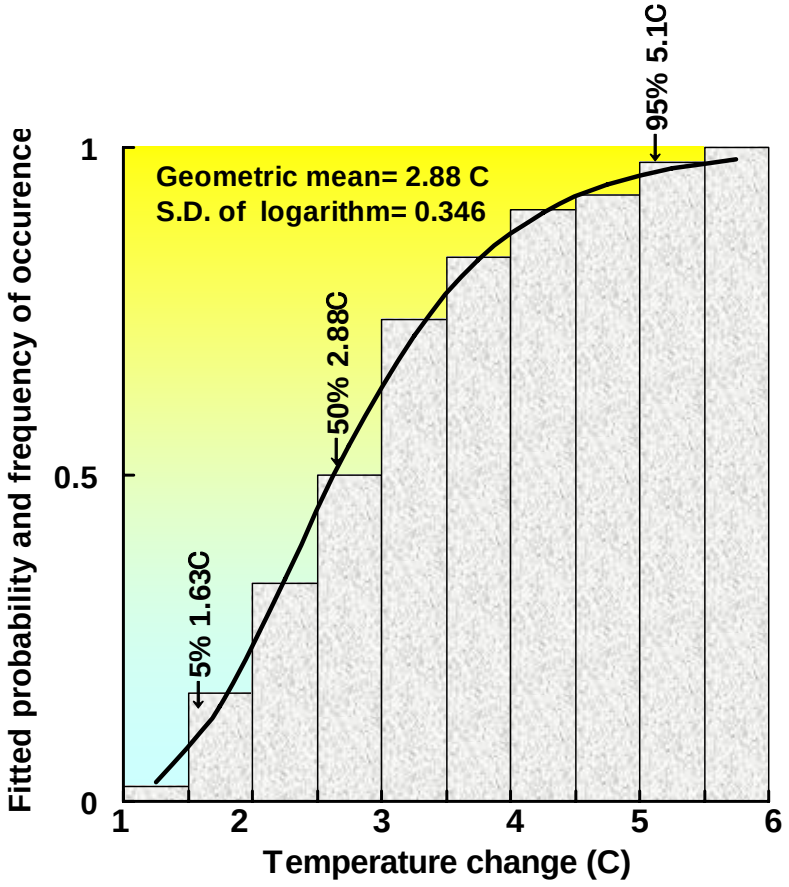
AIM/Climate


AIM/emission
Natural change
Balance and Chemical model of GHGs
Carbon cycle model
CH_4 model
N_2O model
CFCs model
convection and transport of aerosol, SO_2 and NOx
Climate model
Radiative forcing, Energy balance
Ocean model
Upwelling-Diffusion ocean model
Sea level rise model
Ice melt
Glaciers
Greenland
Antarctica
Thermal expansion
Global temperature change
Spatial interpolation with GCM
GCM,RegCM experiments
Sea level rise
Regional temperature change

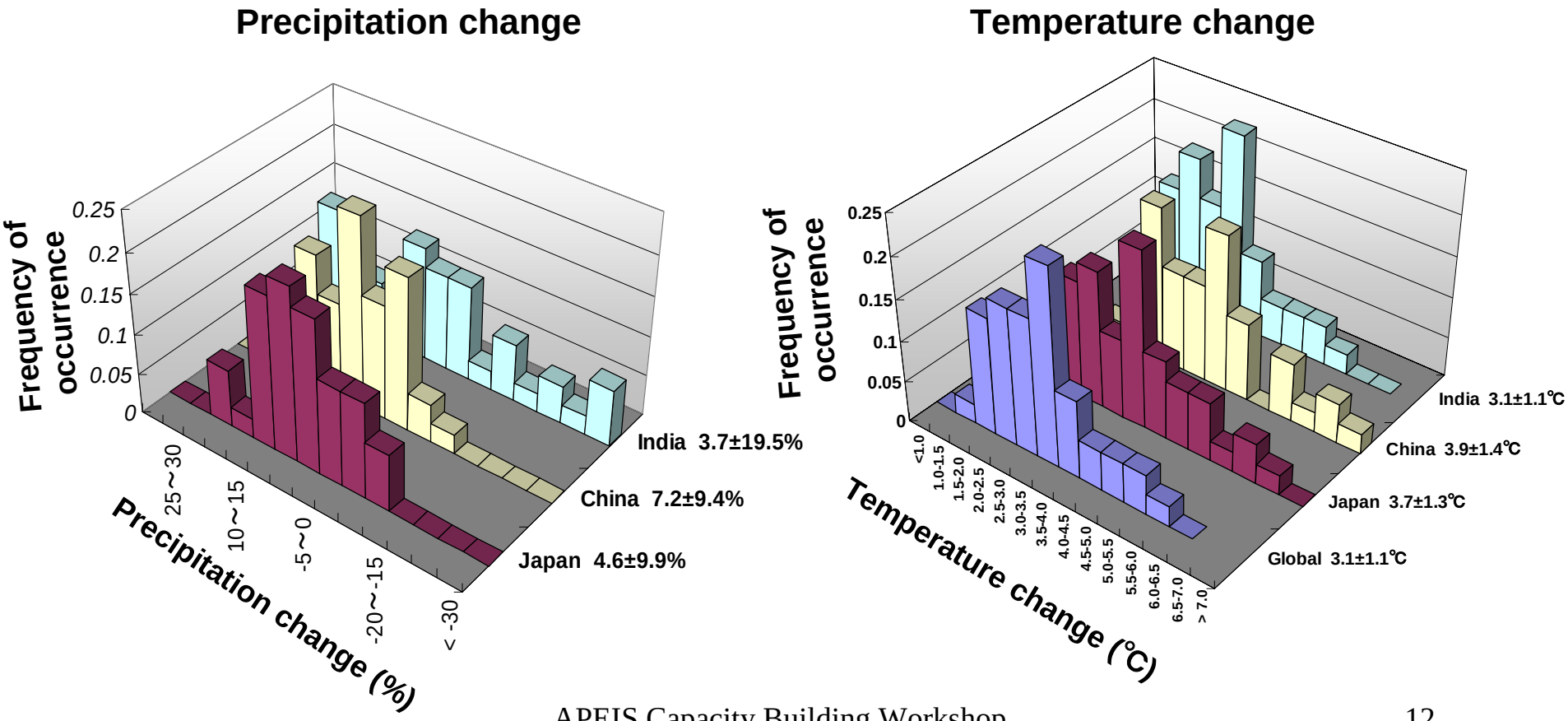
Temperature change between 1990 and 2100

Simulated 7 GCMs are GFDL R15a, CSIRO Mk2, HadCM3, HadCM2, ECHAM4/OPYC, CSM 1.0 and DOE PCM

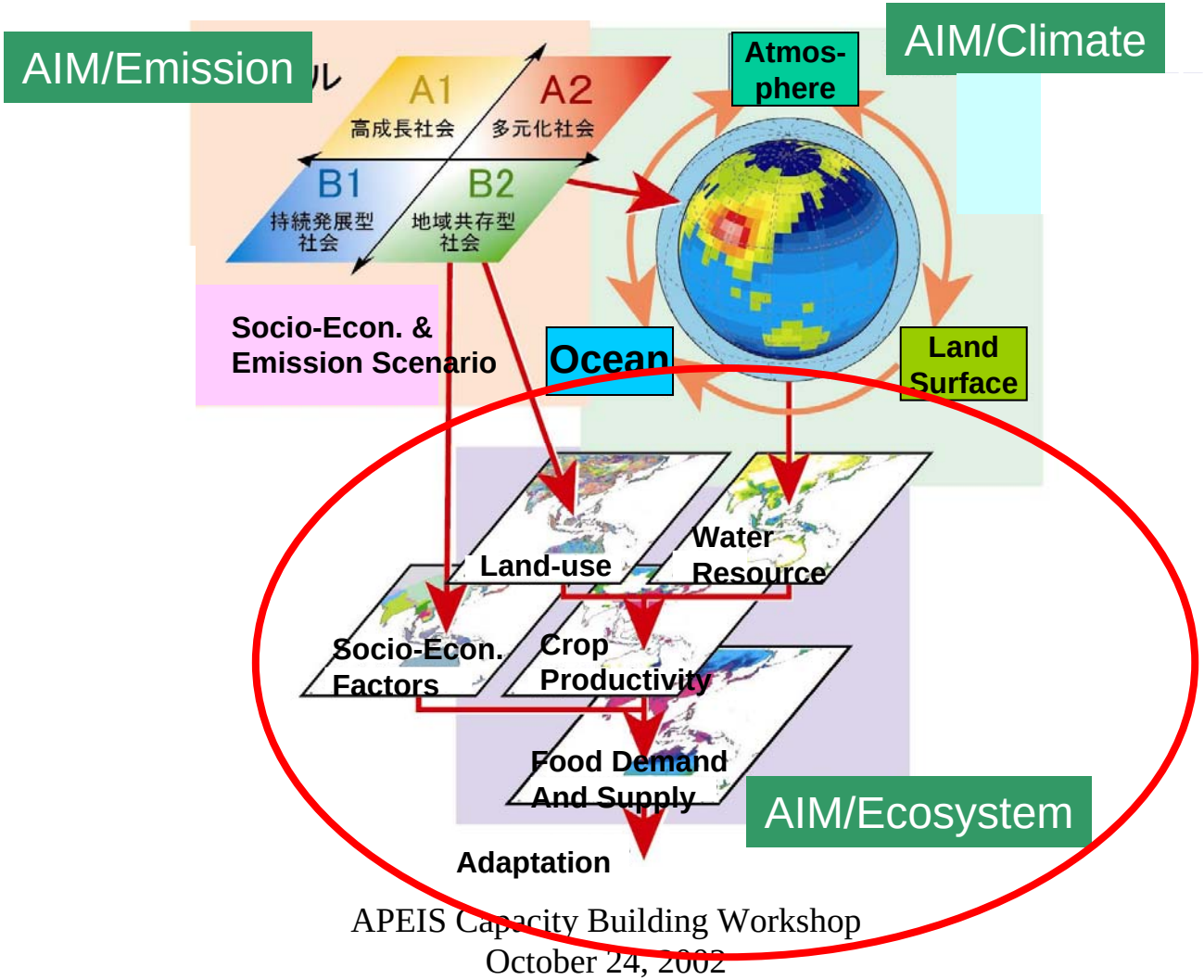




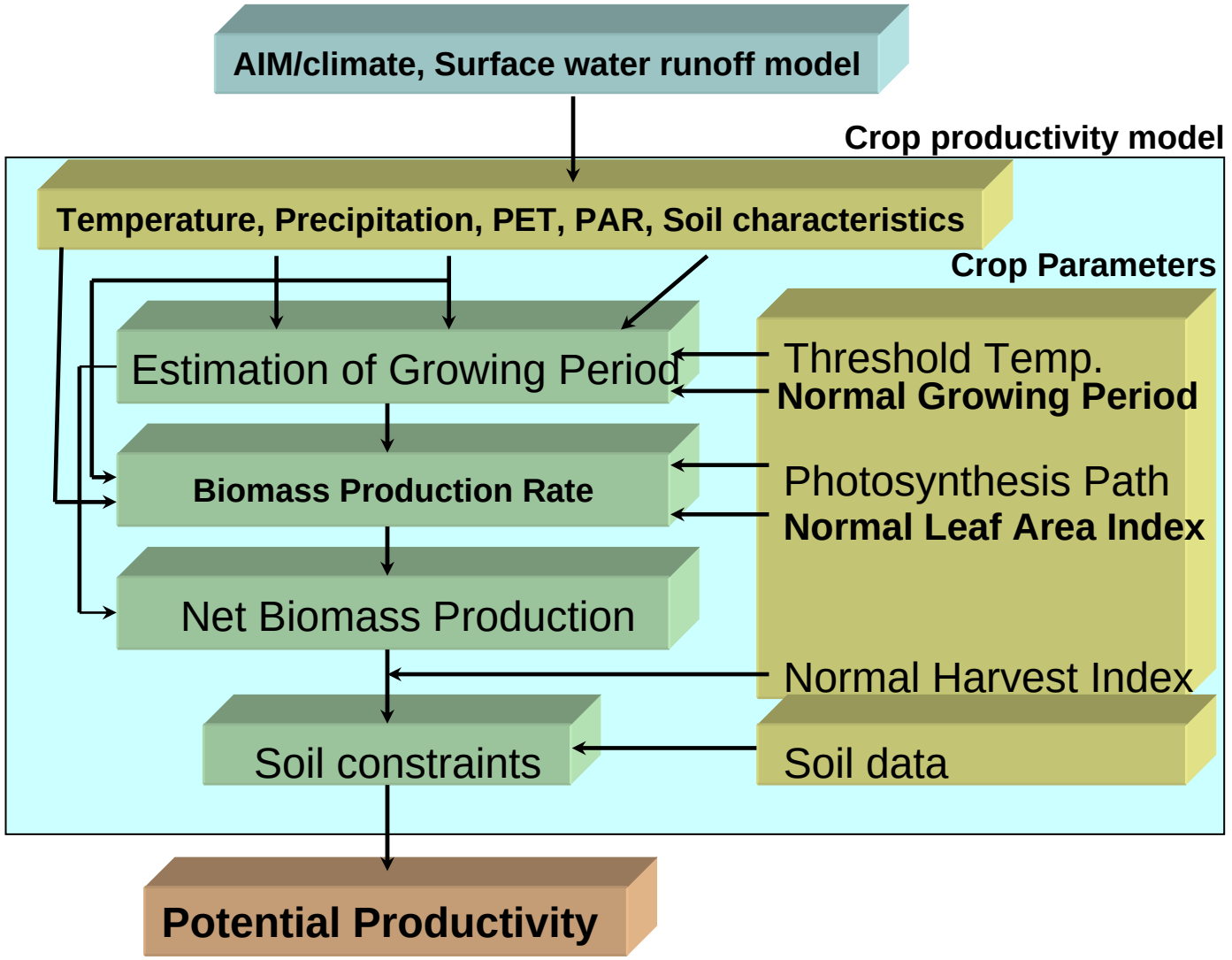
Climate change in Asian-Pacific countries from 1990 to 2100, increase in DJF



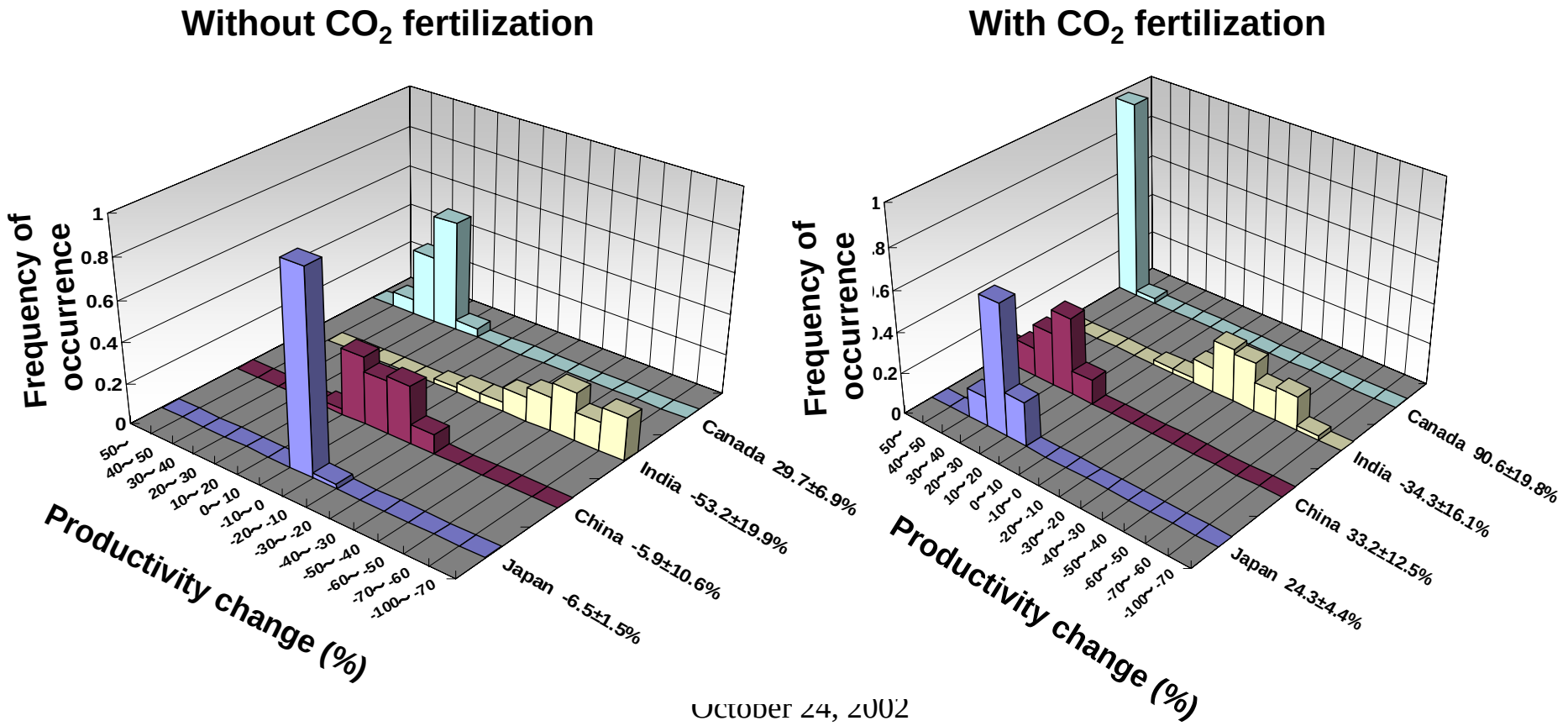
Linkages of AIM models



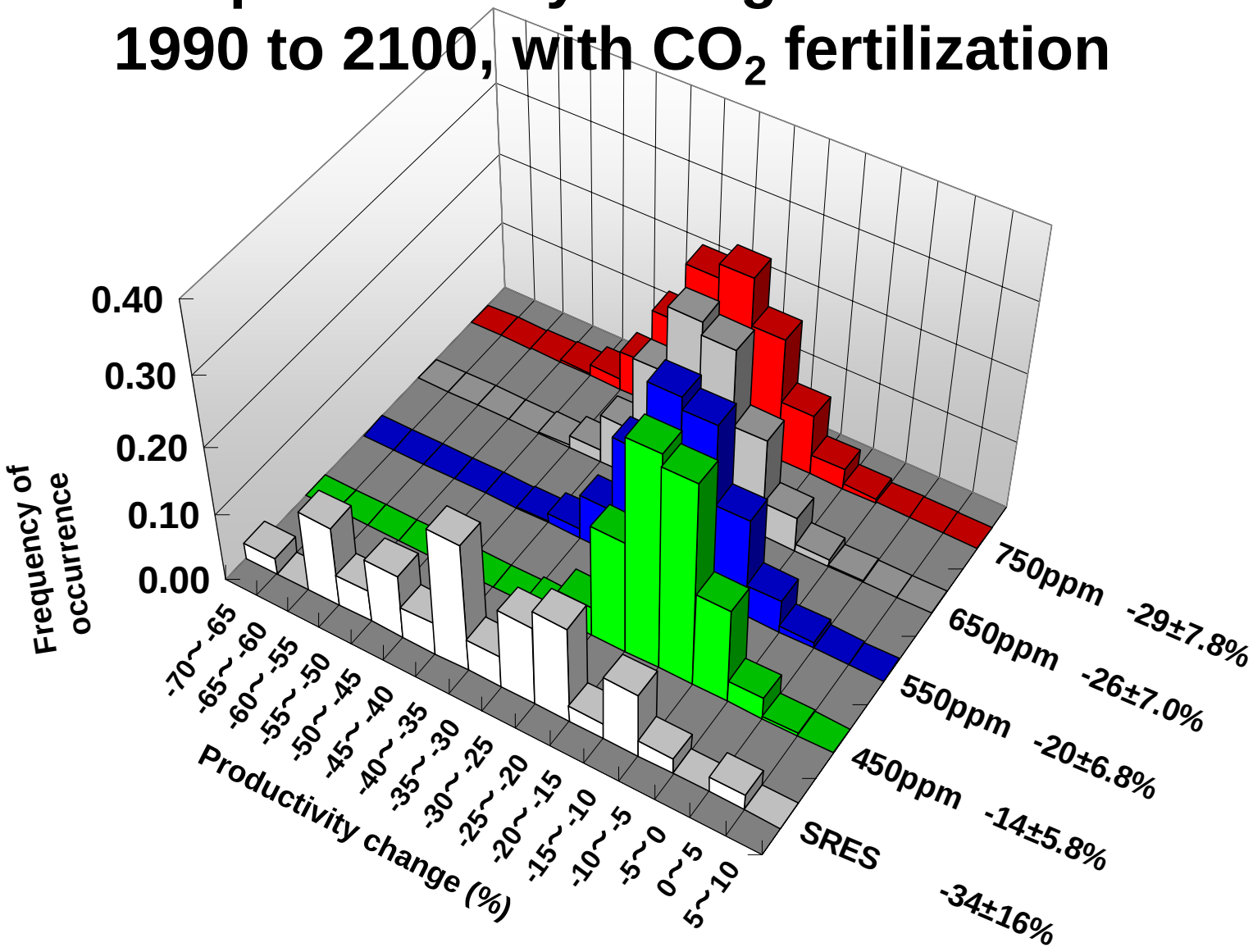
Outline of the Crop Productivity Model



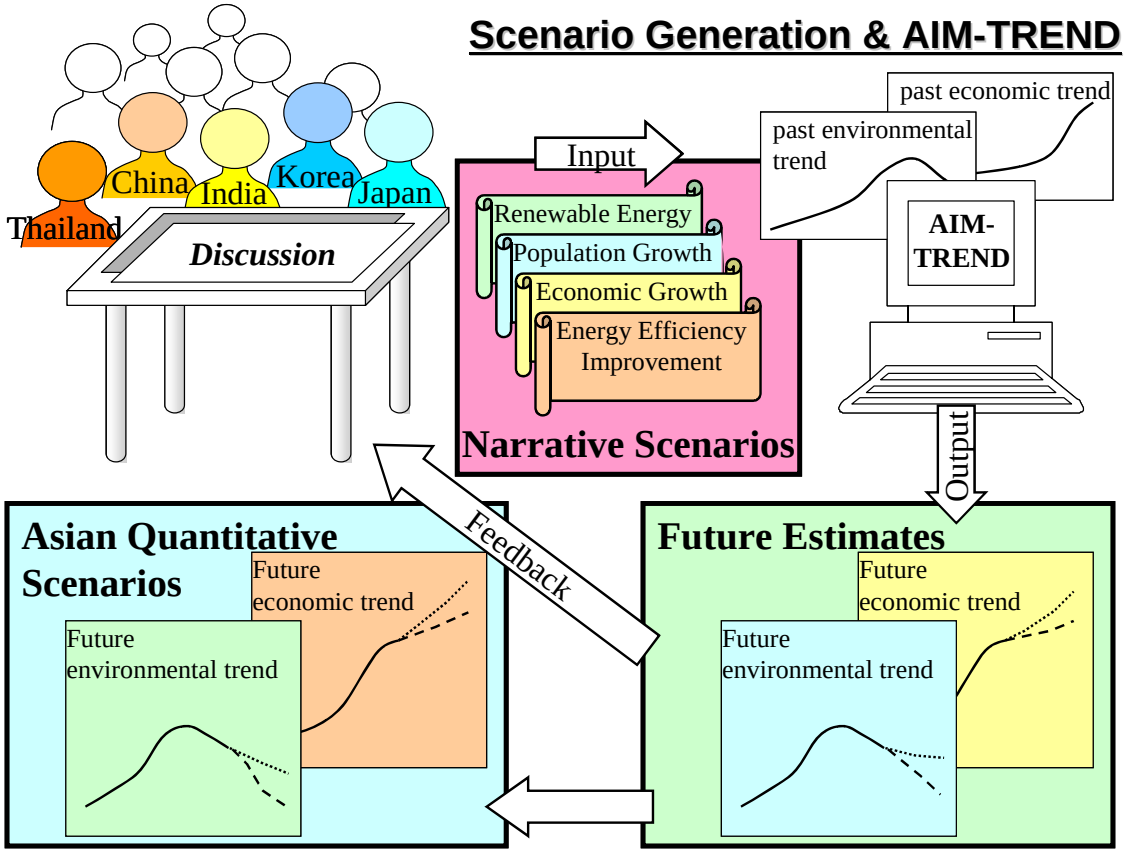
Wheat productivity change in some countries from 1990 to 2100



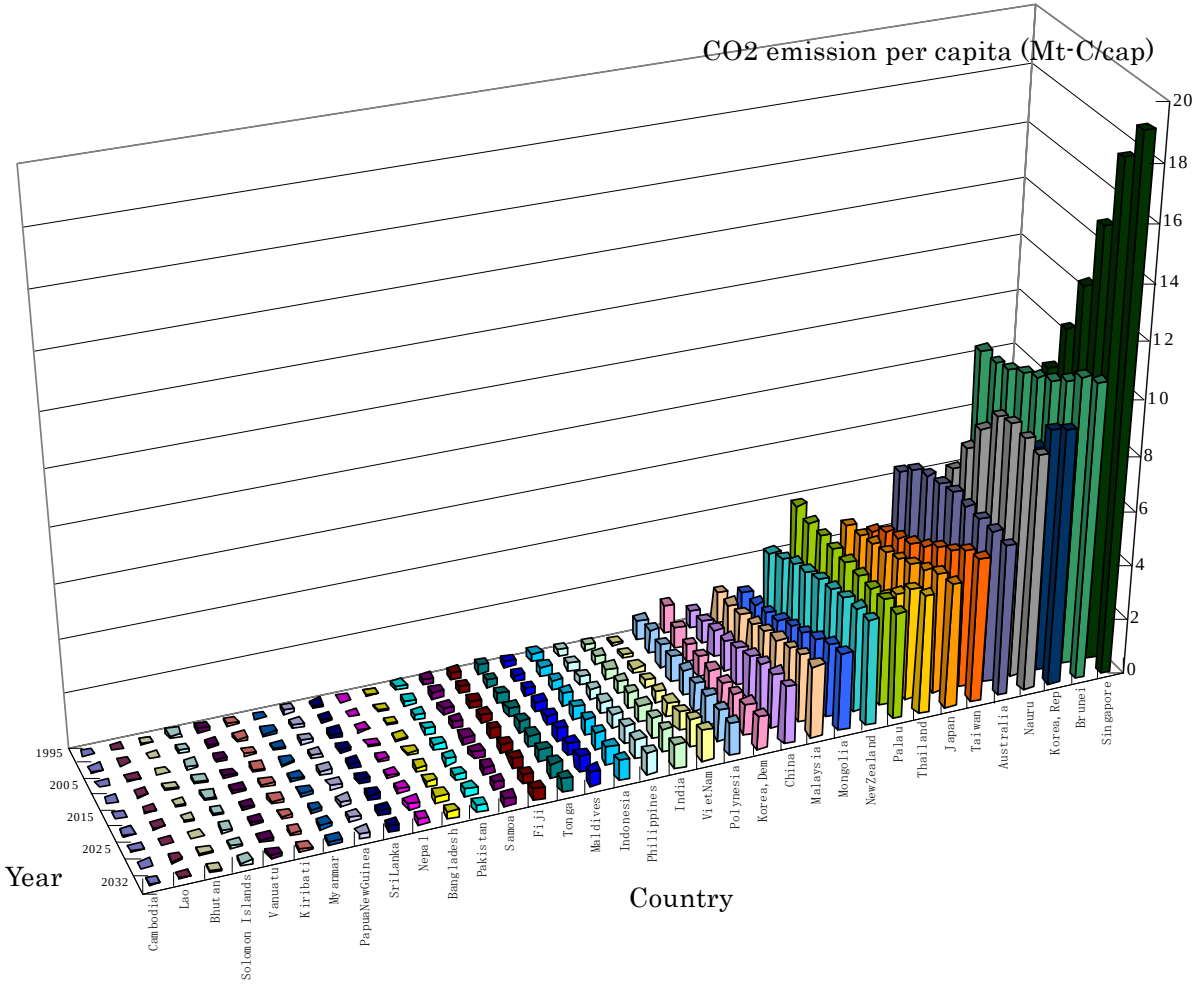
Wheat productivity change in India from 1990 to 2100, with CO_2 fertilization



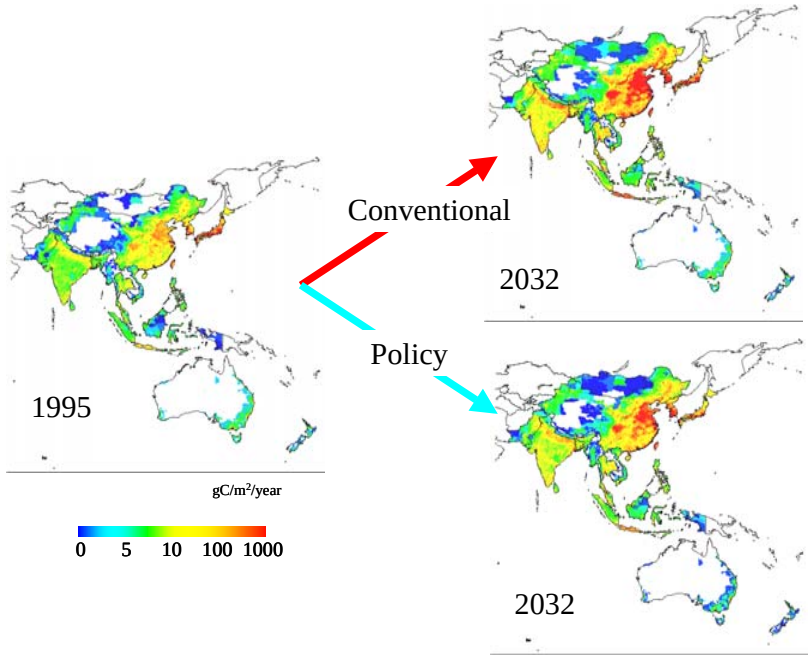
AIM/Trend


Scenario Generation & AIM-TREND
China
India
Korea
Japan
Thailand
Discussion
Input
Renewable Energy
Population Growth
Economic Growth
Energy Efficiency Improvement
Narrative Scenarios
past economic trend
past environmental trend
AIM-TREND
Output
Feedback
Asian Quantitative Scenarios
Future economic trend
Future environmental trend
Future Estimates
Future economic trend
Future environmental trend

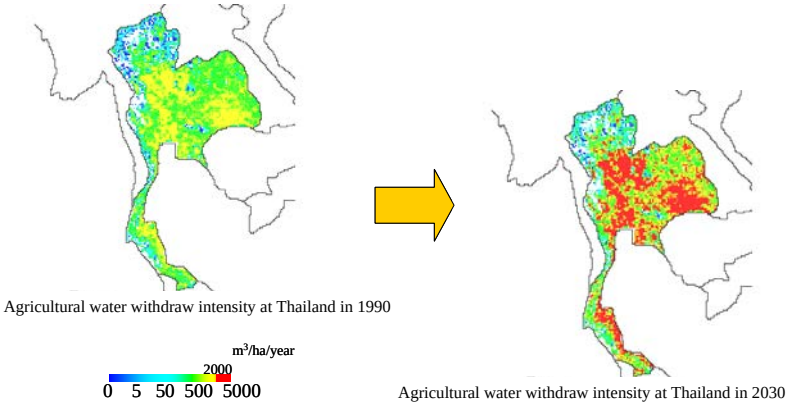
Projection of CO_2 emission per capita for each country



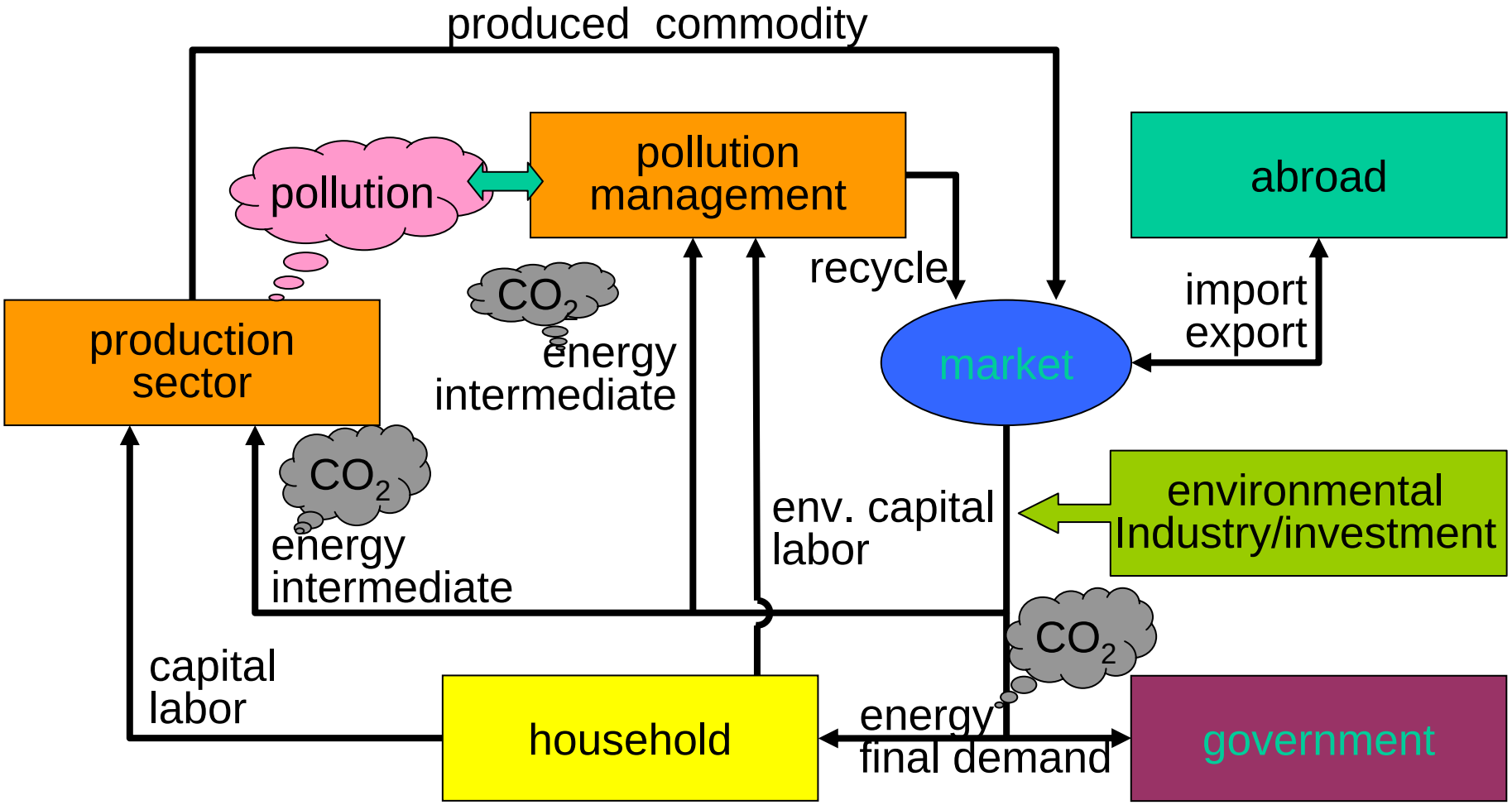
CO_2 emission intensity for each scenario



Change of agricultural water withdraw intensity at Thailand



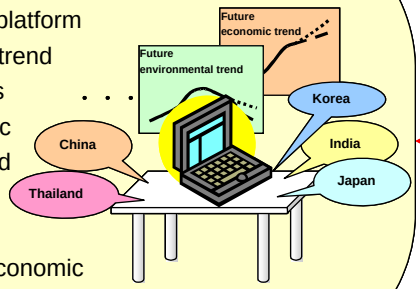
AIM/Material



AIM models for this Workshop

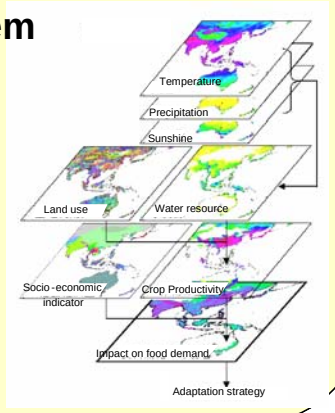
AIM/Trend

Communication platform to assess future trend of each countries in the Asia Pacific Region supported with multi -regional environment -economic CGE model



AIM/Ecosystem

Detailed process model for ecosystem assessment focused on surface water recycling, crop productivity and vegetation

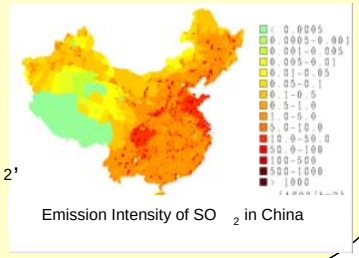


AIM/CGE-Linkage

World Economic Model

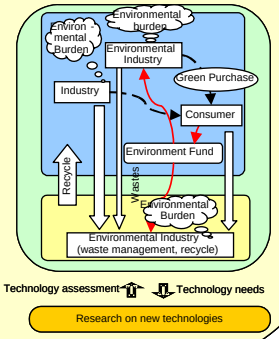
AIM/Emission

Detailed technology selection model supported by CGE model to estimate Emissions of CO_2, SO_2, NO_2, SPM and other pollutants


Emission Intensity of SO_2 in China

AIM/Material

CGE -supported model integrated with material balance to assess recycle process and environmental industry



Review of Models used in this Workshop

- **AIM/Emission : AIM/Enduse is a bottom-up energy model, which focuses on the activities of the people who deal with energy consumption and production, plus the changes in technologies. Based on detailed descriptions of these items, it calculates the changes in energy consumption from technological substitution caused by changes in energy prices, using its bottom-up structure.**

- **AIM/Ecosystem : calculates global and regional climatic impacts, especially on primary production industries, such as water supply, agriculture, forest products and human health.**

- **AIM/Material : intends to estimate economic and environmental effects of environmental investment. It assesses the effects of policy integration for comprehensive environmental problems. It has a consistency of material flow and a consistency of activities and reality of technology and policies.**

- **AIM/Trend : is developed to prospect the basic situation of economy, energy and environment in Asia-Pacific region. It covers 42 countries in Asia-Pacific region. It uses simple method (econometric) and develops several scenarios for capacity building.**

AIM/Emission family

Model	Situation	Object	Characteristics	Implementation
AIM/Enduse	Operating	National CO_2 reduction program	Bottom up, end-use energy-emission model, Constant lifetime cohort, Optimum subsidy option	Fortran program named "engd"
AIM/Local	Operating	Linkage of CO2, SO_2, NO_2, SPM reduction program, National/Regional scale, Coupling reduction program with Emission Inventory	Bottom up, end-use energy-emission model, simple cohort structure, coupling with air pollutant emission inventories ALICE:Ancillary-effects estimating model for local governments to improve their comprehensive environment	MS access interface and GAMS main program, Supported with AIM/Database
		AIM-COUNTRY APEIS	Device combined version (AIM/Enduse Vr.2): Able to treat combined input and output services, e.g. Power generation and secondary use of electricity	
			Subsidy version (SUB) : optimum subsidy to reduce gas emission	
AIM/Energy-economics	Obsolete but Operating (First Generation)	Long-term GHG emission projections from the point of energy supply and demand equilibrium	Based on the ASF/ER model, Backcasting ability from emission and concentration targets, Coupling with the enduse model in near-term projection	Fortran program
AIM/CGE (energy)	Operating	Economic assessment of global GHG reduction, EMF14/19 comparative study	Global multi-regional CGE model with energy resource sectors and interface to bottom-up model	GAMS/MPSGE, GTAP4, IEA energy balance table
AIM/CGE (Asia)	Developing	Environmental and Economic assessment of Global Environmental Policy, focuses on Asia-Pacific region AIM-COUNTRY APEIS	Global multi-regional CGE model with economic goods/bads, natural resource sectors and interface to bottom-up model	GAMS/MPSGE, GTAP5, IEA energy balance table, Commodity statistics, Detailed database of natural resources AIM/Database

AIM/Ecosystem family

Model	Situation	Object	Characteristics	Implementation
AIM/Ecosystem		Climate change impact assessment with detailed process model, surface water cycle, crop productivity, vegetation, health	Grid or basin level hydrological model, crop model, vegetation model, malaria model. Interface with GCM/RegCM output	
		Global/Regional version		
	Operating and Developing (First Generation)	Global assessment Linkage with World crop trade model		GRASS, ArcGIS FORTRAN, C
		Country/Local version		
	Developing	Country impact assessment AIM/Country	Packaged and Disseminate version of global version	IDRISI, FORTRAN,C, VB, AIM/Database
AIM/Ecosystem2	Developing	Assessment of global environmental changes and their counter-measures	Assembly of rather independent modules LAND, WATER, AGRI, ENV, HEALTH, VEG, Exploratory models for next generation AIM activities	GRASS, ArcGIS FORTRAN, C, GAMS

AIM/Material and AIM/Trend

Model	Situation	Object	Characteristics	Implementation	Prospect
AIM/Material	Operating , Applying to Japan, India and China	Economic assessment of nation environmental policy, focused on CO_2 reduction and waste recycling APEIS	One country CGE model with material balance and interface to environmental technology model	GAMS/MPSGE MS ACCESS MS EXCEL	Coupling with bottomup engineering models, Coupling with Household production approach
AIM/Trend	Operating, Distributing	Communicating platform for constructing Asia-Pacific regional environmental outlook, ECO-ASIA, APEIS, GEO3,AIM/Country	Country econometric model. Assembly of Energy, Water, Agriculture and other modules	Visual Basic for MS Excel, National and International statistics AIM/Database	Developing/ evolving to an econometrice tool (ATPL/ATML) included in the AIM/Database and AIM/CGE/ASIA