

Emission Pathway for 6W/m²

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Etsushi Kato

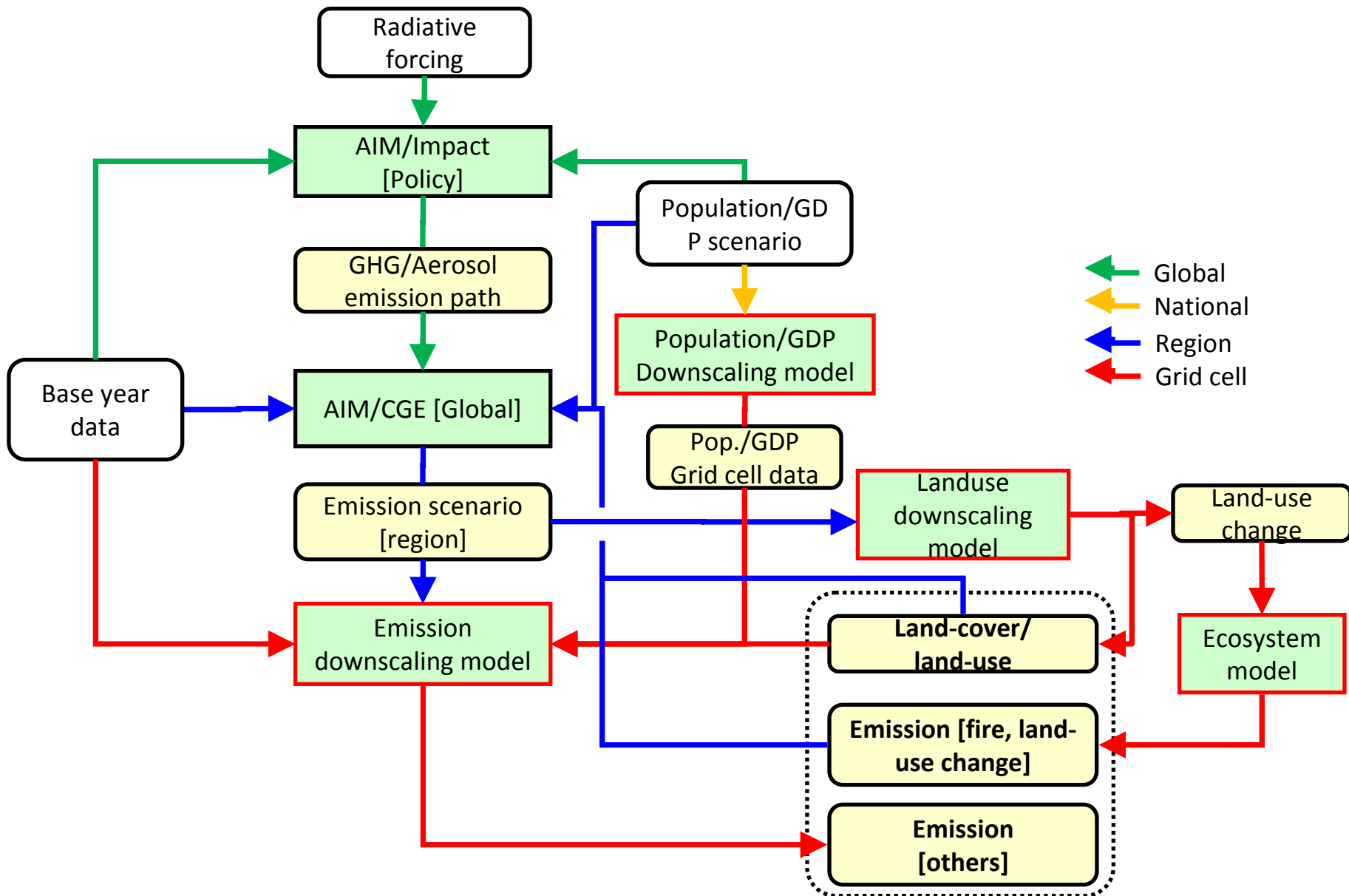
(Japan Agency for Marine-Earth Science and Technology)

IAMC Meeting

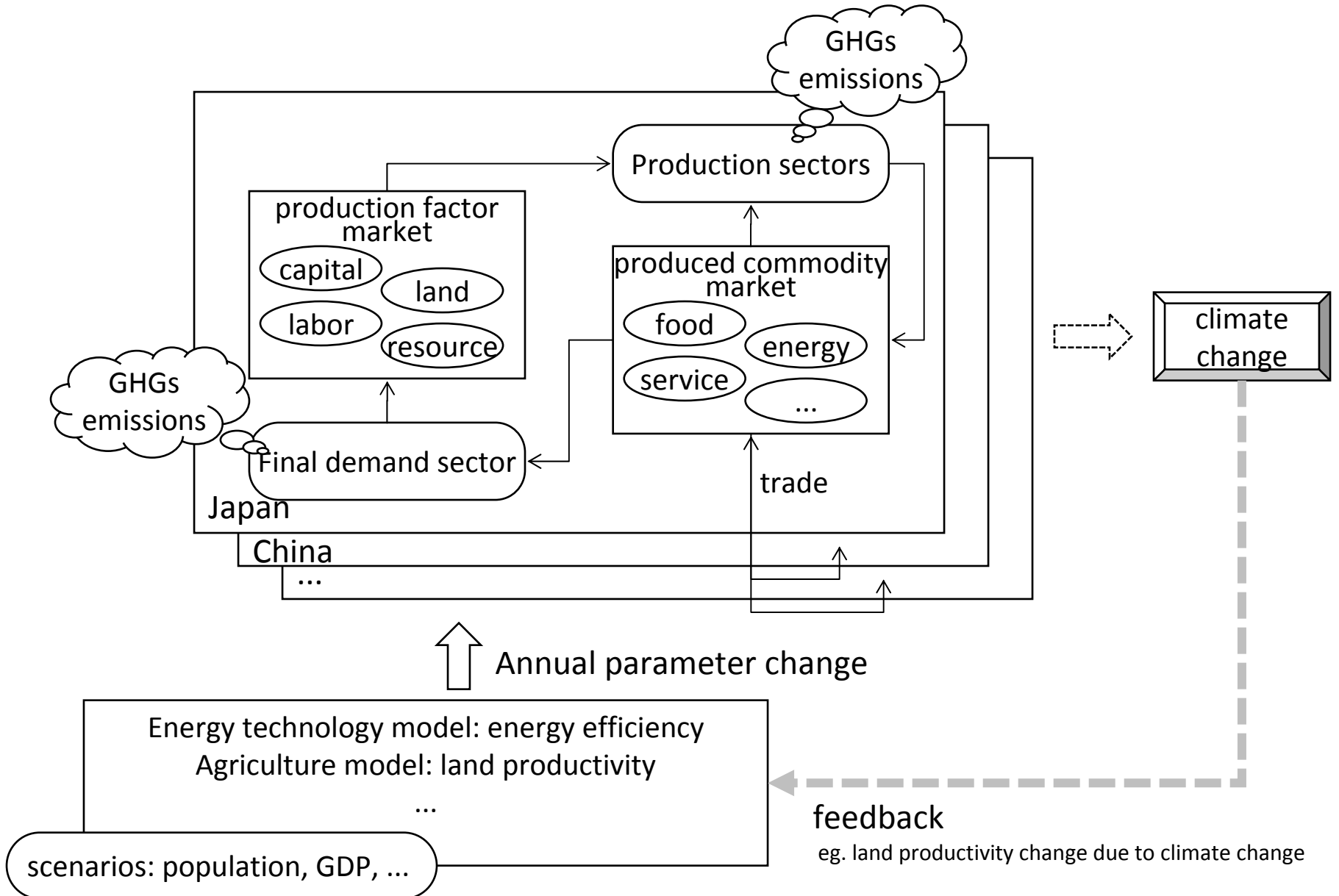
Tsukuba, Japan

September 15, 2009

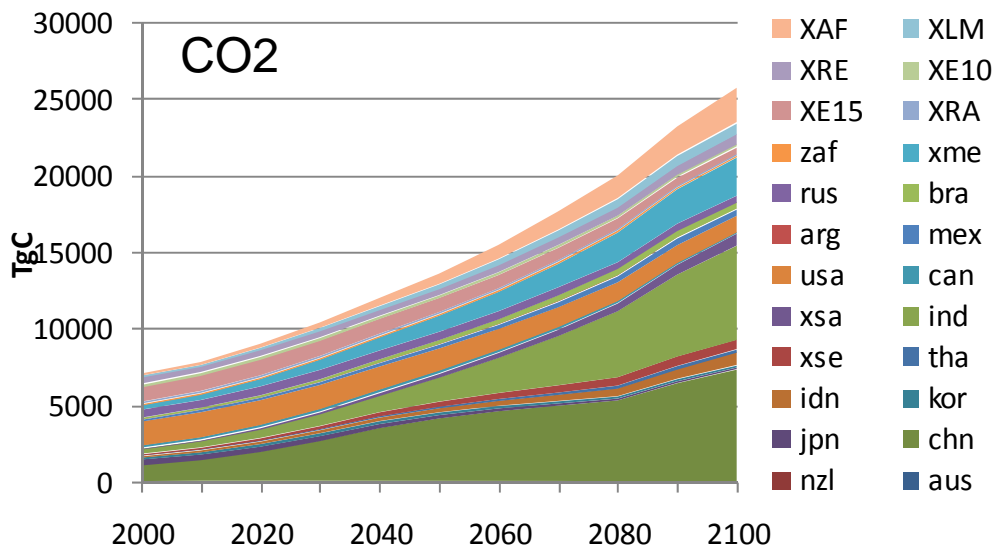
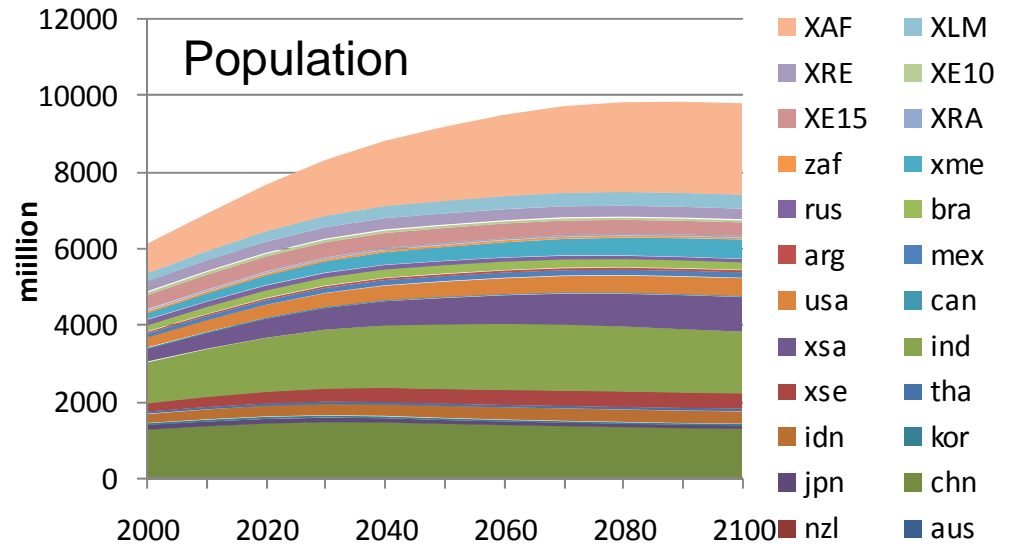
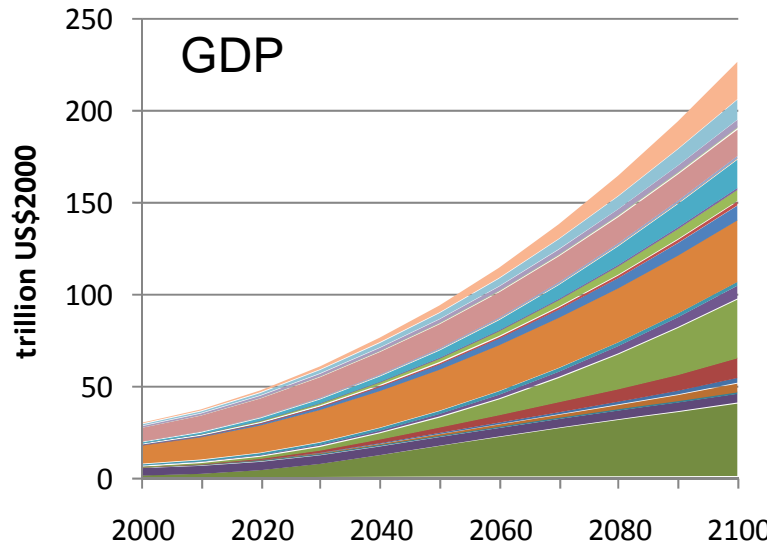
Flowchart of RCP6.0



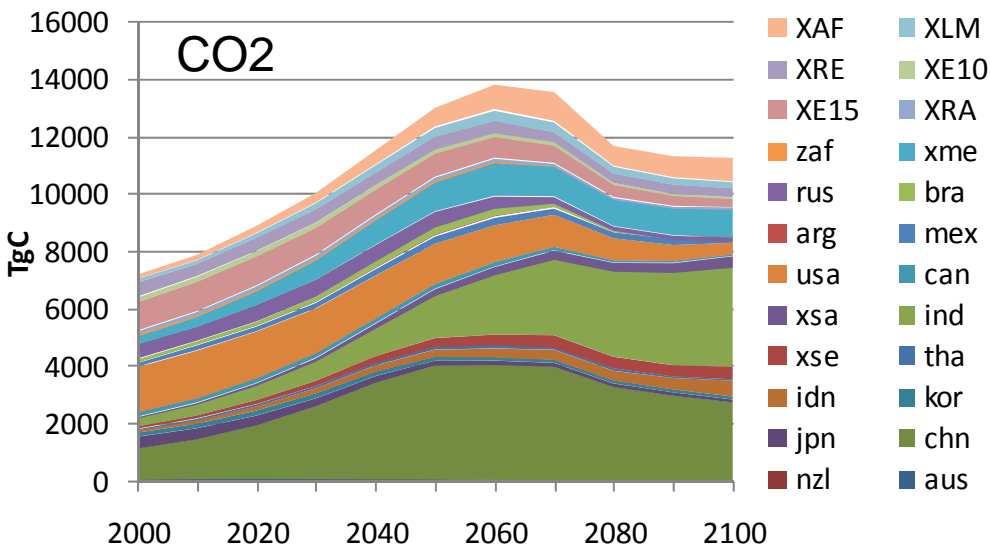
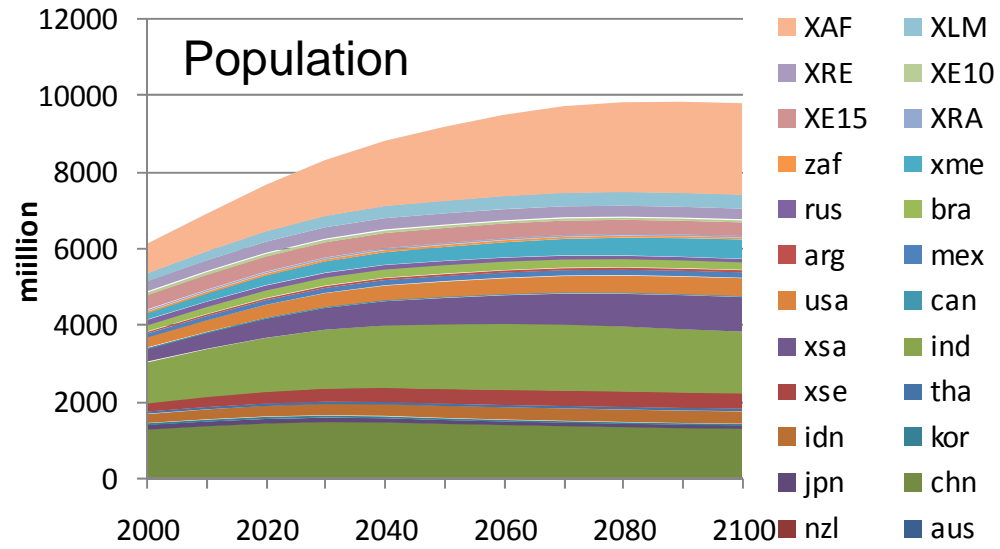
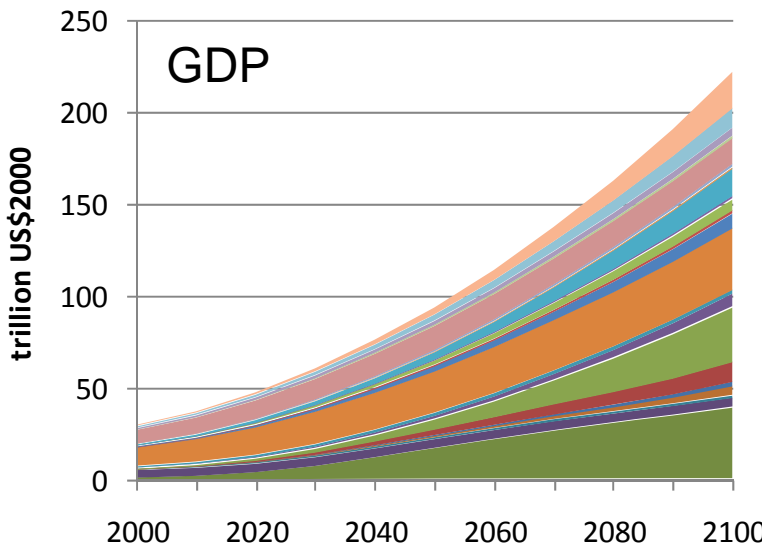
structure of AIM/CGE



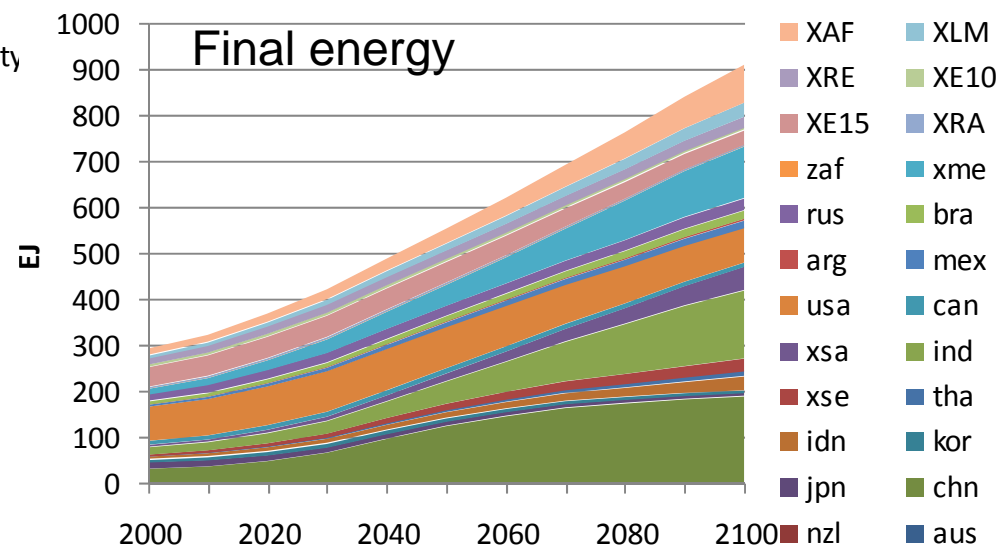
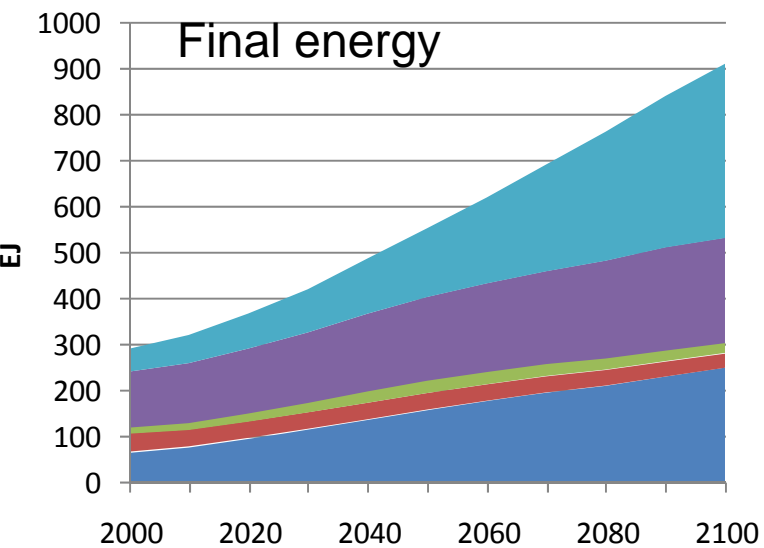
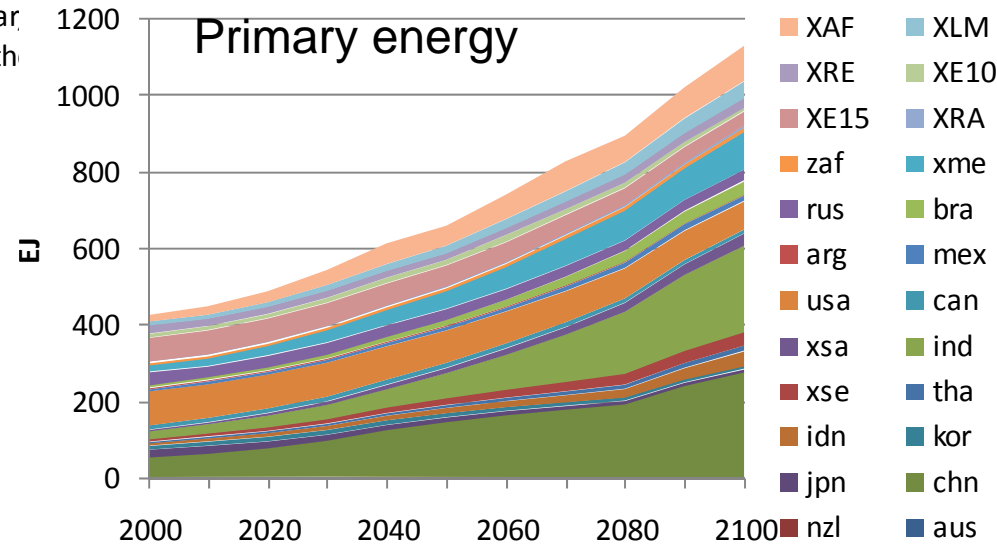
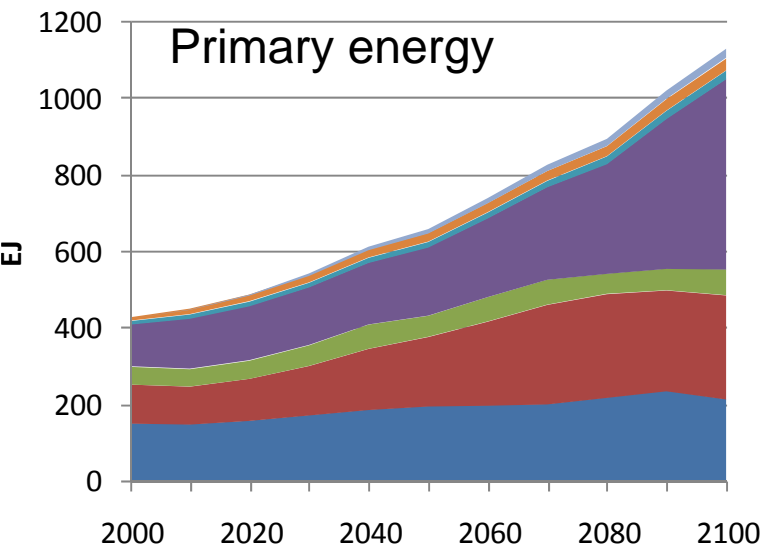
Results of AIM/CGE (Reference)



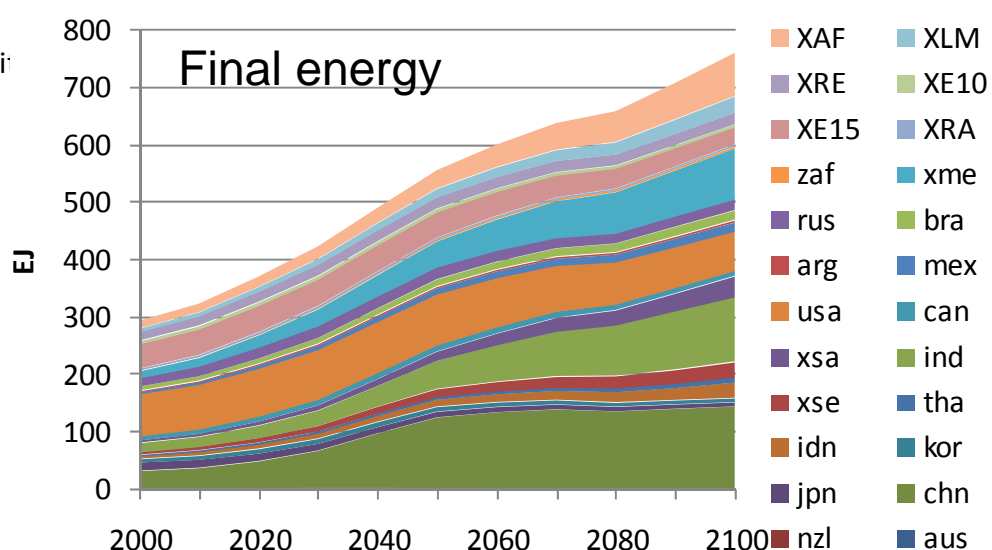
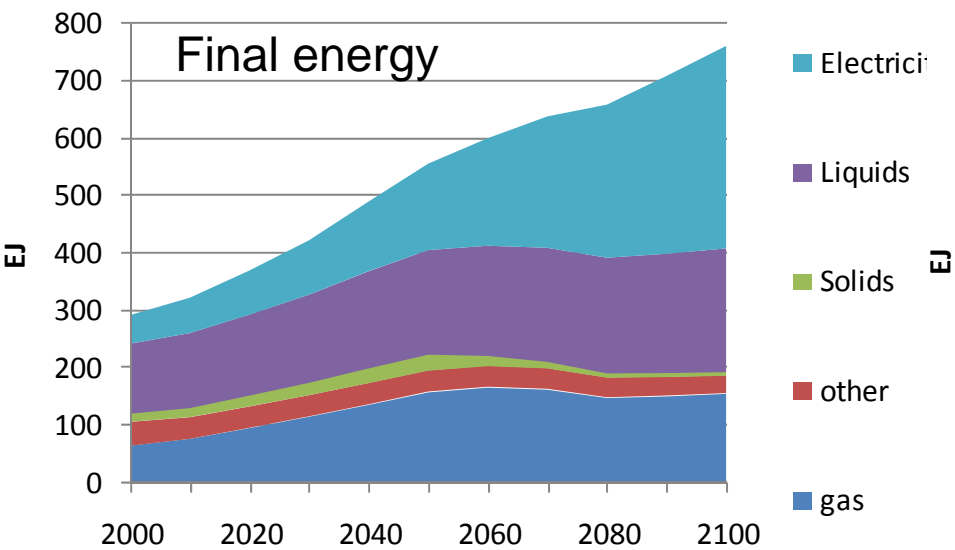
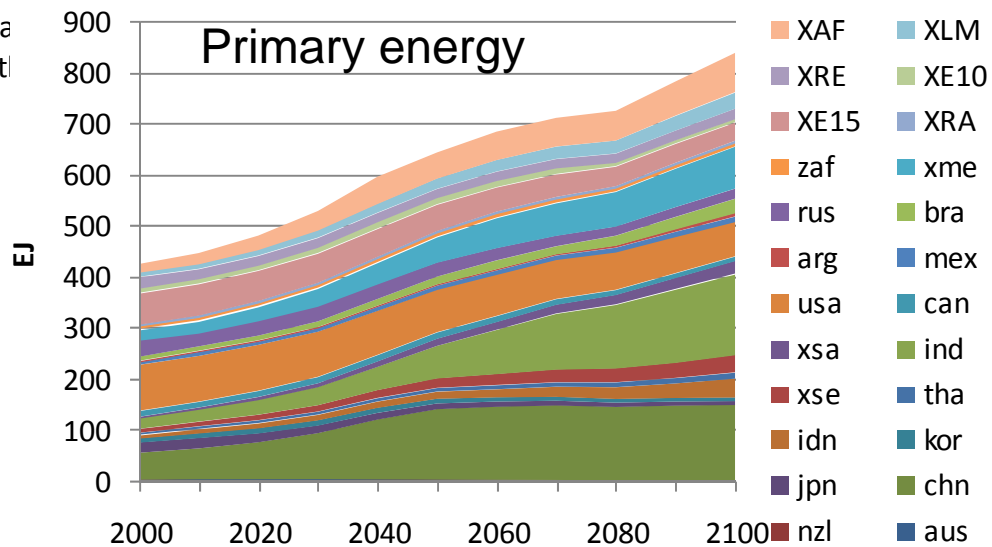
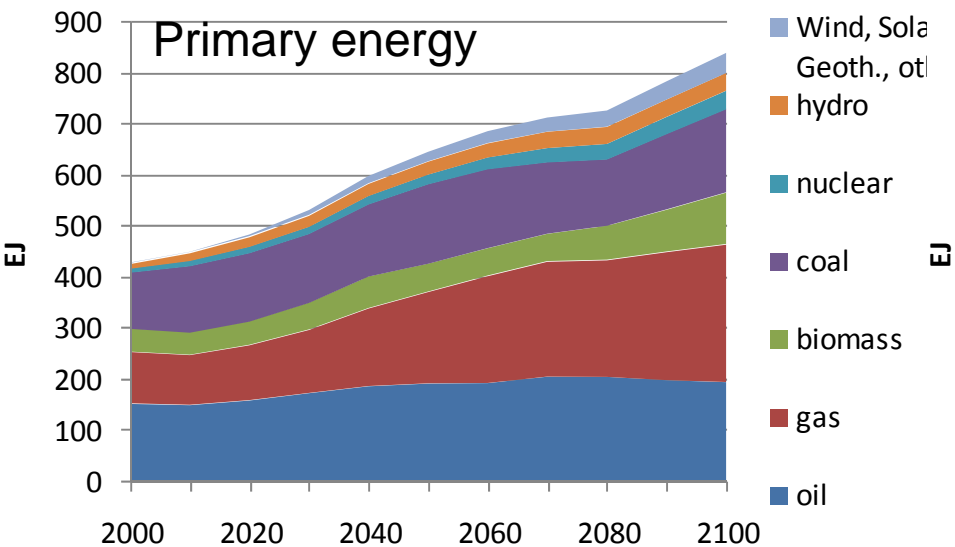
Results of AIM/CGE (6W/m²)



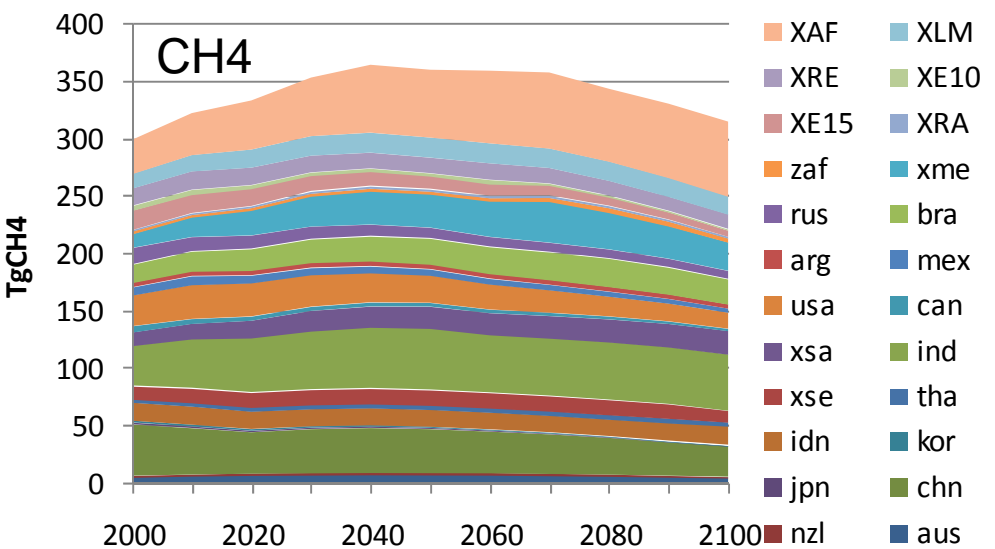
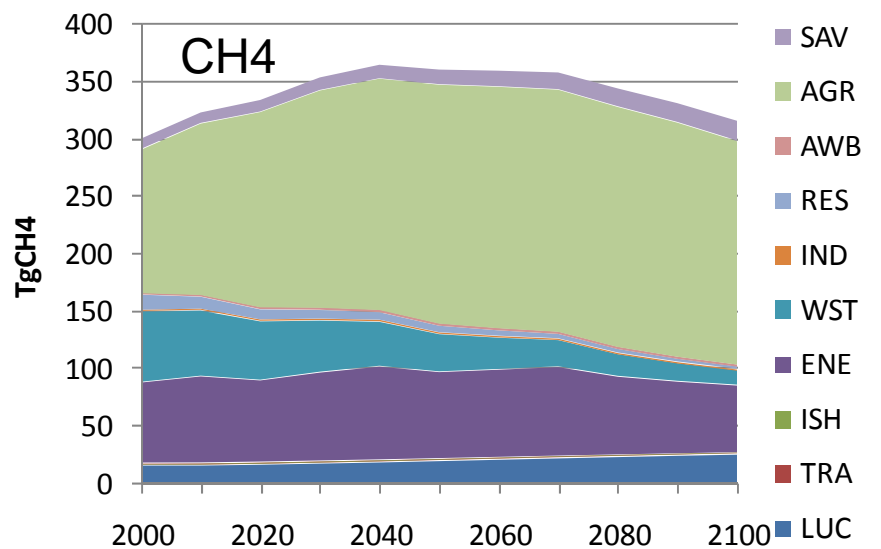
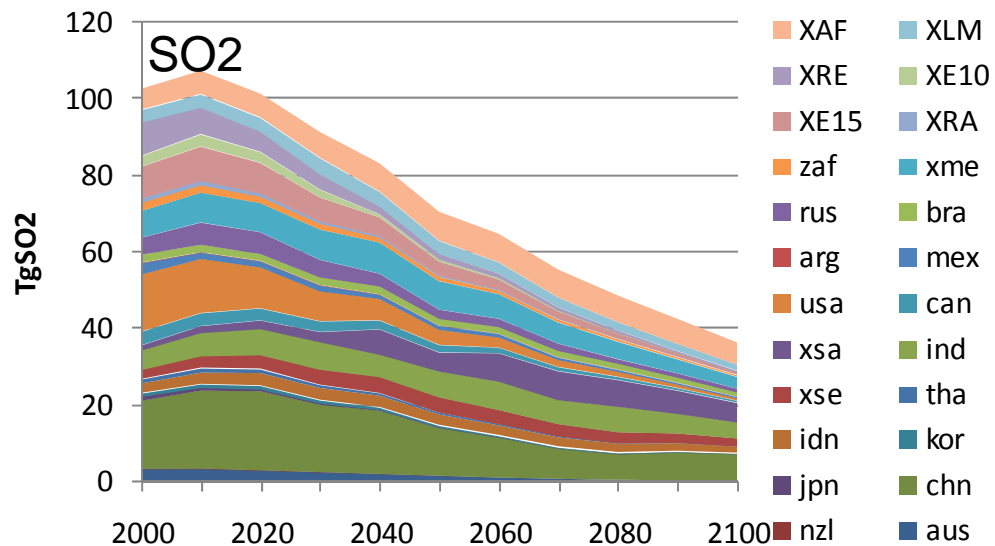
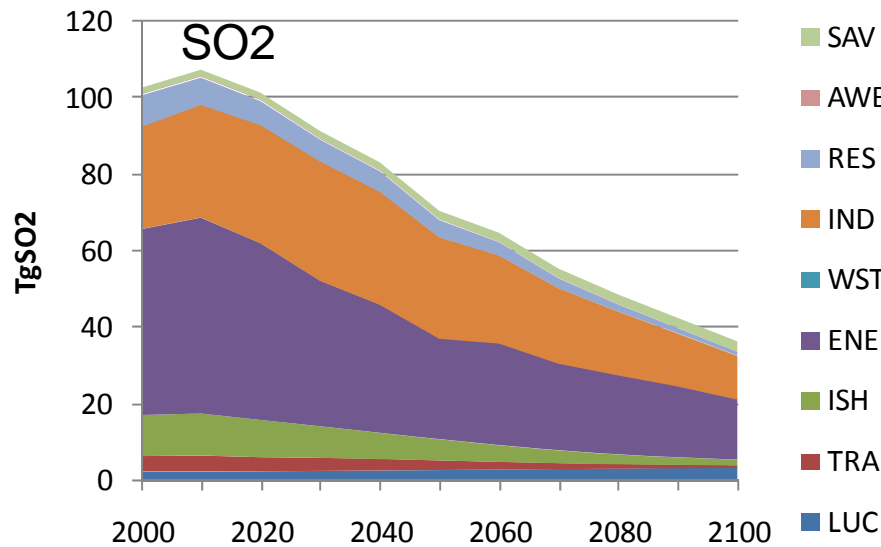
Results of AIM/CGE (Reference)



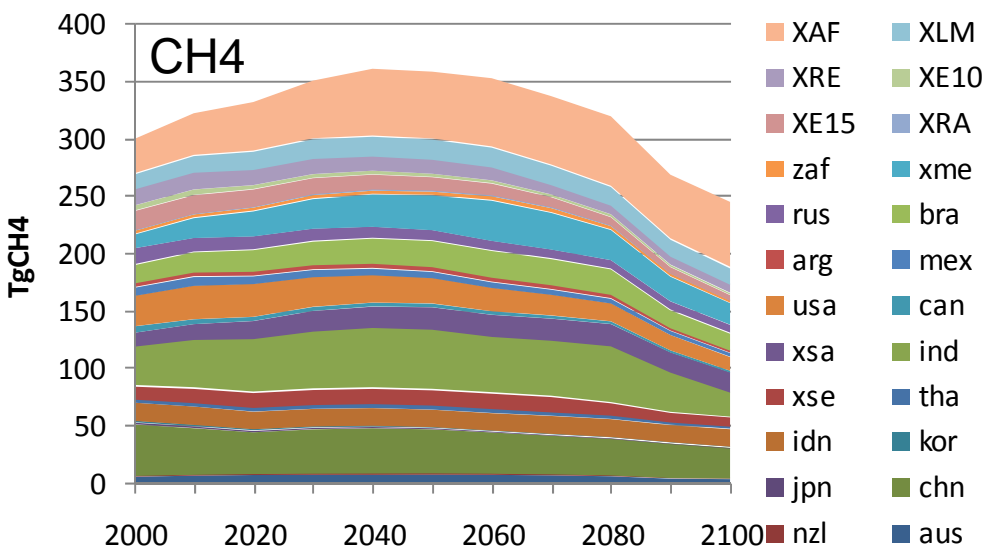
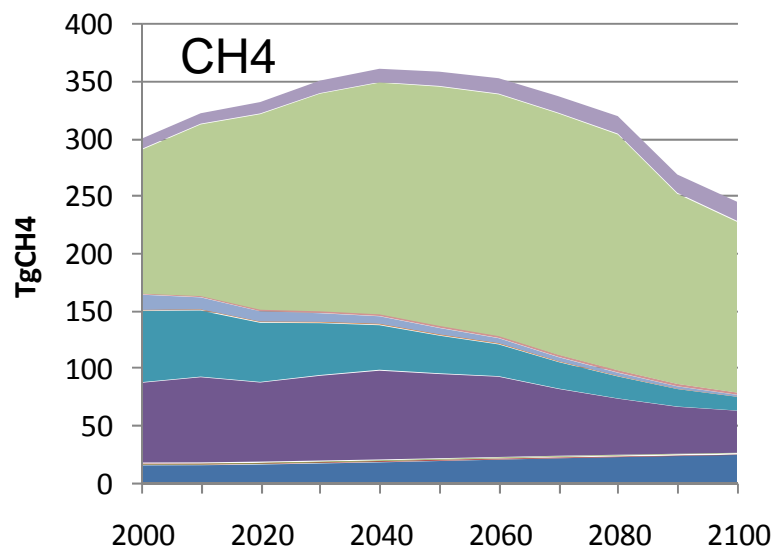
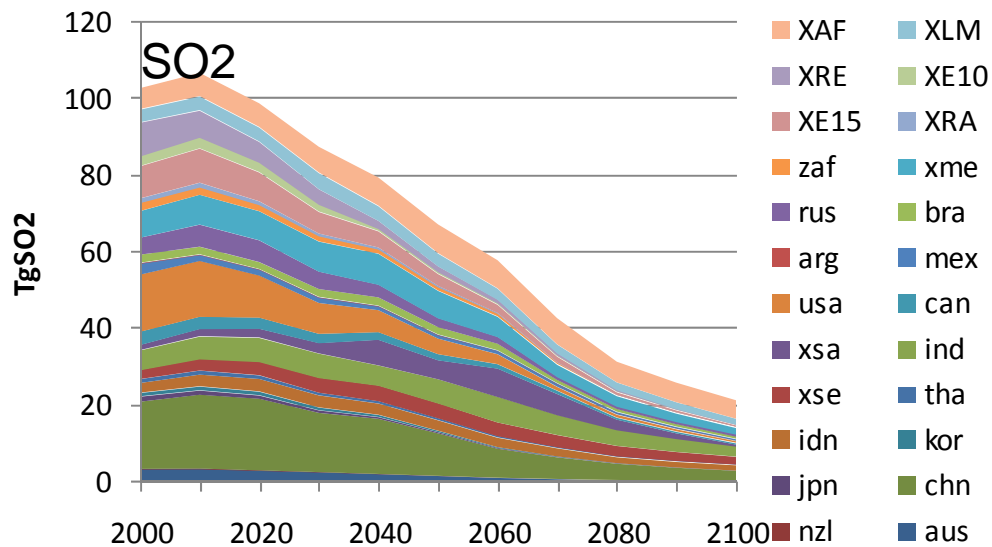
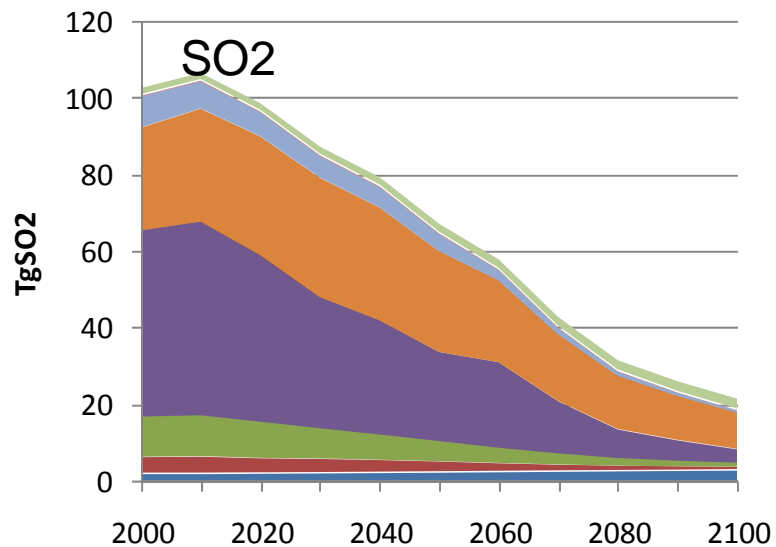
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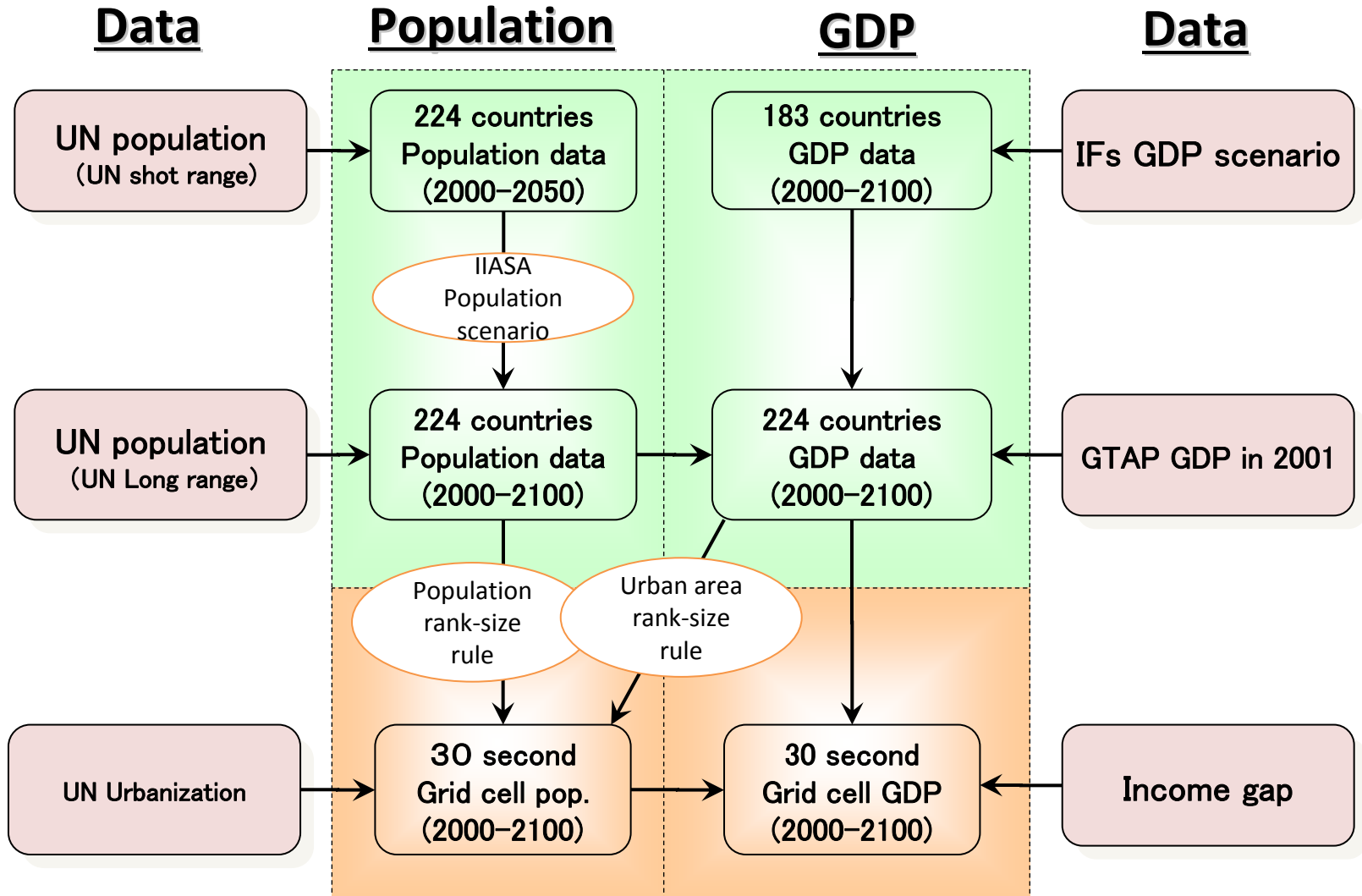
Results of AIM/CGE (Reference)



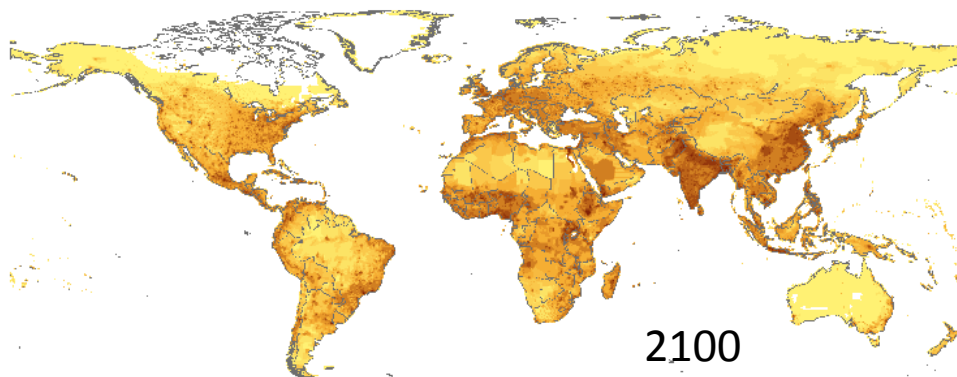
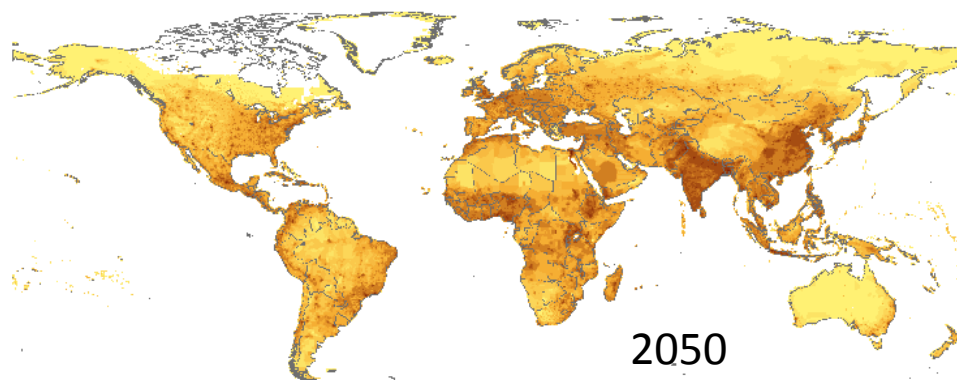
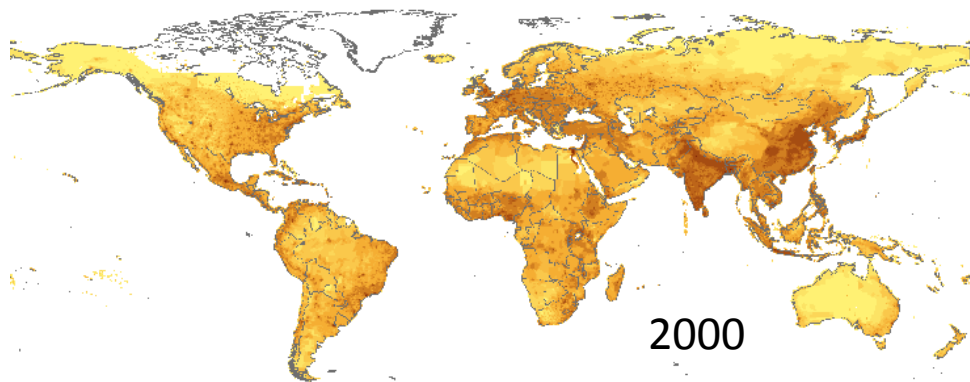
Results of AIM/CGE (6W/m²)



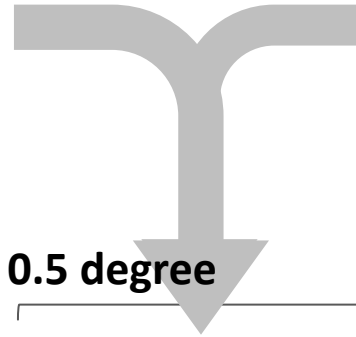
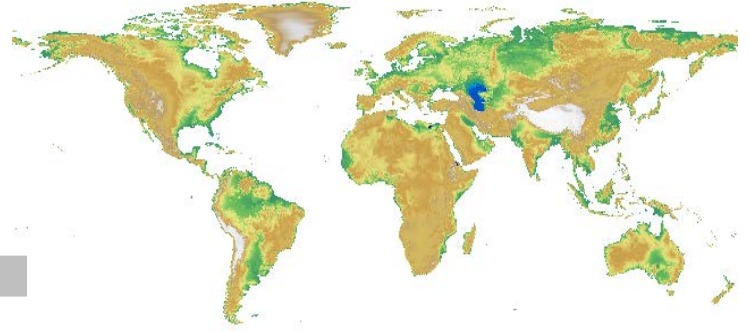
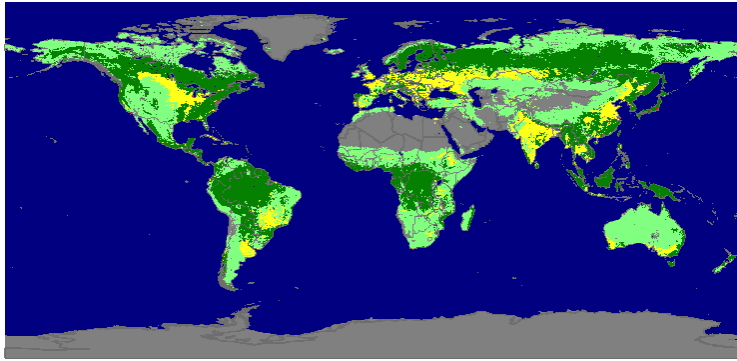
Spatial explicit population/GDP scenario



Population scenario



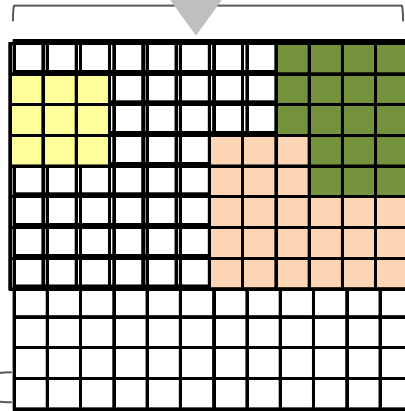
Landuse downscaling model



Geophysical constraint

- Built-up area < 5 degree
- Forest < 20 degree
- etc.

0.5 degree

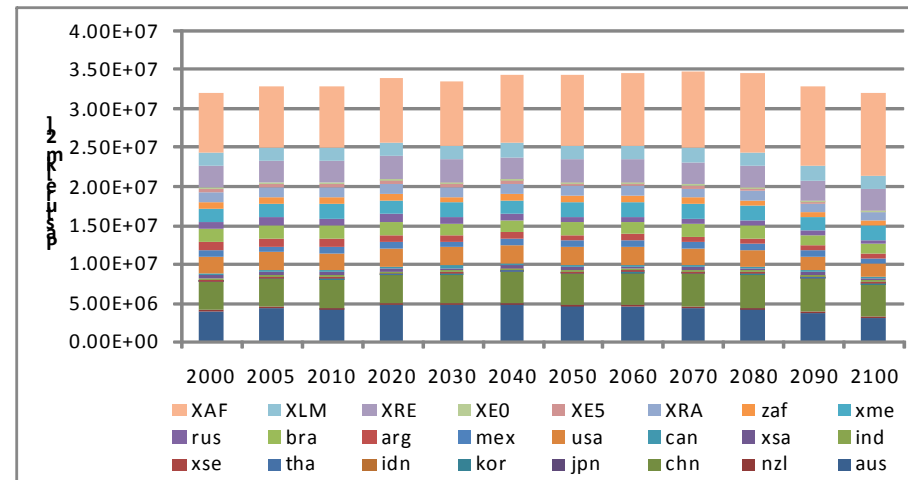
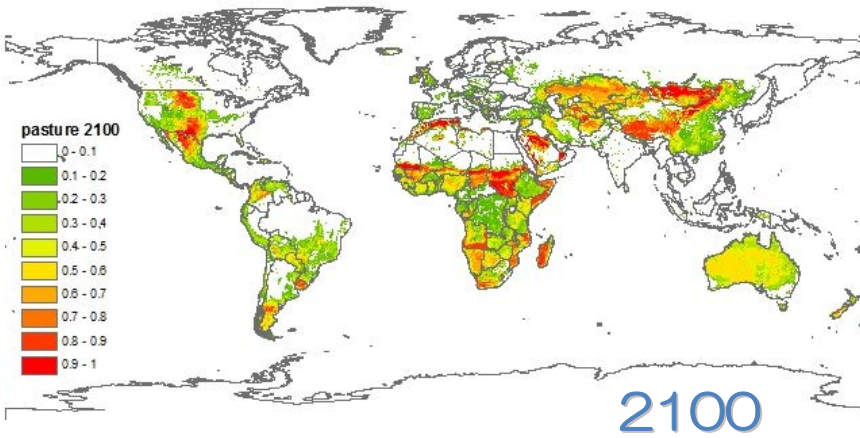
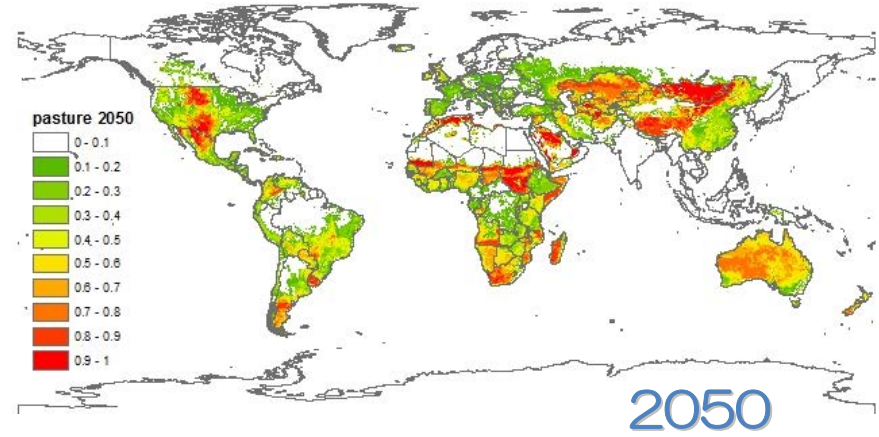
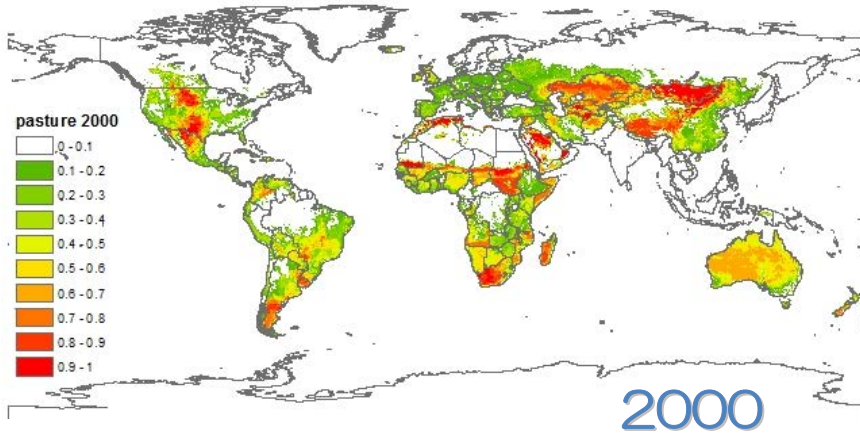


1km

1. Urban (GDP, crop price...)
2. Cropland (yield, slope angle...)
3. Pasture (NPP, slope angle...)
4. Harvest forest (population density..)

Results (Land-use scenario)

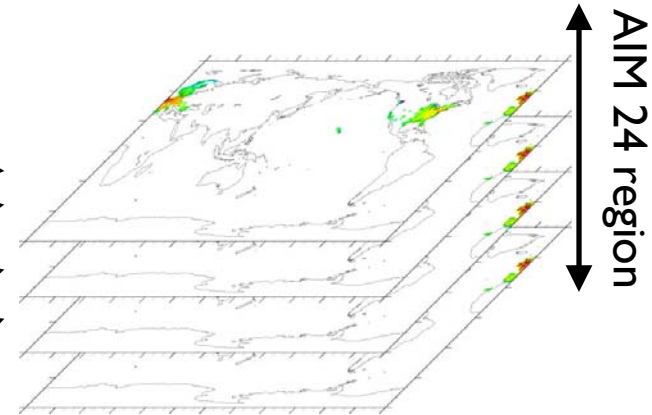
Pasture



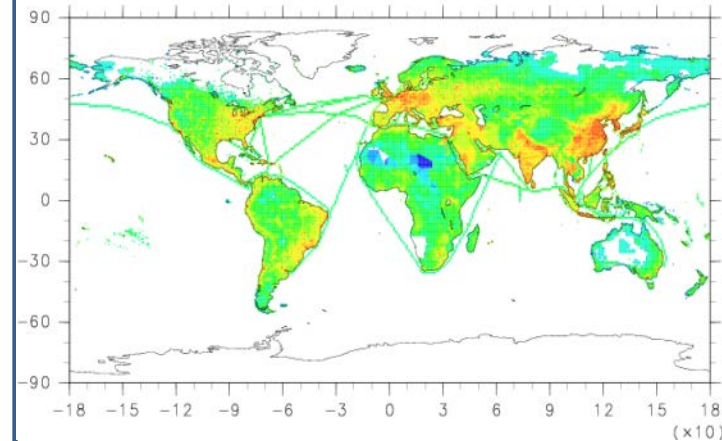
Emission downscaling model

Sector	region	indicator for downscale
electricity	Japan	population
electricity	China	population
...
agriculture	USA	agricultural area
		...

From IAM



Summed up



Downscale by indicator

Global distribution

Regional distribution

- Power plant & energy conv. (by population)
- Industry: process & combustion (by GDP)
- Solvent use (by GDP)
- Residential & commercial (by rural pop)
- Waste (by population)
- Agriculture: waste (by agriculture)
- International shipping
- Aviation
- Transportation (road & railroad)
- Agriculture : Animal & Soil

Case 1

Changes in regional emissions are downscaled according to spatially explicit indicators for each sector and each region.

ENE (total population), IND (GDP), SLV (GDP), DOM (rural population), WST (total population) & AWB (cropland area)

$$E_s(x, y, t) = E_s(x, y, t - \Delta t) + \sum_r \{e_{r,s}(t) - e_{r,s}(t - \Delta t)\} \times \frac{w_{r,s}(x, y, t)}{\iint w_{r,s}(x, y, t) dx dy}$$

x : longitude y : latitude t : year r : region s : sector

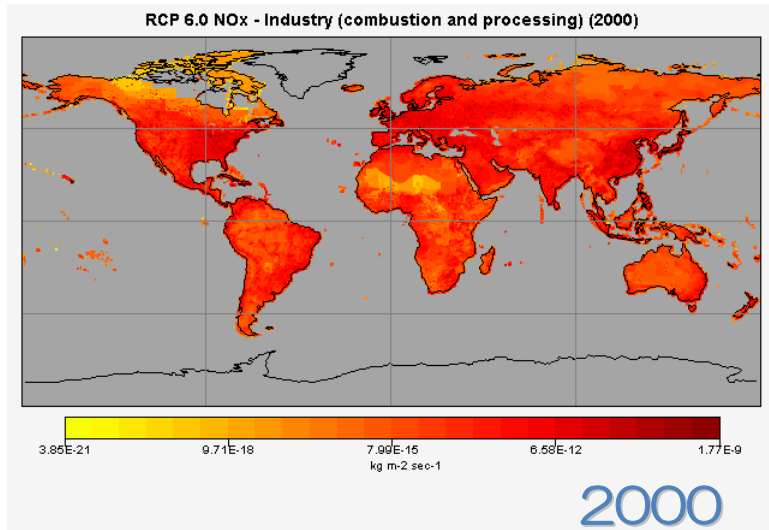
$E_s(x, y, t)$: gridded emissions from a sector s

$e_{r,s}(t)$: regional emissions for region r and for sector s estimated by IAM

$w_{r,s}(x, y, t)$: spatially explicit indicator for region r and for sector s

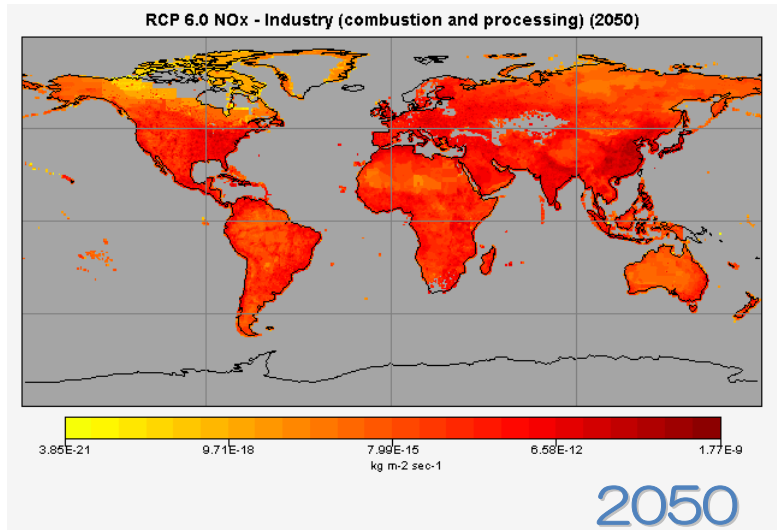
Spatial explicit emission scenarios

Case 1 (Industry, NO₂)



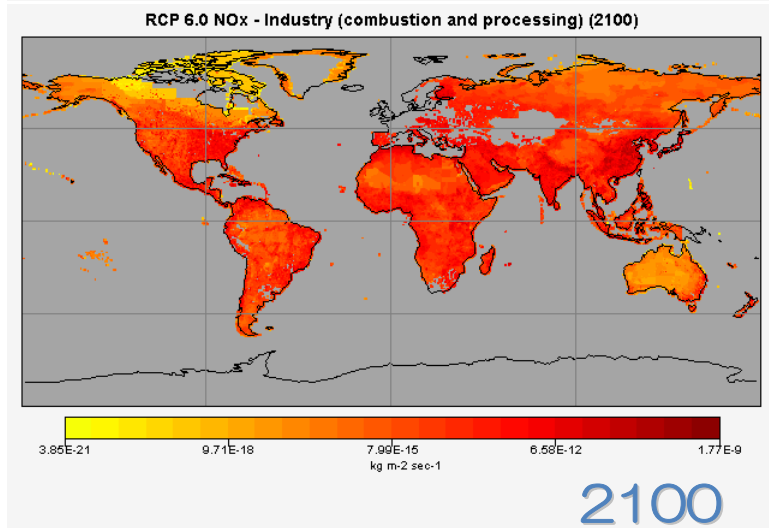
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Case 2

Global distribution at year 2000 is scaled by world total emissions.
SHP & AIR

$$E_s(x, y, t) = E_s(x, y, t_0) \times \frac{e_s(t)}{e_s(t_0)}$$

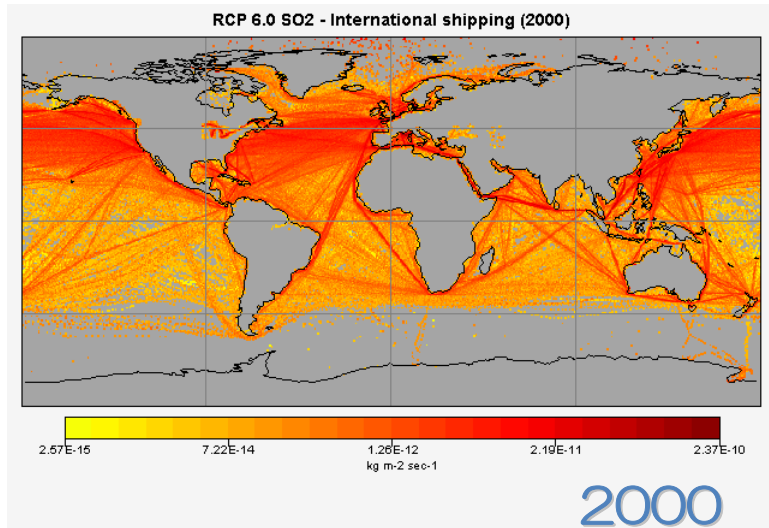
x : longitude y : latitude t : year s : sector

$E_s(x, y, t)$: gridded emissions from a sector s

$e_s(t)$: global emissions for sector s estimated by IAM

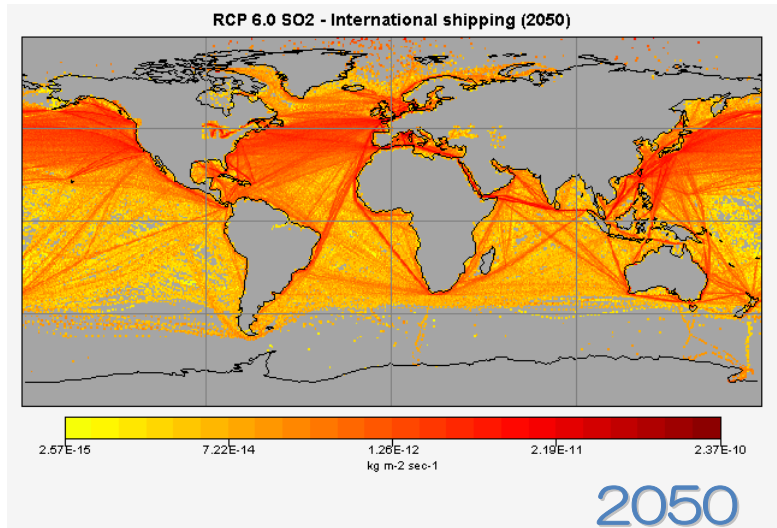
Spatial explicit emission scenarios

Case 2 (International shipping, SO₂)



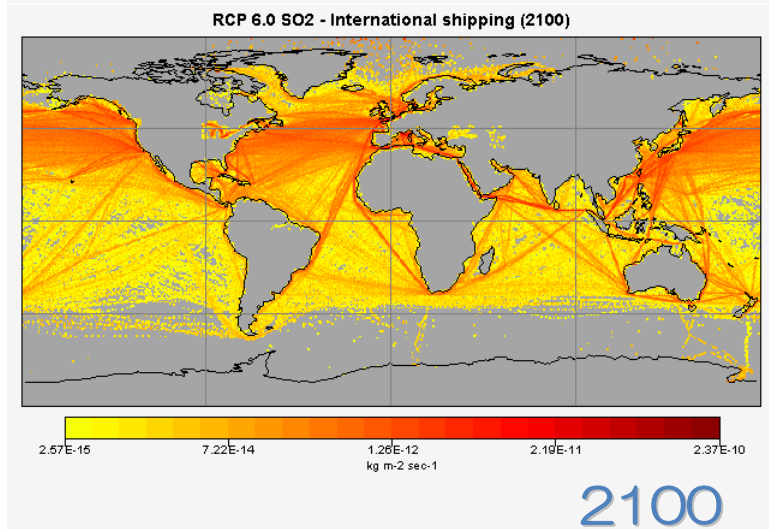
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Case 3

Regional distribution at year 2000 is scaled by regional total emissions for each region.

TRA & AGR

$$E_s(x, y, t) = \sum_r E_{r,s}(x, y, t_0) \times \frac{e_{r,s}(t)}{e_{r,s}(t_0)}$$

x : longitude y : latitude t : year r : region s : sector

$E_s(x, y, t)$: gridded emissions from a sector s

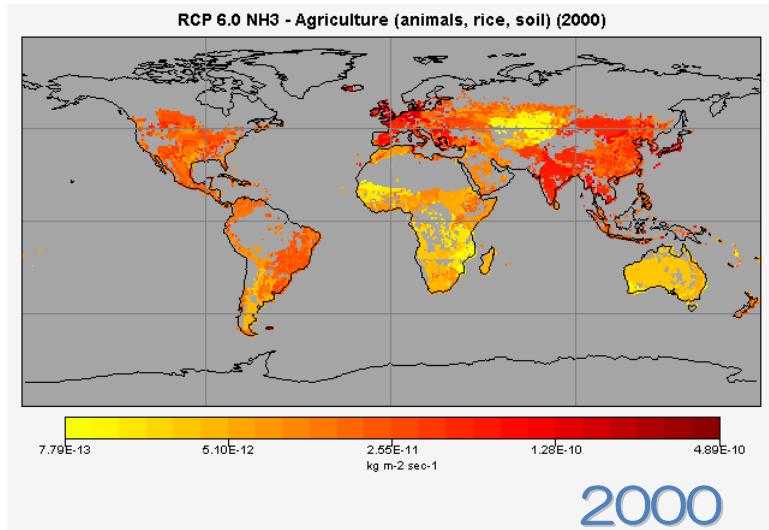
$E_{r,s}(x, y, t)$: gridded emissions region r and for sector s

$e_{r,s}(t)$: regional emissions for region r and for sector s estimated by IAM

$w_{r,s}(x, y, t)$: spatially explicit indicator for region r and for sector s

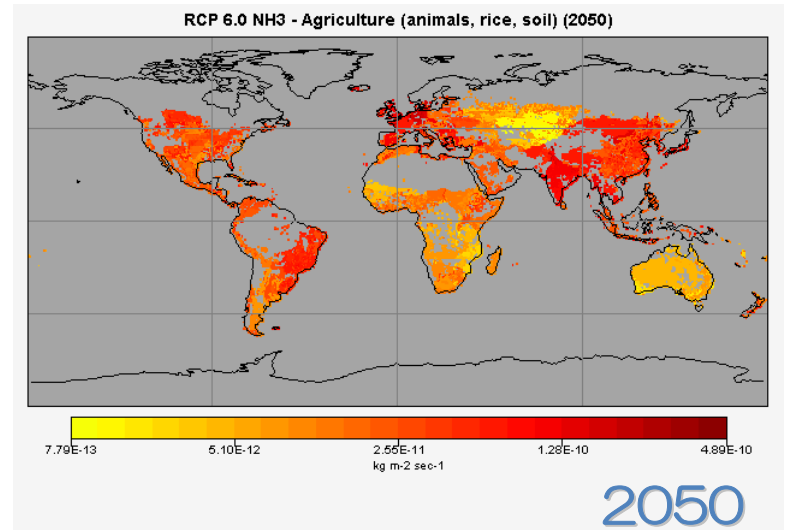
Spatial explicit emission scenarios

Case 3 (Agriculture, NH3)



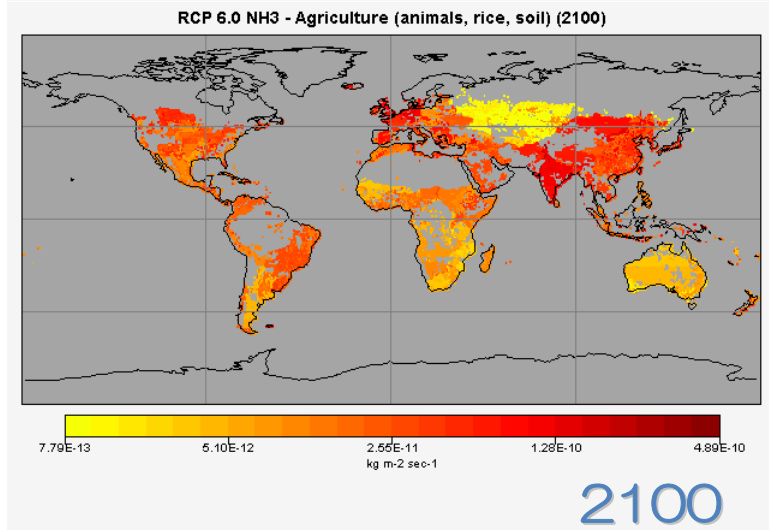
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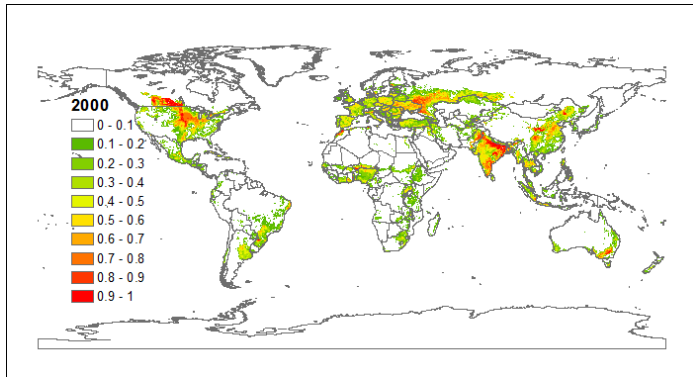
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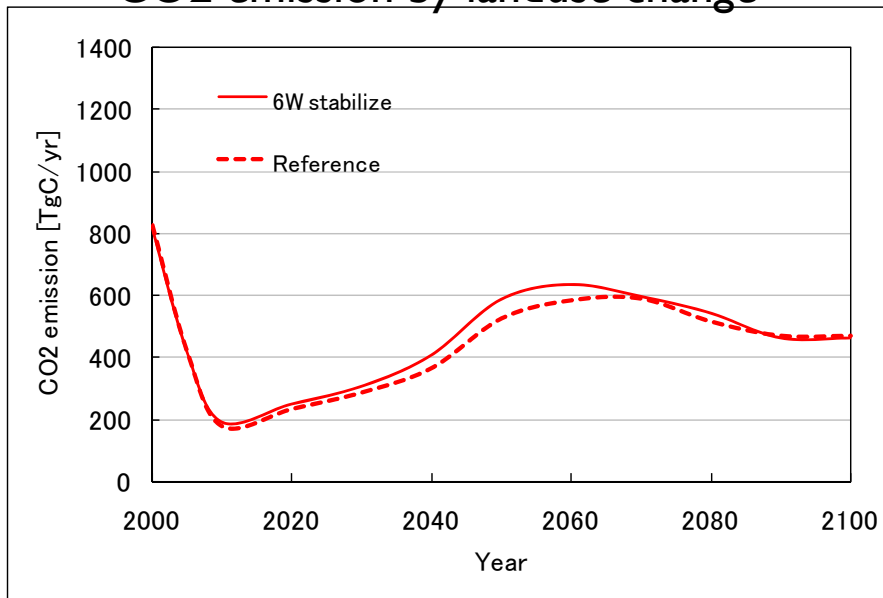
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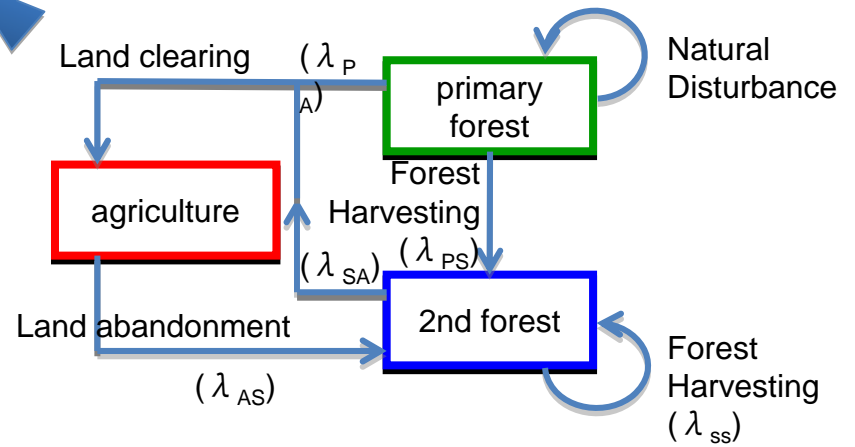
Ecosystem model



CO2 emission by landuse change



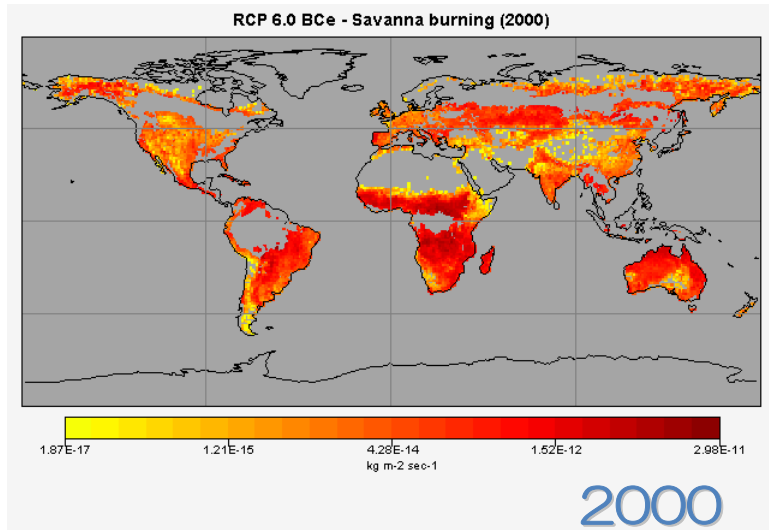
Transition Matrix (λ)



Assessing carbon cycle

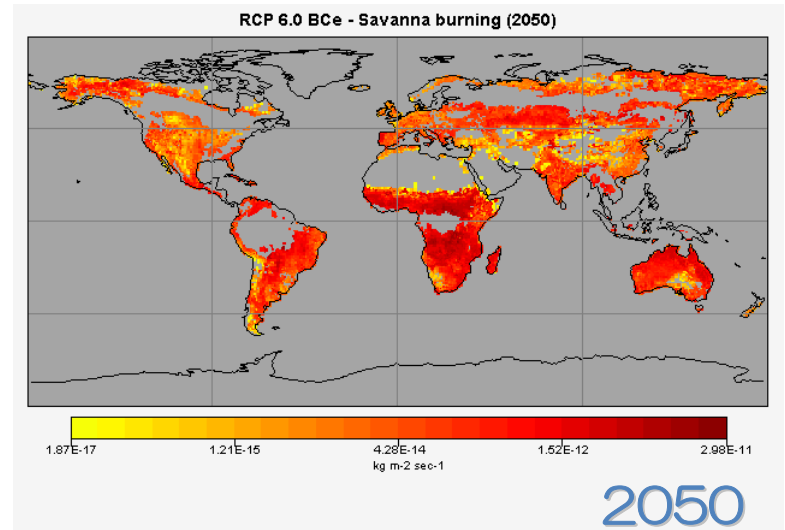
Spatial explicit emission scenarios

Case 4 (savanna burning, BC)



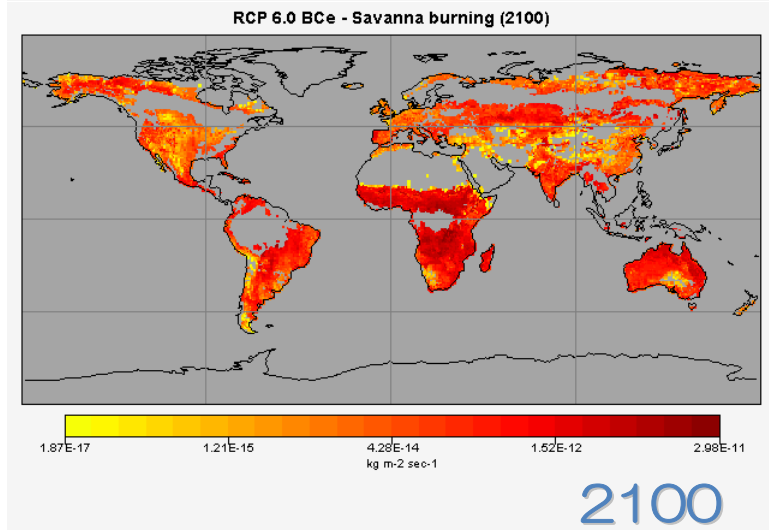
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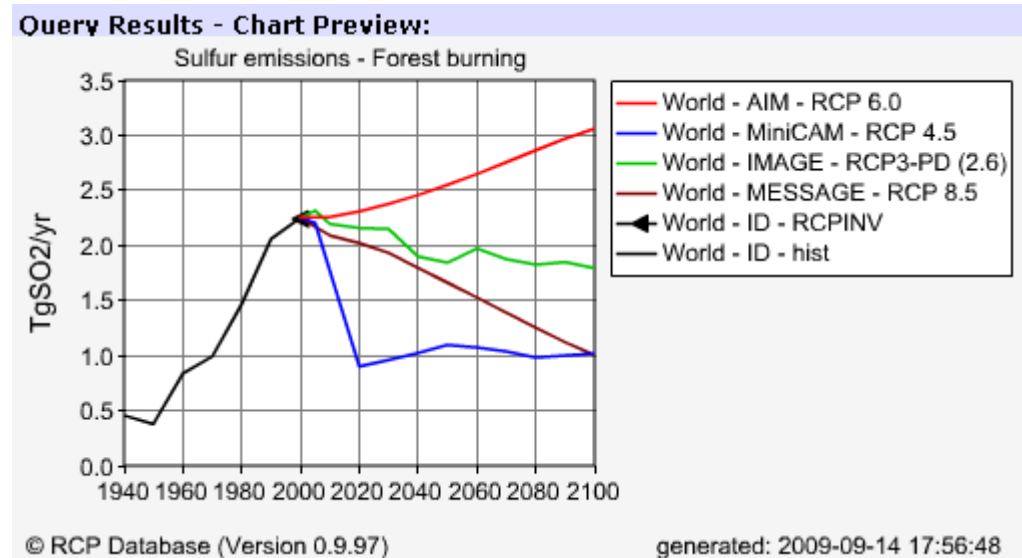


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Remaining works

- Emissions from landuse change are diverse among models.



- Extension to 2300.