Improvement and Application of Crop Productivity Model

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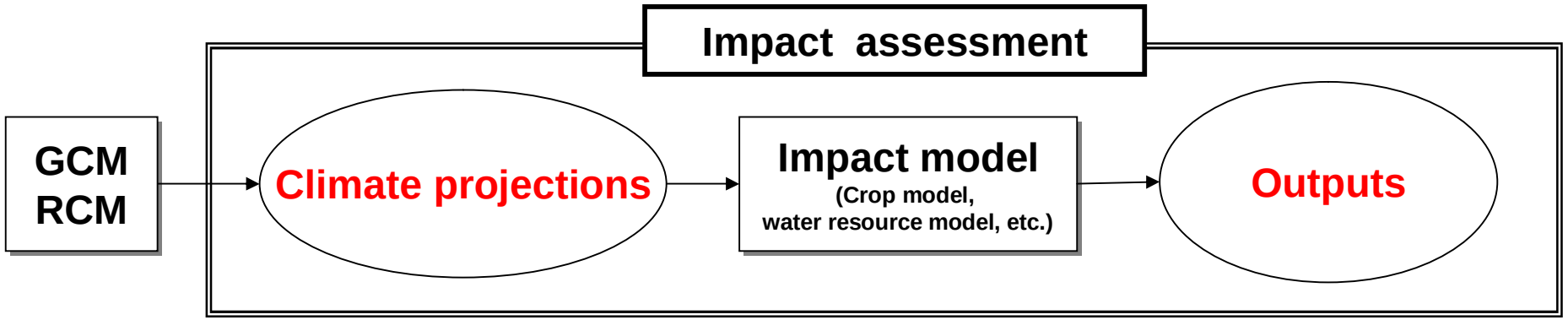
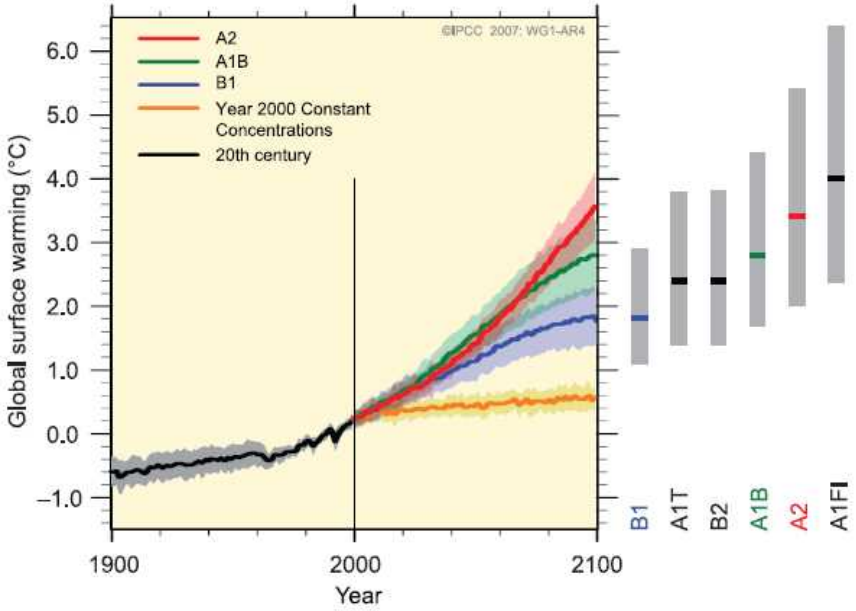
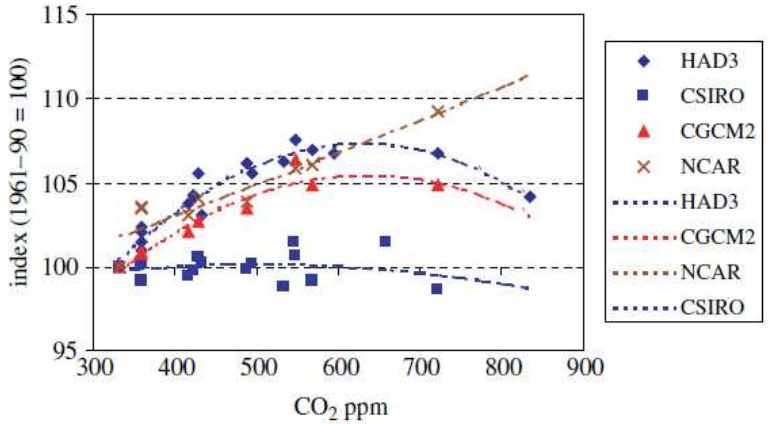
Part I
Impact assessment

-Uncertainty in impact assessment-





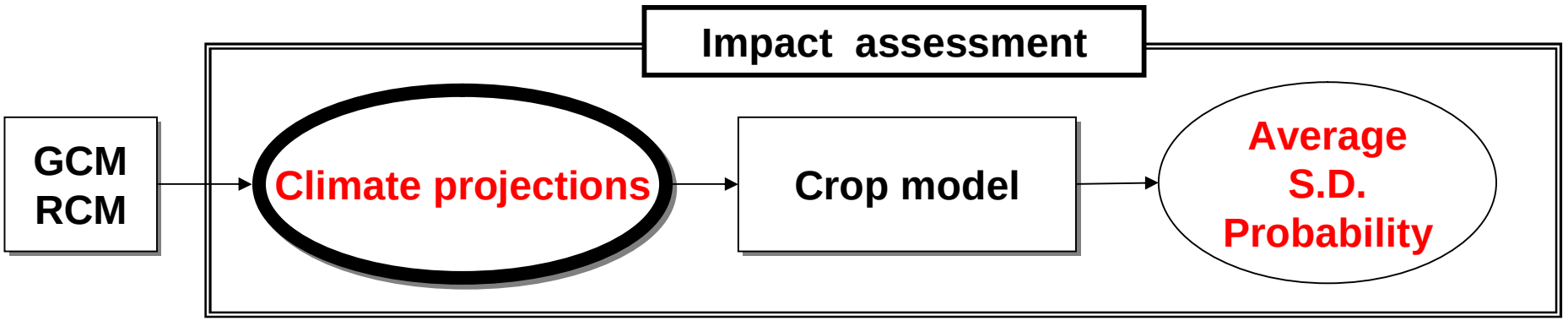
(IPCC AR4)



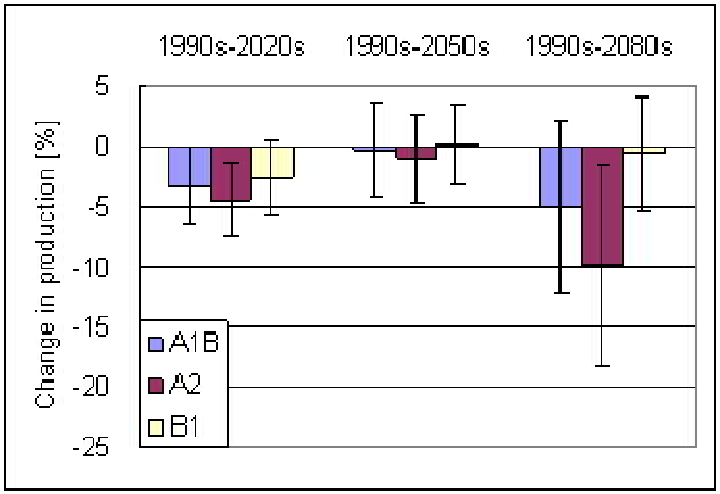
(Ficsher et al., (2005))

Climate projections (from PCMDI)

Country	Model name	A1B (18 GCMs)	A2 (14 GCMs)	B1 (17 GCMs)
Norway	BCCR-BCM2.0		○	○
Canada	CGCM3.1(T47)	○	○	○
Canada	CGCM3.1(T63)	○		○
France	CNRM-CM3	○	○	○
Germany	ECHAM5/MPI-OM	○	○	○
Germany / Korea	ECHO-G	○	○	○
China	FGOALS-g1.0	○		○
USA	GFDL-CM2.0	○	○	○
USA	GFDL-CM2.1	○	○	○
USA	GISS-AOM	○		○
USA	GISS-EH	○		
USA	GISS-ER	○	○	○
Russia	INM-CM3.0	○	○	○
France	IPSL-CM4	○	○	○
Japan	MIROC3.2(hires)	○		○
Japan	MIROC3.2(medres)	○	○	○
Japan	MRI-CGCM2.3.2	○	○	○
UK	UKMO-HadCM3	○	○	○
UK	UKMO-HadGEM1	○	○	



Result - Change in rice production in Asia -

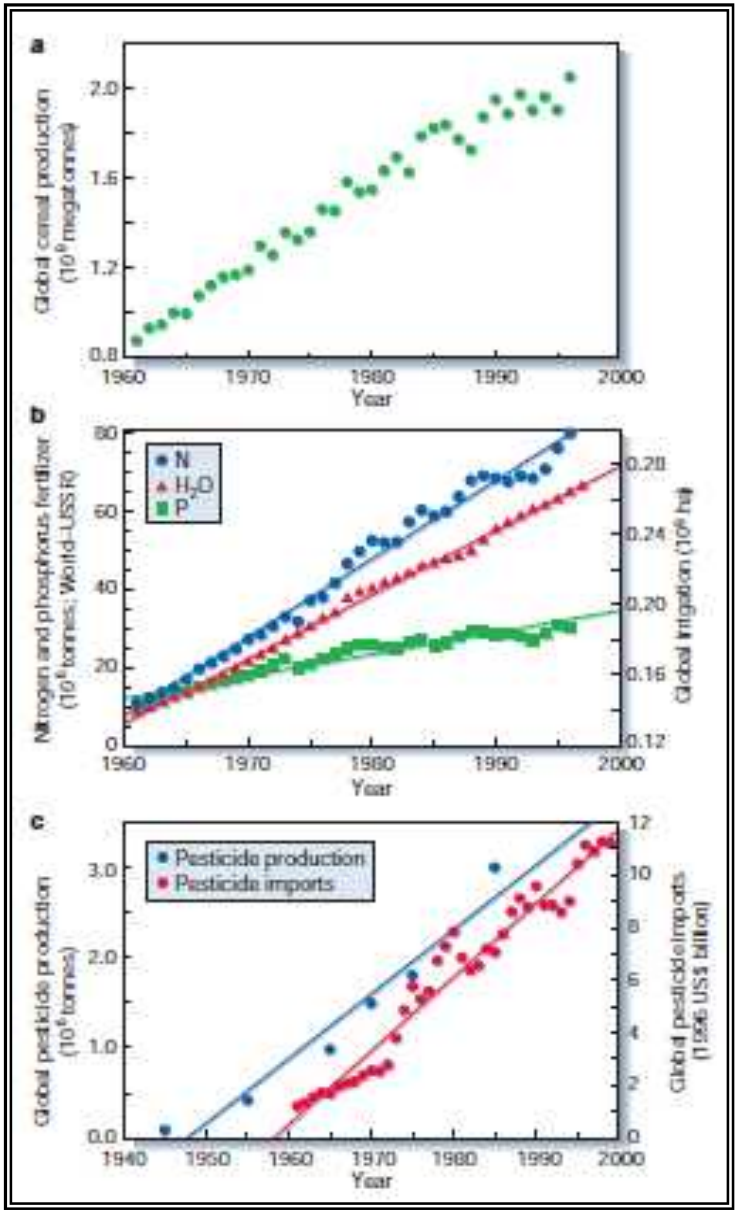


	2020s (vs. 1990s)			2050s (vs. 1990s)			2080s (vs. 1990s)		
	A1B	A2	B1	A1B	A2	B1	A1B	A2	B1
Average	-3.3	-4.5	-2.5	-0.3	-0.9	0.2	-5.0	-9.9	-0.5
S.D.	3.2	3.2	3.1	3.9	3.7	3.3	7.2	8.4	4.8
Pr. of production decrease	83.3	100.0	76.5	44.4	57.1	52.9	72.2	85.7	47.1

- **In the 2020s**
  - High probabilities of a production decrease
- **In the 2050s**
  - Small impact
- **In the 2080s**
  - Large difference in average change in procution among the SRES scenarios
    - A2 has the largest negative impact despite largest CO2 fertilization effect

Part II
Improvement of crop productivity model

Improvement of crop model



- Increase in chemical inputs and technological development brought the large increase in crop productivity for the last 4 decades

- When we assess the impact of climate change and discuss future food security, it is necessary to consider the increase in crop productivity

Unfortunately, AIM/Agriculture model (AEZ model) can not simulate the response of crop to chemical inputs.

Preliminary result

- I developed a new global crop model (G-SWAT)
  - Based on SWAT model
  - Simulate nitrogen and phosphorus cycles in soil.

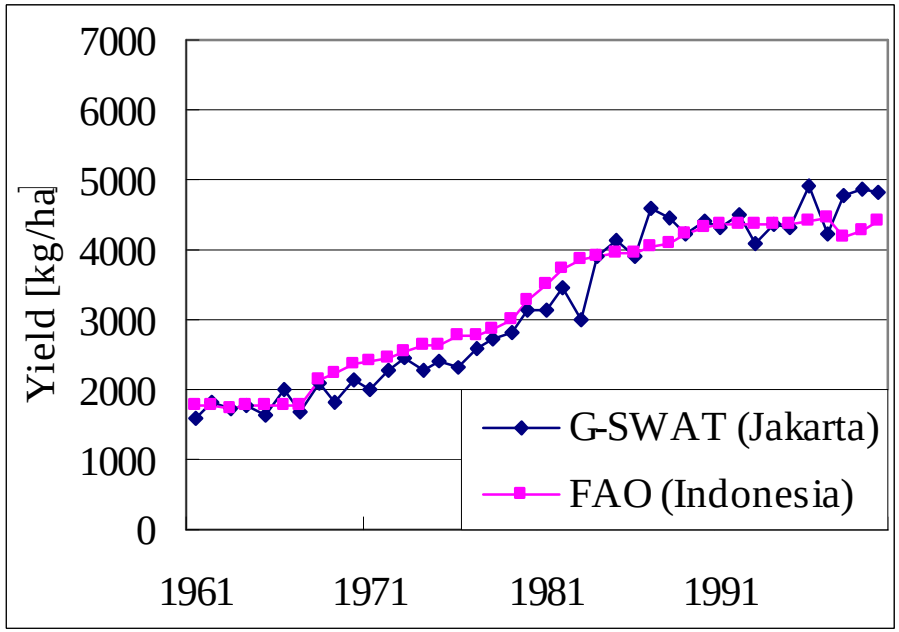


Fig. 1. Comparison of trend in rice yield between G-SWAT (Jakarta) and FAO (Indonesia).

- Considering changes in the amount of nitrogen input and changes in cultivars

Future challenges

- Further improvement of the new crop model
  - Parmeterization
- Impact study
  - Adaptation policy assessment
    - Globally and locally
  - Crop model uncertainty
- Environmental pollution
  - Emission of N_2O
  - Fertilizers and pesticide load
- Model linkage
  - AIM/Impact[policy] (Dr. Hijioka)
  - Water resources model (Dr. Hanasaki)
  - Economic model (Drs. Masui and Matsumoto)
  - Carbon cycle model (Dr. Ito)
  - Land use change model (Dr. Kinoshita)

Thank you for your attention!