International Symposium on Southeast Asian Tropical Forest Research related with Climate Change and Biodiversity

A model-based assessment of the impacts of land-use change in Southeast Asia for mitigation and adaptation

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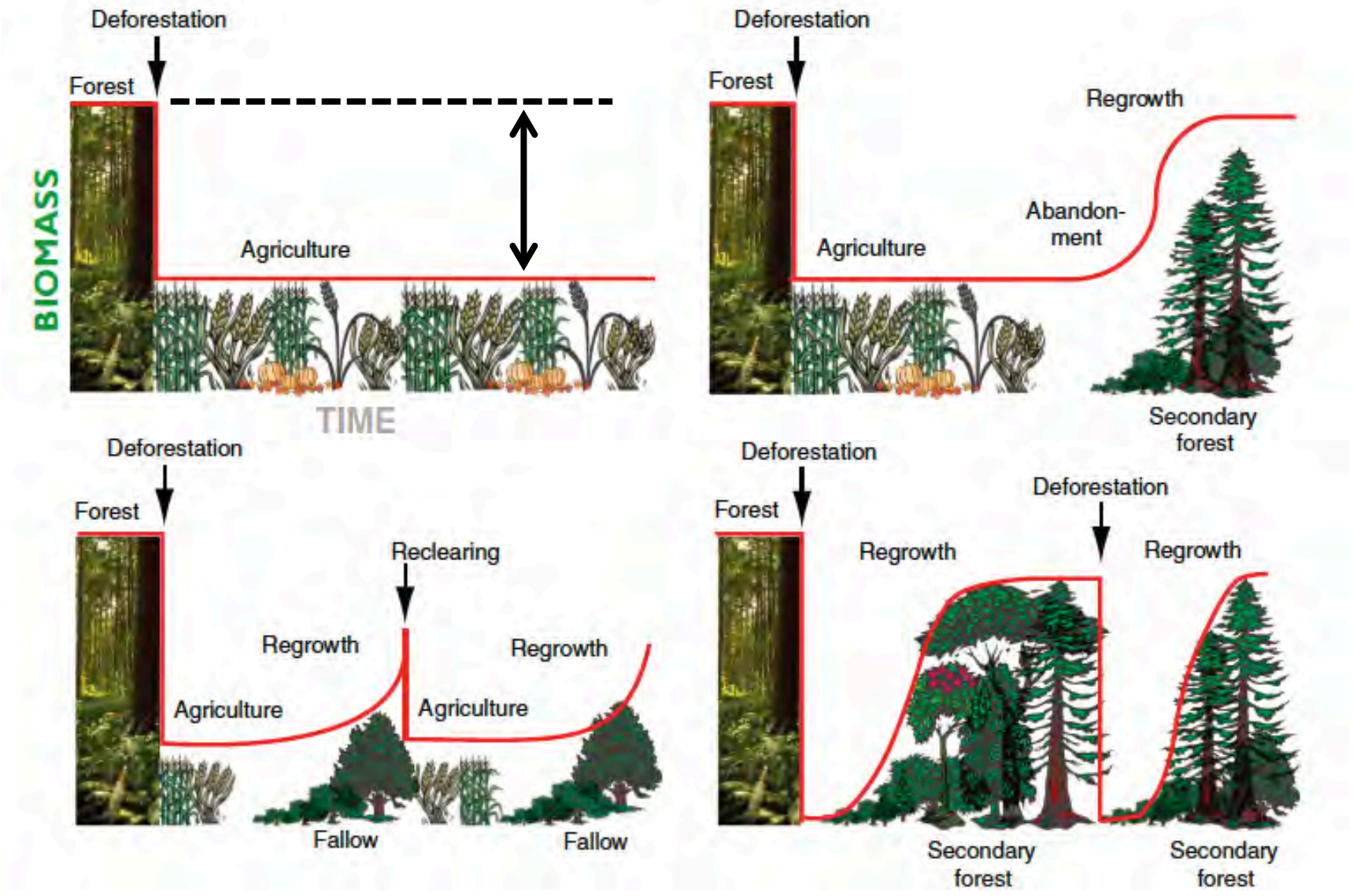
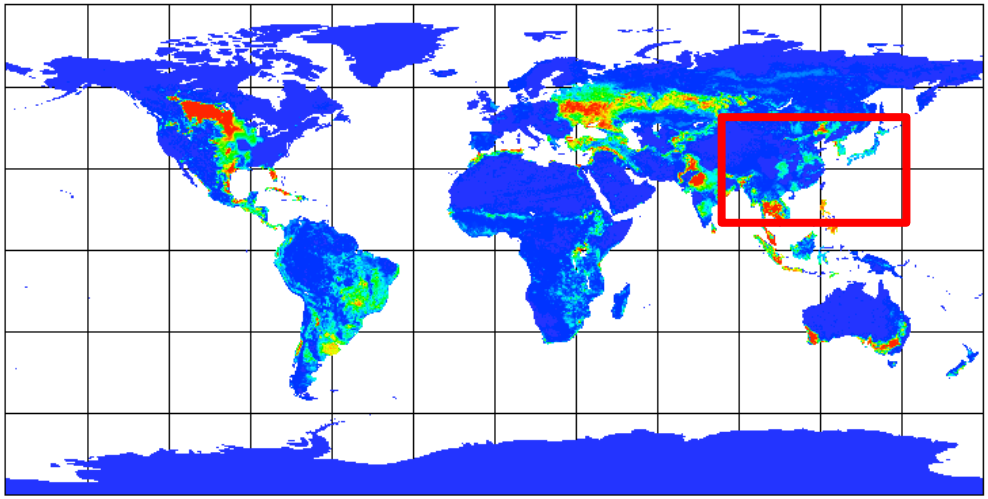
Land-use change and biomass



Ramankutty et al. (2007)

Global estimation (preliminary)

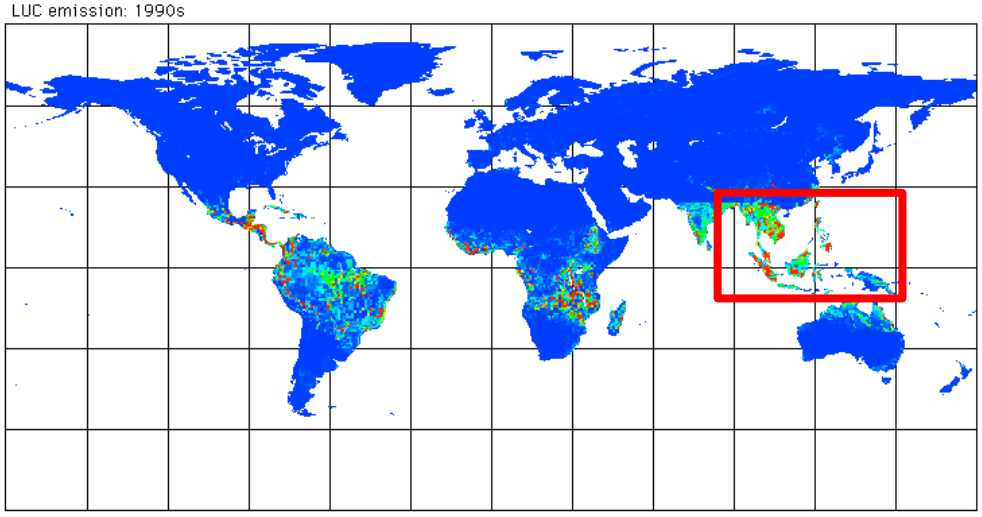


Land-use (inc. croplands)
1901～1990

Cropland increase (fraction)

0 0.2 0.4 0.6 0.8 1.0

(Data: Hurtt et al. 2006)



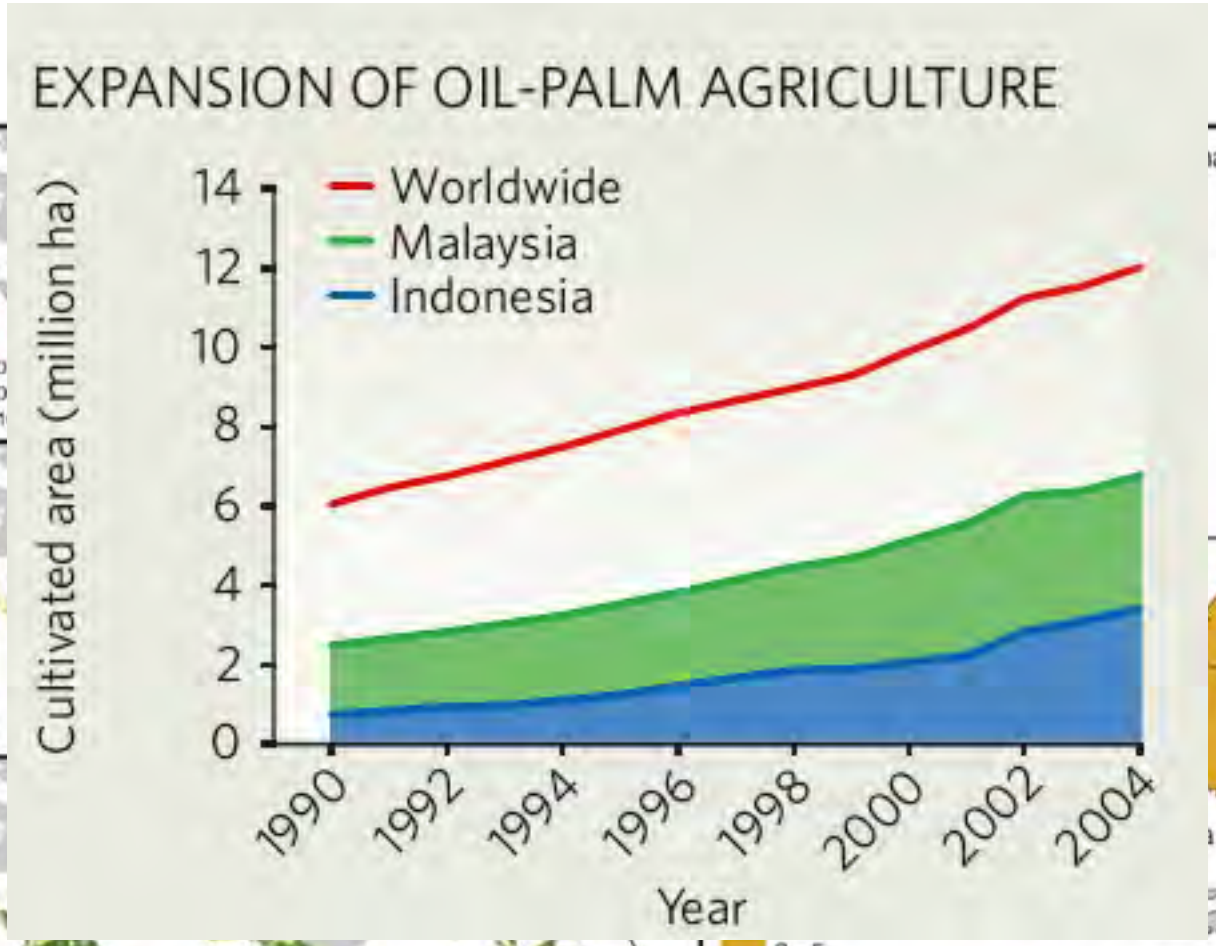
Estimated CO_2 emission
by VISIT、1990s

Emission (g C / m² / yr)

0 20 40 60 80 100 120 140 160

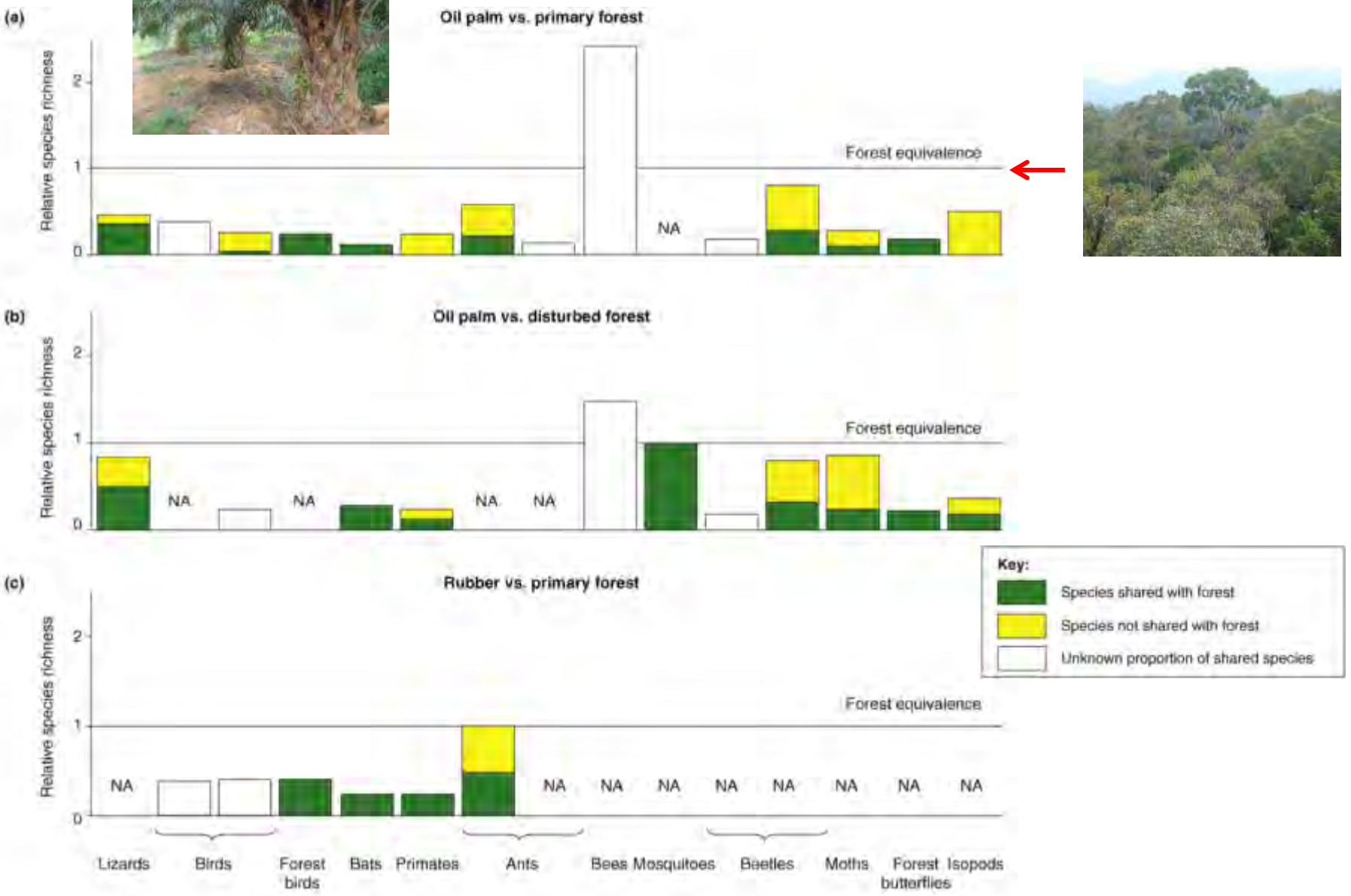
(Ito et al. in preparation)

Oil palm plantation in SE Asia



Fitzherbert et al. (2008), Koh (2007)

Biodiversity decline



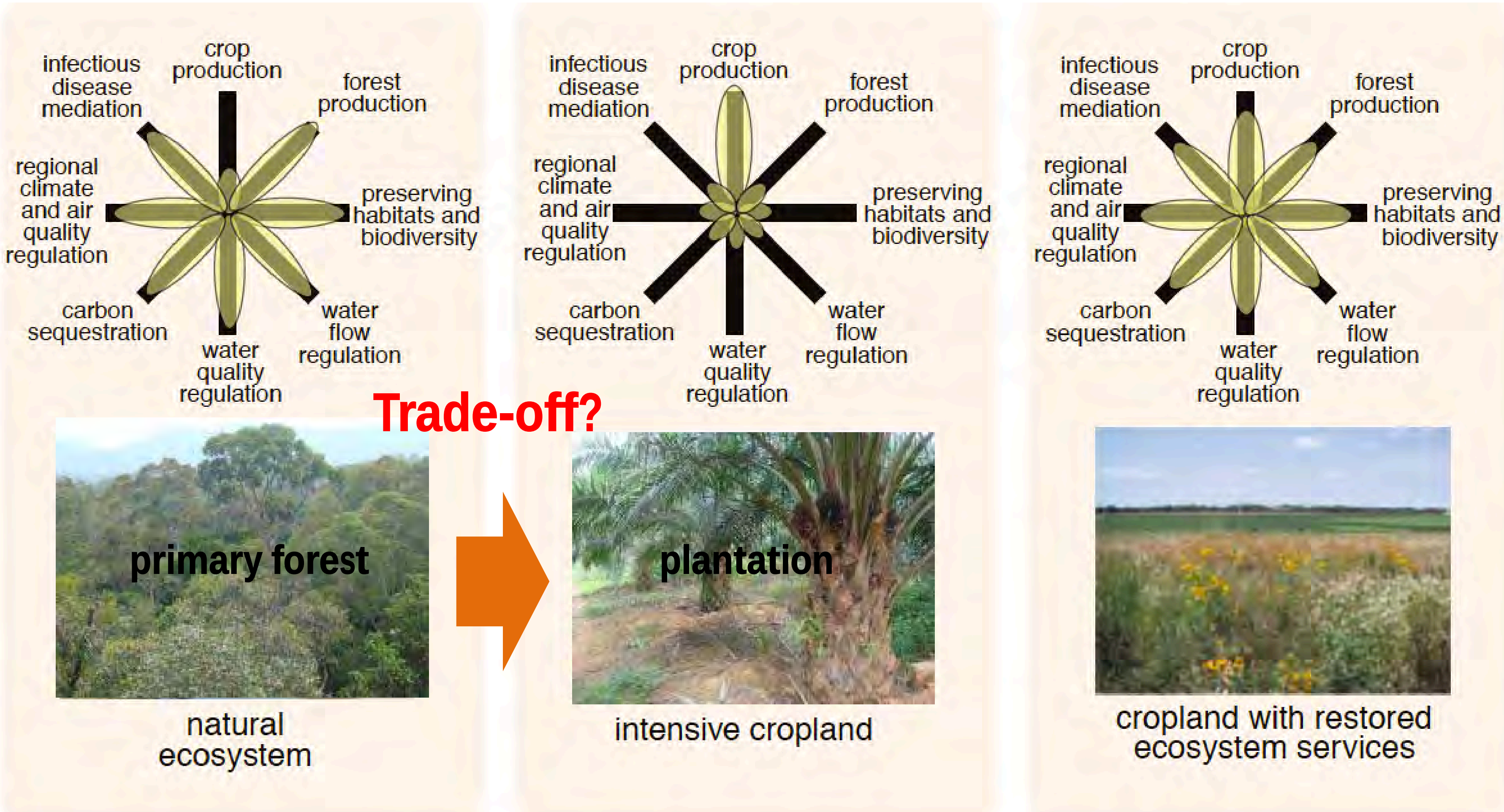
Fitzherbert et al. (2008)

Ecosystem services

=> biodiversity
=> resilience / adaptation?

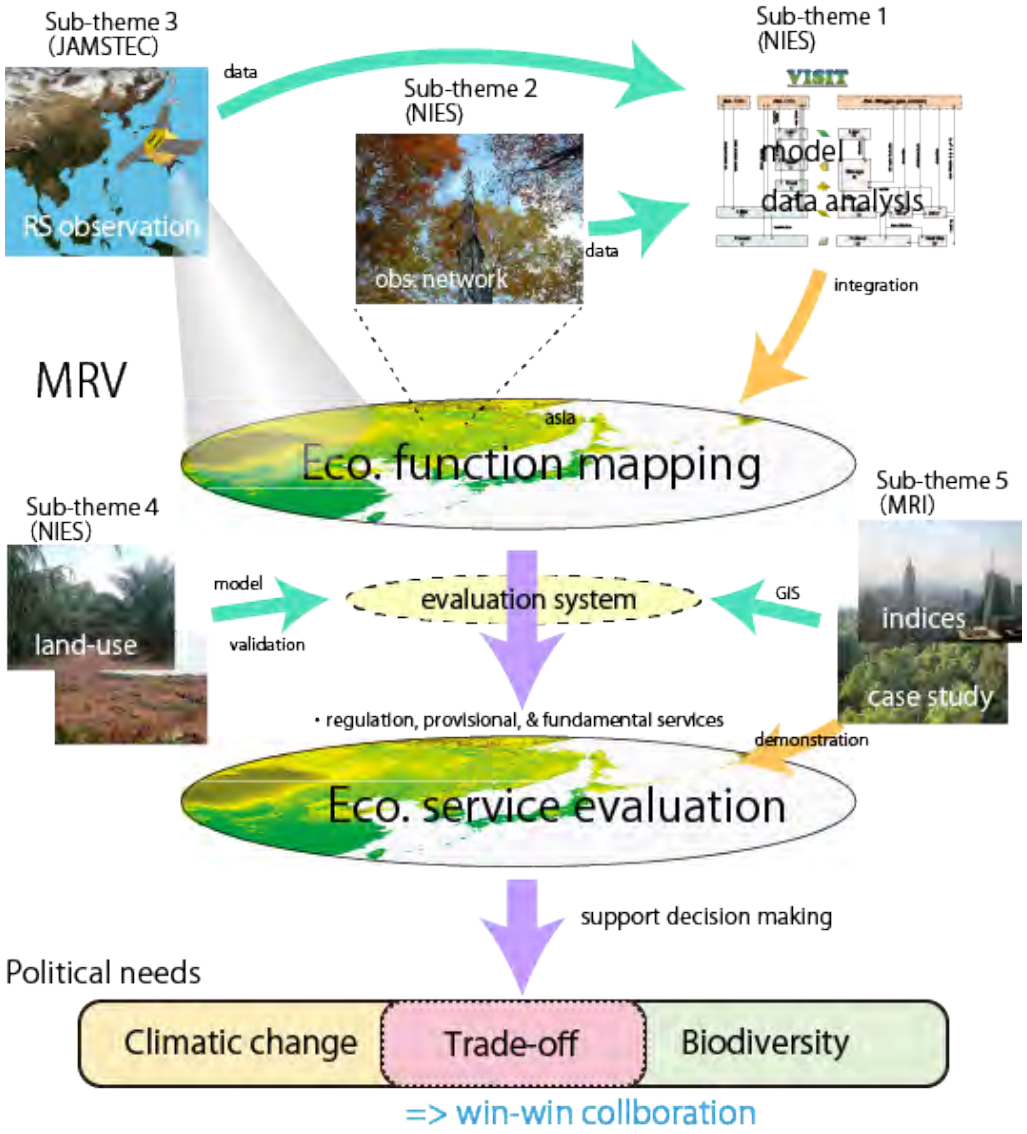
=> biofuel crop
=> mitigation

Best mix?



Foley et al. (2005)

Ecosystem service evaluation



Environmental Research Fund by the Ministry of Environment

"Development of Evaluation Method of Ecosystem Services to Find Good Balance between Climate Change Prevention and Biodiversity Conservation [F-1101]" FY2011–2013

by

- NIES
- JAMSTEC
- MRI

at

- Kushiro, Japan
- Yokohama, Japan
- Lambir/Pasoh

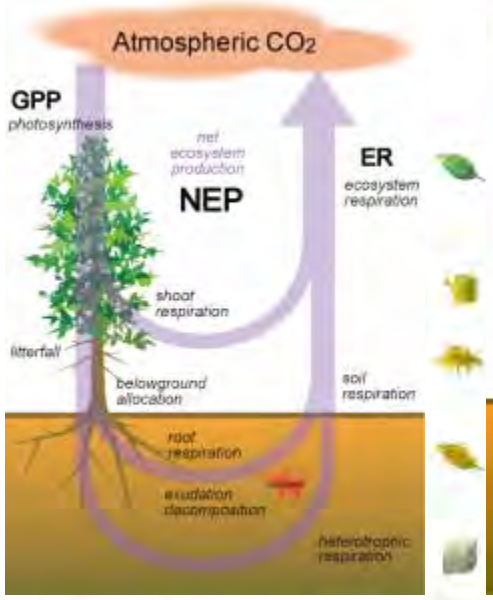
Terrestrial C&N-cycle model

VISIT **Vegetation Integrated SImulator for Trace gases**

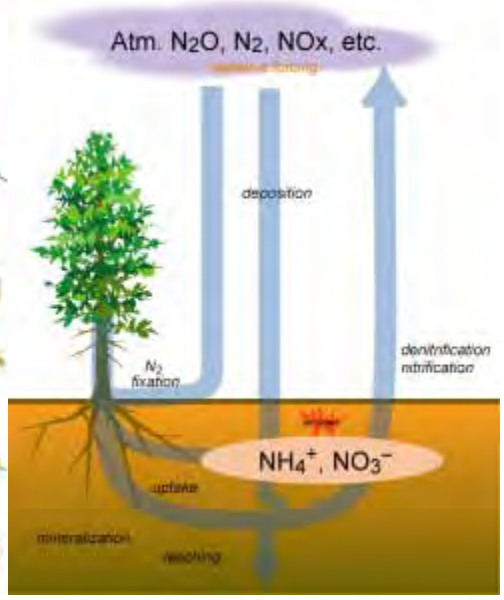
(Developed in NIES & FRCGC-JAMSTEC)

Objectives

- Atmosphere-ecosystem biogeochemical interactions
- Assessment of climatic impacts and biotic feedbacks
- Ecosystem functions related to ecosystem services



Carbon-cycle
(Sim-CYCLE-based)

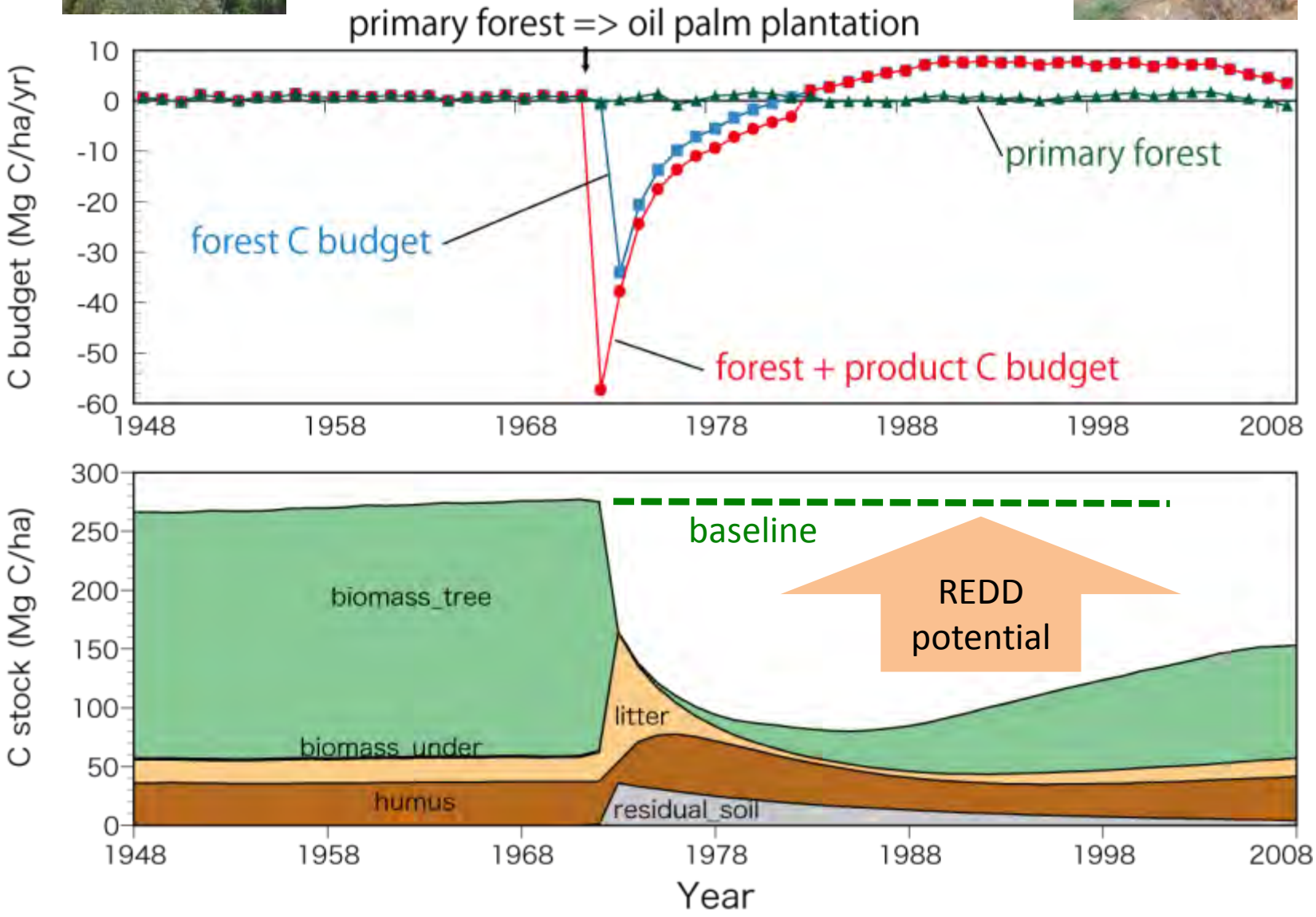


Nitrogen-cycle

Point-global, daily-monthly

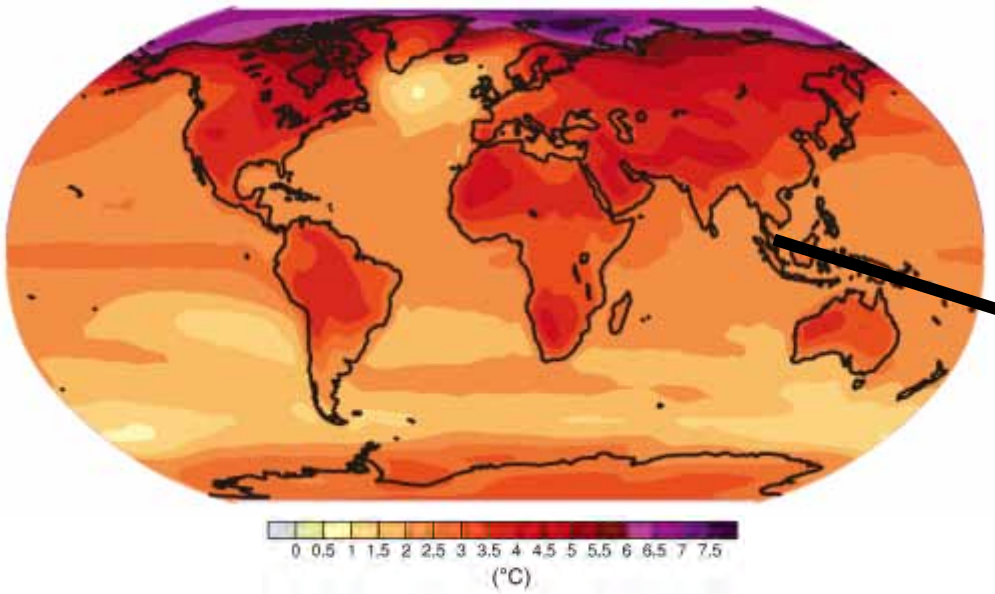
- CO_2: photosynthesis & respiration
- CH_4: production & oxidation
- N_2O: nitrification & denitrification
- LUC emission: cropland conversion
- Fire emission: CO_2, CO, BC, etc.
- BVOC emission: isoprene etc.
- Others: N_2, NO, NH_3, erosion

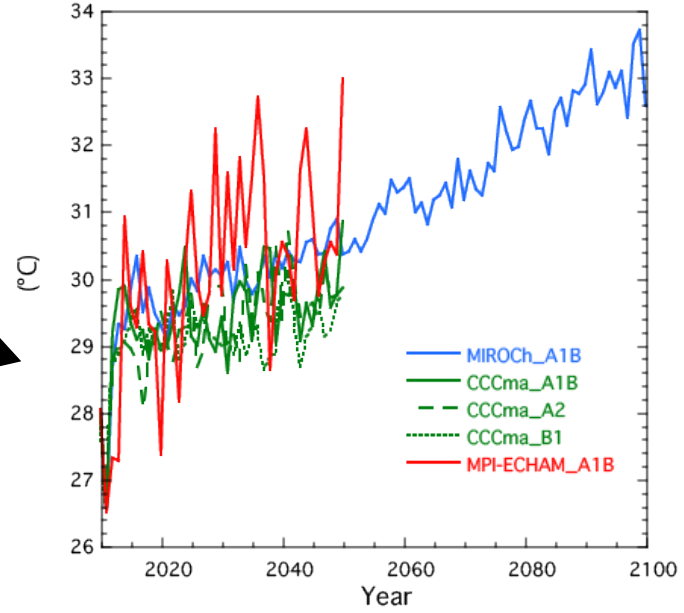
Simulated carbon budget

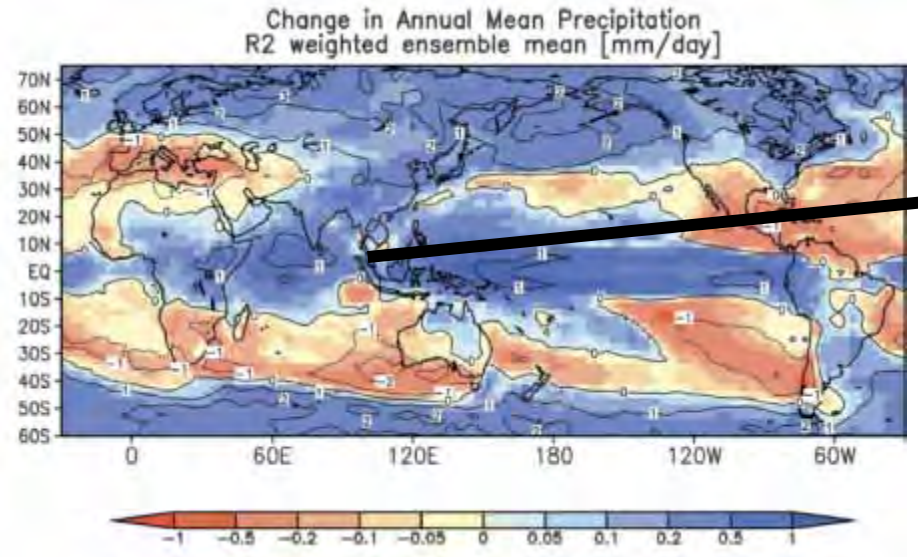


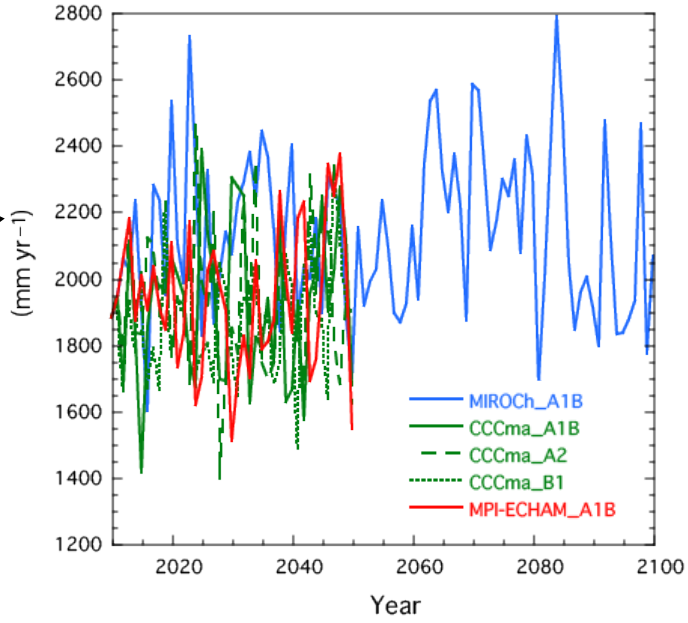
Climate projection

Change in Annual Mean Temperature (° C)





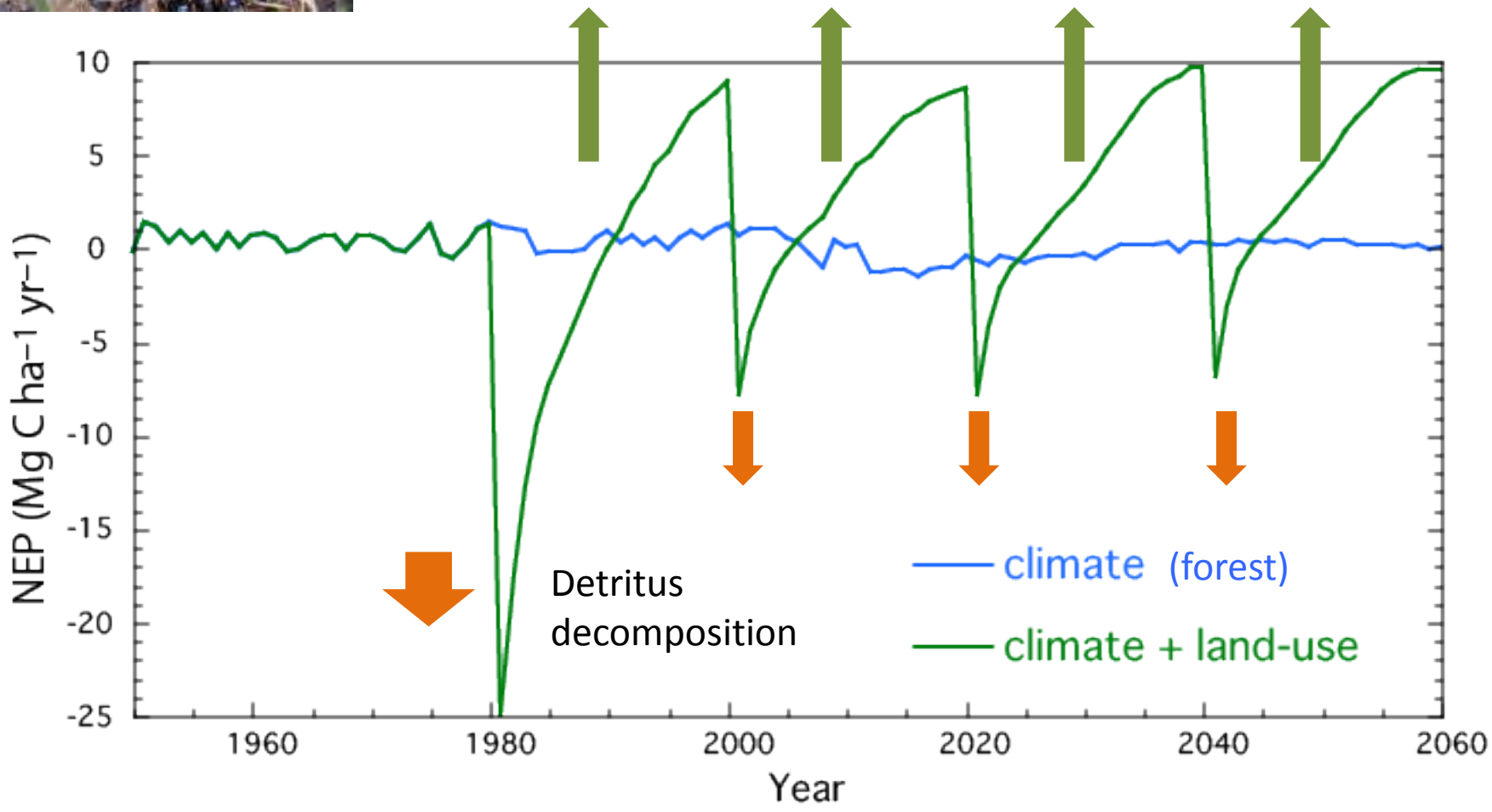




IPCC (2007), Nohara et al. (2006)

Ecosystem projection

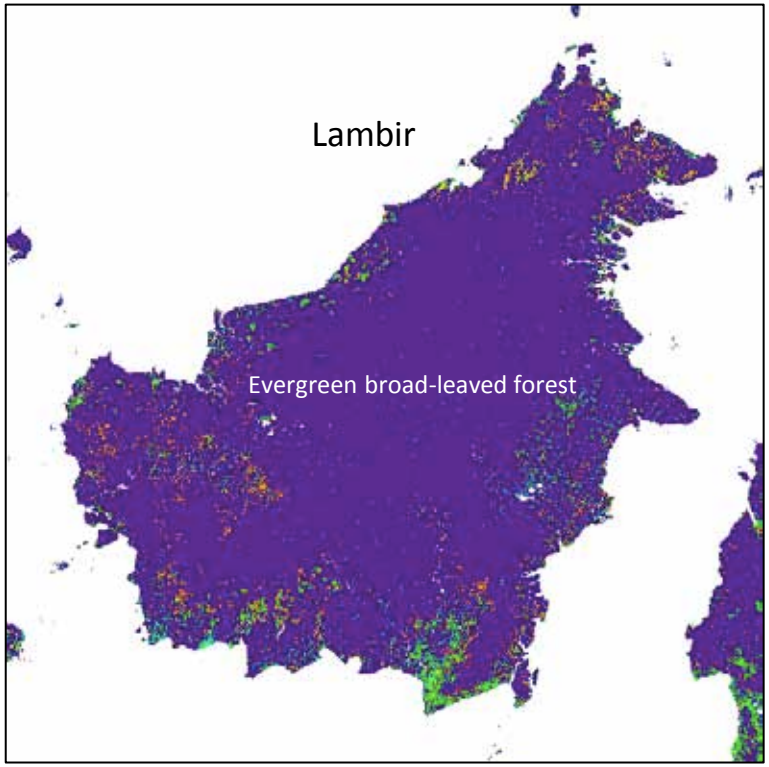
Harvest of oil palm (av. 3.3 Mg C/ha/yr)



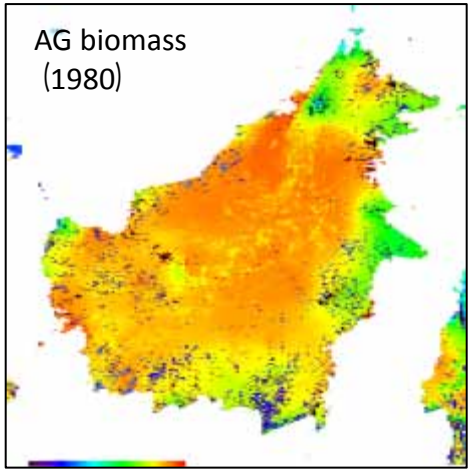
(climate: MIROC-h A1B)

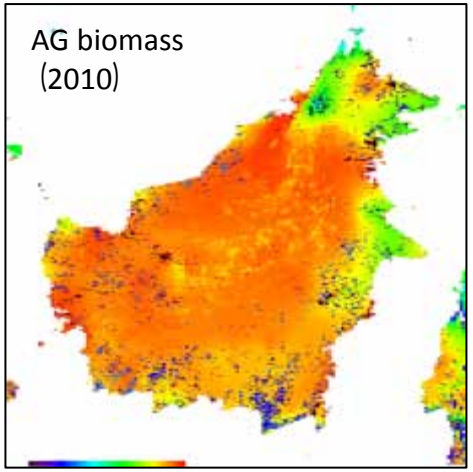
Regional-scale study

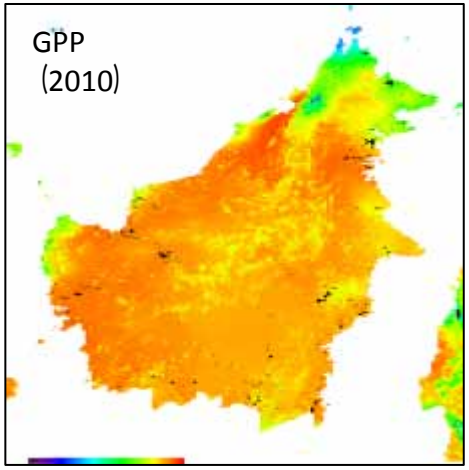
Land cover (MODIS)
=> 1km mesh

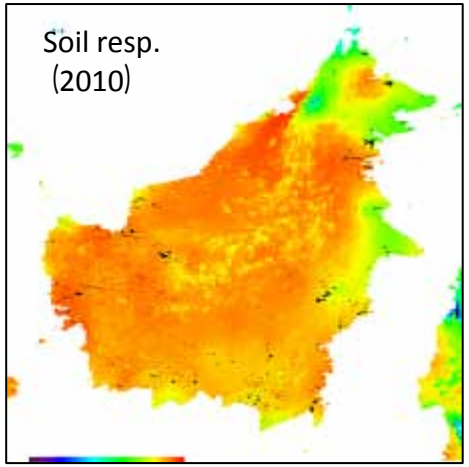


Model estimation



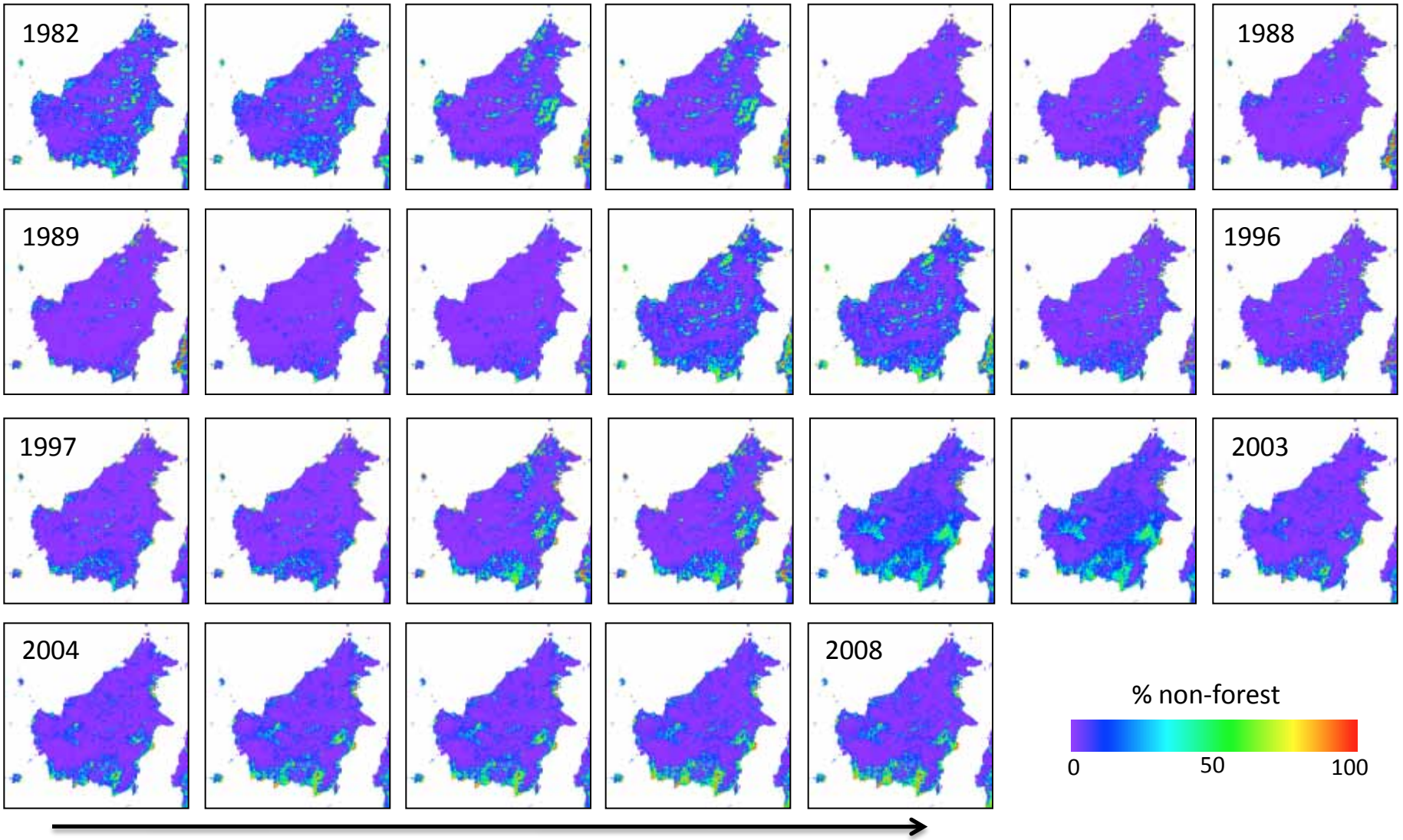






Time-series of forest cover

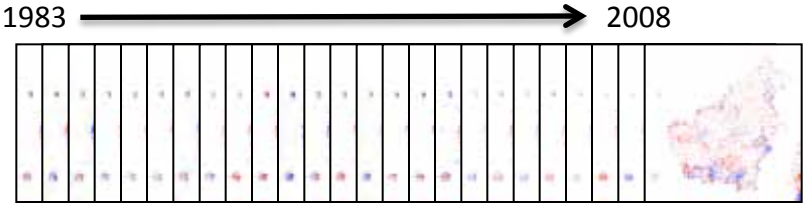
(NOAA-AVHRR, SPOT-VEGETATION, TERRA-MODIS)



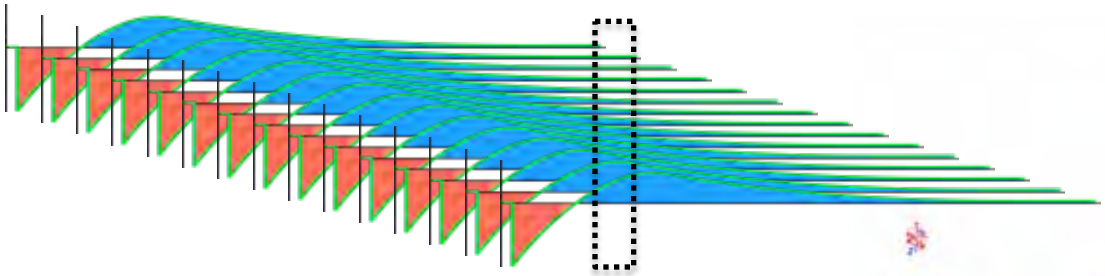
(data by W. Takeuchi of IIS, University of Tokyo)

1st guess

Time-series of forest cover change (RS obs.)



Temporal pattern of carbon budget (model)

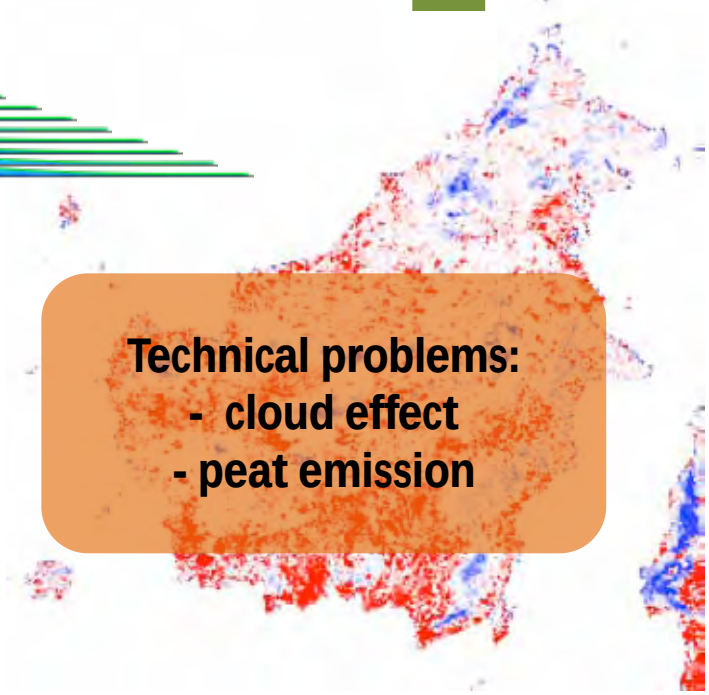


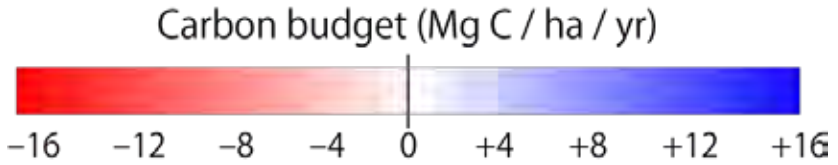
MRV for REDD(+,++)

Σ

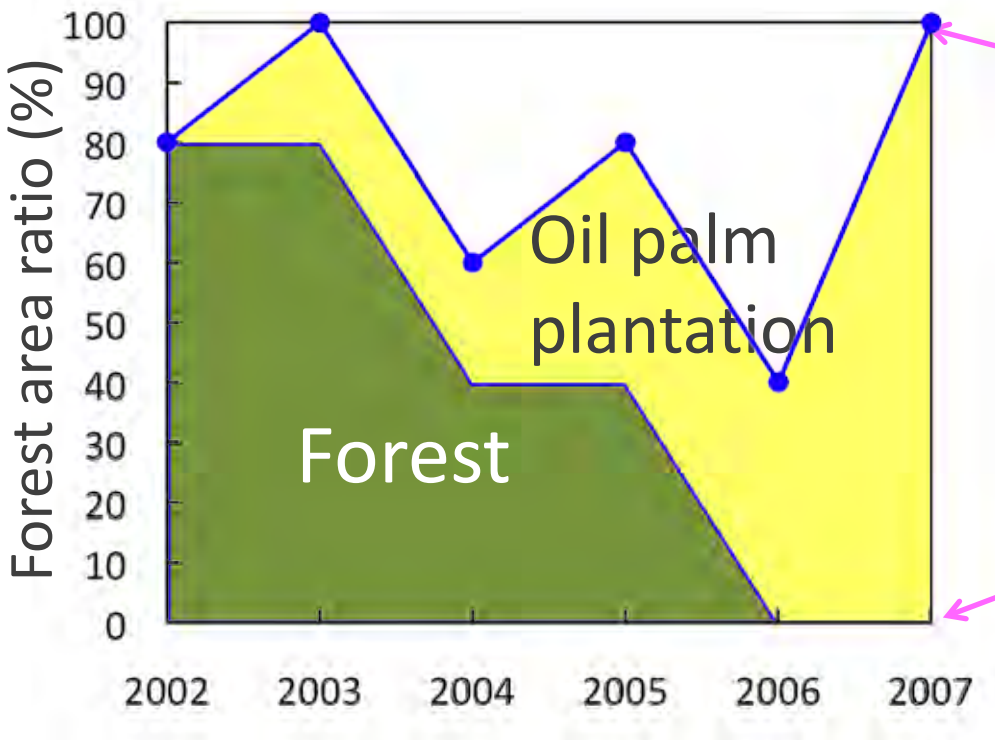
Technical problems:
- cloud effect
- peat emission

Spatial distribution of net carbon budget induced by deforestation on Borneo Island





Revised estimation



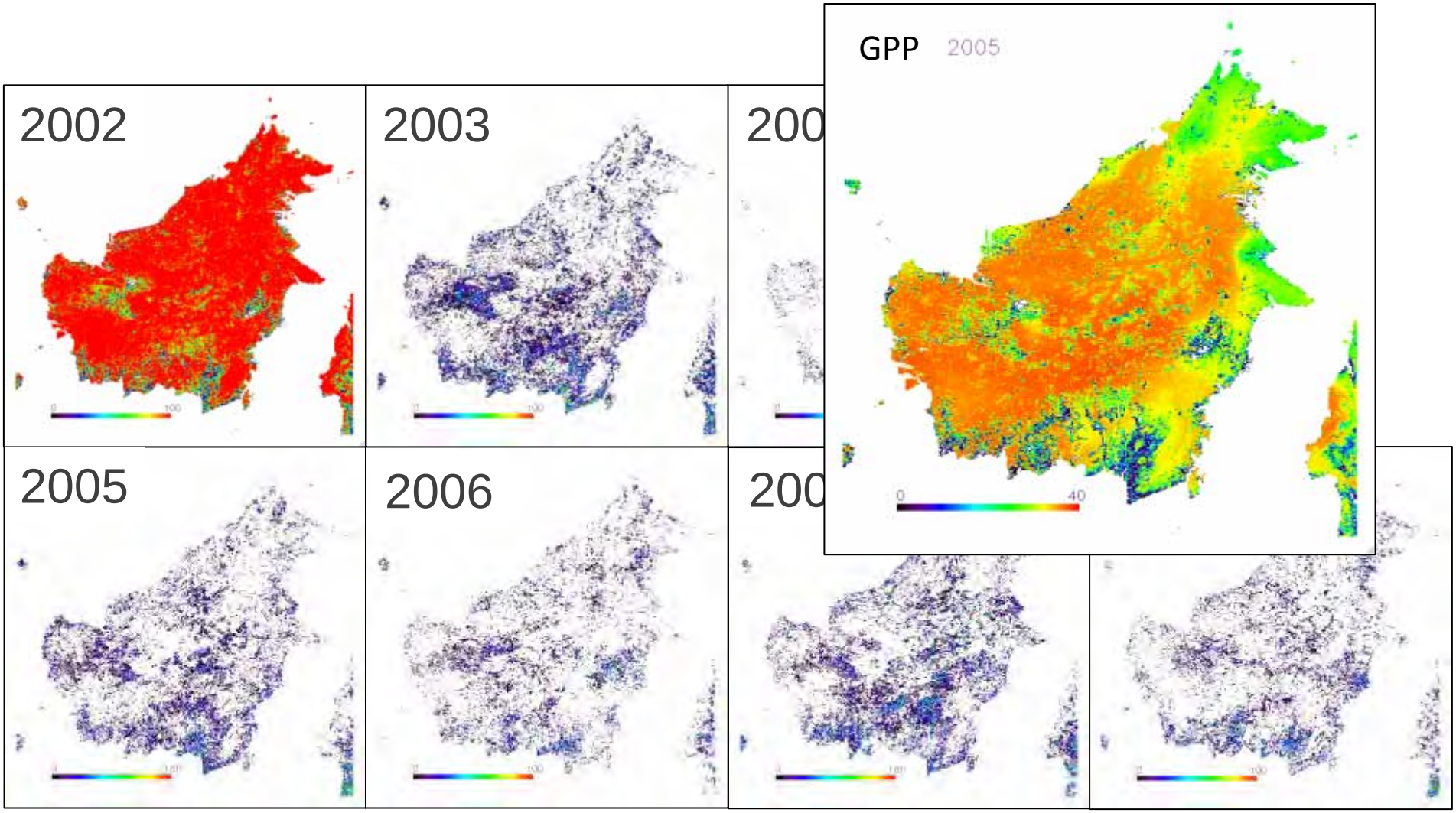
Forest / no-forest was 100%.

Considering land-use history,
Forest area was 0%.

Assumption :

1. Forest area does not increase.
2. when “forest area” increases,
   area of oil palm plantation increases.

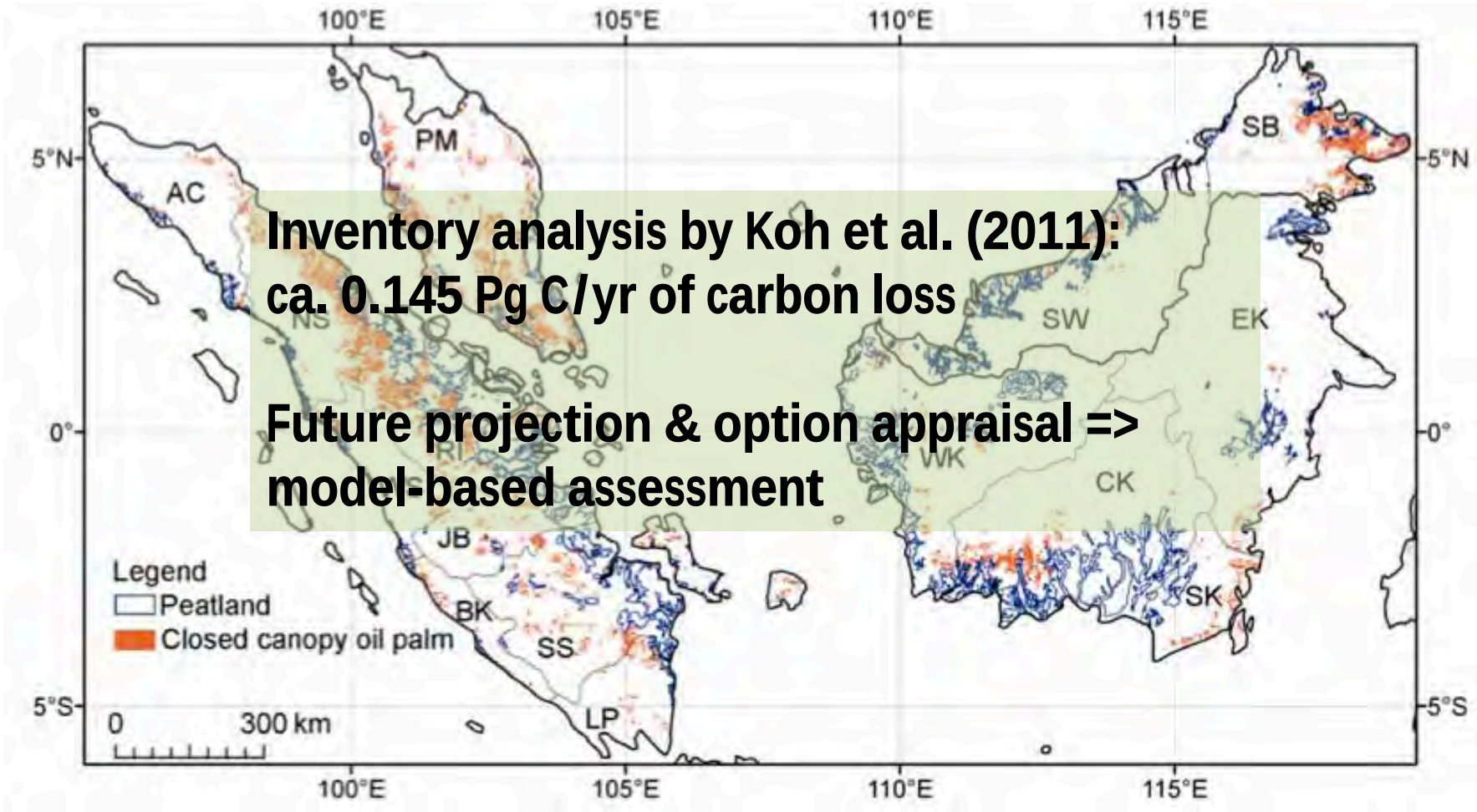
Land-use change and C budget



Area of oil palm during 6 years：147,815km^2

Peat lands and oil palm plantations

Drainage may result in more CO_2 emission but less CH_4 emission.



Inventory analysis by Koh et al. (2011): ca. 0.145 Pg C/yr of carbon loss

Future projection & option appraisal => model-based assessment

Koh et al. (2011)

Conclusion

• Impacts of rapid land-use change (e.g., oil palm plantation) in Southeast Asia should be clarified in a scientific manner.

• Ecosystem service would be a key term in considering ecosystem management under climate change and land-use change, toward mitigation and adaptation.

• Advanced monitoring and ecosystem modeling, including regional characteristics (e.g., peat lands), are required.

• Future works: biodiversity loss, total GHG appraisal, evaluation of mitigation/adaptation options etc.

Ecosystem services