

Integrating ground observation, satellite remote sensing & terrestrial ecosystem model for future forest carbon monitoring systems

N Saigusa, A Ito, Y Yamagata
Center for Global Environmental Research,
National Institute for Environmental Studies,
Tsukuba, Japan

Photo: Tower in a larch forest (Fuji Hokuroku site), Central Japan



Contents

1. Networking ground observations for long-term C-budget monitoring in Asia
2. Integrating ground observation, remote sensing & terrestrial ecosystem model
3. Summary: Toward future forest C-monitoring systems



Contents

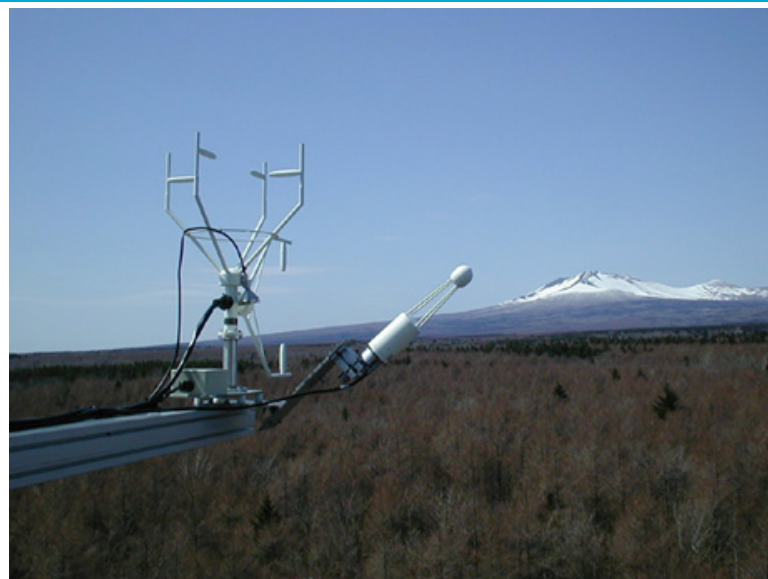
1. Networking ground observations for long-term C-budget monitoring in Asia
2. Integrating ground observation, remote sensing & terrestrial ecosystem model
3. Summary: Toward future forest C-monitoring systems



1. Networking ground observations for C-budget

FLUXNET: (1996~)

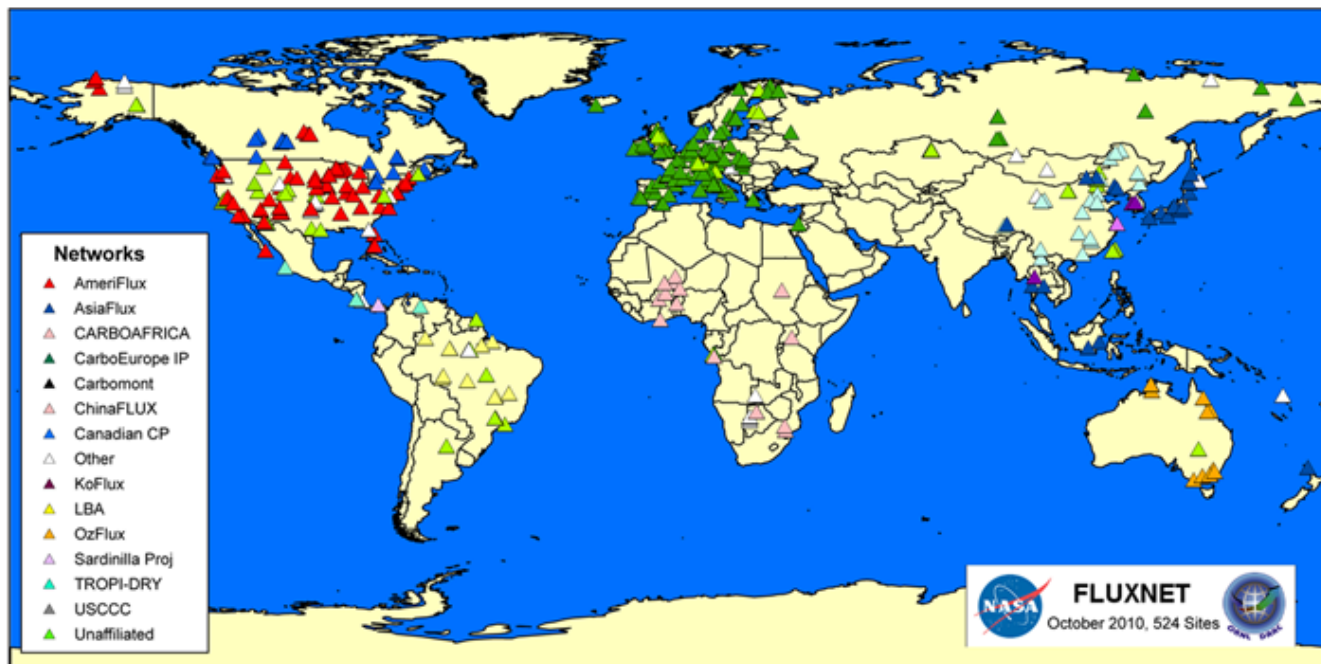
World-wide network for monitoring CO₂, H₂O, and energy exchanges between terrestrial ecosystems and the atmosphere (> 500 sites)



Instruments for eddy covariance method

Distribution of FLUXNET sites

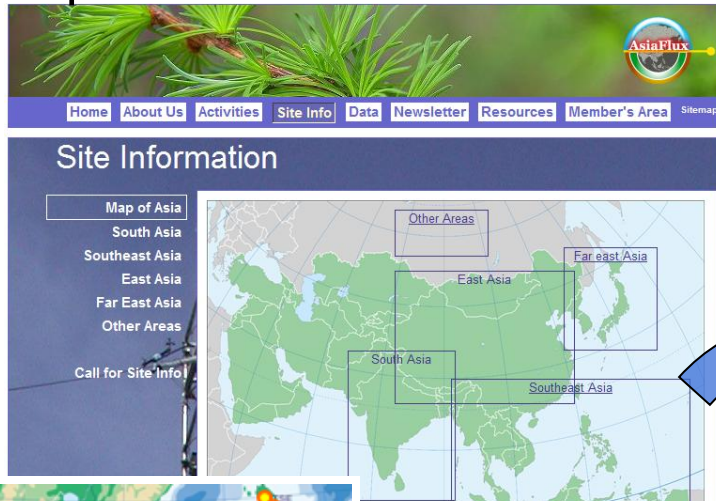
<http://fluxnet.ornl.gov>



1. Networking ground observations for C-budget

AsiaFlux: a regional network in FLUXNET (1999~)

<http://asiaflux.net/>



Organization

- Chair: Kim J (Korea)
- Vice-chairs: Miyata A (Japan)
Li SG (China)

Sites in Asia

- No. of registered sites: 83
- National (regional) networks: ChinaFlux, JapanFlux, KoFlux, TaiwanFlux, ThaiFlux, Malaysia...

AsiaFlux Offices

- NIES, Tsukuba, Japan
- IGSNRR, CAS, Beijing, China
- SNU, Seoul, Korea



Sites in Japan (31)



Sites in SE Asia (18)

1. Networking ground observations for C-budget

Activity of AsiaFlux Tsukuba Office in 2011

- AsiaFlux Web, Mailing List
- Newsletter
- Site Information (83 sites)
- Database (24 sites)

<http://asiaflux.net/datapolicy.html>



- Japan-Korea-China Joint Workshop “Data-Model Synthesis” (Tokyo, Feb. 2011)



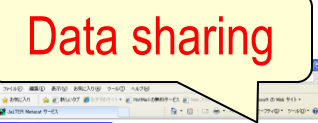
Host: JapanFlux

- AsiaFlux Short Training Course 2011 (Seoul, Korea, Jul. 2011)



Host: KoFlux

- JaLTER (Japan Long-term Ecological Research) Data Registration Workshop



※ Tree census etc.
(Tsukuba, Oct. 2011)



Host: Tsukuba Office

- 10th AsiaFlux Workshop “Bridging Ecosystem Science and Stewardship” (Johor Bahru, Malaysia, Nov. 2011)

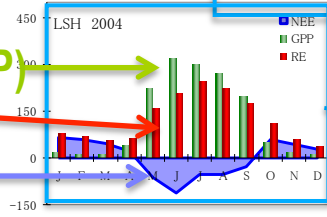
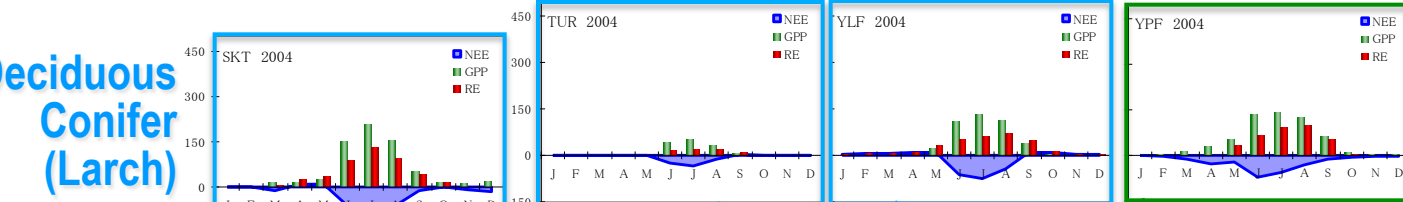


Host: Univ. Technology Malaysia

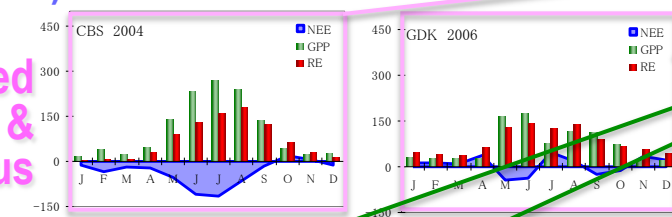
Seasonal patterns of C-budget

Total photosynthesis (GPP)
Total Respiration (RE)
Net CO₂ Exchange (NEE)
(negative: uptake)

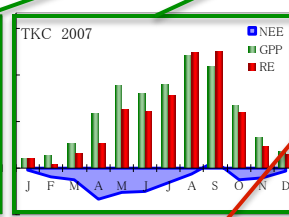
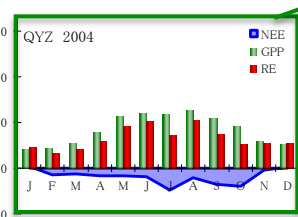
Deciduous
Conifer
(Larch)



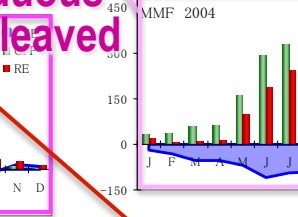
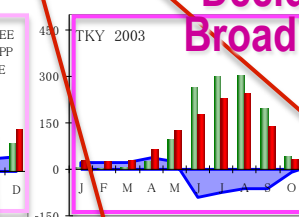
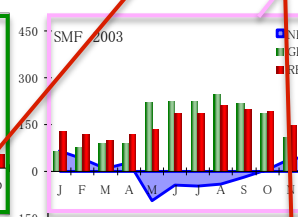
Mixed
Evergreen &
Deciduous



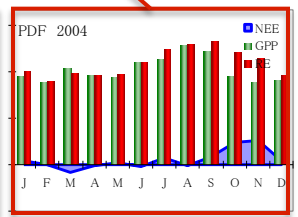
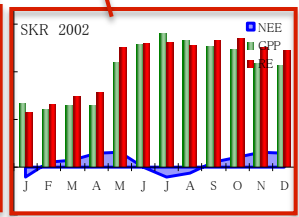
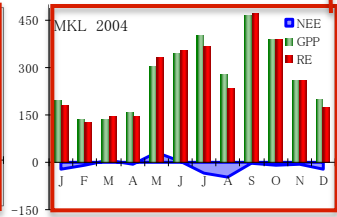
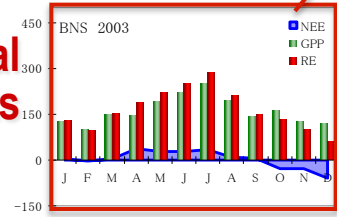
Evergreen
Conifer



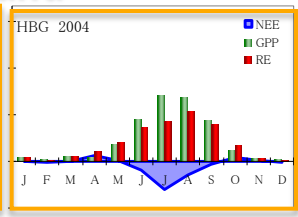
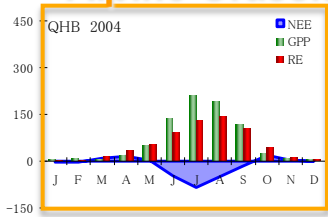
Deciduous
Broadleaved



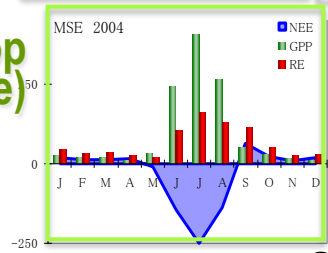
Tropical
Forests



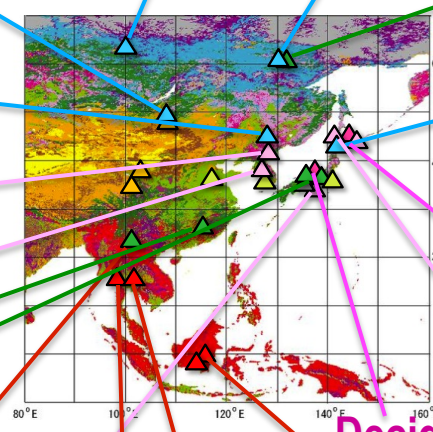
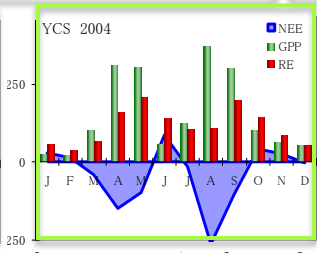
Alpine Grassland



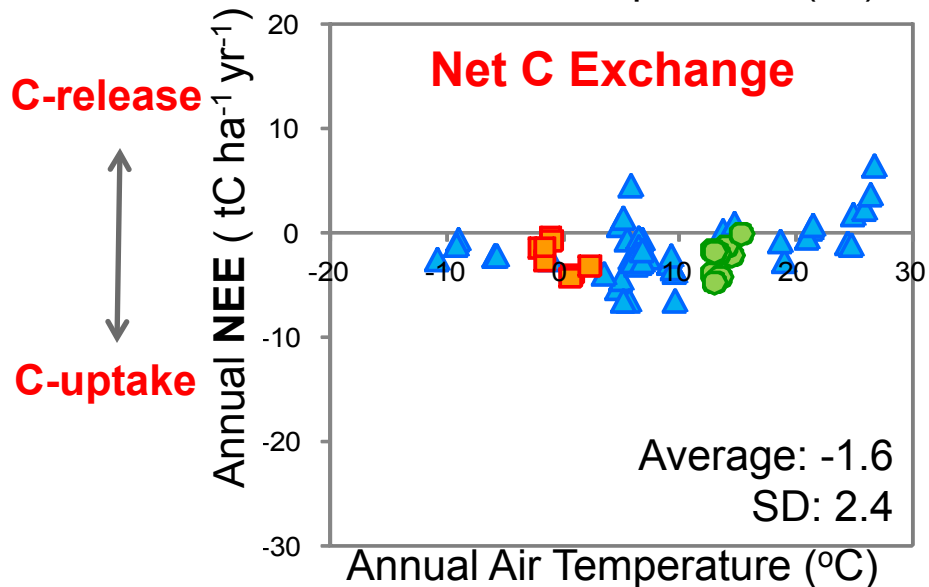
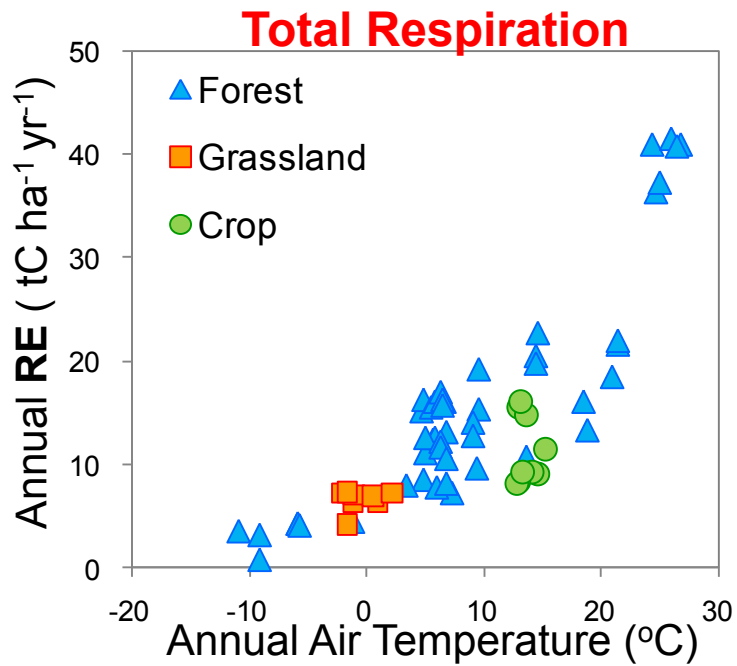
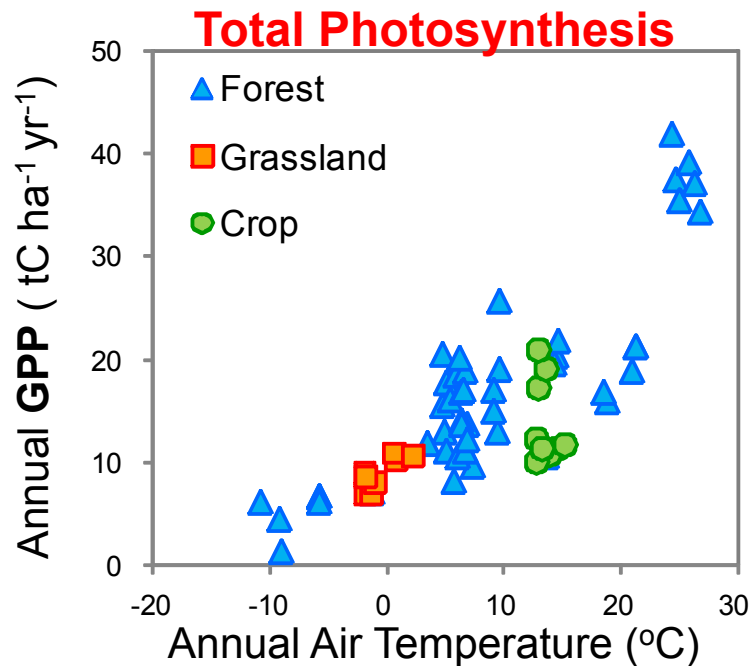
Crop
(Rice)



Crop
(Wheat &
Maize)

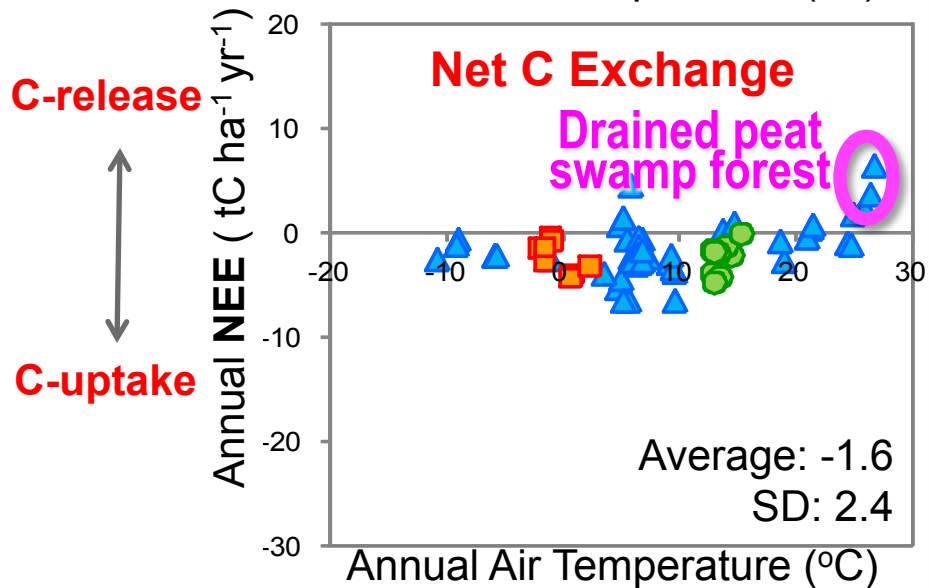
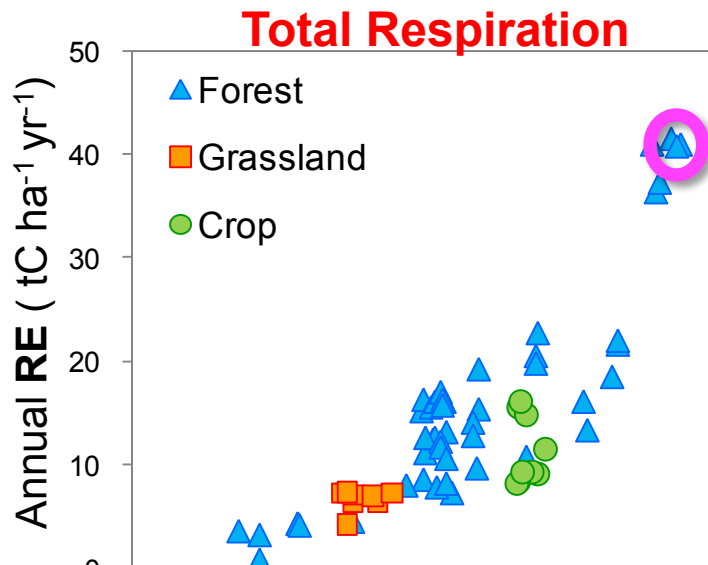
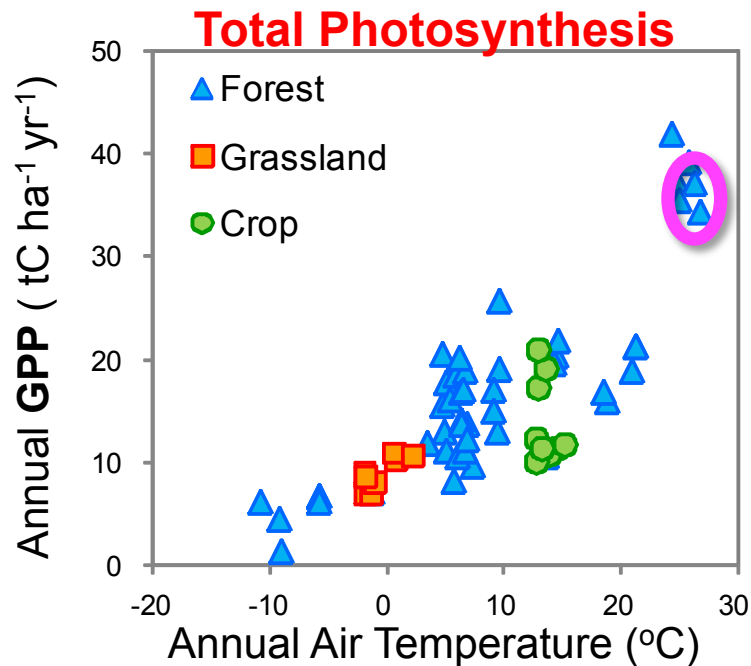


Annual C-budget in various ecosystems



- 1) GPP & RE: Positive correlation with annual temperature
- 2) Net C-uptake: High variation in temperate and tropical forests
- 3) Difference among forests, grasslands, & croplands: Not significant for net C-uptake

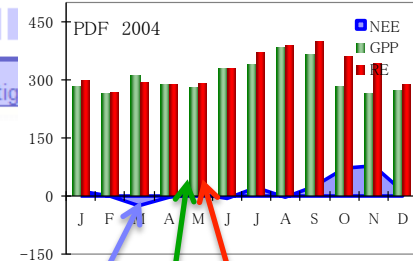
Annual C-budget in various ecosystems



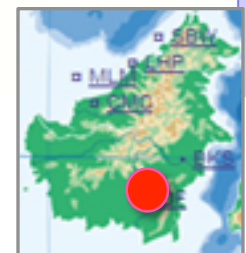
[PDF] http://asiaflux.net/network/008PDF_1.html
Palangkaraya drained forest

Site Description Observation Researchers

The contents of this page are based on Principal Investigator

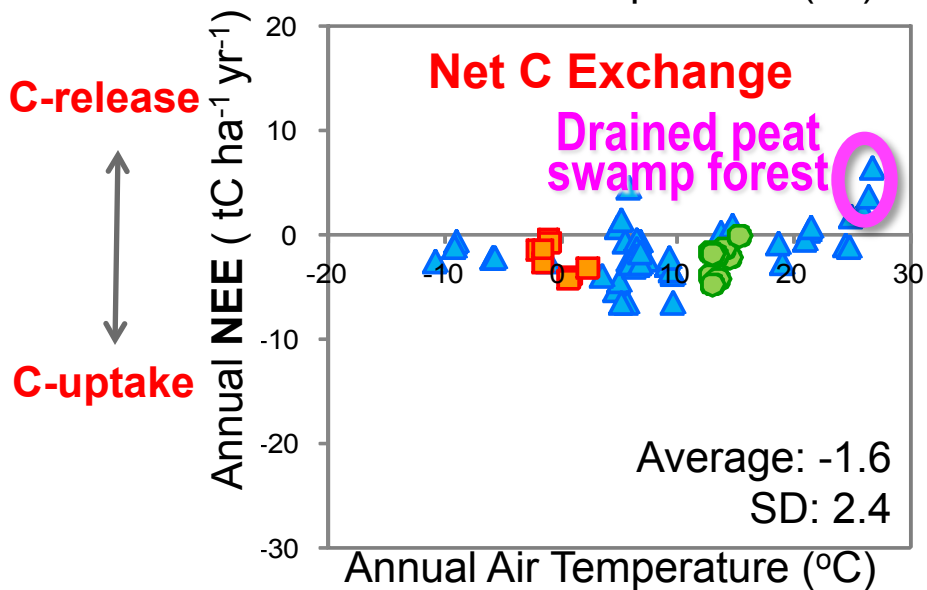
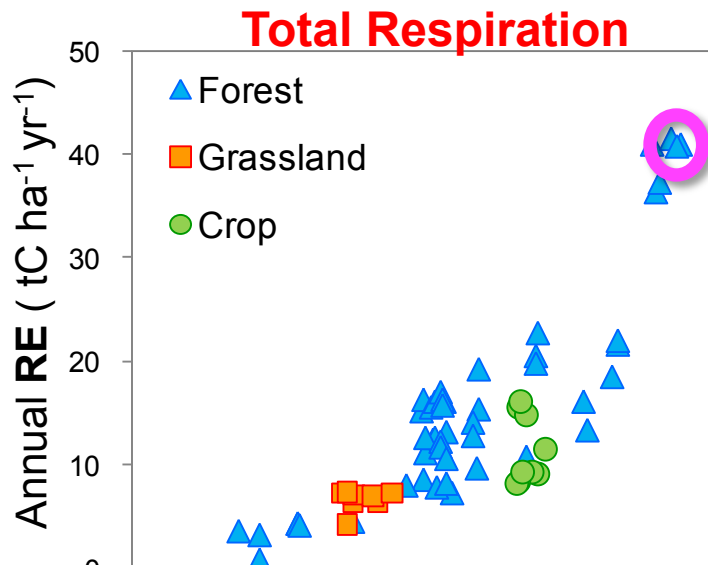
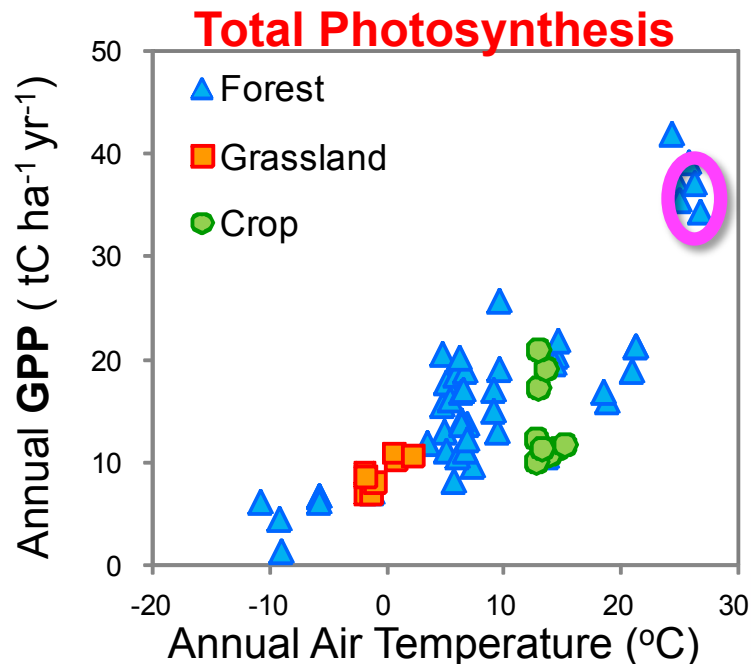


NEE GPP RE



Tropical peat swamp forest drained by canals built in 1990s

Annual C-budget in various ecosystems

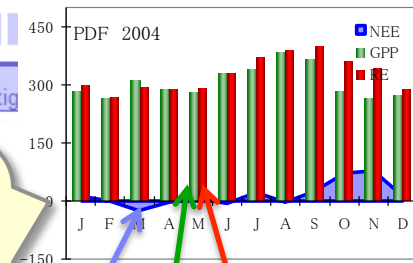


[PDF] http://asiaflux.net/network/008PDF_1.html
Palangkaraya drained forest

Site Description Observation Researchers

The contents of this page are based on Principal Investigator

A slight change in C-balance caused large amount of net C-release.



NEE GPP RE

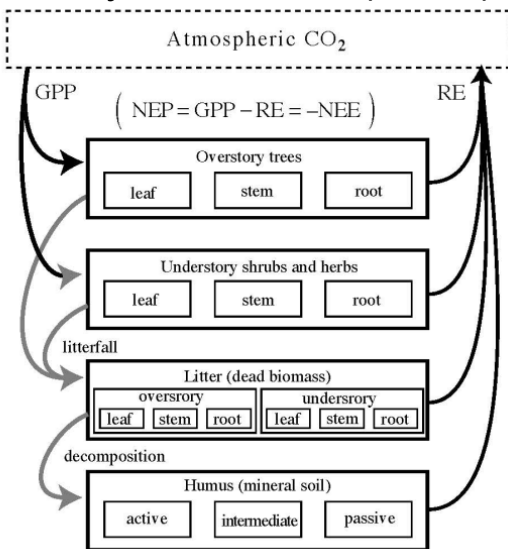
Tropical peat swamp forest drained by canals built in 1990s



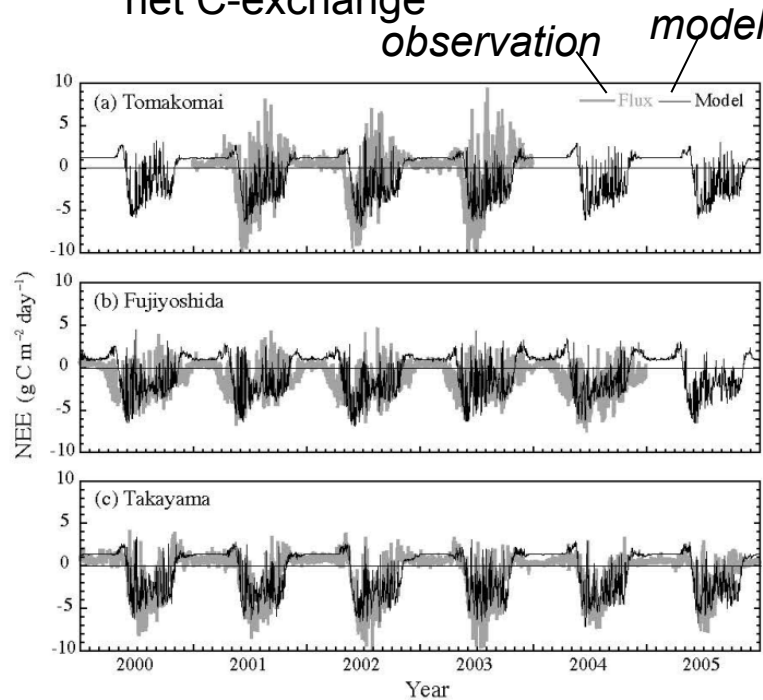
2. Integrating observations and model

Regional and national scale C-budget estimations based on terrestrial ecosystem model calibrated by AsiaFlux datasets

Schematic diagram of basic part of the terrestrial ecosystem model (VISIT)

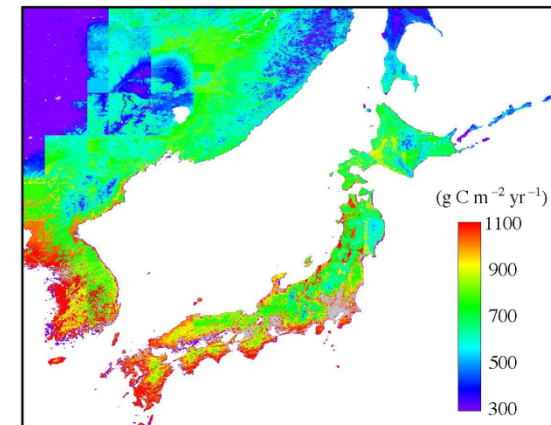


Comparison between observed (AsiaFlux data) and modeled net C-exchange

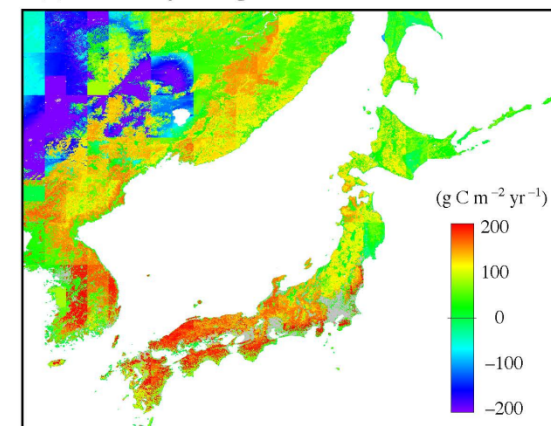


Net C-uptake estimated by the ecosystem model

(a) Net primary productivity, 2000–2005



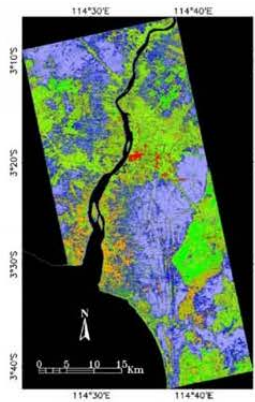
(b) Net ecosystem production, 2000–2005



2. Integrating observations and model

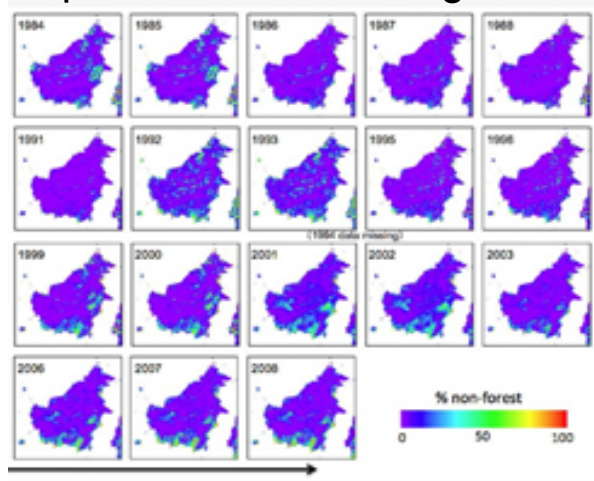
Regional and national scale C-budget estimations based on terrestrial ecosystem model calibrated by AsiaFlux datasets

Land cover classification map estimated by PALSAR data



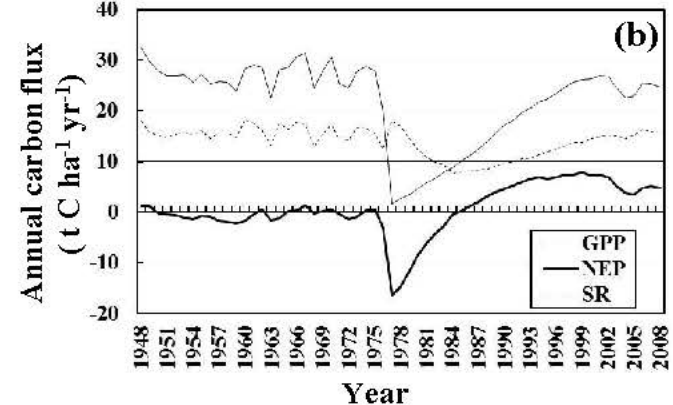
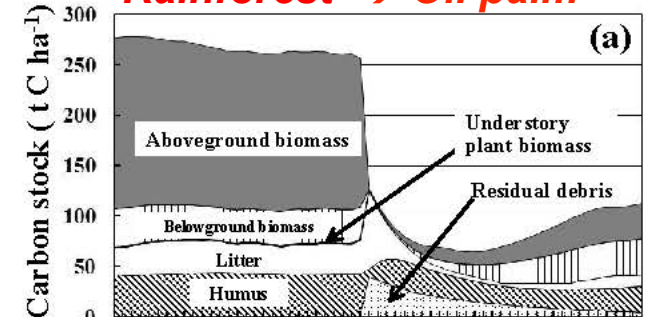
No value
 Forest
 Water
 Urban
 Paddy
 Dry Crop
 Shrubland
 Tree Crops

Temporal change in forest/non-forest cover estimated by optical remote sensing data

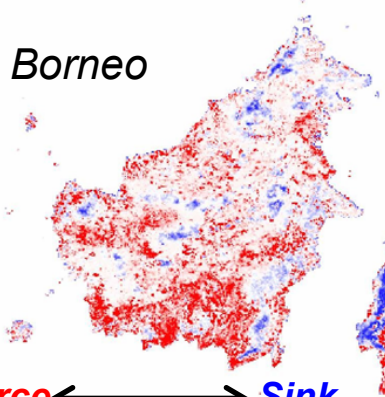


Temporal change in (a) C-stock and (b) C-flux in a primary rainforest and in an oil palm plantation converted from the primary forest

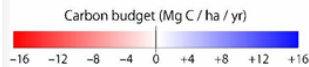
Rainforest → Oil palm



Borneo



C-Source ← → **Sink**



Calculated net C-uptake by the ecosystem model (VISIT) combined with the forest/non-forest distribution data

Yamagata et al. (2010)
Earthzine

Adachi et al. (2011) *Biogeosciences*

Contents

1. Networking ground observations for long-term C-budget monitoring in Asia
2. Integrating ground observation, remote sensing & terrestrial ecosystem model
3. Summary: Toward future forest C-monitoring systems



3. Future forest C monitoring systems

Consistent development of climate change mitigation and biodiversity conservation – To reduce trade-offs –

United Nations
Framework Convention
on Climate Change
(UNFCCC)

Convention on
Biological Diversity
(CBD)



Low-diversity,
High-productivity

High-diversity,
Low-productivity

Biofuel (sugarcane)

Monoculture plantation



Primary forest

Trade-offs?

Urgent need: Evaluation of ecosystem services
based on effective indicators and models

Contents

1. Networking ground observations for long-term C-budget monitoring in Asia
2. Integrating ground observation, remote sensing & terrestrial ecosystem model
3. Summary: Toward future forest C-monitoring systems

