FLUXNET Modeling and Data Workshop
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Model - flux data activities in Japan - Asia

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Flux observations in Asia / Japan

Code	Name	Main Climate *
[TUR]	Tura	D
[YLF]	Yakutsk Larch Forest	D
[YPF]	Yakutsk Pine Forest	D
[CBF]	Chinese Boreal Forest	D
[SKT]	Southern Khentei Taiga	D
[LSH]	Laoshan	D
[TSE]	CC-LaG	D
[MBF]	Moshiri Birch Forest	D

Code	Name	Main Climate *
[KBU]	Kherlenbayan Ulaan	B
[DW7]	Dongwu Steppe	D
[TSX]	Typical Steppe Xilingol	B
[DSX]	Desert Steppe Xilingol	B
[X03]	Xilinhot Degraded Steppe	D
[X06]	Xilinhot Fenced Steppe	D

65 sites in Asia
(40 forest sites +
25 non-forest sites)
Chair: Dr. Joon Kim

23 sites in Japan
Chair: Dr. Takashi Hirano

Models in Asia / Japan

Original terrestrial ecosystem models in Japan - island evolution?

- **BAIM**: Biosphere-Atmosphere Interaction Model by K.Mabuchi (MRI)
  => land surface scheme: cf. SiB2, MOSES, CLM

- **BEAMS**: Biosphere model integrating Eco-physiological And Mechanistic approaches using Satellite data by T.Sasai (Nagoya U.)
  => remote sensing-oriented LUE model: cf. CASA

- **SEIB**: Spatially Explicit Individual-Based (model) by H.Sato (FRCGC)
  => dynamic global vegetation model: cf. ORCHIDEE, LPJ, SDGVM

- **TsuBiMo**: Tsukuba Biosphere Model by G.Alexandrov (NIES)
  => empirical model: cf. Miami?

- **VISIT**: Vegetation Integrative Simulator for Trace gases by A.Ito (NIES)
  => ecophysiological, biogeochemical model: cf. Biome-BGC, Century

Users: DayCent, Biome-BGC, TOPS, SVM, LPJ, ED2, etc.

Topics: data – model fusion

1. **Modeling for greenhouse gas (CO_2+CH_4+N_2O) budget**

2. **Factoring-out of interannual variability in CO_2 flux**

3. **Model Intercomparison Project in Asia**

4. **Earth system model-related task (cf. C4MIP)**

5. **GOSAT-related task**

6. **REDD / FCMS-related task**

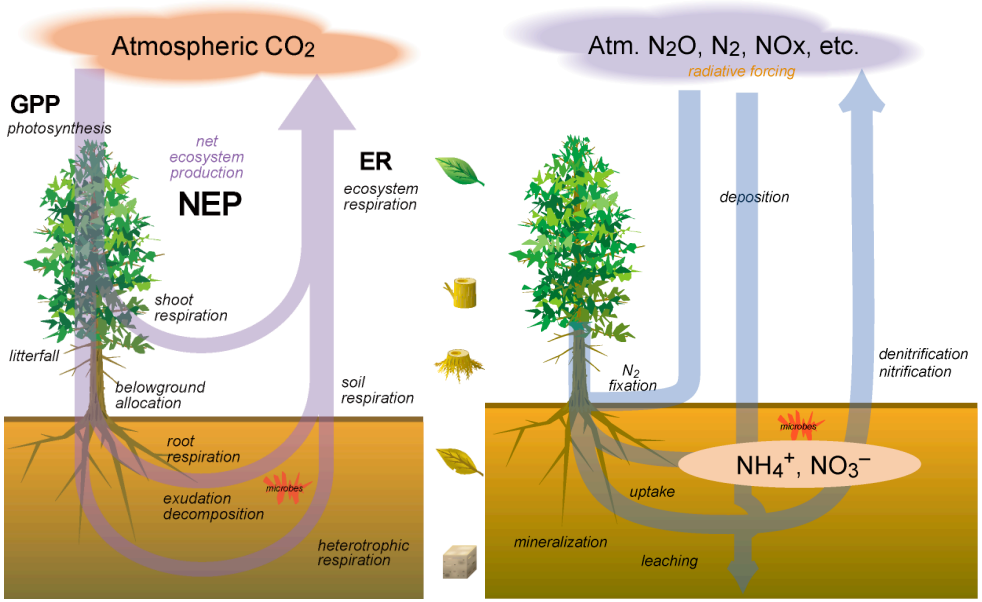
1. GHG modeling

Vegetation Integrated SImulator for Trace gases

(Developed in NIES & FRCGC-JAMSTEC)

Objectives

- Atmosphere-ecosystem biogeochemical interactions
- Especially, major greenhouse gases (CO_2, CH_4, and N_2O) budget
- Assessment of climatic impacts and biotic feedbacks



Carbon-cycle
(Sim-CYCLE-based)

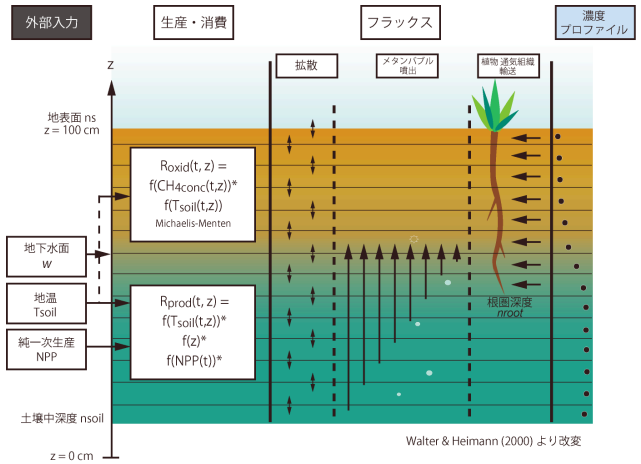
Nitrogen-cycle

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

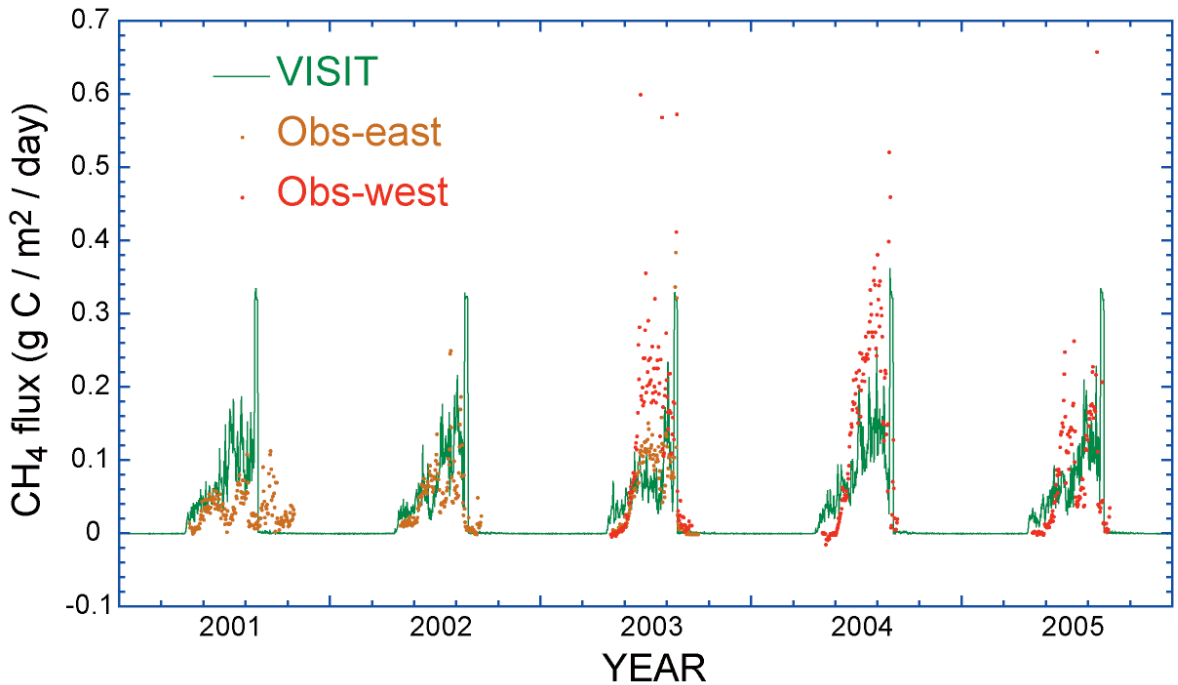
1. GHG modeling – CH_4 from paddy

CH_4 model (Walter & Heimann 2000)

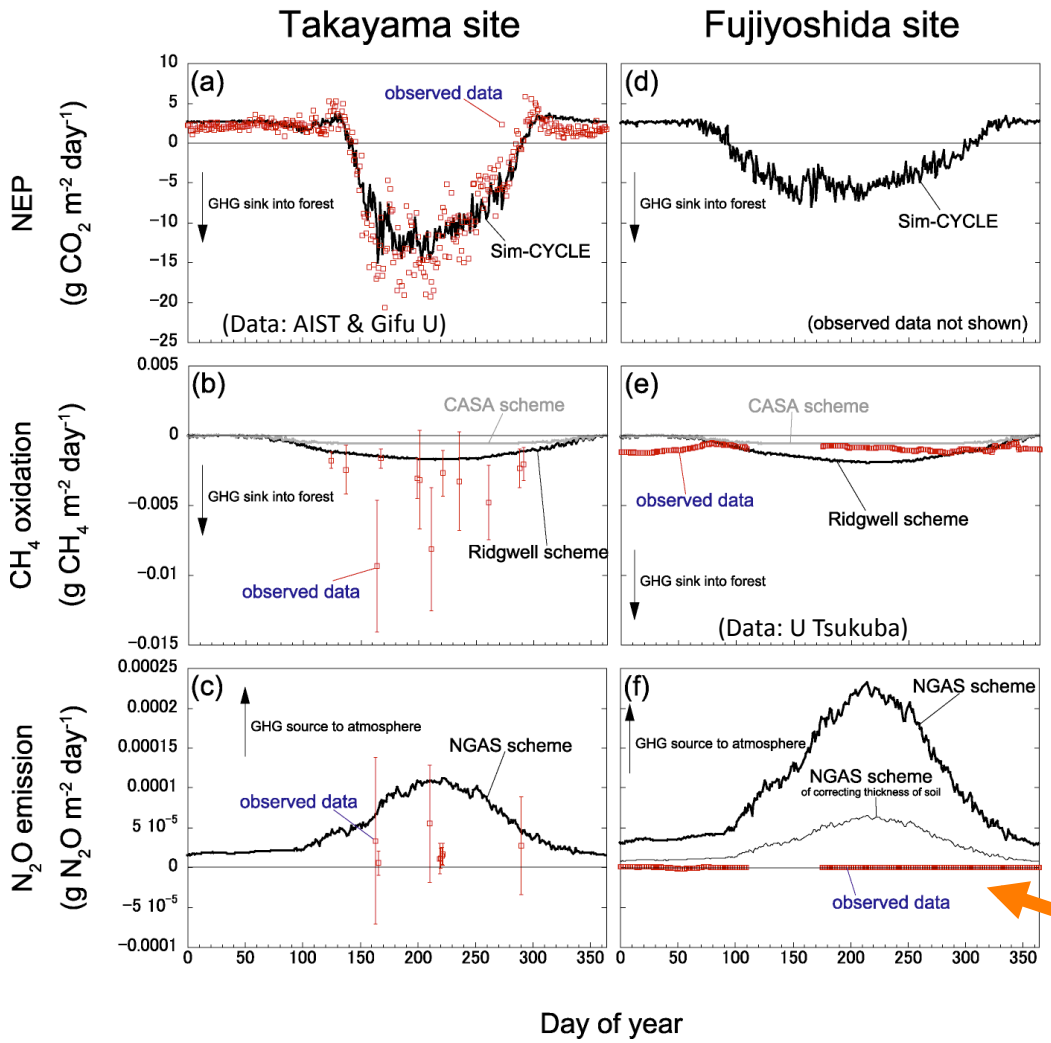


CH_4 emission from paddy field
(25~110 Tg CH_4 yr^{-1}, globally, mostly in Asia)

VISIT applied to a paddy filed gave a fair result
=> regional simulation in progress



1. GHG modeling - forests



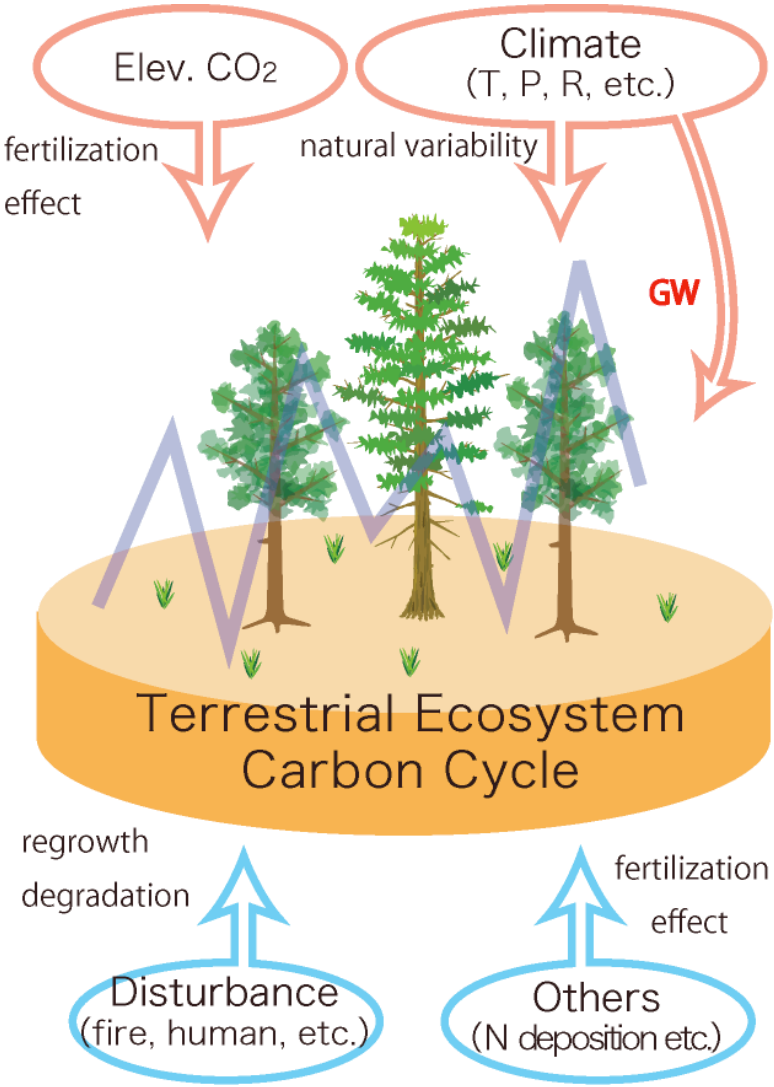
Takayama

Fujiyoshida

Immature volcanic soil

(Inatomi et al. in preparation)

2. Factor-out: i.e., attribution



Variability in flux

Periodic (diurnal & seasonal)

Non-periodic

- linear trend
  - disturbance-induced
  - elevated CO_2
  - increased N deposition
- interannual anomaly
  - teleconnection (ENSO, NAO/AO, etc.)
  - anthropogenic climate change
  - natural local perturbation

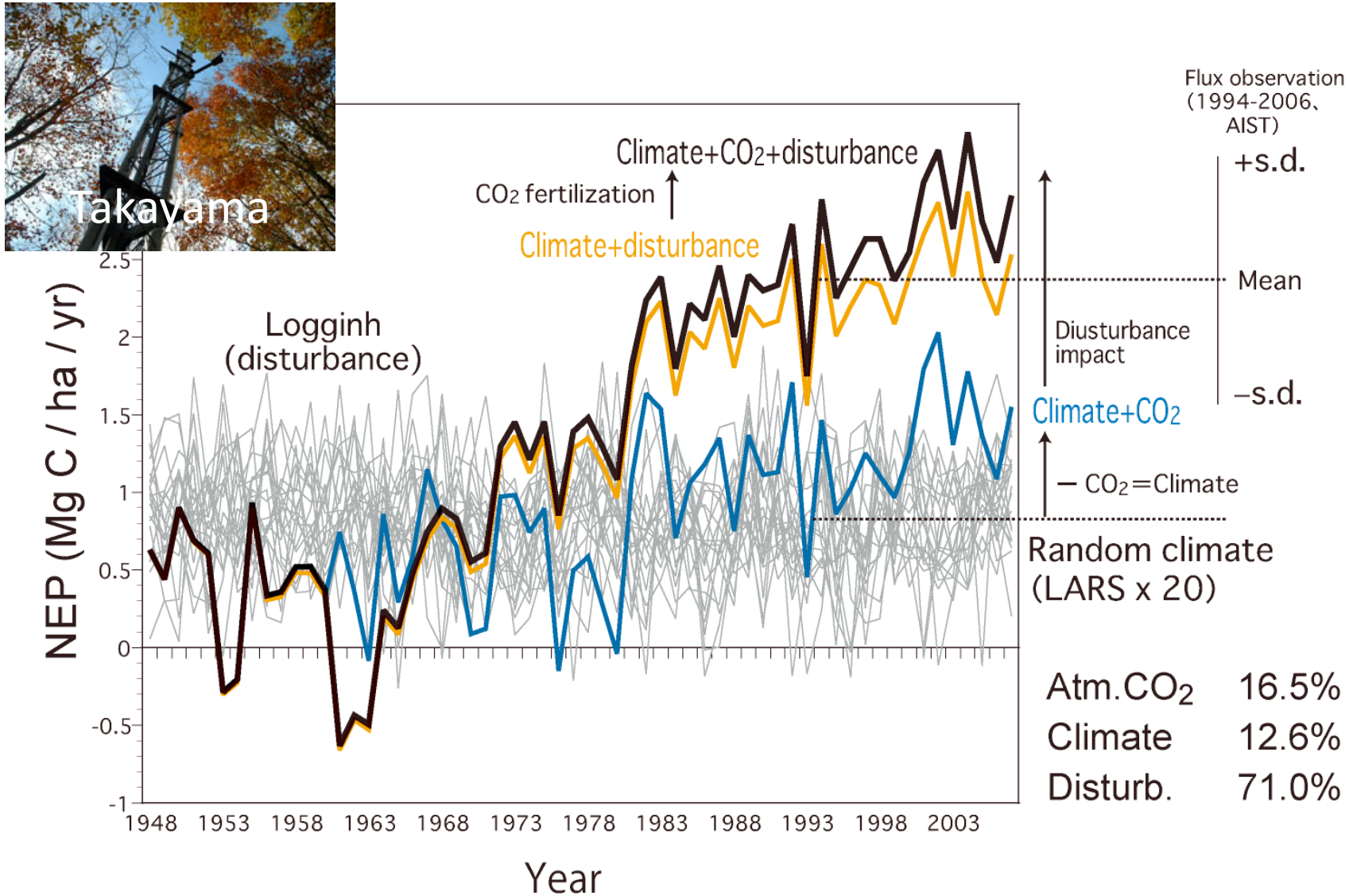
How can we attribute to these factors?

=> Model-aided factoring out

=> Sensitivity analyses

=> Monte Carlo experiments

2. Model-aided factor-out



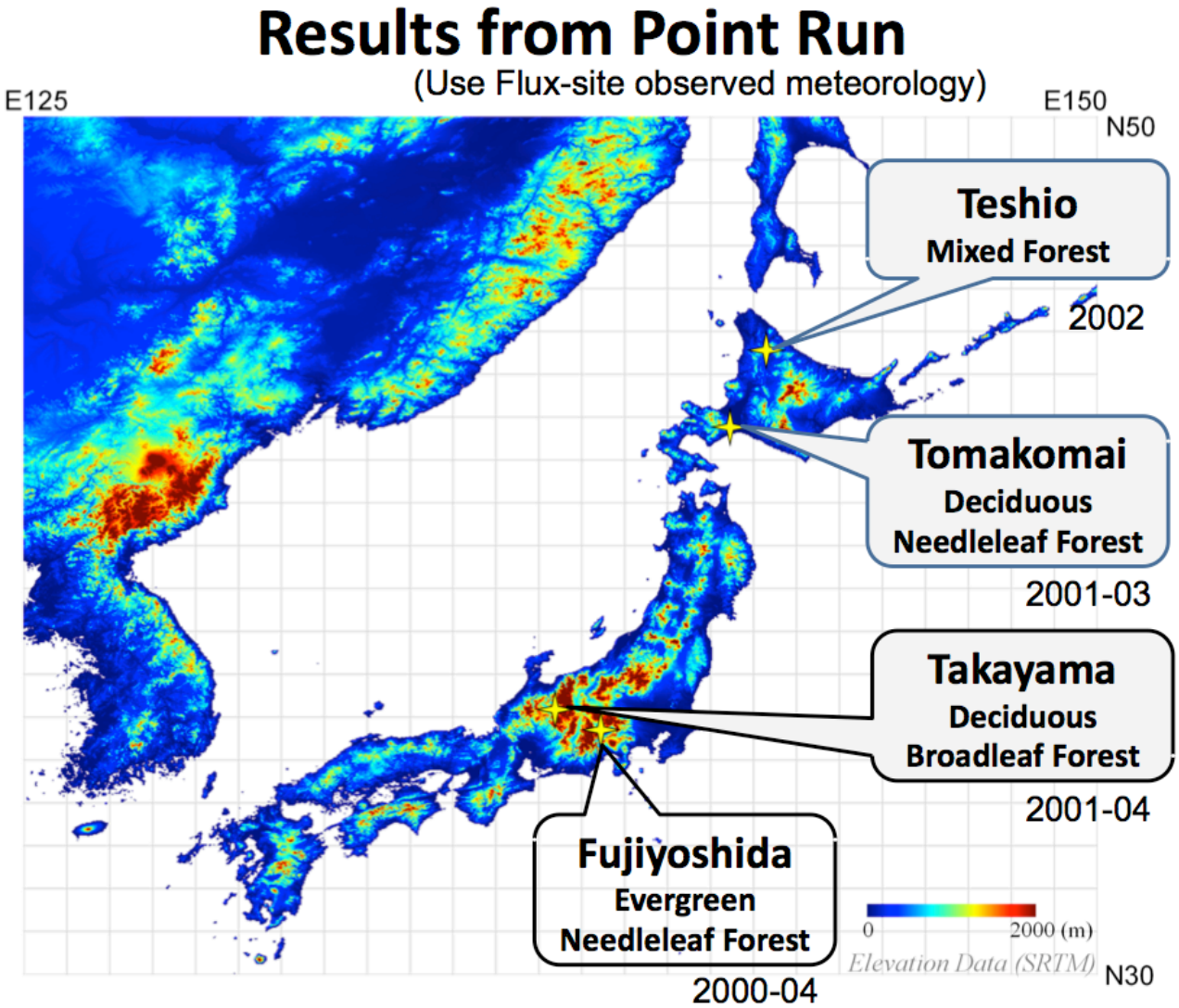
3. Model intercomparison in Asia

PI: Kazuhito Ichii
Empirical models
- SVM (Ichii)

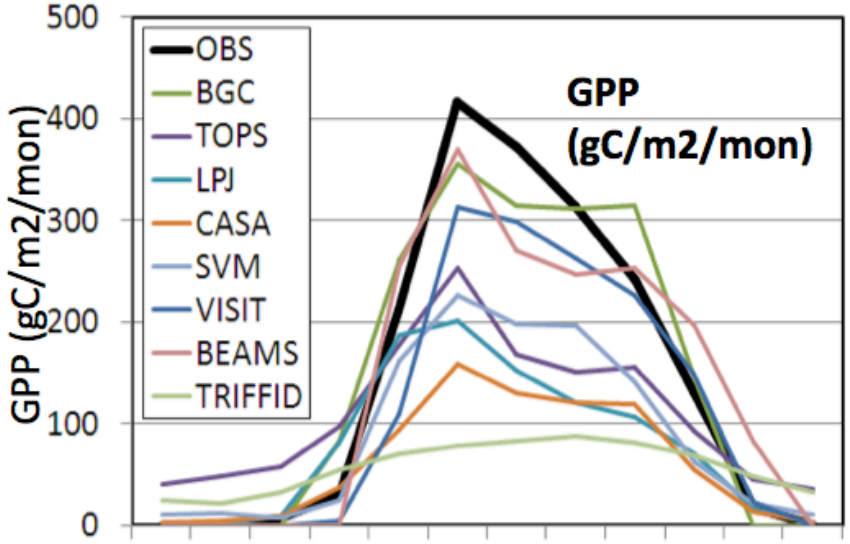
Diagnostic models
- BEAMS (Sasai)
- CASA (Ichii)
- TOPS (Ichii)

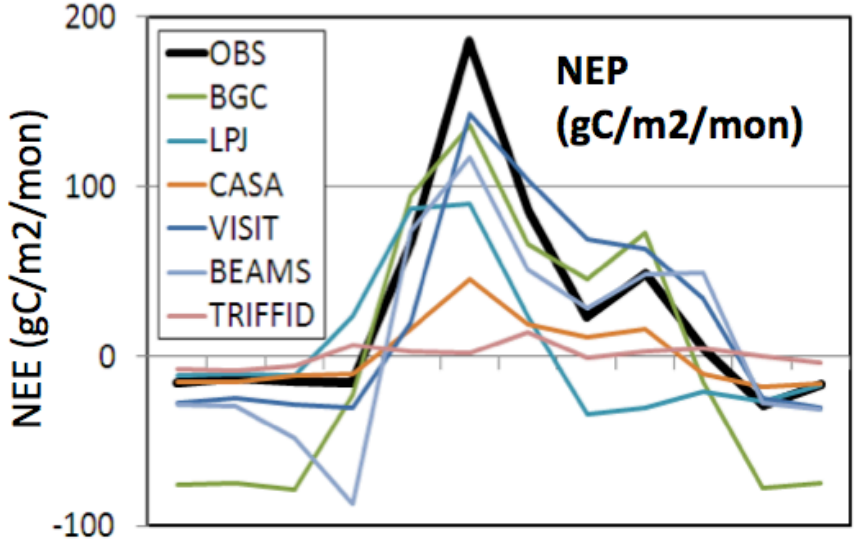
Prognostic models
- VISIT (Ito)
- Biome-BGC (Ichii)
- DayCent (Hajima)

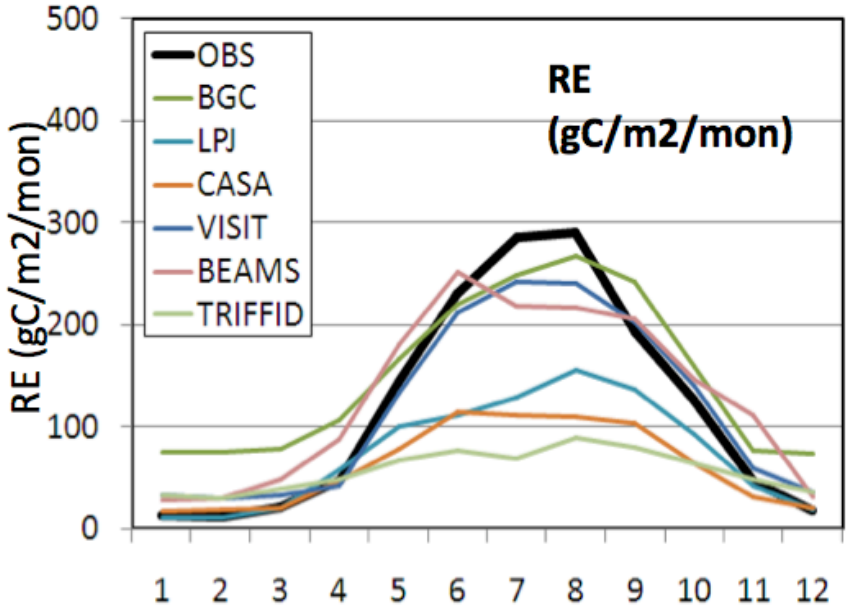
DGVM
- SEIB (Kato)
- LPJ (Ichii)
- TRIFFID (Ichii)
- ED2 (Ise)

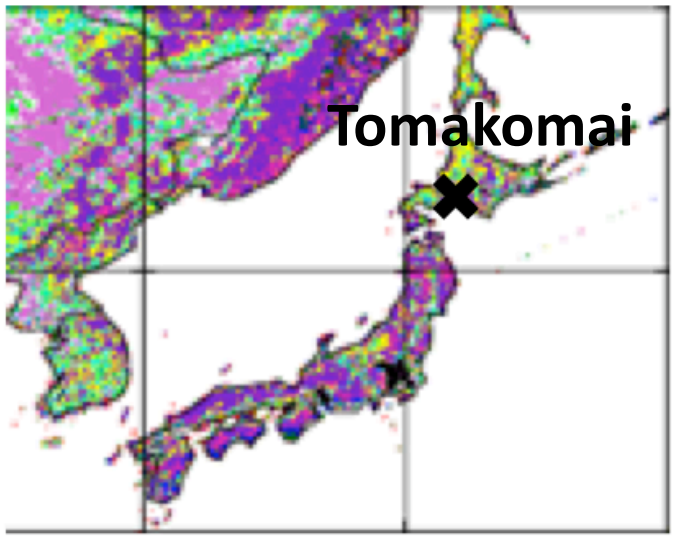


3. MIP result - *default*

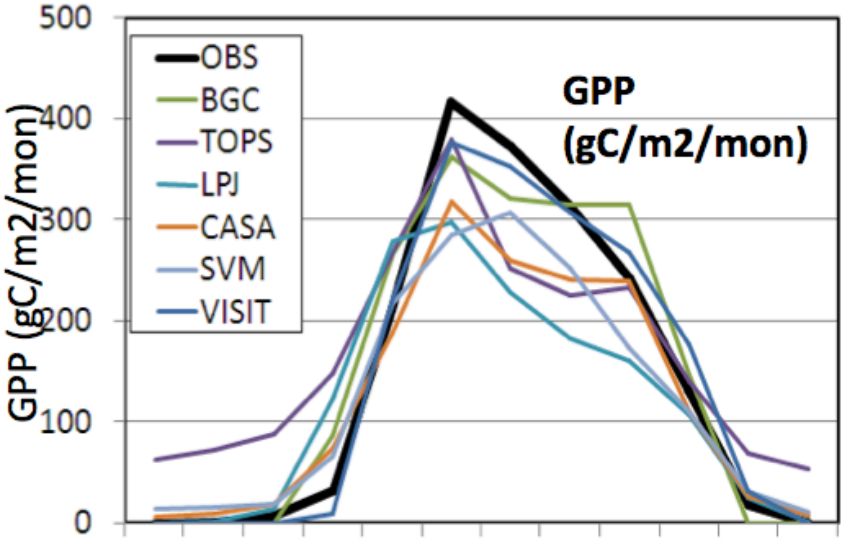


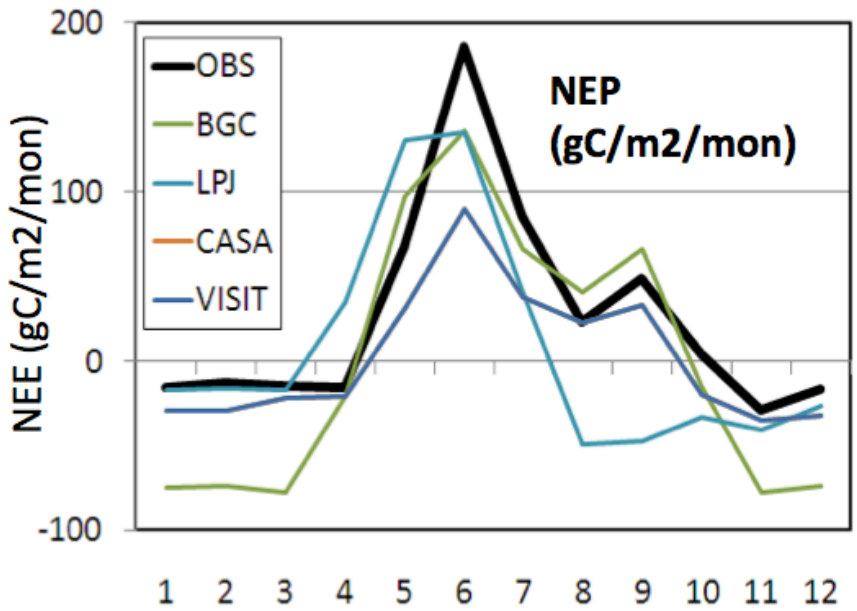


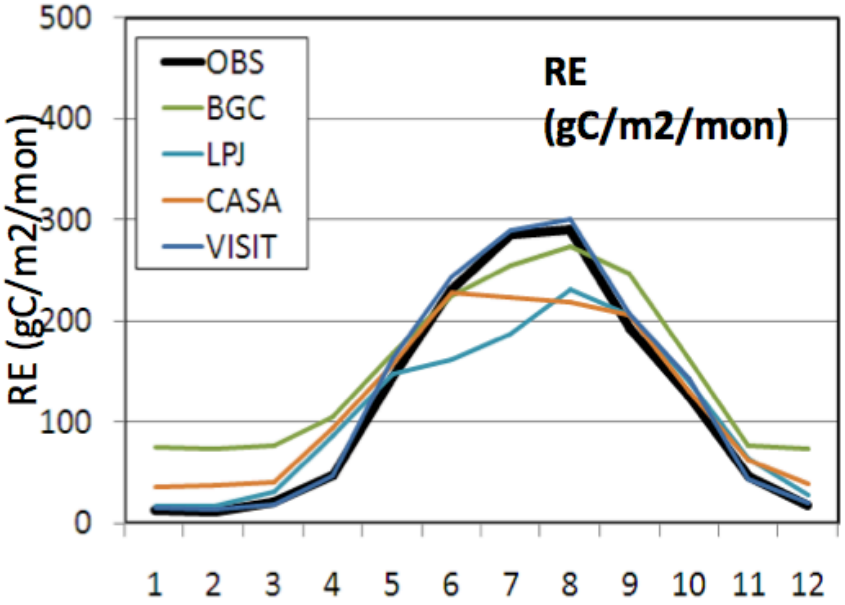




3. MIP result - *improved*



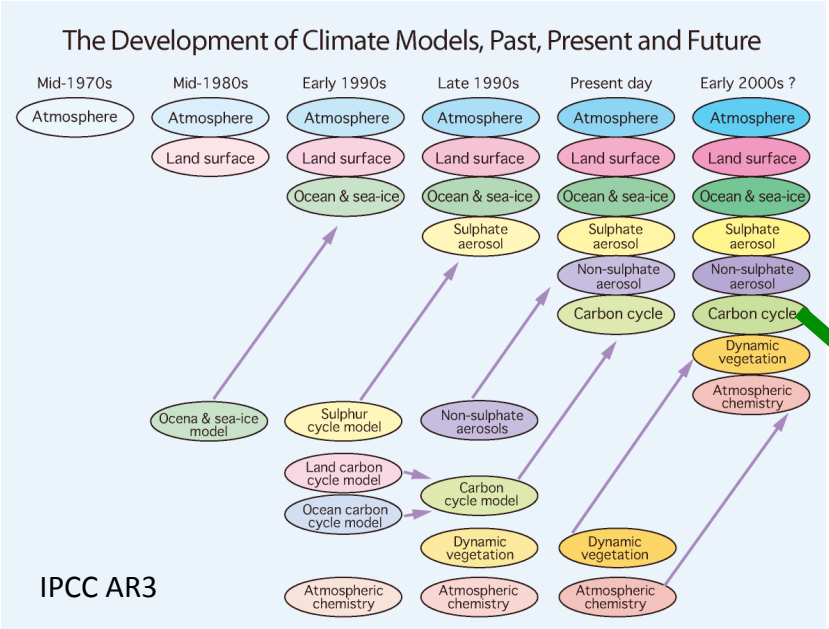




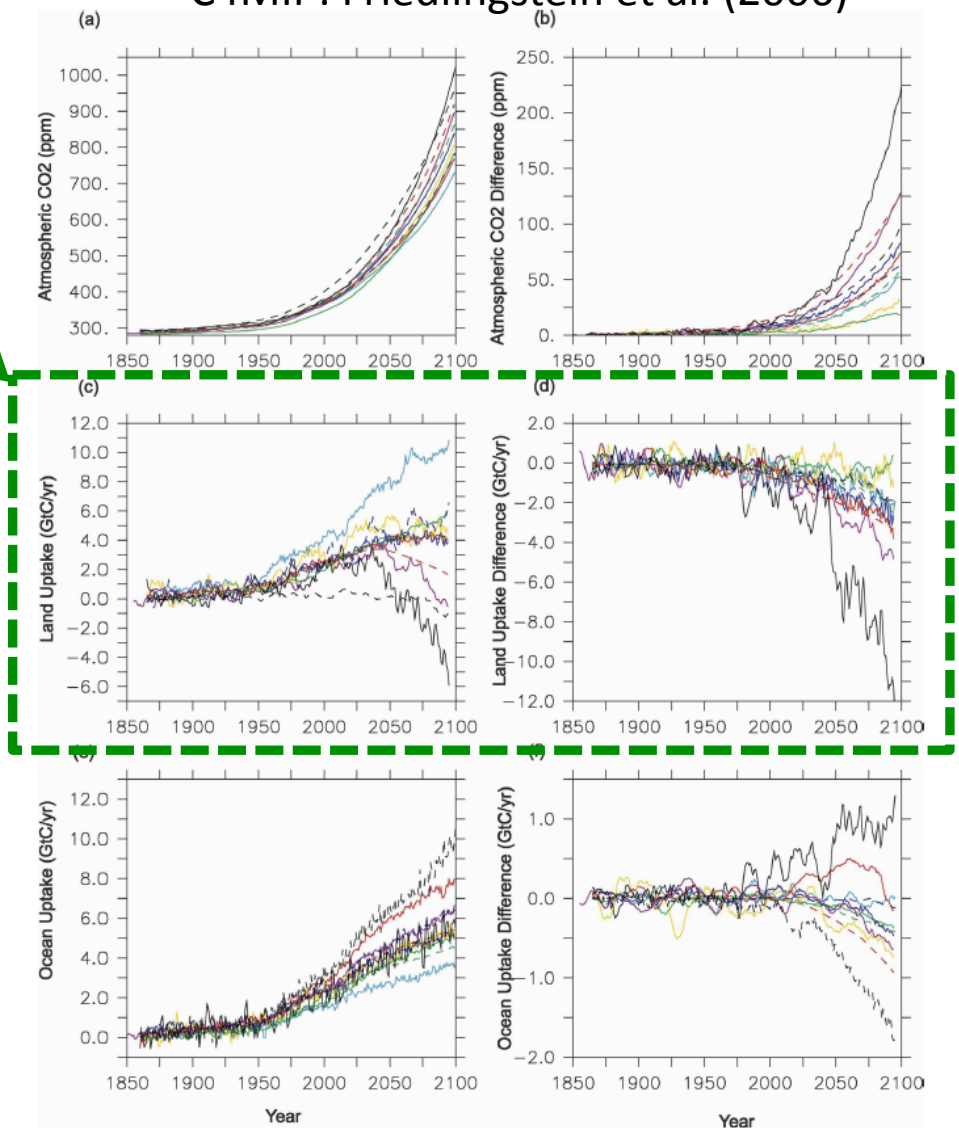
Reduction in standard deviation among models (%) over growing season (Apr-Sep)

GPP	60%
RE	40%

4. Earth system model-related task



C4MIP: Friedlingstein et al. (2006)



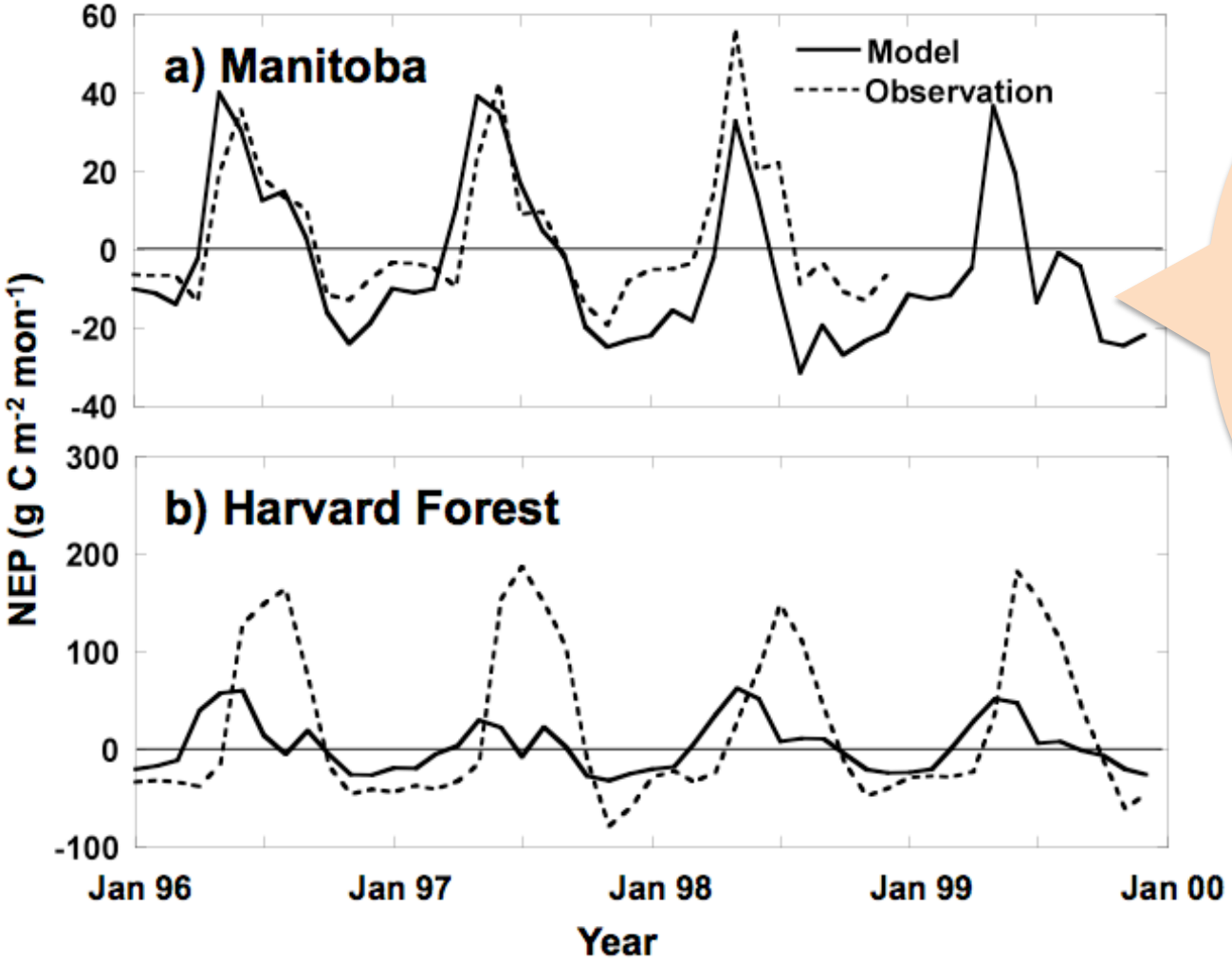
FRCGC Earth-system model

=> MIROC-AOGCM + other components

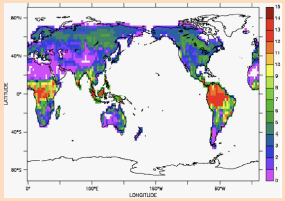
=> Sim-CYCLE (old version of VISIT)

terrestrial carbon cycle scheme

4. Earth system model validation



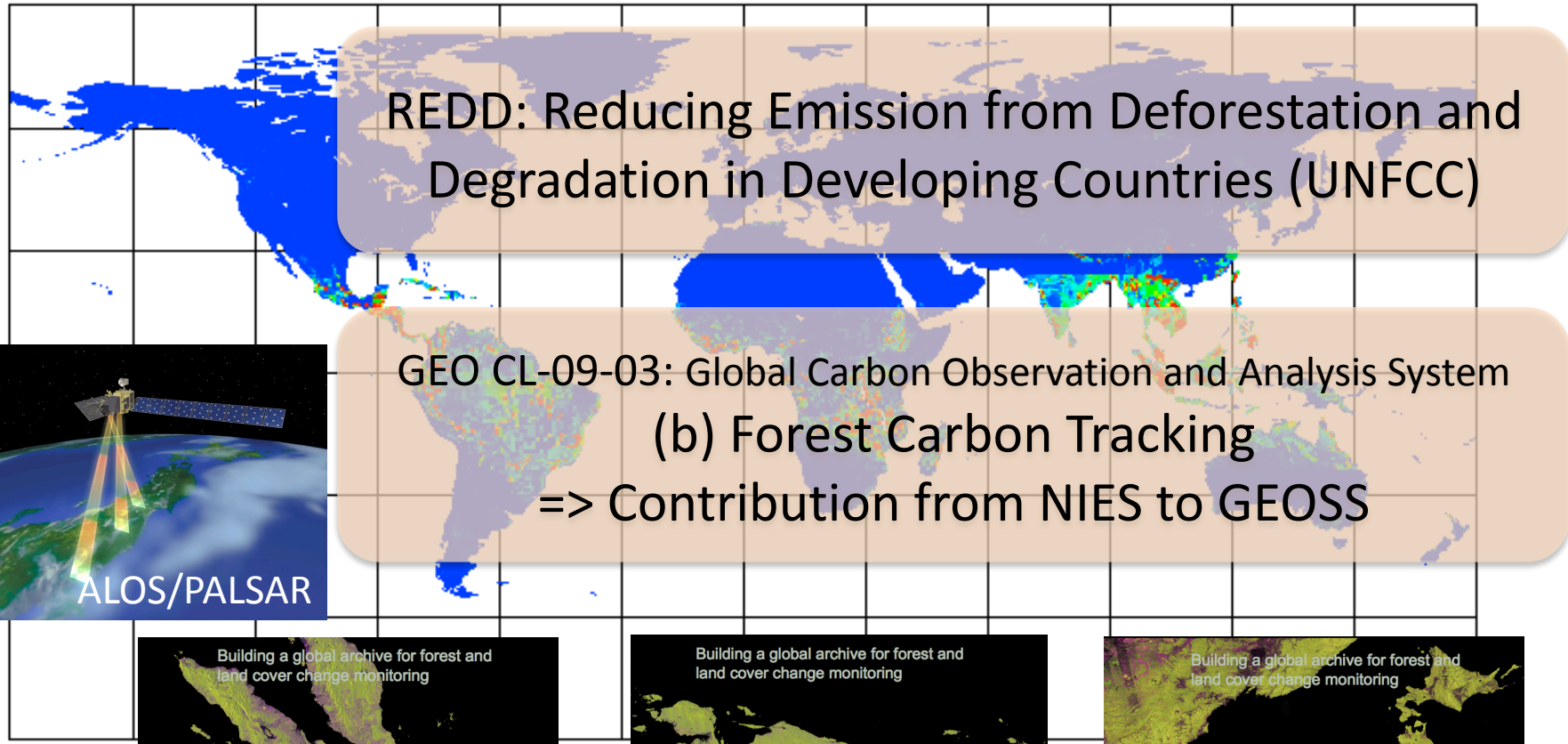
FRCGC earth-system model



Kato, Kawamiya, and Ito (submitted)

5. REDD / FCMS-related task

Land-use change C emission (est. VISIT)

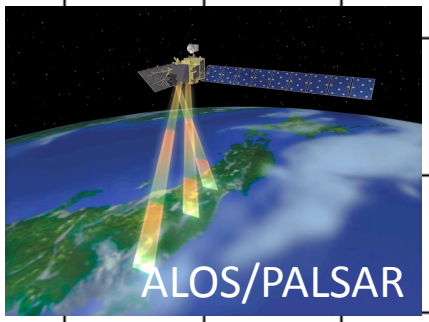


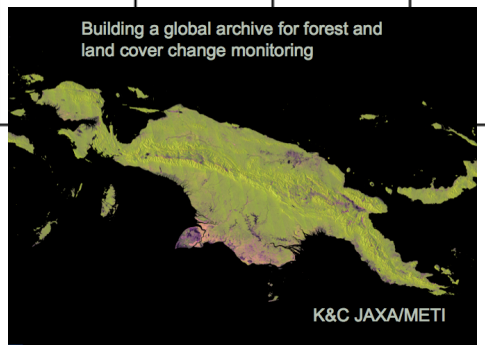
REDD: Reducing Emission from Deforestation and Degradation in Developing Countries (UNFCC)

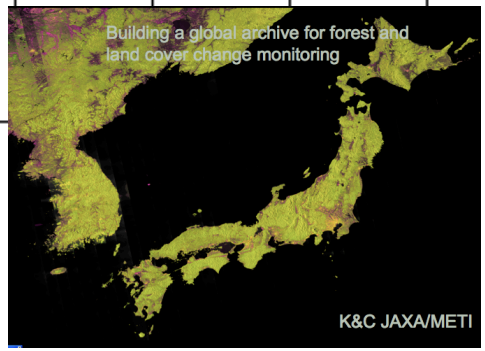
GEO CL-09-03: Global Carbon Observation and Analysis System

(b) Forest Carbon Tracking

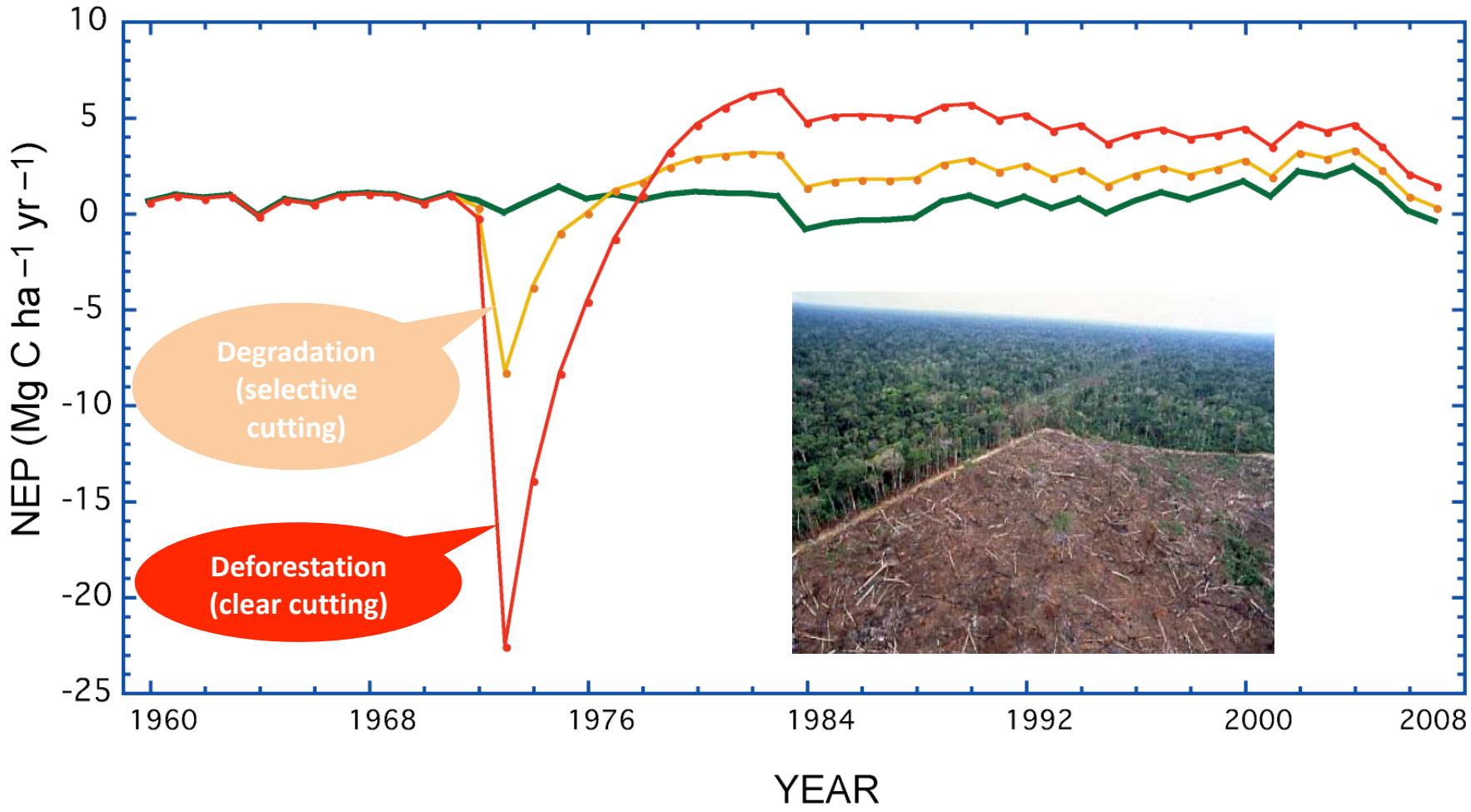
=> Contribution from NIES to GEOSS



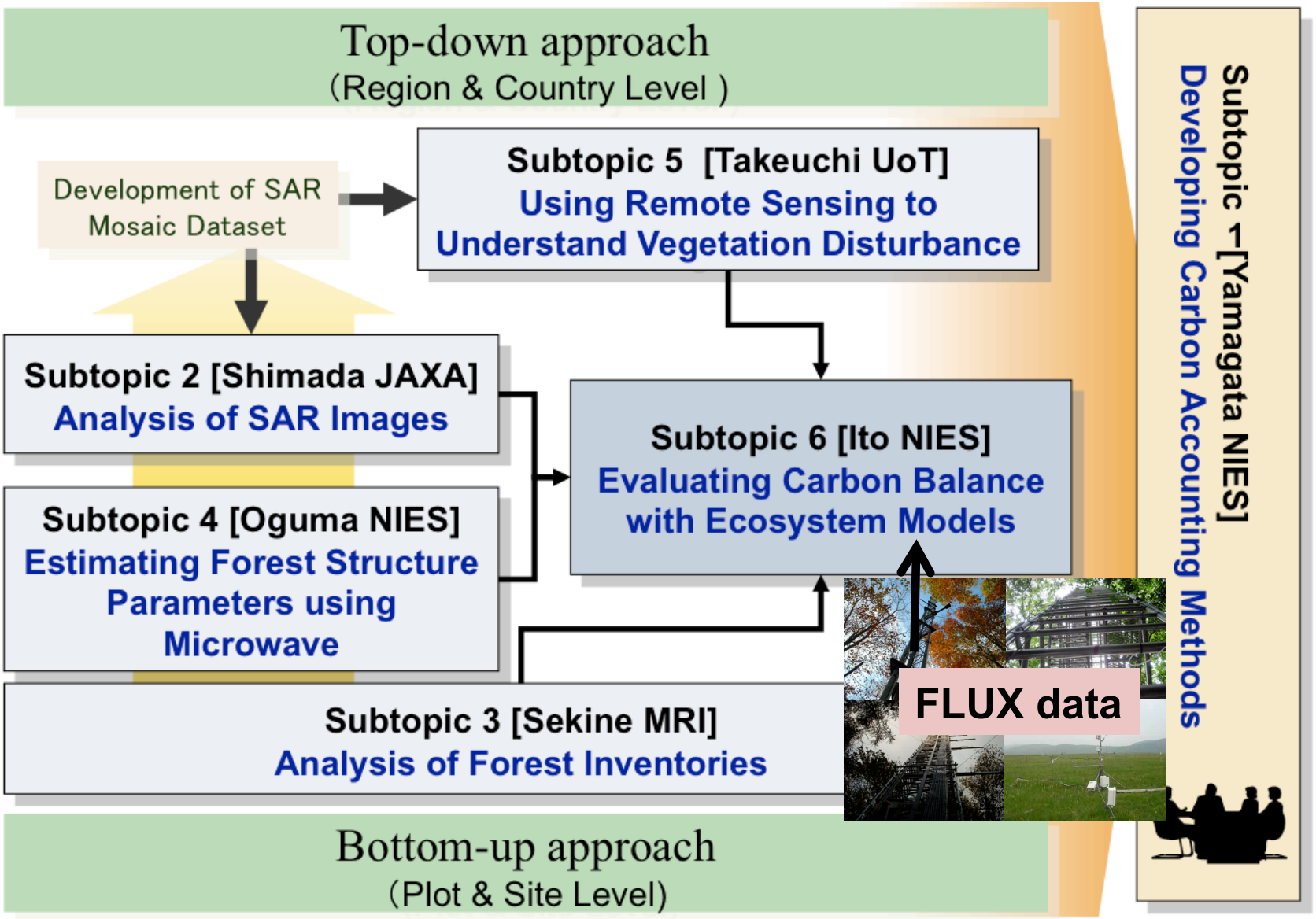




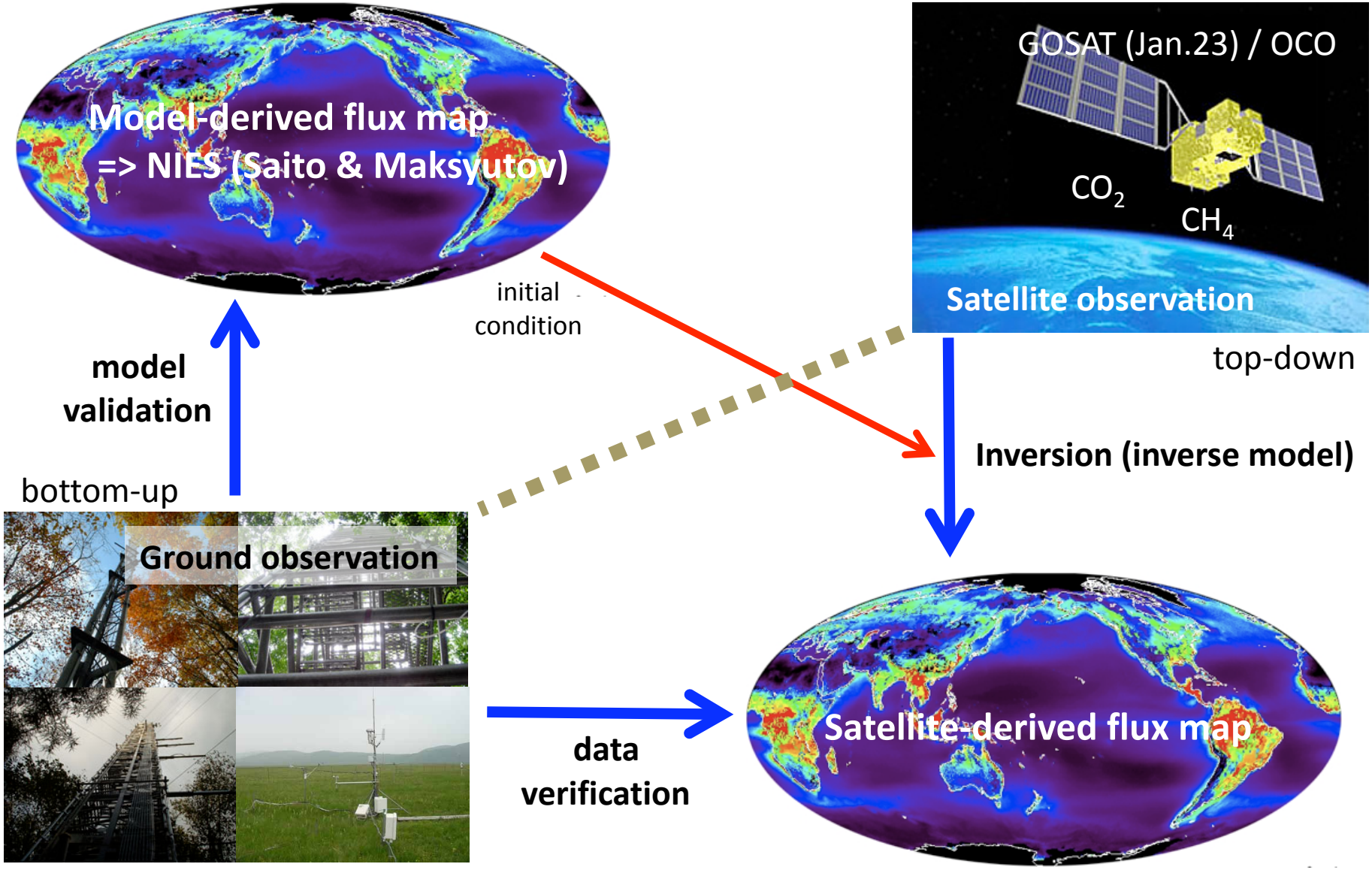
5. Disturbance simulation



5. Forest Carbon Monitoring System (GERF B-81)



6. GOSAT-related task



Future challenges

- Individual observation => meta-analysis, data-assimilation => **what's next?**

- Sophisticated model constraining method using FLUXNET data, especially for Earth-system-model-implemented carbon cycle schemes
- Data-assimilation to obtain a more realistic initial condition for models, reducing uncertainty in GW prediction
- Long-term ecosystem components (e.g., SOM/CWD and vegetation dynamics) through long-term measurements
- Linkage with satellite GHG observation (GOSAT, OCO, etc.)
- Application to policy-relevant issues and decision making
- Early detection of the global warming impact

- Modelers also appreciate methodological improvements in steep topography and/or stable atmospheric condition, gap-filling, etc.