Some CABLE updates and possible future directions

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Updates

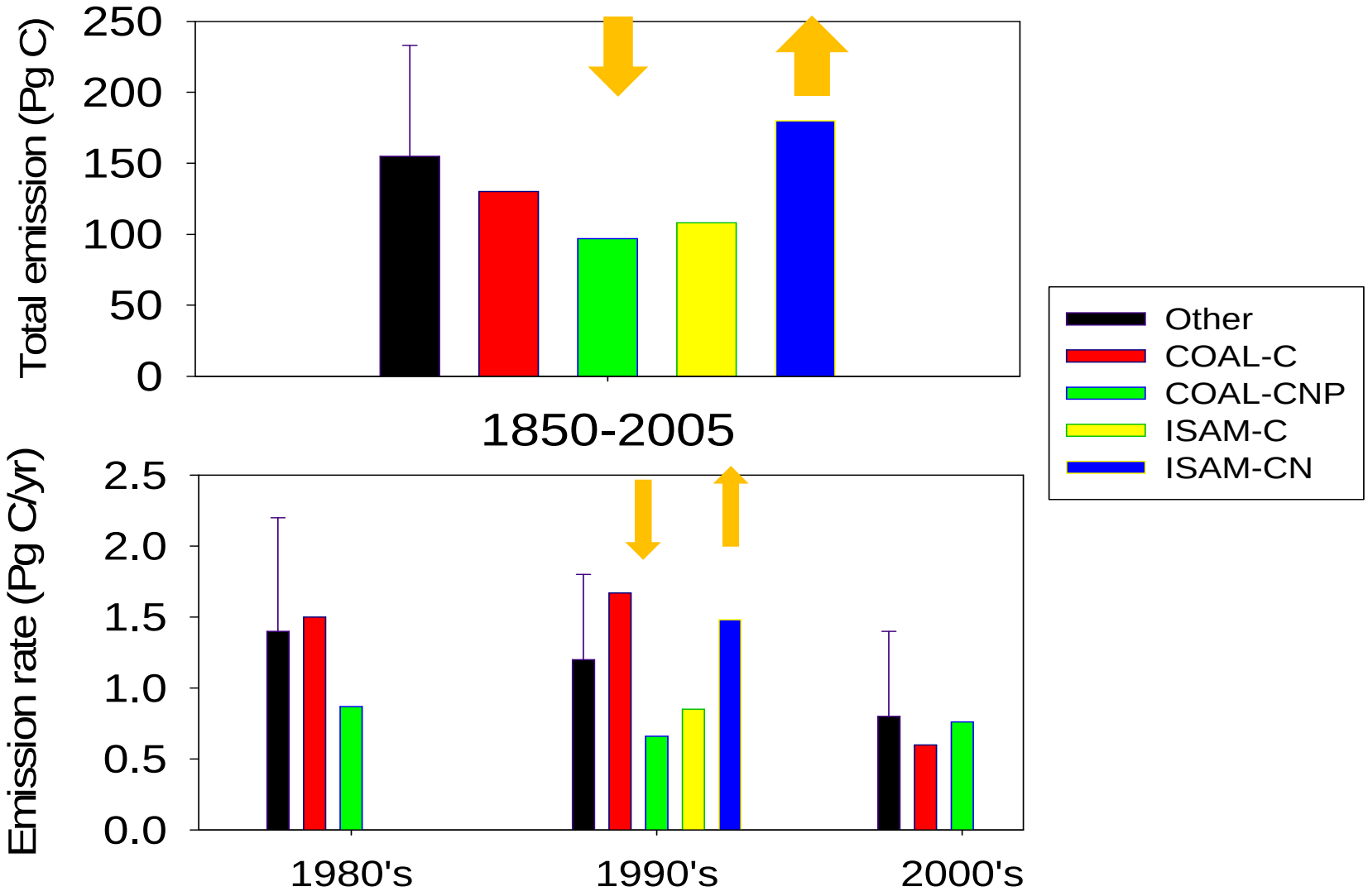
- land use
- soil carbon modeling
- data assimilation
- benchmarking

Land use

- Land cover change: issue with global land sue data set for Australia. Jatin's contribution

- Biophysical and biogeochemical effects of land use change in CABLE: codes near completion;

Different effects of nutrient limitation



Soil carbon modeling

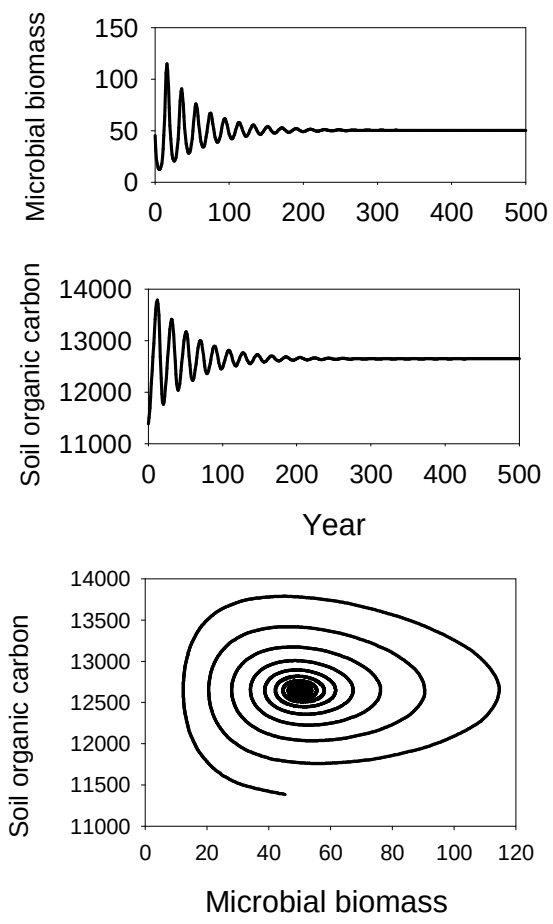
- Nearly all global carbon model uses the first-order kinetics (dC/dt=input –kC);

- Recently nonlinear soil carbon models have been proposed (dC/dt= input $-V_c C_b C/(C+K_c)$); Nonlinear models can simulate response to priming, temperature acclimation, whereas linear models cannot;

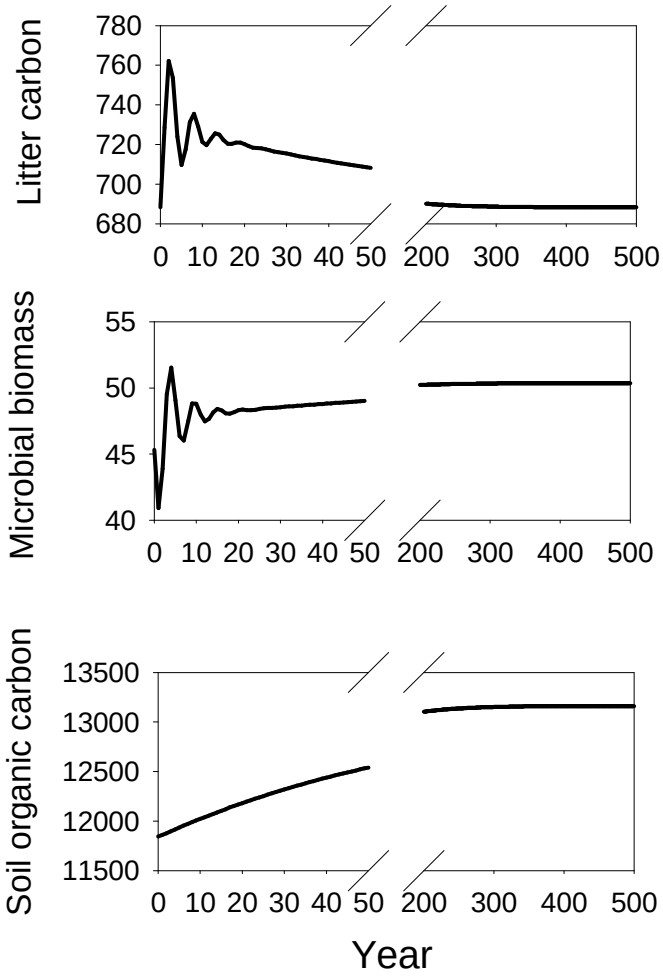
- Wang et al. (2014) showed some nonlinear models can have unrealistic oscillation.

Model responses to perturbation

2-pool

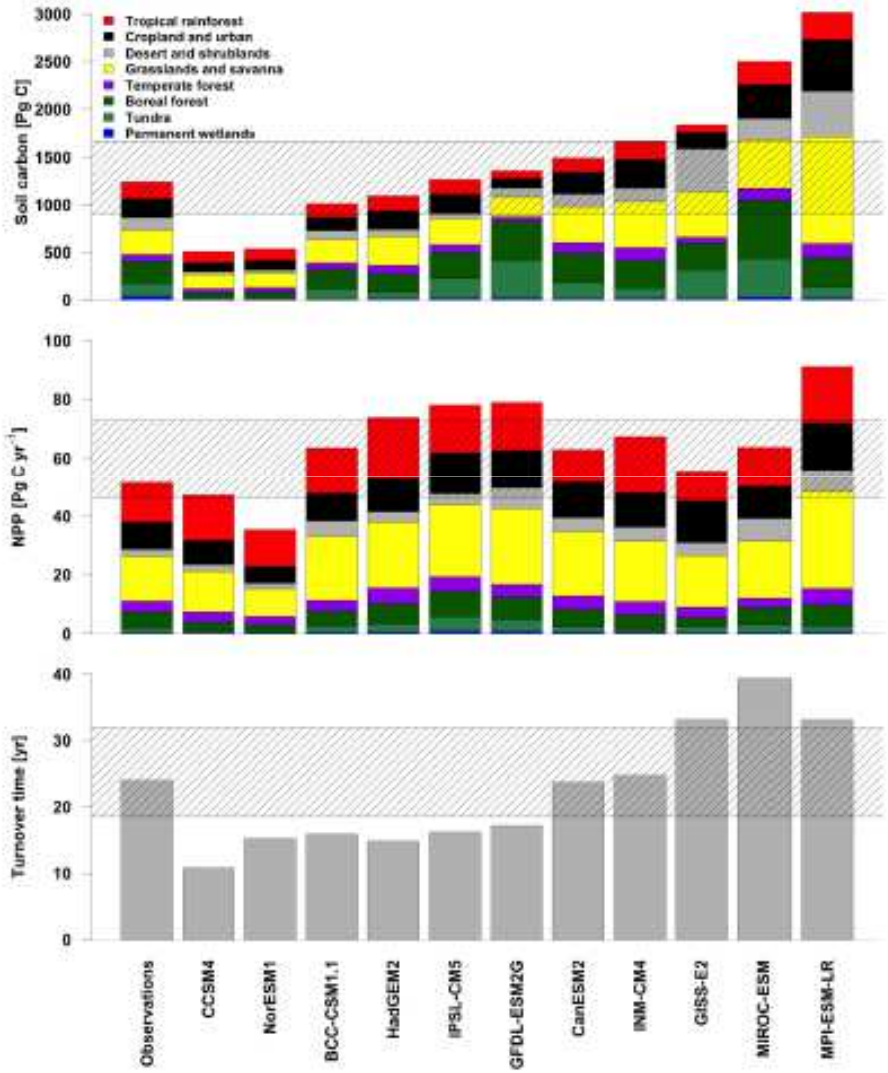


3-pool



Wang et al. (2014) Biogeosciences

Data assimilation



Results of CMIP5 ESM diverges

How much of those differences are caused by parameter errors?

Data assimilation!

Todd-Brown et al. (2013) Biogeosciences

Particle filter

Four steps:

1: start with prior distributions of all parameters to be optimized, and selected N set of parameter values

2: run the model N times and calculate the cost of each set of model parameter values

3: calculate the probability of the each sampled parameter set (Bayesian theorem)

4: re-sample the probability distribution of the each parameter

Repeat 1 to 4 r times until criteria for convergence is met.
Calculate the posterior distribution of all parameters.

Parameter estimation using particle filters

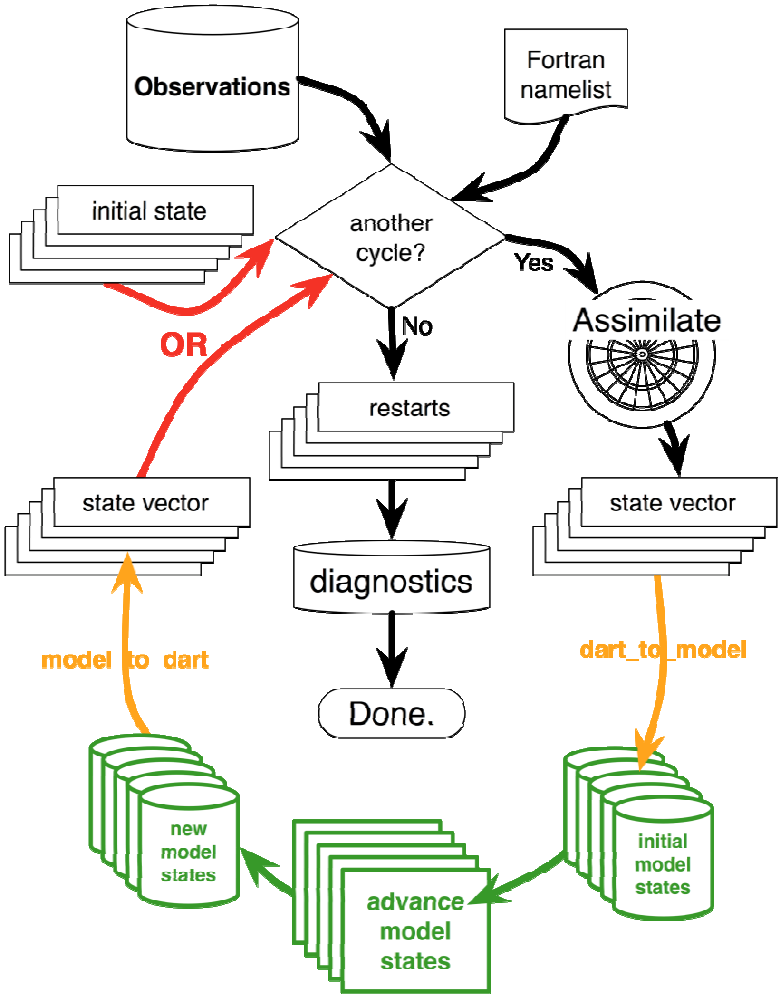
Observations:
regional net land carbon fluxes from global inversion
Global GPP, LE

Input:
CO_2 emission from LULUC

Output:
key model parameters, such as V_{cmax}, *xLAI, m* etc.

OCE PDF project: Chris Lu, Tile Ziehn, YP Wang, Peter Rayner, Rachel Law

CABLE in DART (The Data Assimilation Research Testbed)



CABLE has been implemented in DART;

The system will be used to assimilate remotely sensed canopy LAI into CABLE;

A PhD student from BNU
Peter Rayner
Ying-Ping Wang

Constraining global GPP

Two observations: chlorophyll fluorescence from space and surface carbonyl sulphide (COS)

Model: CABLE

Project led by Alex Norton/Peter Rayner

Model inter-comparison

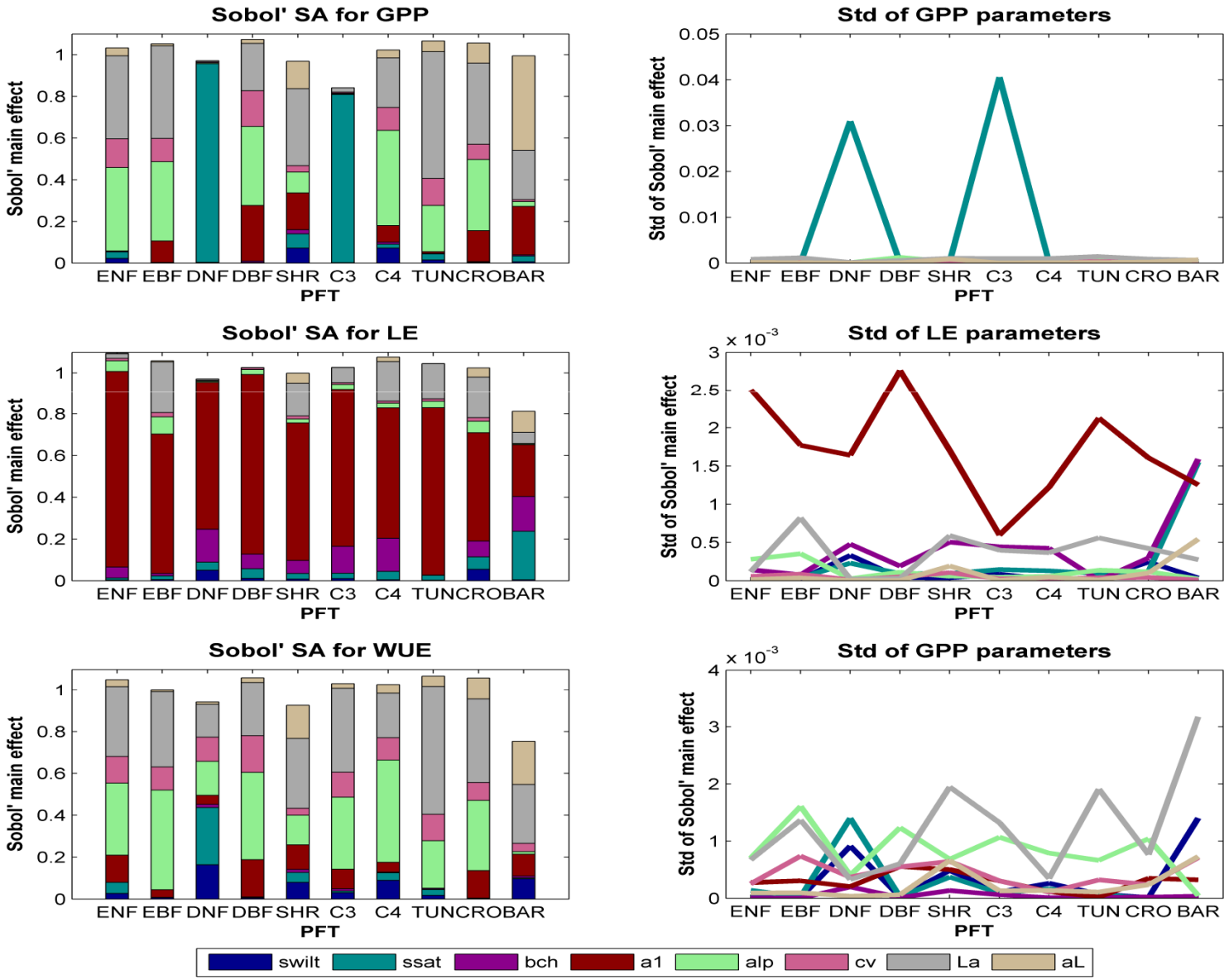
•At AGU fall meeting 2013, we organized a workshop on model inter-comparison

•This model inter-comparison differs from most MIPs (global parameter sensitivity analysis, ensemble simulations).

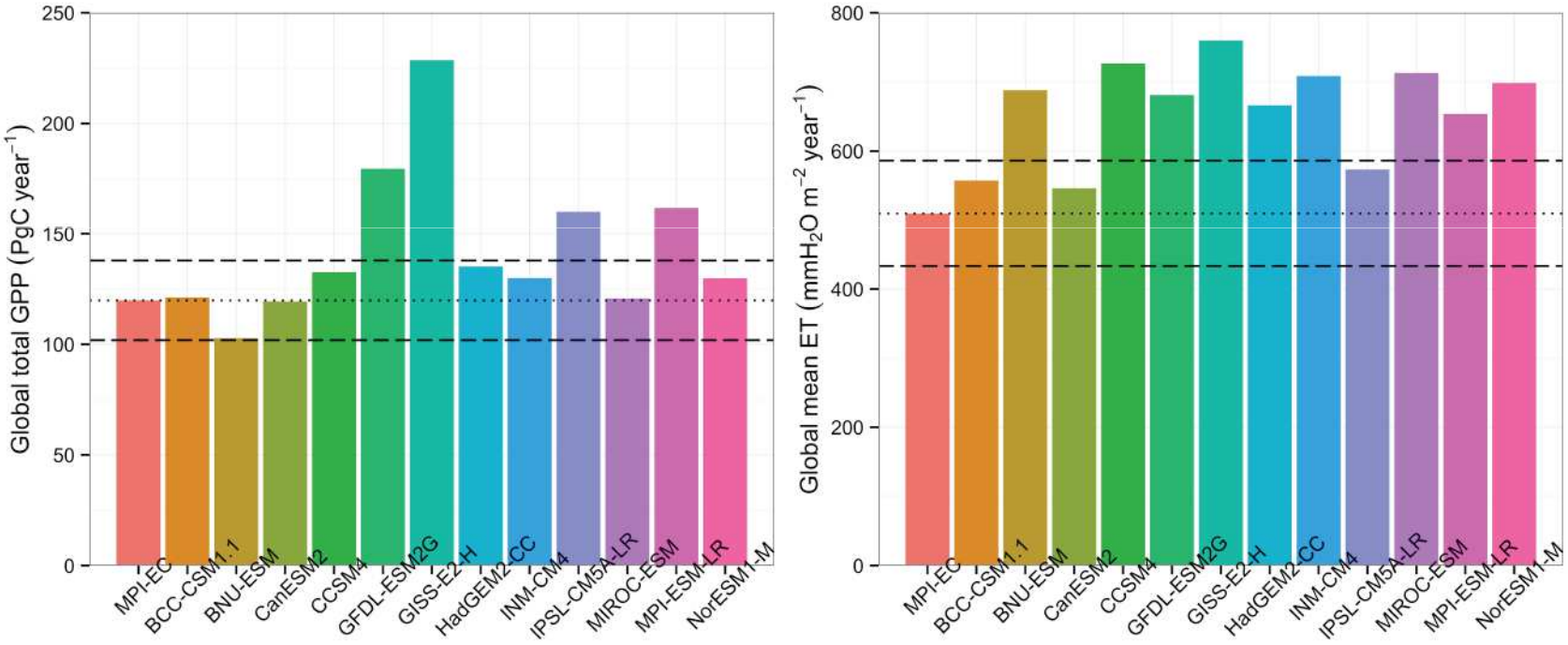
•Three models, CABLE, CLM4.5 and BEPS participated the study. JULES will participate.

Participants:
Jianduo Li, Chris Lu, YP Wang
Qingyun Duan
Jingming Chen
Chris Jones

Quantitative SA results

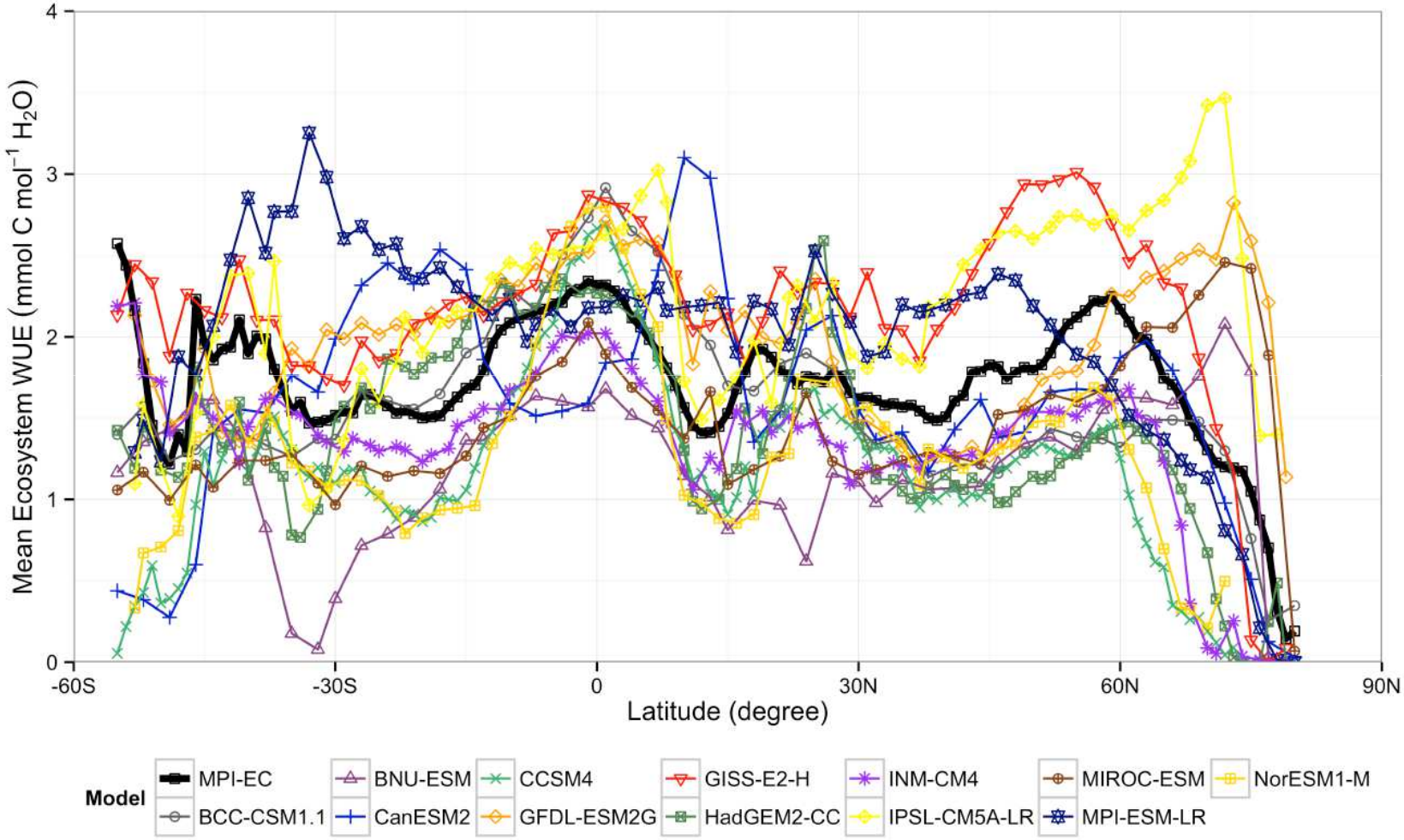


Global mean annual GPP and LE (1960-2005)



In preparation: Li et al.

Ecosystem water use efficiency (GPP/LE)



Li et al. in preparation

Future work

- **Technical issues:**
  - documentation for CABLE2.0
  - Better uses of the repository and ticketing systems
  - More automated system for benchmarking and diagnosis

- **More MIPs**:
  - Run CABLE using TRENDY protocol (iLAMB is likely to be funded, and will use TRENDY model output, CMIP5, CMIP6 model output);
  - More comparisons of JULES vis CABLE (offline and online);

- **New processes**:
  - hydraulic conductance in CABLE?
  - Interpreting land use change information
  - Wetland soil carbon, dissolved organic carbon, microbial soil C model;

- **Use CABLE as tool for global ecology studies**:
  - acclimation of photosynthesis and respiration