

LBA-MIP:
Preliminary Analysis of
Tropical Forest Carbon Cycle Seasonality
(+ MIP activities from Asia)

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Introduction

Importance of Tropical Forest

Terrestrial carbon/water cycle, climate, future changes

Climate Controls on seasonal changes of carbon cycle of tropical forests

Precipitation? Radiation?

Deep root? Moisture control on respiration?

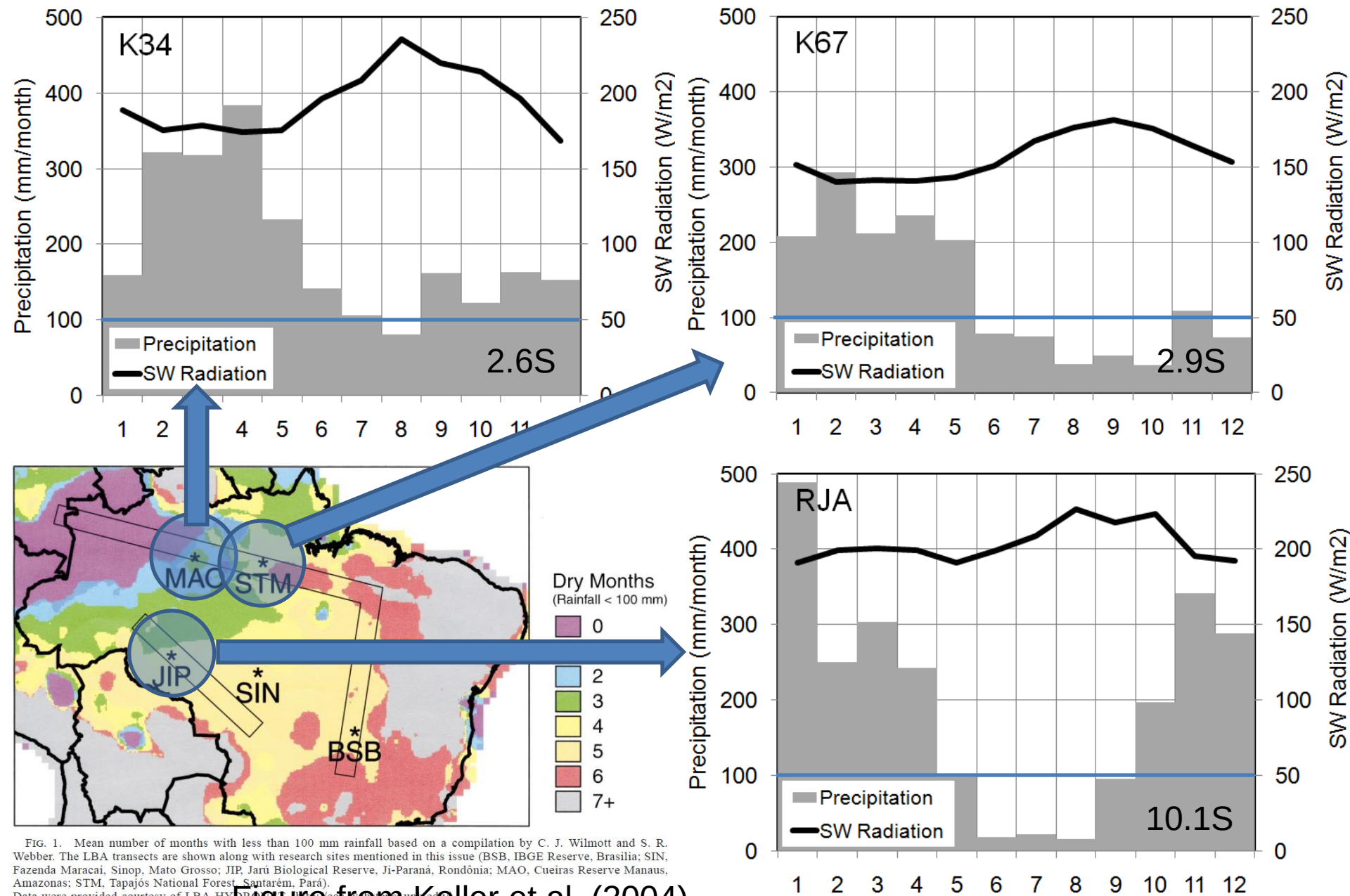
[This study]

Three evergreen tropical forest sites.

Manaus (K34), Santarem (K67), Reserva Jaru (RJA)

- Characterize uncertainties in modeled carbon cycle relating to moisture control.

Sites



Models

'Carbon Cycle' Models

.c?.

Biome-BGC

CLM3.5

CLM4CN

CNCLASS

DLEM

IBIS

ISAM

JULES

LPJ c1d, c1p, c2d, c2p (4 settings)

ORCHIDEE (Hourly)

SiB2

SiB3

SiBCASA

SSiB2 c1,c2,c3 (3 settings)

Analysis

Done

Step 1:

Monthly variations in GPP, RE(AR,HR), NEE

Working

Step 2:

Monthly variations in related parameters
(Soil Wetness, LUE, etc.)

Future

Step 3:

Interpretation through a simplified formula
Identify key factor of model differences.

Results

Done

Step 1:

Monthly variations in GPP, RE(AR,HR), NEE

Working

Step 2:

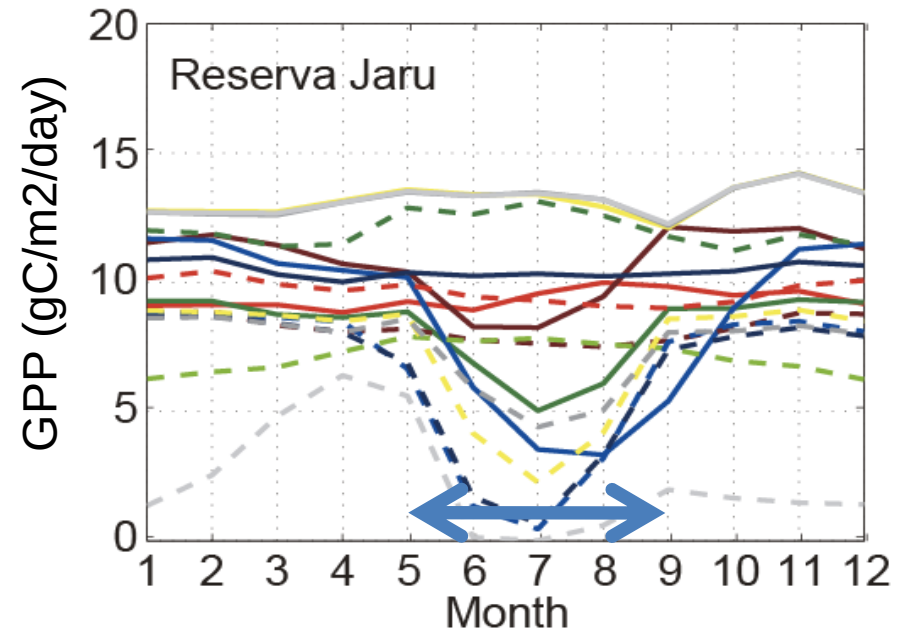
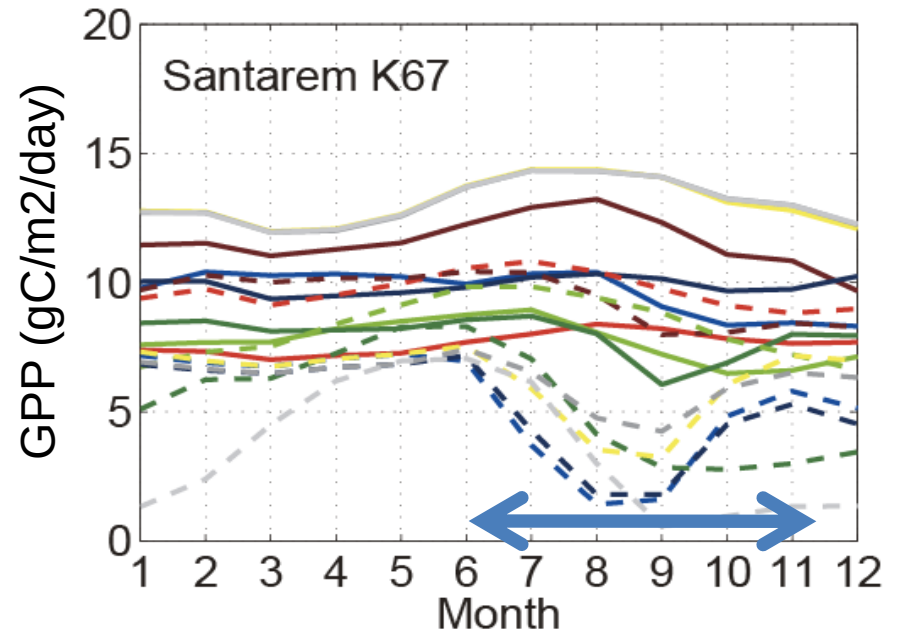
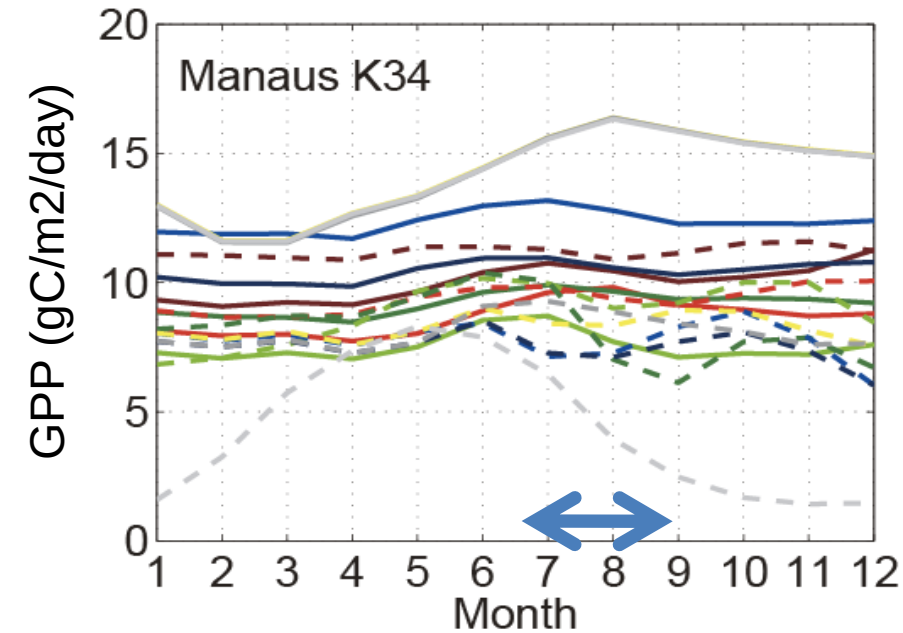
Monthly variations in other parameters
(Soil Wetness, LUE, etc.)

Future

Step 3:

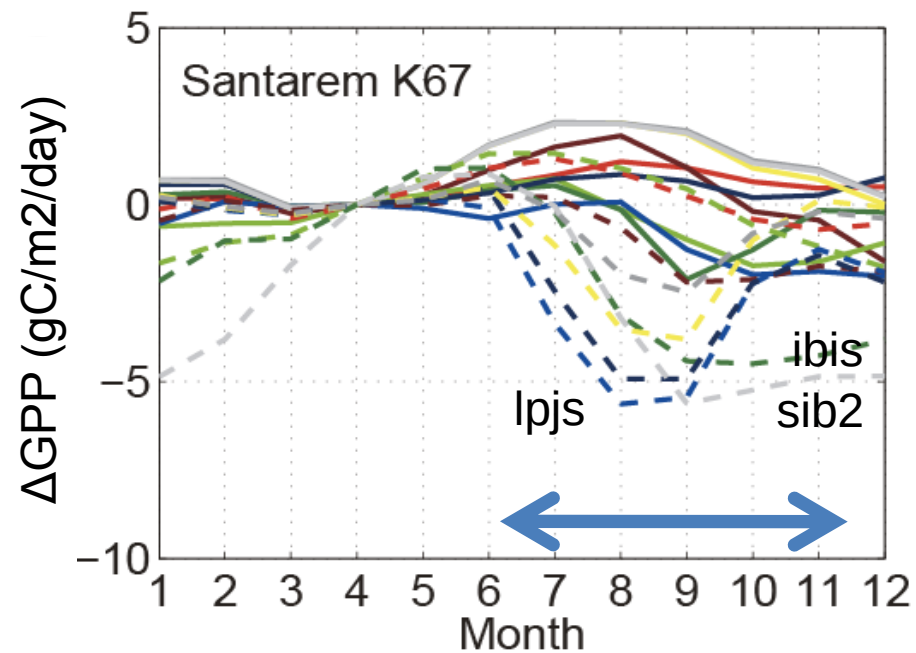
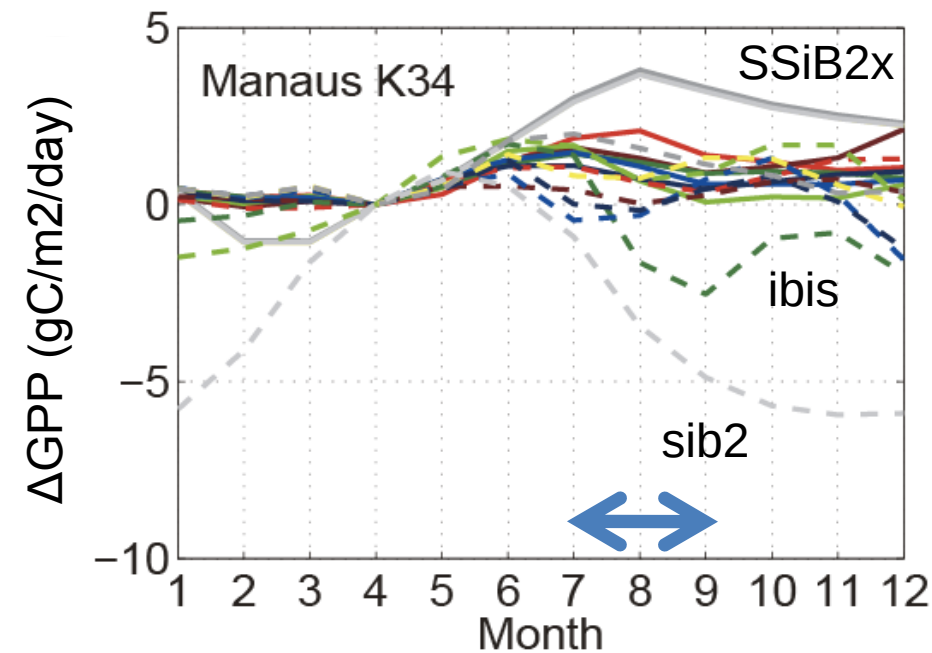
Interpretation through a simplified formula
Identify key factor of model differences.

GPP Seasonality (Magnitude + Seasonal)

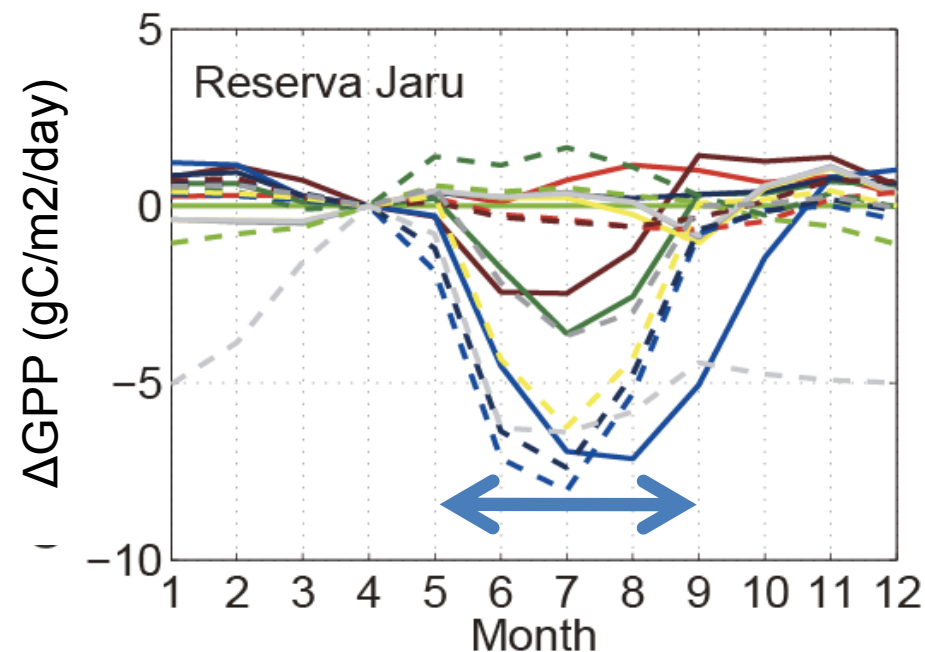
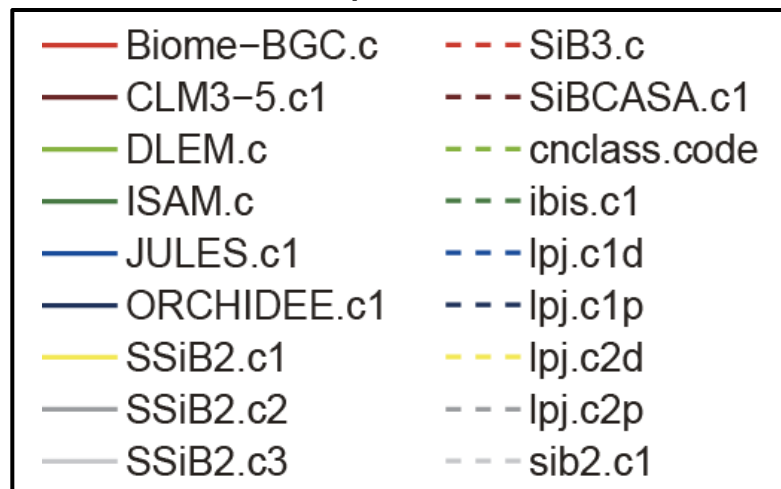


- | | |
|---------------|--------------------|
| — Biome-BGC.c | - - - SiB3.c |
| — CLM3-5.c1 | - - - SiBCASA.c1 |
| — DLEM.c | - - - cnclass.code |
| — ISAM.c | - - - ibis.c1 |
| — JULES.c1 | - - - lpj.c1d |
| — ORCHIDEE.c1 | - - - lpj.c1p |
| — SSiB2.c1 | - - - lpj.c2d |
| — SSiB2.c2 | - - - lpj.c2p |
| — SSiB2.c3 | - - - sib2.c1 |

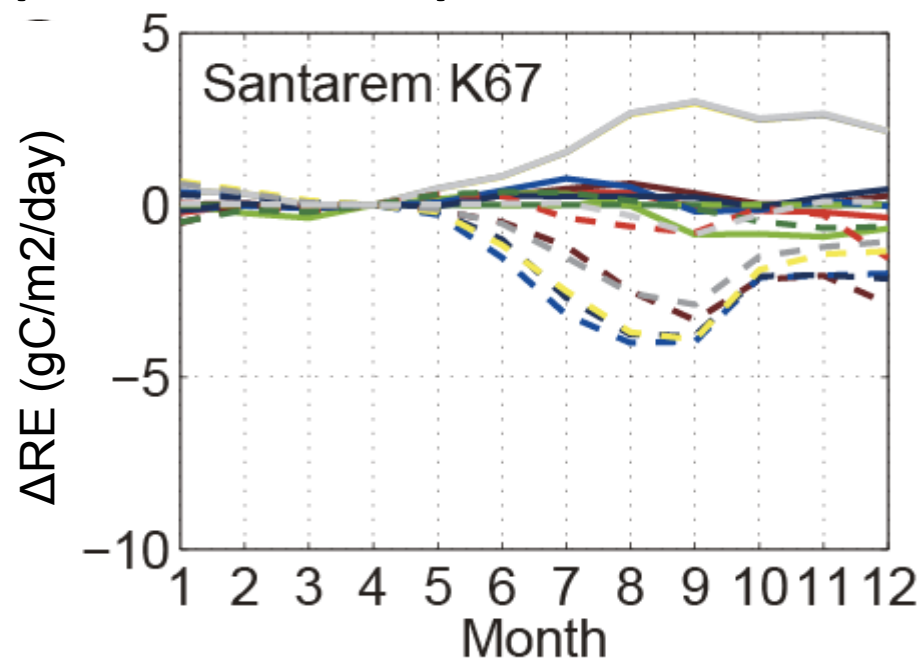
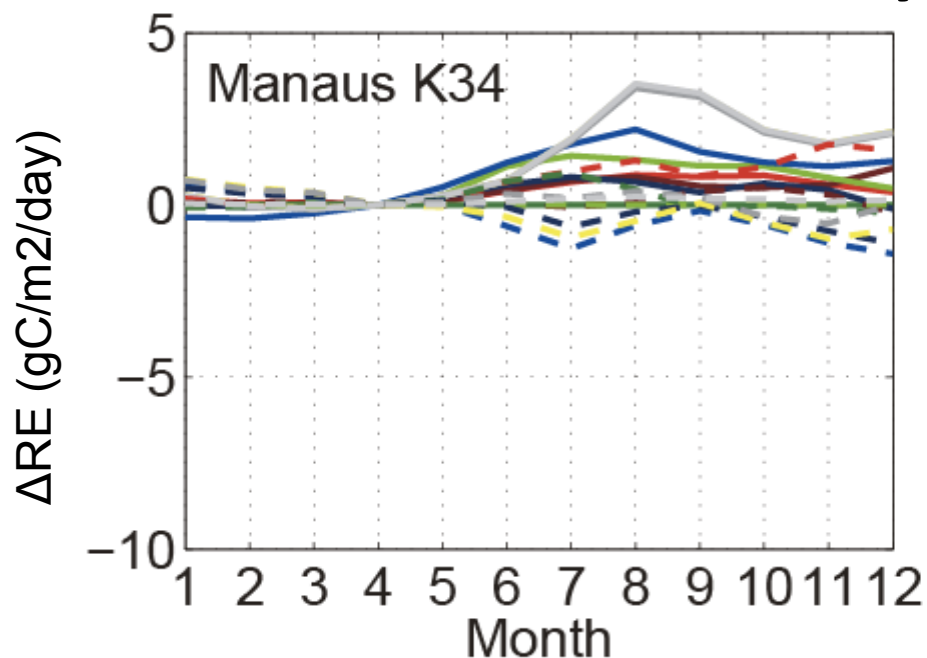
GPP Seasonality (Standardized)



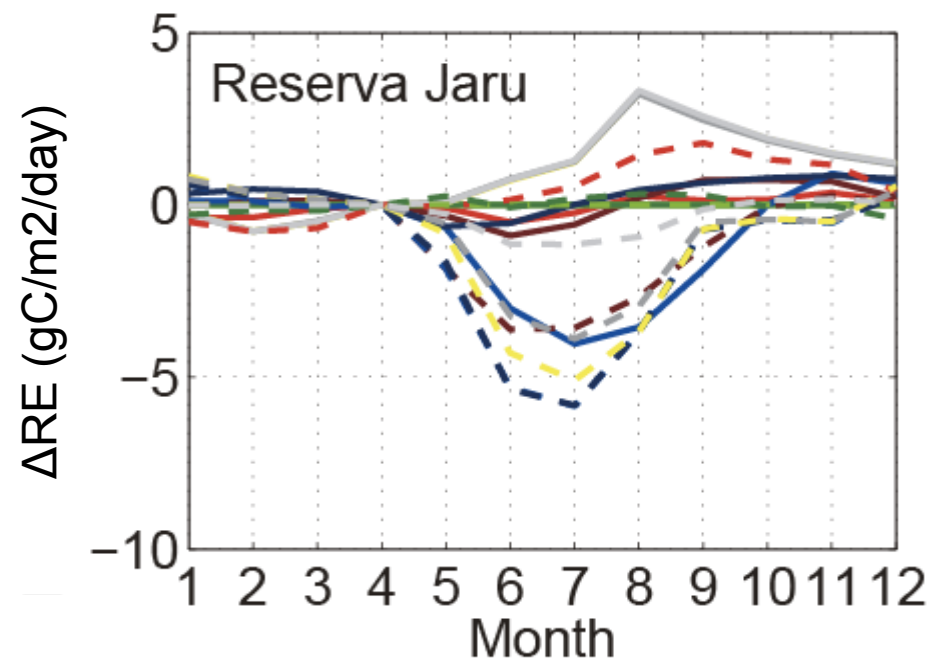
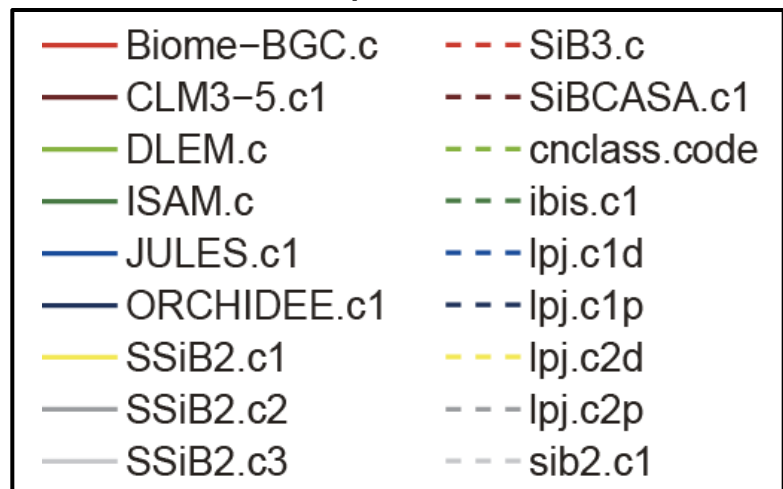
Differences from April



RE Seasonality (Standardized)

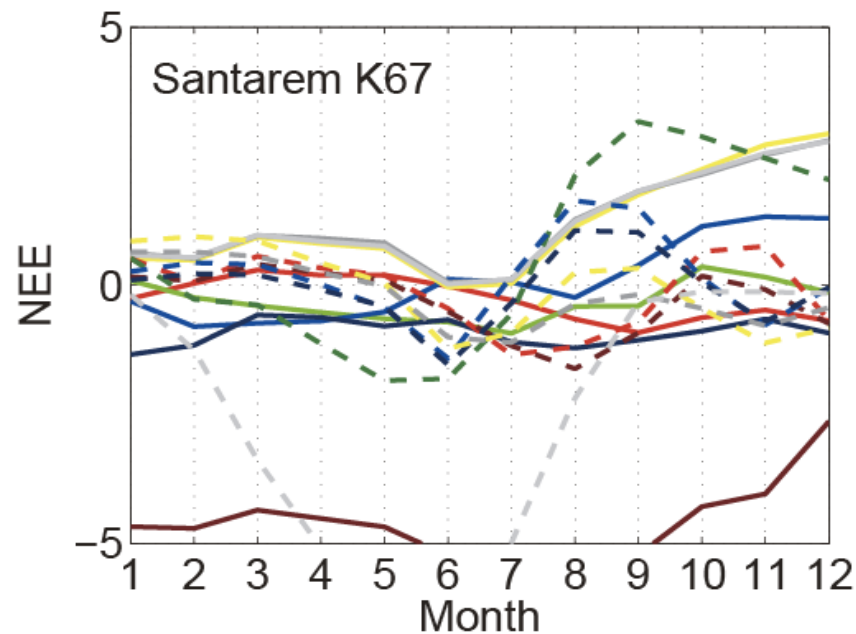
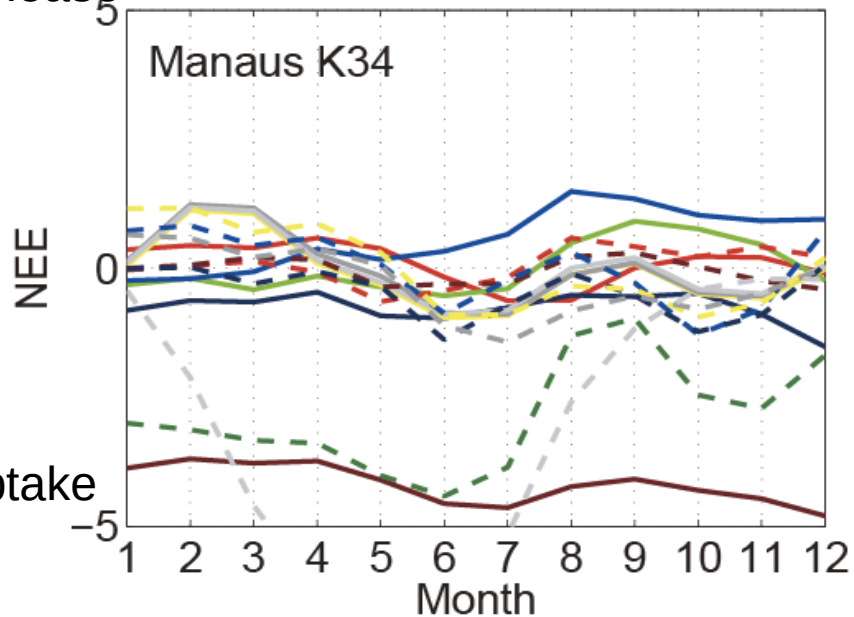


Differences from April

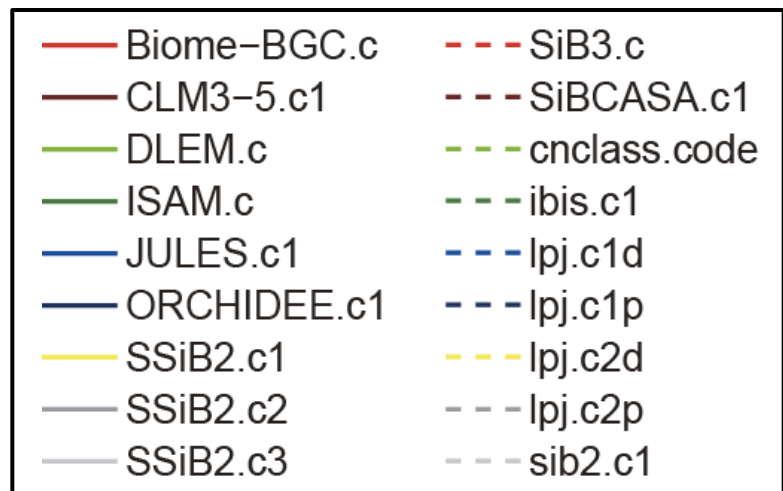
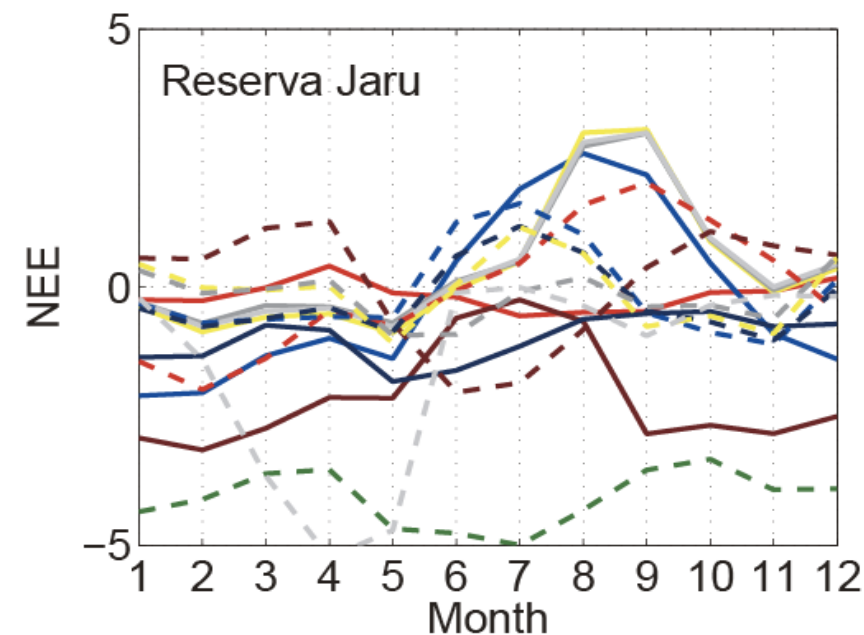


NEE Seasonality

Release



Uptake



Results

Done

Step 1:

Monthly variations in GPP, RE(AR,HR), NEE

Working

Step 2:

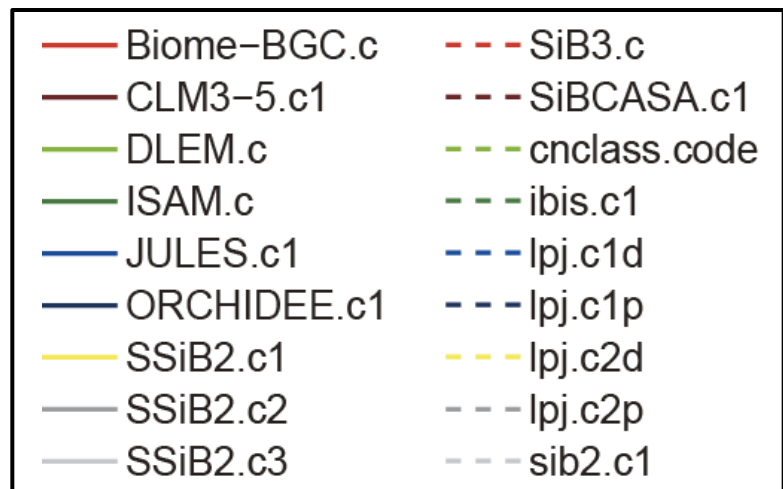
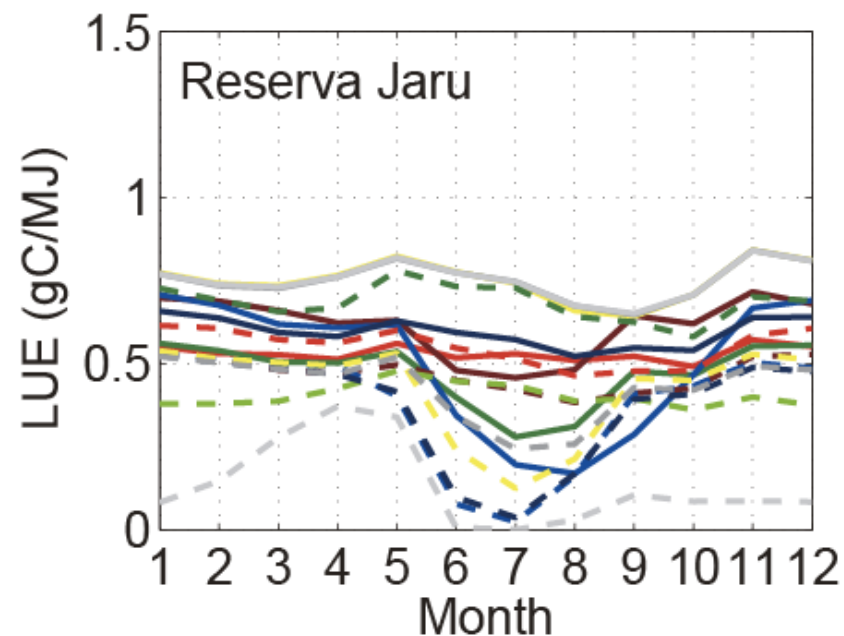
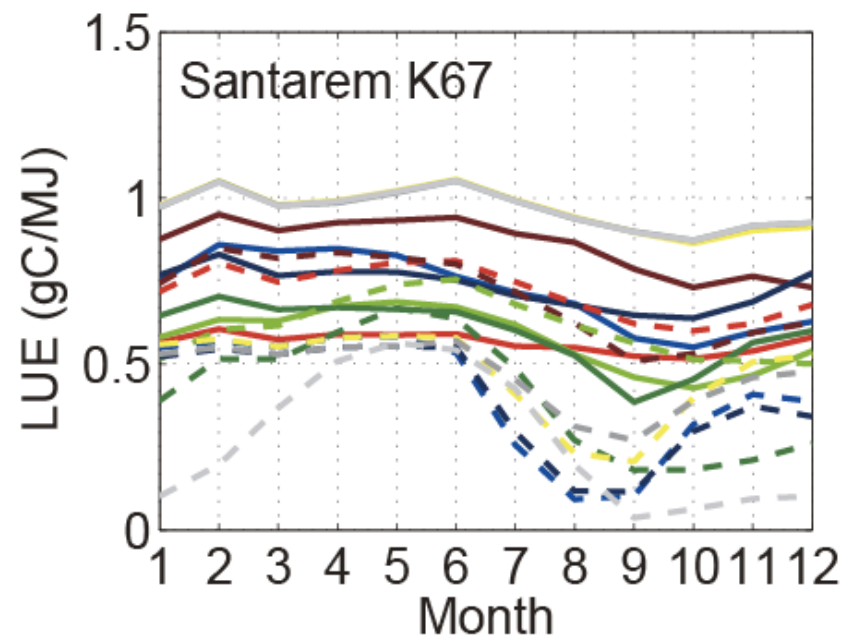
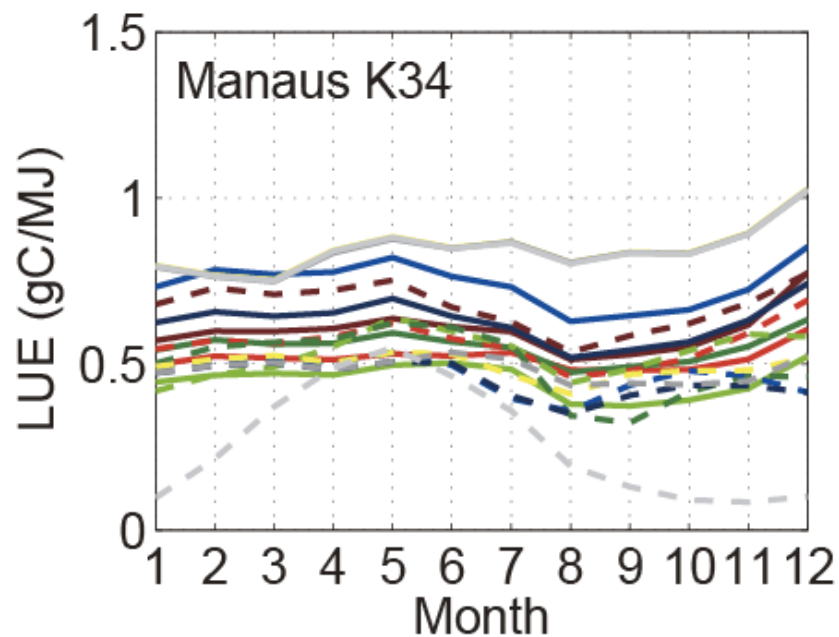
Monthly variations in related parameters
(Soil Wetness, LUE, etc.)

Future

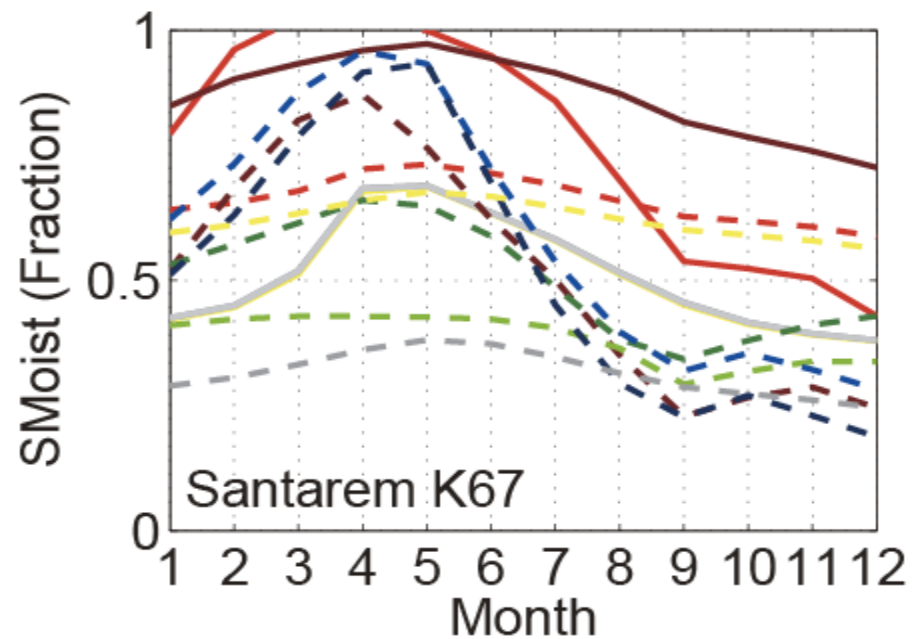
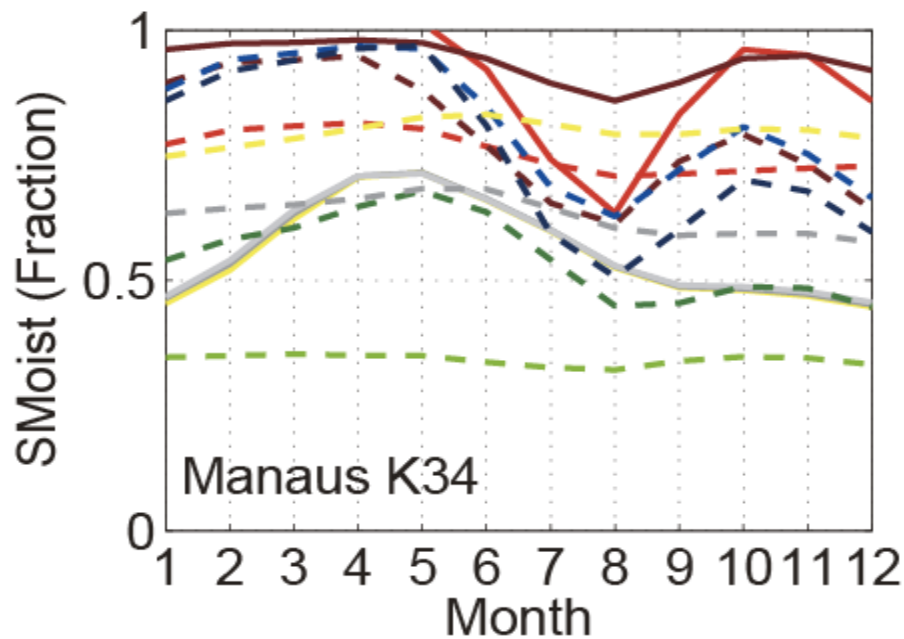
Step 3:

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Identify key factor of model differences.

Useful model output: Light Use Efficiency

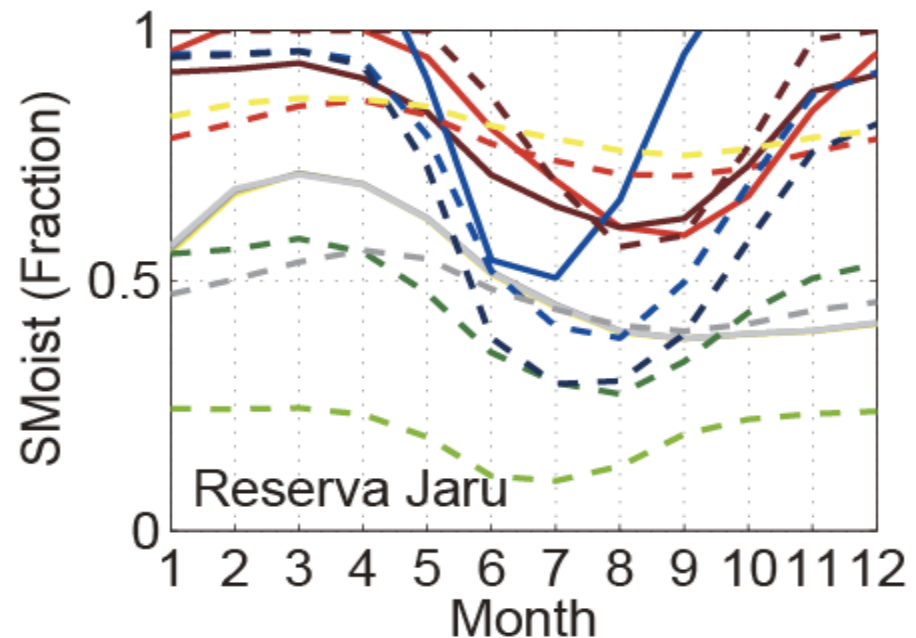
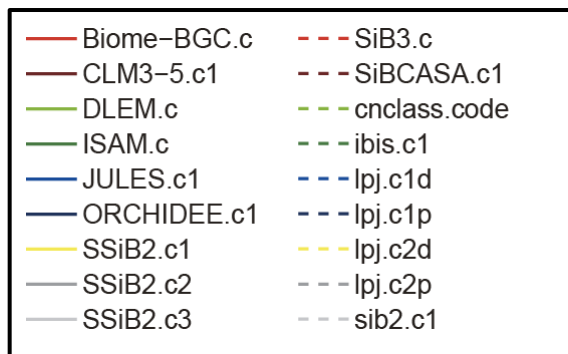


Useful model output: Soil Wetness



Soil Wetness (0-1) =

$$\frac{\text{Soil Moisture}}{(\text{SM at max} - \text{SM at wilting point})}$$



Implications

Drier → Larger differences in simulated carbon cycle
✂ Moisture control is important

Model-by-model differences
GPP > RE

NEE not much differences
; Differences cancelled

Further analysis using climate, other indices (LUE etc..)
Quantifying the model response to moisture availability

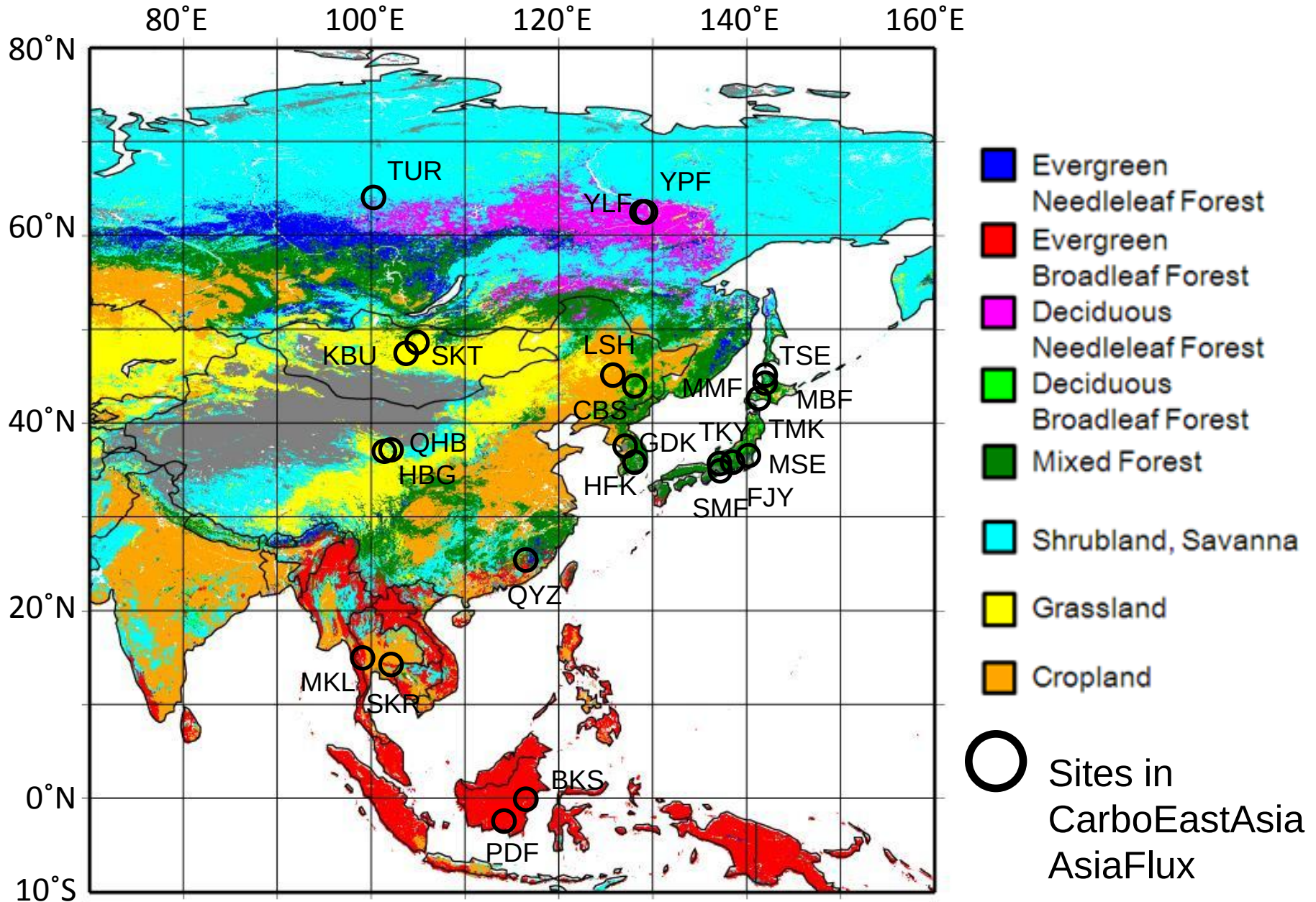
Need help

1. Tower data (Gap-filled, flux-partitioned)
Are they available?
If not, need to create consistently
gap-filled and flux-partitioned data.
2. Model description
Photosynthesis/Respiration
Moisture control
Soil Water Model (depth, layers etc.)
3. Check unit.
4. Help each other

Model Comparison

Activities in Asia

Region



Participating Models : 8+more Models

Empirical model

Support Vector Machine (SVM)
based regression (ET, GPP)
[Yang et al., 2006, 2007]

Satellite-only

Diagnostic model

BEAMS	[Sasai et al., 2005]
CASA	[Potter et al., 1993]
TOPS	[Nemani et al., 2008]

Satellite+Climate

Prognostic model

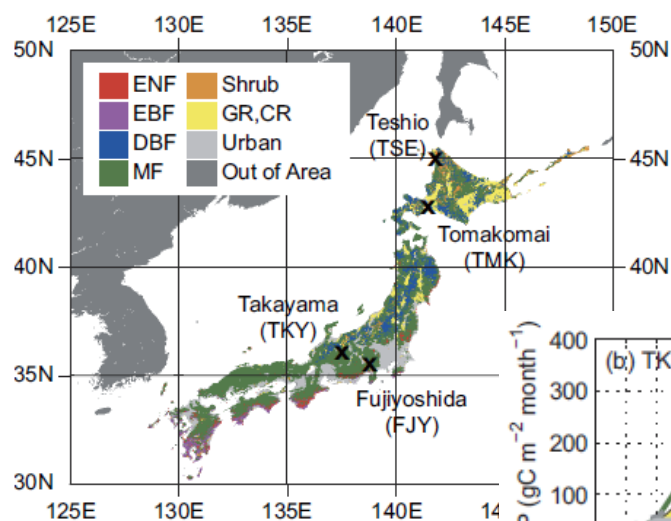
VISIT [Ito 2008]
Biome-BGC [Thornton et al., 2002]

Climate Only

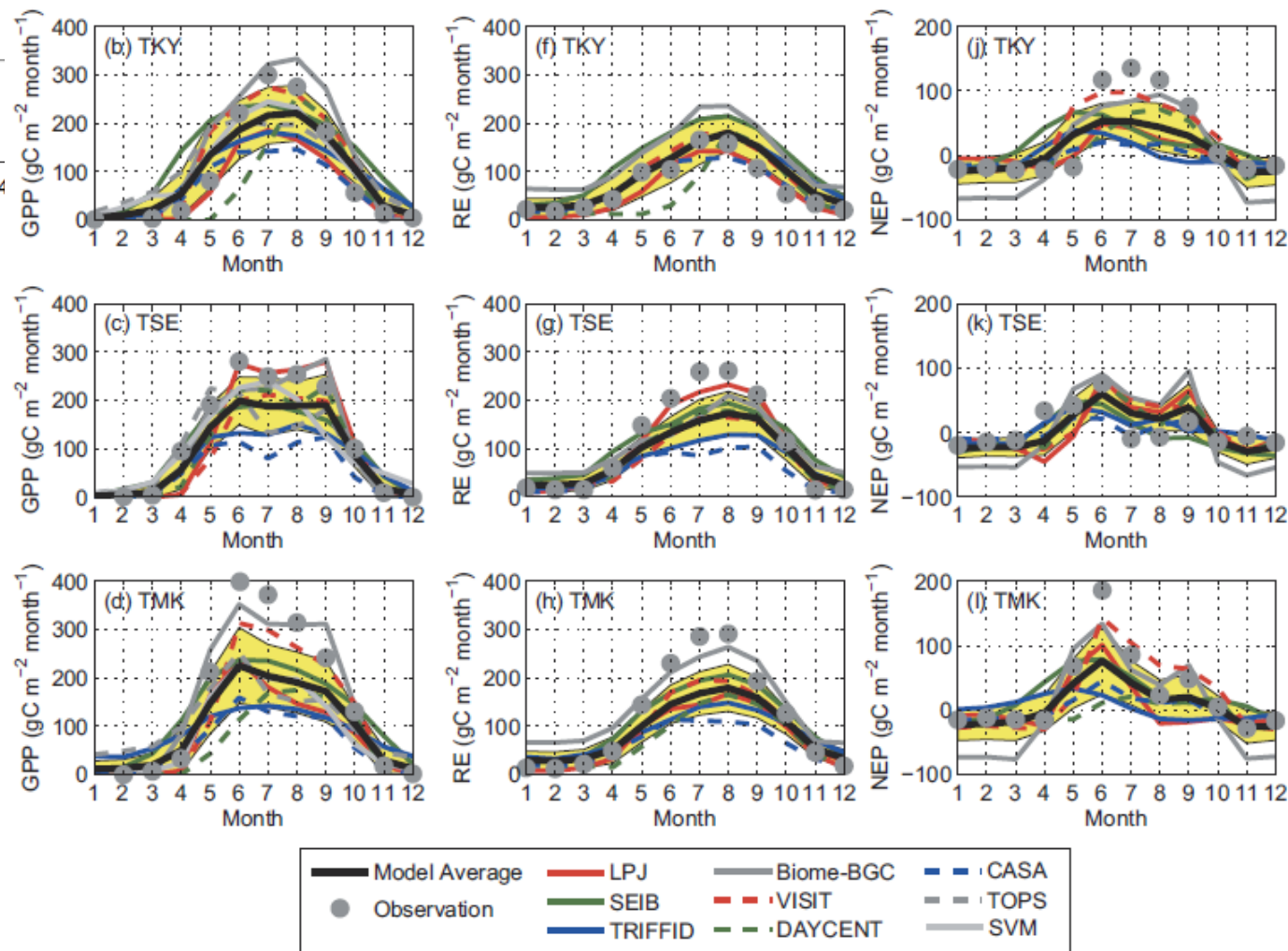
Dynamic Veg. model

SEIB-DGVM	[Sato et al., 2007]
LPJ	[Sitch et al. 2003]
TRIFFID	[Cox et al., 2001]

Climate Only

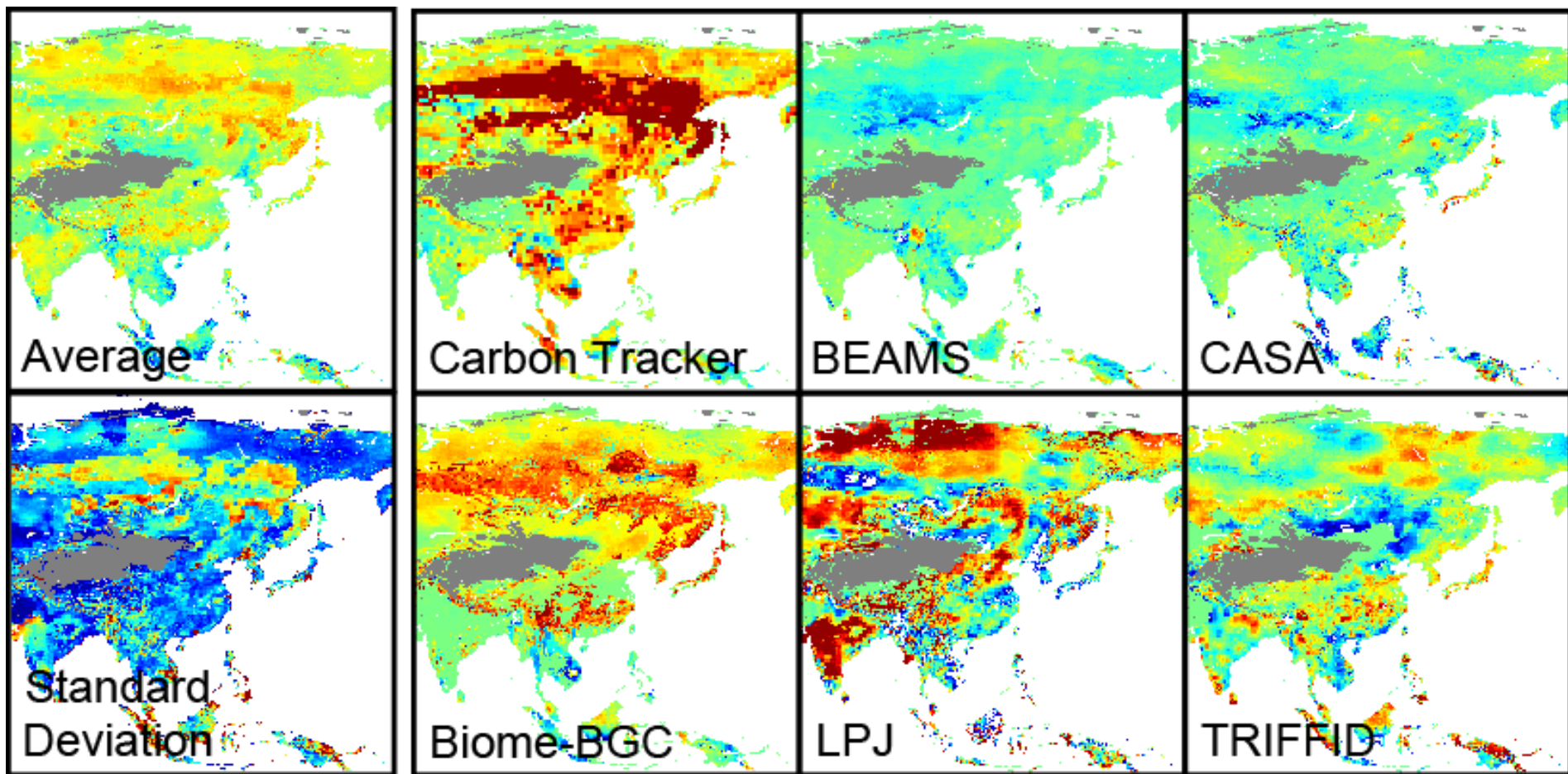


Some results: from Japan-MIP.



[Japan-MIP; Ichii et al., 2010; Biogeosciences (CarboEastAsia Special Issue)]

Annual NEP Spatial Pattern



(6 models, 2001-06 average)

Progress in Asia-MIP

Driver Preparation

Climate	NCEP + CRU merged : from 1901-2010)
RS	MODIS, AVHRR

Main Target

2003, 2010 Summer Climate Anomalies

El Nino/La Nina

Quantify Carbon/Water budget in Asia

Soil Carbon

Regional Siberia, Southeast Asia

Cropland, Dryland

etc..