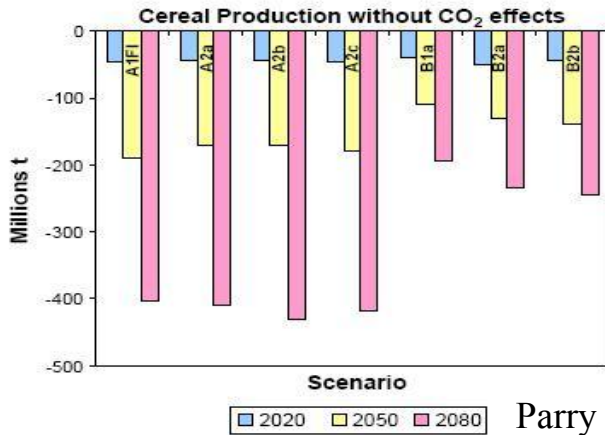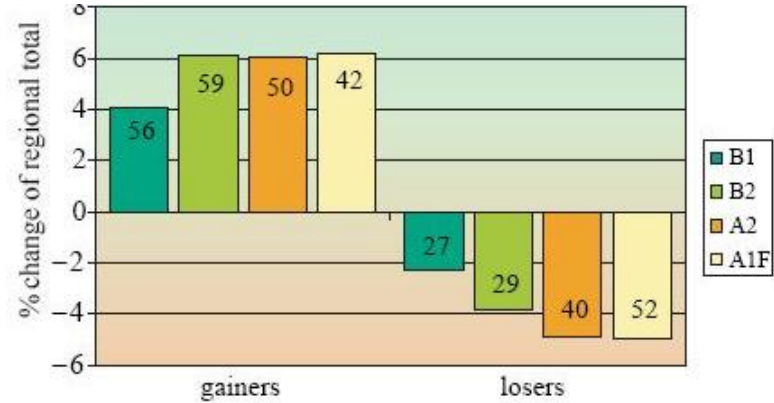# Developments of ORCHIDEEcrop and adaptation for Asian rice

X Wang, X Wu, P Ciais, N Vuichard, N Viovy, L Li, S Piao
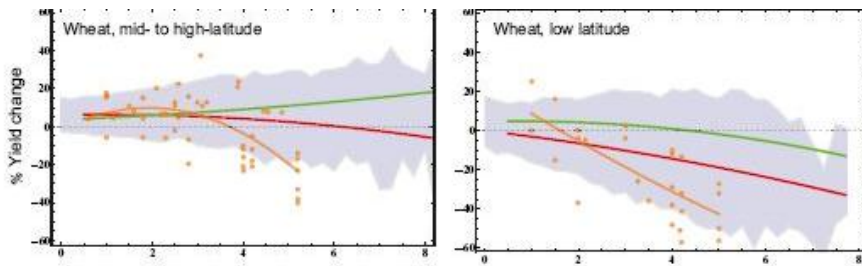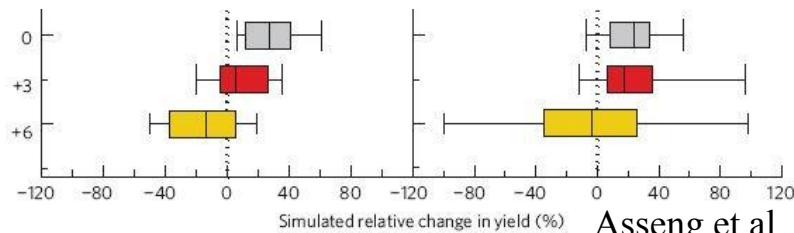
Crop modelling

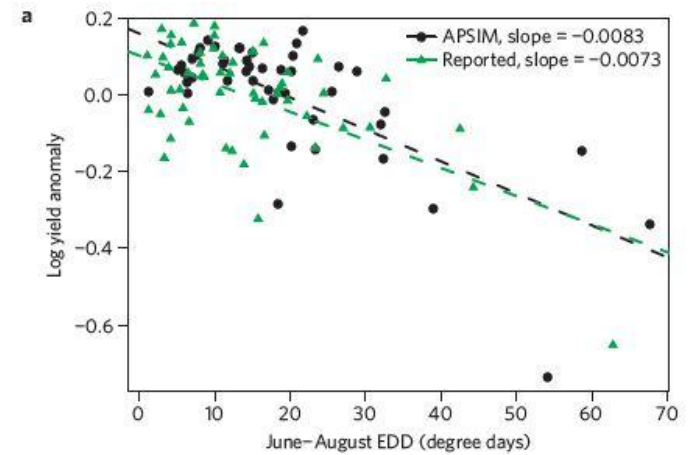Cereal Production without CO_2 effects

Parry et al., 2004

Fischer et al., 2005

Rozensweig et al., 2014

Lobell et al., 2013

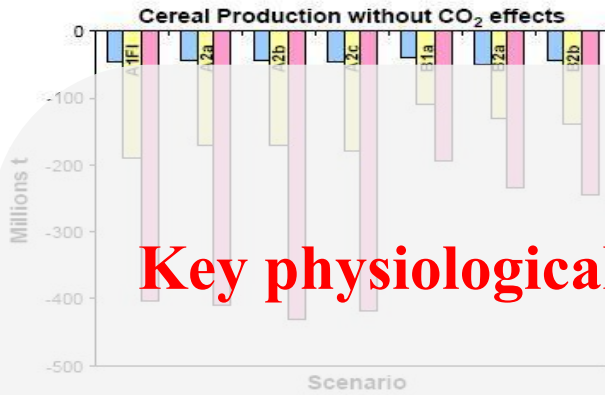Asseng et al., 2014

2

Crop modelling

Cereal Production without CO$_2$ effects
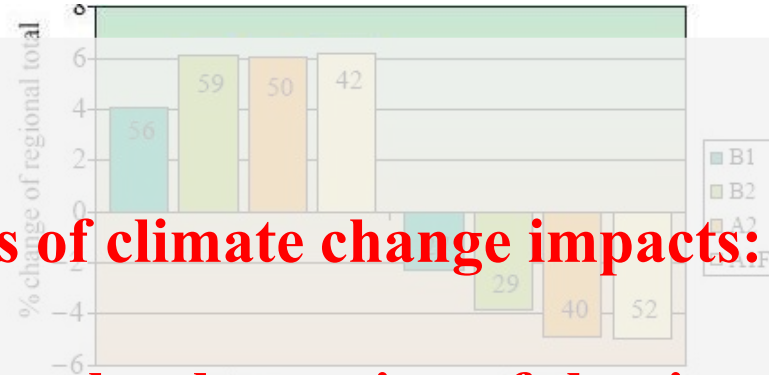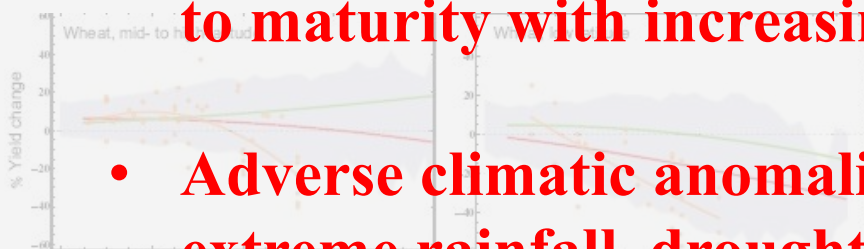
Key physiological processes of climate change impacts:

- **Reduced crop yield due to the shortening of the time to maturity with increasing mean temperature**
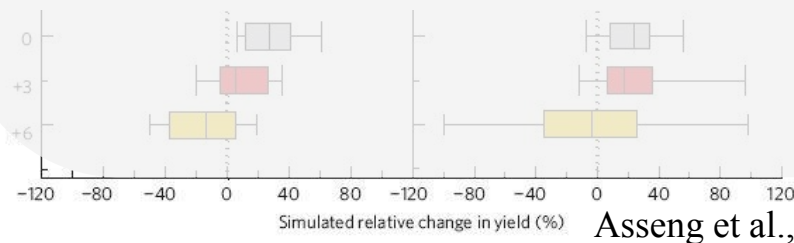
- **Adverse climatic anomalies (e.g. high/low temperature, extreme rainfall, drought) over sensitive period (e.g. flowering & grain filling) of crop growth**
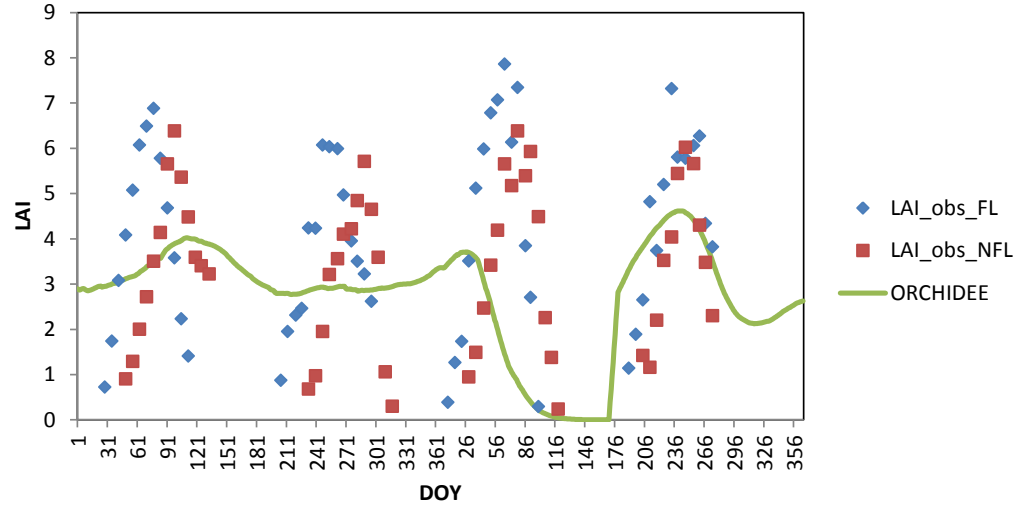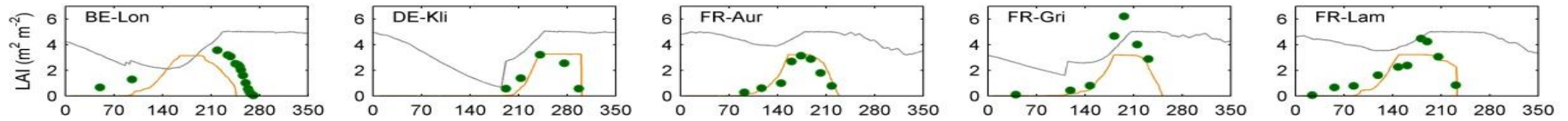
Fischer et al., 2005

Lobell et al., 2013

Asseng et al., 2014
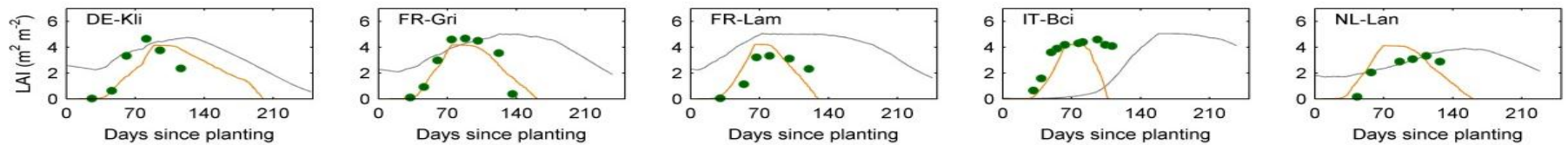
SOFIE
SINO-FRENCH INSTITUTE FOR EARTH SYSTEM SCIENCE
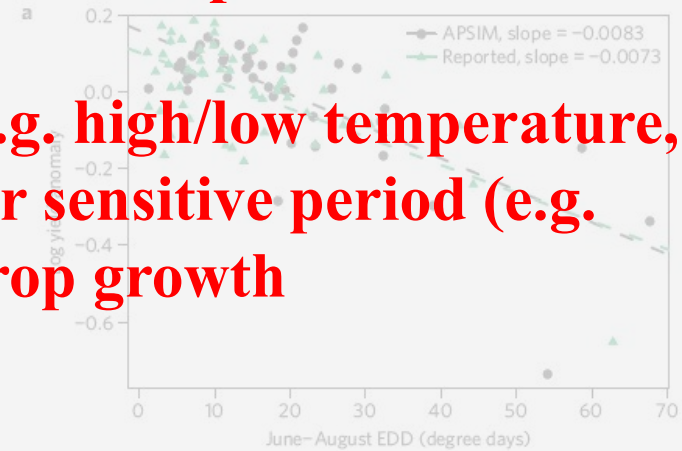
Performance of ORCHIDEEstandard

ORCHIDEEstandard vs. ORCHIDEEcrop

Wheat

Maize

Rice
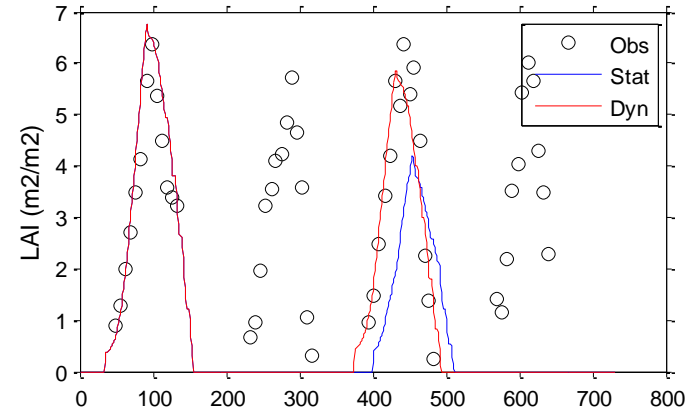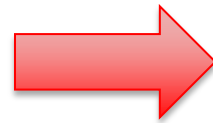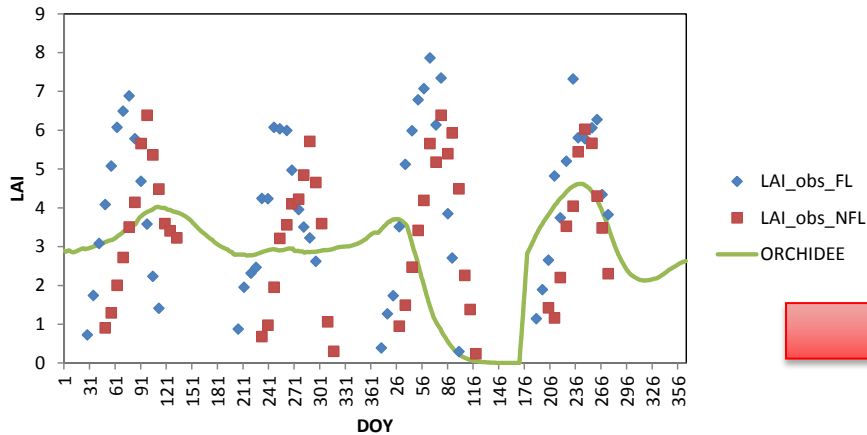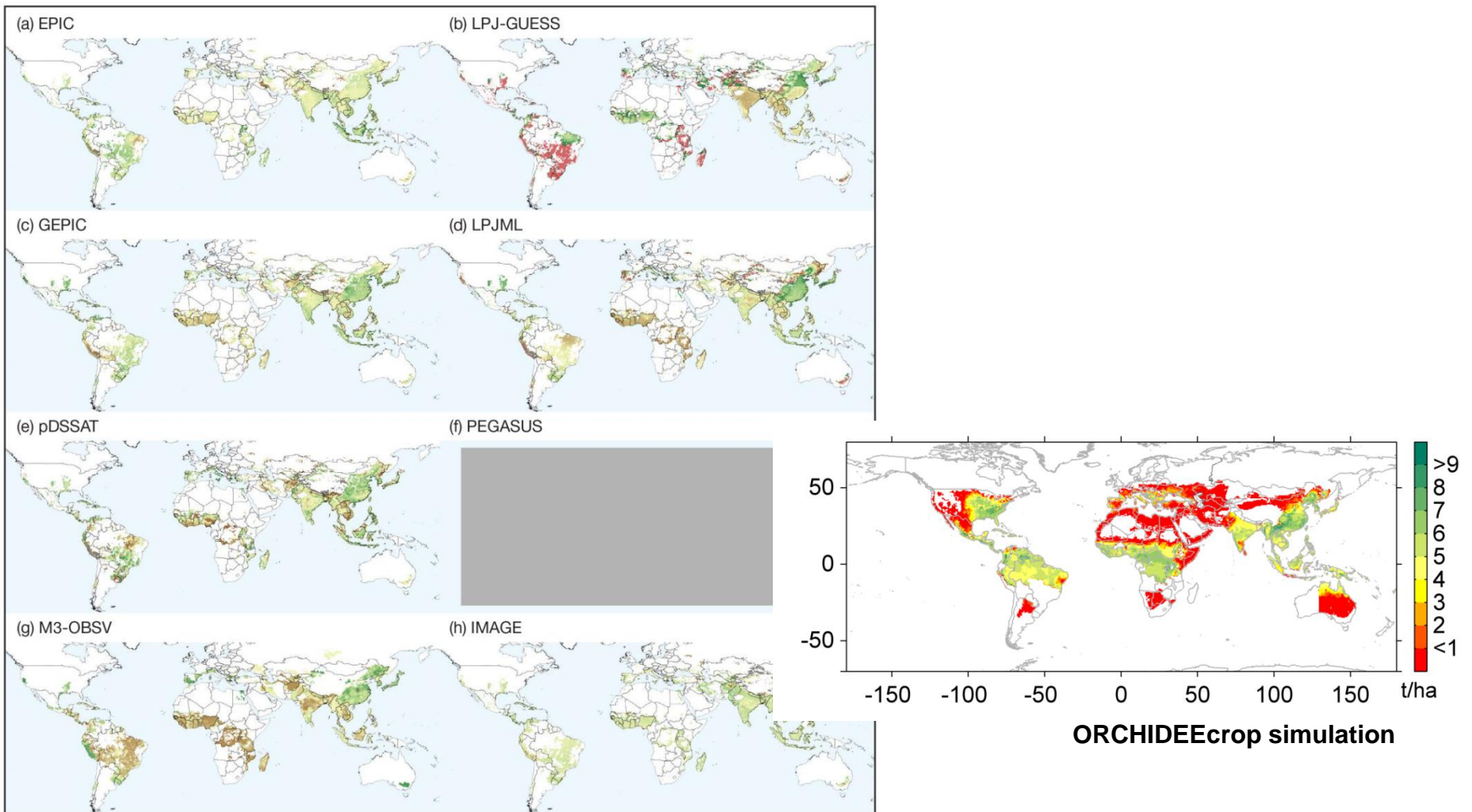
Simulated pattern of rice yield

(a) EPIC (b) LPJ-GUESS (c) GEPIC (d) LPJML (e) pDSSAT (f) PEGASUS (g) M3-OBSV (h) IMAGE

Baseline Rice Yield (t/ha)

0   4   >8

ORCHIDEEcrop simulation

t/ha

Rosenzweig C et al. (2014)

Managements
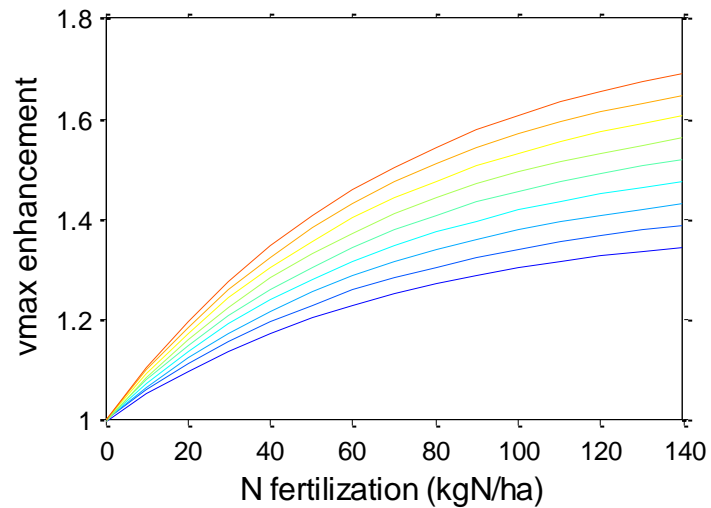
- Nitrogen fertilization
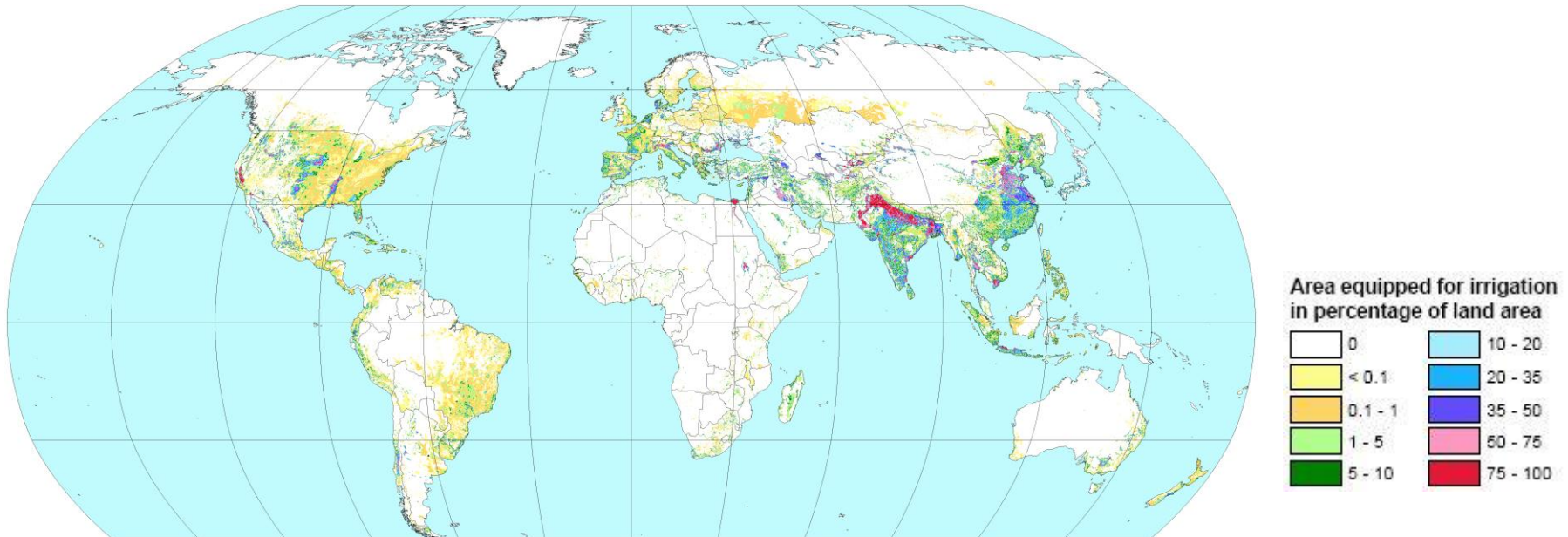- Irrigation practices
- … …

Managements
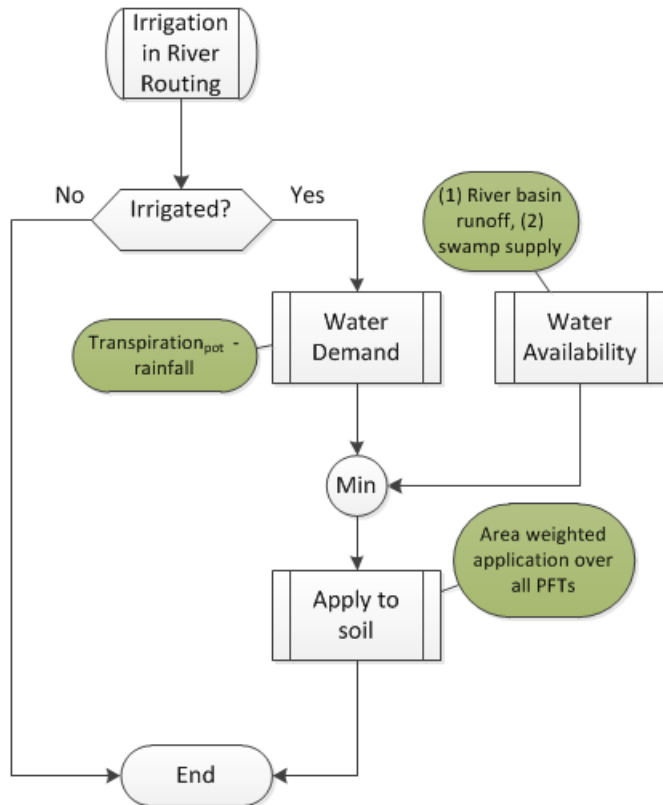
- Nitrogen fertilization
- Irrigation practices

Managements
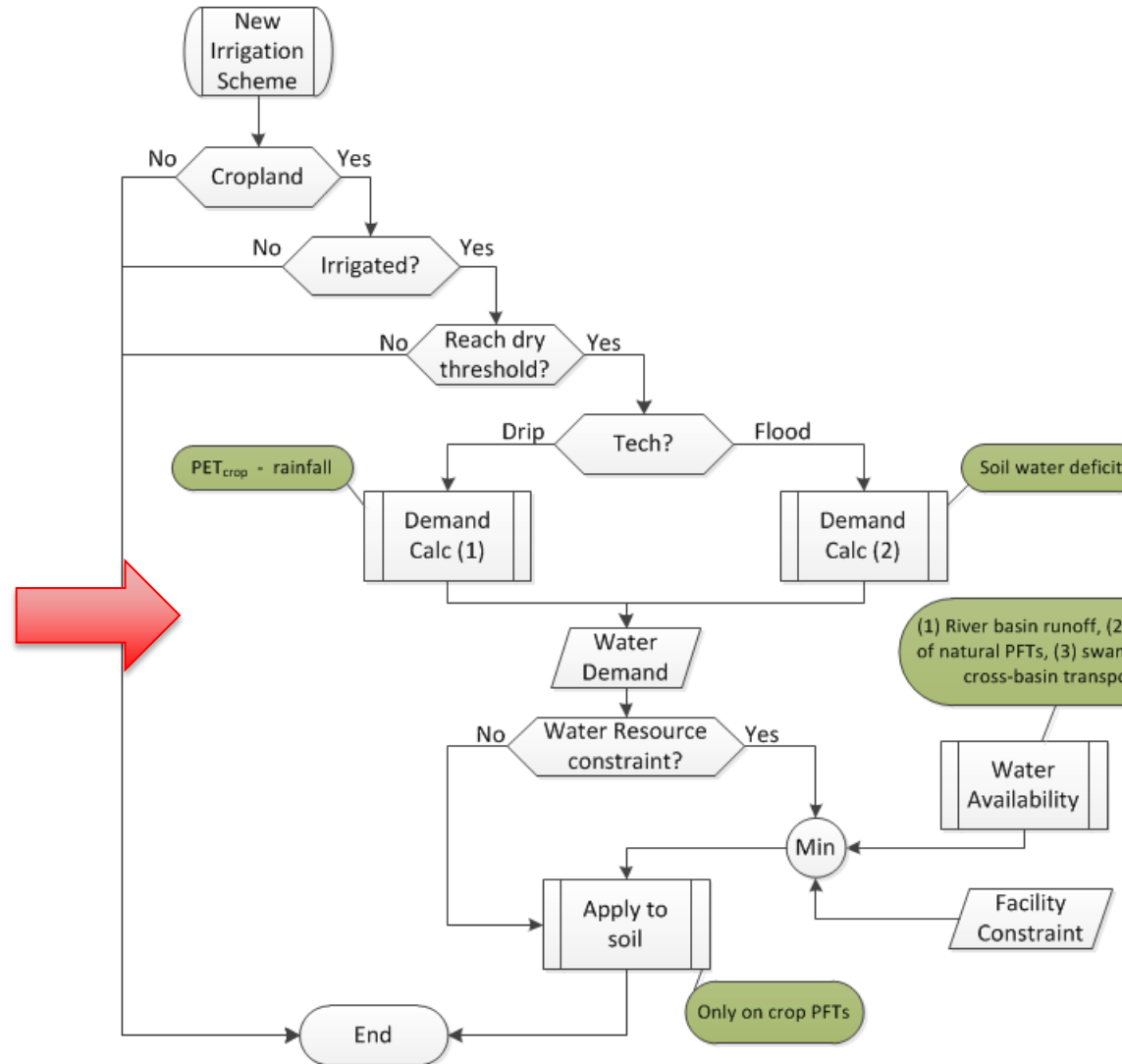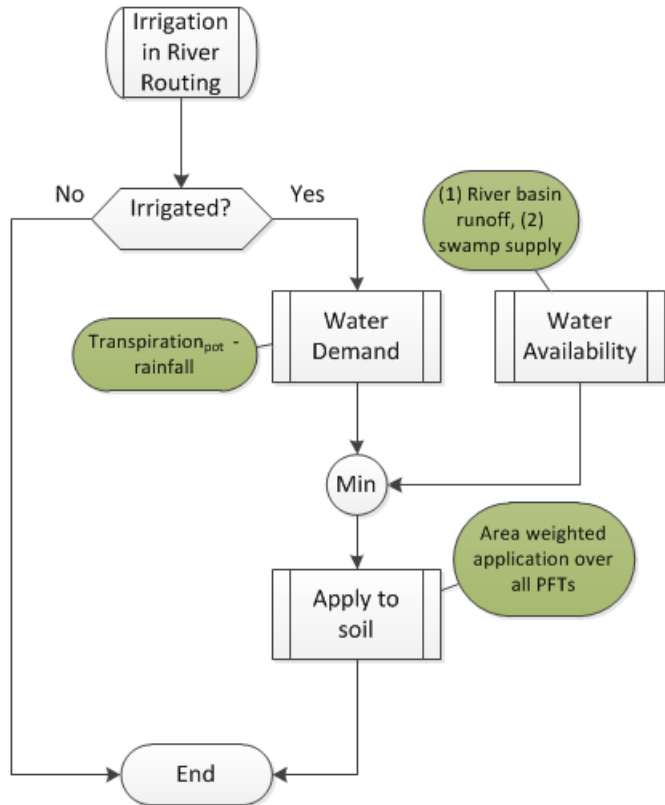
- Nitrogen fertilization

- Irrigation practices

Courtesy from GMIA v5
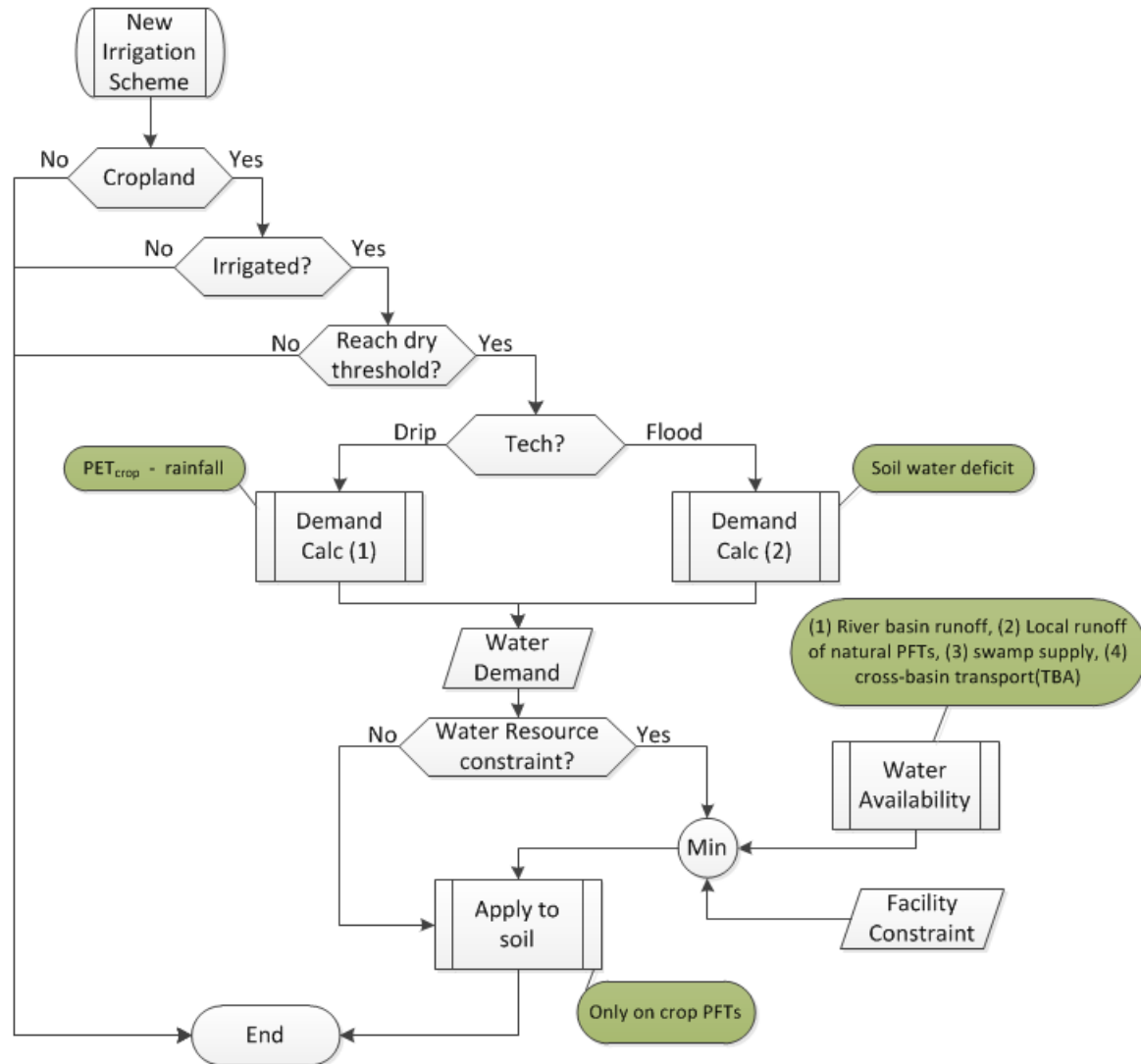
ORCHIDEEstandard irrigation scheme

- Limitations:
  - Only activated with river routing
  - Water demand & applications over all PFTs
  - Considering only potential transpiration, not PET (always deficit)
  - no room for varying irrigation technologies/strategies

Solution?

ORCHIDEEcrop irrigation scheme

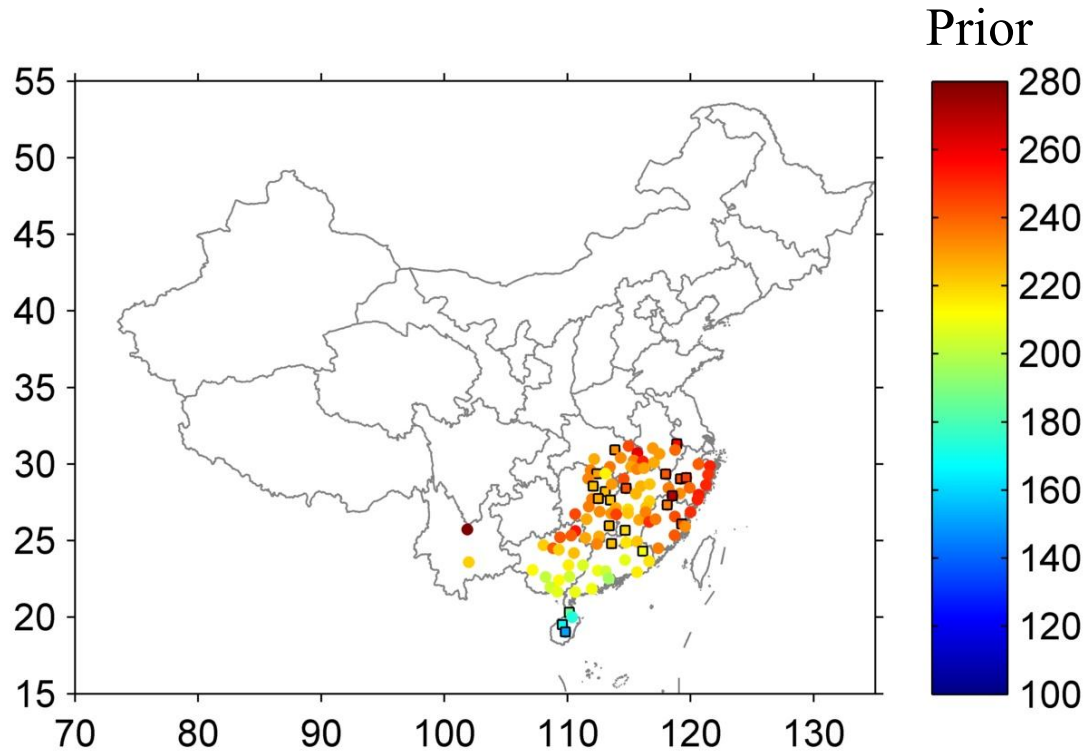- Addressing:
  - When?
  - How much?
  - How?
  - Where?

Adaptation for rice crop in Asia

- Crop phenology

- Sensitivity to Nitrogen fertilizer application
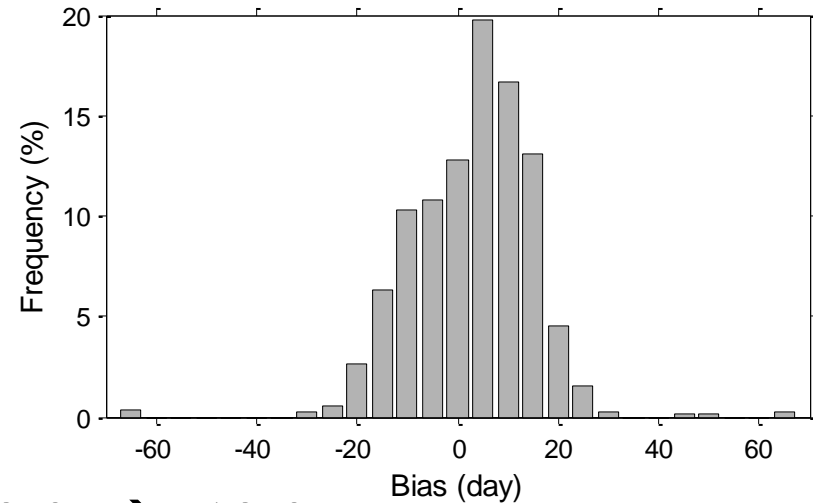
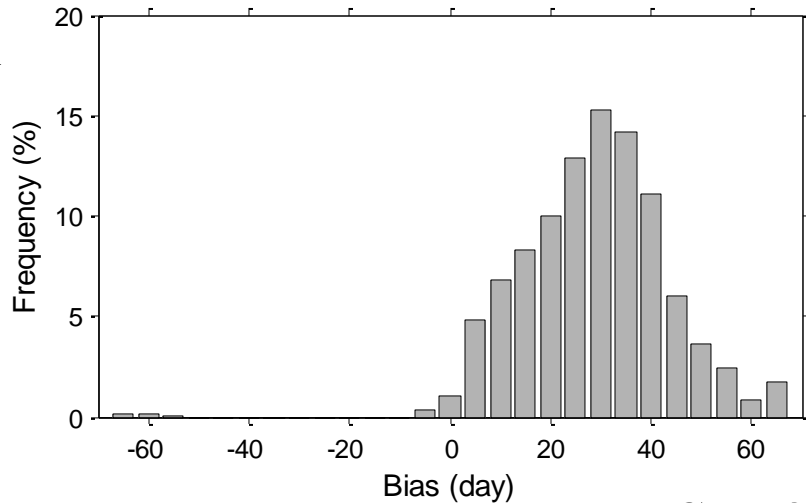# Spatial distribution of early rice sites

- Spatio-temporal variations over 108 early rice sites (86 to optimize, 22 to cross-validate)
- Black squared indicates randomly selected validation sites

Spatio-temporal biases

Spatial gradient

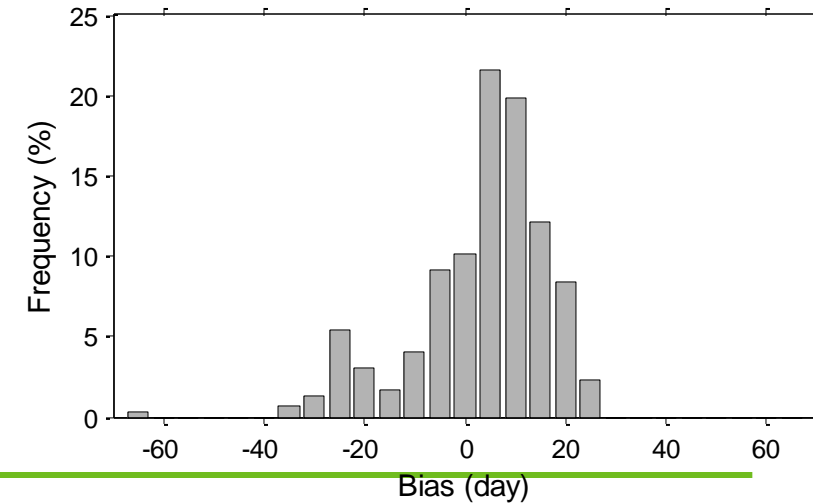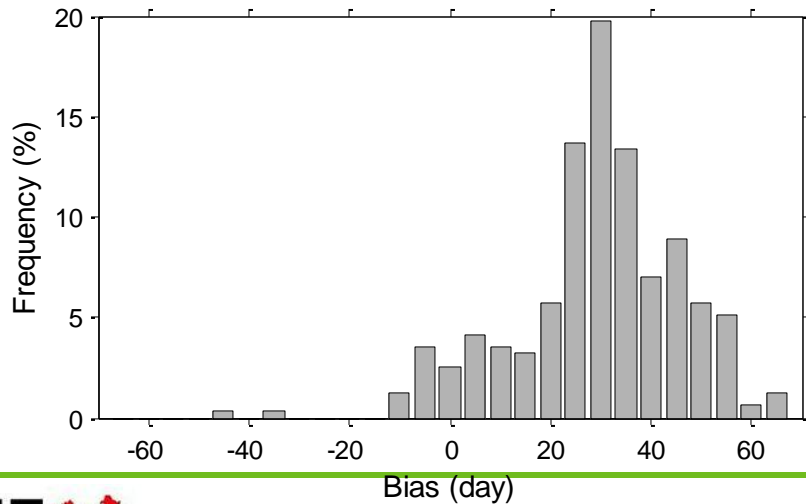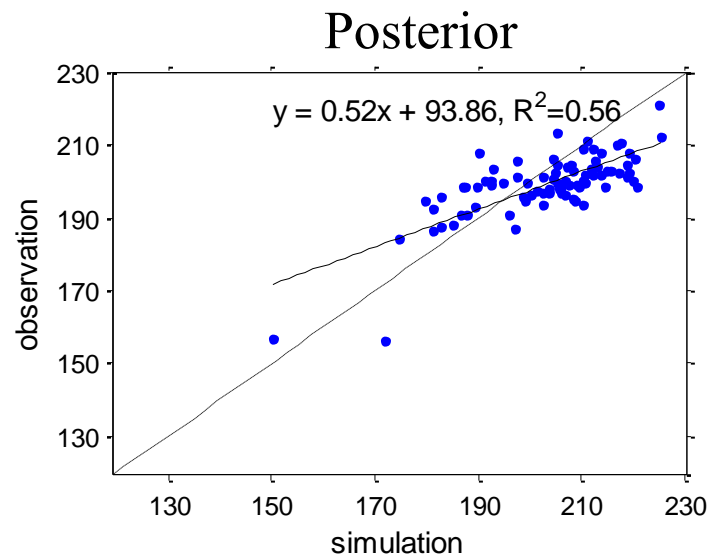
Prior

Posterior

Optimization sites

y = 0.35x + 118.62, R^2=0.40

y = 0.52x + 93.86, R^2=0.56

Validation sites

y = 0.47x + 87.88, R^2=0.88

y = 0.54x + 85.97, R^2=0.93

SOFIE

SINO-FRENCH INSTITUTE FOR EARTH SYSTEM SCIENCE
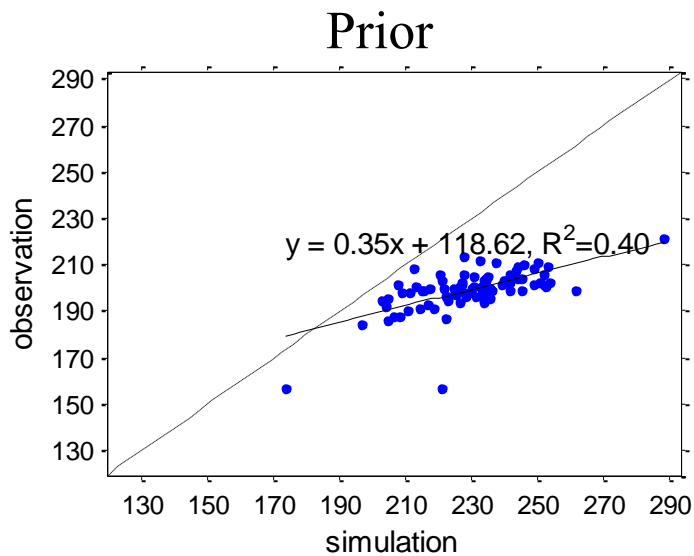
Interannual variations
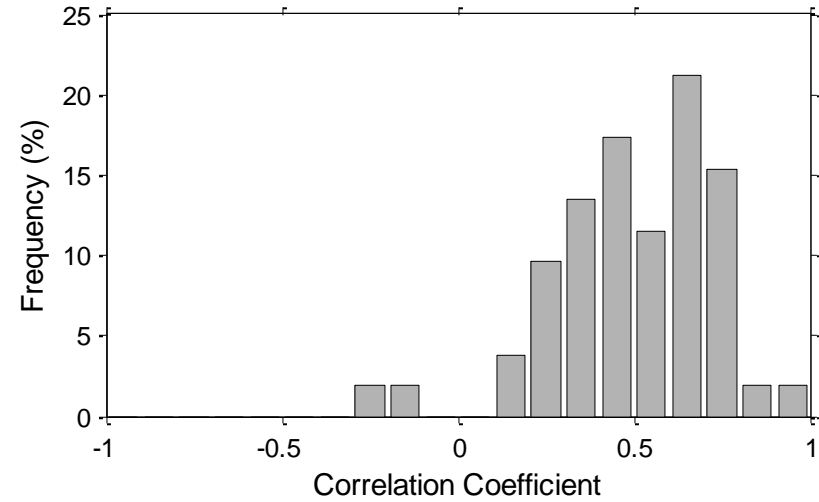
Optimizatio n sites

Validation sites
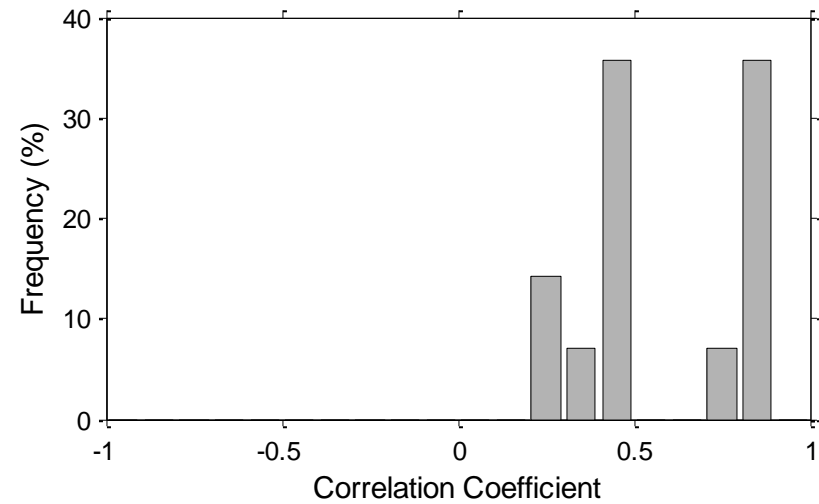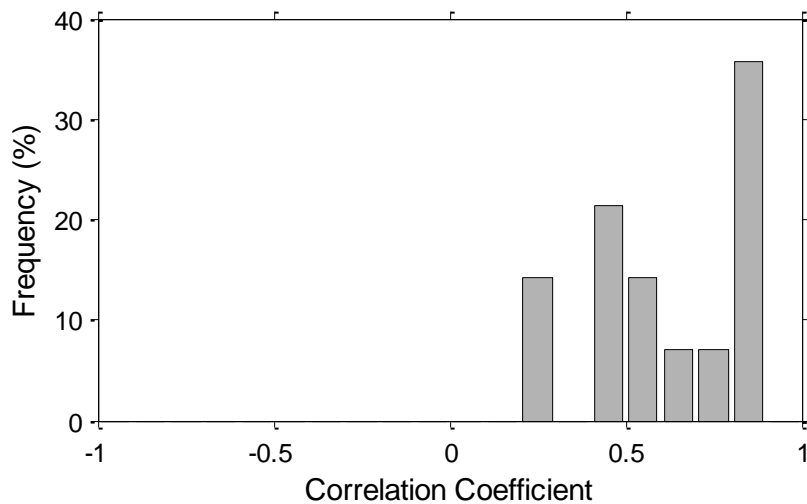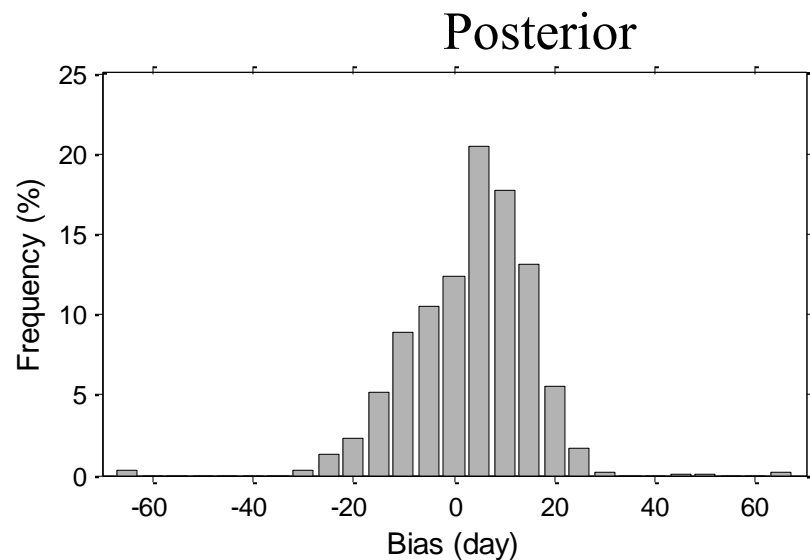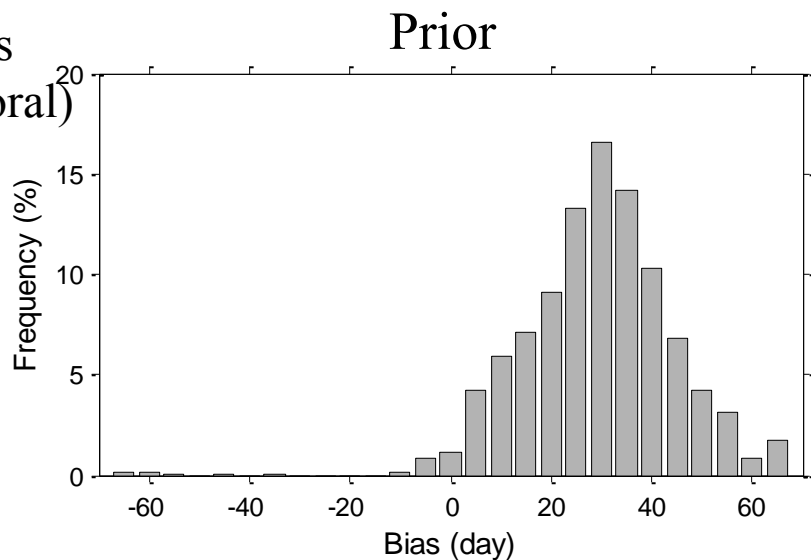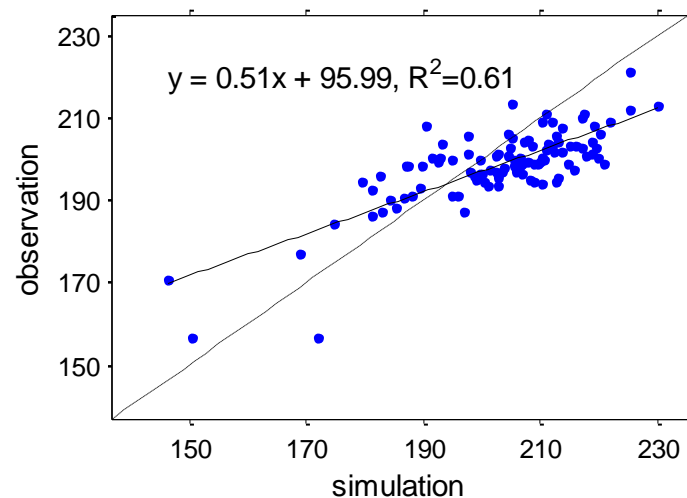
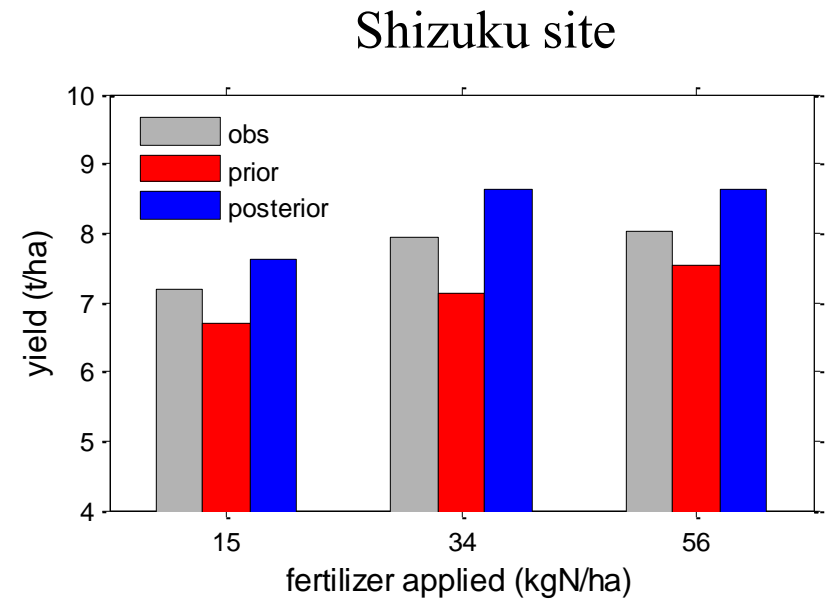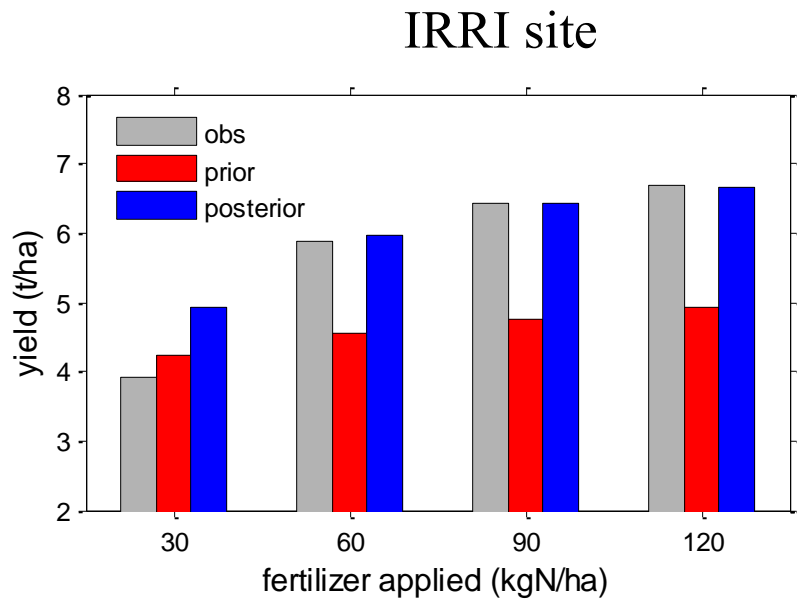# For all sites

Overall biases (spatio-temporal) — Prior / Posterior

Spatial gradient

Prior: $y = 0.36x + 115.74$, $R^2 = 0.48$

Posterior: $y = 0.51x + 95.99$, $R^2 = 0.61$
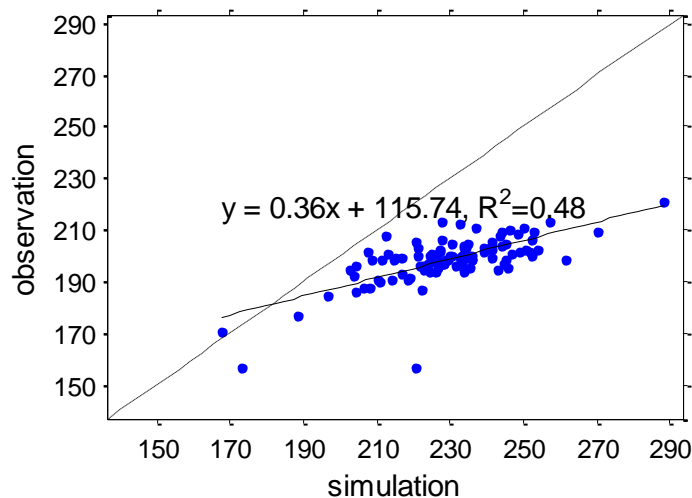
Response to nitrogen fertilizers

IRRI site

Shizuku site

Prior parameters from ORCHIDEE-GM (J. Chang)

Thanks for your attention ☺