国家信息农业工程技术中心

National Engineering and Technology Center for Information Agriculture

Welcome to Nanjing Agricultural University

Yan ZHU

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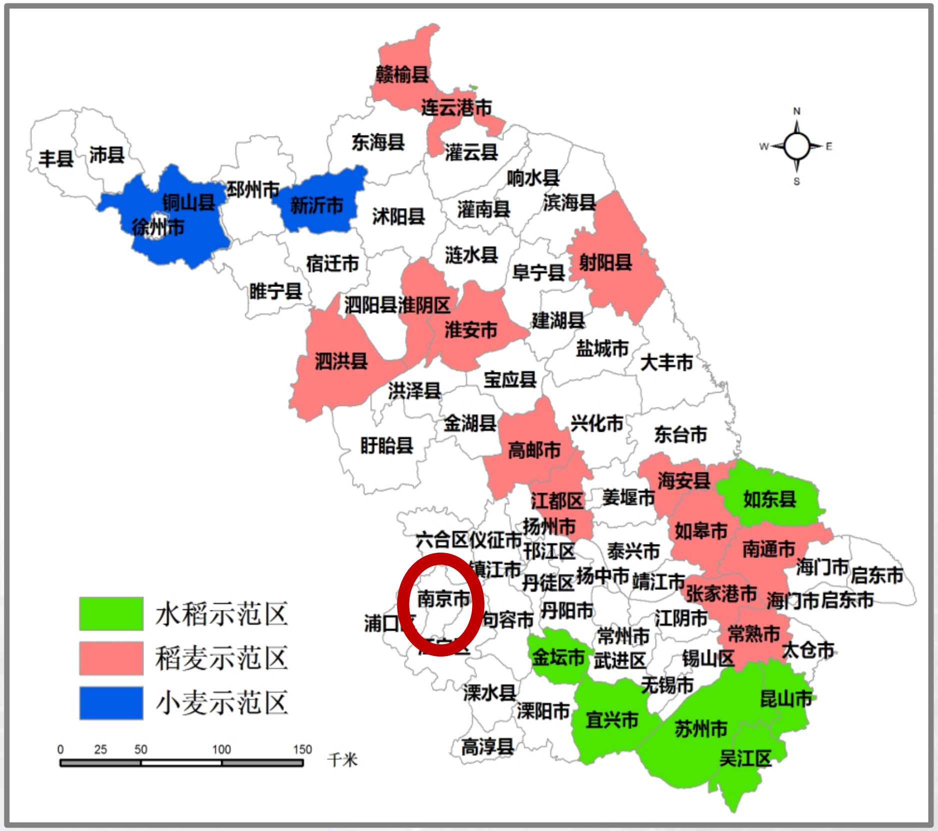
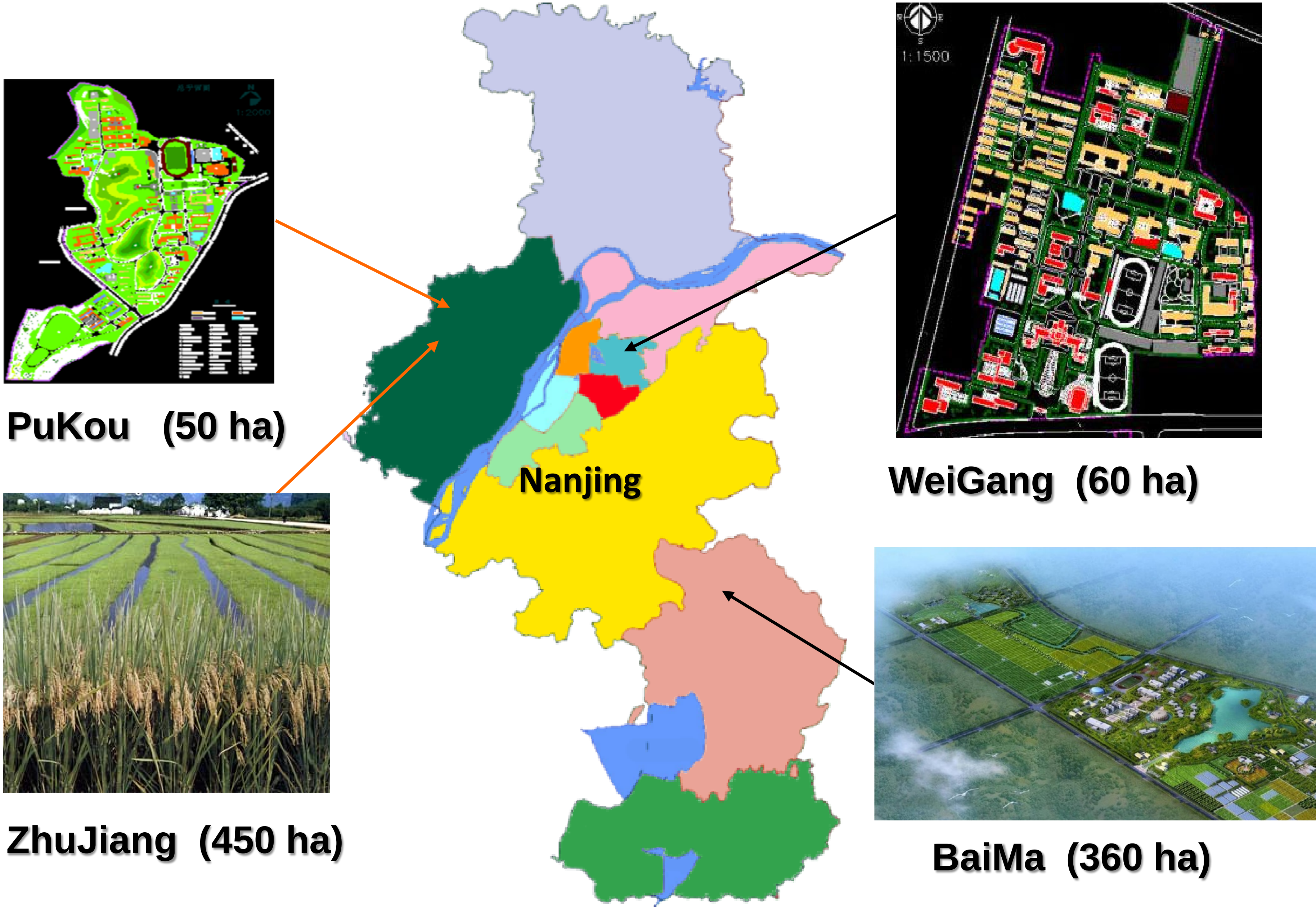


Locations of Jiangsu Province and Nanjing City

Nanjing Agricultural University—NAU

Pioneer of modern agricultural education in China (since 1914)

A state key university, member of "211 Project" (since 2000)


PuKou (50 ha)
ZhuJiang (450 ha)
Nanjing
WeiGang (60 ha)
BaiMa (360 ha)

BaiMa (360 ha) --under construction

Part of National Agricultural Sci-Tech Park

Colleges (19)

Agriculture

Horticulture

Plant Protection

Grassland Science

Animal Sci. & Tech.

Veterinary Medicine

Engineering

Food Sci. and Tech.

Information Sci. and Tech.

Life Sciences

Resource & Envi. Sci.

Sciences

Economics & Management

Finance

Foreign Studies

Humanities and Social Sci.

Public Administration

Rural Development

International Education

National Key Disciplines (14)

- *Crop Cultivation & Farming*
- *Crop Genetics & Breeding*
- Agri. Entomol. & Pest Control
- Pesticide Science
- Plant Pathology
- Agri. Eco. & Mgmt.
- Land Resources & Mgmt.
- Clinical Vet. Med.
- Preventive Vet. Med.
- Theoretical Vet. Med.
- Plant Nutrition
- Soil Science
- Food Science
- Vegetable Science

Research facilities

National Key Lab (1)

National Key Engineering Center (5)

Ministrial-level Key Lab and Research Center (28)

Jiangsu Provincial-level Lab and Research Center(32)



National Key Lab

-- Crop Genetics & Germplasm Enhancement

-Germplasm Resources

-Genomics

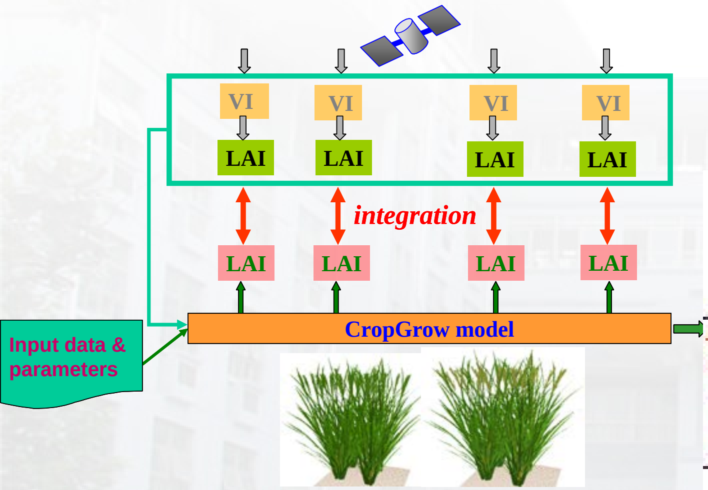
-Crop Breeding

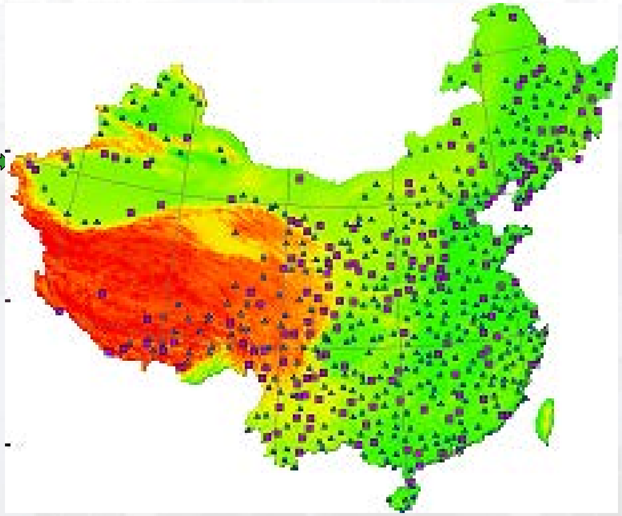
Rice, wheat, soybean,

cotton, rapeseed, maize

National Key Engineering Center

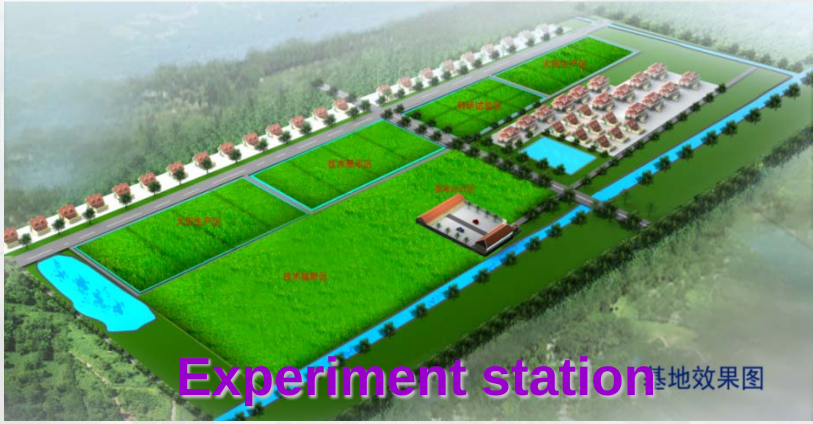
--Information Agriculture





The NETCIA was established by the Ministry of Industry and Information Technology of the People's Republic of China in November, 2010. It is a national research center within NAU for conducting the researches on innovation, integration, and transfer of key technologies in information agriculture.

Technical Innovation Platform



Experiment station

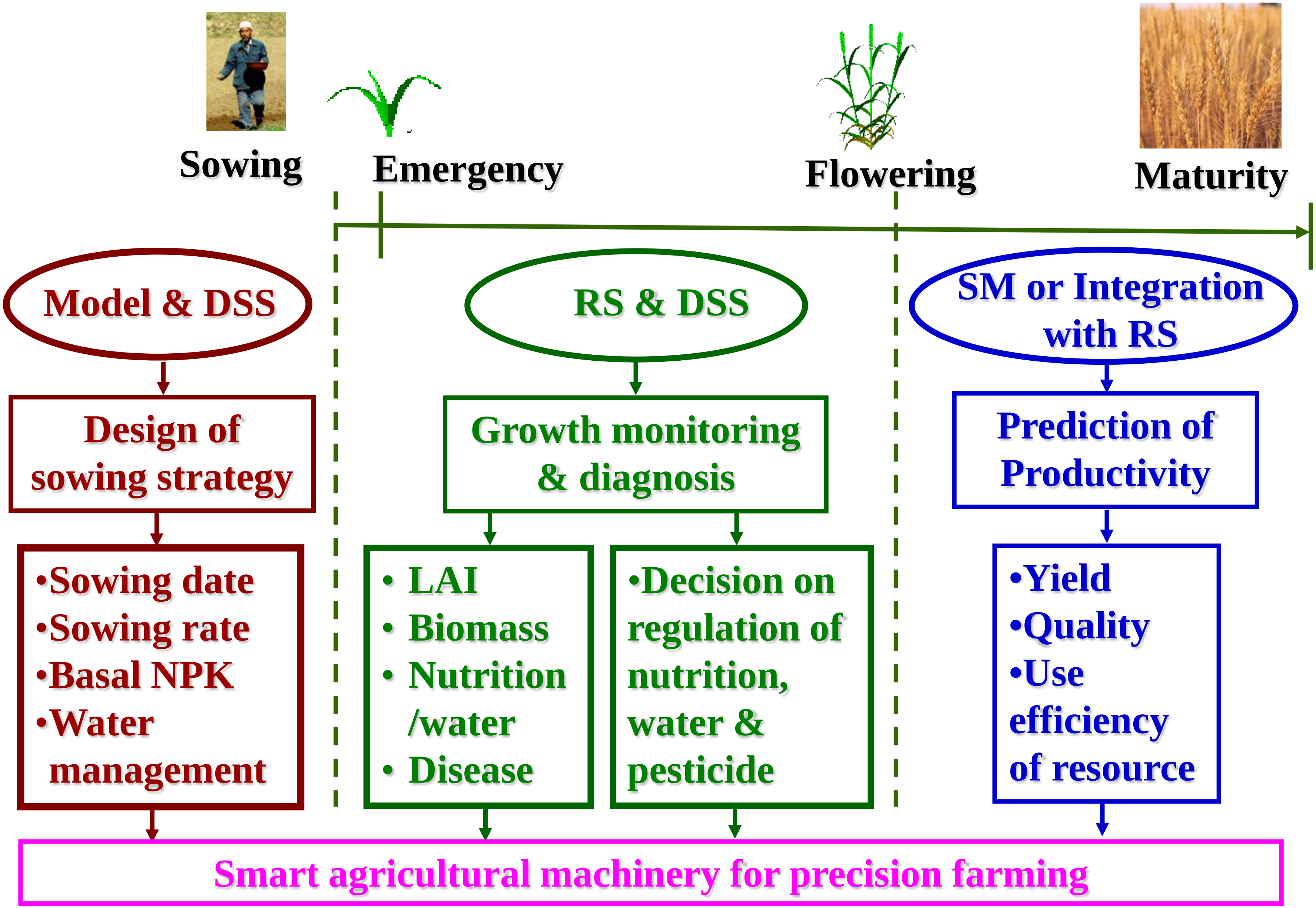
Research Members

- **Faculty members (24)**
  - **Professors (14)**
  - **Assoc. Profs. (7)**
  - **Lecturer (3)**
- **Graduate students (>70)**
- **Post-doctors (2)**
- **Visiting scholars (2)**

All of them are from colleges of:

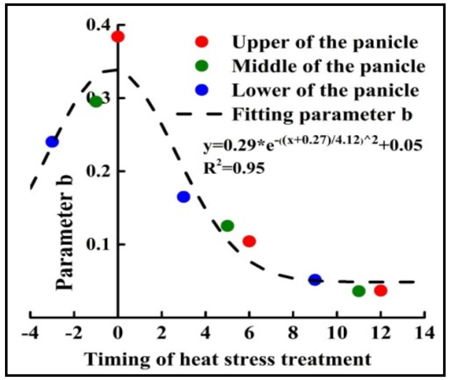
- **Agriculture**
- **Information Science & Technology**
- **Resource and Environmental Sciences**
- **Agricultural Engineering**

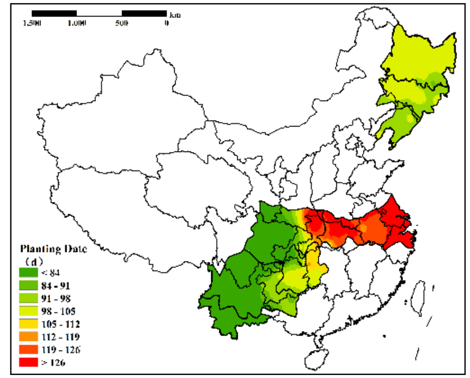
Technique framework of NETCIA

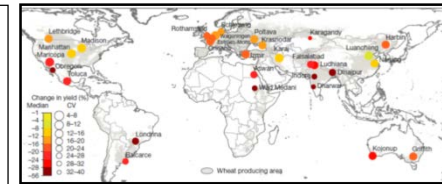
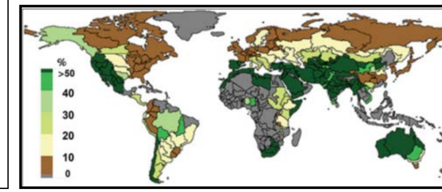


Research areas

- Agricultural remote sensing
- Crop system modeling
- Precision farming and management
- Agro-Information engineering



Model-based prediction of regional productivity in rice and wheat crops of China

Yan ZHU

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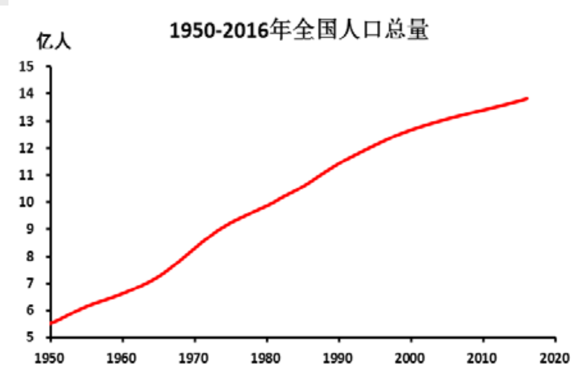
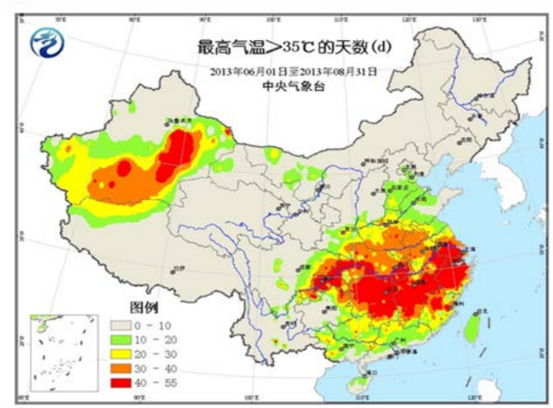
Urgent demand on food security

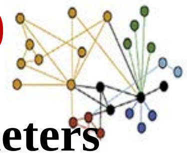
- **Challenges**
  - **Rapid growth in population**
  - **Limited farming acreage**
  - **Increasing shortage of water resources**
  - **Frequent extreme climate events**
  - **Continues increase of industrial use**
  - **Tension in international market**
- **Ensuring national food security is a major task of each country for now and a long time in the future.**

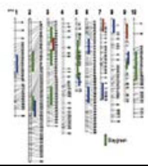




Quantitative prediction on crop productivity

Genotype (G)





Genetic parameters

×

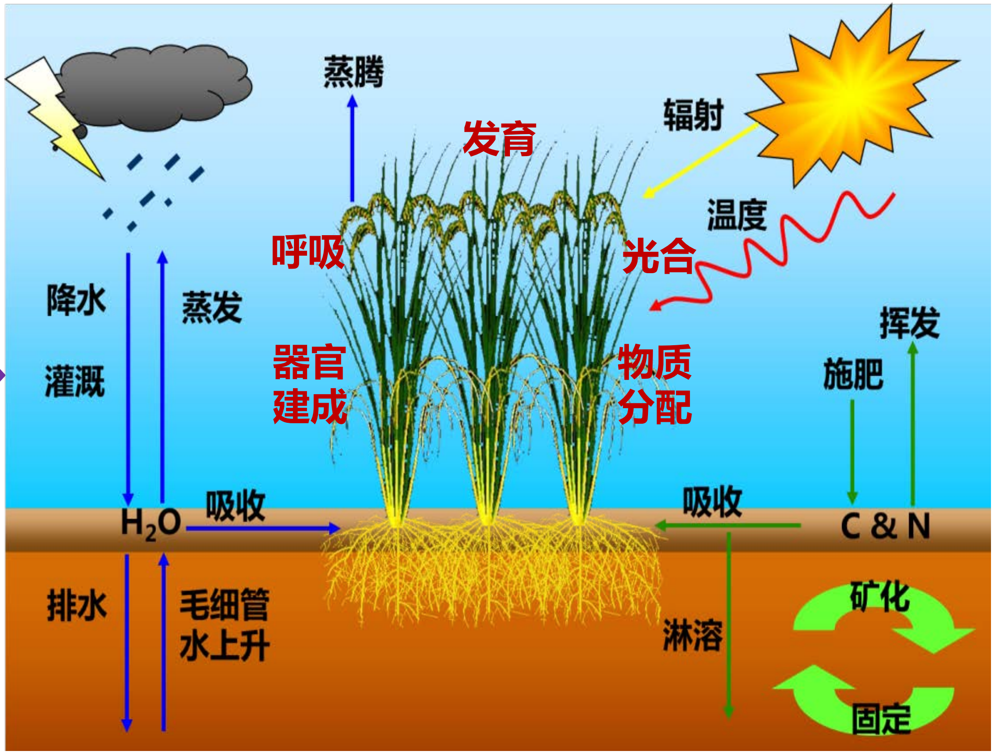
Environment (E)

Climate, soil

×

Management (M)

Sowing date & rate
fertilizer, irrigation……



Crop system model can be used as the quantitative tool for crop productivity prediction and early warning of crop production risks based on the interaction of genotype (G), environment (E) and management strategy (M).

Key problems to be solved

1

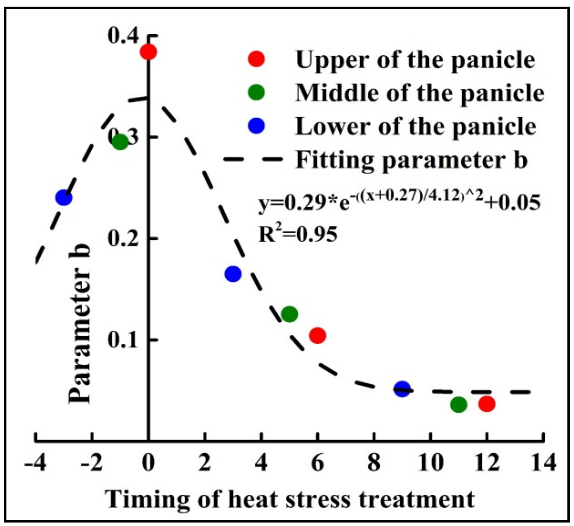
How to improve the model performance under extreme climatic conditions?

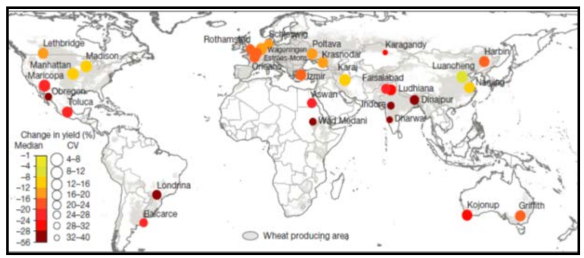
2

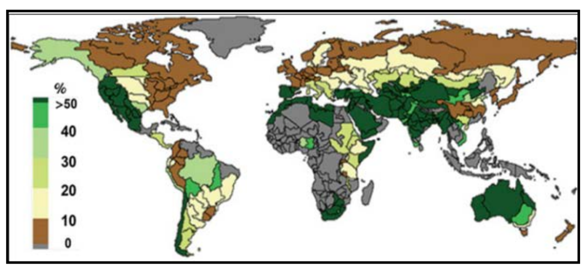
How to expand the point-based simulations to regional forecasting?

3

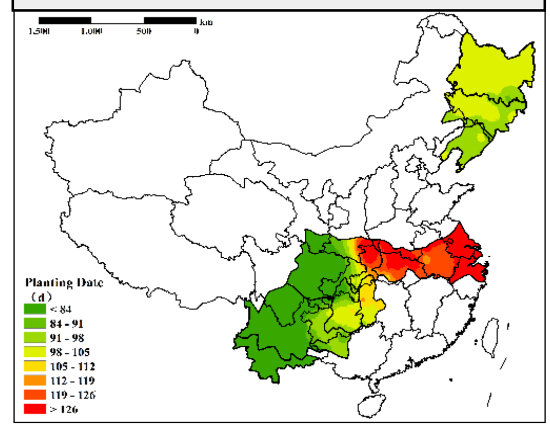
How to design the adaptive strategies under future climate scenarios?



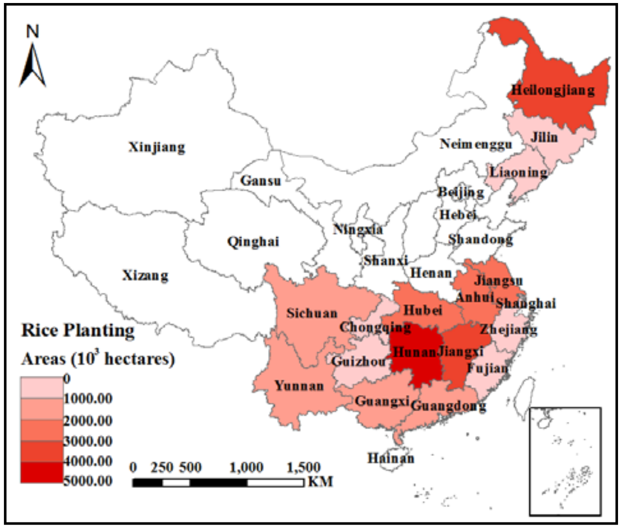


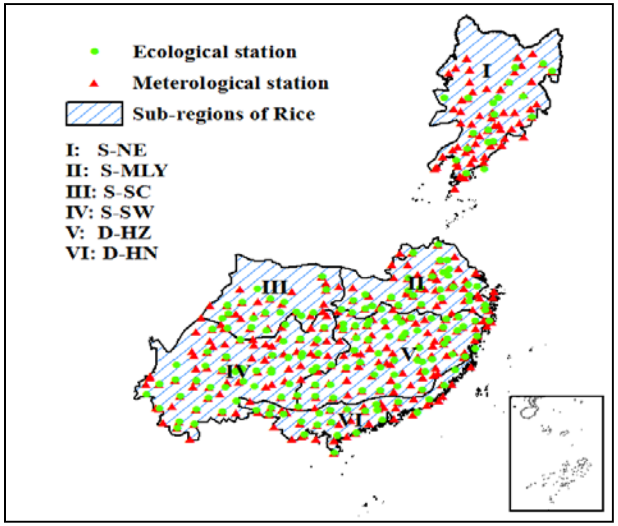


Earliest sowing date



1. Spatial and temporal variation of extreme climate

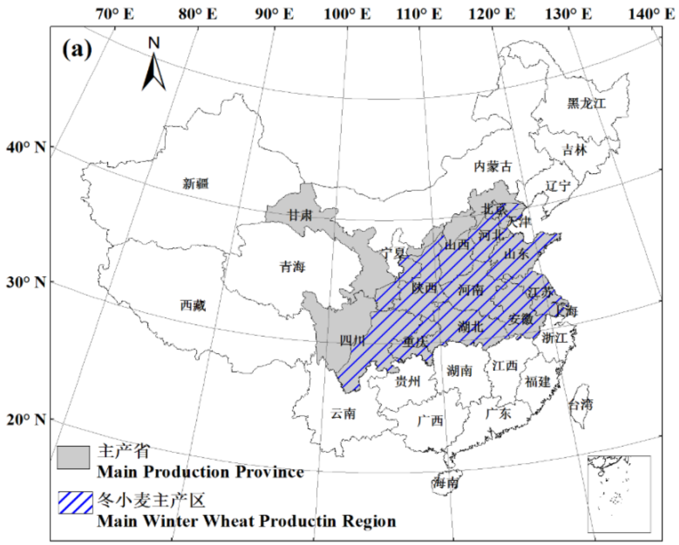


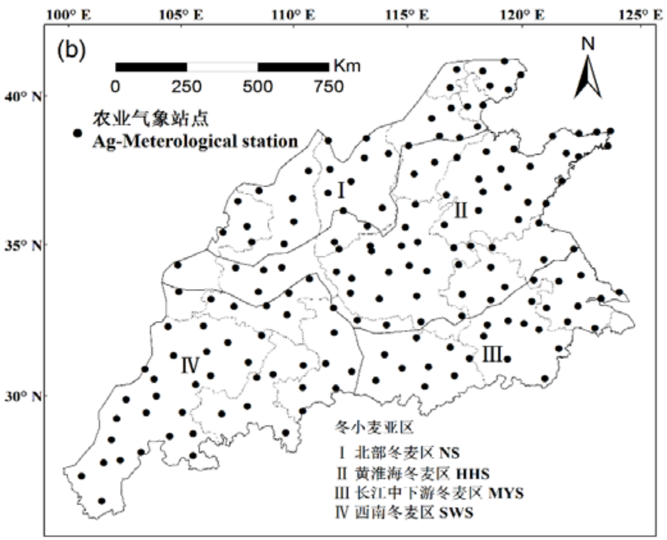


Study region

Single-season rice:
113 stations

Double-season rice:
74 stations

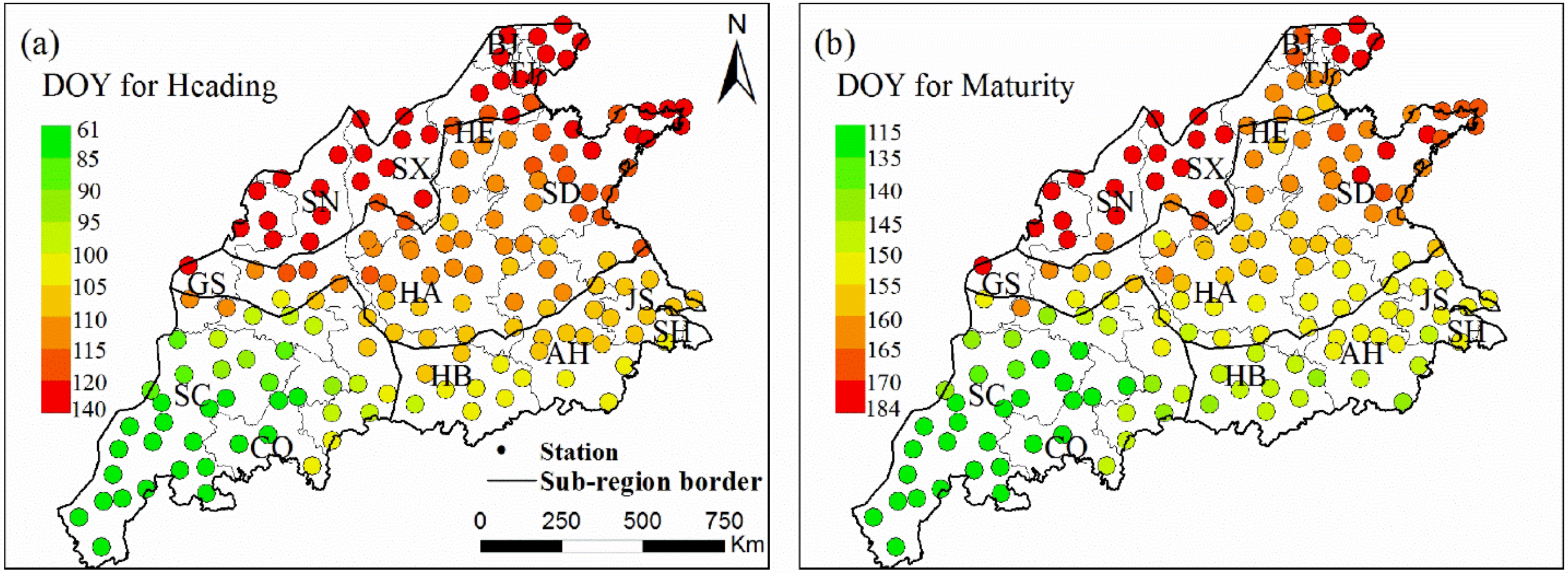




Winter wheat:
166 stations

1. Spatial and temporal variation of extreme climate

Spatial variation of phenological dates

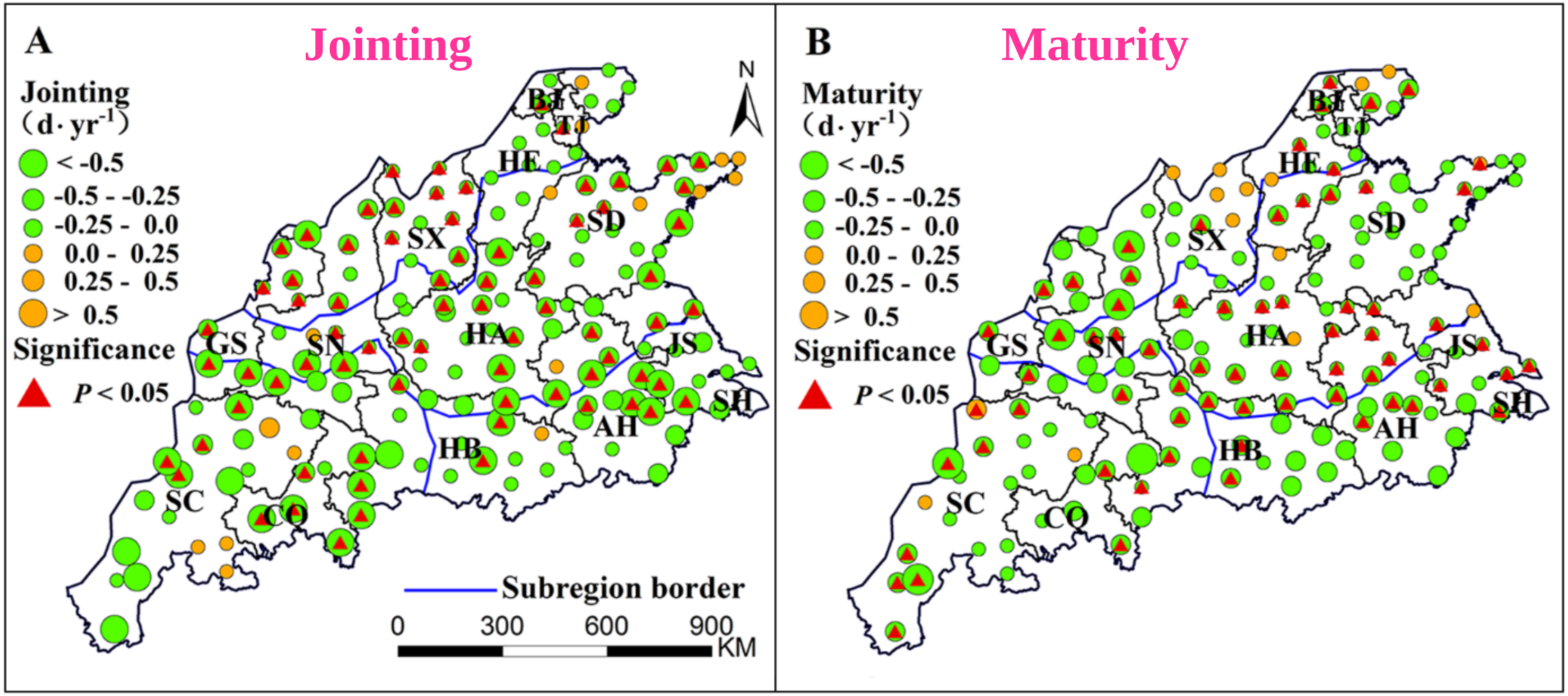


Spatial distribution of DOY for heading (a) and maturity (b) in study region of winter wheat

- **The maximum differences due to spatial variation of heading and maturity are 77 and 68 days, respectively.**

1. Spatial and temporal variation of extreme climate

Temporal trends of phenological dates

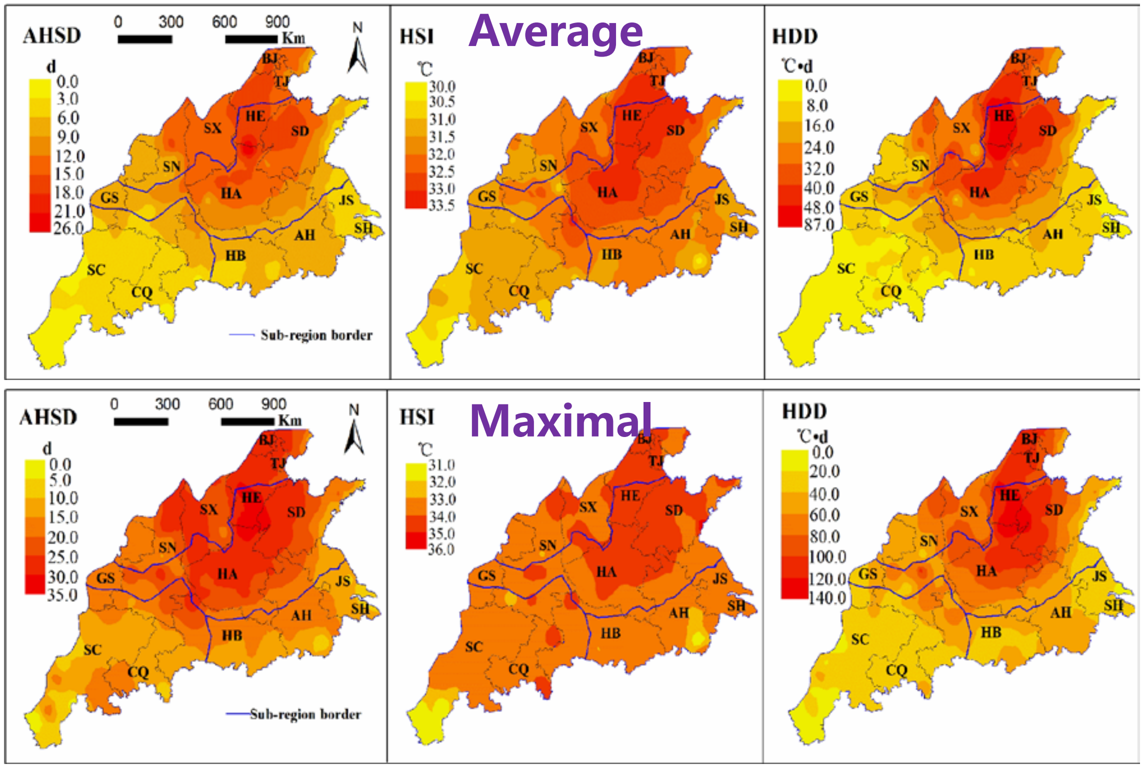


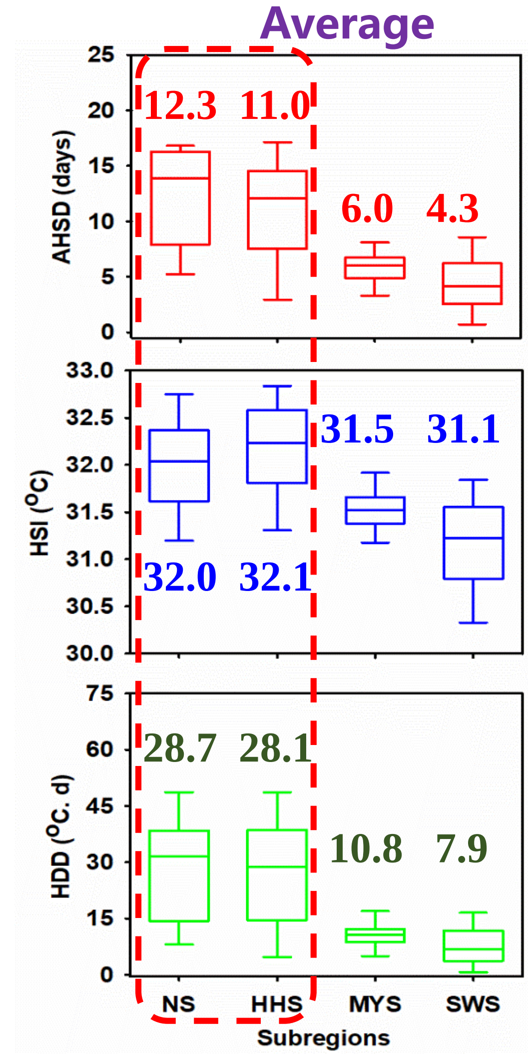
Annual trends of jointing and maturity dates during last 30 years

Significant negative trends ($p < 0.05$) were observed at 45.3% and 42.3% of stations for jointing and maturity stages of winter wheat in China.

1. Spatial and temporal variation of extreme climate

Spatial variation of post-heading heat stress in winter wheat of China



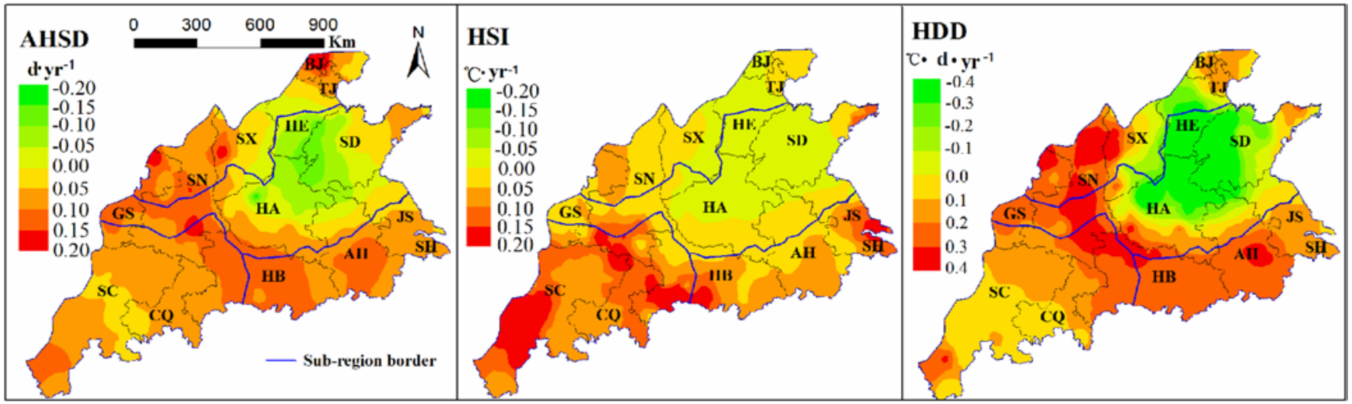


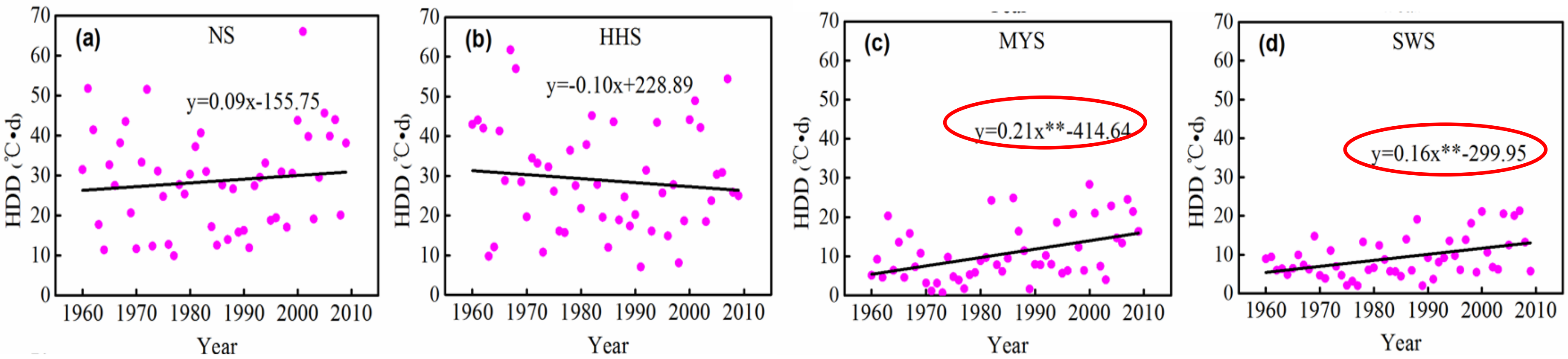
- **Post-heading heat stress was more severe in the two northern sub-regions than the two southern sub-regions**

Global Change Biology, 2014

1. Spatial and temporal variation of extreme climate

Temporal variation of post-heading heat stress in winter wheat of China

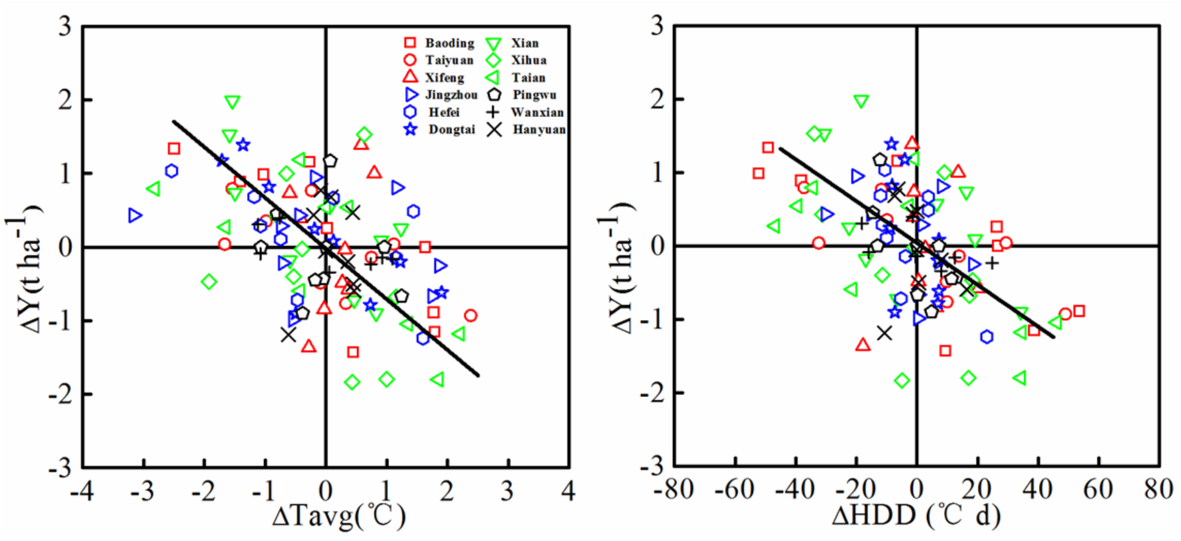




- The significantly increasing trend of post-heading heat stress was observed in two southern sub-regions during last few decades, while not for two northern sub-regions.

Global Change Biology, 2014

1. Spatial and temporal variation of extreme climate



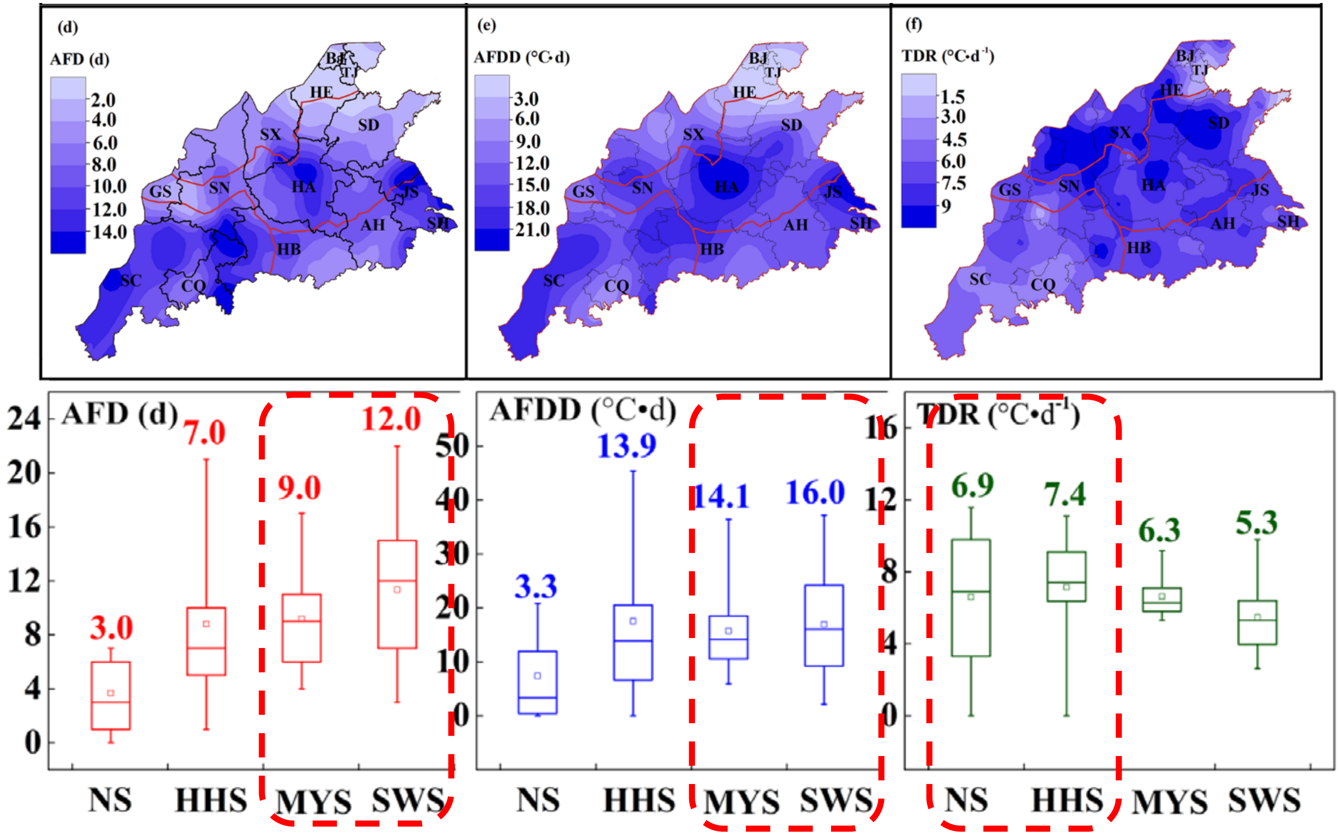
Subregion	β_{Tavg}	β_{HDD}	R^2
NS	-0.06	-0.02	0.26**
HHS	-0.32	-0.01	0.37**
MYS	-0.20	-0.01	0.21*
SWS	0.15	-0.03	0.13
Entire region	-0.19	-0.01	0.29**

- **Heat stress and mean temperature explained about 29% yield variability in winter wheat of China during last 20 years, and varied in different sub-regions.**

Global Change Biology, 2014

1. Spatial and temporal variation of extreme climate

Spatial variation of spring frost in winter wheat of China (Maximal value)

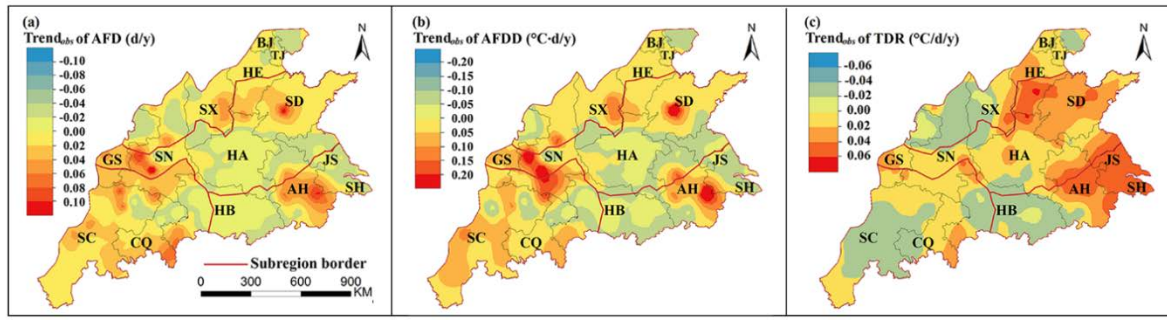


- Maximal AFD and AFDD during last 30 years in MYS and SWS were larger than in NS and HHS, while stations with highest AFDD were found in HHS;
- Higher TDRs were found in NS and HHS than MYS and SWS during last 30 years.

1. Spatial and temporal variation of extreme climate

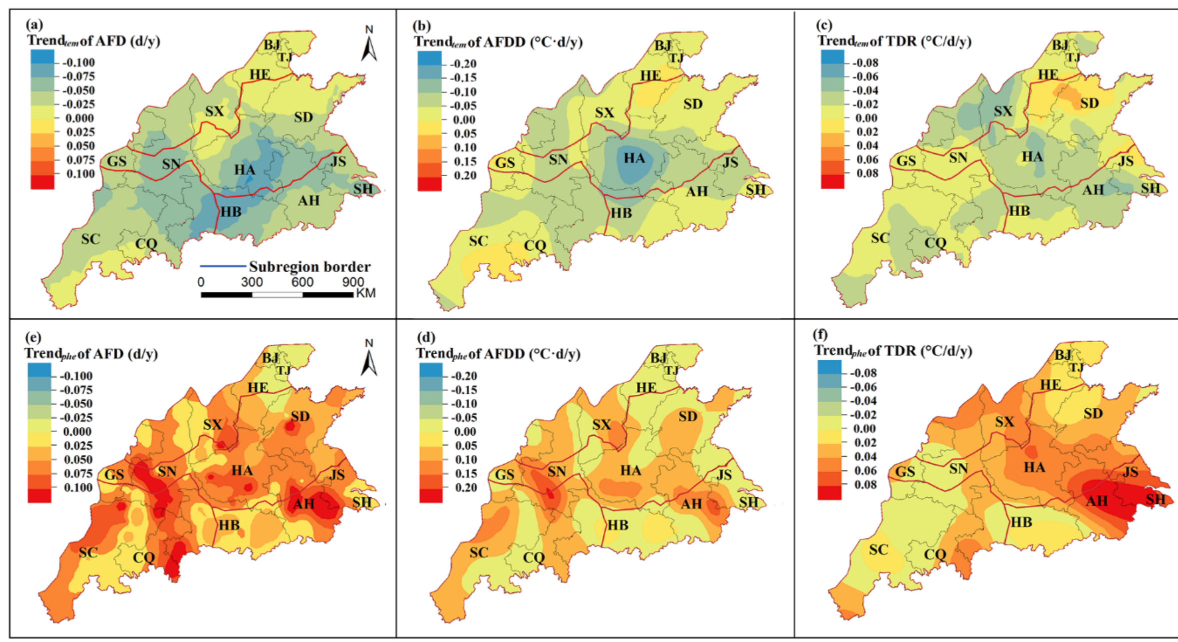
Temporal variation of spring frost in winter wheat of China

Observed value (Mixed effects of temperature variation & phenology shifting)



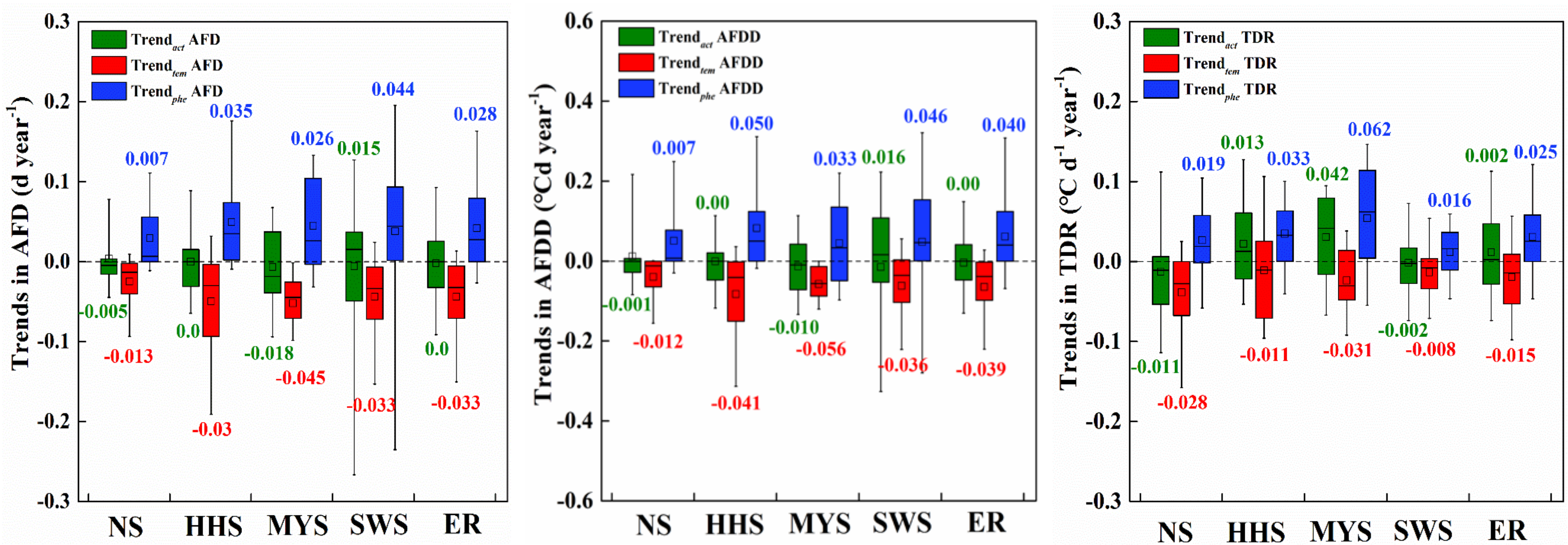
Effect of temperature variation

Effect of phenology shifting



1. Spatial and temporal variation of extreme climate

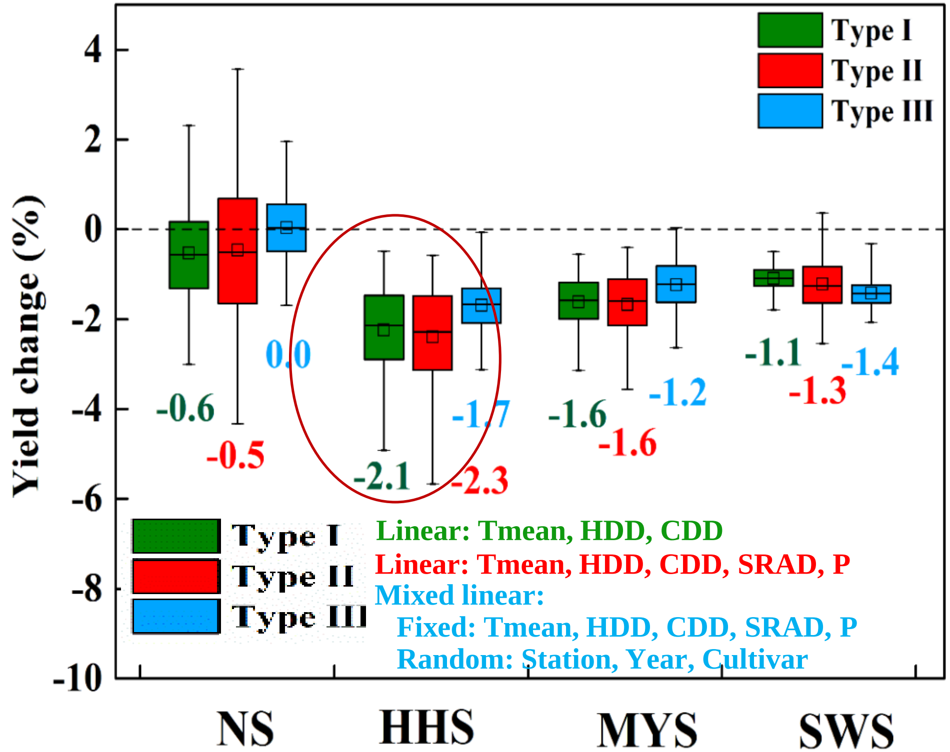
Temporal variation of spring frost in winter wheat of China

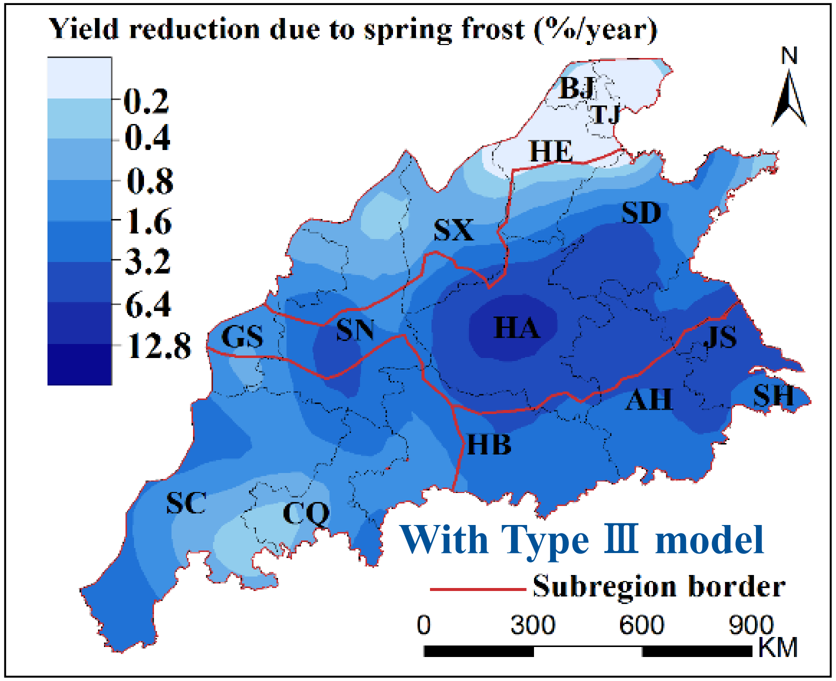


- **Spring frost risk has not decreased, despite of global warming.**
- **Climate warming has reduced the spring frost in more than 75% of stations in the whole region, it also accelerated phenology and shifted the frost-sensitive crop stage to occur earlier;**
- **Phenology shifting has increased the spring frost in more than 70% of stations in the whole region.**

1. Spatial and temporal variation of extreme climate

Impact of spring frost on winter wheat yield





- Observed wheat yield was more sensitive to spring frost in HHS than other three sub-regions;
- Estimated yield reduction was 0.7% (log yield, %) for 1°C·d increase of AFDD (accumulated spring frost degree-days) for entire region.

Agricultural and Forest Meteorology, 2017（Submitted）

2. Responses of productivity formation to extreme climate conditions

Experiments of rice under extreme climate conditions

Treatment	Heat stress	Cold stress
Varieties	Nanjing41 (V1), Wuxiangjing (V2)	Huaidao5 (V1), Huaidao14 (V2)
Temperature levels (Min/Max, ºC)	22/32 (T1), 25/35 (T2) 28/38 (T3), 31/41 (T4)	19/29 (T1), 13/23 (T2) 10/20 (T3), 7/17 (T4)
Durations	2 days (D1), 4 days (D2), 6 days (D3)	4 days (D1), 8 days (D2)
Treatment stages	Anthesis (S1), Grain filling (S2) Interaction of S1 and S2	Anthesis (S1), Grain filling (S2)

2. Responses of productivity formation to extreme climate conditions

Experiments of winter wheat under extreme climate conditions

Treatment	Heat stress	Cold stress
Cultivars	Yangmai16 (V1)，Xumai30 (V2)	
Temperature levels (Max/Min, ^{o}C)	43/33 (T1), 39/29 (T2) 35/25 (T3), 27/17 (T4)	16/6 (T1), 8/-2 (T2) 6/-4 (T3), 4/-6 (T4)
Durations	3 days (D1), 6 days (D2), 9 days (D3)	2 days (D1), 4 days (D2), 6 days (D3)
Treatment stages	Anthesis (S1), Grain filling (S2) Interaction of S1 and S2	Jointing (S1), Booting (S2) Interaction of S1 and S2

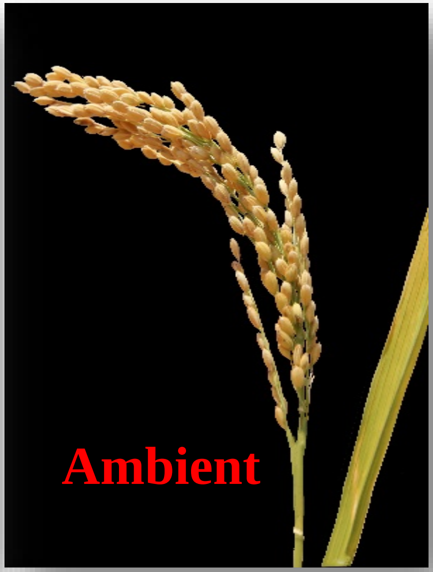
2. Responses of productivity formation to extreme climate conditions

T4D3 (CK)

T3D3

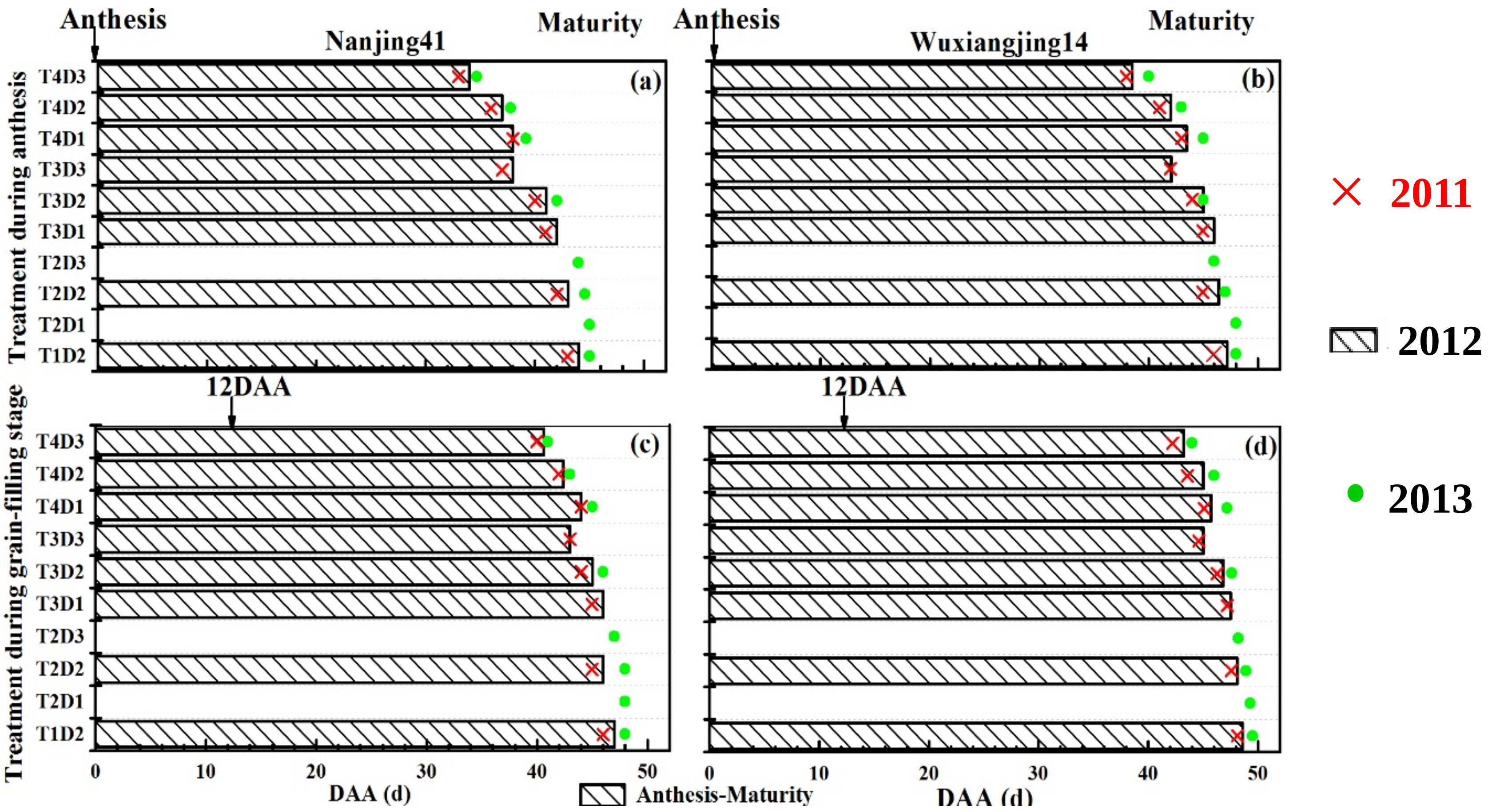
T2D3

T1D3



2. Responses of productivity formation to extreme climate conditions

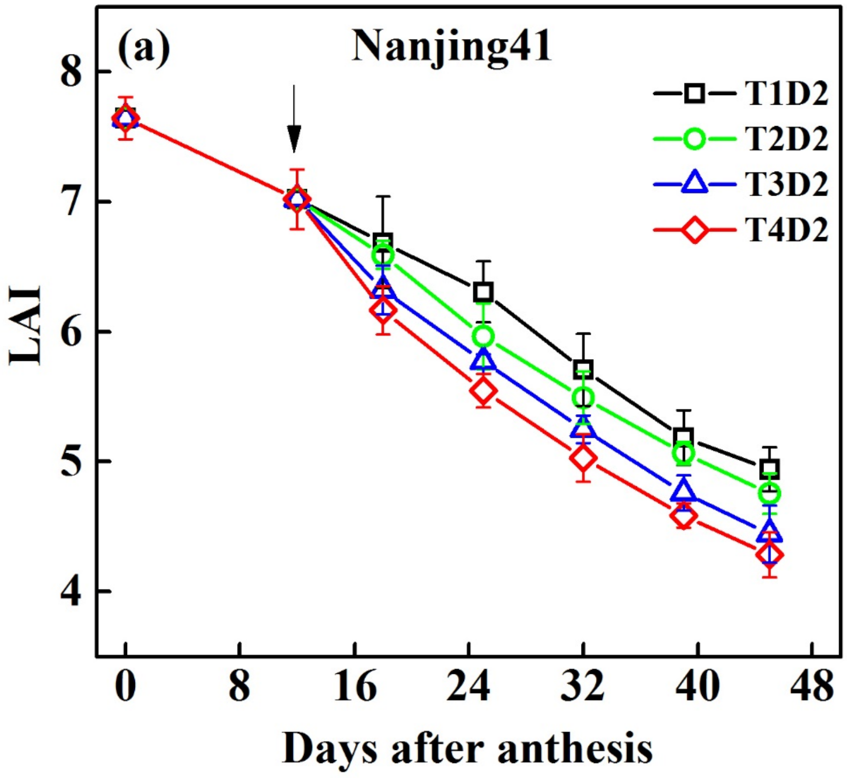
Phenology of rice under post-anthesis heat stresses

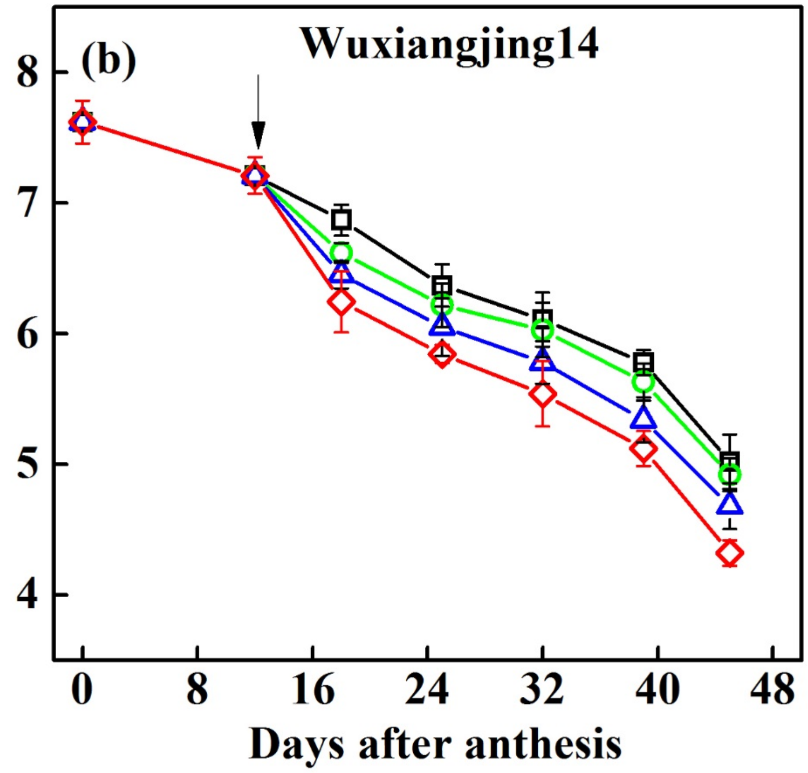


Developmental processes of (a, c) Nanjing41 and (b, d) Wuxiangjing14 under different temperature treatments at anthesis and 12 days after anthesis (12DAA).

2. Responses of productivity formation to extreme climate conditions

Leaf area index (LAI) of rice under post-anthesis heat stresses





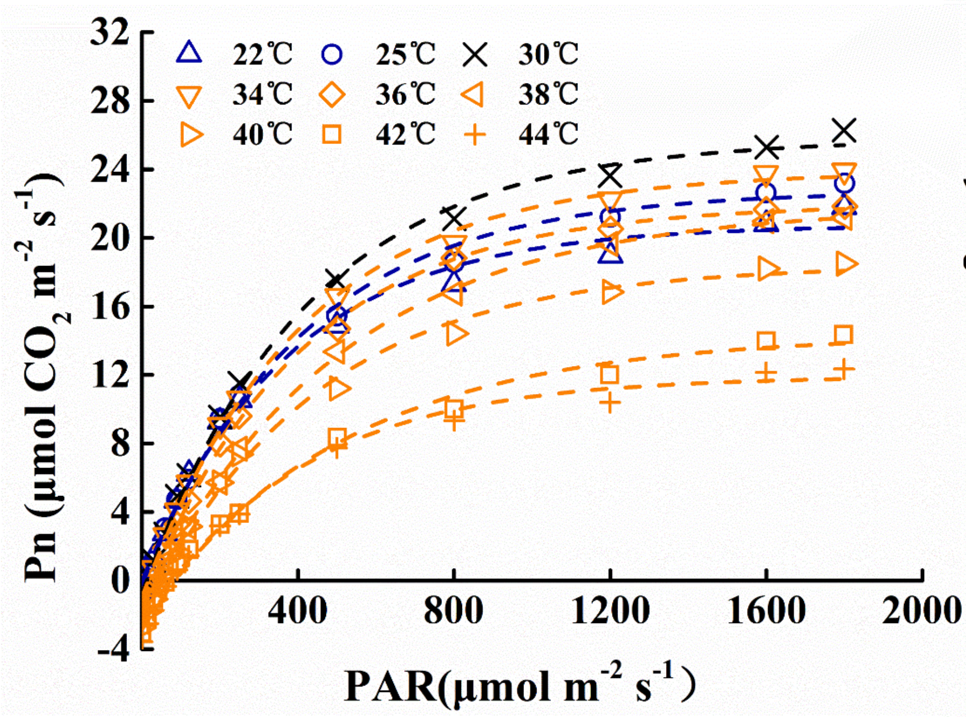
Reduced LAI of rice under heat stress during grain filling stage

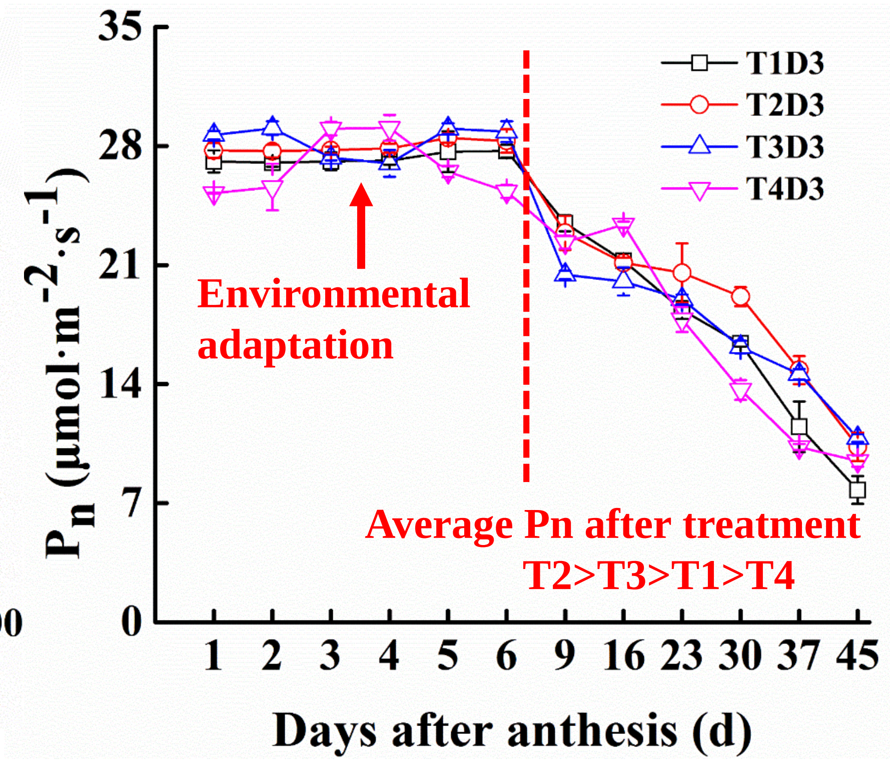
↓indicate the starting time for treatment

2. Responses of productivity formation to extreme climate conditions

Light response curves under different instantaneous temperatures

Net photosynthesis rates of different treatment



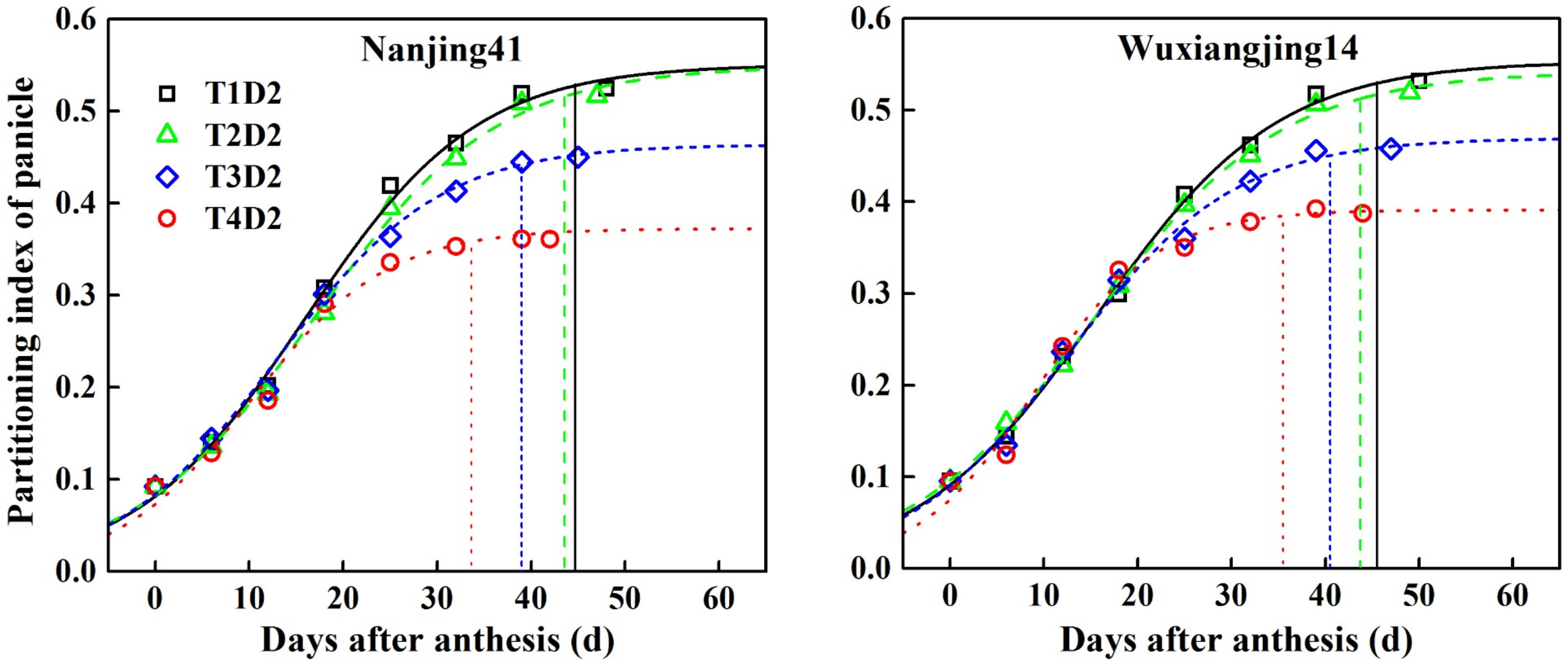


The threshold of photosynthesis is around 30 ℃

Photosynthesis rate can be effected by high temperature, but the slower leaf senescence alleviates the effects of heat stress

2. Responses of productivity formation to extreme climate conditions

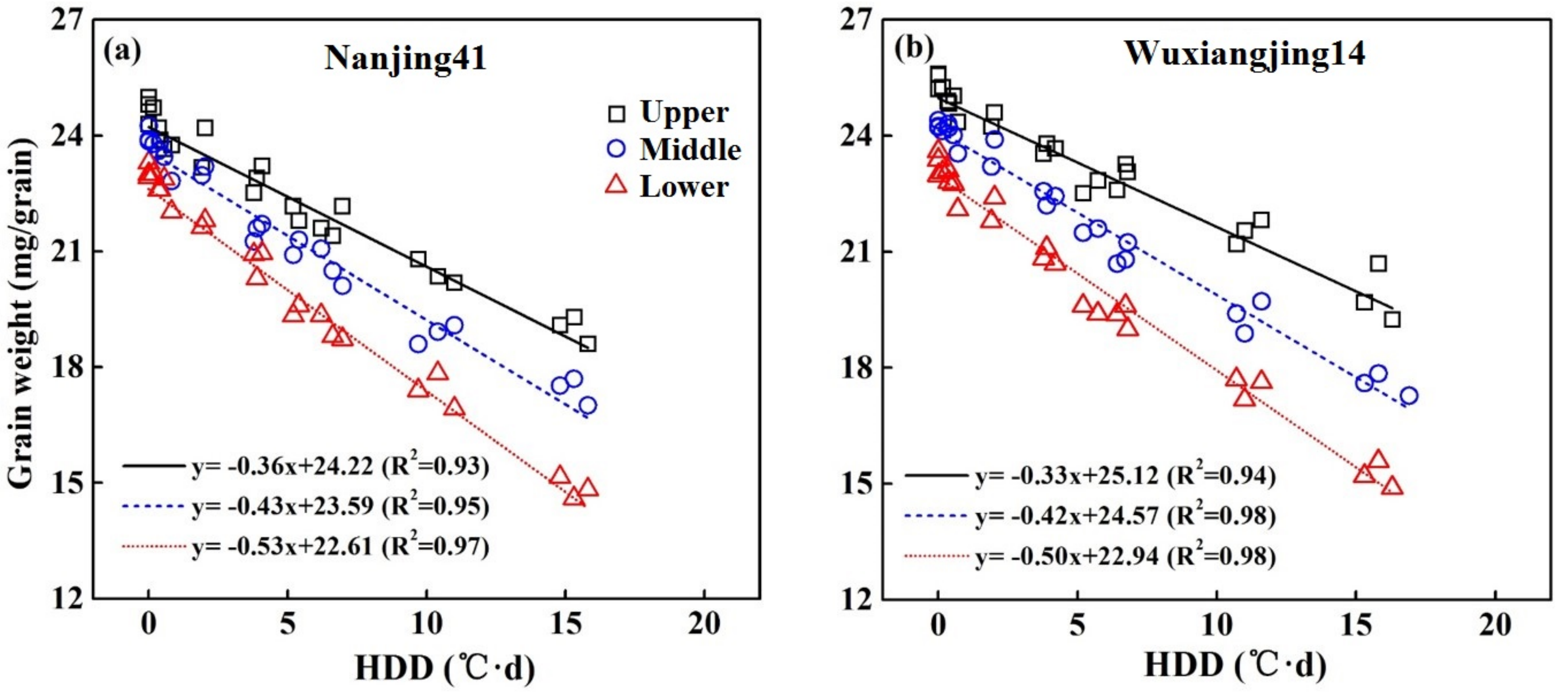
Dry matter partitioning (i.e. partitioning index of panicle) of rice under post-anthesis heat stresses



Heat stress affected dry matter partitioning of rice (e. x. panicle)

2. Responses of productivity formation to extreme climate conditions

Grain weight in different positions of rice panicle under post-anthesis heat stresses

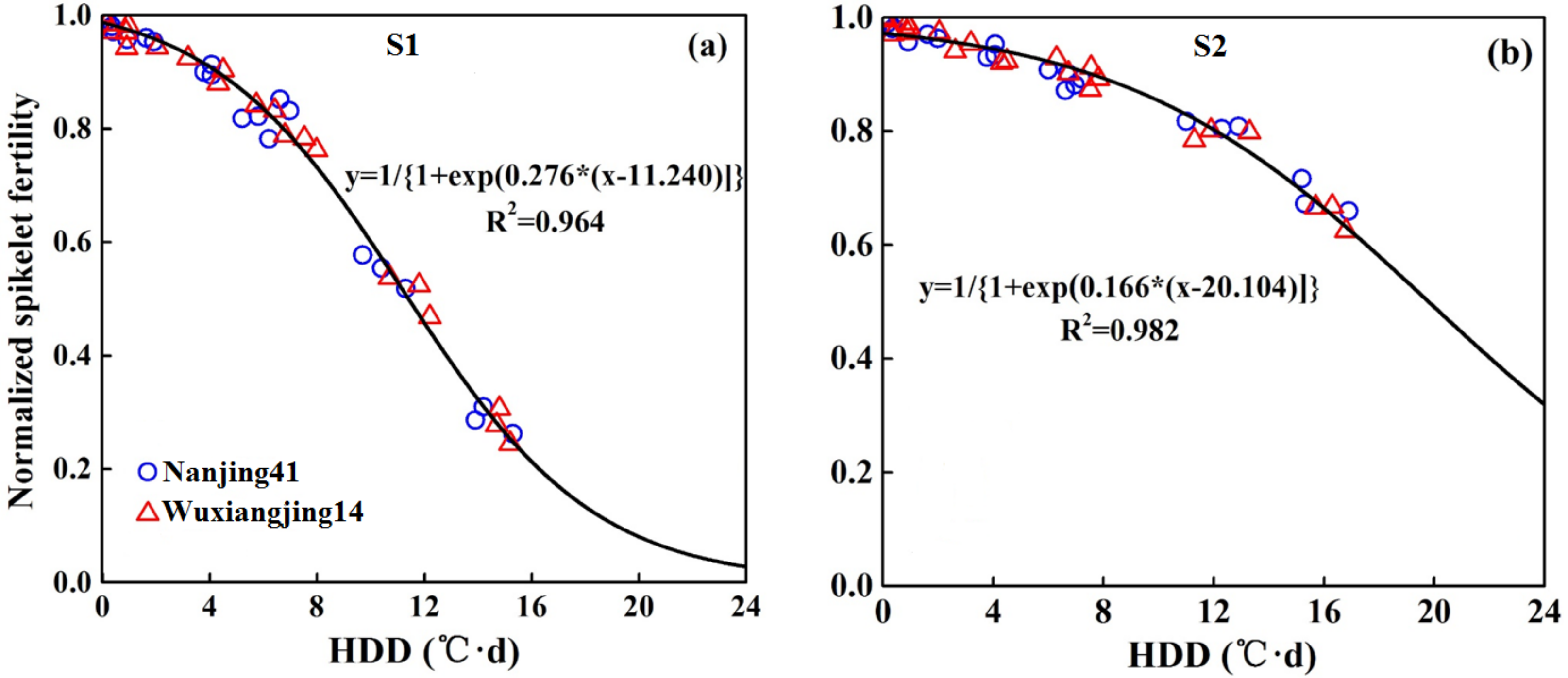


Heat stress reduced grain weight of rice, especially in the lower position of panicle

2. Responses of productivity formation to extreme climate conditions

Spikelet fertility of rice under post-anthesis heat stresses

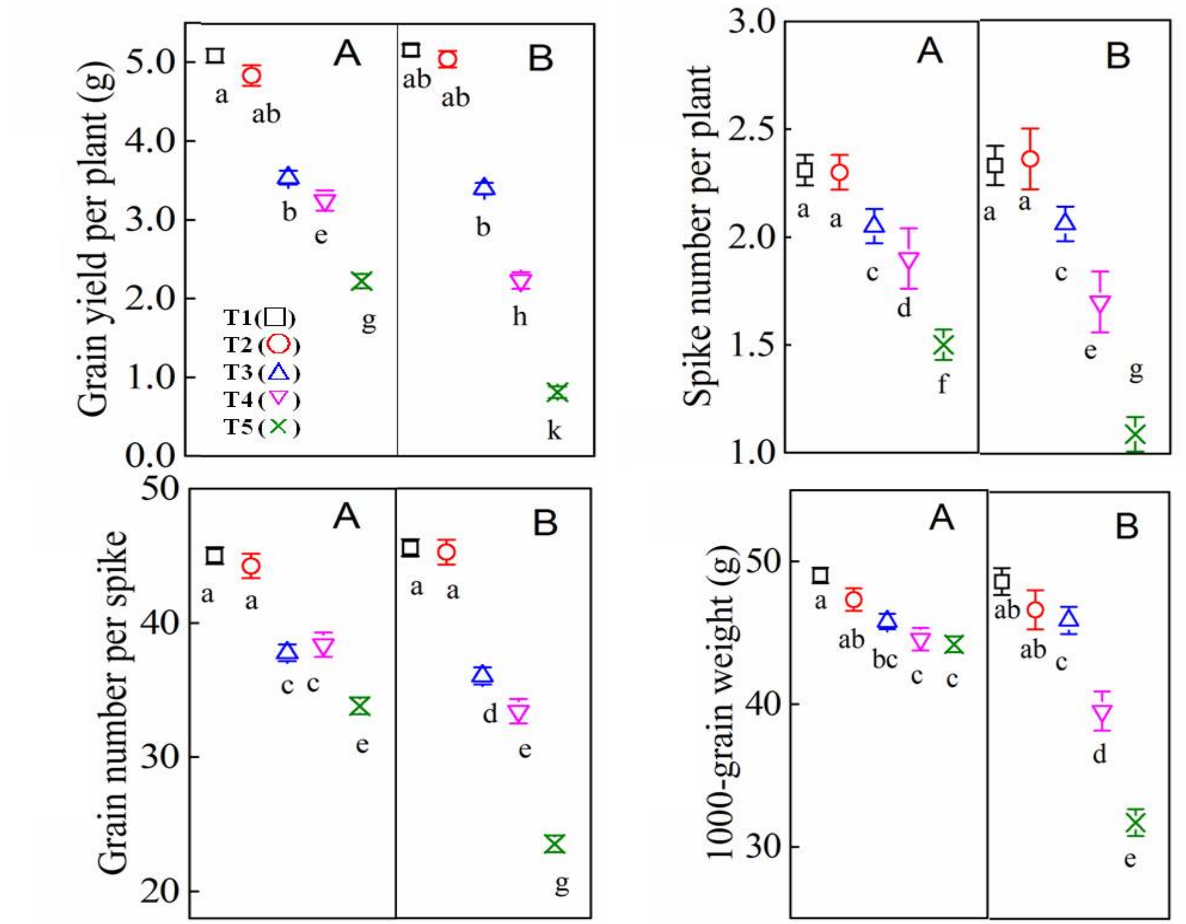
Treatment during anthesis | **Treatment during grain filling stage**



Heat stress reduced spikelet fertility of rice, with different effects for the treatment during anthesis and grain filling stages

2. Responses of productivity formation to extreme climate conditions

Yield and yield components of winter wheat under cold stresses

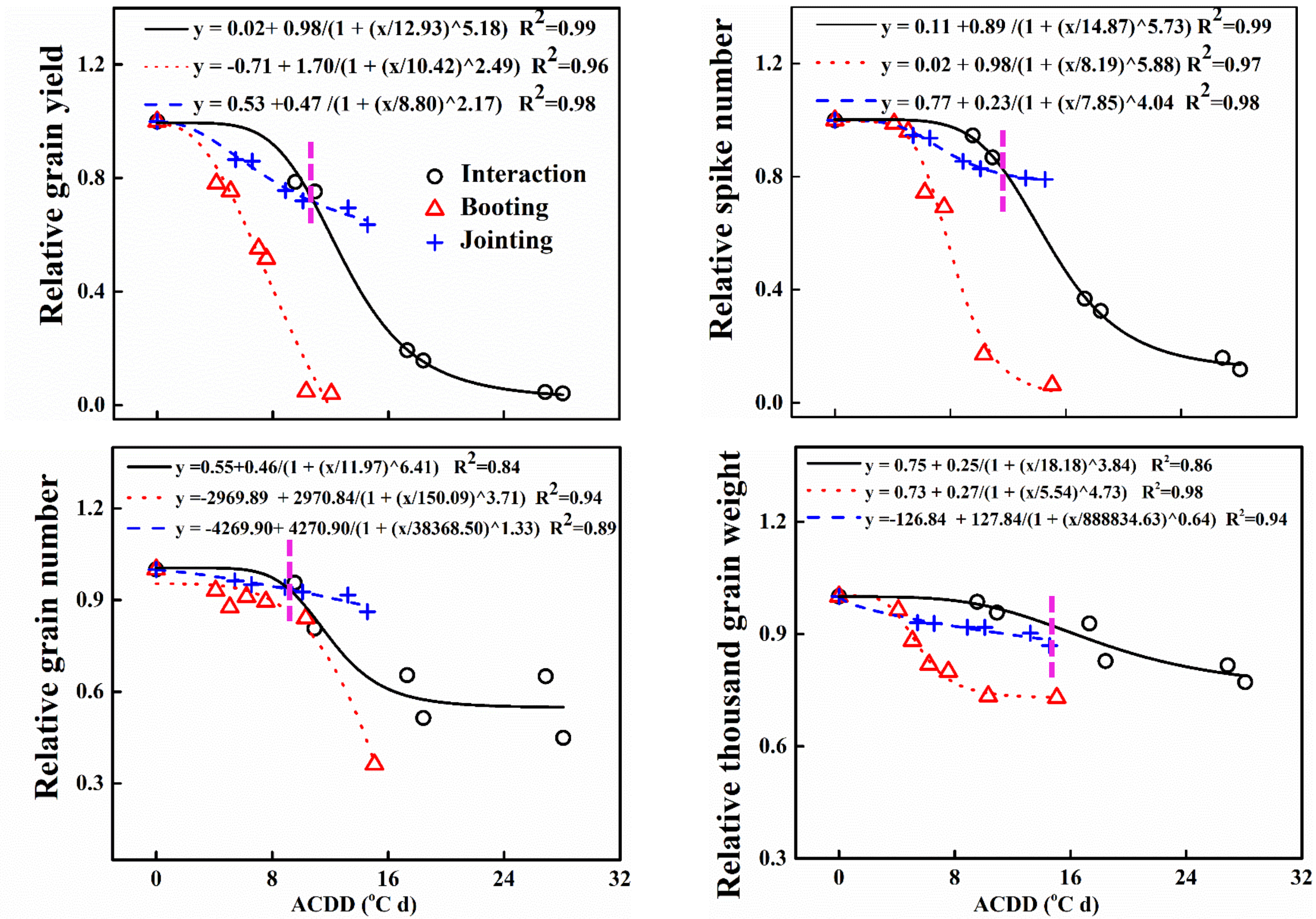


A: Jointing
B: Booting

Cold stress reduced yield and yield components of wheat (Yangmai16), especially when cold stress occurred during the booting stage.

Agricultural and Forest Meteorology，2017

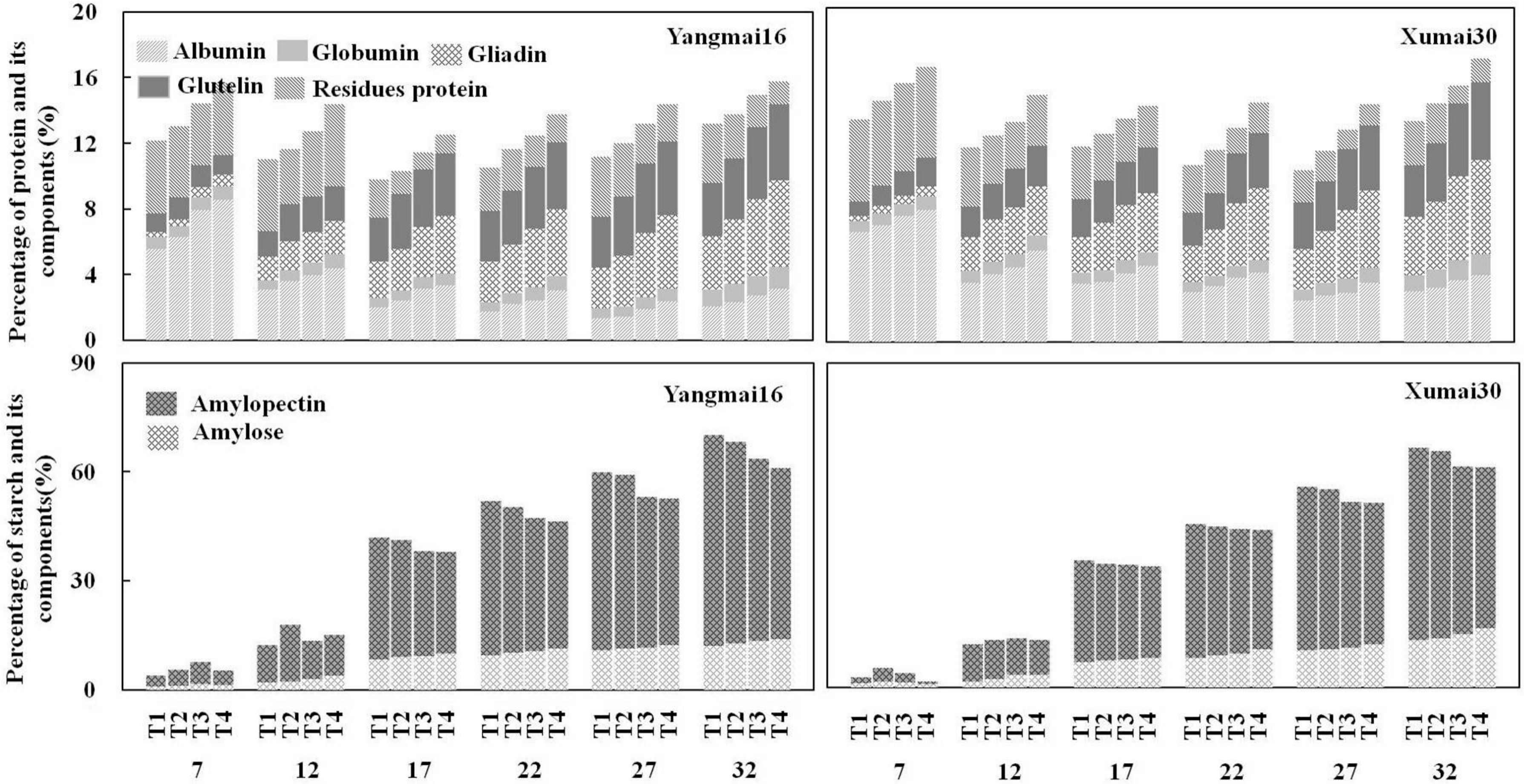
2. Responses of productivity formation to extreme climate conditions



During a certain range of ACDD, the cold stress at jointing could alleviate the loss of yield and yield components due to cold stress at booting.

2. Responses of productivity formation to extreme climate conditions

Grain quality of winter wheat under heat stress



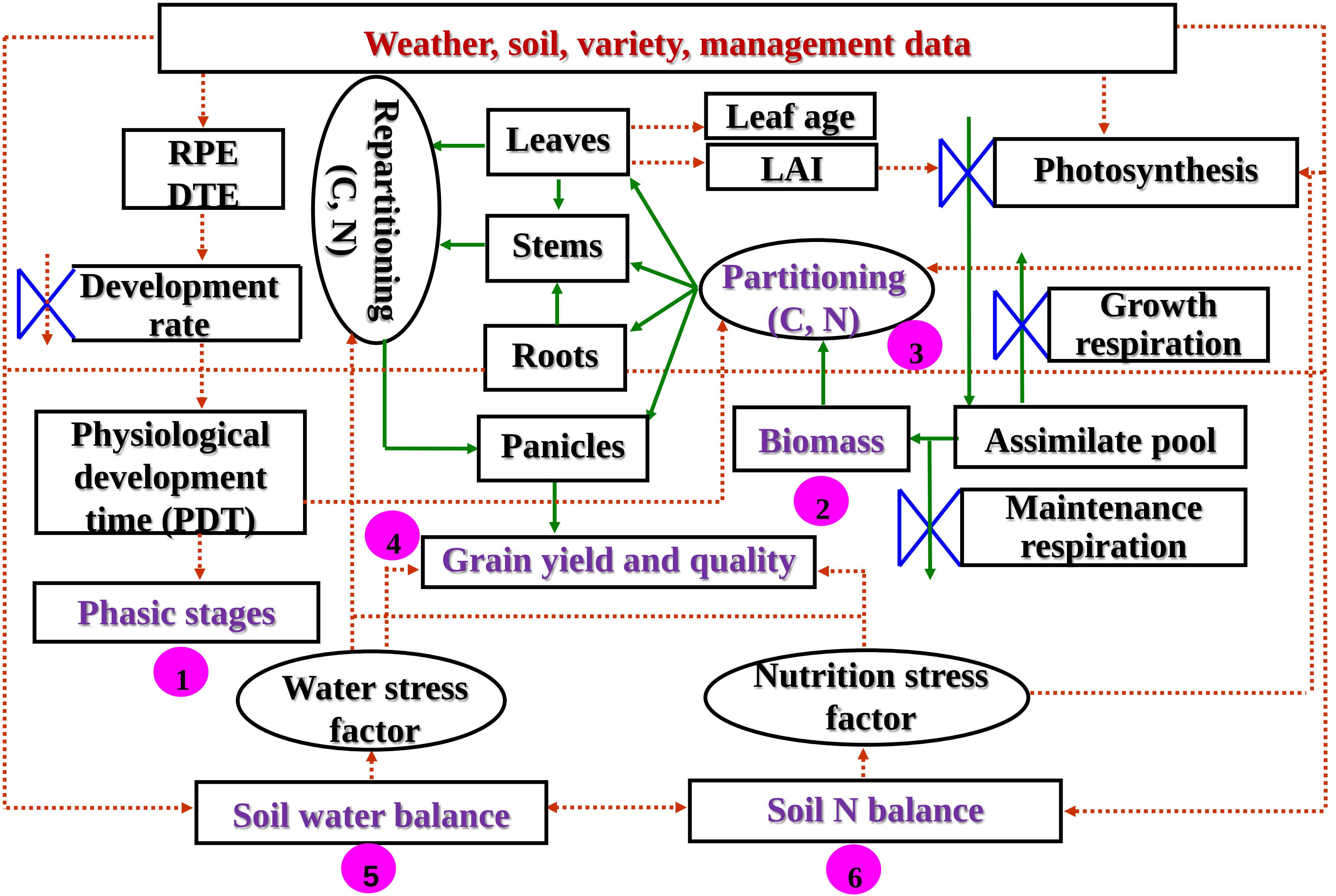
High temperature enhanced both protein and amylose concentrations, but reduced amylopectin and total starch concentrations in grains.

Agronomy Journal，2017

3. Process-based model for predicting crop productivity formation

- NAU-CropGrow was developed by National Engineering and Technology Center for Information Agriculture, Nanjing Agricultural University, from 1994.
- Crops: rice (RiceGrow) and wheat (WheatGrow)
- NAU-CropGrow can simulate crop growth and development under potential, water limited, and nitrogen limited situations, and runs at a daily time step.

Framework of NAU-CropGrow Model



3. Process-based model for predicting crop productivity formation

Sub-models of CropGrow

- Phasic and phenological development
- Photosynthesis and biomass production
- Partitioning and organ establishment
- Grain yield and quality formation
- Water balance
- Nutrient (N, P, K) dynamics

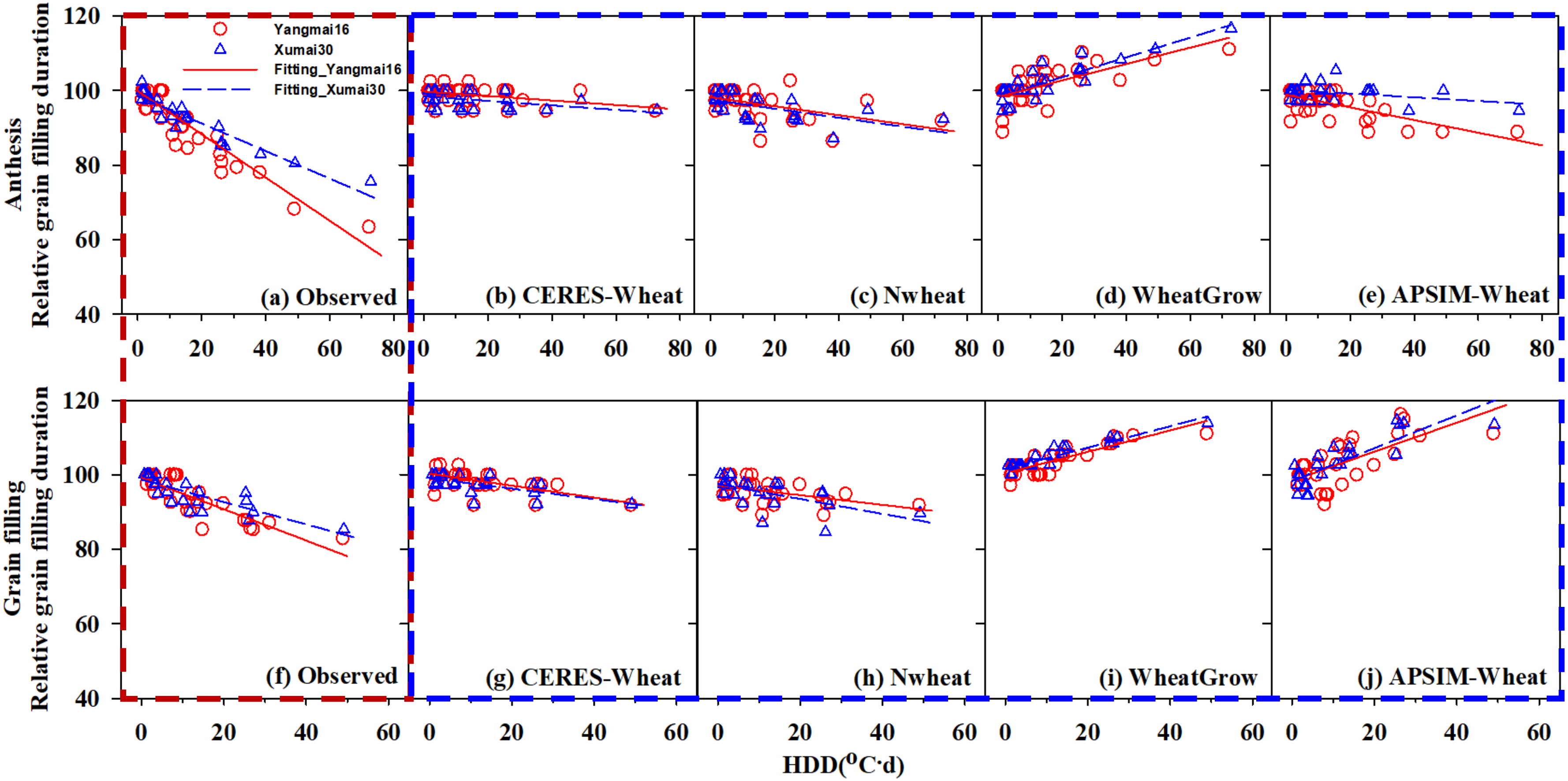
3. Process-based model for predicting crop productivity formation

How about the model performance under extreme climate conditions?

Model evaluation with the data from AgMIP and NAU

Model evaluation with the data under heat stress

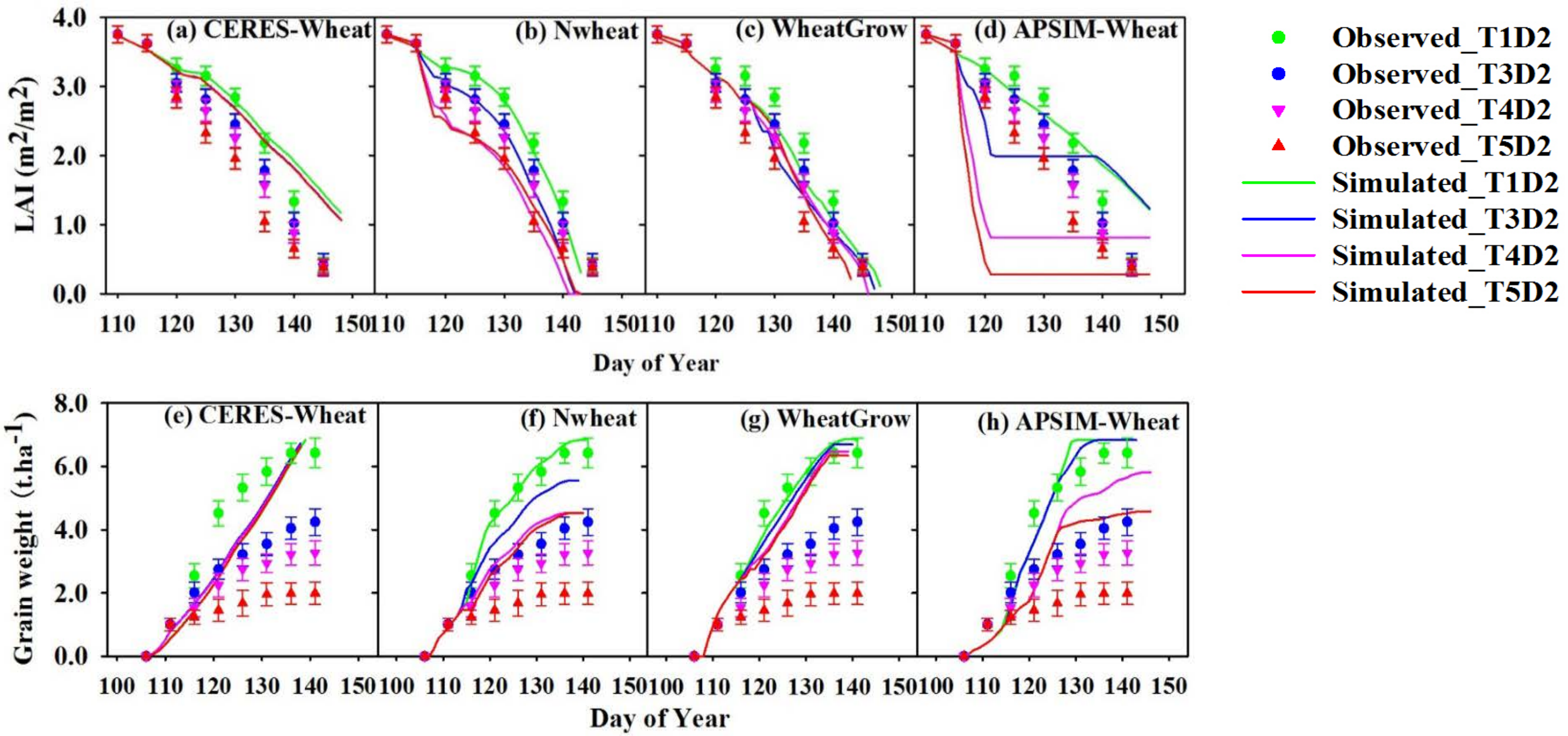
Grain filling duration



3. Process-based model for predicting crop productivity formation

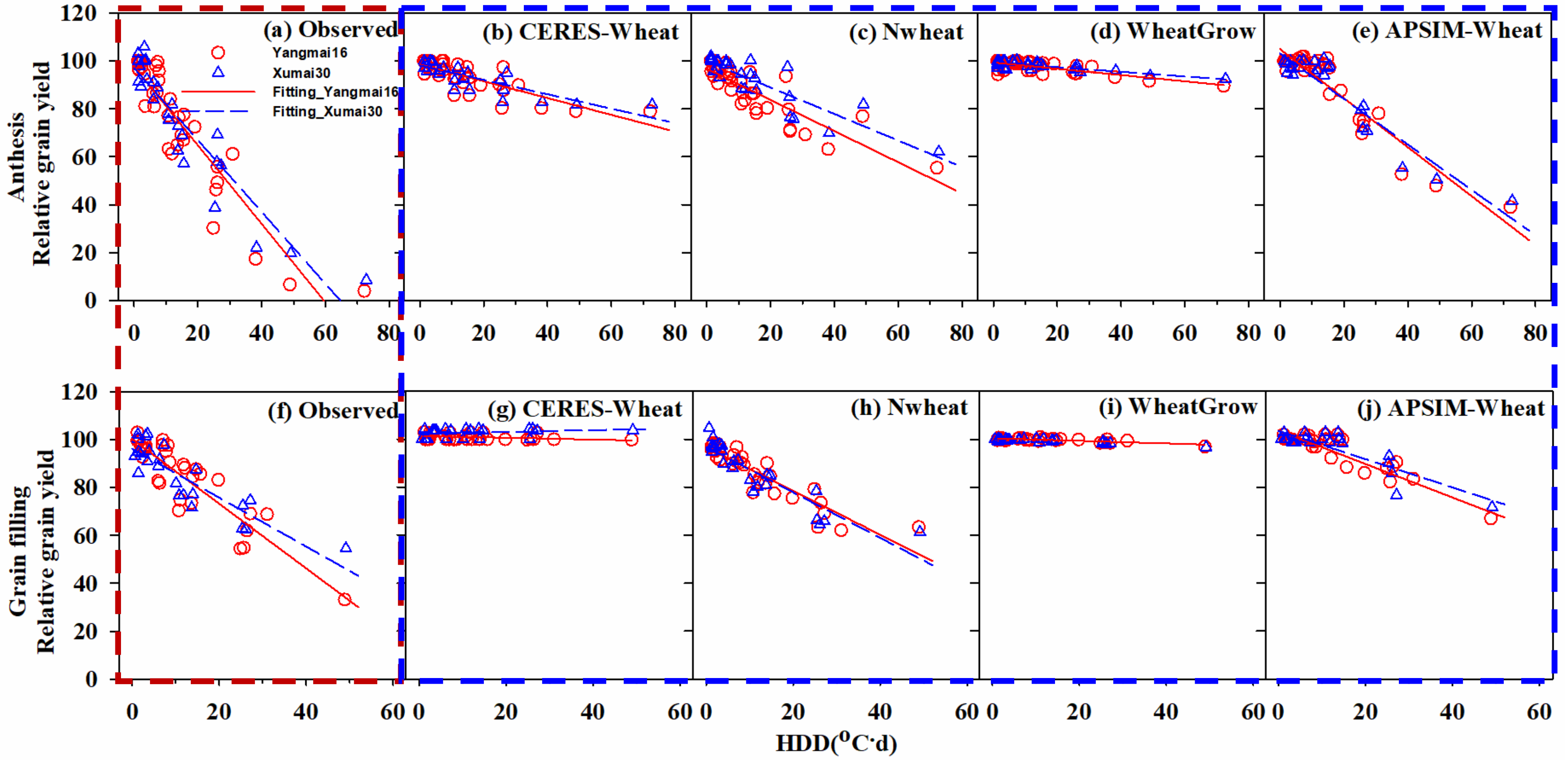
Model evaluation with the data under heat stress

Dynamics of LAI & grain weight



Model evaluation with the data under heat stress

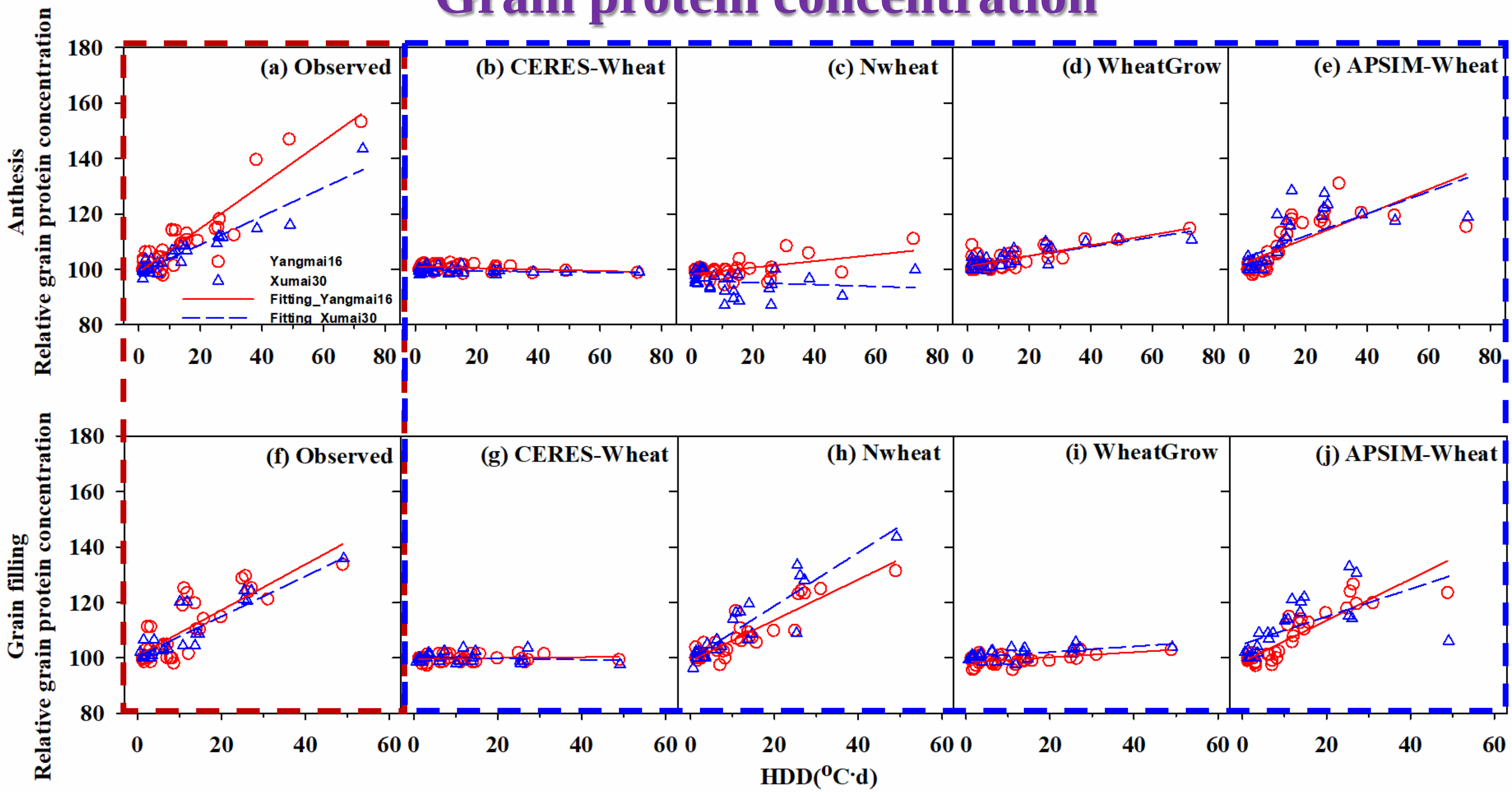
Grain yield



3. Process-based model for predicting crop productivity formation

Model evaluation with the data under heat stress

Grain protein concentration



- **Model performance under heat stress needs to be improved.**

Global Change Biology, 2016

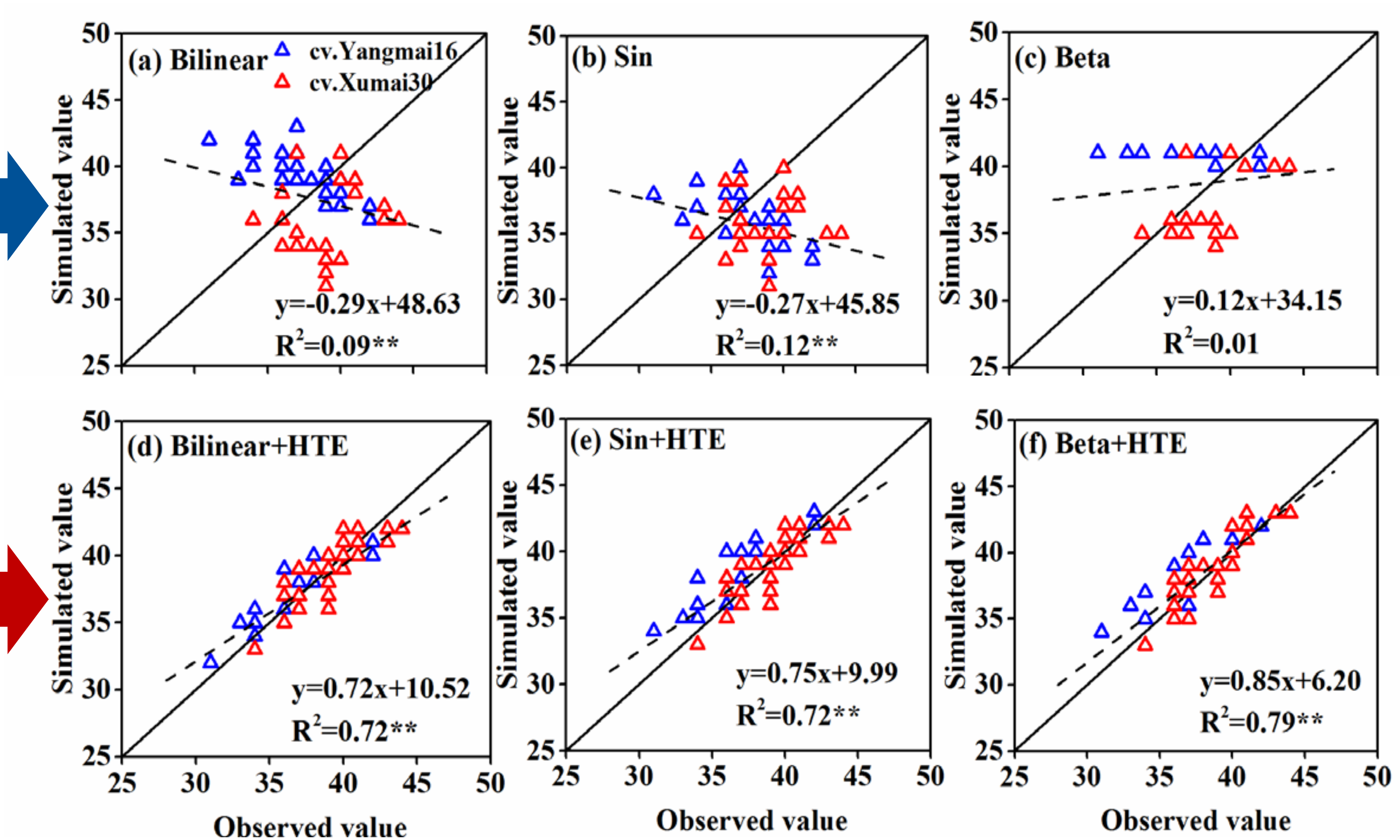
3. Process-based model for predicting crop productivity formation

New heat stress routines significantly improved the model performance

Grain filling duration

Original model

Improved model



Agricultural and Forest Meteorology, 2016

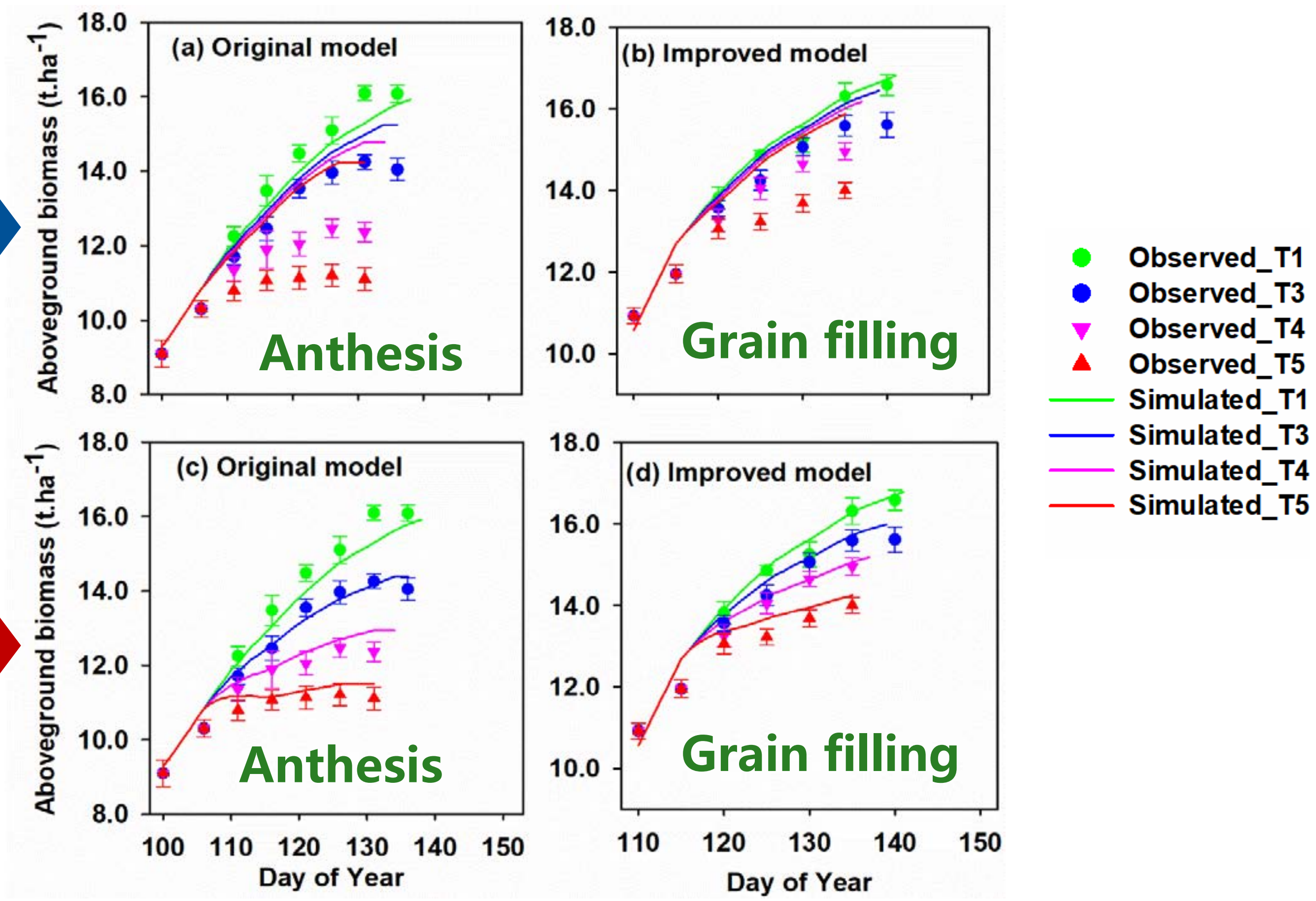
3. Process-based model for predicting crop productivity formation

New heat stress routines significantly improved the model performance

Dynamics of aboveground biomass

Original model

Improved model



Agricultural and Forest Meteorology, 2017

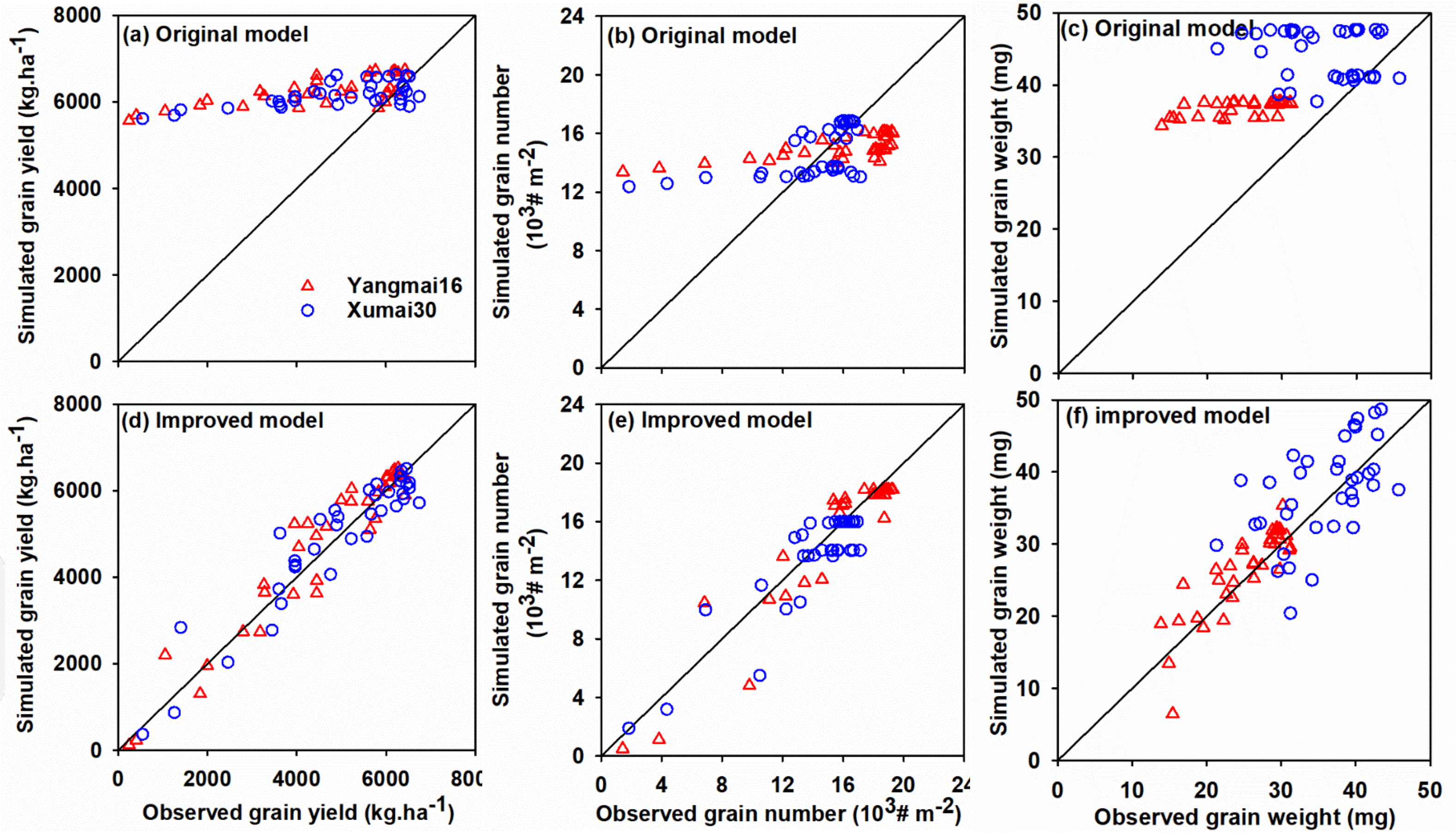
3. Process-based model for predicting crop productivity formation

New heat stress routines significantly improved the model performance

Grain yield & yield components

Original model

Improved model

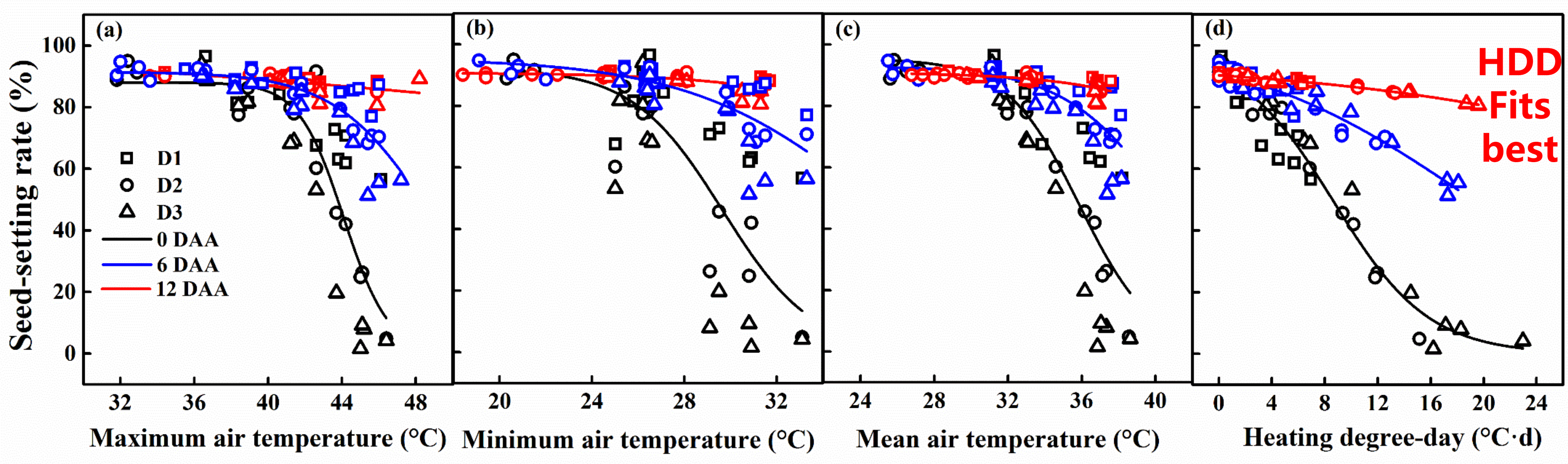


Agricultural and Forest Meteorology, 2017

3. Process-based model for predicting crop productivity formation

Simulation of seed-setting rate under heat stress in rice

The seed-setting rates (SR) can be well expressed as a logistic function of heat stress indices (HSI)



$$SR(HSI) = \frac{1}{1 + \exp\{b(HSI - c)\}}$$

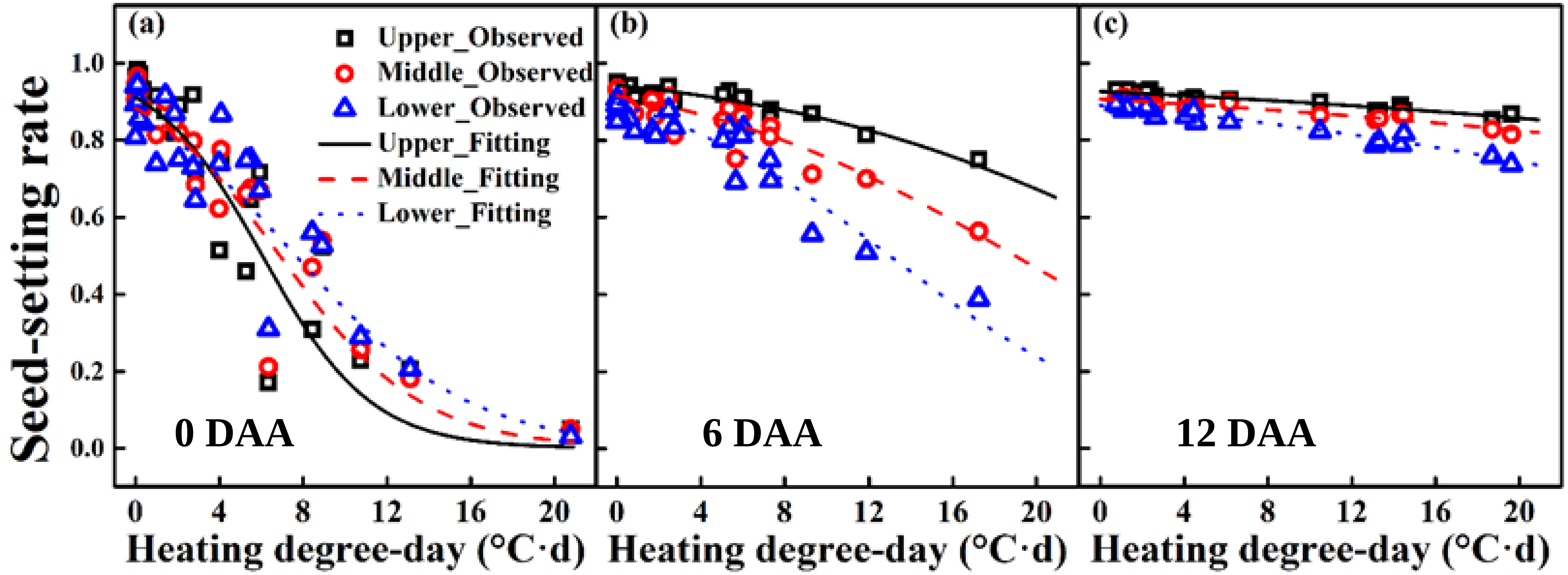
- b and c are parameters of the logistic curve
- Determining the shape of curve, & reflecting the responses of seed-setting rate to heat stress

Agricultural and Forest Meteorology, 2017 (submitted)

3. Process-based model for predicting crop productivity formation

Simulation of seed-setting rate under heat stress in rice

Responses of seed-setting rates at different panicle positions to HDD under different treatment timings



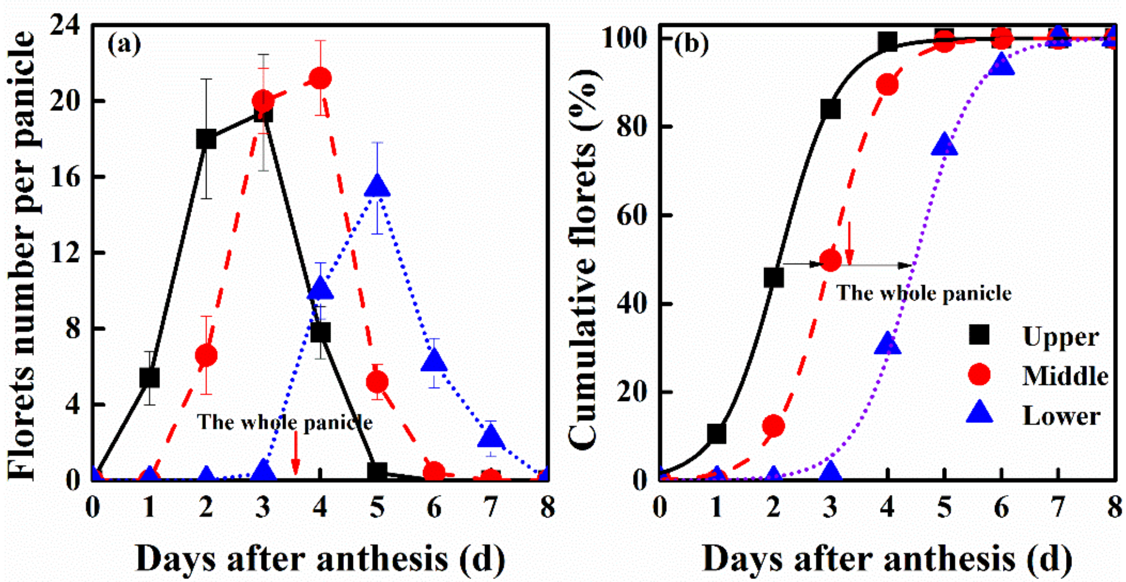
When seed-setting rates were fitted to the best heat stress index HDD, b & c, which were temperature sensitivity parameters, varied with different panicle positions & treatment timings.

Agricultural and Forest Meteorology, 2017 (submitted)

3. Process-based model for predicting crop productivity formation

Simulation of seed-setting rate under heat stress in rice

Flower distribution among different panicle positions

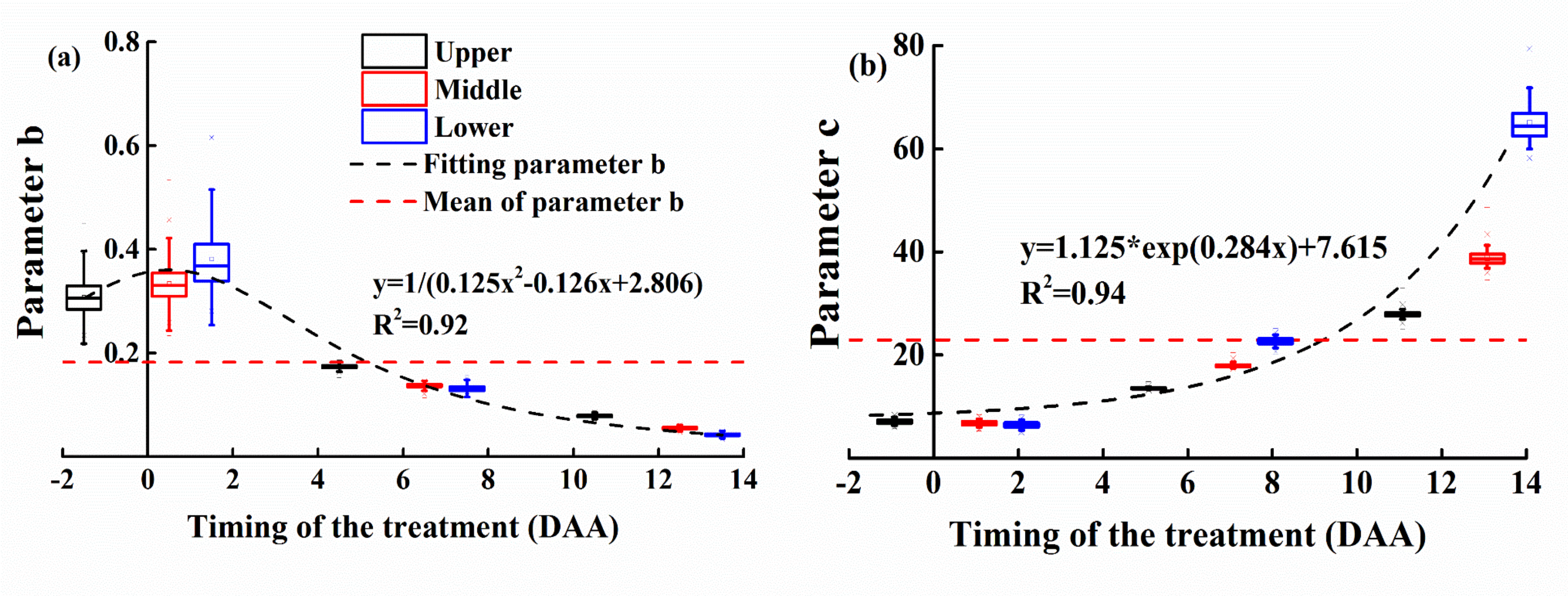


- 1 & 1.5-day delay of anthesis for the spikelets on mid & lower parts of the panicle, respectively, compared with upper ones.
- Hypothesis: The stage difference among panicle positions results in various temperature sensitivities.

Agricultural and Forest Meteorology, 2017 (submitted)

3. Process-based model for predicting crop productivity formation

Simulation of seed-setting rate under heat stress in rice



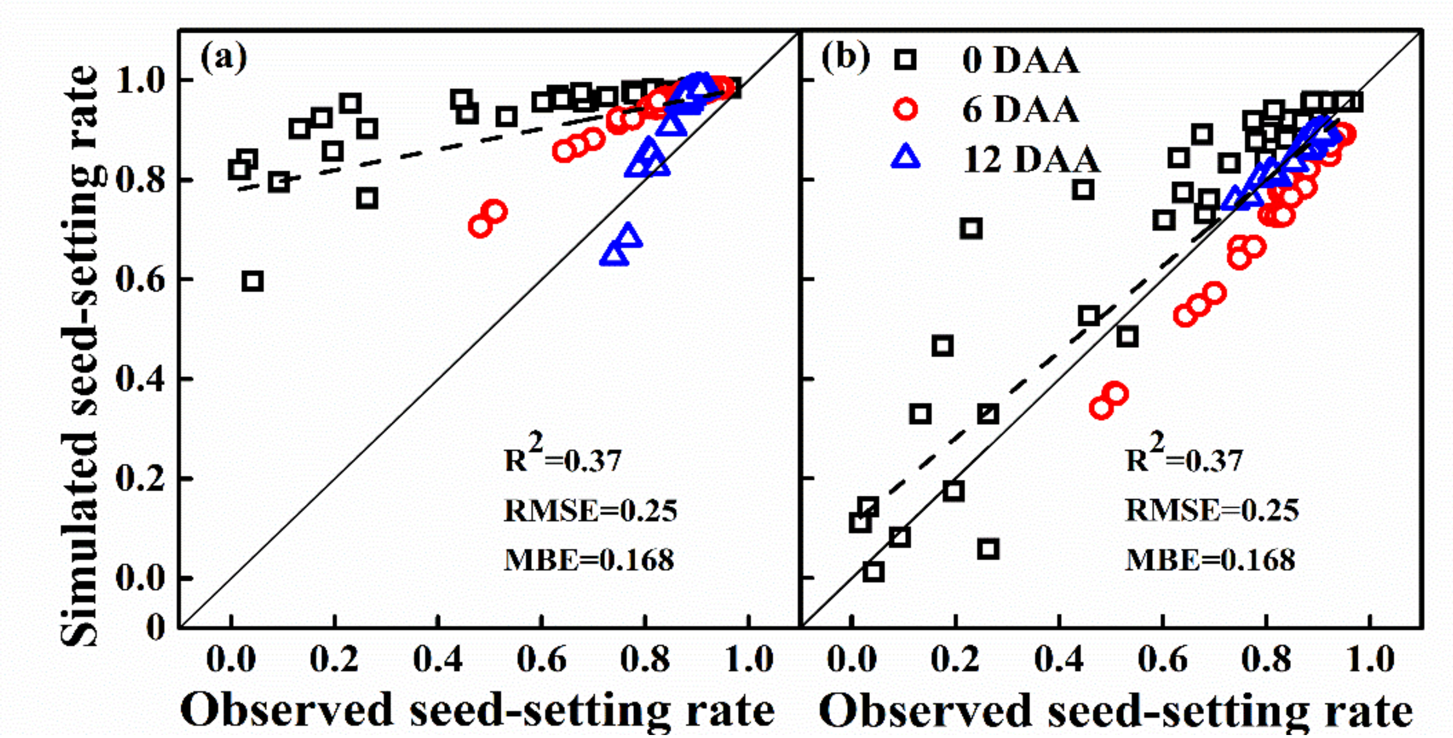
$$SR = SR_{max} \prod_{d_h}^{d_m} f(HDD_i)$$

$$f(HDD_i) = SR(HDD_i)/SR_{max}$$

The daily heat stress impacts $f(HDD_i)$ can be obtained by daily SR / potential SR, and then at maturity SR is the product of multiplicative $f(HDD_i)$ and potential SR

3. Process-based model for predicting crop productivity formation

The performance of new model was improved and virtually no bias if three stages combined.



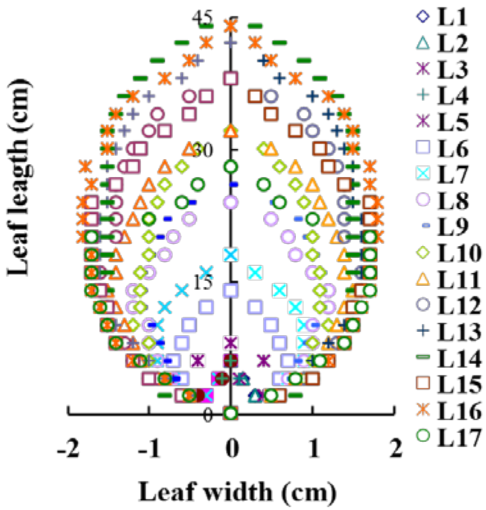
Simulated with constant parameters

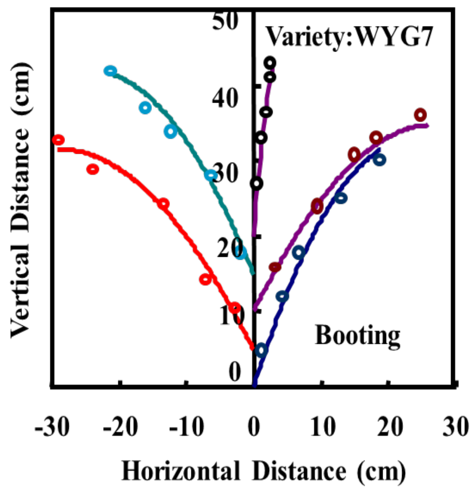
Simulated with stage-dependent dynamic parameters

Agricultural and Forest Meteorology, 2017 (submitted)

3. Process-based model for predicting crop productivity formation

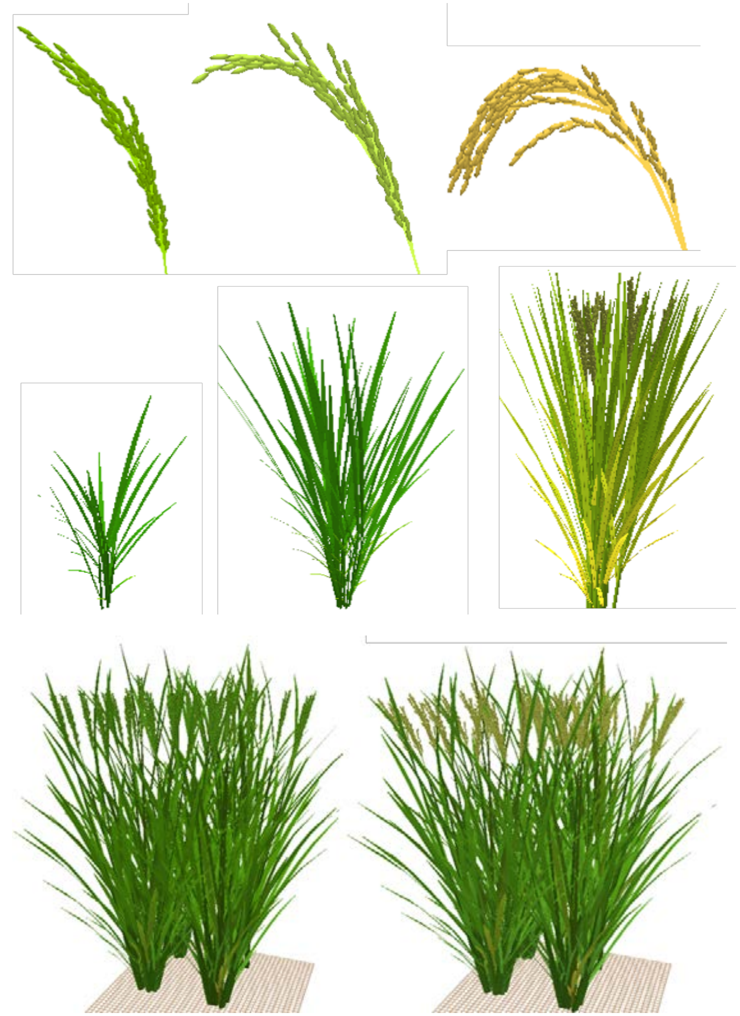
3.4 Built a 3D virtual system for crop visualization





Measured morphogenesis

Simulated spatial pattern



Organ

Plant

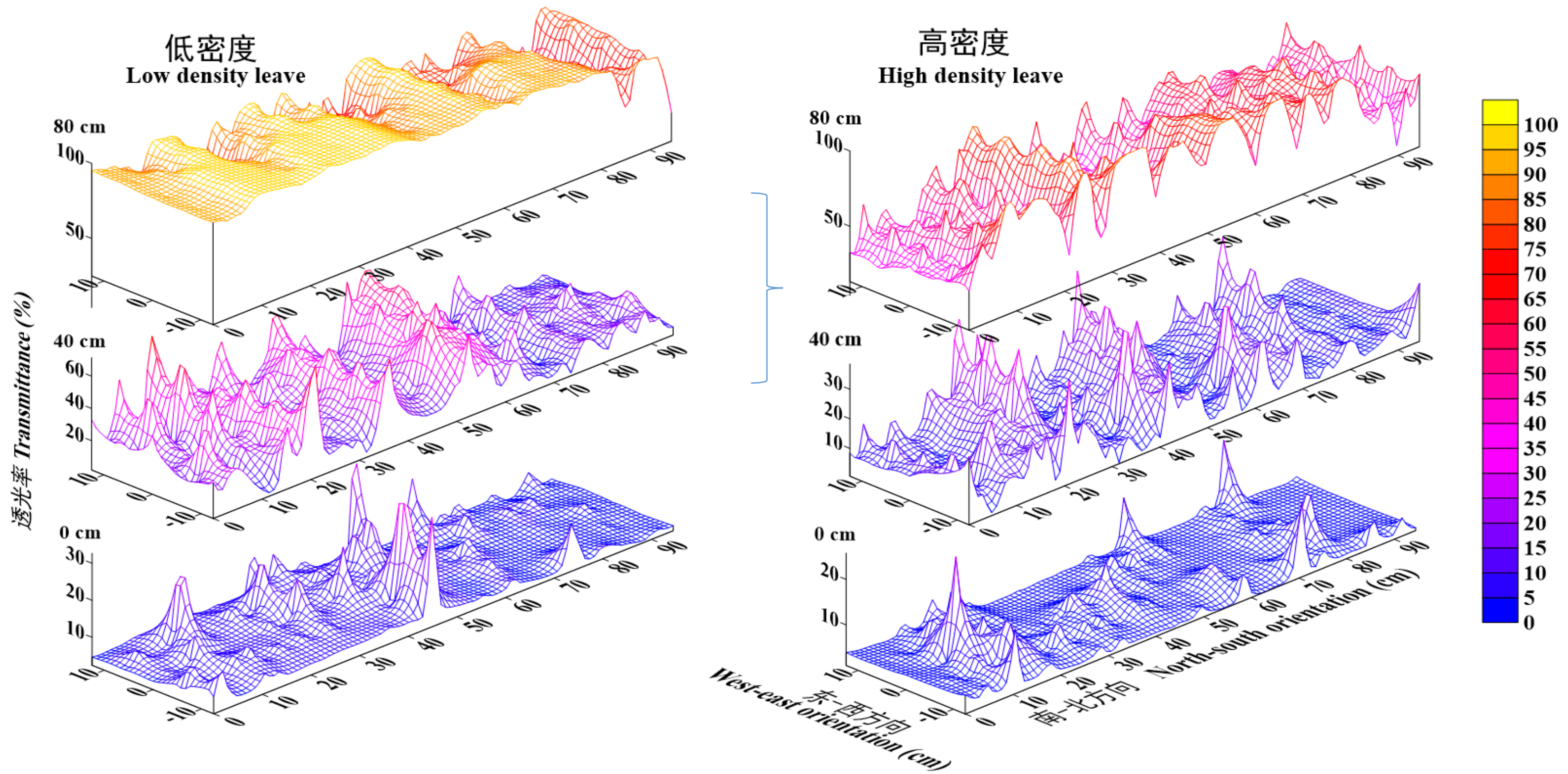
Canopy

European Journal of Agronomy, 2014

3. Process-based model for predicting crop productivity formation

3.4 Built a 3D virtual system for crop visualization at organ/plant/canopy levels

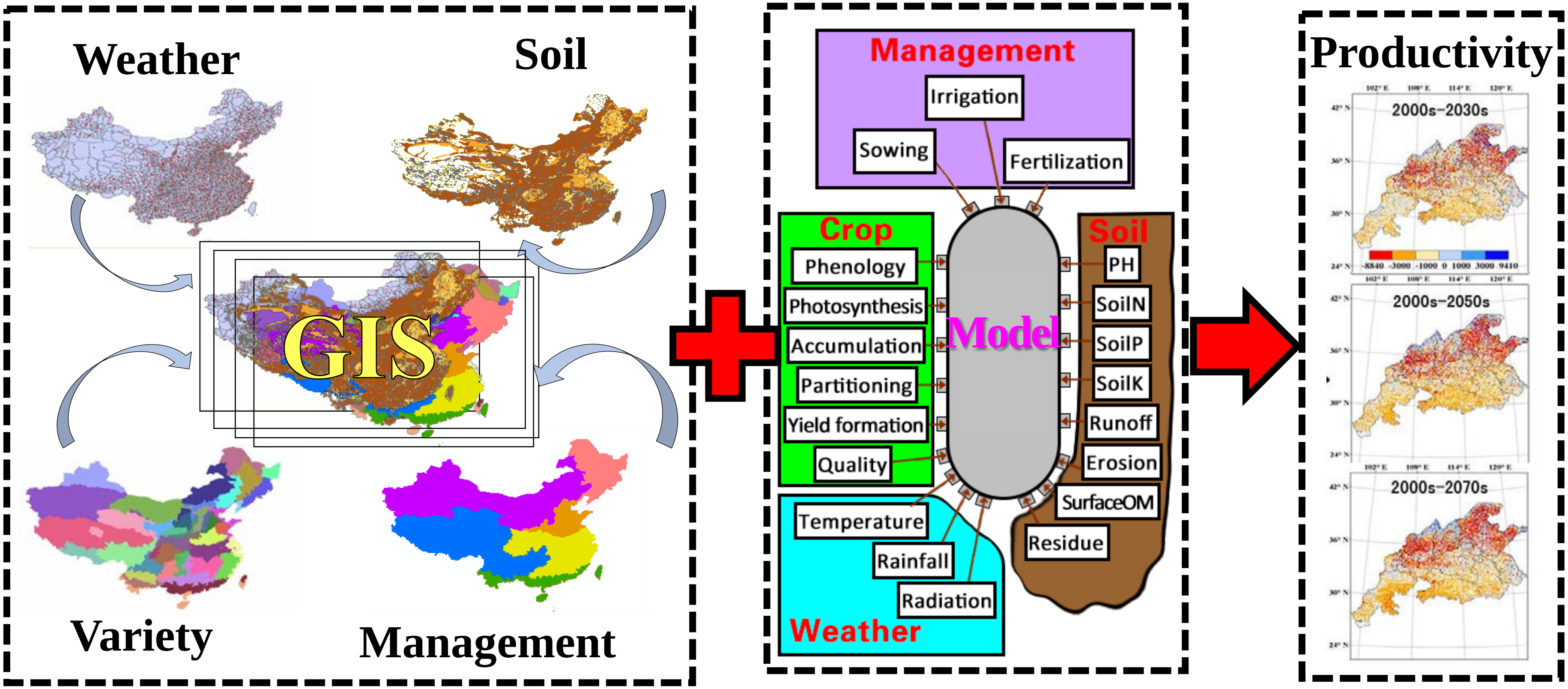
► **Developed a light distribution sub-model based on the simulated canopy structure, which can be used for the design of optimal canopy structure.**



Distribution of light transmittance among canopy at anthesis under different planting densities (cv.Yangmai12)

4. Model-based productivity estimation & impact evaluation

- **Developed the technology for predicting the regional crop productivity based on the integration of model, GIS and RS, and realized the expansion from point simulation to the regional prediction.**

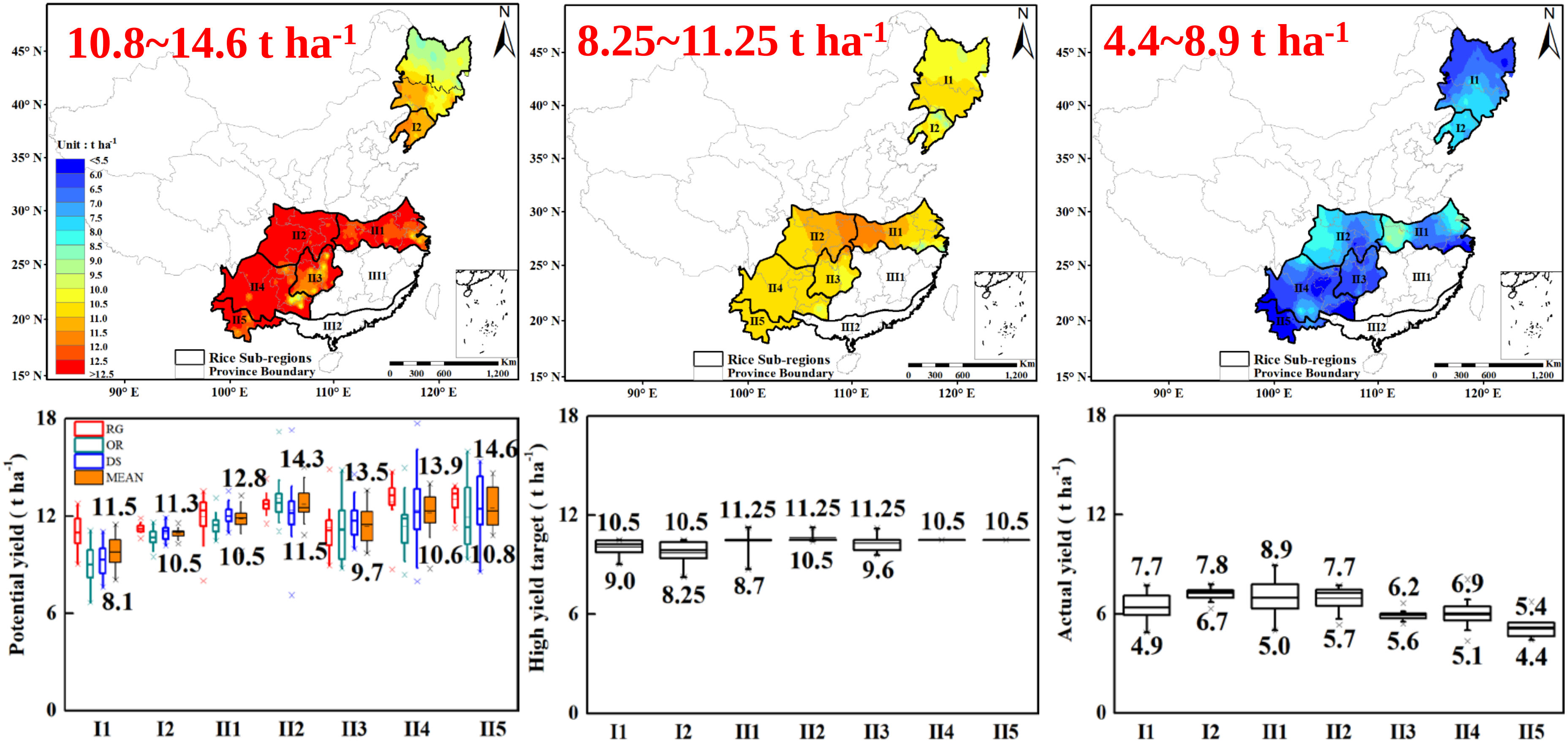


4. Model-based productivity estimation & impact evaluation

4.1 Predicting yield potential & yield gap with multi-models

Yield in single-season rice cropping region

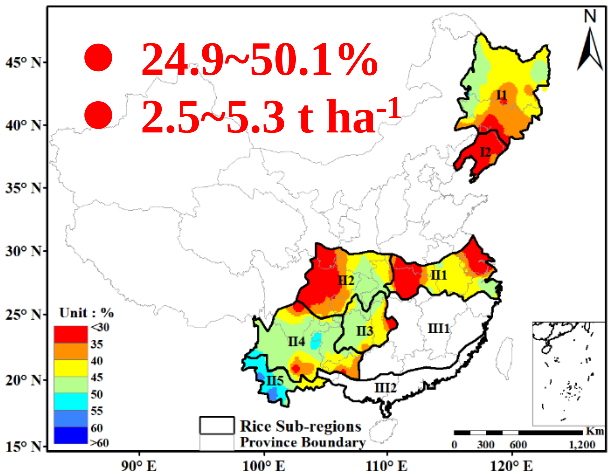
Potential yield | High yield target | Actual yield



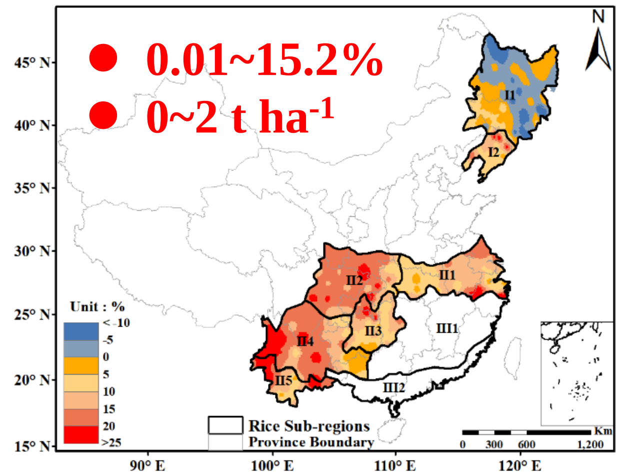
4. Model-based productivity estimation & impact evaluation

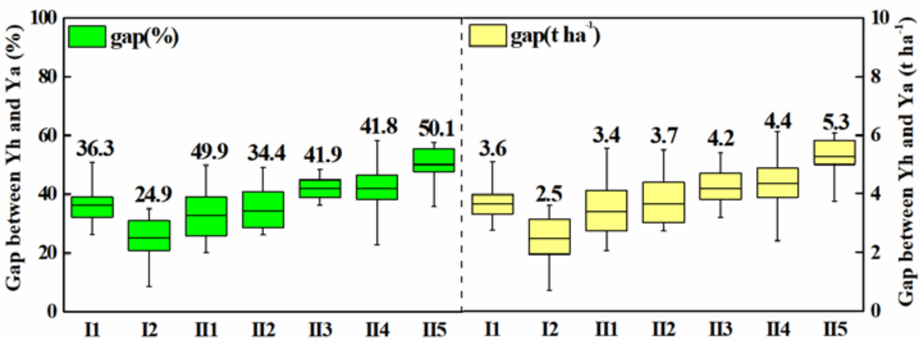
Yield gap in single season rice cropping region

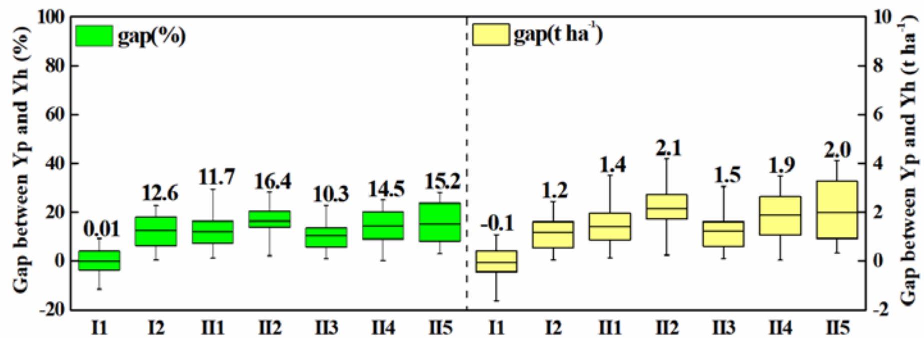
Gap between high yield target & actual yield (%)



Gap between potential yield & high yield target (%)



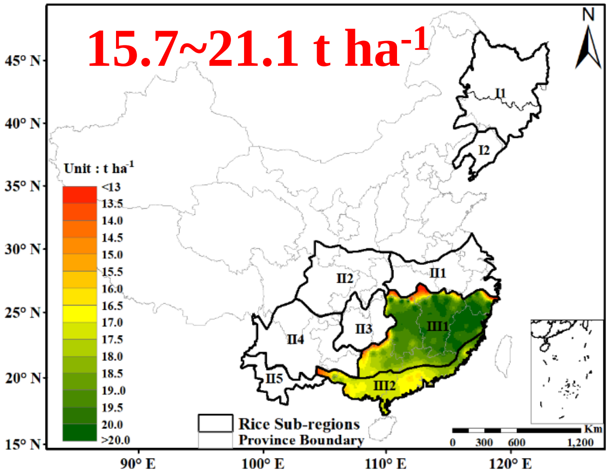


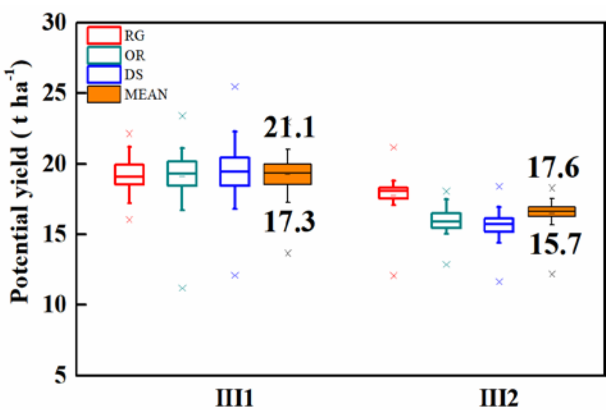


4. Model-based productivity estimation & impact evaluation

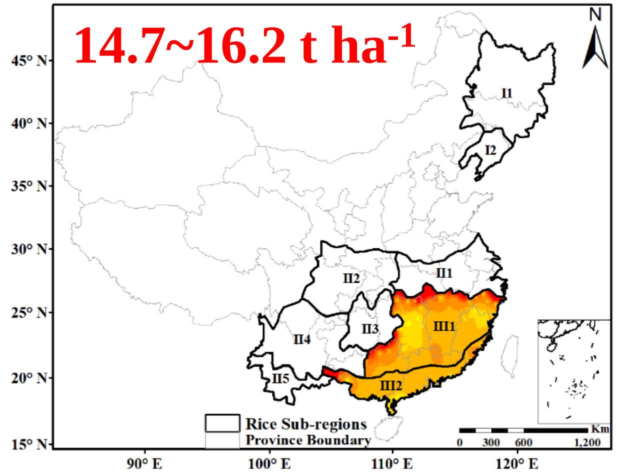
Yield in double-season rice cropping region (Two seasons)

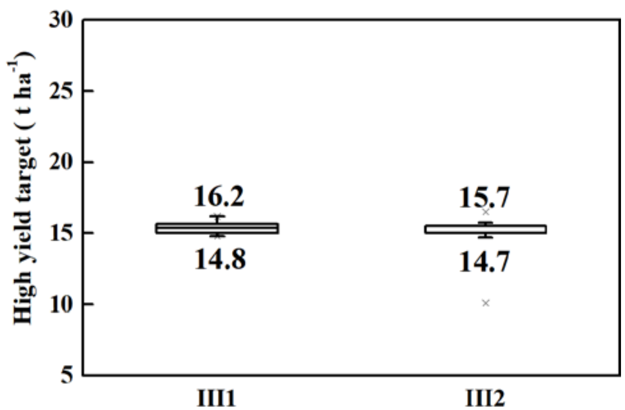
Potential yield



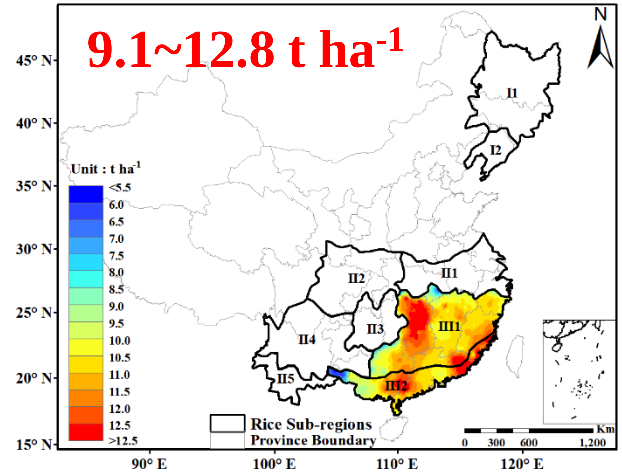


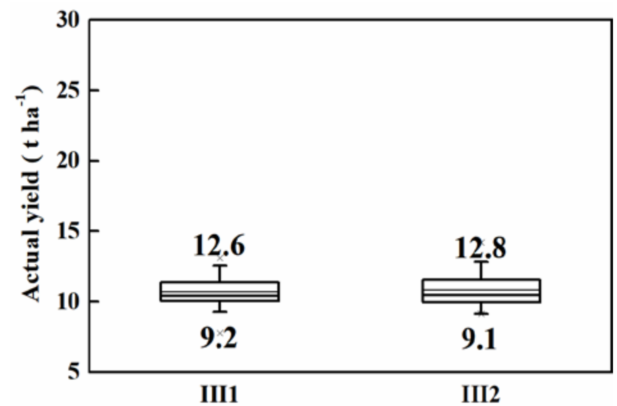
High yield target





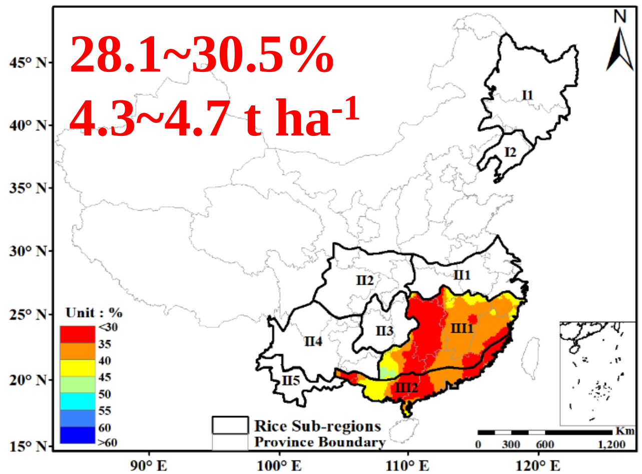
Actual yield

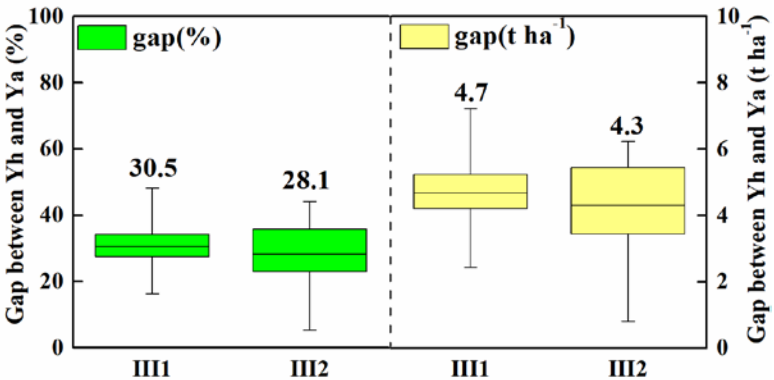




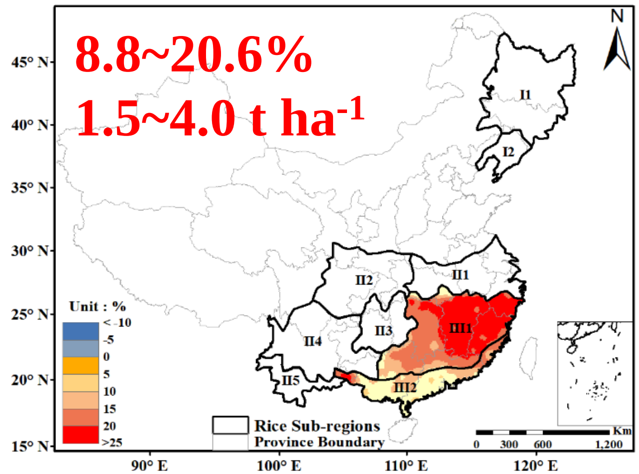
Yield gap in double season rice cropping region (Two seasons)

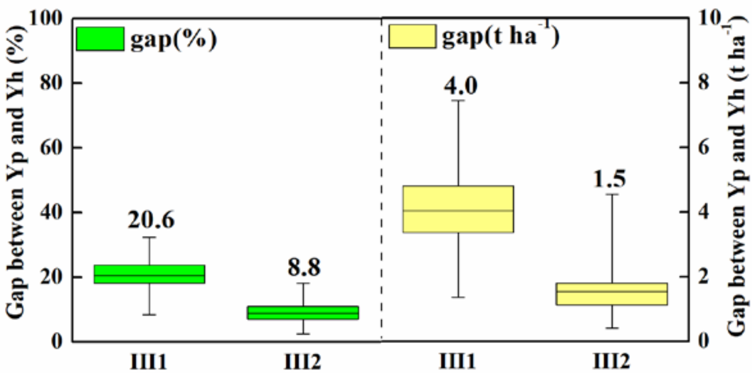
Gap between high yield target & actual yield (%)





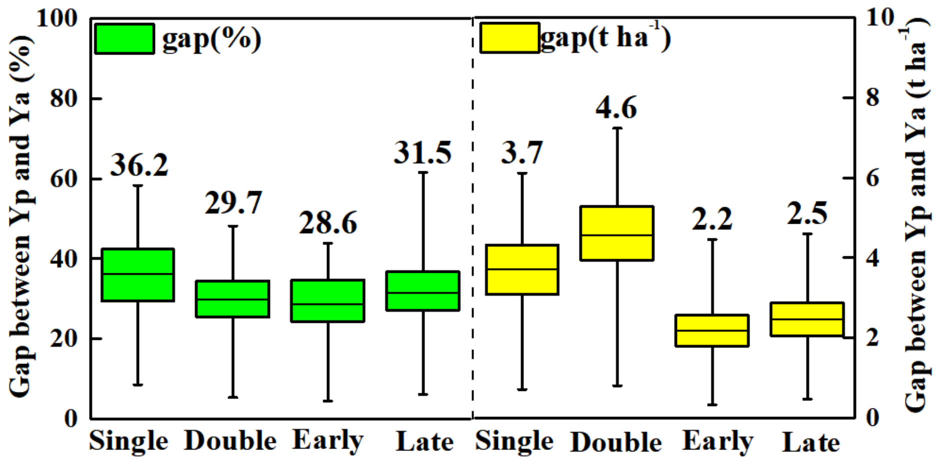
Gap between potential yield & high yield target (%)



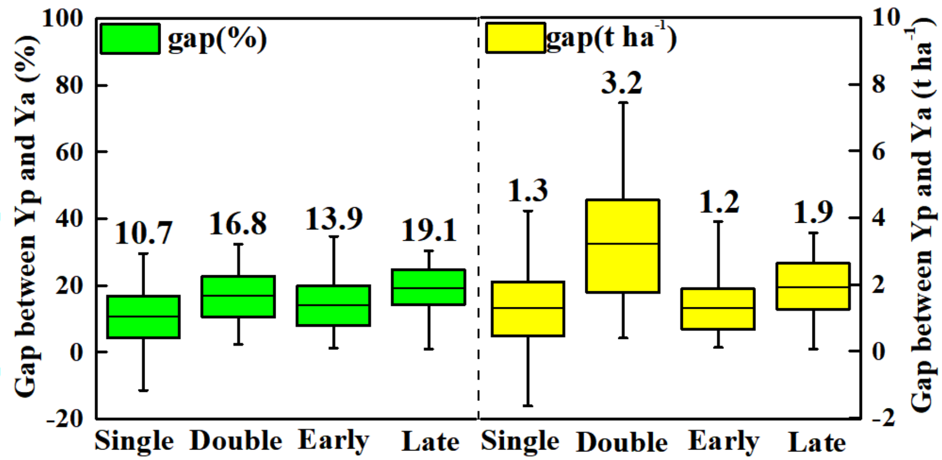


4. Model-based productivity estimation & impact evaluation

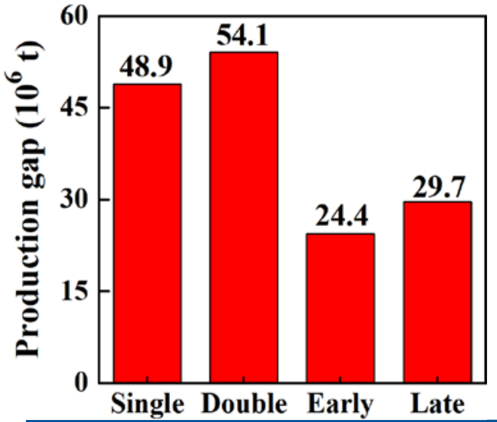
Gap between high yield target & actual yield (%)



Gap between potential yield & high yield target (%)

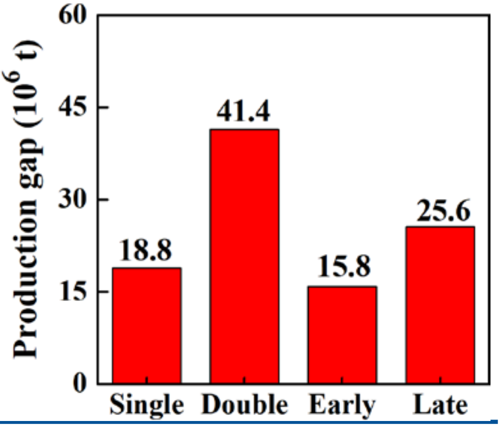


↑157×10^6 t (78.5%)



- **Double-season rice has more yield increasing potential than the single-season rice**
- **Late rice has more yield increasing potential than the early rice.**
- **Current rice production in China is about 200×10^6 t.**

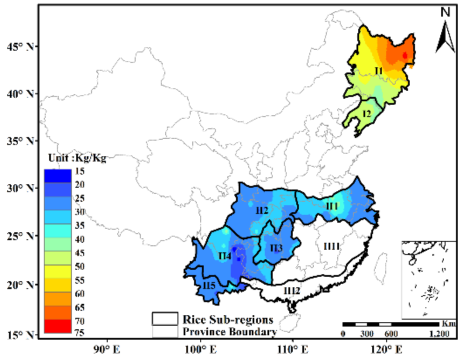
↑101.6×10^6 t (50.8%)



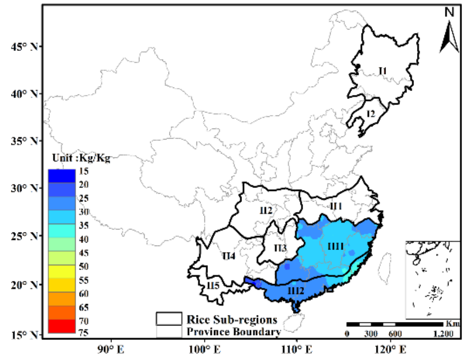
4. Model-based productivity estimation & impact evaluation

Partial factor productivity from applied N (kg/kg)

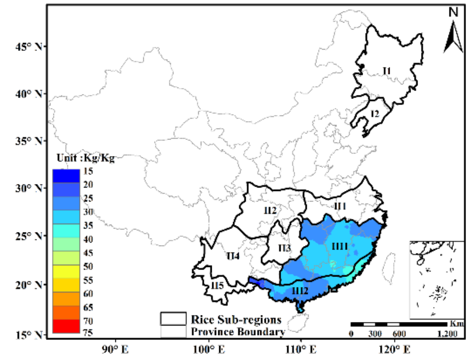
Single season rice



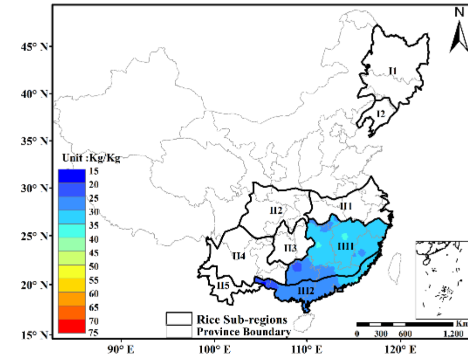
Two seasons rice

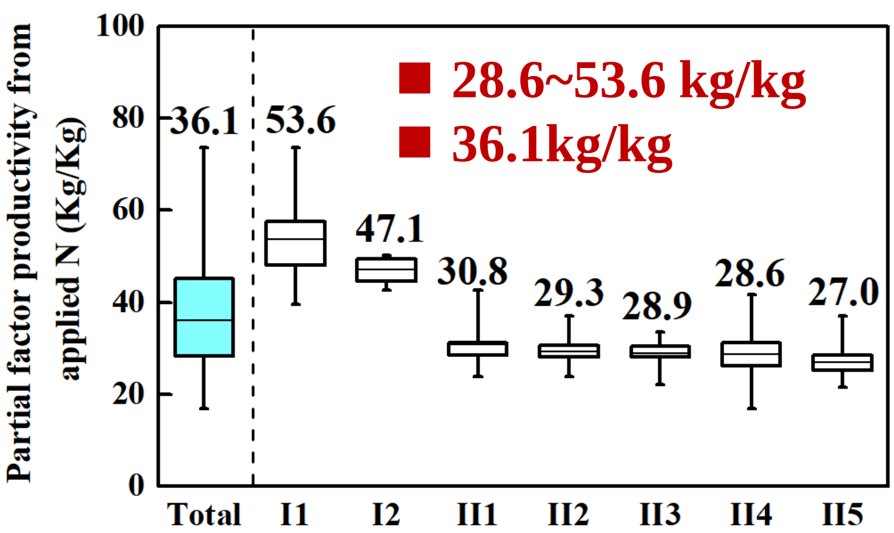


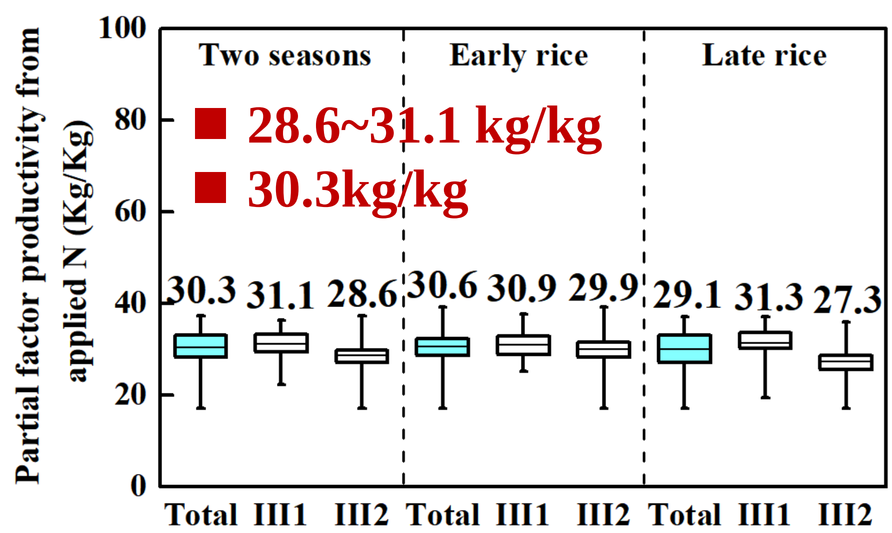
Early rice



Late rice



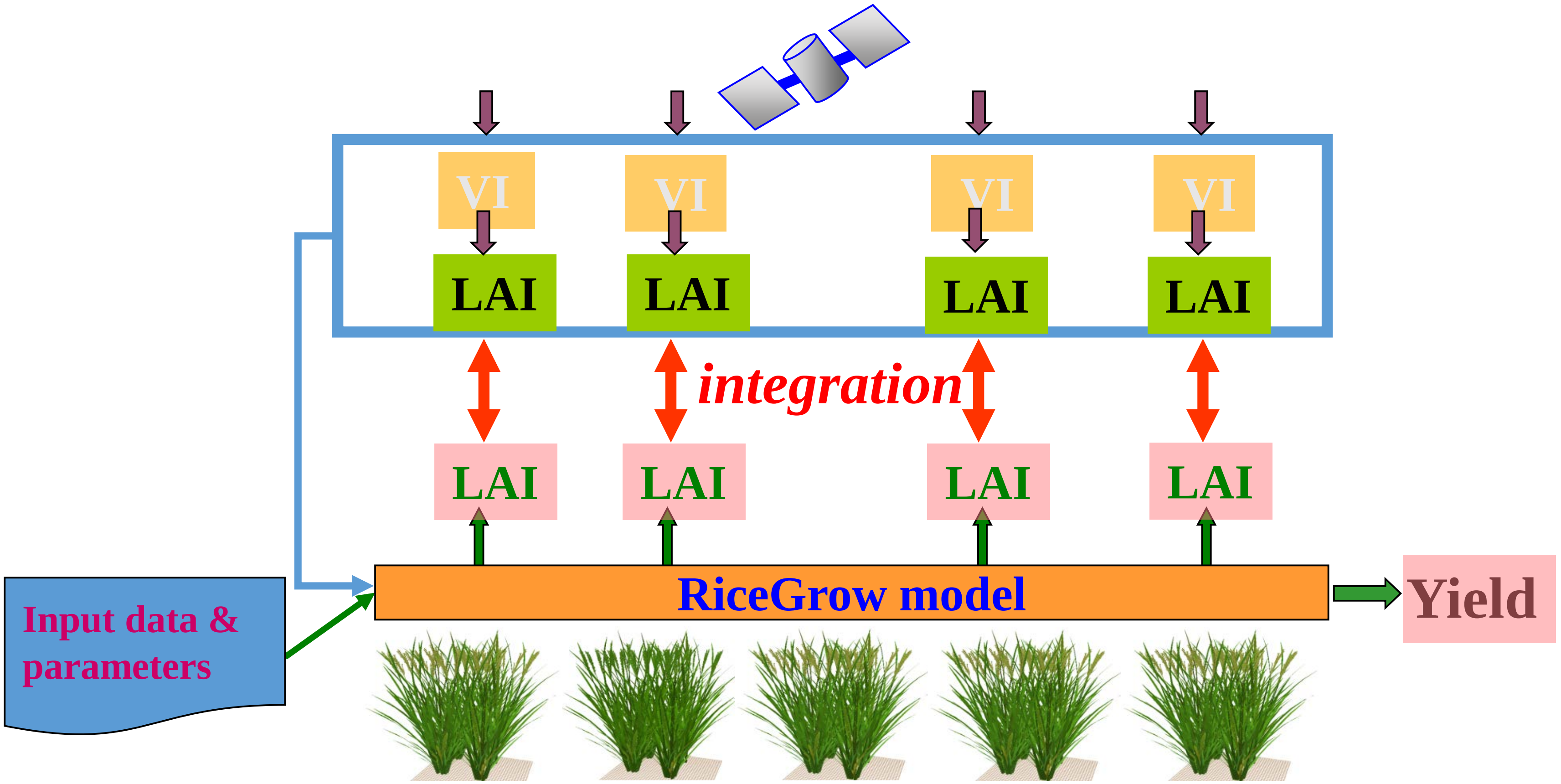




4. Model-based productivity estimation & impact evaluation

4.2 Predicting the regional productivity by integrating SM & RS

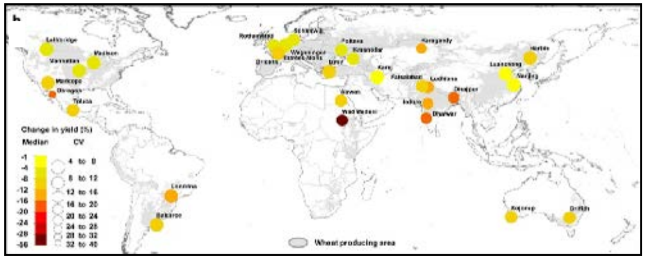
- **Calibration of model prediction with RS monitoring**
- **Complement of temporal dynamics and spatial distribution**



4. Model-based productivity estimation & impact evaluation

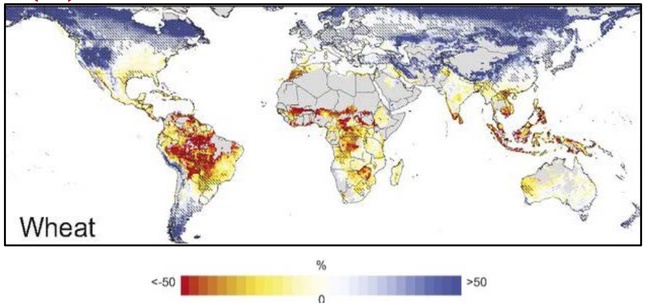
4.3 Comparison of temperature impacts estimated with different methods

(1) Point-based simulation



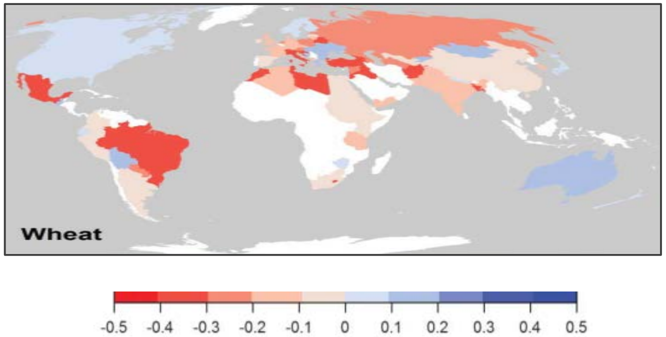
■30 wheat models ■30 locations

(2) Grid-based simulation



■ 7 wheat models ■ 0.5×0.5º

(3) Statistical regression



$$\mathrm{Log}(Y_{i,t}) = c_i + d_{1i} * \mathrm{year} + d_{2i} * \mathrm{year}^2 + \beta \cdot X_{i,t} + \varepsilon_{i,t}$$

- **Crop yields (FAO STAT, 1980-2008)**
- **All wheat production countries (Planting area >10^4 ha)**

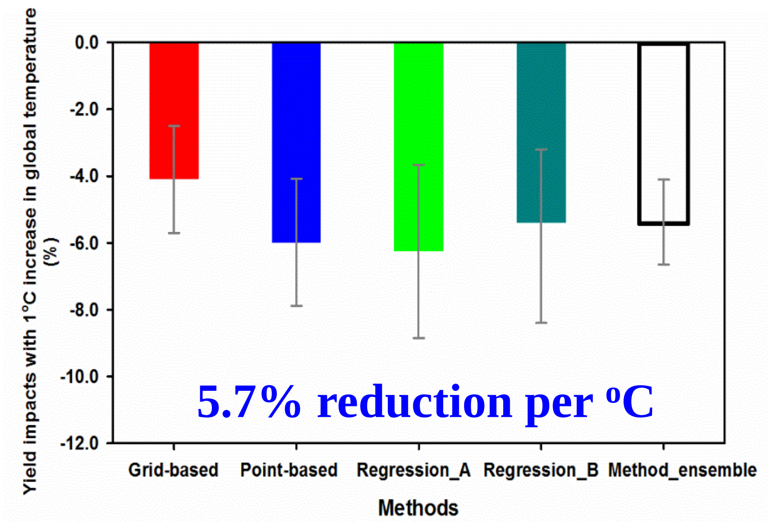
Nature Climate Change, 2016

4. Model-based productivity estimation & impact evaluation

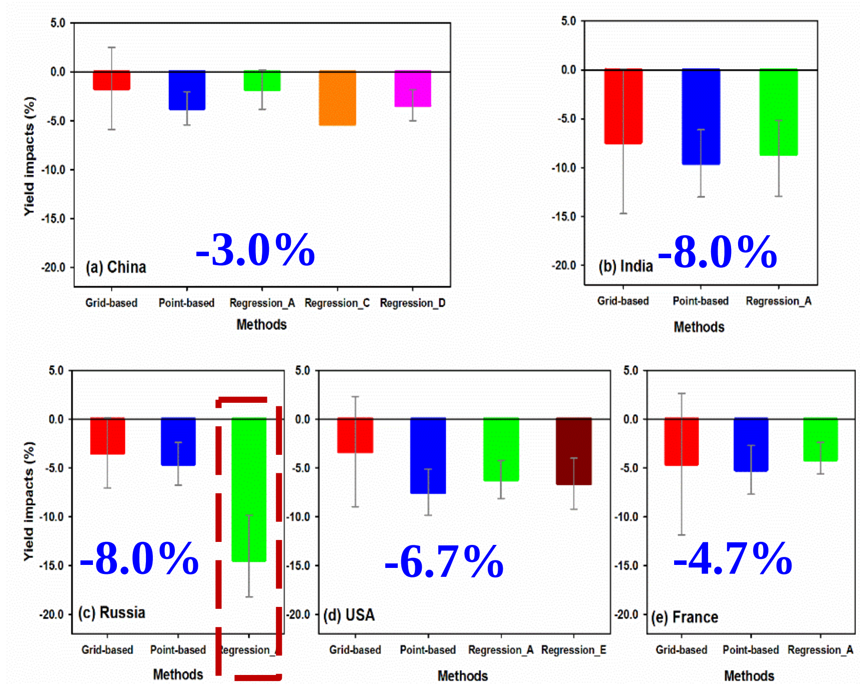
4.3 Comparison of temperature impacts estimated with different methods

Impacts on wheat production with 1°C warming

Global



Top five major wheat producers



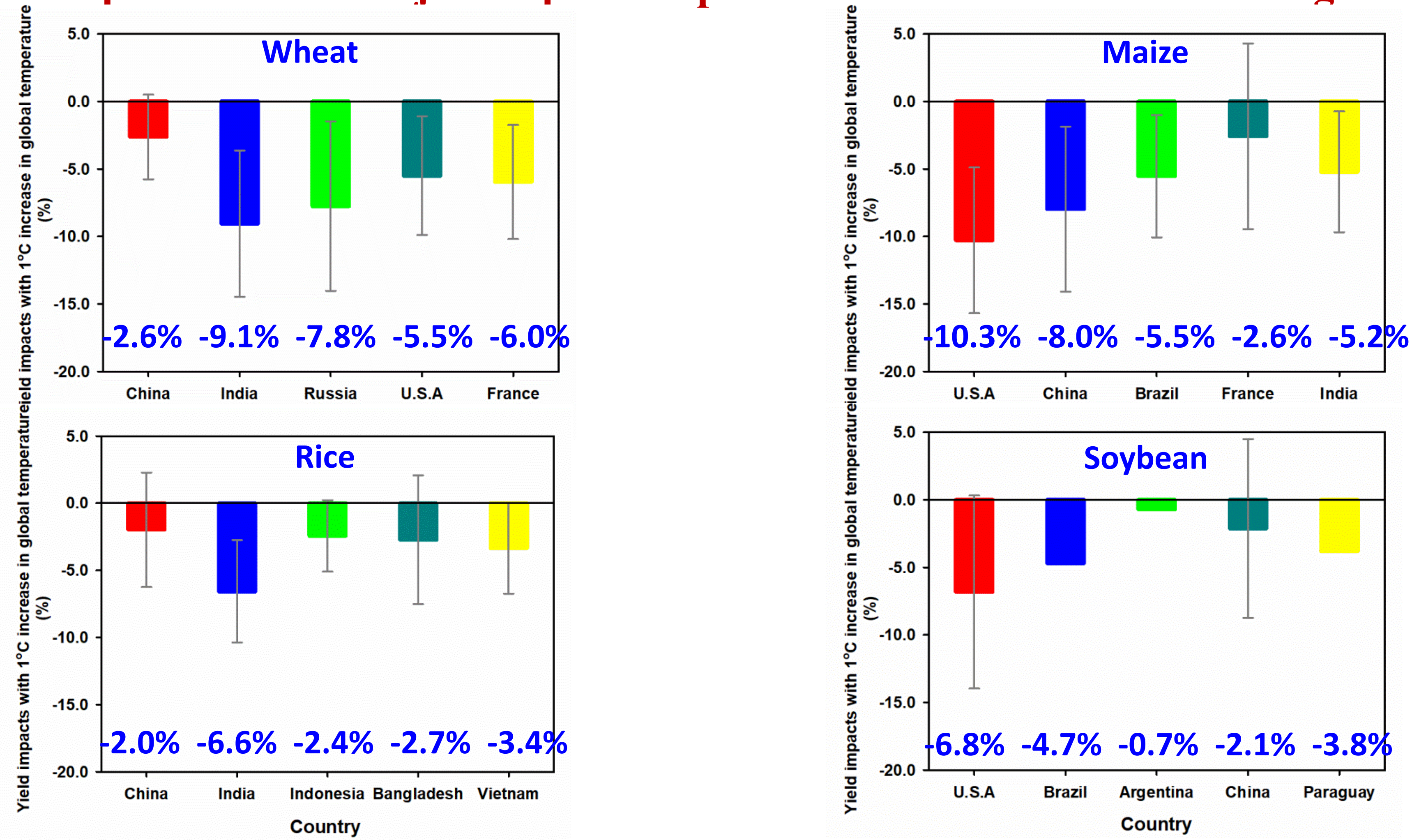
"Multi-method ensemble"

- Projected relative temperature impacts from different methods were similar for Globe, China, India, USA and France, but less so for Russia.
- Warmer regions are likely to suffer more yield loss with increasing temperature than cooler regions.

4. Model-based productivity estimation & impact evaluation

4.3 Comparison of temperature impacts estimated with different methods

Impacts on four major crops for top five countries with 1°C warming

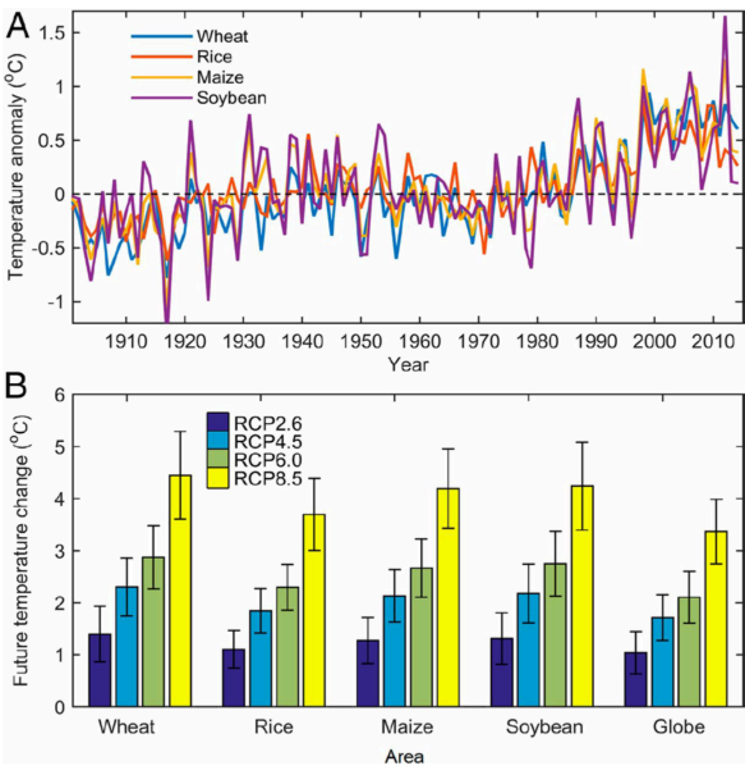


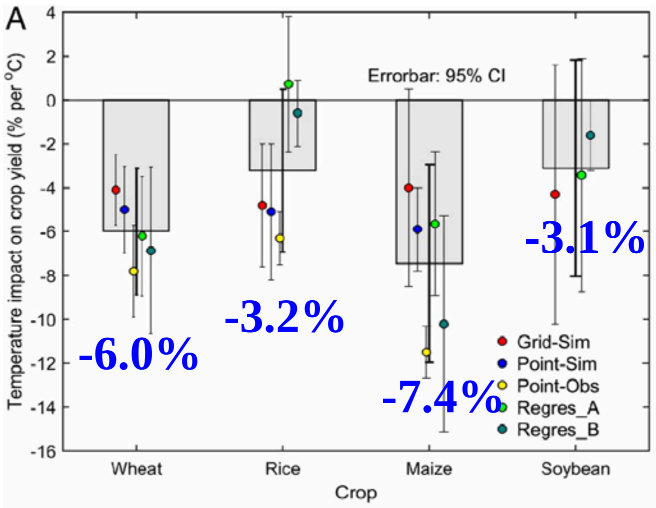
PNAS, 2017

4. Model-based productivity estimation & impact evaluation

4.3 Comparison of temperature impacts estimated with different methods

Global impacts for four major crops





B

Scenario	Yield changes (%) due to temperature changes by the end of century: Wheat	Rice	Maize	Soybean	Mean
RCP2.6	-6.9 [-15.0, -1.4]	-3.3 [-9.2, 0.8]	-8.6 [-18.6, -1.8]	-3.6 [-11.2,1.7]	-5.6 [-14.4, -0.1]
RCP4.5	-11.4 [-21.7, -3.9]	-5.5 [-13.8, 1.0]	-14.2 [-27.9, -4.9]	-5.9 [-17.0, 3.1]	-9.2 [-21.2, -0.3]
RCP6.0	-14.0 [-25.7, -5.1]	-6.8 [-16.8, 1.3]	-17.4 [-33.1, -5.8]	-7.2 [-20.2, 3.6]	-11.3 [-25.6, 0.1]
RCP8.5	-22.4 [-40.2, -8.5]	-10.8 [-25.3, 2.4]	-27.8 [-50.4, -9.7]	-11.6 [-31.0, 6.0]	-18.2 [-38.6, -0.7]

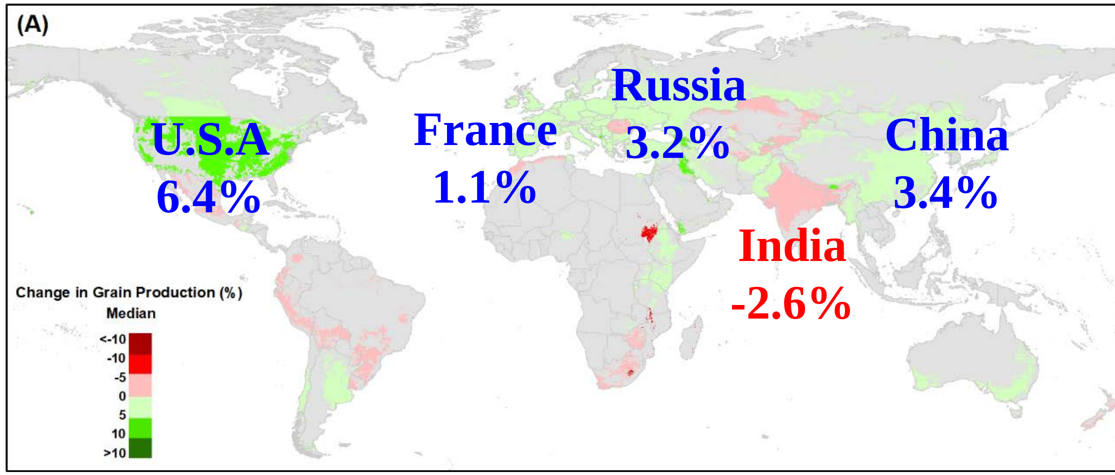
PNAS, 2017

4. Model-based productivity estimation & impact evaluation

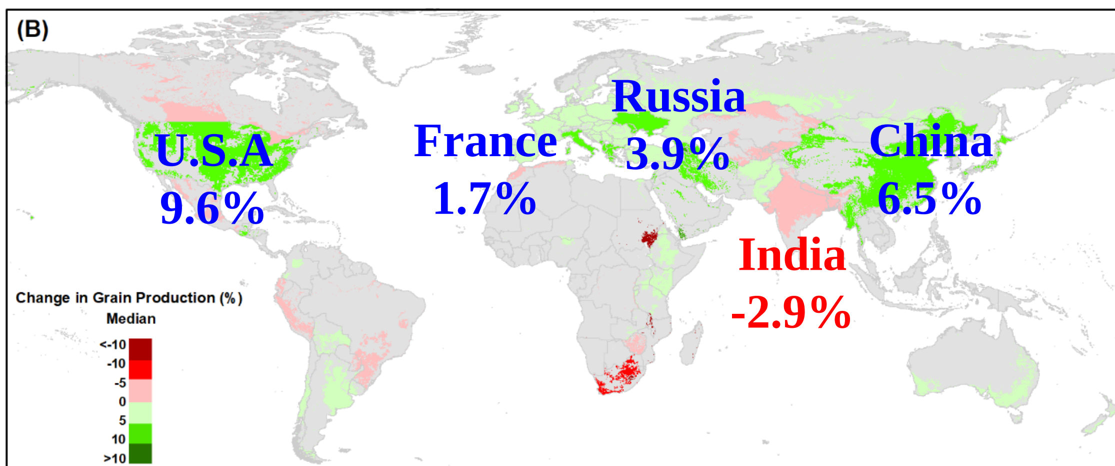
4.4 Assessing 1.5/2.0°C global warming impacts on wheat production

Global wheat production (31 wheat models)

1.5°C Global warming
CO_2: 423ppm



2.0°C Global warming
CO_2: 487ppm

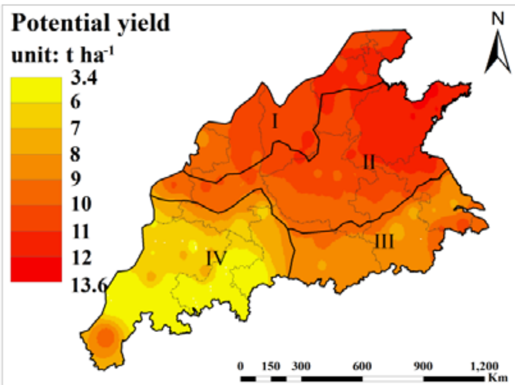


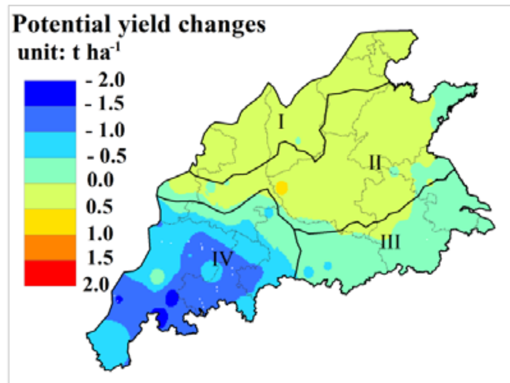
4.4 Assessing 1.5/2.0°C global warming impacts on wheat production

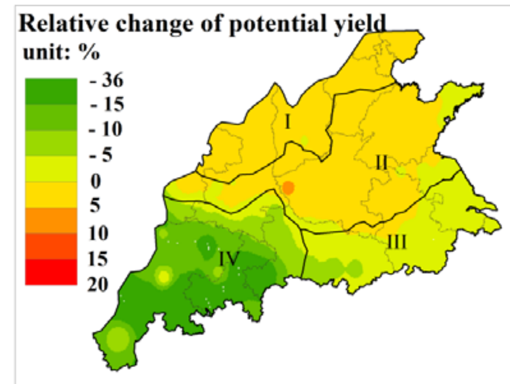
Wheat production in China under 1.5°C global warming (2 wheat models)

Potential yield | **Absolute changes in Yp** | **Relative changes in Yp**

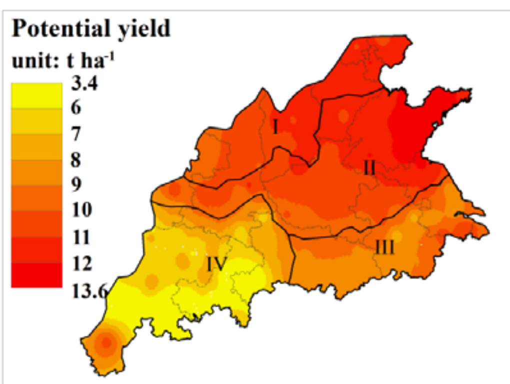
No CO2 effects

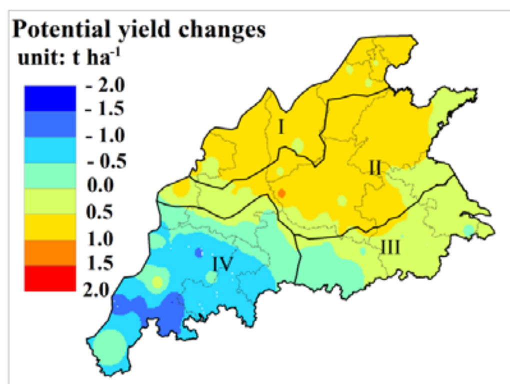


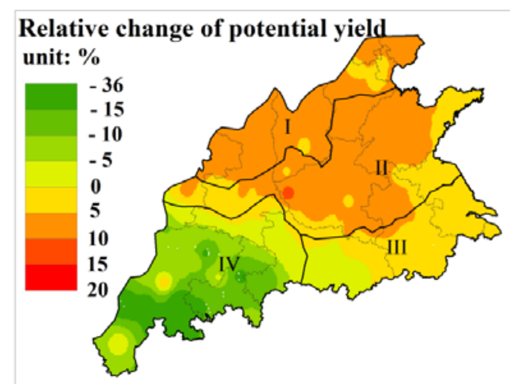




CO_2 423ppm







4. Model-based productivity estimation & impact evaluation

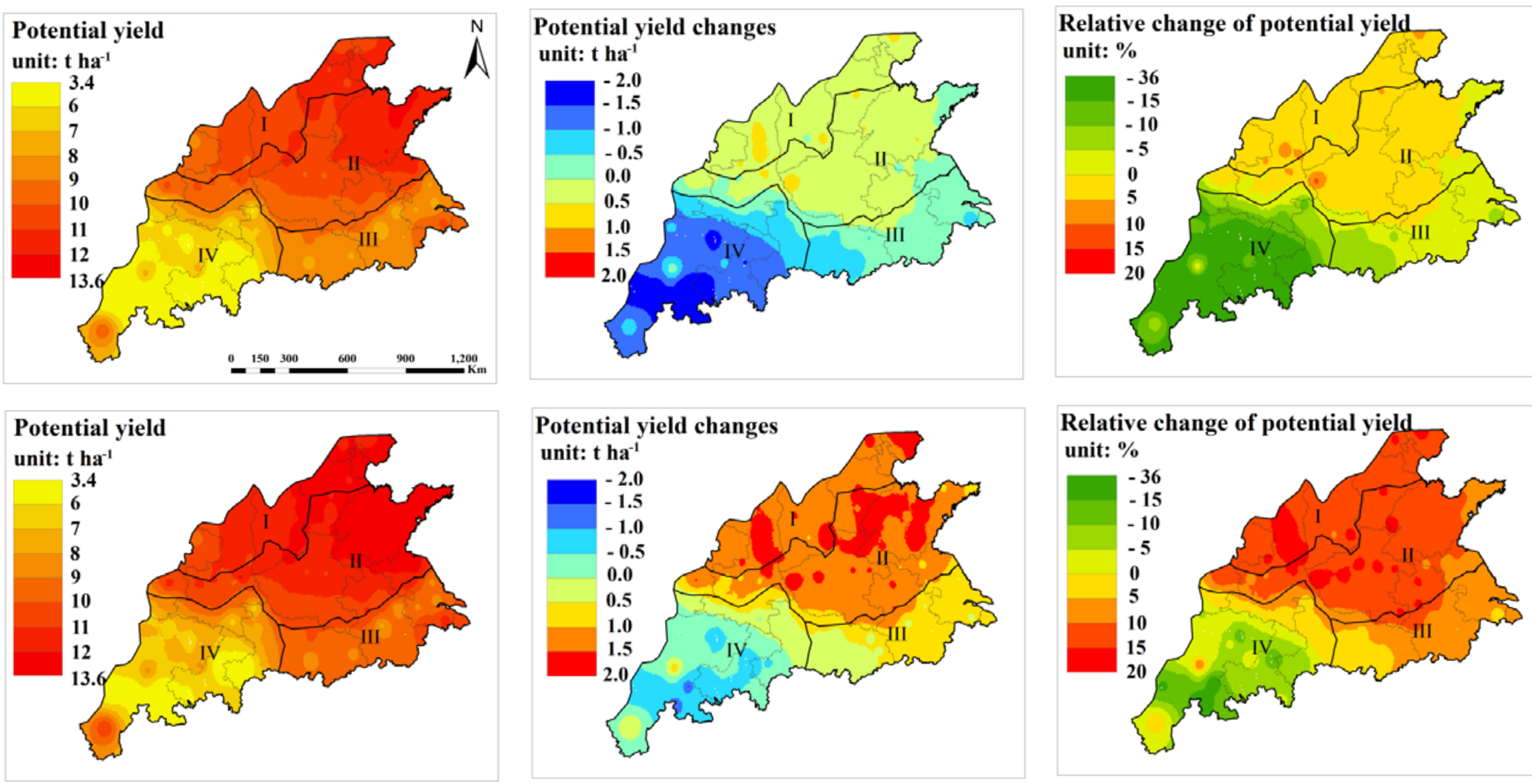
4.4 Assessing 1.5/2.0°C global warming impacts on wheat production

Wheat production in China under 2.0°C global warming (2 wheat models)

Potential yield | Absolute changes in Yp | Relative changes in Yp

No CO2 effects

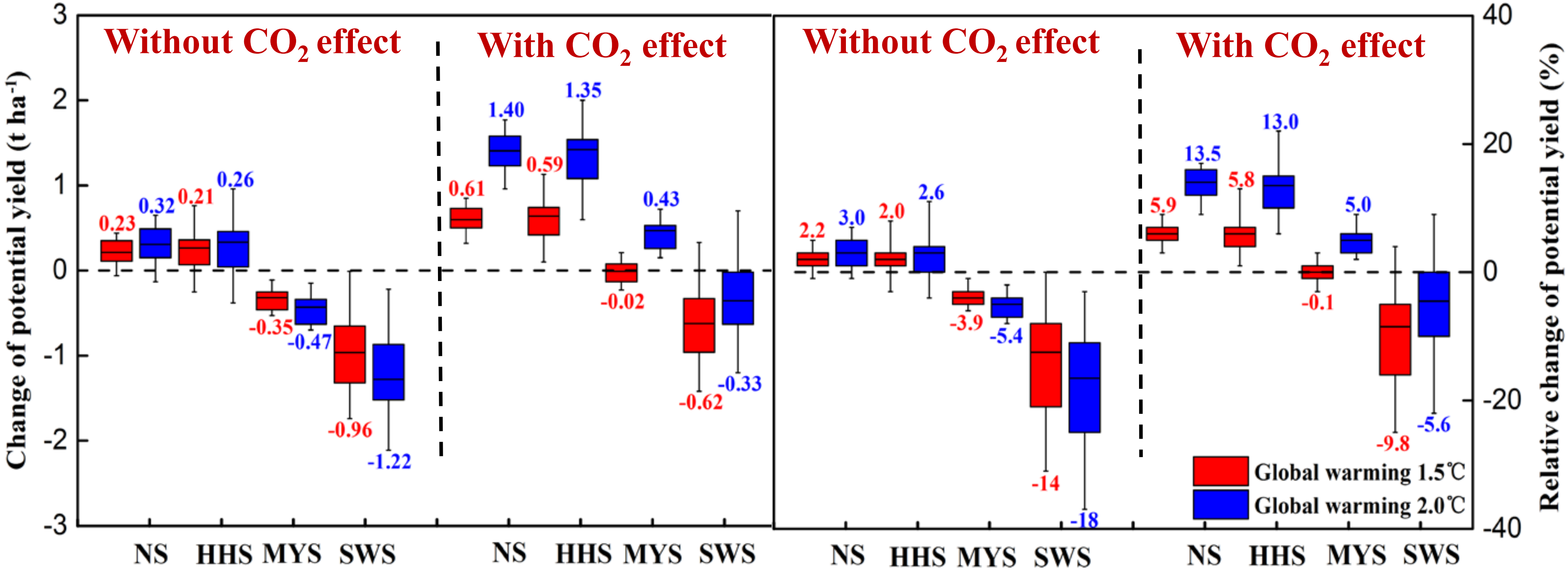
CO_2 487ppm



4. Model-based productivity estimation & impact evaluation

4.4 Assessing 1.5/2.0^{o}C global warming impacts on wheat production

Wheat production in different sub-regions in China (2 wheat models)

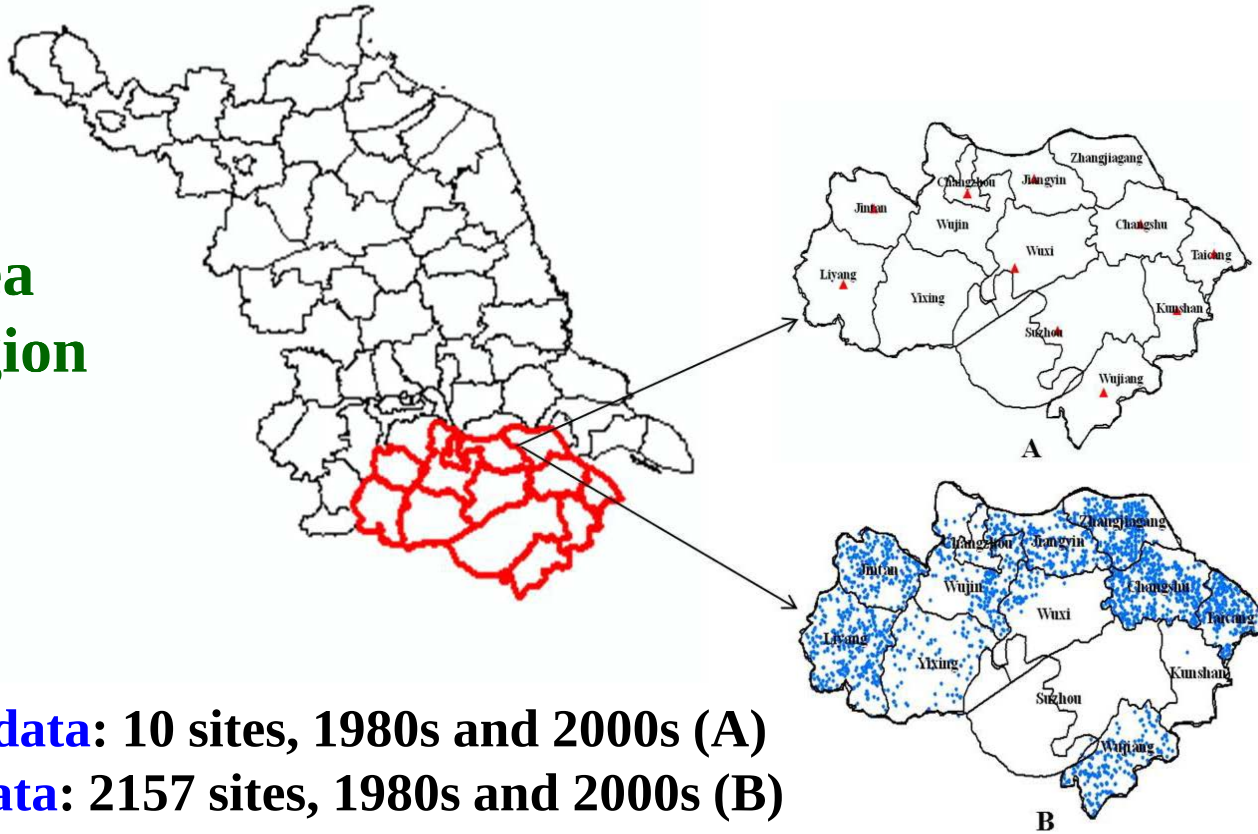


- 1.5/2.0^{o}C global warming was projected to increase wheat yields in two cool northern sub-regions, but decrease wheat yields in the two warm southern sub-regions.

4. Model-based productivity estimation & impact evaluation

4.5 Quantifying the impacts of climate change, soil improvement, variety updating and management

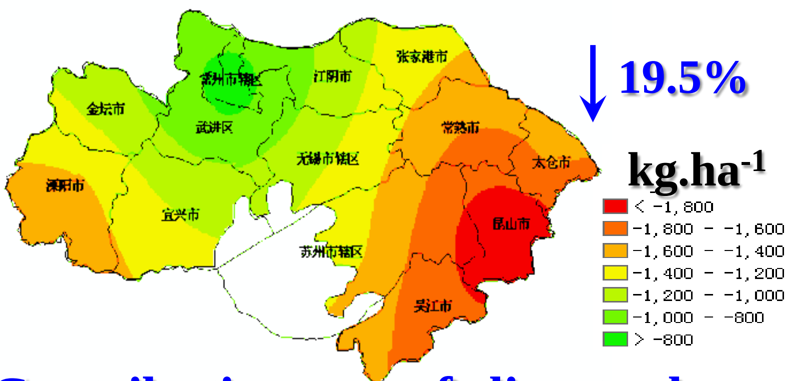
Study area
- Taihu Region



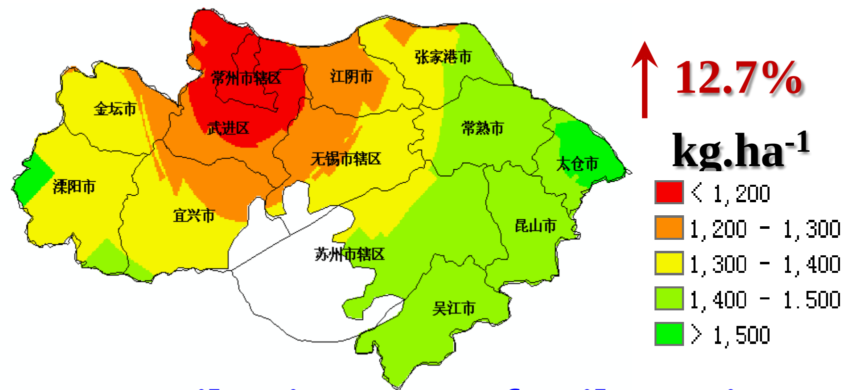
- **Meteorological data**: 10 sites, 1980s and 2000s (A)
- **Soil nutrients data**: 2157 sites, 1980s and 2000s (B)
- **Rice varieties**: Yanjing2 in 1980s and Nanjing44 in 2000s
- **Management practices**: representative in the 1980s and 2000s

Field Crops Research, 2013

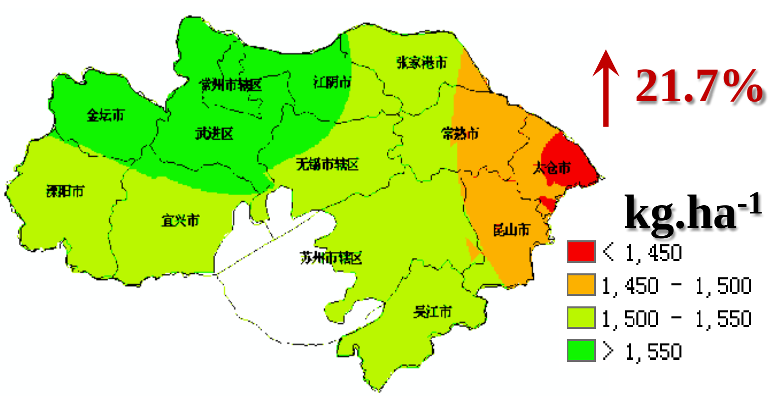
4.5 Quantifying the impacts of climate change, soil improvement, variety updating and management



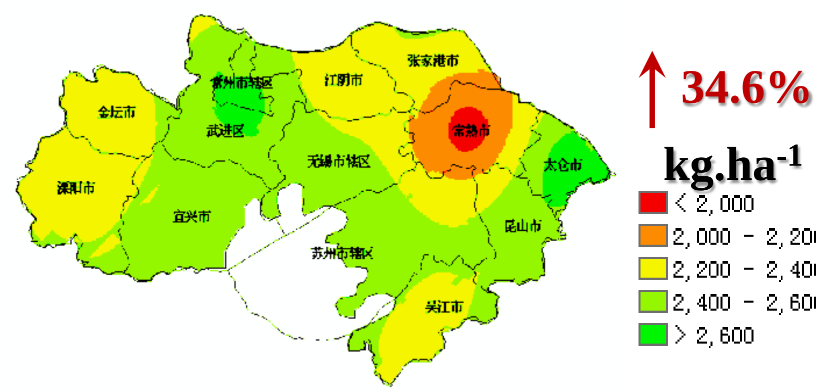
Contribution rate of climate change



Contribution rate of soil nutrients



Contribution rate of variety updating

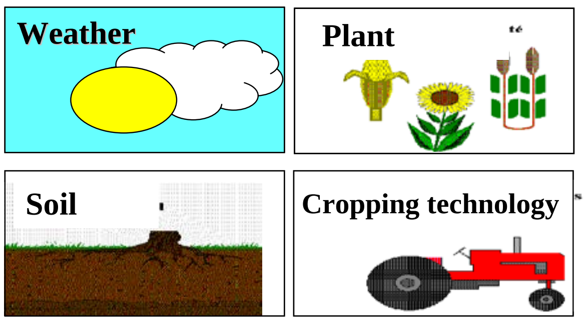


Contribution rate of management

Field Crops Research, 2013

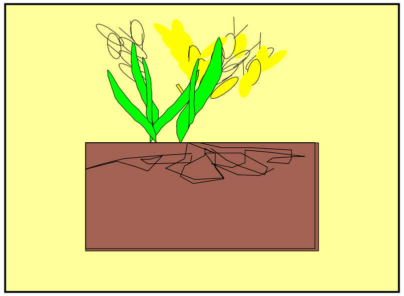
4.6 Designing the optimal strategy for high yield, superior quality and high efficiency crop production

Optimum combination



for

High yield, quality, efficiency

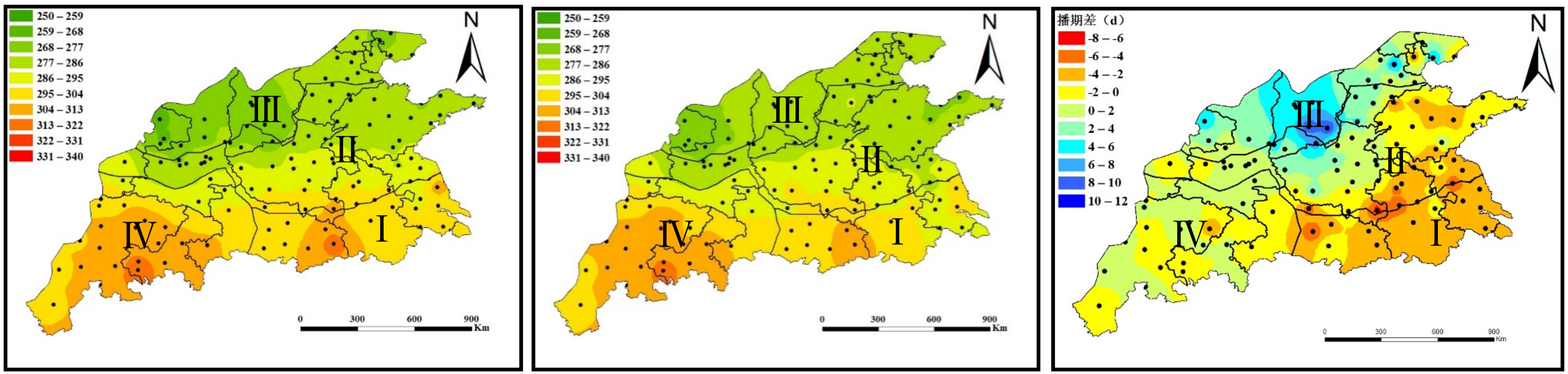


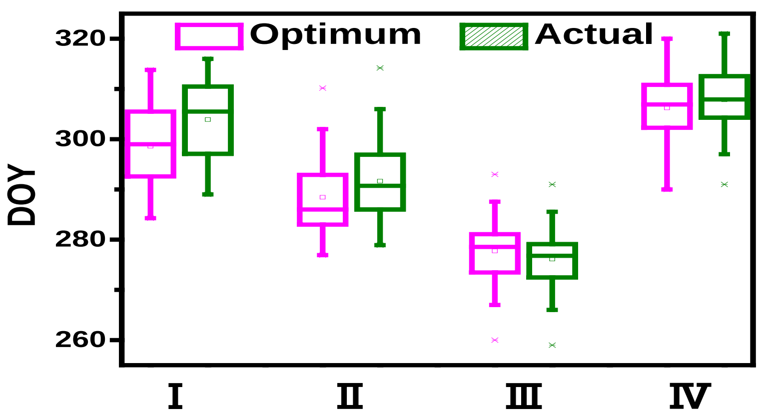
- ✓ **Cultivar**
  (yield, quality, resource use efficiency, stress resistance…)
- ✓ **Climate year**
  (cool, normal, hot; dry, wet; extreme climate…)
- ✓ **Soil characteristics**
  (good, normal, poor…)
- ✓ **Management strategy**
  (sowing date & rate, nutrient and water management…)

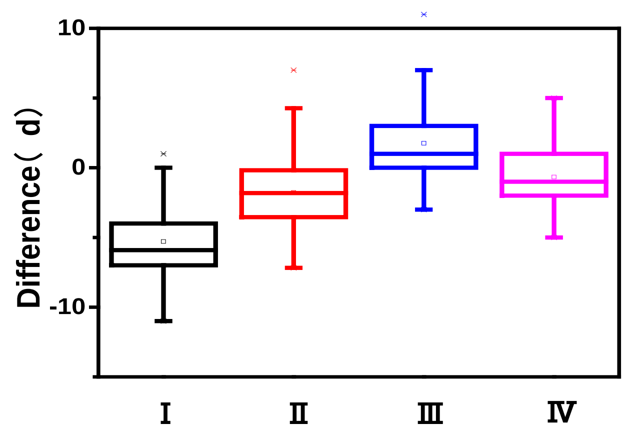
4. Model-based productivity estimation & impact evaluation

Optimal sowing date for winter wheat of China

Optimal | Actual | Difference



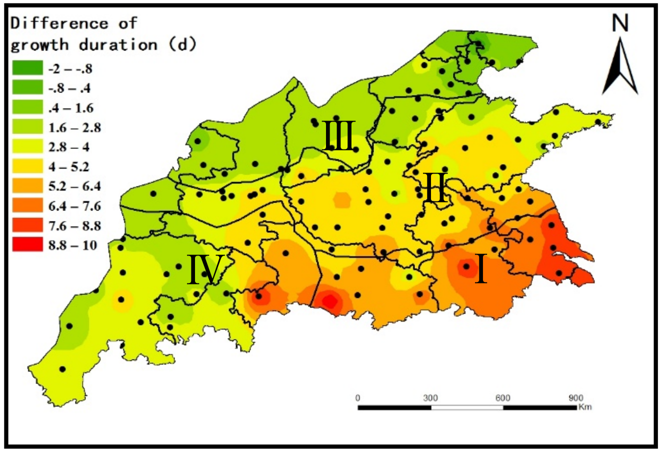


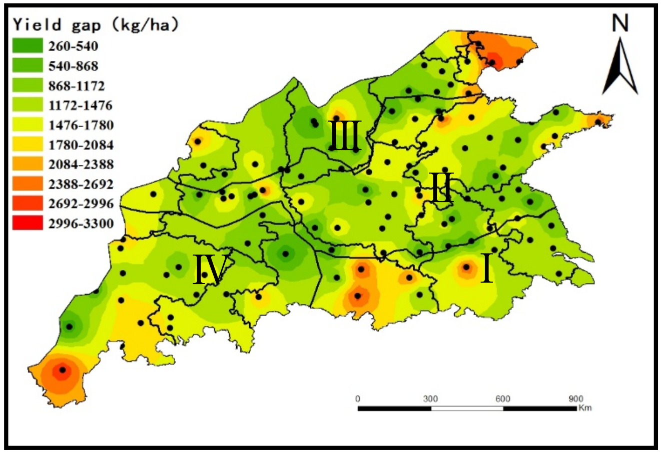


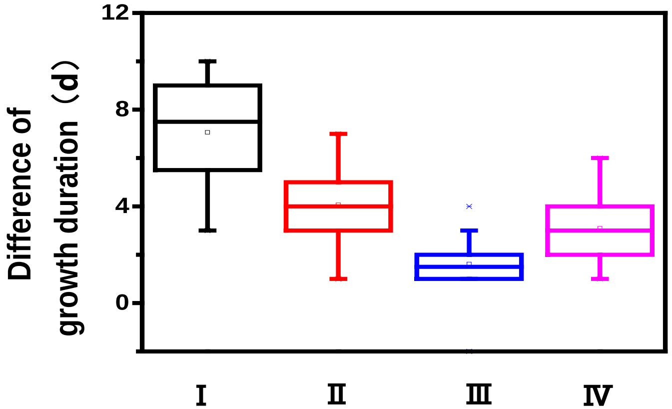
4. Model-based productivity estimation & impact evaluation

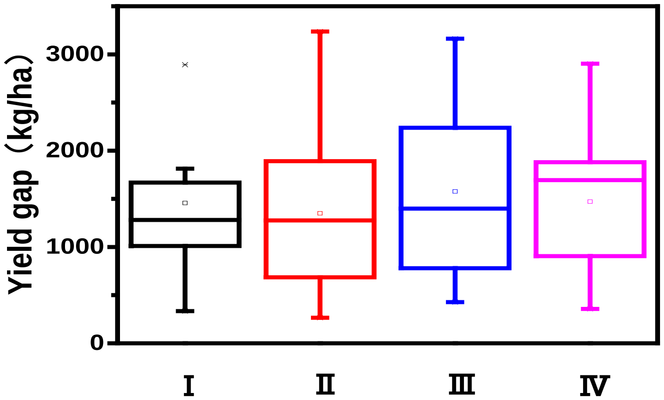
- Changes of growth duration and yield with optimal sowing date for winter wheat

Growth duration | **Yield**





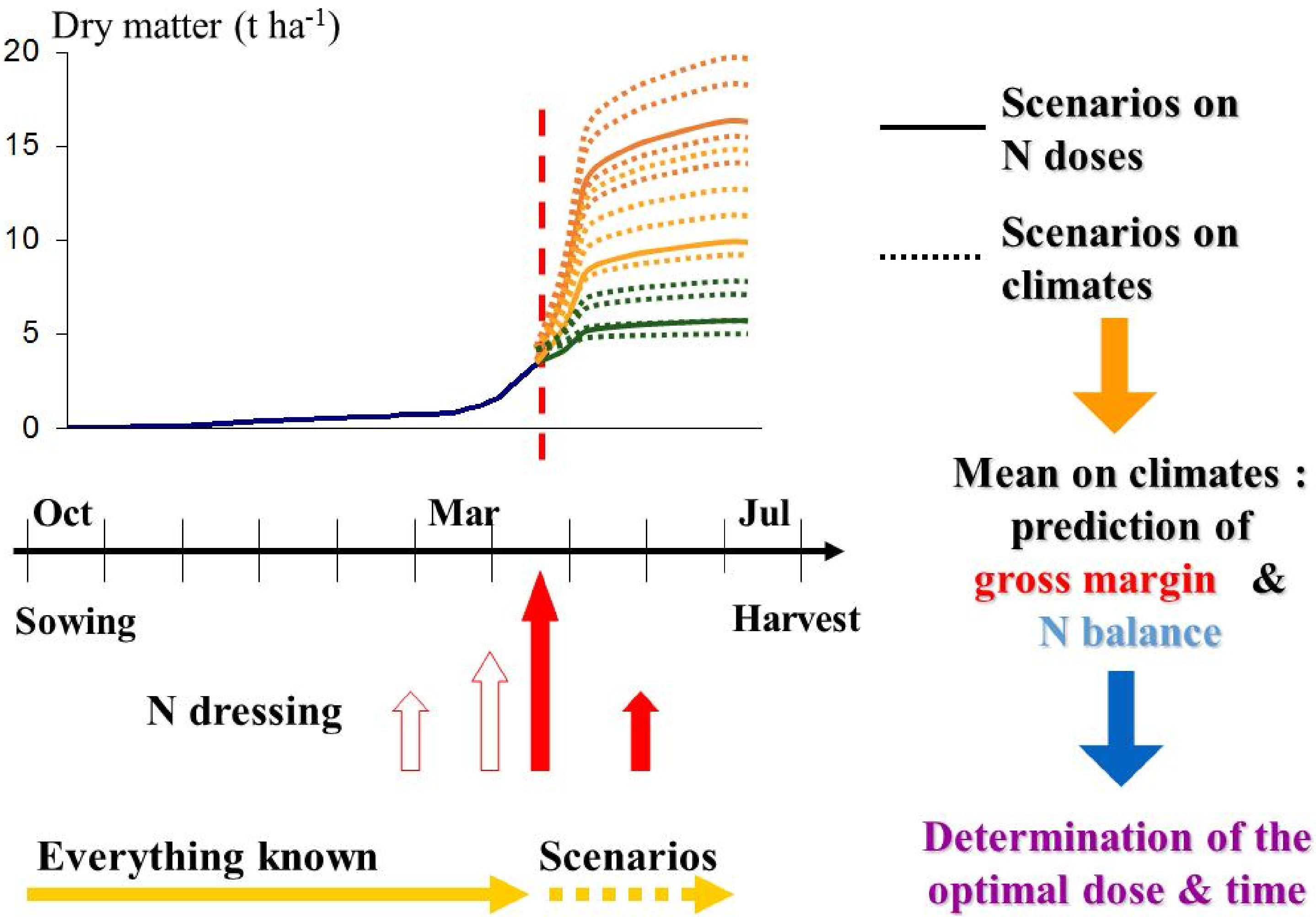




Differences of growth duration and yield between optimal and actual sowing dates

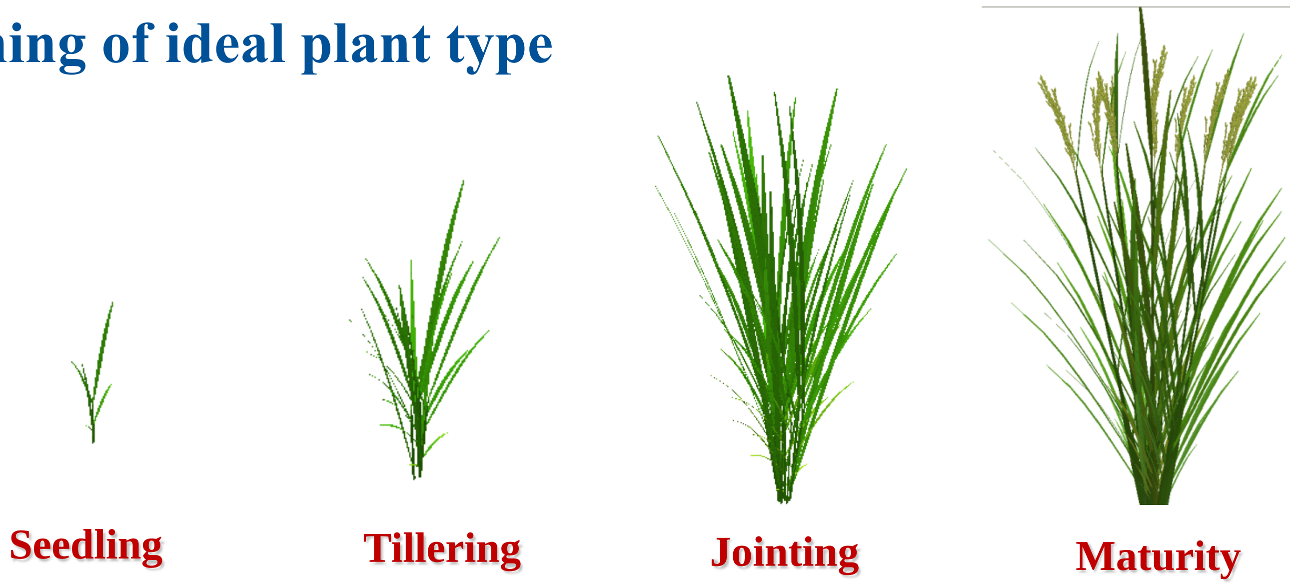
4. Model-based productivity estimation & impact evaluation

■ Designing of optimal nitrogen rate



4. Model-based productivity estimation & impact evaluation

- Designing of ideal plant type



Model–based virtualization of individual and population rice plant

- ➢ **Dynamic of 3D-structure**

↓

- ➢ **Canopy light penetration and interception**

↓

- ➢ **Biomass production and yield formation**

↓

- ➢ **Model-based design of ideal plant type for high yield**

5. Platform for crop productivity estimation & impact evaluation

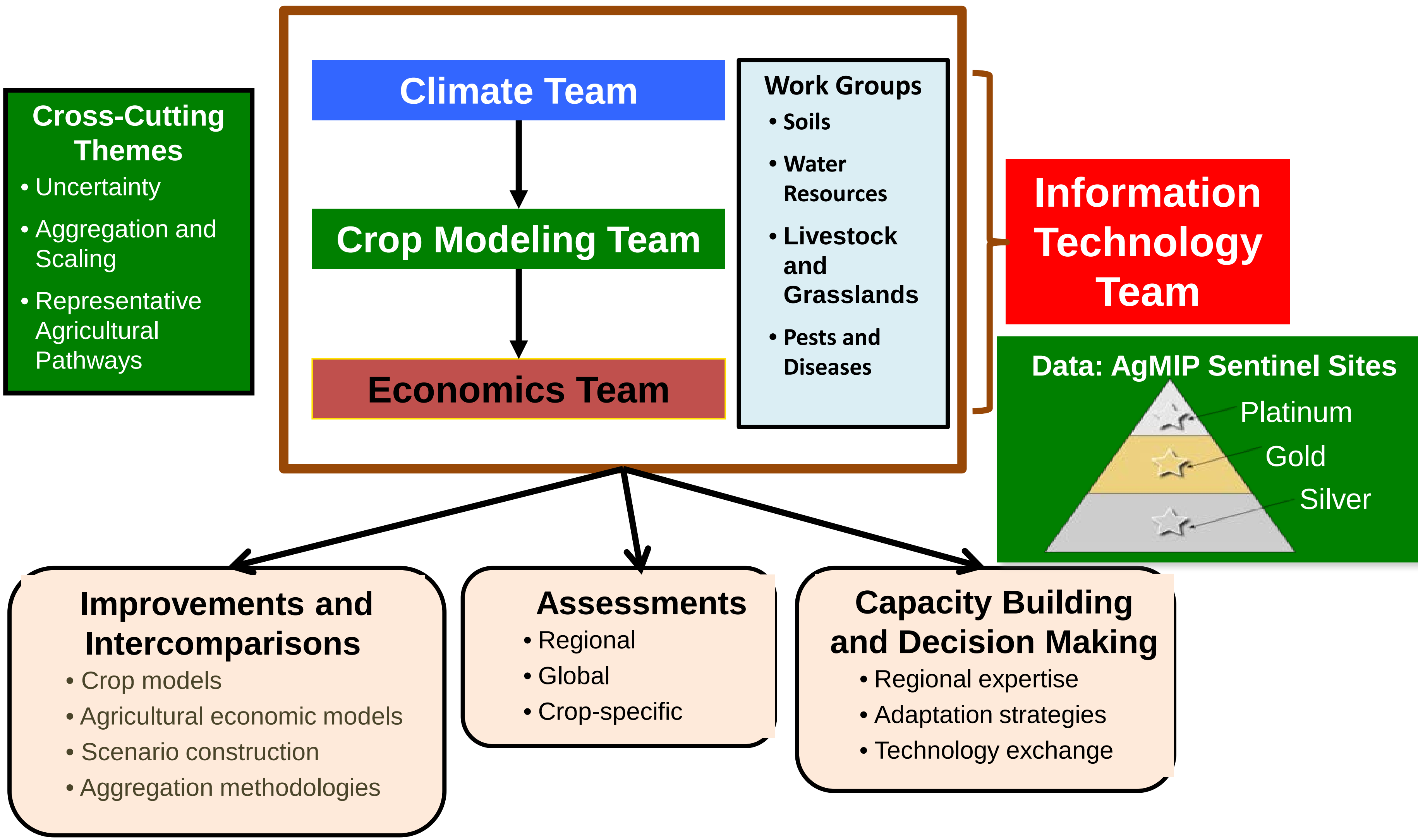
5.1 Developed a platform by integrating SM with RS and GIS for crop productivity estimation, impact evaluation, optimal strategy design, and 3D visualization.

Future Prospects

Experiment	☐ Experiments with single or multi-factor treatments **(Heat stress, Cold stress, Shading, Drought, Waterlogging et al.)**
Physiological Mechanism	☐ Response mechanisms of crop productivity under extreme climate scenarios
Simulation algorithms	☐ Dynamic characteristics of crop growth indices ☐ Simulation models suitable for future climate scenarios
Regional estimation	☐ Model-RS integration methods ☐ Model-based regional productivity estimation & evaluation platform
Impact evaluation	☐ Impacts of climate, variety, soil and management on regional productivity under historical and future climate ☐ Technical routes and adaptive strategies to improve productivity under future climate scenarios

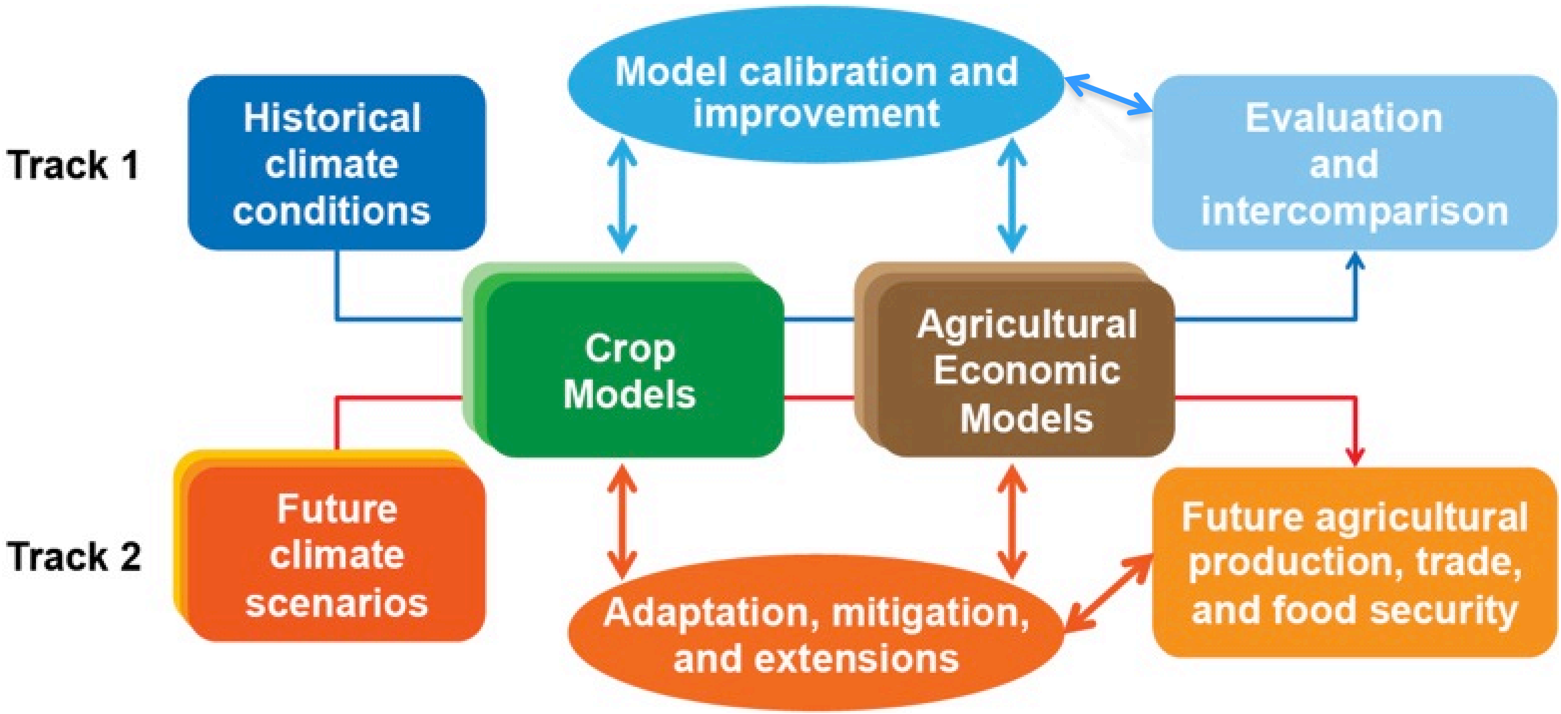
Estimation of food crop productivity and early warning of food security

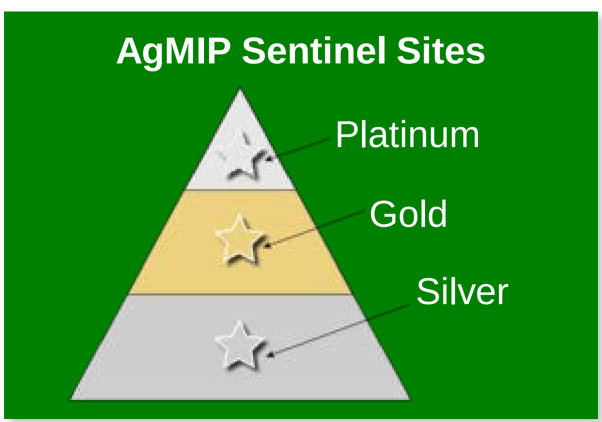
AgMIP Global Community of Science



Links to CCAFS, Global Yield Gap Atlas, Global Futures, etc.

Two-Track Science Goals





Track 1: Model Improvement and Intercomparison

Track 2: Climate Change Multi-Model Assessment

Regional and Global Scales

AgMIP Sentinel Data Sites

Rosenzweig et al., 2013 AgForMet

AgMIP: Global Community of Science

AgMIP — The Agricultural Model Intercomparison and Improvement Project

1st Global Oct 2010

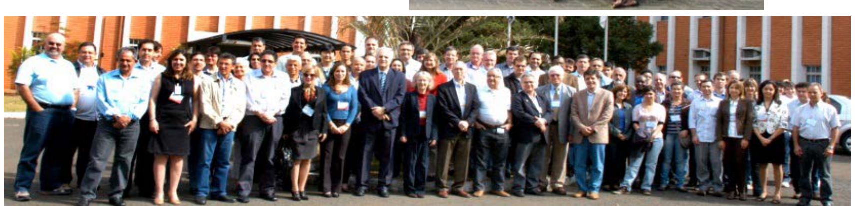
>650 members,
hundreds engaged in >31 AgMIP activities

2nd Global Oct 2011

3rd Global Oct 2012

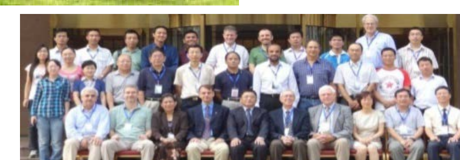
Sub-Saharan Africa

South Asia



South America

Maize



Rice

Wheat


Any questions?
National Engineering and Technology Center for
Information Agriculture of China (NETCIA)