Climate Change in Agriculture in China
-- Impacts and adaptation

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Observed climate changes from 1961-2007 in China

Climate element		SW China	Middle and Lower Yangtze River	South China	NW China	North China	NE China	China
Annual mean temperature	(℃)	**0.4**	**0.4**	**0.4**	**0.7**	**0.7**	**1.0**	**0.6**
	(%)							
Annual sunshine hours	(h)	**-93.9**	**-199.1**	**-159.1**	**-67.3**	**-174.3**	**-101.9**	**-125.7**
	(%)	-5.0	-10.3	-8.5	-2.3	-6.5	-3.8	-5.3
Annual precipitation	(mm)	-13.7	46.6	22.8	3.4	-41.4	5.0	3.1
	(%)	-1.4	3.7	1.4	1.3	-7.2	0.9	0.4
Annual reference crop evapotranspiration	(mm)	**-22.1**	**-34.5**	**-22.3**	**-30.9**	**-33.3**	**-11.6**	**-26.4**
	(%)	-2.2	-3.4	-1.9	-2.9	-3.2	-1.4	-2.6

Observed agro-climate changes from 1961-2007 in China

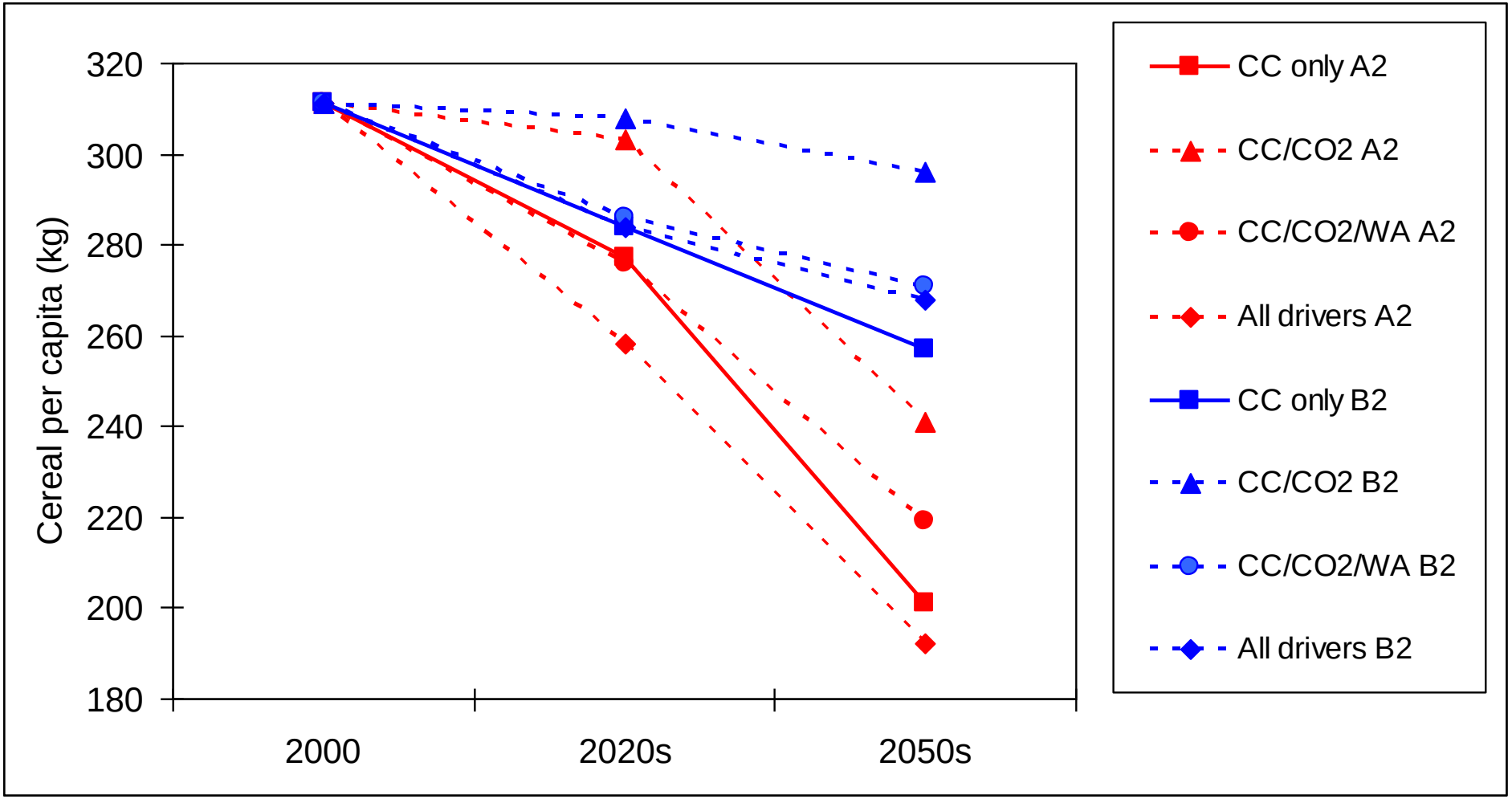
Agricultural climate element			SW China	Middle and lower Yangtze River	South China	NW China	North China	NE China	China
Item	During the period of daily temperature	Unit							
Accumulated temperature	≥0℃	(℃.d)	-	-	-	**120.0**	**118.1**	-	**123.3**
		(%)		-	-	3.7	2.9	-	3.5
	≥10℃	(℃.d)	**100.9**	**123.5**	**178.2**	**105.2**	**131.5**	**140.4**	**125.9**
		(%)	2.6	2.4	2.5	4.0	3.6	5.2	3.2
Precipitation	≥0℃	(mm)	-	-	-	**1.2**	**-33.9**	-	**-9.9**
		(%)	-	-	-	0.5	-7.4	-	-3.0
	≥10℃	(mm)	**-13.6**	**16.6**	**6.6**	**6.1**	**-30.3**	**7.7**	**-0.6**
		(%)	-1.6	1.6	0.4	4.0	-7.3	1.7	-0.1
Sunshine hours	≥0℃	(h)	-	-	-	**-3.1**	**-93.6**	-	**-32.2**
		(%)	-	-	-	-0.2	-4.9	-	-1.7
	≥10℃	(h)	**-46.9**	**-114.6**	**-115.5**	**-1.4**	**-69.4**	**-18.7**	**-53.6**
		(%)	-4.4	-8.1	-6.8	-0.1	-4.8	-1.6	-4.1
Reference crop evapotranspiration	≥0℃	(mm)	-	-	-	**-20.0**	**-15.9**	-	**-19.2**
		(%)	-	-	-	-2.2	-1.8	-	-2.1
	≥10℃	(mm)	**-6.5**	**-21.6**	**-9.4**	**-13.0**	**-8.0**	**2.4**	**-10.7**
		(%)	-0.9	-2.6	-0.9	-1.9	-1.1	0.6	-1.4

The most popularly used projected climate scenario is from PRECIS RCM provided by Hadley, and climate change impacts on crops yield is estimated by using CERES under A2 and B2. The outputs are as in table.

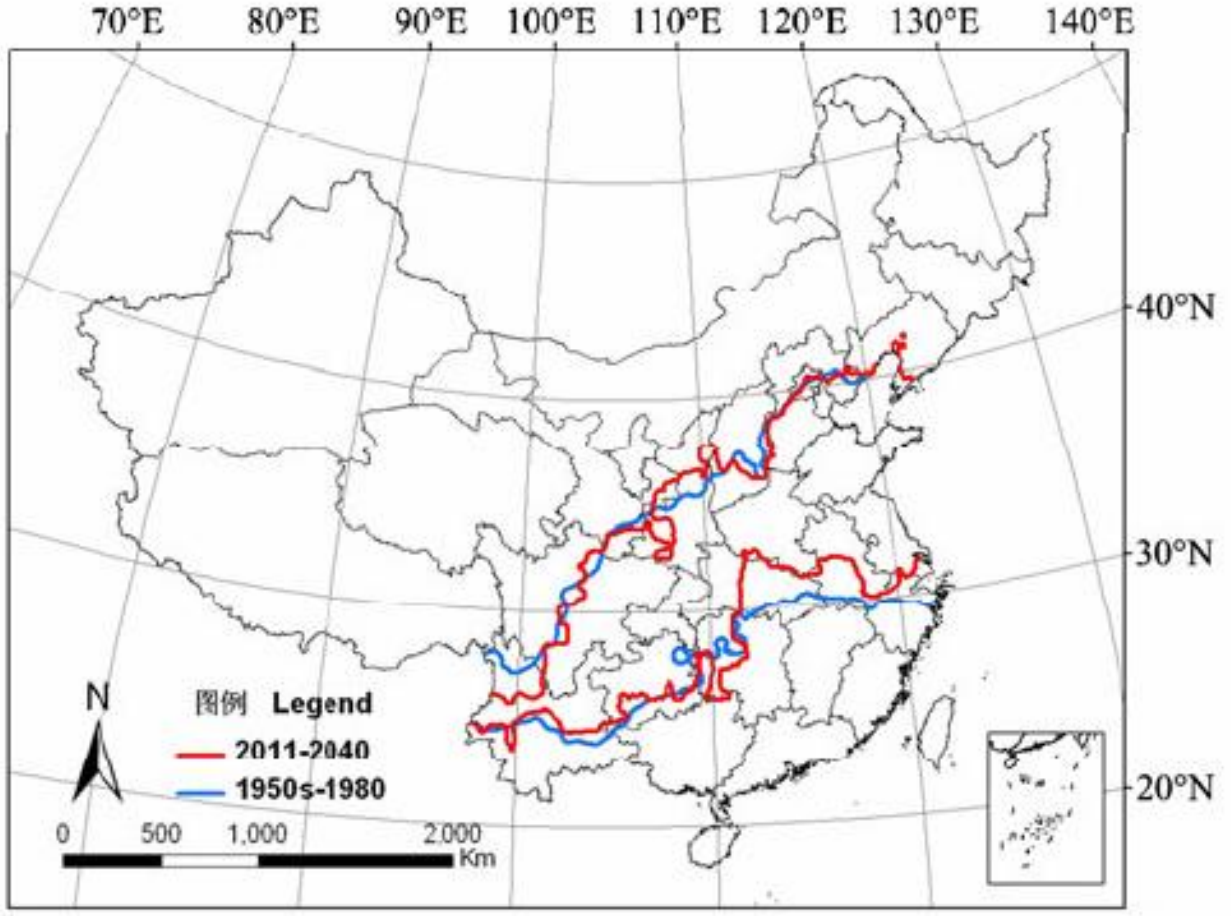
		Rice yiled / %			Wheat yield / %			Maize yield / %		
		2020s	2050s	2080s	2020s	2050s	2080s	2020s	2050s	2080s
A2	No CO2	- 12 9	- 13 6	- 28 6	- 18 5	- 20 4	- 21. 7	- 10. 3	- 22 8	- 36 4
	CO2	2 1	3 4	4 3	15 4	20 0	23 6	9. 8	18 4	20 3
	Irrigation	- 8 9	- 12 4	- 16 8	- 5 6	- 6 7	- 8 9	- 5 3	- 11. 9	- 14 4
B2	No CO2	- 5 3	- 8 5	- 15 7	- 10 2	- 11. 4	- 12 9	- 11. 3	- 14 5	- 26 9
	CO2	0 2	- 0 9	- 2 5	4 5	6 6	12 7	1. 1	8 5	10 4
	Irrigation	- 1. 1	- 4 3	- 12 4	- 0 5	- 2 2	- 8 4	0. 2	- 0 4	- 3 8

时间	温度升高/℃	降水增加/%	CO_2/ppm v*	人口/亿	GDP/万亿
A2(中-高排放情景)					
2020s(2011—2040)	1.4	3.3	440	16.0	20.5
2050s(2041—2070)	2.6	7.0	559	20.9	60.2
2080s(2071—2100)	3.9	12.9	721	22.6	131
B2(中-低排放情景)					
	温度升高/℃	降水增加/%	CO_2/ppm v*	人口/亿	GDP/万亿
2020s(2011—2040)	0.9	3.7	429	14.3	37.4
2050s(2041—2070)	1.5	7.0	492	15.5	141
2080s(2071—2100)	2.0	10.2	561	15.8	226

Changes in cereal production per capita under combinations of drivers



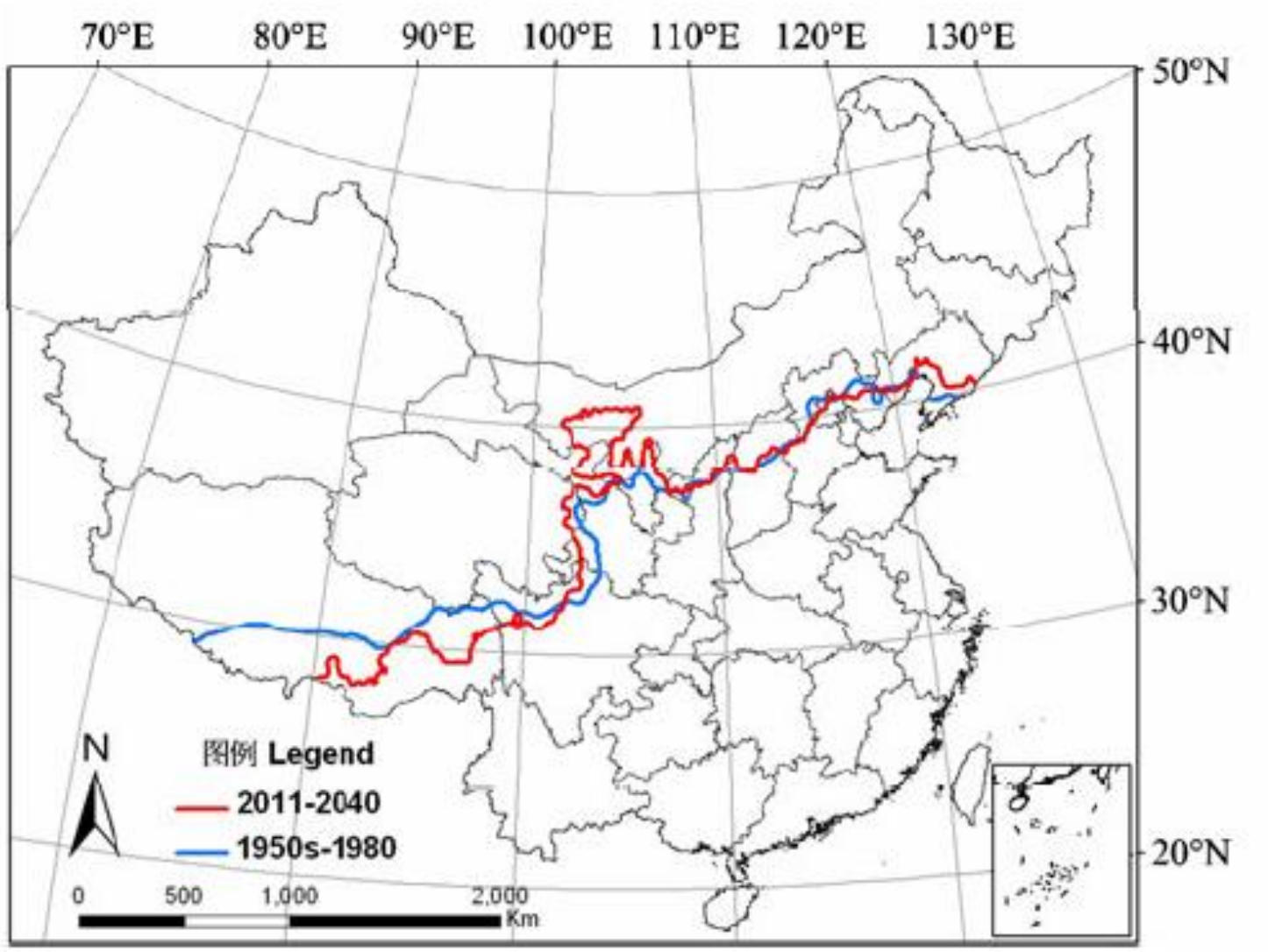
Changes in cropping system:Single cropping area reduce by 23.1%. Triple cropping area increase from 13.5% to 36%



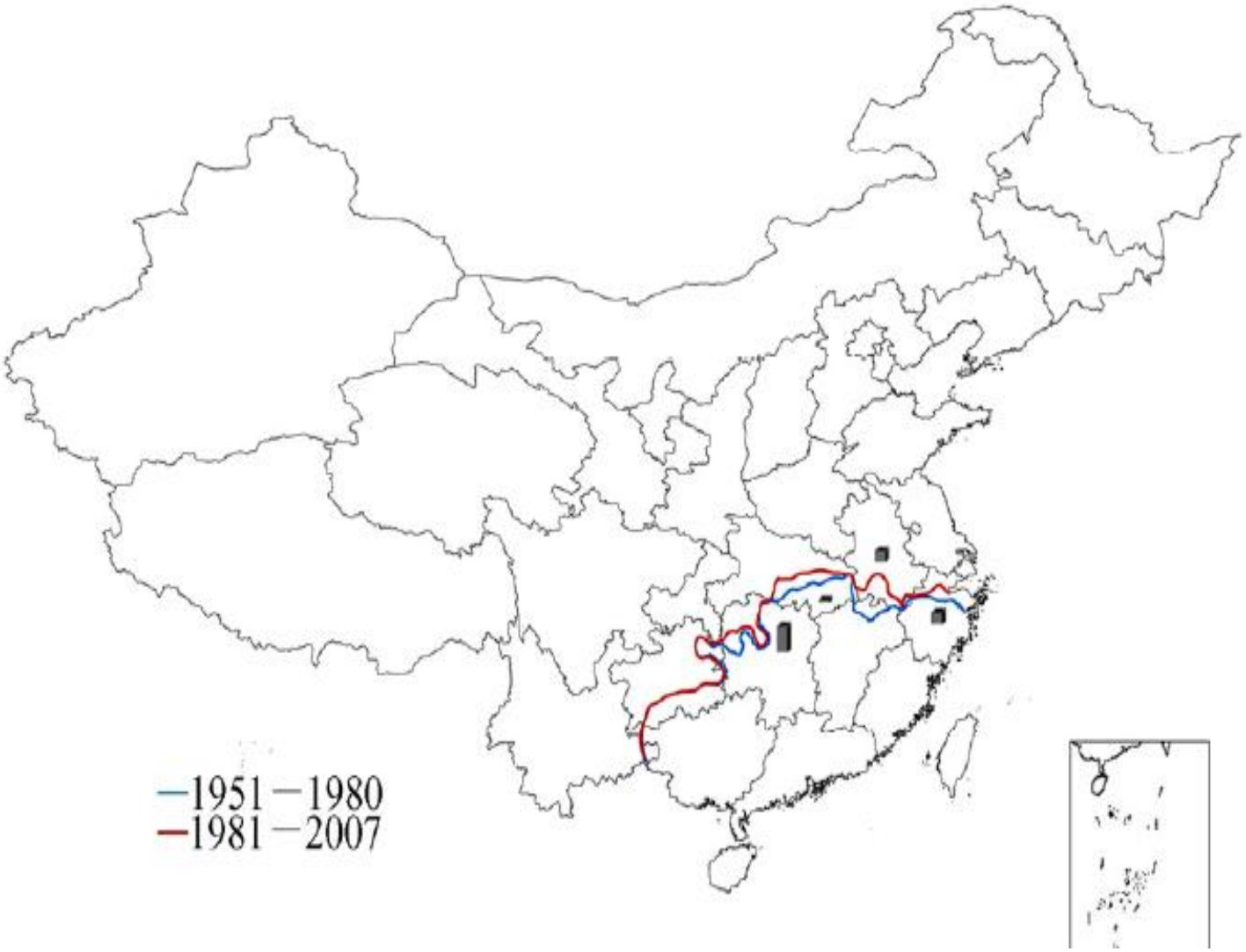
Indicators for the zero-grade zone

Cropping system	≥0℃ accumulated temperature (℃·d)	Extreme minimum temperature (℃)	Terminate date of 20℃
One crop a year	<4000—4200	<-20	Early August-Early September
Two crops a year	>4000—4200	>-20	Early September-Beginning in late September
Three crops a year	>5900—6100	>-20	Beginning in late September-Early November

The change of northern limits of winter wheat under climate scenarios in China



The change of northern limits of double rice under climate scenarios in China

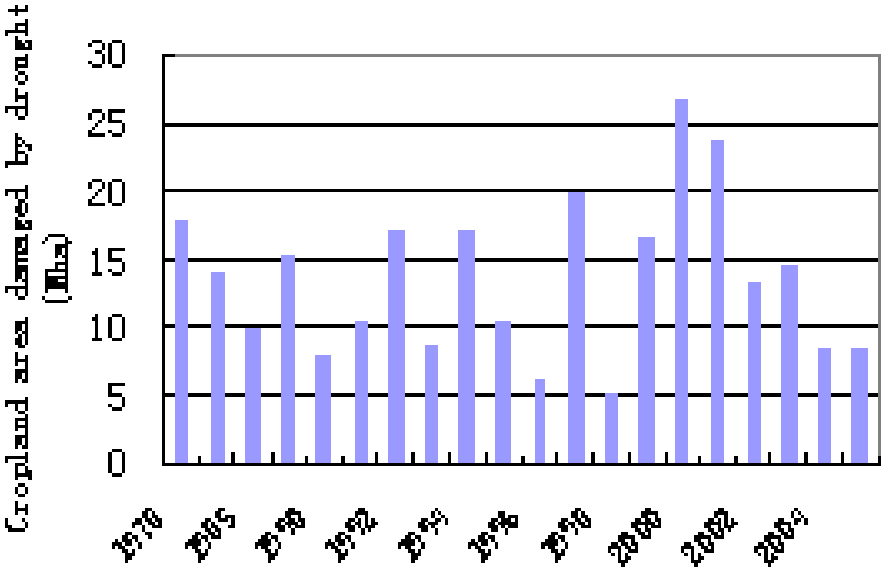


Trends in basin-average annual and seasonal precipitation (normalized) over 10 major river watersheds in China from 1956-2002

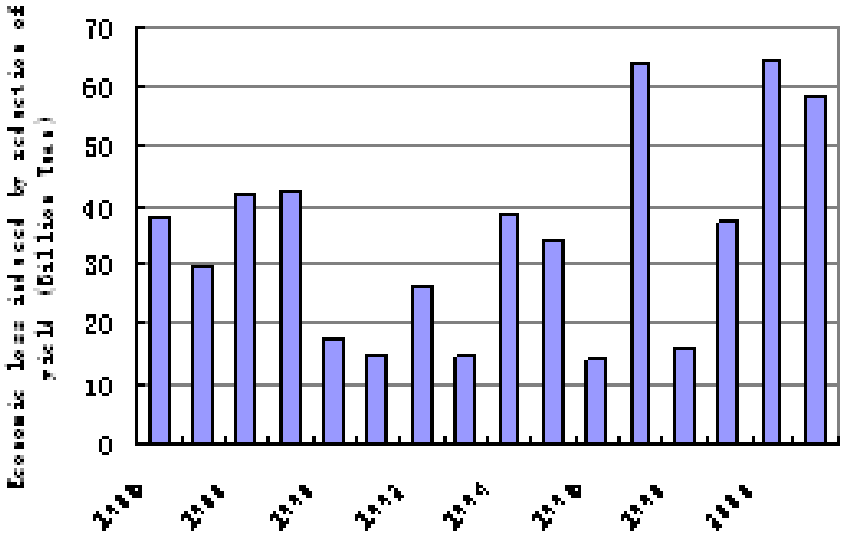
Watershed	Winter	Spring	Summer	Fall	Yearly
Songhuajiang River	-0.08	-0.01	-0.03	-0.11	-0.06
Liaohe River	-0.09	0.03	-0.12	-0.12	-0.15*
Haihe River	-0.07	0.01	-0.16*	-0.08	-0.17*
Huaihe River	0.07	-0.07	-0.11*	-0.13	-0.14*
Yellow River	0.02	-0.05	-0.10	-0.11	-0.14*
Yangtze River	0.06	-0.03	0.06	-0.04	0.03
Rivers in Southeast region	0.07	0.00	0.19**	-0.09	0.11
Rivers in Northwest Region	-0.02	0.03	0.08*	0.07	0.10*
Rivers in Southwest Region	0.05	0.15**	-0.02	0.09*	0.09**
Pearl River	0.08	0.04	0.05	-0.02	0.08
China	0.01	0.01	0.02	-0.02	0.01

Note: ** and * stand for the test passing at 0.01 level and 0.05 level, respectively.

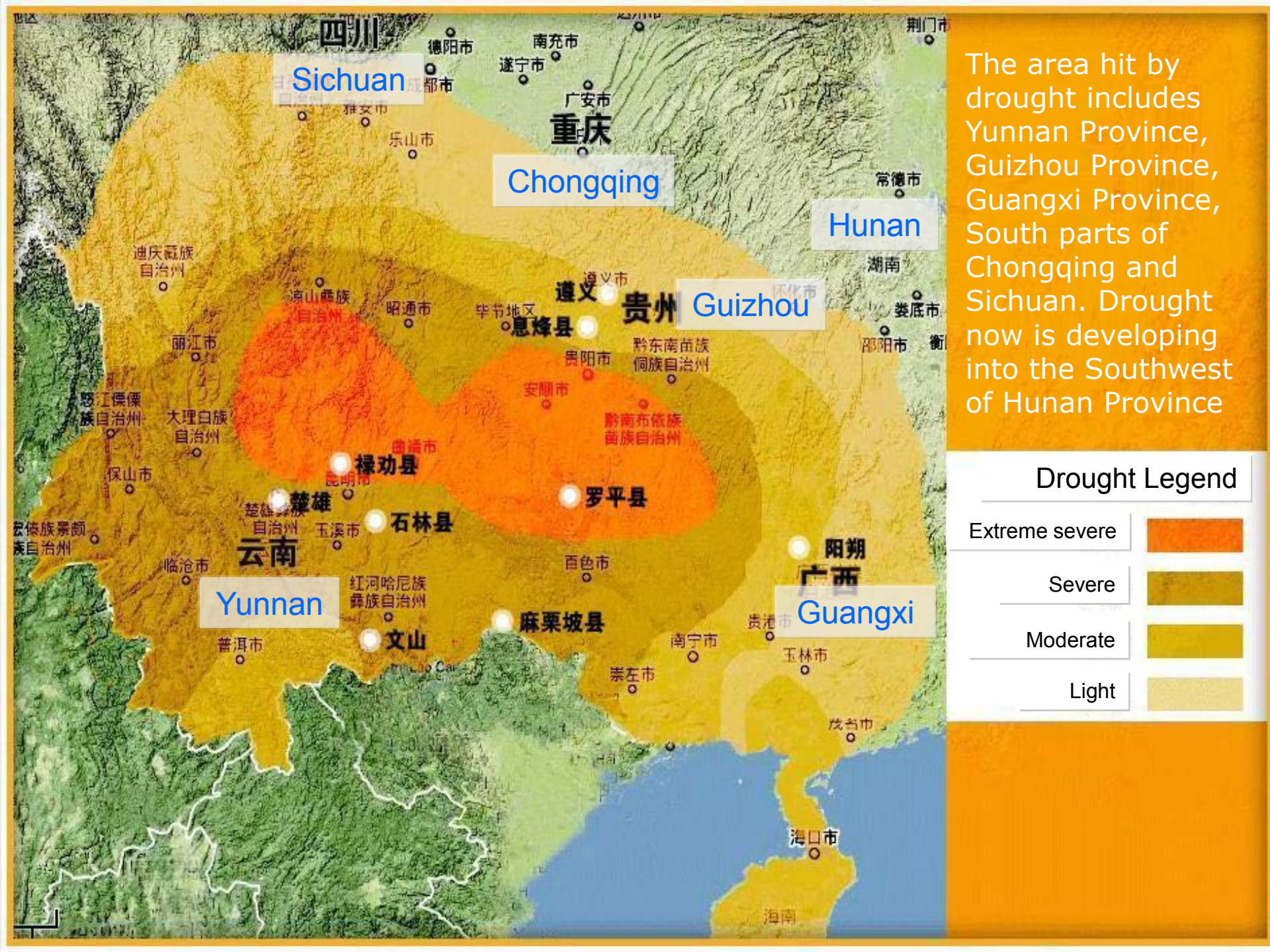
Top damage from droughts. The area affected by droughts reached 13.9 million ha/yr (1978-2004). Since the 1990s, losses caused by droughts have risen to 28.2 million tons, with economic losses of 34.5 million Yuan RMB.

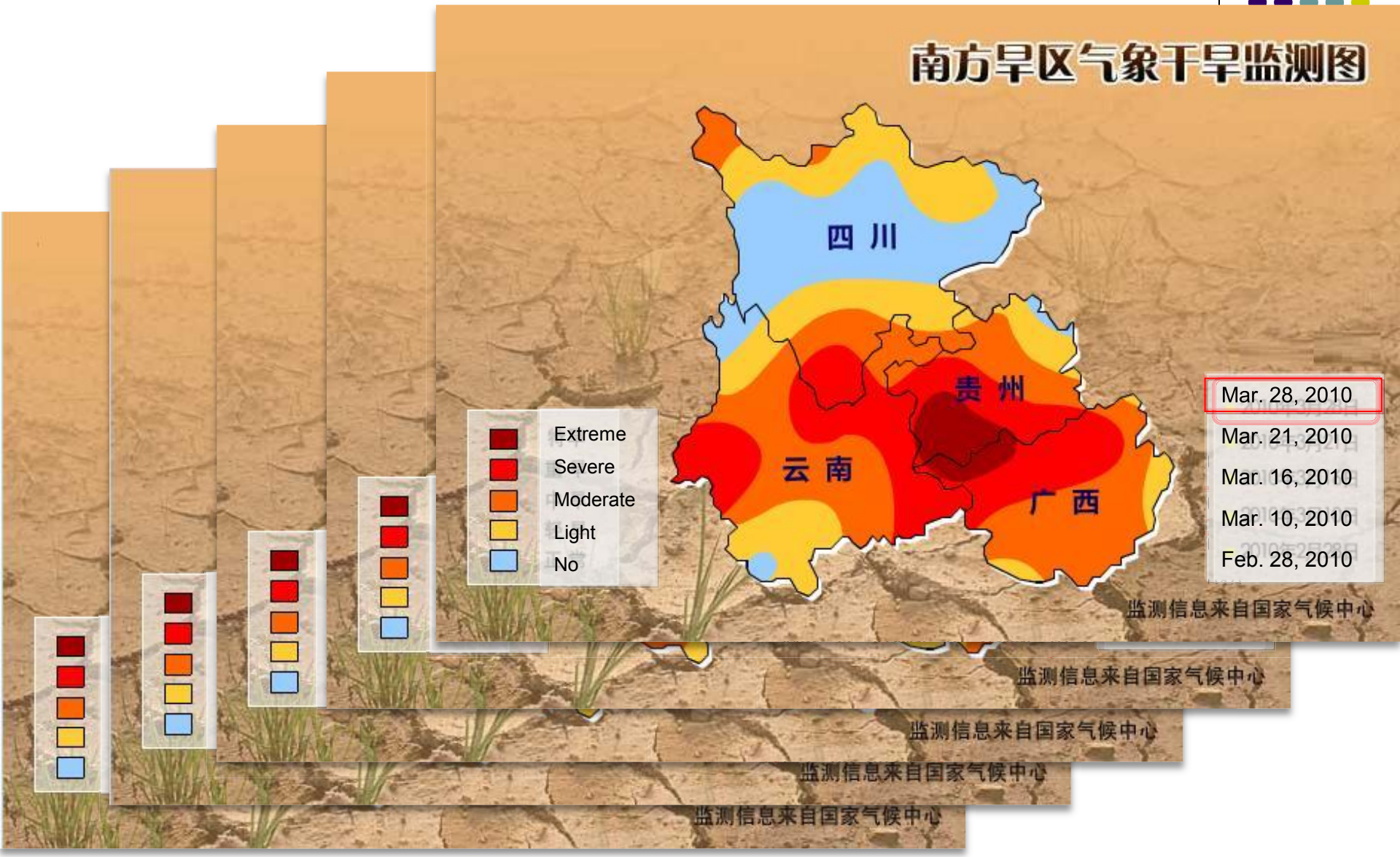


Cropland area damaged by drought in China

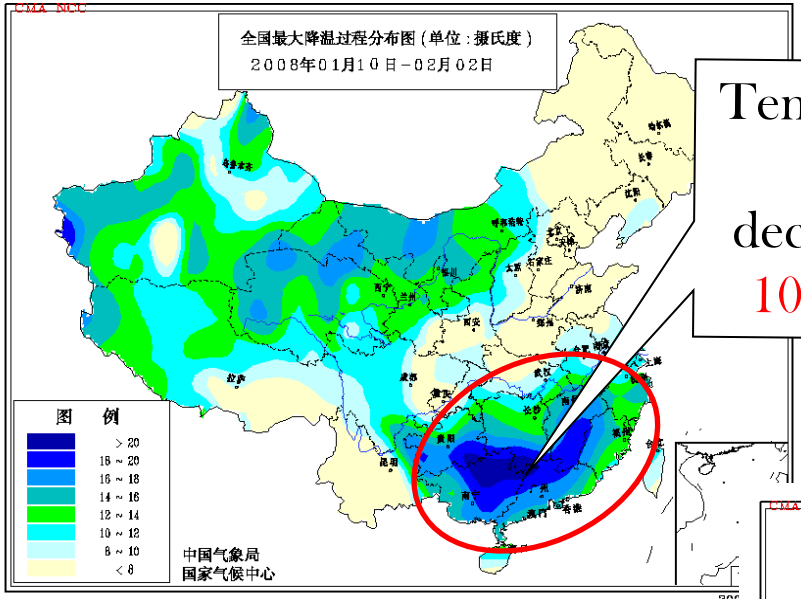


Economic losses from reduced grain production due to drought during the period 1986 to 2001

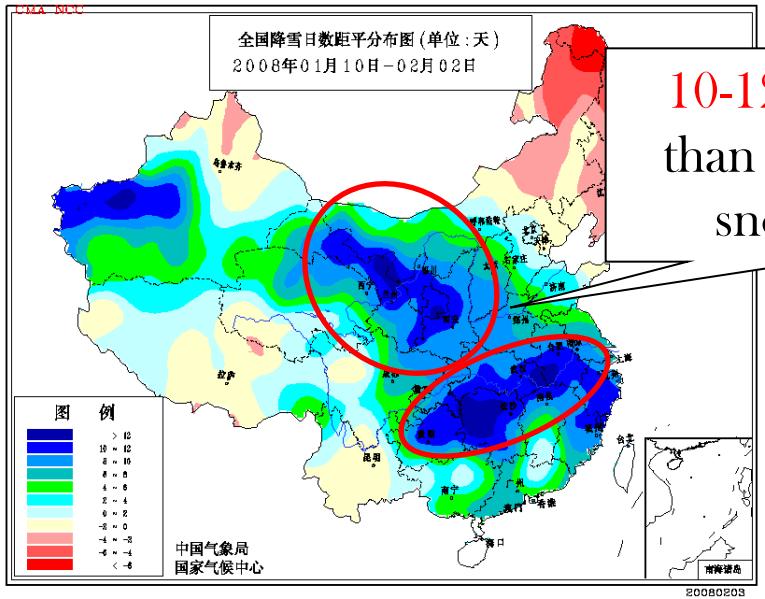

Sichuan
Chongqing
Hunan
Guizhou
Yunnan
Guangxi
四川
重庆
贵州
云南
广西
湖南
遵义
贵阳市
息烽县
罗平县
石林县
禄劝县
麻栗坡县
文山
昆明市
南宁市
海口市
The area hit by drought includes Yunnan Province, Guizhou Province, Guangxi Province, South parts of Chongqing and Sichuan. Drought now is developing into the Southwest of Hunan Province
Drought Legend
Extreme severe
Severe
Moderate
Light


南方旱区气象干旱监测图
四 川
贵 州
云 南
广 西
Extreme
Severe
Moderate
Light
No
Mar. 28, 2010
Mar. 21, 2010
Mar. 16, 2010
Mar. 10, 2010
Feb. 28, 2010
监测信息来自国家气候中心

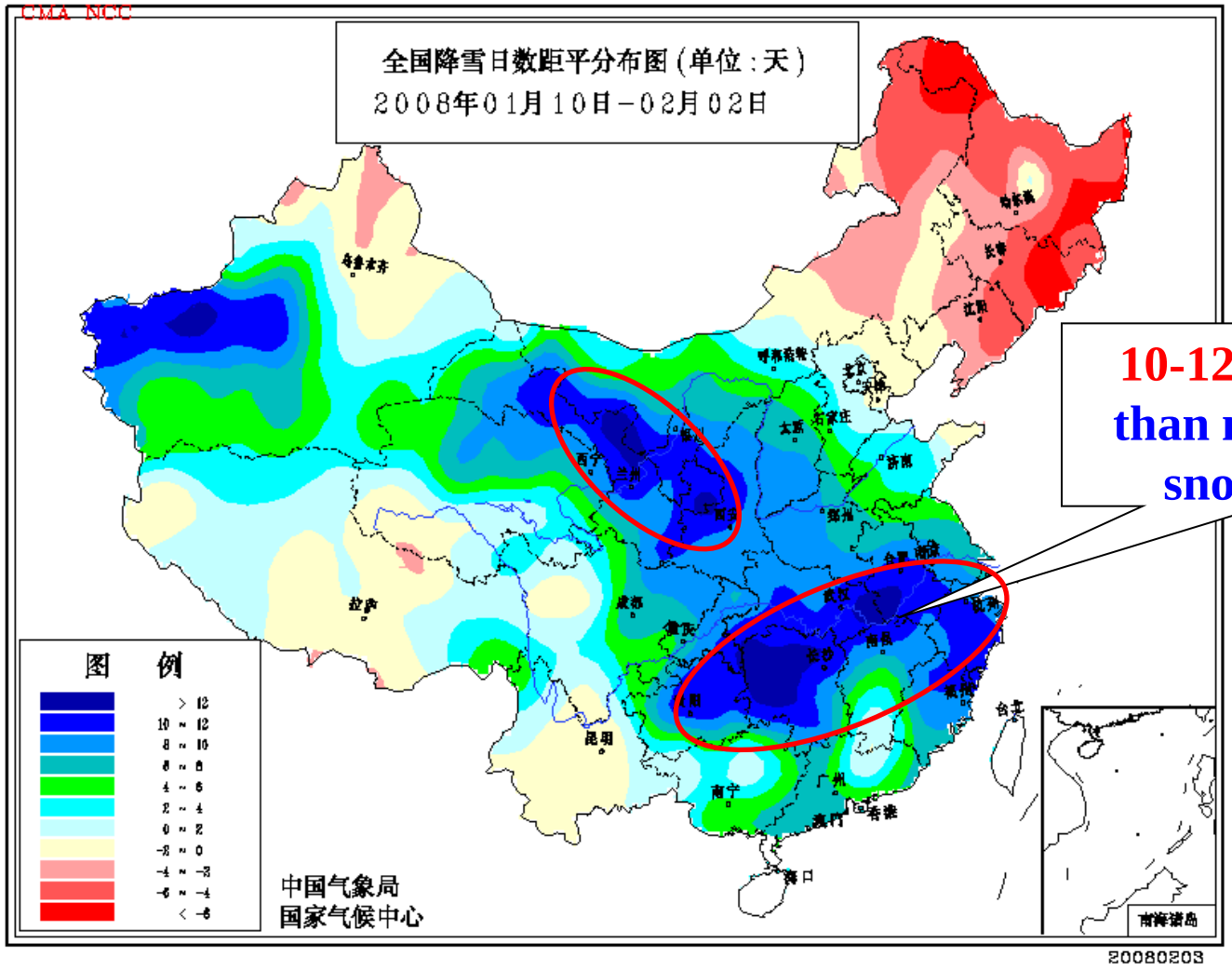
2008 south china snow storm and freezing rain, dramatic temperature decrease from Jan.10 to Feb.2



Temperature decreased 10-20℃



10-12 days longer than mean annual snowing days

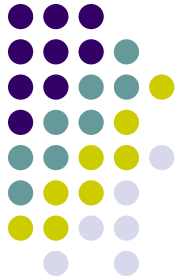


10-12 days longer than mean annual snowing days


cnsphoto

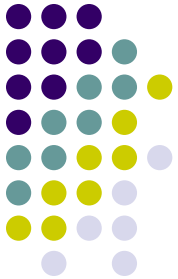

XINHUANET

The most widely used adaptation strategies in agriculture



- Water saving techniques in agriculture,
- Sustainable management of water resources,
- Limitation of underground water exploitation,
- Application of agricultural machine to short the planting and harvest period so that to increase the use of soil water and precipitation.
- Changing planting date to avoid high temperature and dry season
- Choosing of high temperature tolerance crop species

Financing Options



MOA, MOST, SPC, BOF etc. provide financial support to the research on climate change impacts. A special funding is arranged by MOST in National Basic Research Program (973 Program) for the study of climate change impacts on agriculture.

The influence of global change on vulnerability and adaptivity of major terrestrial ecosystems in China

- Funded by The National basic research program (also called 973 program).
- Launched in 2011;
- Aimed testing the sensitivity of rice, wheat, corn, to temperature and CO2 fertilization.

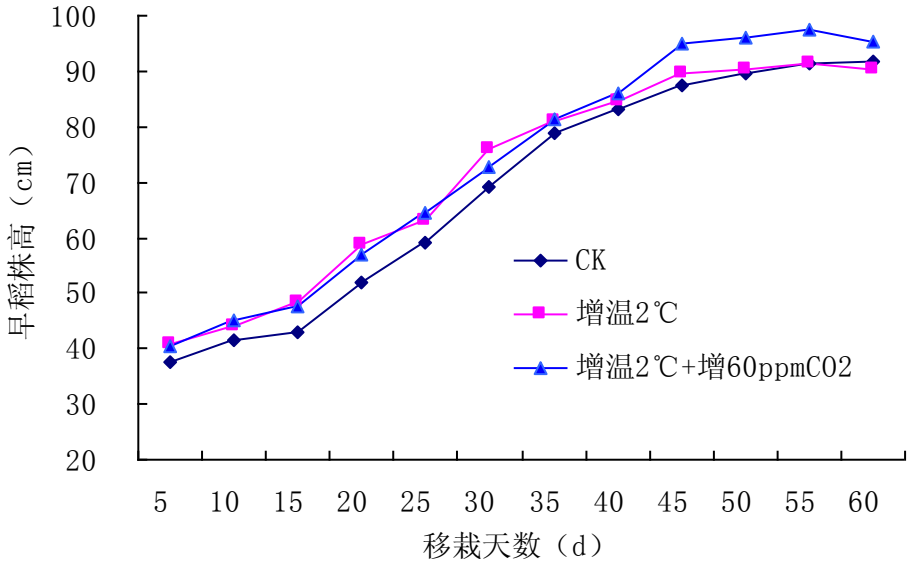
3 replicates * 3 treatment

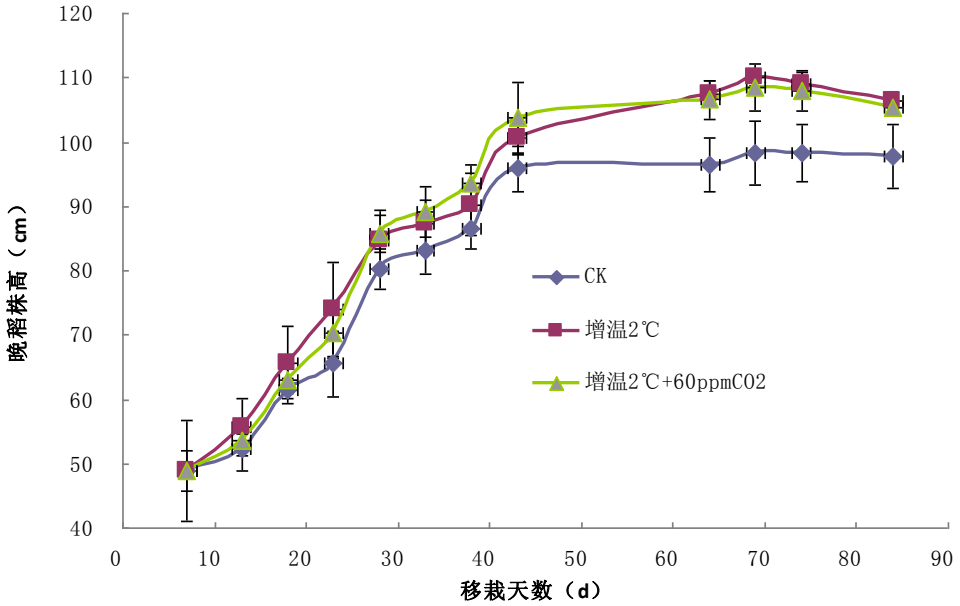
1) CK

2) + 2℃;

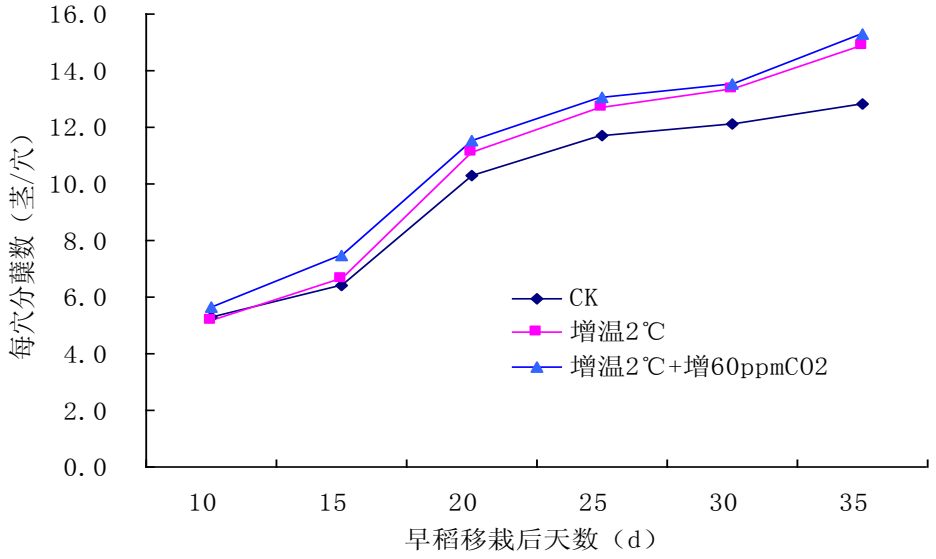
3) +2 ℃/+60ppmCO_2

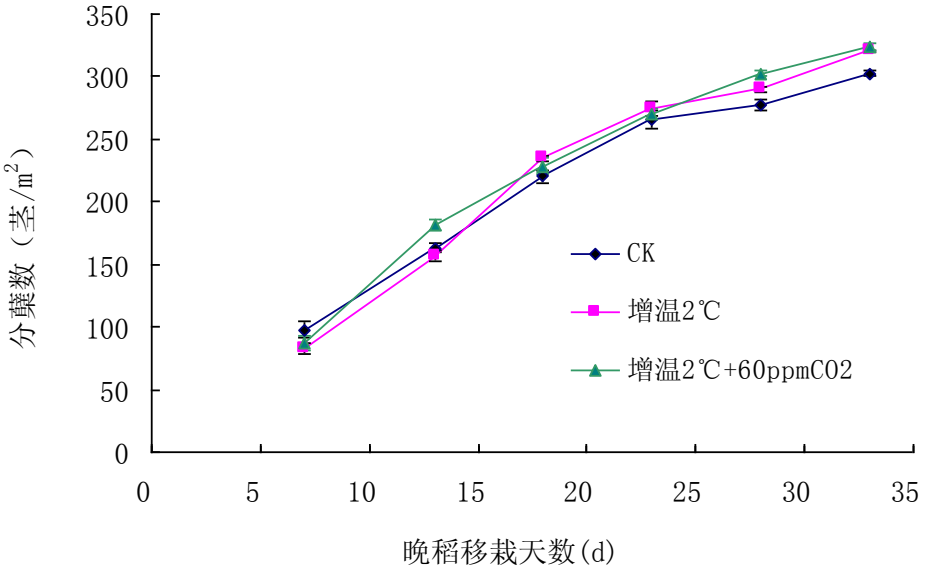

OTC控制与监视系统:
21#箱体/02:
11#箱体/04:
21#箱体/06:
大田数据/10:
12#箱体/05:
22#箱体/07:
32#箱体/03:
00#箱体/11(15):
23#箱体/08:
33#箱体/01(16):
13#箱体/09:
测试
工作
研制单位:
日期/时间
2011-05-27 20:17:52
星期
系统已运行



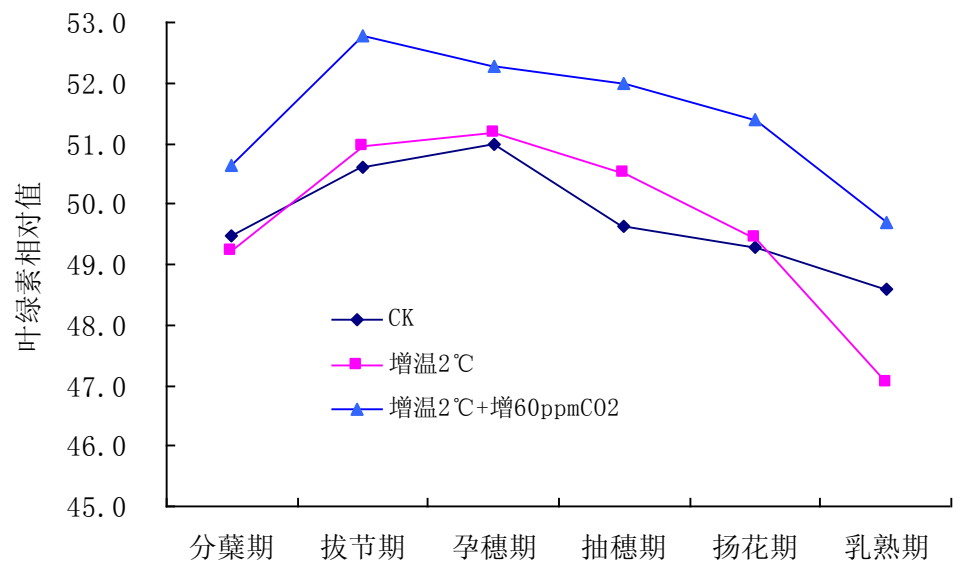


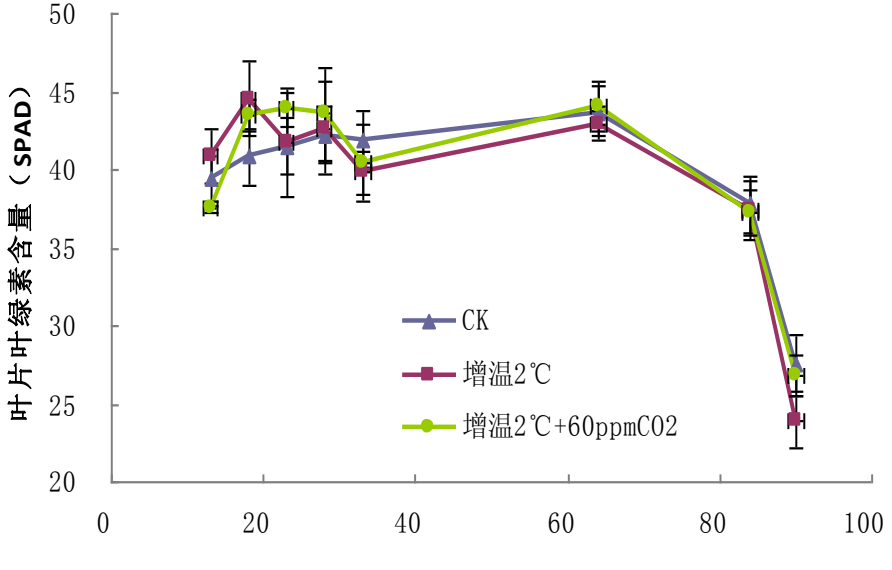
growth days and height (left, early rice; right, late rice)



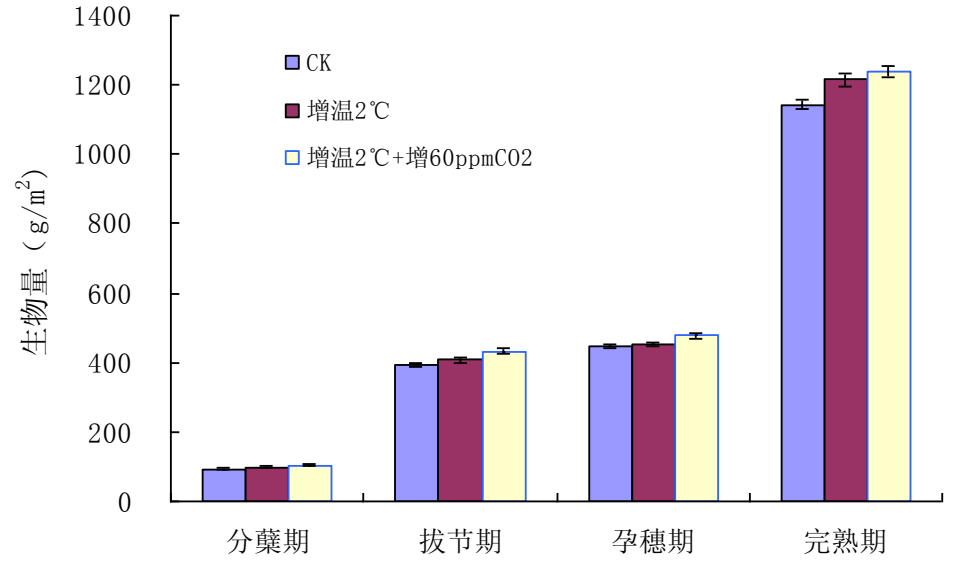


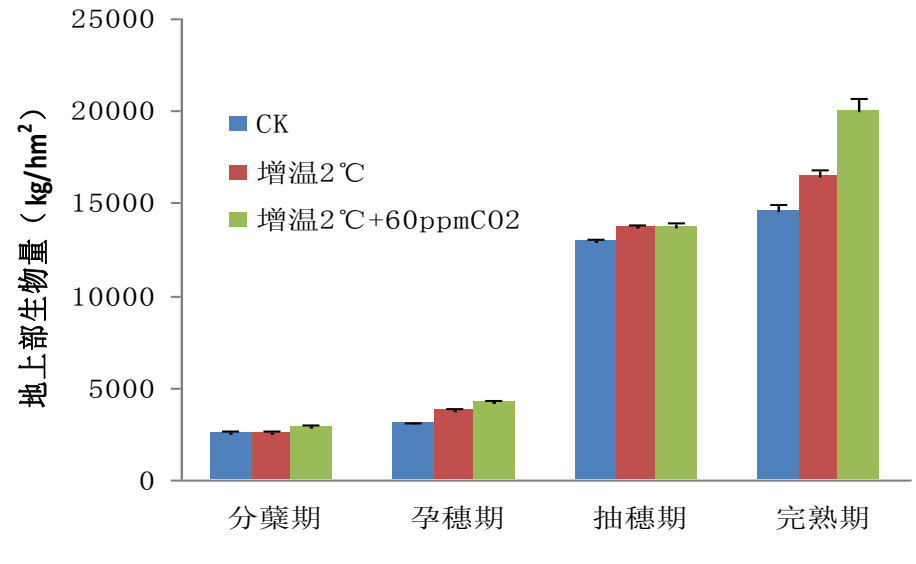
growth days and number of tillers (left, early rice; right, late rice)





growth days and chlorophyll content (left, early rice; right, late rice)





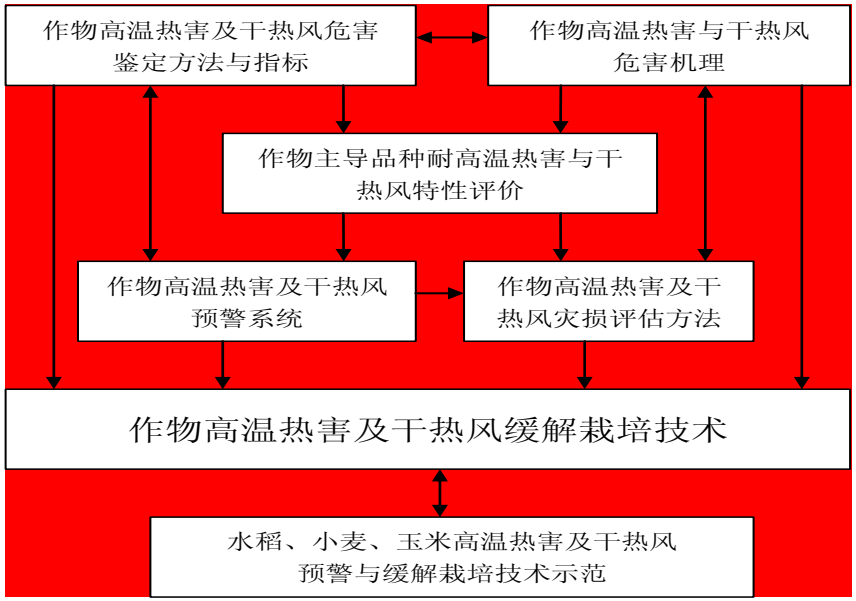
growth days and biomass (left, early rice; right, late rice)

Yield properties

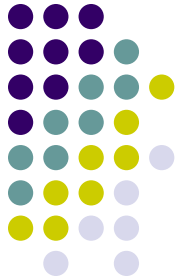
	Early Rice			Late Rice		
	CK	+2℃	+2℃+ 60ppmCO_2	CK	+2℃	+2℃ +60ppmCO_2
Tillers	12.7	13.9	13.7	16.1	15.7	18.8
Spike rate (%)	95.8	95.7	97.1	85.8	95.3	95.2
Grains per spike	131.2	142.4	138.7	193.0	202.4	201.7
Empty husks rate (%)	4.7	11.8	9.3	23.8	21.5	24.4
Spike length (cm)	21.4	21.9	22.3	26.2	27.3	26.8
1000-seed weight (g)	22.2	23.0	22.6	22.3	22.1	22.3
Yield (kg/hm2)	6697.2	7585	7477.9	8243.4	9530	11072.9

Forecast and mitigation techniques to high temperature damage to rice, wheat and corn in China (2012 to 2015)

The purposes are: to identify the high temperature tolerance species of three crops, totally, 1000 species will be identified, of which, 350 species of rice, 430 species of wheat and 220 species of corn; and to set up a warning system of heat wave for winter wheat and of high temperature for rice and corn.



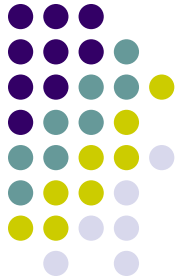
Capacity building



The central government of China had arranged the budget to enhance the capacities especially in water resources development especially in key food production base. The total budget is 4000 billions RMB Yuan (approximately 630 billions US Dollar at current exchange rate) in 10 years.

Summary

- Focused on agricultural capacity building to adapt to climate change impacts.
- Adapting the climate change from top-down both in policy and institutional arrangement, i.e. from central government to local government then to farmers. In practice, governments in each level, research organization, and farmers involved in
- Focused on increase of water use efficiency by water resources management and application of machines.



Thank you

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