

Impact of Climate Change on Cotton Temperature Suitability in China

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Overview of Presentation

- Introduction to the Research of Background
- Establishment and Test of Cotton temperature Suitability Model
- Discussion and Analysis
- Conclusions

Research Background

- Recently 20 years, the crop climate suitability is one of kernel problems of the agricultural meteorology and agricultural ecology field.
- Cotton is an important economic crop in China and sensitive to temperature change.
- It is important to study the change of temperature suitability under climate change scenario, which can provide effective measures to guide agricultural activities.

Research Approach

- Data Sources

- Temperature grid maps
- Observational data of cotton in the field
- Statistic data of cotton production

Research Approach

- Establishment of temperature suitability model

→ as follows,


$$S(T) = [(T-T_1)(T_2-T) B] / [(T_0-T_1)(T_2-T_0) B]$$

Of which, $B = (T_2 - T_0) / (T_0 - T_1)$

Where T is average temperature, T_1 , T_2 and T_0 respectively refers to the bottom, the upper and the optimal temperature. $S(T)$ is temperature suitability, an irregularity parabola ranged from 0 to 1, especially, When $T = T_1$ or $T = T_2$, $S(T) = 0$ while $S(T) = 1$, when $T = T_0$

Research Approach

Table 1 Temperature parameters of different growth stages of cotton

growth stage (day/month)	T ₁ ()	T ₀ ()	T ₂ ()
seeding stage (10/4—30/4)	11	26	35
sprouting stage (1/5—20/6)	15	26	35
flower bud stage (21/6—10/7)	19	28	35
flowering stage (11/7—10/9)	15	26	35
boll opening (11/9—30/10)	11	26	32

Research Approach

Table 2 Test of temperature suitability model of cotton

Province	correlation coefficient	Significant Level
Liaoning	0.813	0.05
Zhejiang	0.758	0.01
Sichuan	0.851	0.05
Xinjiang	0.685	0.05
Hubei	0.883	0.05
Gansu	0.826	0.01
Guizhou	0.799	0.01
Shandong	0.892	0.01
Yunnan	0.754	0.05

- Test of temperature suitability model

← as left,

Using polynomial measure to divide cotton output into two parts, social output and climate output.

Calculating the correlation coefficients between the temperature suitability and the climate output of cotton

Research Approach

- Calculating methods based on grid map

Arcview and *Arcmap* software were employed to spatial analysis

→ *Arcview*

Got temperature suitability value of cotton of the grid map with algebra function

→ *Arcmap*

Got total temperature suitability each year with statistical function

Discussion and Analysis

- Temperature change scenario in the future
 - Ocean-atmosphere coupled model (IAPCGCM) used in this paper showed some capacity of simulating average climate in different region.
 - With its simulating results of temperature change under the scenarios of CO₂ doubled in different regions, mean temperature changes of ten days in cotton growing period in China were obtained, using interpolating.

Discussion and Analysis

Table 3 Mean temperature changes in cotton growing period in China under the scenario of CO₂ doubled

d/mon-d/mon	northeast	north	south	northwest	Inner Mongolia	middle	southwest	Tibet
10/4-20/4	3.9	3.4	1.2	3.2	3.6	2.5	2.1	3.3
20/4-30/4	3.5	3.4	1.1	3.25	3.5	2.55	2.15	3.6
1/5-10/5	3.1	3.4	1	3.29	3.4	2.6	2.1	3.9
10/5-20/5	2.8	3.4	1	3.3	3.2	2.7	2.2	4.2
20/5-30/5	2.45	3.5	1	3.34	3.15	2.9	2.4	4.25
1/6-10/6	2.19	3.6	1	3.7	3.1	3.1	3	4.35
10/6-20/6	2	3.7	1	3.4	3	3.2	3.6	4.5
20/6-30/6	2.2	4	-0.1	3.6	3.25	3	3.5	4.8
1/7-10/7	2.5	4.4	-1	3.8	4	2	3.4	5.5
10/7-20/7	3	4.7	-1.8	4	4.6	1.1	3.3	6
20/7-30/7	3.1	4.4	-1.6	4.2	4.5	0.8	2.4	5.9
1/8-10/8	3.15	3.8	-1.4	4.5	4.4	0.75	1.7	5.8
10/8-20/8	3.2	3.4	-1.1	4.8	4.1	0.7	1	5.6
20/8-30/8	3.25	3.1	-0.8	4.3	3.7	1	1.2	5.3
1/9-10/9	3.28	3	-0.2	3.7	3.4	1.3	1.6	4.9
10/9-20/9	3.3	3	0.6	3.4	3.2	2	2	4.3
20/9-30/9	3.7	3.12	1.4	3.35	3.3	2.6	2.3	3.8
1/10-10/10	4.2	3.1	2.3	3.31	3.6	3.5	2.8	3.3
10/10-20/10	4.8	3.2	3.3	3.3	3.8	4.2	3.2	3
20/10-30/10	5.2	3.3	3.3	3.28	4.1	4	3.6	2.8

Discussion and Analysis

- Change of temperature suitability of cotton under the temperature scenarios
 - Temperature suitability of cotton under climate conditions of 1995 and that of future was respectively produced with temperature suitability model mentioned before.
 - To get distribution of temperature suitability of cotton, temperature suitability of Chinese cotton were classified into three categories by method of equal intervals classification, that is to say, namely **non-suitability category** (temperature suitability is less than 0.3), **suitability category** (temperature suitability is 0.3-0.6) and the **most suitability category** (temperature suitability is more than 0.6) .

Discussion and Analysis

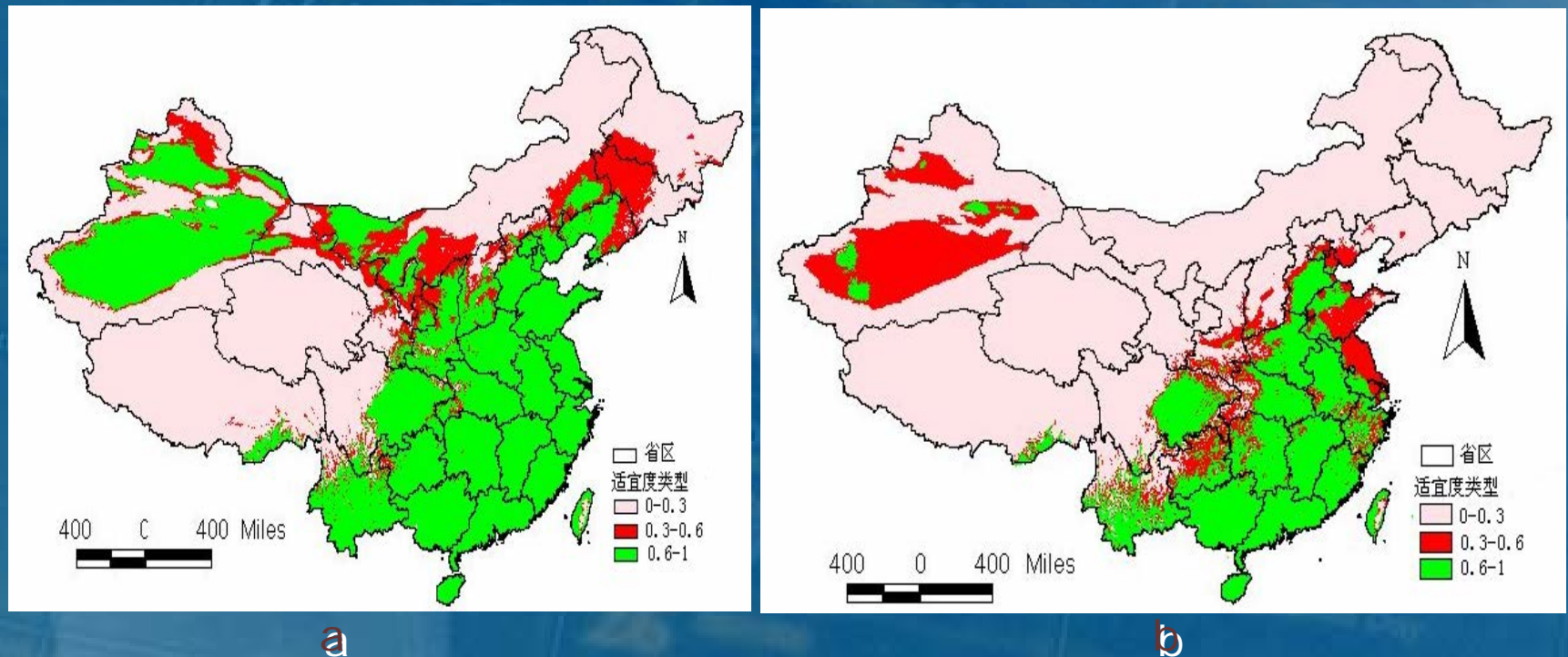


Fig.1 Classification map for cotton temperature suitability of China under future climatic scenario (a) and 1995s(b)

Discussion and Analysis

- Change of temperature suitability of cotton under the temperature scenarios

→ Temperature suitability change map of cotton in every growth stage were obtained by subtracting cotton temperature suitability map in 1995 from that of cotton under the future temperature scenario.

→ Change of temperature suitability of cotton were classified into five categories by method of equal intervals classification, that is to say, namely **strong increasing category** (more than 0.400), **slightly increasing category** (0.001-0.400), **non-changing category** (0), **slightly decreasing category** (-0.001 ~ 0.400), **strong decreasing category** (less than -0.400).

Discussion and Analysis

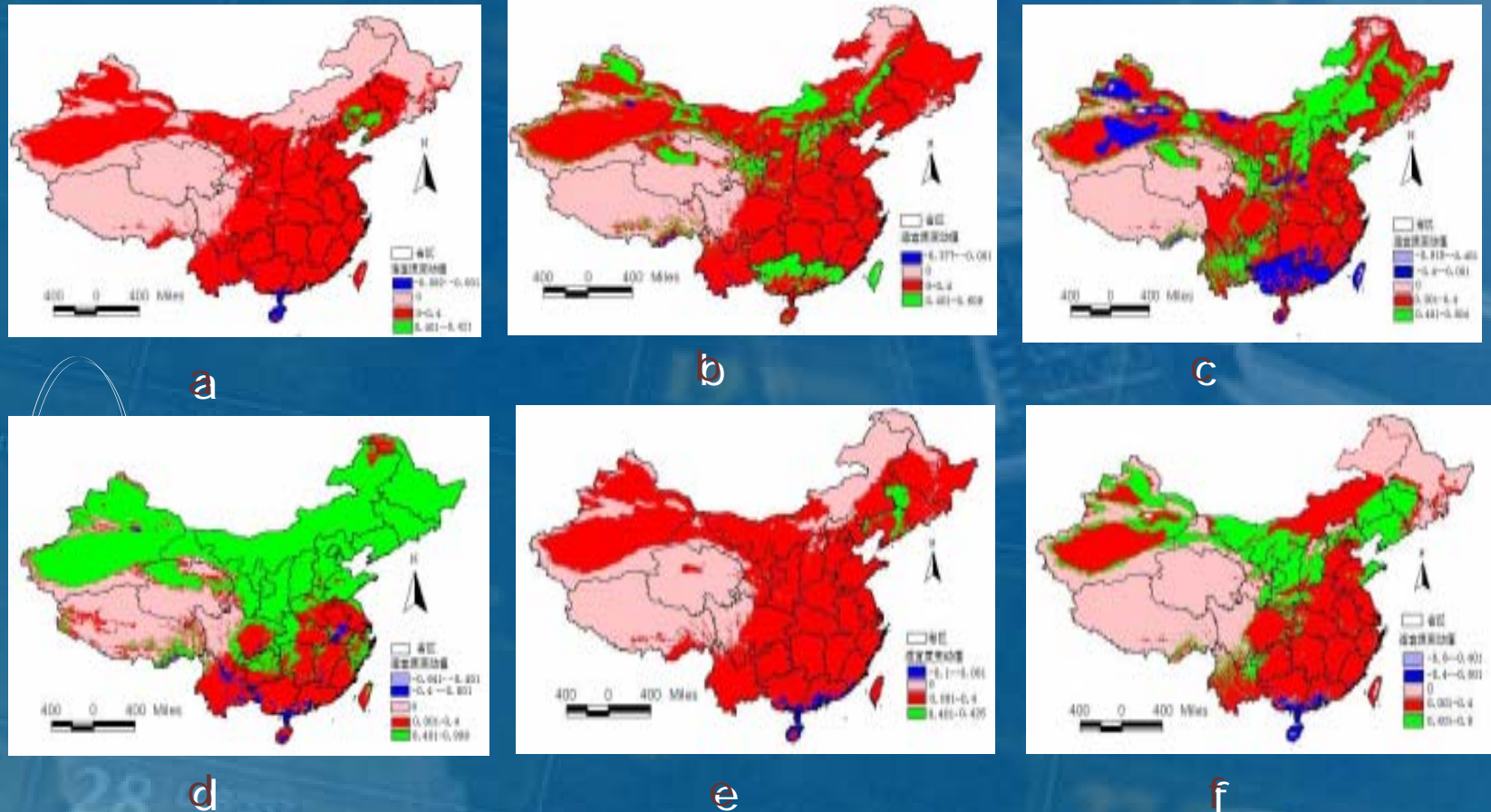


Fig.2 Classification map for change trend of cotton temperature suitability of seeding stage (a), sprouting stage (b), flower bud stage (c), flowering stage (d), boll opening stage (e), total growth stage (f) in China

Conclusions

- Distribution scope of the suitability category and most suitability category of cotton in China will broaden, mainly expanding toward the northeast and northwest region. In addition, the temperature suitability of cotton in many regions will be altered obviously.
- The total temperature suitability takes on the increasing tendency with the temperature increasing.
 - The changes of the temperature suitability go up from the south to the north.
 - In fact there are many factors affecting the growth of cotton, such as precipitation, sunlight, pest, diseases and so on.

Thanks