Examining Methods of Agroclimate Long-range Forecasting in Jilin Province, China

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Abstract

In this paper, meteorological data recorded in Changchun from 1909 to 1988 and historical data were examined, in order to analyze the agroclimatic ecology index and forecast the long-range climate with deduction year by year and climatic cycle. The relationships between climatic change and the Heavenly Stems, the Earthly Branches, Solar activities and El Nino are investigated. Based on this the writer released forecasts of temperatures and rainfall for the subsequent crop growth season (from May to September) in Jilin province. The six year forecast was correct for the six year real climate (1985-1990).

Key words: Agroclimatic condition, Long-range forecast.

1. Agroclimatic ecology index

Meteorological data from Changchun recorded from 1909 to 1942 and from 1949 to 1988, all together for a period of 74 years, were analyzed.

Based on an analysis of agroclimatic ecology, the accumulated temperature in Changchun from May to September of more than 2940.1°C (50°C more than the average yearly value) was defined as a high temperature year, 2840.1°C to 2940.0°C as an average temperature year, less than 2840°C (50°C less than the average yearly value) as a low temperature year and less than 2790°C (100°C less than the average yearly value) as a very low temperature year. In Changchun rainfall between May and September of less than 400mm is defined as a drought year, 400.1mm to 600mm as a medium rainfall year, more than 600mm as a waterlogging year and more than 680.1mm as a serious waterlogging year.

2. Climate forecasted by deduction year by year

The climate of the next year was deduced from the climate of the previous one year or previous two years. It can be seen that (1) a very low temperature year will most likely be followed by a high temperature year (a frequency of 55%) or a slightly higher temperature year (a frequency of 22.2%). (2) generally, after a low temperature year one should be on guard against a continuing low temperature year (a frequency of 55.5%). (3) a high temperature year will mostly be followed by an average temperature year (a frequency of 56.5%). (4) after a medium rainfall year and an average temperature year the temperature will probably be higher (the frequency of the high temperatures year is 47.1%) and the rainfall will be medium (the frequency is 64.7%). (5) two continuous waterlogging years will likely occur (the frequency is 52.5% of all waterlogging years), though three continuous waterlogging years have not yet occurred. (6) after the first waterlogging year one should be on guard against low temperatures and waterlogging calamity (frequencies are all 35.7%), (7) after a serious waterlogging year one should take precautions against drought and also against waterlogging (frequencies are all 37.5%), (8) after two continuous waterlogging years there will most likely be a drought year (a frequency of 60%) and (9) after a drought year there will most likely be a medium rainfall year (a frequency of 72.7%) (Table 1).

3. Climate forecasted by climate cycle method

Based on past meteorological data and on variance cycle analysis using microcomputer, the average temperature and rainfall from May to September of 1989 and 1990 were forecasted. The climatic values forecasted are close to the realistic values.

Using variance analysis as a cycle analysis, it can be seen that the main rainfall cycle is ten years and that the main temperature cycle is three years, which shows that climate closely relates to the Heavenly Stems and the Earthly Branches. Using the Heavenly Stems and the Earthly Branches can supplement meteorological data lack in the middle stage and thus full use can be made of early meteorological data.

Rainfall closely relates to the Heavenly Stems. Generally in the Year Gui (the last of the ten Heavenly stems, unit's place is 3 A.D.), in the Year Bing (the third of the ten Heavenly stems, unit's place is 6 A.D.) and in the Year Geng (the 7th of the 10 Heavenly Stems, unit's place is 0 A.D.), floods and waterlogging were apt to occur. Frequencies of waterlogging years are 57.1%, 42.9% and 37.5% respectively. In the Year Ren (the 9th of the 10 Heavenly Stems, unit's place is 2 A.D.) and in the Year Wu (the 5th of the 10 Heavenly Stems, unit's place is 8 A.D.) drought were apt to occur. The frequencies of drought years were 50.0% and 42.9% respectively (Table 2).

Temperature was closely related to the Earthly Branches. In the Year Zi (The Mouse, the 1st of the 12 Earthly Branches), in the Year You (The Chicken, the 10th of the 12 Earthly Branches) and in the Year Hai (The Pig, the last of the 12 Earthly Branches), low temperature damage were apt to occur. The frequencies of low temperature were all 50%. The probabilities of high temperature years occurring in the Year Wei (The Sheep, in the 8th of the 12 Earthly Branches), in the Year Chou (The Ox, the 2nd of the 12 Earthly Branches), in the Year Yin (The Tiger, the 3rd of the 12 Earthly Branches) and in the Year Mao (The Rabbit, the 4th of the 12 Earthly Branches) were varied greatly. The frequencies were 60.0%, 57.1%, 42.9% and 42.9% respectively (Table 3).

4. The relationship between climate change and relative sunspot number.

Taking 100 and 20 sunspots as limits, sunspots can be divided into three levels, many, average and few. (1) Waterlogging and low temperature years are apt to occur in years with fewer sunspots, especially in the years of sunspots in the valley value, in which the climatic conditions are worse and there were probably flood and waterlogging and low temperature damage. Waterlogging year frequencies and low temperature years are all 57.1%. The climate of the one year before and one year after sunspots in the valley value was much better than in the year of valley value sunspots. (2) Temperatures were higher in years with average sunspots, especially in medium I type (sunspots from few to many). The frequency of high temperature years was as high as 45.5%. In the Medium II type (sunspots from many to few), the frequency of drought years was as high as 31.6% and the temperatures were also higher. In the year of Medium III (sunspots between few and few), the frequency of low temperature years was as high as 37.5%. (3) In years with many sunspots, the climate was similar to the average annual climate, in which there were mostly average temperature years in the years of peak value sunspots. One year before peak value sunspots, drought and waterlogging were apt to occur. After one year of peak value sunspots low temperatures were apt to occur.

5. The relationship between climate change and El Nino

(1) The frequency of low temperature El Nino years is high. Eight of 23 El Nino years were low temperature years, which was 34.8% of all El Nino years. In El Nino years, the frequency of waterlogging years was higher than average.

(2) Temperatures were higher in years after an El Nino year.

(3) Temperatures were high (frequency of high temperature years was as high as 70%) and the rainfall is medium (frequency is 80%) in Anti-ENSO year.

(4) Temperatures were low years after Anti-ENSO years.

6. Proving the effects of climate long-range forecasting

Since 1985, the writer has released forecasts of temperature and rainfall for the next growth season (May to September) in Jilin province in the newspaper. The writer forecasted that calamities would occur in 1985, that waterlogging would continuously occur in 1986, that there would be a bumper harvest year in 1987, that there would be a bumper harvest year with medium rainfall and high temperature in 1988, and there would be medium rainfall and an average temperature year in 1989 and in 1990. The forecasts were correct, which tally with the facts occurring in those years. The newspaper reported the news, that Pan Tiefu released Jilin climate forecasts for 6 years, from 1985 to 1990, which were accurate for the 6 year's real climate.

References

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Table 1. Estimation of the next year's rainfall and temperature frequencies

Type	Freq. of rainfall (%)				Freq. of Temp. (%)			
	Drought year	Medium rainfall year	water-logging year	serious water-logging year	High temp. year	Average temp. year	Low temp. year	Very low temp. year
After lowest temp. year	22.2	44.4	33.3	0	55.5	33.3	11.1	11.1
After general low temp. year	33.3	33.3	33.3	0	33.3	11.1	55.5	33.3
After high temp. year	17.4	65.2	17.4	13.0	21.7	56.5	21.7	8.7
After medium rainfall and average temp. yr.	11.8	64.7	23.5	11.8	47.1	41.2	11.8	5.9
After the first waterlogging yr.	7.1	57.1	35.7	21.4	28.6	35.1	35.7	7.1
After very waterlogging yr.	37.5	25.0	37.5	25.0	37.5	37.5	25.0	12.5
After two continuous waterlogging yrs.	60.0	40.0	0	0	40.0	40.0	20.0	20.0
After drought yr.	9.1	72.7	18.2	0	18.2	63.6	18.2	9.1
Over year	16.2	58.1	25.7	10.8	32.4	43.2	24.3	12.2

Table 2. Agroclimate in the different Heavenly Stems in Changchun

The Heavenly Stems	Unit's places in A.D.	Freq. of rainfall (%)				Freq. of Temp. (%)			
		drought year	medium rainfall year	water-logging year	serious water-logging yr.	high temp. yr.	average temp. yr.	low temp. yr.	very low temp. yr.
Jin	4	14.3	57.1	28.6	0	42.9	42.9	14.3	14.3
Yi	5	0	71.4	28.6	28.6	42.9	42.9	14.3	14.3
Bing	6	14.3	42.9	42.9	42.9	14.3	71.4	14.3	14.3
Ding	7	0	71.4	28.6	0	42.9	42.9	14.3	14.3
Wu	8	42.9	42.9	14.3	14.3	28.6	57.1	14.3	0
Ji	9	12.5	87.5	0	0	37.5	25.0	37.5	25.0
Geng	0	25.0	37.5	37.5	0	50.0	25.0	25.0	0
Xin	1	0	87.5	12.5	0	12.5	50.0	37.5	0
Ren	2	50.0	37.5	12.5	12.5	25.0	50.0	25.0	25.0
Gui	3	0	42.9	57.1	14.3	28.6	28.6	42.9	14.3
Over yr.	-	16.2	58.1	25.7	10.8	32.4	43.2	24.3	12.2

Table 3. Agroclimate in the different Earthly Branches in Changchun

The Earthly Branches	The 12 animals	Freq. of rainfall (%)				Freq. of Temp. (%)			
		drought year	medium rainfall year	water-logging year	serious water-logging yr.	high temp. yr.	average temp. yr.	low temp. yr.	very low temp. yr.
Zi	Mouse	33.3	33.3	33.3	16.7	33.3	16.7	50.0	33.3
Chou	Ox	0	57.1	42.9	14.3	57.1	28.6	14.3	14.3
Yin	Tiger	0	85.7	14.3	14.3	42.9	57.1	0	0
Mao	Rabbit	0	71.4	28.6	14.3	42.9	42.9	14.3	0
Chen	Dragon	42.9	57.1	0	0	28.6	57.1	14.3	14.3
Si	Snake	0	83.3	16.7	0	16.7	50.0	33.3	16.7
Wu	Horse	33.3	16.7	50.0	16.7	33.3	33.3	33.3	16.7
Wei	Sheep	20.0	80.0	0	0	60.0	20.0	20.0	0
Shen	Monkey	40.0	40.0	20.0	20.0	20.0	80.0	0	0
You	Chicken	0	83.3	16.7	0	16.7	33.3	50.0	33.3
Xu	Dog	33.3	16.7	50.0	16.7	33.3	50.0	16.7	0
Hai	Pig	0	66.7	33.3	16.7	0	50.0	50.0	0
Over yr.	--	16.2	58.1	25.7	10.8	32.4	43.2	24.3	12.2