A MEDIUM-RANGE PREDICTION METHOD FOR THE FOREST FIRE DANGER RATING

Duan Xiuying, Hu Mingchen and Zhou Wei
(Heilongjiang Forest Protection
Institute, Harbin, China, 150040)

ABSTRACT

In this medium-range prediction method for the forest fire dangerrating, the Forest Fire Danger Rating 801[1] are used to be the predictand. The historical data for upper 500Hpa and the data for geostro phic vorticity are used to be the predictor . The prediction equations are formulated . The meduim-range prediction charts for upper 500Hpa issued by ECMWE are used to be the effective predictands to caculate the 3-5 days forest fire danger rating for the 10 monitor stations over the forest area on the Xin'an Mountains in spring . According to the testing results, the prediction accuracy for this method is over 70% .

DATA AND METHOD

In this predictive method, three Kinds of data are used:

1. Daily Forest Fire Danger Rating 801 at 10 weather staions over the forest area on the Xin'an Mountains from April to June in 1982 , 1984 and 1986 are used to be the predictants. The stations are Mohe, Amuer, Tahe, Huzhong, Xinlin, Huma, Jiagedaqi , Heihe , Nenjiang and Yichun . The indexes for The forest-fire danger rating are nondimention from 0 to 100. see Tab. 1.

2. Daily height and vorticity fields at 500Hpa level over East Asia(30° -75° N , 70° -170° E) from April to June in 1982 , 1984 and 1986 are used to be the predictors . Geostrophic vorticity at 500Hpa are caculated by the formular of geostrophic vorticity.

The fomular is showed as follow :

$$\zeta = \frac{196\,(H - H_o)}{7.29 \times 10^{-6} D^2 \sin \varphi_o}$$

where H_o : height value for 500 Hpa at caculating point.
H : mean height value for 4 points around point H_o.
D : grid distance.
φ_o : latitude for point H_o

3. Daily medium-range prdiction charts (72hrs, 96hrs and 120hrs) for upper 500Hpa over East Asia (30° -50° N, 70° -170° E) from April to June in 1982, 1984 and 1986 issued by ECMWF are used to be effective predictands for the implemention of the medium-range forest fire rating prediction . The prediction method is applied to study the relationship between the predictands and the predictors , through using of the historical data as mentioned above and the predictive equations are formulated. Then the real-time data of height and geostrophic vorticity issued by ECMWF are substituted into the predic tive equations to realize the aim of the medium-range forest fire danger rating prediction.

THE PREDICTIVE EQUATIONS

The stepwise regrssion anaylsis is used to select the historical data of height and of geostrophic vorticity at upper 500Hpa to formulate the predictive equations for the predictands . 30 predictive equations are formulated respectively for the 10 weather stations over the Xin' an mountains from April to June . Because of the limited space . The predictive equations for April are given in Tab . 2.

HISTORICAL TESTING FOR THE PREDICTIVE EQUATIONS

The historical data for the height and the geostrophic vorticity at 500Hpa level in 1982 , 1984 and 1986 are applied and are substituted into 30 equations to make a historical fitting test . The results are shown in Tab. 3. The results show the average of fitting rate for the predictive equations is 75% . It proves that the equations formed by the predictands and the predictors are feasible.

THE TESTING OF THE MEDIUM-RANGE PREDICTION FOR THE FOREST-FIRE DANGER RATING

Two parts of statistical testing as follow are made to prove out the feasibility of the implementions of the medium-range prediction for the forest fire danger rating by applying the medium-range predictive values issued by ECMWE .

1. The historical data height of 500Hpa issued by ECWUE in 1982, 1984 and 1986 are used and are substituted into 30 equations . The fitting rate are shown in Tab. 4.

Tab. 4 shows that the mean fitting rate for the prediction by using the historical data issued by ECMWE is over 70% . It proves intentively that the predictive method is feasible.

2. A testing medium-range prediction for the forest-fire danger rating was made for 10 weather stations over the Xin' an Mountains from April to July in 1987 and 1988 by using the predictive values for the field of height recieving from ECMWE day by day The accuracy for the prediction is shown in Tab. 5 .

The accuracy of the meduim-range prediction for the forest fire danger rating in the two years were over 70% . It proves that the predictive method is fit for the historical law and has a universal law, as well .

CONCLUSIONS

1. The medium-range prediction method for the forest-fire danger rating has adefinite principle. It is easy to operate. The method is objective and the predictive results are accuracy . It is convenient to popularize.

2. Applying the medium-range prog charts issued by EDMWE to put the prediction into effect, the accuracy of prediction and the effective for the predictive period of validity can be raised and a new learning thought is afforded.

3. Some problems in this method are remained to be solved. It is limited in applying in the spring season and is overtoborate to find out the correlation and to formulate the predictive equations in each place and in each month.

REFERENCES

1 Duan Xiu-ying , Pan Zhai-chen and Chen Zhenzhi, ' Prediction Method 801 for the Forest-fire Danger Rating ' , Bulletin on scientific and Technological Achievements, 2 (1991), SSTCC, 7.

2 Ding shichen, ' Model Output Statistics Prediction '. Shangxi Meteorology , 1 (1984) , Information Office Meteorological Institute of Shangxi Province.

APPENDIX

Tab. 1 The Forest-Fire Danger Rating 801

Forest-fire Danger Rating	Forest-fire Danger Index	Probability of the Fire ocaurring	situation for Danger
1	01-10	0	no danger
2	11-20	5	less dangerous
3	21-40	15	danger with medium degree
4	41-60	30	danger with high
5	61-100	50	the most dangerous

Tab. 2 The Predictive Equations For April

station Name	Predictive Equations and Latitude and longtitude where the factors Located*	Multiple correlation coefficient
Mohe	Y_1=3.372+0.548H(40, 170) -0.03S(60, 100) +0.039S(50, 120)	0.763
Tahe	Y_2=-76.788H+0.678H(45, 125) +1.012H(30, 160) -0.025S(60, 100) -0.051S(40, 170)	0.753
Huzhong	Y_3=-3.583+0.7H(45, 115) -0.041S(60, 100) +0.022S(50, 120) -0.07S(40, 170)	0.765
Huma	Y_4=-21.067+0.768H(45, 125) +0.335H(40, 170)	0.598
Xinlin	Y_5=-11.747+0.882H(45, 115) -0.042S(60, 100) -0.077S(45, 125)	0.710
Amuer	Y_6=-54.471+0.349H(45, 125) -0.019S(60, 100) +0.297H(30, 160) +0.66H(30, 100)	0.760
Jiagedaqi	Y_7=-38.098+0.494H(55, 75) +1.265H(45, 115) -0.419H(60, 140)	0.745
Heihe	Y_8=-16.57+0.643H(50, 80) +0.776H(45, 125) -0.643H(60, 140)	0.654
Nenjiang	Y_9=-8.216+0.372H(50, 80) +0.989H(45, 125) -0.588H(60, 140) +0.164S(70, 150)	0.686
Yichun	Y_{10}=-8.214+0.946H(45, 125) -0.03S(60, 100) +0.135S(70, 130)	0.722

Tab. 3 The Fitting Rate (%) for the Predictive Equations

Sation Name	Month			
	April	May	June	Averages
Mohe	84	80	82	82
Tahe	79	70	69	73
Huzhong	86	72	70	76
Huma	70	69	76	72
Xingling	77	75	73	75
Amuer	80	77	88	82
Jiagedaqi	68	73	73	71
Heihe	71	85	73	76
Nenjiang	69	71	74	71
Yichun	76	71	76	74
Averages	76	74	75	75

Tab. 4 The Historical Fitting Rate For the Medium-range Prediction

Mean Fitting Rate (%)	72hrs	96hrs	120hrs
71.3	73.3	72.6	68.1

Tab. 5 The Accuracy of the Medium-range Prediction for the Forest-fire Danger Rating in 1987 and 1988

Mean Accuracy (%)	peiod of validity		
	72hrs	96hra	120hrs
71.7	70.8	71.5	71.3

* The predictor H(I, J) shows the height value for 500Hpa . I shows the latitude where the factor placed . J as the longtitude where the predictor placed . S(I, J) shows the geostrophic vorticity at 500Hpa level I and J shows the latitude and longtitude where the predictor placed respectively.