SVD Iteration Model and Its Use in Prediction of Summer Precipitation*

ZHANG Yongling1(张永领), DING Yuguo2(丁裕国), and WANG Jijun3(王纪军)

1 Henan Polytechnic University, Jiaozuo 454000
2 Nanjing University of Information Science & Technology, Nanjing 210044
3 Henan Meteorological Bureau, Zhengzhou 450003

(Received April 29, 2008)

ABSTRACT

A new short-term climatic prediction model based on the singular value decomposition (SVD) iteration was designed with solid mathematics and strict logical reasoning. Taking predictors into prediction model, using iteration computation, and substituting the last results into the next computation, we can acquire better results with improved precision.

Precipitation prediction experiments were separately done for 16 stations in North China and 30 stations in the mid-lower catchment of the Yangtze River during 1991–2000. Their average mean square errors are 0.352 and 0.312, and the results are very stable. Mean square errors of 9 yr are less than 0.5 while only that of 1 yr is more than 0.5. The mean sign correlation coefficients between forecast and observed summer precipitation during 1991–2000 are 0.575 in North China and 0.623 in the mid-lower catchment of the Yangtze River. Librations of them in North China during the 10 years are small. Only in 1996 the sign correlation coefficient is below 0.5; the others are all over 0.5. But sign correlation coefficients in the mid-lower catchment of the Yangtze River vary obviously. The lowest is only 0.3 in 1992, and the highest is 0.9 in 1998. As the distribution of the forecast precipitation anomaly field in the summer 1998 of is examined, it is known that the model captured the positive and negative anomalies of precipitation, and also well forecasted the anomaly distributions. But the errors are obvious in quantities between the forecast and the observed precipitation anomalies.

Climate characteristics of large scale meteorological elements, such as summer precipitation have obvious differences in spatial distribution. We can forecast better if we divide a big region into many subregions according to the discrepancy of climatic characteristics in the region, and predict in each subregion. The research shows that the model of SVD iteration is a very effective forecast model and has a strongly applicable value.

Key words: SVD iteration, precipitation prediction, sign correlation coefficients

1. Introduction

China is a country with frequent natural disasters. Each year, the average economic loss due to natural disasters is 3%–6% of the national GDP, of which 70% is caused by meteorological disasters. Therefore, short-term climate forecast is of great importance to prevent and mitigate these disasters and protect the national economy and society. Statistical methods play an important role in the short-term climate forecast. Based on the understanding of the integral characteristics of physical mechanisms of weather and climate or certain aspects of climate system, the design of statistical forecasting models or schemes is an efficient way to climate forecast with low cost. From the 1960s to 1970s, a successive regression method was applied to the practical meteorological operations, using one dependent variable vs. multiple independent variables to perform regression analysis for meteorological forecasts. Since the 1980s, due to the need of practical operations and the rapid development in computer technology, there emerge methods including the stepwise regression analysis of multi-variables (predictors) vs. multiple dependent variables (predictands), ridge regression analysis, principal component regression analysis, optimal subset regression, and so on. These methods are being applied in the meteorological forecast (Xie et al., 2003). However, regression