Spatiotemporal Variations of Summer Rainfall over Eastern China during 1880–1999①

Li Xiaodong (李晓东), Zhu Yafen (朱亚芬), and Qian Weihong (钱维宏)

Department of Atmospheric Sciences, School of Physics, Peking University, Beijing 100871

(Received January 5, 2002; revised July 15, 2002)

ABSTRACT

By applying rotated complex empirical orthogonal function (RCEOF) analysis on 1880–1999 summer rainfall at 28 selected stations over the east part of China, the spatio-temporal variations of China summer rainfall are investigated. Six divisions are identified, showing strong temporal variability, the middle and lower reaches of the Yangtze River, the Huaihe River, Southeast China, North China, Southwest China, and Northeast China. The locations of all divisions except Southwest China are in a good agreement with those of the rainband which moves northward from Southeast China to Northeast China from June–August. The phase relationship revealed by the RCEOF analysis suggests that rainfall anomalies in the middle and lower reaches of the Yangtze River, Southeast China, and Northeast China are all characterized by a stationary wave, while a traveling wave is more pronounced in the Huaihe River division, North China, and Southwest China. The fourth RCEOF mode indicates that rainfall anomalies can propagate from south of Northeast China across lower reaches of the Huanghe River and the Huaihe River to the lower reaches of the Yangtze River. A 20–25-year oscillation is found at the middle and lower reaches of the Yangtze River, the Huaihe River valley, North China, and Northeast China. The middle and lower reaches of the Yangtze River and Northeast China also show an approximately-60-year oscillation. Northeast China and the Huaihe River division are dominated by a 36-year and a 70–80-year oscillation, respectively. An 11-year oscillation is also evident in North China, with a periodicity similar to sunspot activity. The interdecadal variability in the middle and lower reaches of the Yangtze River, the Huaihe River valley, and North China shows a significant positive correlation with the solar activity.

Key words: empirical orthogonal function (EOF), rotated complex EOF (RCEOF), China summer rainfall, drought and flood anomaly, stationary wave, traveling wave, interdecadal variability

1. Introduction

Recently, global climate change has become a tremendous public concern. Each year, drought and flood hazards directly cause huge loss of life and economic damage. Therefore, better weather prediction is urgently needed. Yet droughts and floods tend to have significant spatial and temporal variability which hinders the investigation. Most previous studies on China rainfall variability were focused on eastern China during the last 50 years (Deng et al. 1989; Chen and Wu 1994; Nitta and Hu 1996; Wang and Wu 1997). Due to the lack of long-term observations, the rainfall anomaly pattern over a longer period (~ 100 years) is poorly understood (Wei et al. 1995). Lately, Wang et al. (2000) reconstructed seasonal and annual rainfall at 35 stations located east of 100°E in China during the period 1880–1998 using both operational rainfall observations as well as historical documents. These 35 stations were evenly distributed over eastern China and thus can provide a good representation of the cov-

①E-mail: zhuyf@pku.edu.cn