CHAPTER 2

ESTIMATES FOR MID-LATITUDE NON-OROGRAPHIC REGIONS

2.1 INTRODUCTION

2.1.1 Summary

(a) Key factors influencing precipitation can be summarized as the moisture factor and the dynamic factor. The moisture factor is usually determined using surface dewpoints. The dynamic factor is usually determined indirectly through data on observed extraordinary storms, but it may be estimated directly using a specific meteorological factor.

(b) Three methods are usually used in estimating probable maximum precipitation (PMP) in non-orographic regions. The first is local storm maximization. Methods of maximization include moisture maximization and wind maximization. The second is the storm transposition method. Elevation adjustment, barrier adjustment and horizontal displacement adjustment need to be performed in the transposition. The third method is spatial and temporal maximization, where the spatial and temporal distributions of one or more storms are adjusted deliberately using certain principles, thereby forming a new storm sequence to enhance the effect of flood creation. In China this third method is called storm combination.

(c) The term enveloping means that results obtained from one or several methods are used to draw the depth–area–duration (DAD) enveloping curve, or PMP. It is used to maximize observed storms or hypothesized storms with certain durations and areas in a particular watershed and the result is called the probable maximum storm (PMS).

(d) Generally, there are two methods for deriving spatial and temporal distributions. The first is the generalized spatio-temporal distribution method. In this method, the temporal distribution is generalized into the single-peak type with the peak slightly behind; and the spatial distribution is generalized into a set of concentric ellipses. The second method is the simulated observed typical storm method. In this case, the spatio-temporal distribution of a certain observed storm is used as the spatio-temporal distribution of PMP.

The above methods are applicable to certain watersheds and generalized estimation in a meteorologically homogeneous zone.

2.1.2 Convergence model

The theoretical interrelationship of convergence, vertical motion and condensation is well known. If either the convergence at various heights in the atmosphere or the vertical motion (averaged over some definite time and space) is known, or assumed with a given degree of precision, then the other can be calculated to an equal precision from the principle of continuity of mass.

Observations confirm that the theoretical pseudo-adiabatic lapse rate of temperature of ascending saturated air is an accurate approximation from which to calculate precipitation yield in deep precipitating clouds. The higher the specific humidity, the greater the precipitation yield for a given decrease in pressure. All these factors are basic to the formulation of a convergence model, and several such models have been postulated (United States Weather Bureau, 1947; Wiesner, 1970; WMO-No. 233).

2.1.3 Observed storm rainfall as an indicator of convergence and vertical motion

There is a problem in estimating PMP with a convergence model. Maximum water vapour content can be estimated with acceptable accuracy for all seasons for most parts of the world by appropriate interpretation of climatological data. However, there is neither an empirical nor satisfactory theoretical basis for assigning maximum values to either convergence or vertical motion. Direct measurement of these values to date has been elusive. The solution to this dilemma has been to use observed storm rainfall as an indirect measure.

Extreme rainfalls are indicators of maximum rates of convergence and vertical motion in the atmosphere, which are referred to as the storm or precipitation-producing mechanism. Extreme mechanisms for extreme storms may then be determined for basins under study without the need to actually calculate the magnitude of the convergence and vertical motion. The procedures for using