determining the right PMP estimation method, and to check the accuracy of the resulting estimates. The analysis covers: geographic, orographic and climatic conditions; basic types of storms and floods; the synoptic causes of storms/floods; and the characteristics of their spatial and temporal distribution in the watershed.

Geographic, orographic and climatic conditions combine to provide the macroscopic background for the formation of storm and floods.

It is important to know what types of storms and floods occur in the design watershed so that the qualitative characteristics of storm models can be deduced through a comprehensive analysis based on the design requirements of a particular project.

7.2.5 Deducing qualitative characteristics of storm models

7.2.5.1 Importance of correct storm model

The method used to determine PMP introduced in this chapter is maximization. There are two key issues here: the first is determining the storm models and the second is selecting parameters of maximization. The first part is critical since it forms the basis of the study. Choosing the storm model correctly means that the physical basis for the PMP/PMF required in a particular project is sound, thereby increasing the reliability of the PMP/PMF results.

7.2.5.2 Qualitative characteristics

Qualitative characteristic assessments of PMP storm models should include three points: the occurrence season of the storm; the type of significant weather generating the storm, including the circulation type and the storm weather system; and details for the storm, including the duration, temporal distribution, isohyetal distribution, storm area and location of the storm centre.

7.2.5.3 Methods for determining characteristics

An understanding of the required characteristics of the PMP storm models can be obtained by considering the design requirements of the project, data about the relevant significant weather systems, observed storms and floods in and around the design watershed – both surveyed and recorded in literature, as well as the characteristics of the watershed. Specific details are presented in the following example.

7.2.5.4 Example of qualitative characteristic analysis – San-Hua region, China

Methods of deducing qualitative characteristics of storm models are explained for the San-Hua region – a watershed area of 41 615 km^2 between Sanmenxia and Huayuankou on the Yellow River (Wang G., 1999) are outlined in this section.

7.2.5.4.1 *Analysis based on project requirements*

Analysis of PMF in the San-Hua region aims to provide a hydrological basis for the arrangement of a flood-control system in the lower reaches of the Yellow River. In this region, floods with high peaks and large volumes are critical to flood control. According to historical analyses, it is the flood peak and the flood volume over a duration of 5 days that is critical for this project.

7.2.5.4.2 *Analysis based on flood data observed in the watershed*

Collection of flood data in the San-Hua region started in 1919. According to statistical data, large floods occurred in 1937, 1954, 1957, 1958 and 1982. These can be categorized as midsummer longitudinal type floods (1937, 1954, 1958 and 1982) and a midsummer latitudinal type flood (1957) according to the circulation type, the weather system responsible for the storm and the storm area distribution.

The midsummer longitudinal type floods are formed by storms that are caused by north–south shear lines, sometimes interacting with a typhoon to produce high peaks and large volumes. When such storms happen, the maximum 1-hour rainfall often exceeds 100 mm, and the 24-hour rainfall exceeds 700 mm, with the storm area in a longitudinal, elongated, narrow distribution. The storm area typically extends to the middle and upper reaches of the Huaihe River in the south and to the lower and middle reaches of the Fenhe River in the north, spanning the entire watershed of the San-Hua region longitudinally. In the San-Hua region, the storm centre is often over the middle and upper reaches of the Yihe River and Luohe River, the lower and middle reaches of the Qinhe River, or in the region between Sanmenxia and Xiaolangdi along the main branch of the Yellow River. The duration of precipitation for such a storm might be around 7 days, while the main burst duration associated with the storm (the areal mean rainfall is 50 mm or greater in the San-Hua region) is approximately 3 days. Such storms often occur in July and August when the watershed is already wet from previous rains.