

## ESTIMATES FOR TROPICAL REGIONS

This chapter discusses probable maximum precipitation (PMP) procedures that are considered applicable within about 30° of the equator, the region commonly referred to as the humid tropics or the tropical rainy climates. Excluded from this chapter are high mountain areas where snowfall is an important factor and arid or semi-arid regions generally found in the interior of large landmasses.

### 6.1 MODIFICATION OF COMMON TEMPERATE-LATITUDE PROCEDURES

When estimating PMP for humid tropical regions or tropical rainy climates, the greatest difficulty is a shortage of rainfall stations. As a result, it is necessary to supplement rainfall data with indirect measurements from satellites, etc. In addition, the transposition range needs to be enlarged by transposing existing observed data on large storms in regions within 30° north and south of the equator. Moreover, meteorological conditions for storms in tropical regions are different from those in temperate latitudes because abnormal sea surface temperatures play a critical role in moisture changes and the generation of large storms.

Despite these difficulties, the basic steps used for PMP estimation in mid-latitude regions – such as moisture maximization, transposition, spatial and temporal maximization and methods for enveloping – can still be applied, with corrections for tropical regions. This chapter discusses which elements need to be corrected, based on a combination of PMP studies on Hawaiian Islands, the Lower Mekong basin in Viet Nam, India and the Chang-huajiang River basin on Hainan Island, China. Included are meteorological studies in the regions, analyses on depth–area–duration (DAD) relationships from regional storms as well as moisture extremes, wind structures, and other key factors for the process of precipitation generation.

#### 6.1.1 Meteorological storm analysis

The initial step in preparation of PMP estimates is a thorough understanding of the meteorology of major storms throughout the region. A starting point is a synoptic analysis of meteorological conditions associated with important rain events. All

surface and upper air charts should be used to make an analysis of the meteorological situation that is as comprehensive as possible. Using upper-level charts is particularly important in tropical regions. Data from all layers should be examined. In some instances, important information can be obtained from the 300- or 200-hPa charts. These charts can usually be obtained from the various national meteorological services. Particular attention should be given to the primary cause of the rain event – for example, thunderstorm, tropical cyclone, or monsoon. Tracks of tropical storms have been published for some regions of the world (Arakawa, 1963; Chin, 1958; Crutcher and Quayle, 1974; Koteswaram, 1963; Lourensz, 1981; Neumann and others, 1981; United States Department of Defense, 1960). Date and location comparison of large rainfall amounts with tropical storm locations along appropriate tracks can aid in identifying rainfalls that may be caused by such storms.

Other factors that should be evaluated to the greatest possible extent are:

- (a) location of moisture sources;
- (b) amount and vertical distribution of the wind bringing moisture into the storm area;
- (c) the vertical distribution of temperature and information on cloud structure and cloud tops.

Data from various regions that are subject to the same type of storms – for example, tropical storms – should be utilized to develop the best analysis of storm structure (Schwarz, 1972; Schwerdt and others, 1979). To the extent that data are available, all dynamic features of the major storms should be analysed. In some instances, data from global weather experiments can be used to aid in the examination of storm structure. The advent of meteorological satellites has made a significant contribution to synoptic analysis in tropical regions. Over many parts of the tropics, satellite sensors provide the only comprehensive source of meteorological data.

It should be emphasized that knowledge of the meteorology of severe storms that have occurred over the region is a requirement for any of the PMP estimation approaches being considered. It is also during this preliminary phase of storm analysis that