procedures are discussed in sections 2.5 and 2.6. When considering non-contiguous regions, particularly those that are spread over widely separated regions, other adjustments may be used. The differences in tropical storm PMP values between various regions will be related to variations in sea-surface temperature, tropical storm intensity, and orographic effects (Schwarz, 1972). For variations in other storm types – for example, TIFCA – other factors related to the dynamics of the storm processed should be considered. Factors that can be utilized are:

(a) strength of inflow winds into the storm;
(b) cloud height or cloud top temperatures that can be derived from satellite, radar or aircraft data;
(c) instability measures or horizontal temperature gradients.

If direct measures of the geographic variations in storm dynamics are not available, indirect measures are frequently used. A commonly used factor is the transposition of the moisture maximized precipitation amount expressed as the per cent of the normal annual or seasonal precipitation. If annual or seasonal precipitation is used, adjustment of this factor by the number of rainy days above some threshold value – for example, 6 mm – would tend to minimize the influence of the frequency of small storms. Another rainfall factor that can be used as a transposition index is the rainfall frequency value for some duration, for example the 50-year, 24-hour value. A rainfall-frequency event for a single recurrence interval and duration selected for an appropriate duration minimizes the problem associated with normal or annual seasonal precipitation. It does not yield, however, complete information about the difference in storm potential between regions. A more complete approach based on rainfall-frequency information would use a combination of the central tendency – this is, the mean of the annual series – and some measure of the dispersion – that is, the standard deviation.

6.1.6 Sequential and spatial maximization

In temperate climates, many storms have occurred as a result of different storm mechanisms within a region and the variability of moisture between storms is relatively large. In these regions, the increase of total storm experience to the storm that would have occurred with maximum available moisture produces an estimate of the upper limit of rainfall that has been accepted as realistic. With a large storm sample, it can be reasonably assumed that some storms have occurred with a near-optimum combination of all rain-producing factors other than moisture. In tropical regions, where the variation of storm types and moisture availability is generally less, simple maximization for moisture may not produce realistic estimates even when combined with liberal transposition procedures. Sequential and spatial maximization can be an important tool. Although the techniques do not differ from temperate climates, considerable judgement must be exercised in developing appropriate meteorological sequences of storms. The particular storms considered need not have occurred over the same basin to be considered in a sequential or spatial maximization procedure. It is sufficient to find sequences of similar storms that have occurred within the basin and then to develop meteorologically reasonable minimum time sequences to make the transition from one selected large storm event to the second.

6.2 PMP ESTIMATES FOR INDIVIDUAL REGIONS

Fewer PMP studies have been completed for tropical regions than for temperate climates. Consequently, the procedures have not been as fully developed. The following sections discuss some completed studies (Rakhecha and Kennedy, 1985; Schwarz, 1963; United States Weather Bureau, 1970) that outline possible approaches.

6.2.1 Hawaiian Islands PMP

Drainage areas in the Hawaiian Islands are generally less than 120 km^2. Isolated peaks extend above 3 000 m for two of the islands, and to about 1 200 m for the three other islands. Numerous investigations have indicated that winds tend to flow around rather than over the higher mountain peaks. Record-breaking rainfall situations feature complex thunderstorms and disturbances of the normally prevailing easterly trade winds. The optimum situation was, therefore, determined to be (Schwarz, 1963) a relatively fixed zone of convergence with imbedded regenerative smaller areas of intense vertical motion of the size and intensity associated with thunderstorms (TIFCA). Examination of 156 cases of daily Hawaiian rainfalls exceeding 300 mm disclosed that about 60 per cent were associated with thunderstorms. Thunderstorms were thus revealed as important products of extreme rainfalls, although, as a general weather feature, severe thunderstorms are relatively uncommon in the Hawaiian Islands.