Introduction

Several methods exist for the empirical estimation of crop
evapotranspiration (ET). These include temperature, pan evaporation,
radiation and combination methods, referring to the data requirements
of each method. Combination methods such as the Penman Equation
require air temperature, dew point temperature, wind speed and
radiation information, reflecting meteorological parameters
influencing ET. All methods use empirical coefficients to compute
crop ET which depends on the crops and climate of a region. When
considering the real-time, historical and future data requirements of
each estimation method the only alternative available for the
consumptive use operation is a temperature method. The SCS Blaney
Criddle method, which has been used in the Western United States, was
originally developed to compute ET on a monthly basis but can be
modified to estimate daily values of ET with mean daily temperature
(ASCE 1990).

Evapotranspiration (ET) Estimation

The SCS Blaney Criddle method estimates monthly ET from mean monthly
temperature, percent of annual daylight hours and empirical
coefficients (ASCE 1990). An adjustment can be made in the equation
to compute ET on a daily basis. This calculation is shown in
Equation 1.

$$ET = k * t * p / 100 \tag{1}$$

    where ET is the daily crop ET (L)
          k   is the daily empirical crop & meteorological coefficient
          t   is the mean daily temperature (T)
          p   is the daily percent of annual daytime hours

Temperature, latitude and Julian day must be input while mid-month
empirical coefficients would be determined in calibration. Daily
empirical coefficients can be determined through linear interpolation
of the mid-month coefficients. Daily percent of annual daylight
hours is computed using latitude and Julian day information. These
computations are shown in Equations 2, 3, 4, 5 and 6 (ASCE 1990).

$$DEC(DAY) = 0.4093 * \sin (2 * PI * (284 + DAY) / 365) \tag{2}$$

    where DEC is the declination (radians)
          DAY is the day of the year (1-365)

$$SSANGLE(DAY) = \mathrm{acos} (-1 * \tan (LAT) * \tan (DEC)) \tag{3}$$

    where SSANGLE is the sunset angle (radians)
          LAT   is the latitude (radians)

$$H(DAY) = SSANGLE * 24 / PI \tag{4}$$

$$\text{HYEAR} = \text{SUM } \{H(I)\} \ldots I = 1,365 \tag{5}$$

$$p(\text{DAY}) = (H(\text{DAY}) / \text{HYEAR}) * 100 \tag{6}$$

where H   is the daily daylight hours
      HYEAR is the annual daylight hours
      p   is the daily percent of annual daytime hours

Applicability of SCS Blaney Criddle Method

In general temperature methods tend to under-estimate ET in arid
regions while over-estimating in humid regions. In addition the time
lag of air temperature relative to solar radiation is cause for
errors in estimating ET. Therefore local calibration of the
empirical coefficients is required to produce reliable estimates of
ET (ASCE 1990).

Reference

American Society of Civil Engineers (ASCE), 'Evapotranspiration and
Irrigation Water Requirements', Manuals and Reports on Engineering
Practice, ASCE. No. 70, New York, New York, 1990.