II.4-CONS_USE-ET  SCS BLANEY CRIDDLE METHOD FOR EVAPOTRANSPIRATION ESTIMATION

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.

\[ \text{ET} = k \times t \times p / 100 \]  

where 

- \text{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).

\[ \text{DEC} (\text{DAY}) = 0.4093 \times \sin (2 \times \pi \times (284 + \text{DAY}) / 365) \]  

where \( \text{DEC} \) is the declination (radians) 
\( \text{DAY} \) is the day of the year (1-365)

\[ \text{SSANGLE} (\text{DAY}) = \arccos (-1 \times \tan (\text{LAT}) \times \tan (\text{DEC})) \]  

where \( \text{SSANGLE} \) is the sunset angle (radians) 
\( \text{LAT} \) is the latitude (radians)

\[ \text{H} (\text{DAY}) = \text{SSANGLE} \times 24 / \pi \]  

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HYEAR = SUM \{H(I)\} ... I = 1,365 \hfill (5)

\[
p(DAY) = \left(\frac{H(DAY)}{HYEAR}\right) \times 100 \hfill (6)
\]

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.