Daylight hours

Definition

The daylight hours are maximum possible duration of sunshine for a given day of the year (Allen et al. 1998).

Formula

Formulation according to FAO:

The daylight hours N are obtained as follows (Allen et al. 1998):

$$N = \frac{24}{\pi} \cdot \omega_s$$

where ω_s is the sunset hour angle [rad], which is calculated as follows:

$$\omega_s = \arccos[-\tan\varphi \cdot \tan\delta]$$

where δ is the solar declination [rad], and φ the latitude [rad].

The solar declination δ is calculated as follows:

$$\delta = 0.409 \cdot \sin\left(\frac{2\pi}{365} \cdot J - 1.39\right)$$

where J is the number of the day in the year between 1 (1 January) and 365 or 366 (31 December).

The conversion from decimal degrees to radians is obtained as follows:

$$[\text{Radians}] = \frac{\pi}{180}\,[\text{decimal degrees}]$$

NB: for calculating potential evapotranspiration according to Thornthwaite, a daylight coefficient C is required, which corresponds to the duration of sunlight in units of 12 hours. This daylight coefficient C is thus given by:

$$C = \frac{N}{12}$$

Formulation according to NFDRS

The procedure for determining daylight hours N_{nfdrs} proposed by (Cohen & Deeming (1985)) in order to calculate some components of the NFDRS is slightly different from that proposed by (Allen et al. (1998)):

$$N_{nfdrs} = 24 \cdot \left(1 - \frac{\arccos(\tan\varphi \cdot \tan\delta)}{\pi}\right)$$

where φ is latitude [rad] and δ the solar declination [rad].

The latitude φ [rad] is given by:

$$\varphi = \varphi_{deg} \cdot 0.01745$$

where φ_{deg} is the latitude in decimal degrees.

The solar declination δ is calculated as follows:

$$\delta = 0.41008 \cdot \sin\left((J - 82) \cdot 0.01745\right)$$

where J is the Julian date.

Reference

Cohen & Deeming (1985)
Allen et al. (1998)
