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Probability analysis of weekly crop evapotranspiration of Rahuri region

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ABSTRACT

Probability analysis of reference evapotranspiration (ETr) and crop evapotranspiration (ETc) of different crops was carried out to know the ETr and ETc values at different probability levels. It was found that for ETr by Penman-Monteith method, Gamma distribution function fits to maximum number of weeks. For ETr by modified Penman and Hargreaves-Samani method, normal distribution function fits to maximum number of weeks. Normal distribution fit to maximum number of weeks for ETr by FAO pan evaporation method. The weekly ETr values by different methods at different probability levels were then estimated using the probability distribution of the best fit. Values obtained by Penman-Monteith method were considered for the probability distribution of crop evapotranspiration of different crops. It was observed from the probability distribution analysis of ETc of different crops that more than one probability distribution was found suitable for the ETc values for many weeks. However, it was also observed that there are instances where none of the probability distributions under consideration are found suitable. The ETc values at different probability levels for the crops under consideration were obtained from the probability distribution function that gave best fit.

Key words : Probability analysis, Probability distributions, Crop evapotranspiration

Probability analysis can be used for prediction of occurrence of future events from available records. Based on theoretical probability distributions of evapotranspiration data, it would be then possible to generate/forecast crop evapotranspiration with desired level of probability. Theoretical probability distributions generally used for hydrological series include Normal, Log normal, Log Pearson III, Gumbel and Exponential distributions. The probability distributions that are used for evapotranspiration data are: i) Normal distribution (Ingle, 1993); ii) Log normal distribution (Dalvi and Thakur, 1990) and iii) Gamma distribution (Kumar and Sharma *et al.*, 2007; Kulshrestha *et al.*, 2007). They used Chi-square test (Dalvi and Thakur, 1990; Suresh, 2003) and Kolmogorov-Smirnov test (Kulshrestha *et al.*, 2007) to test the goodness of fit of parametric probabilistic distribution to the given set of data. In this study, therefore, normal, log normal and Gamma probability distributions were used to fit reference crop evapotranspiration and crop evapotranspiration values.

METHODOLOGY

The climatological data for twenty six years (1975-2000) of Rahuri region were obtained from E – Block Observatory, Mahatma Phule Krishi Vidyapeeth, Rahuri and the lysimetric data of crop evapotranspiration (ETc) of seven different crops were obtained from AICRP on Water Management, Mahatma Phule Krishi Vidyapeeth, Rahuri for this study.

The following three distributions were considered for determining the amount of weekly reference crop evapotranspiration and evapotranspiration of different crops at various probability levels.

Normal distribution, Log normal distribution and Gamma distribution.

Normal distribution:

This is a two parameter (mean and variance) distribution, which is symmetrical, bell shaped, continuous, theoretically representing the distribution of accidental errors about their mean, or the so called law of errors. The probability density function is expressed as given by equation (1).

$$p(X) = \frac{1}{\sigma\sqrt{2\pi}} e^{-(x-\mu)^2/2\sigma^2} \quad (1)$$

where,

p(X) - probability that X is less than or equal to x when X is N (μ, σ^2); x is variable, μ is mean value of variable and σ is the standard deviation.

Log normal distribution:

Since the X_i are random variables, the $Yi = \ln X_i$ are also random variables. From the central limit theorem Y_i can be accepted to be normally distributed with mean u_y and variance σ^2_y .Its probability distribution is given by given by equation (2).