Irrig Sci (2008) 26:303–312
DOI 10.1007/s00271-007-0094-8

ORIGINAL PAPER

Spatially distributed monthly reference evapotranspiration derived from the calibration of Thornthwaite equation: a case study, South of Iran

Seyed Hamid Ahmadi · Hamid Reza Fooladmand

Received: 16 May 2007 / Accepted: 17 September 2007 / Published online: 10 October 2007

Abstract The Penman-Monteith equation is the most common method for estimating reference crop evapotranspiration (ET_o). Using this method reqiures many different meteorological data, yet few stations with adequate meteorological data may exist in a region. Setting up a station that records the required data for Penman-Monteith equation is expensive. Alternatively, the Thornthwaite equation is a simpler method for estimating ET_o since it is a temperature-based method. In this study, the Thornthwaite equation was spatially calibrated based on the Penman-Monteith method (as the standard and reference method to compute ET_o) for every month of the year, using the meteorologica data of seven synoptic weather stations in Fars province, and seven synoptic stations outside the Fars province. The Thornthwaite equation using effective temperature that has been introduced recently in other studies was used (Camargo et al. in Revista Brasileira de Agrometeorologica 7:251–257, 1999). For this purpose a calibration coefficient k must be determined. The results of the spatial and temporal calibration of the new approach using the Thornthwaite equation showed that for each station different k values should be used monthly. Generally, the k values fluctuated between 0.55 and 1.12, and the mean RMSE for all stations was less than 1 mm day^{-1}, which showed good and reliable agreement between the ET_o estimations obtained from the Penman-Monteith and calibrated Thornthwaite equations. Depending on the geographical location of each station, spatial distribution maps of monthly k values were created for the study area using the inverse distance weighting (IDW) interpolation method. It is therefore possible to estimate monthly ET_o using the appropriate k map and the Thornthwaite equation for different regions of study area instead of using the Penman-Monteith method. This case study showed that the same analysis might be used for the other parts of the country or any part of the world and would result in efficient scheduling of water resources for agriculture.

Communicated by S. Azam-ali.

S. H. Ahmadi (✉)
Agricultural Research and Education Organization,
Agricultural Engineering Research Institute,
Zarghan 73415-111, Iran
e-mail: seyedhamid.ahmadi@gmail.com

H. R. Fooladmand
Department of Water Engineering,
Marvdasht Islamic Azad University, Marvdasht, Iran
e-mail: hrfoolad@yahoo.com

Introduction

Water resources management in arid and semi arid regions, where agriculture is the primary job activity, is very important and plays a key role in sustainable agriculture and environment. Having knowledge on the level of evapotranspiration in order to determine agricultural water use is as important as managing the water resources efficiently.

Evapotranspiration (ET) is an important component in water and energy balance on the earth's surface, and the knowledge of the distribution of ET is a key factor in hydrology, climatology, agronomy and ecology studies (Rivas and Caselles 2004). Accurate estimation of ET is essential for irrigation scheduling and water resources planning and management (Al-Ghobari 2000; George et al. 2002). Also, understanding ET is essential in planning economical uses of water resources (Chuanyan et al. 2004).