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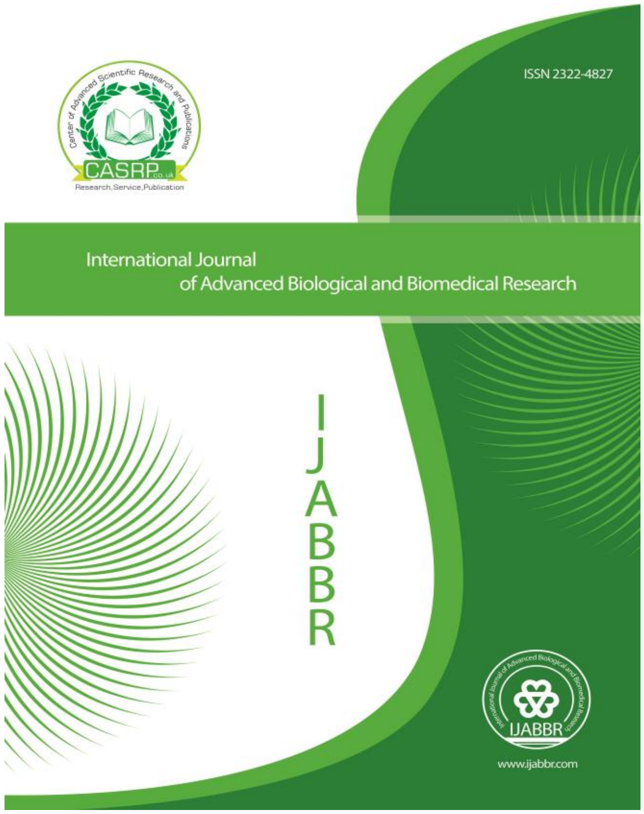

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Comparison of Various Sensitivity Approaches to Estimate Evapotranspiration, to Climatic Variables in Fasa-synoptic Station_Iran

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Abstract

Sensitivity analysis to determine variations in evapotranspiration is much important considering a known variation in one of climatic variables. In this study, sensitivity of evapotranspiration from Penmann-Mantith, Penmann-Kimberly (1996), Penman-Kimberly (1972) and Penmann (1984) and Hargrivs (1985) approaches to three climatic variations (maximum temperature, wind speed, solar radiation) was studied in station Fasa for an interval of 22 years (1982-2003). In this research, in order to represent the effect of climatic variables on evapotranspiration, variation percentage standard was used. The results showed that, in most approaches, the most sensitivity was to net radiation, maximum temperature and wind speed, respectively. The results of this study are applicable for measurement of climatic variations in order to estimate evapotranspiration.

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Keywords: Potential evapotranspiration, Sensitivity analysis, Variation coefficient, Fasa synoptic station.

1. Introduction

Sensitivity analysis shows variability of a factor on another one (McCuen, 1974). Sensitivity analysis is much

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important to determine variations in evapotranspiration with regard to a known variation in one of climatic variations. The results of this study are applicable to determine needed accuracy during climatic variations measurement in order to estimate evapotranspiration (Irmak et al., 2006). Sensitivity coefficients for hydrology models were presented by various scientists including Babajimopoulos et al. (1992), McCuen (1974), Saxton (1975), Coleman and DeCoursey, (1976), Beven (1979), Gong et al. (2006), Ambas and Baltas(2011). In evaporation studies (Beven, 1979; Coleman and DeCoursey, 1976; Saxton , 1975; McCuen, 1974) and also in other hydrologic applications, a number of sensitivity coefficient have been determined dependent on the purpose of analysis(Gong et al. 2006). Babajimopoulos et al. (1992) estimated the effect of weather variables on evapotranspiration with variations of 10, 20, and 30 percent and calculated evapotranspiration values. McCuen (1974) was one the earliest researchers who tested sensitivity of evapotranspiration models to understand their structure, the effect of variables in weather factors on the amount of evaporation and also tested the effect of weather measurement errors. Their measure was followed by Saxton (1975) who evaluated the extraction of sensitivity equations by changing Penmann (1984) equation with regard to each variation, and results showed this equation as the most sensitive to Rn. Gong *et al*. (2006), carried out sensitivity analysis in Yangteze watershed – China and calculated dimensionless relative sensitivity coefficients in order to predict evapotranspiration responses to climatic chaos. Ambas and Baltas (2011) conducted evapotranspiration sensitivity analysis by a number of approaches. In this research, a new sensitivity coefficient was suggested. The new sensitivity coefficients used standard partial deviation of each independent variable. Weather parameters such as temperature, Rs, wind speed and relative moisture were used for Amenito in Florida, western Makoya and sensitivity coefficients for each month, season, and irrigation period were calculated. Comparison of sensitivity for the month when there is the maximum water demand (July), irrigation period and year was done for each evaporation method. The effect of variables on evapotranspiration for each interval was not similar. Comparison between five approaches for calculating evapotranspiration showed that, Rs and temperature are mainly effective parameters on evapotranspiration while, relative moisture and wind speed are not important for calculating evapotranspiration. Tafazzoli *et al*. (1386). indicated that temperature and net solar radiation have the most impact on evapotranspiration by FAO Penmann Mantith and Hargrivsapproaches in Hamedan. Goyal (2004) showed that, a 20% increase of temperature, radiation and wind speed causes to increase evapotranspiration by 14.7, 11 and 7 respectively by Penmann-Mantith approach in semi-arid region of India. According to IPC (Intergovernmental Panel on Climate Change)recommendation, climatic variations are in the range of 10 to 20 percent of weather parameters (Bayat et al., 2008). In this study, considering 10 to 30 percent variations of climatic variables, their effect on the amount of evapotranspiration has been evaluated.

2. Materials and methods

2.1. Study area

Fasa synoptic station is located in the longitude of 53 degree and 41 minutes and latitude of 28 degree and 58 minutes with a height of 1288 from sea level. Annual mean rainfall during the statistical interval 1361-1382 is 292.6 mm and monthly mean temperature is 19.04 ˚C.

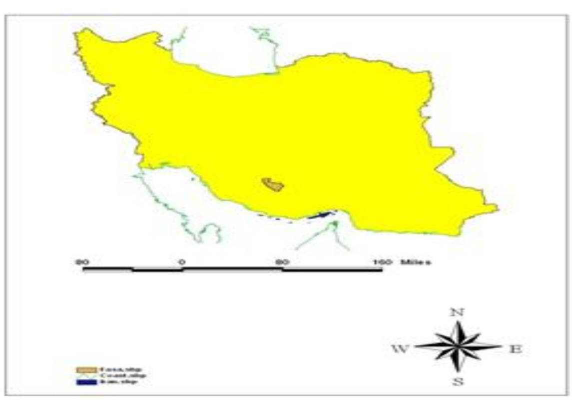

Fig. 1. ocation of study area.

2.2. Research method

After collect long-term of monthly data from Fasa station based on Penman-Mantith, monthly long-term evaportranspiration were calculated. Then by higher and lower each climate factor that used in evaportranspiration equation about 10, 20 and 30 percent, evaportranspiration again was calculated. After that, result shown by monthly and annually in the plot, comparision were applied between them. By implementation of this research, penetration amount of each climate factor in evaportranspiration with separated were investigated.

2.3. Sensitivity coefficients

In this study, in order to indicate the effect of climate variables on evapotranspiration, variations percentage standard was used.

Variations percentage = ET_{or}-Et_{oe}/ET_{or}

Where, ET_{or} IS evapotranspiration by Penmann-Mantith approach, Et_{oe} is evapotranspiration by other approaches.

3. Results and discussion

Figure (1) to (3) shows 10, 20 and percent of climatic variables on evapotranspiration.

As it is represented, by increasing variations percentage in climatic variables, variations percentage of evapotranspiration increases.Penmann-Mantith, Penmann-Kimberly (1996), Penman-Kimberly (1972) and Penmann (1984) methods had the most sensitivity to net radiation, maximum temperature and wind speed respectively. Hargrivs-Samani does not have any sensitivity to Rs and wind speed due to the nature of this approach.

Figures (4) to (6) shows the results of increase and decrease in climatic variations on the amount of evapotranspiration by FAO-Penmann-Mantith approach. As it is shown in Figure (7), net radiation has the maximum effect with 54 percent and wind sped has the lowest effect with 13 percent. These percentages have the relative importance of each weather variable by evaluating the reference evapotranspiration.

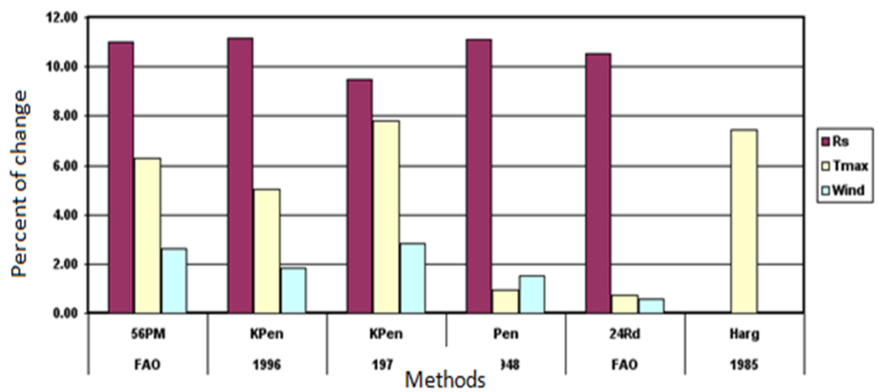

Fig. 2. Variation percentage of various approaches to 10 percent increase of climatic variables.

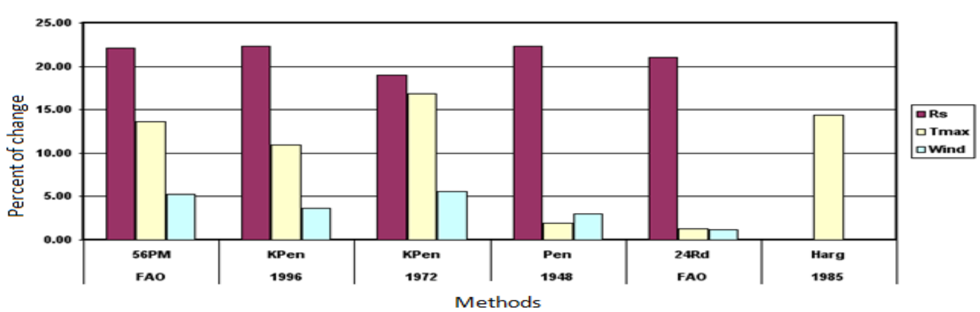

Fig. 3. Variation percentage of various approaches to 20 percent increase of climatic variables

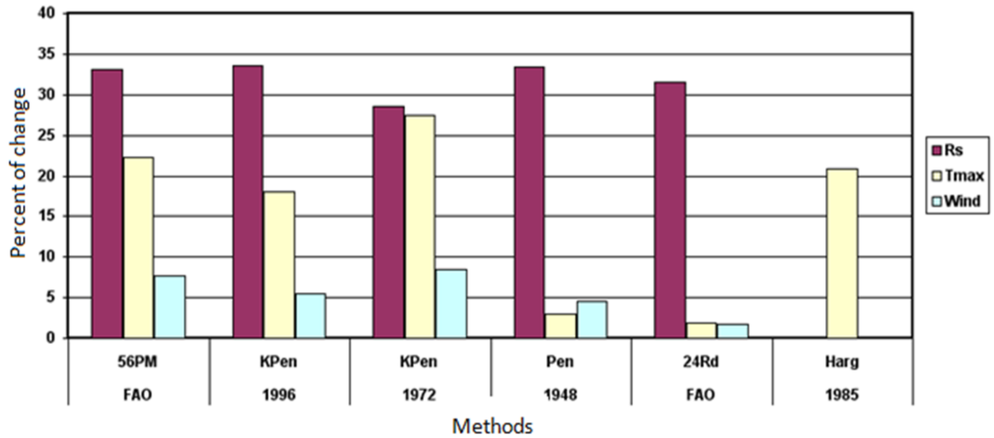

Fig. 4. Variation percentage of various approaches to 30 percent increase of climatic variables

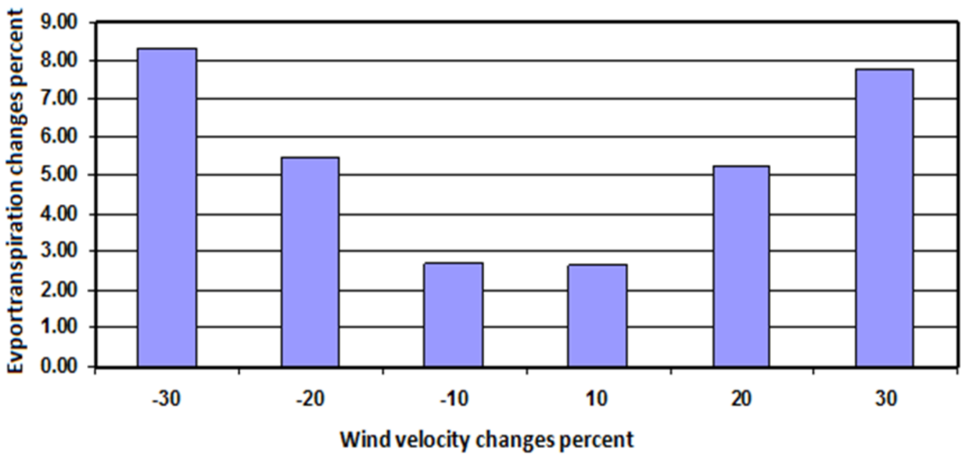

Fig. 5. Increase and decrease of wind to the amount of evapotranspiration variations by FAO-Penmann-Mantithapproach

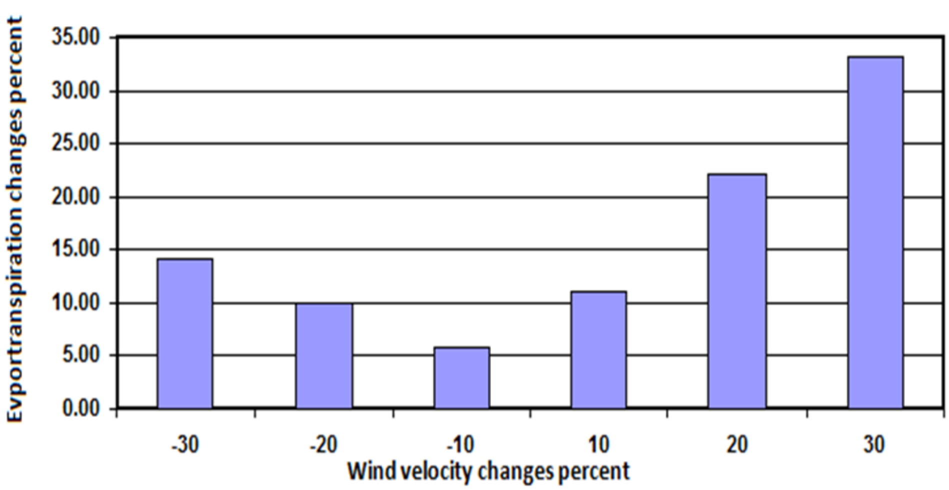

Fig. 6. Increase and decrease of temperature to the amount of evapotranspiration variations by FAO-Penmann- Mantith approach.

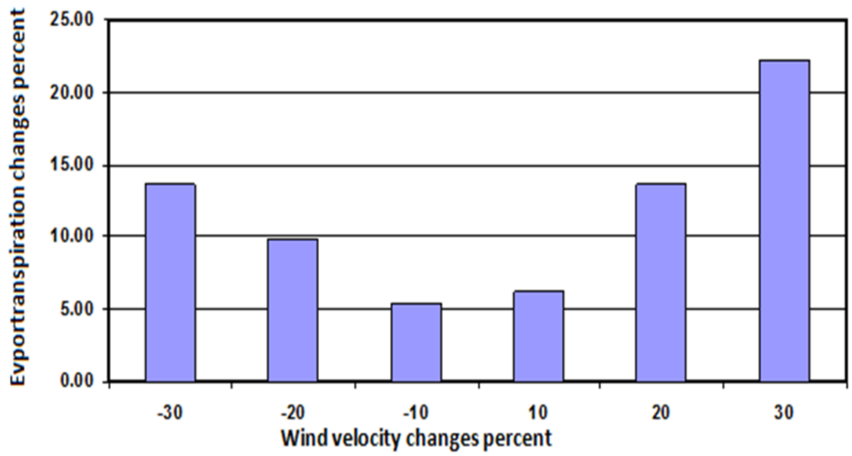

Fig. 7. Increase and decrease of net radiation to the amount of evapotranspiration variations by FAO-Penmann- Mantith approach

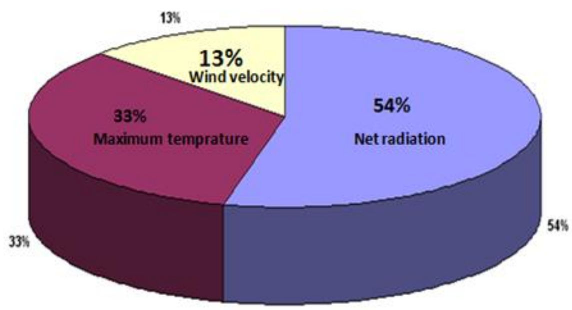

Fig. 8. Relative impact of climatic variables variations coefficient in FAO-Penmann- Mantithapproach in Fasa synoptic station

4. Discussion and Conclusion

The study was conducted in order to indicate evapotranspiration sensitivity to three climatic variables in Fasa synoptic station for a 22 years interval. Sensitivity of various evapotranspiration estimation approaches to climatic variables, variations coefficient standard was used. The study showed that, by increasing variations percentage in climatic variables, evapotranspiration variations percentage would be increased.Also in most approaches, the most sensitivity exists in net radiation, maximum temperature and wind speed with 33, 55 and 13 percent, respectively. Ambas and Baltas (2011) also indicated that, Rs and temperature are mainly effective parameters on evapotranspiration while, relative moisture and wind speed are not much important to calculate evapotranspiration. Tafazzoli et al. (1386) showed that, temperature and net solar radiation had the maximum effect on evapotranspiration by FAO-Penmann-Mantith and Hargrivs approaches in Hamedan. The results of this study can be used as a theory for future researches in evapotranspiration responses to climate change.

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