Simulations reference evapotranspiration using artificial intelligence and comparison with experimental methods (Case Study: East Azerbaijan)

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Introduction

Reference evaporation and transpiration is one of the important elements of the hydrological cycle, which plays an important role in agricultural studies, water resource management plans, irrigation and drainage network design and water structures (Nuri et al., 2013, Volume twenty, number five, page 12). Due to the small amount of precipitation and the limitation of water resources in Iran, the correct management of water resources is very important and it is necessary to be careful in using water.

Data and Method

In order to carry out this research, daily climatic data during the years 2014 to 2015 of East Azerbaijan (four stations of Maragheh, Midane, Jolfa and Ahar) were prepared from the regional meteorological organization. After normalization and determination of correlation, the data were used in MATLAB software with artificial neural network method with Lunberg-Marquardt training to 70-30 combination for training and simulation. The input data for the simulation of evaporation and transpiration (temperature, sunshine hours, humidity, wind speed) and the work evaluation criteria are RMSE, R2 and MAE, which we gave priority to the data with less error.

Results and Discussion

In this research, the method based on artificial intelligence (ANN) and three experimental models (Penman Monteith Fau (PMF56), Blaney Kridel (B-C) and Kimberly Penman (K-P) were used to model the non-linear transpiration evaporation system of the reference plant. The results showed that the artificial intelligence method has better accuracy and speed in estimating ET0 compared to experimental methods

Conclusion

The results showed that the artificial intelligence method has better accuracy and speed. Also, comparing the method of artificial neural networks with classical methods, the results indicate the appropriateness of the performance of artificial neural networks.

Key Words: East Azerbaijan, Blaney Cradle, Penman-Monteith, evapotranspiration, artificial neural network,

Refrences:

- ثنایی‌نژاد، حسن. نوری، سعید. هاشمی‌نیا، محمد، برآورد تبخیر و تعرق واقعی با استفاده از تصاویر ماهواره‌ای در منطقه مشهد). نشریه آب و خاک (علوم و صنایع کشاورزی 25(3)540-547، 1390،.
- جهانبخش، سعید، موحد دانش، علی ، مولوی، احسان. (1380)، تحلیل مدلهای برآورد تبخیر - تعرق برای ایستگاه هواشناسی تبریز، دانش کشاورزی، شماره2، جلد11، صص65-51.
- خوشحال، محسن. علیزاده، احمد. ثنایی، علی، کاربرد شبکه عصبی مصنوعی در شبیه سازی عناصر اقلیمی و پیش بینی سیکل خشکسالی، مجله جغرافیا و برنامه ریزی محیطی، ش،39، 1389، صص 120-107.
- زارع ابیانه، حسن.، نوری، حسین.، لیاقت، علی.، نوری، حسن.، کریمی، وحید، مقایسه روش پنمن مانتیث فائو و پژوهشهای جغرافیای .با دادههای لایسیمتری در براورد تبخیر و تعرق گیاه برنج در منطقه آمل A تشت تبخیر کلاس طبیعی، شماره 76، تابستان1390،صص .83-71
- زارع ابیانه، حسن.؛ قاسمی، علی.؛ بیات ورکشی، محمد.؛ معروفی، محمد. ، ارزیابی دقت شبکه عصبی در پیش بینی تبخیر – تعرق گیاه سیر بر اساس داده های لایسیمتریی در منطقه همدان، دانش آب و خاک، دوره 23، شماره 3.، 1388، صفحات 185-176
- هیدرولوژی، انتشارات سمت(1387) .زاهدی، م، بیاتی خطیبی، مریم.،
- و NN-ARX سلطانی، جمشید. مقدم‌نیا، علی. پیری، جمال. میرمرادزهی، جواد، مقایسه کارآیی مدل‌های تلفیقی نشریه آب و .جهت تخمین تبخیر روزانه از تشت در شرایط اقلیمی خشک و گرم بلوچستان GA-GT با ANFIS جلد 27. شماره2، 1391، صص 393-381 .(خاک (علوم و صنایع کشاورزی.

- Allen, R.G and W.O. Perot .(1998) ،Closure to Relational Use of the FAO Blaney-Criddle Formula ،Irrig and Drian Eng . 114(2):375- 380.
- Allen, R.G., M. Tatsumi, A. Morse. (2005) ،Satellite-based Evapotranspiration by METRIC and Landsat for Western Estates Water Management, US Bureau Reclamation Evapotranspiration Workshop.
- Cai J., and Santos L. (2007) ،Estimation reference evapotranspiration with the FAO Penman-Monteith equation using daily weather forecast messages. Agricultural and Forest Meteorology, 145: 22-35.
- Clothier, B.E., J.P. Kerr, J.S. Talbotand D.R. Scott.(1982) ،Measured and Evapotranspiration from Well-Watered Crops", New Zealand, J.Agr.Res ., 25: 301-307.
- Goyal, R.K. (2004،(Sensitivity of evapotranspiration to global warming: a case study of arid zone of Rajasthan (India). Agricultural Water Management, 69: 1-11.
- Grange r, R. J.(1999) Satellite -derived estimation of evapotranspiration in Gediz bas in, Journal of Hydrology 229, 70 -76.
- Gundekar, H. G., Khodke, U. M, & Sarkar, S. (2008،(Evaluation of pan coefficient for reference crop evapotranspiration for semi-arid region. Irrigation Science 26:169–175.
- Jensen, N.E.R.D and R.G. Allen .(1990،(Evapotranspiration and Irrigation Water Requirements, ASCE Manuals and Reports on Engineering Practices , No. 70: 354-358.
- Kumar, M., Raghuwanshi., N.S., Singh, R., Wallender, W.W.and Pruitt, W.O. (2002،("Estimating evapotranspiration using artificial net work". J Irrig. Drain. Eng., 128(4), 224-233.
- Landeras, G., Ortiz- Barredo, A., and López, J.J .(2008،(Comparison of artificial neural network models and empirical and semi-empiric al equations for daily reference evapotranspiration estimation in the Basque Country (Northern Spain). J. Agric. Water Manage 65:553-565.

- Lopez-Urrea, R., Martín de Santa Olalla, F., Fabeiro, C. & Moratalla A. (2006‹(Testing evapotranspiration equations using lysimeter observations in a semi-arid climate. Agric Water Management 85:15–26.
- Misra D, Oommen T, Agarwal A and Mishra SK, (2009). Application and analysis of Support Vector machine based simulation for runoff and sediment yield. Journal of Bio Systems Engineering, 103(9) 527-535.
- Paulo C., Terry J., and Eduardo A .(2009) ‹Evaluation of FAO Penman–Monteith and alternative methods for estimating reference evapotranspiration with missing data in Southern Ontario, Canada. Agricultural Water Management, 97: 635-644.
- Piri ‹Amin ‹S. Moghaddamnia ‹A. Keshavarz ‹A. Han ‹D. Remesan ‹R. 2009. Daily Pan Evaporation Modeling in a Hot and Dry Climate. Journal of Hydrologic Engineering.
- Salih, A.M.A. and U. Sendil ‹Evapotranspiration under Extremely Arid Climates, J. Irrig., and Drain, Eng., ASCE, 110(3): 289-303.
- Samani, Z.A., and M. Pessarakli. 1986‹ Estimating Potential Crop Evapotranspiration with Minimum Data in Arizona, Trans, ASAE , 29: 522-524.
- Sudheer, K.P., Gosain, A.K., and Ramasastri, K.S) .2003) ‹Estimating actual evapotranspiration from limited climatic data using neural computing technique. J. of Irrig. Drain. Eng. ASCE. 129: 3. 214-218.
- Trajkovic, S., B. Todorovic and M. Standkovic) .2003‹(Forecasting of reference evapotranspiration by artificial neural network .J. Irrig. And Drain. ASCE.129(6):454-457.

- Tzimopoulos, C., Mpallas, L., and Papaevangelou, G. (2008)‹Environmental Science and Technology. 1:4. 181-186.
- Tezel‹ Buyukyildiz‹M.2015. Monthly evaporation forecasting using artificial neural networks and support vector machines ‹Theor Appl Climatol.
- Wang, Y.M, Traore, S., and Kerh, T. (2008)28‹- Neural network approach for estimating reference evapotranspiration from limited climatic data in Burkina Faso. WSEAS Transactions on Computers. 7: 704-713