

## Evaluation of stability of surface water quality variation in Gorganrood River basin

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### Abstract

Information of water quality and pollution sources is important for the implementation of sustainable water resource management strategies. In this research, to evaluate spatial variation and the interpretation of large complex water quality data taken at seven different sites along Gorganrood River were subjected to multivariate statistical analysis. The factor analysis generated two significant factors explaining 97.80% of the variance in data sets. Factor 1 and 2 explained 86.27 and 15.76% of the total variance in water quality data sets. Principle components analysis results revealed that surface water quality was mainly controlled by Ca and pH parameters. In next step, information entropy theory applied to interpret the stability of surface water quality variation in each factors and each parameters. Overall results revealed instability in data recorded in Tamar and Galikesh sites. In factor 2, EC and TDS, Lazoreh has highest instability. With a well knowing the factor score and overlaying entropy, in factor 1, Mg and Cl had highest stability. The ranks of information entropy values for Mg parameter at Galikesh, Tagi Abad, Basir Abad, Ramian and Tangrah sites vary noticeably due to geological formation. In general, sampling uncertainties are highly site specific.

**Keywords:** cluster analysis, Gorganrood, uncertainty, variance analysis, water quality.

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## Efficiency of evaluation of Diskin method in derivation of instantaneous unit hydrograph in Jafar-Abad watershed, Golestan Province

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### Abstract

Instantaneous Unit Hydrograph (IUH) is the response of a watershed subjected to a storm with an excess rainfall of 1 unit depth occurring to the watershed instantaneously, used as the response function in rainfall-runoff modeling. Omission of excess rainfall duration from unit hydrograph theory has made it better and easier to investigate in rainfall-runoff relationship. This study focuses on derivation of IUH from direct runoff hydrograph using Diskin method in Jafar Abad watershed (109 km<sup>2</sup>) located in Golestan Province. Using hourly hydro-meteorological data, the index unit hydrograph was derived from 27 storms by S curve method and then index IUH was calculated from S curve. Diskin method was used for derivation of IUH from four different direct runoff hydrographs. The efficiency of Diskin method was evaluated by statistical comparison with the observed IUH. The results indicated that the method derived IUHs with good accuracy, 85% according to the Nash-Sutcliffe criterion. Also, mean relative error of instantaneous peak discharge and relative error of instantaneous time to peak are 2.24% and 6.25%, respectively while the model bias for water balance is -0.92%. Nonetheless more researches in other watersheds are suggested for derivation of instantaneous and flashy floods for planning into reduction of flood damages.

**Keywords:** direct runoff hydrograph, Diskin method, instantaneous unit hydrograph, Jafar-Abad watershed, S curve.

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## Sub-watershed flooding prioritization of Golestan Province using morphometric and correlation analysis

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### Abstract

Planning of watersheds is indispensable in terms of sustainable development and landscape management. Therefore, watershed prioritization and morphometric characterization are important to identify hydrological behavior of the watershed for conducting management strategies. In this study, geospatial-statistical approach was used for identifying critical and priority sub-watersheds in the Golestan watershed. At first, eight morphometric parameters (bifurcation ratio, drainage density, constant of channel maintenance, stream frequency, form factor, drainage texture rate, relief ratio, ruggedness number) effecting on hydrological, soil erosion and sediment transport were selected. The map of morphometric parameters using digital elevation model (DEM) were produced in ArcGIS10.2 software. In order to determine prioritization of sub-watersheds a new method based on morphometric and statistical analysis was applied. The Kendall's tau and weighted sum analysis (WSA) methods were used for analyzing the relationship between morphometric parameters and determining their effect weights. Finally, sub-watershed prioritization index (SWPI) based on weighted linear composite (WLC) method was calculated for each sub-watersheds. Previous destructive floods location in the Golestan Watershed was used for validation of the mentioned results. The results showed that, meanwhile innovation method of prioritization isn't proper for all of the sub-watersheds in the study area, but the mentioned method was identified the sub-watersheds 3, 16, and 9 as the best regions for watershed management plans.

**Keyword:** correlation analysis, Golestan watershed, morphometric analysis, prioritization of sub-watershed.

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## Investigation of the effect of karst development on Karstic springs hydrogeology treatment of Kermanshah Province

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### Abstract

Karstic aquifer is one of the important groundwater resources in Kermanshah Province. The aim of this study is investigation the role of development in karst aquifer in hydrological characteristics of karst springs. The study area in this research includes two karstic aquifers include Bistoon-Parau and Patagh mountain in Kermanshah Province. In the Bistoon-Parau region, we used Bistoon, Berkeh and Gaznahleh springs data and Patagh region of Ghareh Bolagh Spring data. In this study, we used monthly precipitation and springs discharge during 20 years. To determinate the development or undevelopment of karstic aquifer, recession coefficient, storage volume dynamics and catchment area were calculated for each springs. The results of calculation of dynamic storage volume showed that the Gharebolagh Springs in Patagh region has dynamic storage volume equal 29.3 Million cubic meters more than Bistoon, Berkeh and Gaznahleh springs in Bistoon-Parau region with dynamic storage volume equal 0.55, 2.2 and 1.3 Million cubic meters, respectively. So, these results showed more development of the Bistoon-Parau than Patagh region. Based on the results responses of the hydrological model Bistoon-Parav as a developed karst aquifer more quickly and severe than is Patagh area.

**Keywords:** Bistoon-Parav mass, karst, lag time, recession coefficient, storage volume dynamics.

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## Effects of climate changes on surface runoff changes (Case study: Urmia Lake Basin)

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### Abstract

Climate change is one of the most important problems in the present century. So, assessing and prediction of future changes is important on water resources and so important for economics and socio-economic consequences. The purpose of this research is assessing the effects of climate change on surface runoff volumes under the scenarios: A1B, A2 and B1 using HadCM3 general circulation model and IHACRES rainfall-runoff model for three time periods (2011-2030, 2046-2065 and 2080-2099). LARS-WG downscaling model was used to bridge global data to sites, data sets. The results of the evaluation of observed and simulation data using statistical and measurement error indices show that there is no difference between the simulated and the observed values on the critical error 0.5%. The results of climate model show that the average temperature of basin will be increased between 0.55 to 3.15°C, and rainfall reduces amount 11.94% in the basin. Performance analysis of IHACRES rainfall-runoff model also showed good accuracy of the model to simulate the runoff changes in basin. The results of surface runoff changes showed that the long-term average of annual runoff is reduced in 2020s, 2050s and 2080s than the base period, respectively 5.4, 22.35 and 64.5 percent.

**Keywords:** climate change, IHACRES, LARS-WG, rainfall-runoff, Urmia Lake basin.

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## **Influence of climatological-hydrological variables on ground water level in Ajabshir Plain**

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### **Abstract**

The proper understanding of water resources for underground and surface water management is important as two inseparable systems. In this study by examining the time series of climatic variables (precipitation), hydrological (flow and consumption) and the level of water table, the relationship of parameters with each other and by oscillation of water table is investigated. First, the correlation matrix of spearman is formed to determine this relationship. There was a direct relation between precipitation and flow with the ground water level; on the other hand the consumption and ground water level were inversely related with each other. Then, by examining the cross correlation diagram of rainfall and flow versus water table level, their delay relationship was identified. The results indicated the water table level of Ajabshir plain has the most dynamic relationship with rainfall, discharge and consumption by one lag time, simultaneous and two lag times, respectively. Finally, the regression analysis of variables with the level of the water table was obtained.

**Keywords:** cross correlation, flow, precipitation, water table level.

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## Phytoremediation potential of *Puccinellia distans* (Jacq.) Parl in Cd contaminated soil and method of leaching risk reduction into ground waters

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### Abstract

The aim of present study was to investigate phytoremediation potential of *Puccinellia distans* (Jacq) Parl using EDTA and DTPA and identify method of decreasing Cd- chelating leaching risk. The soil samples spiked with CdCl<sub>2</sub>. The treatments comprised the following dosages 2.5DTPA, 5DTPA, 2.5EDTA, 5EDTA, 2.5EDTA+2.5DTPA, 2.5EDTA+5DTPA, 5EDTA+2.5DTPA, 5EDTA+5DTPA and control pots were not treated with EDTA and DTPA. Bioconcentration factor (BCF), translocation factor (TF) and tolerance index (TI) were calculated to determine the Cd phytoremediation efficiency. Results indicated that EDTA and DTPA application significantly increased Cd content in the plant tissues and root concentration of Cd was greater than the concentration in the shoot. The maximum bioconcentration factors (BCF) were observed in 5DTPA and 5EDTA, respectively, and the maximum translocation factor (TF) was obtained for 5EDTA+5DTPA treatment. The results indicated that EDTA and DTPA had the potential to promote the uptake of Cd by *P. distans*. In the next step, to reduce leaching of Cd-chelate, 5mgkg<sup>-1</sup> EDTA and DTPA in three methods of single, triple and six successive dosages were added to the soil. The results indicated that under single application, Cd content reached at its minimum concentration in the soil and in the plant organs, the Cd concentration was the maximum. Metal concentration in the plant organs did not vary significant when triple and six successive dosage were added (P<5%). Overall, optimum phyto extraction of *P. distans* and Cd leaching reduction into ground waters was achieved when 5mg kg<sup>-1</sup> EDTA and DTPA was added in single dosage.

**Keywords:** cadmium, leaching risk, phytoremediation, soil contamination, tolerance index.

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## Effect of land use changes on runoff depth in Chaloustrud watershed

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### Abstract

Due to the importance of the role of land use changes on runoff changes, several studies have taken place to develop models with simulating land use changes. In this study, the L-THIA model was used for estimating the runoff made by land use changes in Chaloustrud watershed. Results of runoff modeling using L-THIA model showed that runoff depth increased from 422.98mm to 809.168mm during 1984 to 2000 that state an increase in runoff depth of 368.18 mm during 16 years. During 2000 to 2006 from 809.168mm to 825.496mm that state an increase 16.32 mm during 6 years. The results show that surface runoff depth increased due to decreasing of forest land with 3527.13ha from 58907.31ha to 55380.08ha and increasing of urban land with 7757.58ha from 7757.58ha to 362.50ha and increasing of abandoned land with 23176.01ha from 720.29ha to 23996.3ha. As a result of this study the L-THIA model has acceptable ability in explaining the way of land use changes effect on volume and depth of runoff. This model could provide the possibility of identifying accident prone areas, flood zones and flood management by spatial distribution map of runoff.

**Keywords:** Mazandaran Province, modeling, rainfall-runoff model, satellite images, soil conservation service model.

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## Groundwater potential mapping using Shannon's entropy and random forest models in the Bojnourd plain

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### Abstract

Nowadays, water supply for sustainable development is one of the most important concerns and challenges in most countries of the world. Due to determination of groundwater, potential zones are one of the important tools in the conservation, management and utilization of water resources. Thus, the present study aimed to prioritize the effective factors on groundwater potential and its susceptibility zonation using Shannon's entropy and Random Forest in Bojnourd Township. So, layers of slope angle, slope aspect, plan curvature, profile curvature, slope length, altitude, topographic wetness index, distance from fault, fault density, distance from river, drainage density, lithology and land use are known as affecting factors on groundwater potential and were digitized in ArcGIS software environment. Subsequently, using Shannon's entropy and random forest models, weight of affective factors was calculated in R statistical package and finally groundwater potential maps were prepared for the study area. The accuracy of groundwater potential zoning has been evaluated using relative operating curve (ROC). According to the results, the accuracy of the Shannon's entropy model was (85.55%), which is more acceptable than the accuracy of the random forest model (76.95%). Also, layers of land use, lithology, distance from river and altitude layers had the most effect on groundwater potential in the study area based on the Shannon's entropy model.

**Keywords:** Bojnourd plain, groundwater potential, random forest model, Shannon's entropy model, spring.

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## **Simulation of rainfall-runoff process using multilayer perceptron and adaptive neuro-fuzzy interface system and multiple regressions (Case study: Khorramabd watershed)**

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### **Abstract**

The discharge or runoff which ousts from a watershed is important, because its deficiency leads to financial losses and its excesses cause damage in lives and property as flood. In this research by using Artificial Neural Network Multi-layer Perceptron (MLP) and Adaptive Neuro-fuzzy interface system (ANFIS) and multiple regression method were simulated rainfall- runoff process on daily basis in the Khorramabad watershed. For inputs, different combinations of precipitation inputs including current rainfall, pervious day rainfall and two previous days were used. Inputs membership function for ANFIS model in this research is: the trapezoid, triangular, Gaussian and Gaussian type 2. MLP model using in this research was evaluated with one hidden layer and the number of variables neurons. The results showed that Adaptive Neuro-fuzzy interface system (ANFIS) compared to multi-layer perceptron model (MLP) and multiple regression model has better performance. Also, by increasing in the number of inputs, involvement pervious day rainfall and two previous days, all three models performance will be better.

**Keywords:** adaptive neuro-fuzzy interface system, Khorramabd watershed, multi-layer perceptron, multiple regression, runoff.

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